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Ronald Munson

*University of Missouri - St. Louis*

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**BROCKPORT**  
STATE UNIVERSITY OF NEW YORK



*Ronald Munson  
University of Missouri - St. Louis*

# The Human Limits of Science

Ronald Munson

One of the favorite themes in classical science fiction concerns an encounter with alien beings who possess a science so superior to ours that we are literally incapable of understanding it. They are able to make discoveries about the universe that are impossible for us either because they are more intelligent than we are, or because they live a great deal longer, or because they are able to manipulate time and space in ways that are a mystery to us.

I mention these enviable aliens only because in recent years some writers have suggested that, even without the aliens for comparison, we human beings have characteristics that constitute inescapable restrictions on what science can discover about the world. That is, some writers have claimed that there are inherent human limitations that, in turn, place limits on the concepts and methods of science. As a result, we cannot expect science to provide us with explanations of all phenomena we regard as puzzling.

I would like to say at the outset that I don't know whether the general thesis that science is (or is likely to be) restricted by human nature is right or wrong, and I am not prepared to offer a decisive counterargument against every specific version of it that might be offered. Rather, what I wish to do is to provide three construals of the thesis — three specific versions of it — and examine the reasons that can be offered in support of them.

I shall try to show that the first version of the thesis is demonstrably false and rests on misunderstandings about the methods of science and what can be established by their use. In the second version, the thesis is plausible and may even be true, but it is quite harmless in its implications. The third version of the thesis requires that we accept contested claims about the nature of the human mind and the character of scientific theories. However, even granting these assumptions, I want to show that the arguments in favor of the thesis are inadequate to establish that it is *likely* that there are aspects of the world beyond the reach of our concepts and theories.

I make no pretense that these constitute all the arguments that could be offered, but they seem to me to represent the most influential and most common ones.

## 1. The Argument from Practical Limits

The first argument I want to talk about is one the 18th century would have called "vulgar," because to the best of my knowledge, it is

offered exclusively by those who display little sophistication concerning the workings of science. Nevertheless, its immense popular appeal and influence make it worthwhile to examine.

The argument is best appreciated by focusing on the context in which it has most recently been offered in public debate. Opponents of evolutionary theory, calling themselves creationists or creation scientists, frequently charge that we cannot have any scientific knowledge about such matters as the origin of species. Science is supposed to be based on observations, yet as they charge, "No one has ever seen a species evolve."

This assertion is quite correct, for speciation appears to require a time scale of millions (or at least tens of thousands) of years. Since human lives and even human cultures occur on a time scale several orders of magnitude shorter, there is no way in which we can witness the occurrence of speciation. The argument intended to establish this position is put quite succinctly by a defender of creationism in a letter to the science magazine *Discover*:

Given the scientific methodology of today, . . . it should be obvious to any thinking person that evolution is a *theory* and a *theory* alone, for one very good reason. It is a nonreproducible hypothesis; no one has ever witnessed evolution taking place, and no one ever will since the time frame for evolution precludes human observation.<sup>1</sup>

Quite apart from the creationist perspective, the fact remains that there is no way in which we can directly test theories of speciation to determine, for example, whether the gradualism of the synthetic theory or the relatively fast tempo of the punctuated equilibrium model is correct. Producing species is not like crossbreeding peas, and we cannot "witness" it.

We can generalize from this example, for what is true of speciation or evolution in general is also true of other processes that require vast amounts of time for their occurrence. New configurations of the tectonic plates, the creation of sandstone, the reversal of the magnetic poles of the planet, and the apparent 26 million year cycle of widespread extinctions of biological species are all among those geological and biological events we cannot witness. Similarly the increase of entropy in our local group, the movement of our galaxy through a complete rotation, the formation of planets by the condensation of gaseous materials, and the origin of the universe itself are just a few of the astronomical occurrences we cannot directly observe.

To extend this line of argument, we can call attention to the fact that there are other kinds of events that require both enormous

amounts of time and special circumstances that are beyond our capacities and capabilities. For example, we cannot study the origin of life by constructing a planet and trying out various combinations of chemicals under a variety of conditions for a few million years. Nor can we solve the problems presented by such an inquiry by travelling backwards in time and studying the processes taking place at the beginning of our own planet. The paradoxes such a trip would generate would violate our fundamental physical theories and make it an impossibility. We may shatter worlds and destroy life, but we cannot create planets and cause life to spring forth from chemical mixtures.

As these examples illustrate, we are creatures bound by time and limited in power. Both the irretrievable past and the distant future, as well as our inability to control and construct large-scale conditions, deny us direct access to numerous significant events in the natural world. In effect, then, our own limitations constitute barriers beyond which science cannot proceed.

For antievolutionists, these "boundaries" mean that the requirement that science be based on observation cannot be met, and consequently, all claims about the origin of species or life or the universe are basically unscientific. This leaves open a door through which creationism can walk without opposition. As the letter writer I quoted earlier says, "The fact of the matter is that *any* view of the origins of the universe, and the beginning and destiny of man, is based upon a faith system."

Whether or not one wishes to open the door for creationism, there still remains the argument to the effect that our human limitations form a roadblock that science cannot get around. More formally stated, the argument runs like this:

- (1) Legitimate scientific claims require direct observations.
- (2) Events such as the origin of species, the origin of life and the universe, the reversal of the magnetic poles, and so on cannot be directly observed or studied.
- (3) Therefore, claims about them cannot be legitimate scientific claims.

The most obvious and wholly adequate response to this argument is to point out that it involves a false premise. The argument assumes that all legitimate scientific knowledge requires that we immediately or directly study the events that are the objects of our inquiry. But, of course, we both can and do establish reliable scientific theories that concern events that are remote from us in time or are beyond the scope of our power to reproduce.

Even though we cannot watch speciation taking place before our very eyes, for example, we can study changes in populations that we

have reason to believe exemplify the sorts of mechanisms involved in the emergence of new species. (The classic case of such studies is that of the increase in the frequency of melanic forms of moths under conditions that include a darkening of crucial parts of the environment by industrial pollution, predation by birds, and an existing low frequency of melanic forms in the initial population.) In the controversy between the classic neo-Darwinian account and the punctuated equilibrium model, we also have available for consideration the fossil record of a variety of forms, and information about geographical distribution, genetic mechanisms, and environmental changes.

Similarly, we have not seen Pangea broken up by the movement of the tectonic plates, but we have evidence of the actions of the plates in the occurrence of the event. We cannot create life or fashion new planets by exercising godlike powers, but we have managed to acquire an experimental and theoretical understanding of the processes likely to be involved. Furthermore, although we have not "witnessed" the creation of the universe, we have been able to discover signs of its beginnings and, together with our physical theories, we can at least reconstruct the story of what is likely to have happened.

Despite appearances, the argument we are examining is not really one about the limits of what we can know. At best, it is an argument about the limits of certain ways of finding out or coming to know. It emphasizes the obvious truth that the finite scope of our time and powers restricts us in the methods we can employ in investigating certain sorts of phenomena. In particular, we cannot employ "direct" observation or experiment in a number of cases in which it would be nice if we were able to do so. We cannot watch species evolve in the way in which we watch cells divide or litmus paper change color.

Yet having to proceed in indirect ways is nothing peculiar within science. We can no more "directly" observe the behavior of quantum mechanical entities than we can, for very different reasons, observe the origin of species. It is part of the cunning of science and of scientists to be able to solve the empirical problems of the world on the basis of the most feeble clues. The constraints on time and experiments surely constitute barriers, but just as surely, they do not constitute inescapable limits.

## 2. The Argument from the Insufficiency of Brain Hardware

The second argument I want to examine is one presented by Carl Sagan, although not endorsed by him. The argument resembles in its line of reasoning suggestions made by some writers on brain physiology.<sup>2</sup>

The basic notion underlying the argument is that the size and structure of the human brain are such that they constitute limits on the quantity of information that the brain can store. If we assume that the

brain contains as many as  $10^{11}$  neurons, that each neuron has a thousand dendrites, and that a bit of information can be represented by a single connection of one dendrite with another, then (in Sagan's words) "the total number of things knowable by the brain is no more than  $10^{14}$ ."<sup>3</sup> Given this limit on the capacity of the brain to store information, it follows that if the things to be known in the universe exceed the capacity, then we simply cannot know them all.

It is easy to show that there is such a barrier to our knowledge. Indeed, it is possible to show that we cannot know fully even a single grain of salt. A grain of salt — a microgram — contains by our best estimates about  $10^{16}$  sodium atoms. To know everything about the grain would require, at the very least, knowing the location of each of the atoms in the three-dimensional array. But the information required for this exceeds by two orders of magnitude the information capacity of the brain. In a real sense, then, we cannot even know all there is to know about a single grain of salt.

Given that the universe itself contains as many as  $10^{80}$  elementary particles, it is obvious that it is impossible for us to know each of them. The hardware of our brains thus restricts what we can know of the world. All our knowledge must, perforce, be partial and incomplete. If we cannot fully know even a grain of salt, then *a fortiori*, we cannot know the universe. Since human science is dependent on the human brain, the physical limits of our brain also constitute a limit on science.

Several responses to this argument are possible. We could challenge the factual premises and suggest that the assumption of  $10^{11}$  neurons as a measure of brain size is too small a number. Or we could take issue with the assumption that a connection of one dendrite with another is required to store a single bit of information. There is good reason to believe that information storage in the brain is not in accord with such a simple wired-up model and some other more appropriate model (a field-type, for example) might provide more potential capacity for storage.

This line of criticism is not likely to be effective. Whatever reasonable number of neurons is assumed and whatever model for encoded storage is assumed, we will still be left with the undeniable fact that there are differences amounting to orders of magnitude between what the brain can store and the "facts" there are to know. It would not be enough, for example, to show that the brain *could* know a grain of salt. That would still leave everything else in the universe unknowable in the required sense.

A second response to the argument is to point out that it assumes that a radical form of what Russell called knowledge by acquaintance is the only legitimate kind of knowledge. The argument is phrased in

such a way that to know something requires something like a one-to-one correspondence between what is known and how it is represented in the brain. It seems that we must be able, in effect, to reproduce a simulacrum of what is known. At least, the information specifying the object known must be represented by some brain state.

But, of course, we know *that* a microgram of salt contains about  $10^{16}$  atoms without performing an impossible feat. Knowing this fact in no way entails that we have somehow been able to encode the structure of the array of atoms in the salt crystal. Thus, we can respond to the argument by pointing out that it has too narrowly construed the requirements for knowing something.

Besides, even if we accepted the notion that to know something requires encoding information that would allow us to represent the object known, we need not agree that the representation must be one-to-one, that the representation must be a simulacrum. The positions of the atoms in a crystal of salt are boringly invariant — sodium is attached to chlorine, which is attached to another chlorine, which is attached to another sodium, and so on. One line of atoms is just like the line above it and the line below it. Because of this, as Sagan points out, “An absolutely pure crystal of salt could have the position of every atom specified by something like 10 bits of information.” There is no difficulty, then, in the brain “knowing” a grain of salt.

This response to the argument is both reasonable and appropriate. However, it is a response and not a refutation. The response reminds us that we should not think that there is *no way* in which we can know a grain of salt, for there surely is. Similarly, we should not conclude that there is no way in which we can know the universe and its furniture.

The argument itself, I think, is left unscathed both by this response and by the first response we considered. We can disagree about how much information the brain can store and about how it stores it. We can point out that we can dramatically increase our information storage abilities by employing a large number of brains, books, and computers. But after all of this has been said, the fact will remain that we will lack the capacity to know  $10^{80}$  elementary particles, all of their configurations, and all of the objects and the relationships at the various levels of physical organization that involve the elementary particles.

In sum, I believe that the argument is basically correct and that there is an upper limit to the amount of information that, individually or collectively, our brains can store. I believe that it is even correct to say, in the *argument's* sense, that we cannot know a mere grain of salt. This limit on information storage does constitute a limit on science.

However, such a limit is hardly a cause for despair. Even if it is true that we are not capable of knowing (being acquainted with) literally



everything that we might potentially find out about a grain of salt or the entire universe, nothing of any significance follows from this. The argument gets its shock value only because it assigns a special and quite out of the ordinary sense to the word "know."

What we really want to know and what we look to science to provide are the basic principles and theories that supply the patterns and connections that make sense out of the almost limitless number of particulars that form the universe and its furnishings. We cannot know all the particulars. This much we can concede to the argument. What we need not concede is that this makes a significant difference to the development of science. Our brains are finite and the information they can handle is thus also finite. But the amount of information it is possible for the brain to store is so large that the existence of a theoretical limit has (for all practical purposes) no consequences. We need not be bothered by it any more than we need to worry about approaching the speed of light and acquiring infinite mass while riding a bicycle.

### 3. The Argument from Mental Architecture

The third defense of the limits thesis is one based on a general evolutionary approach to the understanding of human abilities and cognitive capacities. Both Noam Chomsky and Jerry Fodor claim that the architecture of the human mind places limits on our cognitive abilities and that these limits make it likely that we are not suited to solve all the problems that a scientific understanding of the world may require.

Later I want to state this argument more formally, but let me begin by presenting some of the details offered by Chomsky and Fodor to make their position plausible.

For Chomsky, one of the primary reasons for studying language is that by doing so "we may hope to gain some understanding of the specific characteristics of human intelligence" and "discover abstract principles that govern its structure and use, principles that are universal by biological necessity and not mere historical accident, that derive from mental characteristics of the species."<sup>4</sup>

Thus, language, for Chomsky, offers us clues about our mental architecture. But language is only an instance of our intellectual capacities. More generally, according to Chomsky, all that we say we know and all that we come to believe is dependent upon experiences that "evoke in us some part of the cognitive system that is latent in the mind."<sup>5</sup> This means, then, that "our systems of belief are those that the mind, as a biological structure, is designed to construct."<sup>6</sup>

Chomsky is quite explicit in pointing out that the innate biological principles (whatever they may be) that have permitted us to make scientific discoveries are also ones that must "sharply constrain the

class of humanly accessible sciences."<sup>7</sup> After all, Chomsky writes, "There is surely no evolutionary pressure that leads humans to have minds capable of discovering significant explanatory theories in specific fields of inquiry."<sup>8</sup> Indeed, Chomsky suggests that we should consider ourselves fortunate that we have done as well as we have, for "it is only a lucky accident if [our mind's] cognitive capacity happens to be well matched to scientific truth in some area."<sup>9</sup>

In short, Chomsky seems to believe that our minds have been formed by evolutionary factors that suit us for escaping from marauding lions and for hunting down our dinner but not for inventing or discovering whatever concepts we may need in order to grasp the hidden mechanisms that operate the world. In performing this later task, he must admit, we have met with some degree of success, but this success he attributes to a "lucky accident."

For Chomsky, the restricted character of the human intellect, of human cognitive capacity, has an explanatory power. It explains, he says, why it is that "there are so few sciences and that so much of human inquiry fails to attain any intellectual depth."<sup>10</sup> If we had a better understanding of human cognitive capacity, then we might be able to determine "the class of humanly accessible sciences,"<sup>11</sup> and these might turn out to be only "a small subset of those potential sciences"<sup>12</sup> that deal with aspects of the world that we would like to understand.

Presumably, a better understanding of the principles of our mental architecture might permit us to determine, for example, whether we can ever expect to solve the mind-body problem or ever establish a comprehensive science of society. As to exactly how a knowledge of our cognitive capacities might enable us to make such determinations, Chomsky is silent.<sup>13</sup>

Chomsky also endorses a realistic notion of theories and a correspondence view of truth. Explanatory theories or sciences, according to Chomsky, can be developed by humans if and only if "something close to the true theory in a certain domain happens to fall within human 'science forming' capacities."<sup>14</sup> Thus, we are invited to think of principles, theories, or sciences as existing independently of us and as being, as it were, implicit within phenomena. It is the task of science as an enterprise to formulate explicit theories that may or may not capture the true, implicit theories.

Science requires empirical inquiry, of course, but whether that inquiry has even the possibility of success depends ultimately on human "science forming" capacities with respect to the domain of inquiry. In some domains, as I read Chomsky, try as we may, we might not ever be able to formulate "the true theory" of the domain. It will elude our conceptual grasp for much the same reasons that an understanding of the calculus will always elude the housecat. In both

cases, cognitive capacities will simply be inadequate to perform the tasks required. Our theories will be successful when there is a match between them and the real entities and relationships in the domain of inquiry. As Chomsky writes, "We attain knowledge when the 'inward ideas of the mind itself' and the structures it creates conform to the nature of things."<sup>15</sup>

Chomsky's claim that the architecture of the human mind places limits on scientific inquiry is one also accepted by Fodor. Although the terms he uses in talking about cognitive capacities are somewhat different, he argues for the limits view along essentially similar lines. Like Chomsky, Fodor rejects the notion that human cognitive capacities are general or unspecialized. In his terminology, he denies that intelligence is "horizontal" or "non-modular." Instead, again like Chomsky, Fodor opts for a "vertical" or "modular" theory of intelligence, according to which the architecture of the mind is a collection of special-purpose mechanisms or "mental organs." These mental organs are, presumably, the result of the operation of natural selection's fitting us to deal with the world of ordinary experience, although Fodor does not emphasize this as Chomsky does.

Granted that our mental architecture is modular, that we possess only special-purpose "mental organs," then it follows that our minds are capable of solving only problems with a certain kind of structure. (To offer an analogy, we would not expect a machine capable only of adding to be able to solve a differential equation. The machine can solve only problems with a certain structure, namely addition problems.) If our minds are collections of special purpose mechanisms, then, Fodor says, "it is surely in the cards that there should be some problems whose structure the mind has no computational resources for coping with."<sup>16</sup>

Fodor does not let matters rest with the statement that there are sure to be some problems our minds are unable to solve. He goes on to claim that one of those problems might be "the true theory of the structure of the world." As Fodor writes:

. . . it is entirely compatible with modularity theory that there should be endogenously determined constraints on our mental capacities such that the best science — the true theory of the structure of the world — is not one of the theories that we are capable of entertaining.<sup>17</sup>

If I read this correctly, this means that in Fodor's view it is possible that we do not have, and never will have, "the best science." That is, it is possible that the architecture of our minds is such that even our current best theories, ones that we believe to be true, do not actually provide us with an understanding of the world, for if we could only grasp "the true theory of the structure of the world" we could see

their faults and deficiencies. Indeed, it is possible that we are forever doomed to be stuck with second-rate science at most, for "the best science" lies beyond the power of our cognitive capacities.

As I mentioned earlier, except for terminology and a focus on different details, Chomsky and Fodor argue for the limits view along essentially similar lines. What I take to be the basic position of both can be represented and summarized in a more formal fashion by the following argument:

(1) Cognitive functioning (the mind, intelligence, thinking) is either modular (involves specialized mechanisms or mental organs) or non-modular (is general and unspecialized).

(2) Evidence from evolution (linguistics, animal studies, etc.) supports a modular theory. In particular, it supports a theory according to which our mental architecture has been shaped by selection pressures adapting us to deal with the world of ordinary experience.

(3) If a modular theory is correct then intelligence is epistemically bounded.

(4) If intelligence is epistemically bounded and has been shaped by selection pressures to deal with ordinary experience, then it is likely ("surely in the cards") that there are scientific problems the mind cannot solve or scientific theories ("true theories," "sciences") the mind cannot grasp, for much of science lies outside the sphere of ordinary experience.

We might deal with this argument by challenging the premise that a modular theory of mind is the correct type of account for human intelligence. This would embroil us in the question of the adequacy of psychological theories, and at the moment, this is not a question that can be decisively settled. Besides, I think it is fair to say that a modular theory does seem to be the odds-on favorite for accounting for our mental architecture.

Agreeing on this point does not mean agreeing that Chomsky and Fodor have adequately established the claim that our cognitive functioning makes it likely that there are scientific theories we will never be able to establish, "sciences" that we will never be able to develop. For example, the general line of argument can be successful only when it is offered in conjunction with Chomsky's and Fodor's realistic view of theories and correspondence notion of truth. We must believe that there are true theories (or one true theory) implicit (as it were) in the phenomena of the world that we must discover, and we know that the theories we formulate are correct when, as Chomsky says, they "conform to the nature of things."<sup>18</sup> Only the realistic view makes it possible to say that there are true theories beyond our conceptual competence and many philosophers would simply reject realism as an adequate account of the aims and structure of science and deny that scientific theories are attempts to provide us with the one true des-

cription of the facts of the world. By viewing theories pragmatically, for example, and making empirical adequacy as determined by observations the standard of acceptability, some philosophers would simply dissolve the grounds for arguing for epistemic boundedness.

Taking this approach would involve us in the complex dispute between realism and antirealism. A better approach to evaluating the Chomsky-Fodor position, I believe, is to grant them their assumptions and show that, even so, they have not adequately established their conclusion that it is likely or "in the cards" that the modular character of our minds or "innate biological principles" place constraints on science's attempt to understand the world. This is what I would now like to attempt to do.

Chomsky is undeniably correct in claiming that our brain and its cognitive capacities have been shaped by evolutionary forces operating in the ordinary world. Predators and prey, heat and cold, fight and flight, sex and reproduction, tools and weapons, and so on are all matters far removed from those dealt with by quantum mechanics, relativistic physics, and even evolutionary biology itself. Who could have guessed, given our evolutionary history, that we would be able to invent (or discover) the concepts and theories needed to understand events so alien to us as hadron production, Riemannian space, and the Krebs's cycle?

Gunther Stent may be right in saying that some of the difficulty we have in dealing with physical theory, in particular, may be attributed to the fact that evolution did not select for just the capacities required.<sup>19</sup> Hence, what we now do with pain and effort we can imagine doing more easily, if only our evolutionary history had been different. Perhaps if it had been different in just the right ways, our basic physical theories would not seem puzzling and even counterintuitive. We would have the right sort of "feel" for them, in the same sort of way that some people have a knack for writing jokes.

However, notice that, despite the counterintuitive character of these theories, we were able to formulate them and use them to acquire an understanding of the processes that constitute their domain. I believe it is fair to say that, as it turned out, our brains *are* fit to deal with even relativistic and quantum mechanical phenomena. Our cognitive capacities *are* adequate for grasping the processes and events we presently consider basic. We may have reached understanding the hard way, but we did reach it. (That we still have further to go towards understanding does not alter the fact that we have come as far as we have.)

Yet we have little reason to believe that *just because* our brains were shaped by evolution, there are aspects of the world that science (as made by us) will be incapable of comprehending. Since there were apparently no selection pressures favoring our capacities to under-

stand calculus or measure the charge of an electron, Chomsky refers to these abilities as "lucky accidents." We are just fortunate that our brains work in ways that have permitted us to get as far along the scientific path as we have, and we might not be so fortunate where other matters are concerned. Yet Chomsky has no real argument for this claim. The evolution of the human brain remains one of the big mysteries of physical anthropology, and we really do not understand what the selection pressures were. The brain certainly seems to exceed in power the needs of our human ancestors, and that anomaly is one of the facts that make an evolutionary account of the brain so difficult.

It is obvious, to be sure, that making measurements in particle physics was not among the selection pressures that shaped the brain. To this extent, Chomsky may be correct in saying that an ability to make them or to perform the other tasks required by the developed sciences is a lucky accident. However, granted that we have such cognitive capacities, it does not follow that the capacity to understand whatever else we may wish to understand will also be a special kind of luck. It may be that we were just lucky one time but in a *major way* and that we have the cognitive capacity to do all that science requires that we do.

Let me put the point another way. Even granting that Chomsky and Fodor are right and that there are epistemic limits, it may be that they are so remote (that our sphere of competence is so large) that we will never encounter them. It may be that everything that we will ever want to know we will be able to know. It may be that we possess the intelligence we need to understand the world.

There is, to be sure, the possibility that we are in the position of an ant that never encounters the geographical limits of the planet, although they are real enough. It may be that there are true theories that we are unable to grasp, but it may also be that this makes no difference in our efforts to acquire a scientific understanding of the world. Both states of affairs are possibilities.

A philosophical dictum that has become a commonplace since Wittgenstein is that there is no way in which we can know both sides of a boundary. We simply do not know what it is that (perhaps) we are unable to know, what we perhaps lack the cognitive capacity to know. That is, if there is an epistemic boundary, then we cannot say what lies on the other side. If we repeatedly fail to solve certain kinds of problems, then we may begin to suspect this is because we are not able to invent or grasp the concepts needed. But there is no way for us to be sure of this. It may be, instead, that we merely have not yet come up with the needed concepts, although we are potentially capable of doing so. On the contrary, the boundary may be very genuine, and it may stand as an impenetrable barrier to what we need to know

about the universe and its furniture. That, too, is a possibility.

What Chomsky and Fodor surely have not demonstrated, even granting them their arguments and assumptions, is that "it is surely in the cards" that there are scientific problems beyond our powers to solve. What they have demonstrated, at most, is that it is at least *possible* that we will never be able to achieve a true understanding of the world and that one *possible* source of this *possible* inability is that we are not able to grasp the concepts needed.

This is a conclusion that seems to me wholly unobjectionable. It also seems to me to be a conclusion wholly without any consequences for the development of science or the conduct of scientific inquiry.

Nor, I think, does the conclusion have the explanatory power that Chomsky seems to think it has. Our failure to make any headway in the development of some of the sciences may indeed be due to our failure to grasp the concepts required. However, as I mentioned above, we have no way of knowing whether this is so in any particular case. The demonstration that there *are* limits, even if we grant its correctness, is virtually useless without knowing *where* the limits are. The mere possibility of failure may be discouraging, but it is inadequate to explain why we have not been outstandingly successful in the development of the social sciences or in solving the myriad problems that still remain open to inquiry.

## Conclusion

The three arguments that I have examined are all attempts to demonstrate that human characteristics place restrictions on what can be known by science. They are all attempts to show that certain things are not possible, or, in the case of the third argument, are not likely to be possible. In this respect, the arguments resemble a number of well-known demonstrations in mathematics and the sciences.

For example, no serious mathematician now believes that it is possible to construct a square exactly equal in area to a given circle using only a compass and a straightedge. In 1882 the German mathematician Lindemann demonstrated that it was impossible to "square the circle" in this way, even though for hundreds of years mathematicians had made the attempt. Similarly, no well-informed physicist believes that a perpetual motion machine can be constructed nor that we might be able to design a spacecraft to travel faster than the speed of light.

The arguments that lie behind these conclusions are based on fundamental mathematical and physical principles and are so compelling that only poorly-informed cranks continue the effort to do what surely cannot be done. Such demonstrations play an important role in the economy of scientific research. Problems regarded as potentially solvable can become the focus of effort and those that cannot be

solved, even in principle, can be set aside as pointless exercises. Thus, an immense amount of scientific labor and resources are saved.

Furthermore, the arguments, even with their negative conclusions, call attention to certain fundamental features of the world. Circles cannot be squared, and angles cannot be trisected. Every mechanical system eventually succumbs to entropy, and the speed of light is a limit we may approach, or even match, but not surpass.

The three arguments I have considered resemble only superficially the well-known demonstrations that have influenced the practice of science and mathematics. Each of the arguments is seriously flawed, and none of them compels us to alter our ideas about what it is possible for science to accomplish.

The first argument would have us believe that no legitimate scientific claims can be made about events that occurred in the remote past or that require geological periods of time or the control of great forces. However, as we have seen, the argument rests on a false premise. We do, in fact, possess adequate means of establishing claims about processes that we cannot directly witness.

The second argument would have us believe that it is impossible for us to acquire complete knowledge about the world or, indeed, even a small fraction of it. This claim is surprising only because we are invited to give a plain reading to "knowledge" and interpret it in some ordinary sense, whereas in fact the argument rests on some special sense. In that special sense, it does seem true that we cannot come to know the world completely, and in this respect, the second argument resembles the classical demonstrations of impossibility. However, the special sense of "know" employed in the argument renders a conclusion that is fundamentally trivial. In this way, the second argument is quite unlike the classical demonstrations.

The third argument would have us believe that it is likely that the structure of the human mind makes it impossible for us to produce the concepts and theories we need to understand significant aspects of the world. The argument is erected on a tower of shaky assumptions, but even granting those assumptions, quite unlike the classical demonstrations of impossibility, the third argument is far from compelling. Indeed, it is hardly more than a fascinating bit of speculation about why it is that some parts of the world may remain opaque to us — if it should turn out that they *do* remain opaque to us. Despite its reliance upon evolutionary theory and the cognitive sciences, the third argument is hardly more than an elaborate restatement of the old science fiction notion of aliens who understand the world better than we shall ever be able to, because they are more intelligent than we are.

I want to say again that I do not know whether there are limits imposed by human nature that make it impossible for us to acquire a scientific understanding of the world. However, I am quite sure that the three arguments I have considered do not demonstrate the exist-

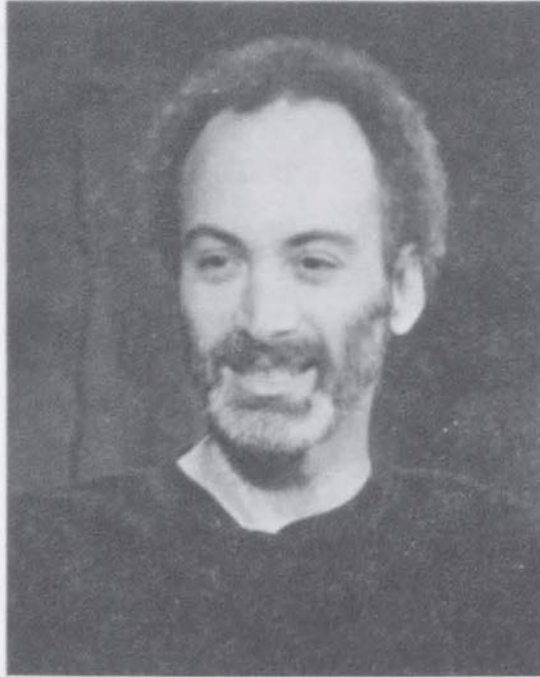


ance of any genuine restrictions. Science is not free to invest resources in building a perpetual motion machine or in attempting to square the circle. But it is free to continue to investigate the origin of the universe, the evolution of species, the contents of the universe, and even the mind-body problem.

Perhaps if we are really lucky we will someday meet some of those aliens who have already solved these problems and save ourselves a great deal of time and effort.

#### Notes

- <sup>1</sup> Gary E. Somerville, Letter, *Discover* 5 (February, 1984): 6.
- <sup>2</sup> See, for example, John von Neumann, *The Computer and the Brain* (New Haven: Yale University Press, 1958), pp. 61-62 and Harry J. Jerison "Paleoneurology and the Evolution of Mind," *Scientific American* 234 (January, 1976): 90-101.
- <sup>3</sup> Carl Sagan, "Can We Know the Universe?" in *Broca's Brain* (New York: Random House), p. 15.
- <sup>4</sup> Noam Chomsky, *Reflections on Language* (New York: Random House, 1975), p. 4. For essentially the same position as the one described here, see also Chomsky's *Problems of Knowledge and Freedom* (New York: Pantheon, 1971), esp. pp. 9-21.
- <sup>5</sup> Chomsky, *Reflections*, p. 6.
- <sup>6</sup> Chomsky, *Reflections*, p. 7.
- <sup>7</sup> Chomsky, *Reflections*, p. 25.
- <sup>8</sup> Chomsky, *Reflections*, p. 24.
- <sup>9</sup> Chomsky, *Reflections*, p. 25.
- <sup>10</sup> Chomsky, *Reflections*, p. 25.
- <sup>11</sup> Chomsky, *Reflections*, p. 25.
- <sup>12</sup> Chomsky, *Reflections*, p. 25.
- <sup>13</sup> For Chomsky's speculation about such limitations, see "Interview: Noam Chomsky," *Omni* (November, 1983): 113-118, 171-172.
- <sup>14</sup> Chomsky, *Reflections*, p. 24.
- <sup>15</sup> Chomsky, *Reflections*, p. 8.
- <sup>16</sup> Jerry A. Fodor, *The Modularity of Mind* (Cambridge: MIT Press, 1983), p. 120.
- <sup>17</sup> Fodor, *Modularity*, p. 120.
- <sup>18</sup> Chomsky, *Reflections*, p. 8.
- <sup>19</sup> Gunther Stent, "Limits to the Scientific Understanding of Man," in *Paradoxes of Progress* (San Francisco: W.H. Freeman, 1979), p. 200.



*Stephen E. Braude*  
*University of Maryland, Baltimore County*

# You Can Say That Again

Stephen E. Braude

In this paper I shall address what strike me as a number of related confusions in the philosophy of language and logic. Although the discussion will center around a certain analysis of tenses, what is more fundamentally at issue are widely-held views about meaning and the nature of agreement and disagreement.

Consider the following puzzle. Most philosophers readily assume that

- (i) Necessarily, sentences having different truth-conditions express different propositions

and also that

- (ii) The truth-conditions of a tensed sentence are relativized to its time of production

If (i) and (ii) are true, however, then it would seem as if a tensed sentence produced at different times can never express the same proposition. But pre-theoretically, it seems obvious that the same tensed sentence (e.g., 'J.F.K. was assassinated') can, on different occasions, express (or mean) the same thing. Hence, in some important sense of the term 'proposition', it seems obvious that

- (iii) Sometimes, nonsimultaneous occurrences of a tensed sentence express the same proposition

How should we deal with the apparent inconsistency in (i)—(iii)?

Part of what I shall argue is that as long as we want to understand how a real living language works, then the first statement in this triad should be rejected. Moreover, we shall also have to reconsider seriously a number of received ideas in the philosophy of language and logic. Specifically, I think we shall have to reject the view that

- (iv) Tenses refer to times

and also possibly that

- (v) Propositions have truth-values.

Furthermore, and perhaps most controversially, I believe that, if we

are ever to have a satisfactory understanding of natural languages, we will have to accept two related claims:

(vi) Sentences expressing the same proposition  
can have different truth-values

(vii) Contradictory sentences can have the same  
truth-value.

## I

For simplicity, let us consider only well-formed declarative sentence-events (tokens) the sentences. In other words, let us take a sentence to be an instance of a concatenation of morphemes, having truth-conditions. The visual or auditory pattern of a sentence may (of course) be replicated, and let us think of a sentence and its replicas as instances of the same string of morphemes. Although I prefer here to regard sentences as events or tokens rather than types, I may occasionally appear to treat sentences as types, as when I say that a sentence has different truth-values or expresses different propositions at different times. This is merely a short cut for saying that a sentence and its replicas do not all have the same truth-conditions or express the same proposition.

Of more central importance to this discussion is the notion of a *proposition*. But here, matters are more complicated. One aim of this paper is to address the question: What do sentences express? Let us agree that sentences do express things (have meaning), and let us take our task to be that of determining what these things are. Moreover, since philosophers typically use the term 'proposition' to designate what a sentence expresses (or can be used to express), it would be natural to rephrase our question as follows: What are propositions like? But I want to consider how to answer that question with an eye to the inconsistent triad above, and at this stage in the game it would be improper to answer it by appealing to any familiar view of propositions, much less the received view according to which statements (i) and (v) above are true. After all, it is this received view in particular that I want to call into question. I suggest, therefore, that we try (as much as possible) to return to a state of philosophical innocence and proceed as though there had never been a theory of propositions. Beginning afresh in this way, we will be forced to look at language use — and *not* the pronouncements of philosophers — for clues as to the

nature of what sentences express. In fact, I shall henceforth avoid, when possible and appropriate, the term 'proposition', and simply say that sentences express *things*. Hopefully, this will help us to clarify our intuitions about what sentences express, by distancing us from a familiar theoretical framework. It should also enable us better to understand what it is for users of a natural language to *agree* or *disagree* with one another.

But now that we are starting from scratch, so to speak, we can see one reason why I regard statement (i) in the original inconsistent triad as the most dispensable of the three. To begin with, statement (iii) is a fundamental pre-theoretic truth about language use, one which any theory of language must be compatible with. Although it contains the provisionally dreaded theoretical term 'proposition', (iii) merely captures the ordinary language-user's intuition that successive replicas of a sentence can express the same thing. For example, when I say

(1) J.F.K. was assassinated

I (or someone else) can later express what I earlier expressed by replicating (1). Moreover, in some cases replicas of a tensed sentence produced many years apart can express the same thing — for example, (1) produced now and 5 centuries hence. Among other things, this is how historians of different epochs can make the same observations about the past.

Even less controversial is statement (ii), which is simply an abbreviated definition of 'tensed sentence'. It captures the feature of a certain class of sentences that sets members of that class apart from such expressions as '7 is a prime number', ' $2 + 2 = 4$ ', and 'all bachelors are unmarried'. The timelessness of these latter sentences, as I have argued elsewhere (Braude, 1973), is best understood in terms of the invariance of their truth-conditions over time.

Moreover, not only are (ii) and (iii) antecedently plausible and relatively non-theoretical, they are also empirically supportable. One reason we know (ii) to be true is that we know how language-users assign truth-values to tensed sentences, and we know that such assignments depend on when, relative to those sentences' times of production, what is said to occur in fact occurs. And we know that (iii) is true, first of all, because language-users believe themselves able to re-express what they or others have previously expressed, either with different sentences or by replicating the sentence(s) used earlier. To suppose that one is never correct in such beliefs is simply to confuse speaking a natural language with some more esoteric form of linguistic activity. Furthermore, if (iii) were false, if we could never re-express what we or others expressed previously by replicating the sentences used earlier, then our natural languages would not serve the urgent human needs that motivated their development in the first place, and

they would not be usable by small children and idiots (see Braude, 1976).

Statement (i), by contrast is wholly theoretical and non-empirical; it is a component of a philosophical theory of language. But the adequacy of any theory of language, I submit, depends in part on whether it is compatible with (iii). On the surface, of course, it appears that (i) and (iii) are blatantly incompatible, given the truth of (ii). And as I shall argue below, the maneuvers required to reconcile (i) and (iii) involve adjustments to (iv) which are far from convincing. In fact, a misguided allegiance to (iv) may lie at the root of the whole problem.

## II

One reason those who accept

- (ii) The truth-conditions of a tensed sentence are relativized to its time of production

are inclined to accept

- (i) Necessarily sentences having different truth-conditions express different propositions

is that in addition to (ii) they also accept

- (iv) Tenses refer to times.

The idea behind (iv) is that the indexicality of tenses is reflected in what a tensed sentence expresses, just as the indexicality of the personal pronoun is reflected in what 'I am hungry' expresses (for example, as produced by different people). Many philosophers maintain that an ordinary tensed sentence without an explicit temporal demonstrative contains a reference to a certain time or times, simply in virtue of being tensed. For example, what 'S is *now* O' expresses through the use of the demonstrative 'now', 'S is O' is supposed to express simply in virtue of being in the present tense. That is why the demonstrative in the former sentence is regarded as superfluous; 'S is O' is already supposed to contain a reference to the present. Similarly, the past and future-tense sentences 'S was O' and 'S will be O' are supposed to contain references respectively, to times before and after the present, even though they contain no explicit singular terms referring to those times.

Various systems of tense logic display their allegiance to

this general approach to tenses by defining tense operators in terms of a chronological logic, such as Prior-type *UT*-calculus (see, e.g., Prior, 1967, 1968; also Rescher and Urquhart, 1971). For example, where 'Uab' is 'instant *a* is earlier than instant *b*', 'TaA' is 'formula *A* is true at instant *a*', and where 'n' is a constant for 'now', the past-tense 'PA' (to be read, 'it was the case that *A*') is often defined as '(∃t) (Utn & TtA)'.

If we ask 'What is the present to which a tensed sentence implicitly refers?', a natural first answer might be to expand (iv) as follows.

(iv') The tense of a sentence refers to an interval coterminous with the sentence's time of production.

But then we can see why it would be difficult from this perspective to explain how replicas of

(1) J.F.K. was assassinated

(2) Jones is feeling tired

produced at *t*, can express the same thing as replicas produced later at *t'*. For example, at *t*, (2) would express whatever is expressed by the presumably tenseless sentence

(2') Jones [is] feeling tired at *t*

while at *t'* it would be equivalent instead to

(2'') Jones [is] feeling tired at *t'*.

Some have endeavored to sidestep this problem by arguing that the tense of a sentence refers to more than the sentence's time of production. Specifically, they would amend (iv') to read

(iv'') The tense of a sentence refers to the sentence's *specious present*

A sentence's *specious present* is a *variable* interval; its length, or extremities relative to a sentence's time of production, may change from one context to another. Hence, a sentence's *specious present* may be a short interval on one occasion and a long interval on another. Moreover, on some occasions the *specious present* for a sentence may lie mostly in that sentence's future (or past), while on other occasions it may extend equally into the sentence's past and

future. But given that the specious present for a tensed sentence varies in these ways, nonsimultaneous replicas of a tensed sentence can contain references to the same specious present, an interval including all the times of production of those replicas. And since successive replicas of a tensed sentence can contain references to the same specious present, those replicas can express the same thing, despite being produced at different times.

Tyler Burge has advanced a sophisticated and provocative version of this view (see Burge, 1974). He observes that a sentence like

(3) My body is too weak for dancing

can be used appropriately as an answer not only to the question ‘Why aren’t you dancing?’, but also to ‘Why didn’t you attend the dance last month?’. This suggests to Burge that the interval referred to in (3) as the present can vary from replica to replica. In answer to the first question, that interval might be considered relatively short — say, that evening (the speaker might just have given blood). But in answer to the second question, the interval referred to as the present extends into the previous month. Moreover, since we are presumably free to choose any interval we like as the present, Burge believes we can choose the same interval at different times and thereby express the same proposition with nonsimultaneous replicas of a tensed sentence.

In my view, however, allegiance to (iv) only makes it more difficult to understand how nonsimultaneous replicas of a tensed sentence could express the same proposition. Consider, for example, replicas of

(4) Plato is buried in Athens

produced now and shortly after Plato’s death. On the view under consideration, if these temporally remote replicas of (4) express the same thing, it is because they contain references to the same specious present. But how does it happen that the speakers of these replicas consider the same interval to be the present? How, in fact, does a speaker select a specious present for his tensed sentences? Are we to suppose, for example, that the producer of (4) in antiquity regarded the present for that sentence as a period extending more than 2,000 years into the future? Would it be impossible for us now to express with (4) what that sentence expressed after Plato’s death, if the ancient speaker considered the present to extend only to 1968?

The problem with using (iv”) to resolve the apparent inconsistency in (i)—(iii) is that it presupposes a bizarre picture of language use. In order to explain how nonsimultaneous tensed sentences can express the same thing, it must endow speakers of a natural language with



extraordinary good luck and a preposterous historical perspective. For me to express the same thing with a tensed sentence as earlier (or later) speakers express with their replicas, not only must I regard the specious present for my sentence as sufficiently extensive to include those other times, but the producers of the other replicas must regard the present for their sentences as the *same* interval I take to be the present. Now of course we do not know the entire history (including the future history) of language use. Hence, we do not know, at the time of speaking, when earlier or later replicas of our sentences are produced, or when producers of that (or other) sentences express what we are expressing. And since we do not, as a rule, communicate with each other about our choice of specious presents, we certainly do not know what speakers of those other sentences take to be the specious present. But then if (iv<sup>''</sup>) is true, whether or not nonsimultaneous tensed sentences express the same thing is completely fortuitous. But of course it is not fortuitous; in fact, a natural language would be a total failure if it were.

Besides, it is perfectly clear that considerations concerning the length of specious presents do not intrude on our use of ordinary tensed sentences. For example, in saying

(1) J.F.K. was assassinated

we don't need to worry about the extent of its specious present, lest our decision prevent some future speaker of (1) from expressing what we expressed. In fact, we simply don't think *at all* about specious presents when using our language. But it is difficult to see how a view like Burge's could be true unless speakers of ordinary tensed sentences frequently engaged in considerations concerning specious presents. And it is absurd to suppose that such a complicated selection of intervals of time is a process or activity that occurs automatically, or without conscious deliberation. Indeed, it is imperative that speakers *know* what the specious present for their sentences is, if they are ever to know when they've succeeded in expressing what they or others express.

Although I regard the above considerations as sufficient to subvert the view that tenses refer to a specious present, I want to consider some additional difficulties facing those who would use it to reconcile our original statement (i) with (ii) and (iii). The importance of these further problems is that they direct our attention to some fascinating and (to my knowledge) hitherto undiscussed features of tenses and their role in communication.<sup>1</sup> They also provide a further illustration of just how far allegiance to (iv) takes us from an accurate account of the use of natural languages.

## III

The issues I want now to examine can best be introduced by considering some cases.

*Case 1:* I am attending a party with my friend Jones, who (I happen to know) has had an extremely exhausting day. At one point I notice that Jones is nodding off to sleep in a comfortable chair. Turning to my host, I remark,

(2) Jones is feeling tired

But suppose that my host is unable to see Jones dozing in the chair. Believing him to be well rested, he says to me, 'You must be mistaken'. But I shake my head and reply, 'Jones is feeling tired'.

I realize that speakers are rarely so boring as to repeat exactly the same words used previously, when trying to express again what they earlier expressed. In real life I probably would not have replicated (2) exactly in response to my host's incredulity. I would instead have chosen another sentence to express what I earlier expressed with (2) — for example, 'Jones is wiped out' 'Jones is exhausted', or (in deference to my host's ego) 'I know you seldom err, but Jones is feeling the effects of a rough day'. But apart from this convenient artificiality, we have here a paradigm case of nonsimultaneous tensed sentences expressing the same thing. In ordinary discourse, of course, that sort of agreement seldom occurs simultaneously; people agree with themselves or with others on separate occasions. And in the situation we are imagining here, it is clear that by replicating (2) my intention was to express what I expressed previously. It is not a case in which I wanted merely to report the sentence I had uttered previously, as though I might no longer wish to be claiming that Jones is feeling tired. If that had been all I wanted to do, it would have been more appropriate to say, 'What I said was...'.

Case 1, then is just the sort of case which partisans of (iv") believe they can explain. Let us say that my first replica of (2) was produced at moment  $M$ , and that my later replica was produced at  $M'$ . Champions of the specious present would claim that the two replicas of (2) express the same thing because they each refer to the same specious present, some moment  $M''$  which includes moments  $M$  and  $M'$ .

Now an ordinary present-tense sentence 'S is O' is true just in case S is O, *not* simply *during* the interval regarded as the present (i.e., at some time or other during that interval), but *throughout* the present. At the very least this is true of (2) in this case. In real life, had I wanted to express, for example, the more cautious and complicated proposition typically expressed by 'Jones is feeling tired at some time during the present', I would not have produced as simple a sentence as (2). And we may suppose that I had no reason to expect Jones'

condition to undergo any sudden or rapid change. Hence, there would be no reason for me to say anything more circumspect than 'Jones is feeling tired'. Presumably, then, defenders of (iv<sup>''</sup>) would take the two replicas of (2) to have the same truth-conditions; that is how they would explain the fact that the replicas express the same thing. Both sentences would be considered true just in case Jones is feeling tired throughout M<sup>''</sup>.

But now let us suppose that *between* M and M' a powerful amphetamine that Jones had ingested several minutes beforehand suddenly takes effect, so that by the time I replicate (2) at M', Jones is brimming with energy. What truth-values should we then assign to my two replicas of 'Jones is feeling tired'? I submit that we should take the first replica (produced at M, before Jones feels the effect of the drug) to be true, and the second (produced after Jones' resurgence of energy) to be false. In this case, I think we should say that although I expressed the same thing at M and M', nevertheless the sentence I produced at M is true, while the sentence I produced at M' is false. In this way we can capture what is semantically peculiar about the case, while still respecting what seemed initially to be correct about it — namely, that I expressed at M' what I expressed earlier at M. After all, that is what seemed to be obvious about my verbal performance at M' *before* learning about the amphetamine. And I submit that this extra bit of information should not alter our assessment of what I expressed at M'. Whether or not Jones felt the effect of an amphetamine is completely irrelevant to determining whether I expressed at M' what I expressed earlier at M. Recall that, *ex hypothesi*, I had no knowledge at M and M' that Jones had taken an amphetamine, and so that fact certainly did not enter into my consideration at those times.

But notice that we cannot analyze the case this way on the view under consideration. According to the view of language embracing (i) and (iv<sup>''</sup>), both replicas of (2) have the same truth-conditions, and necessarily, any two sentences having the same truth-conditions have the *same* truth-value. Therefore, by insisting that nonsimultaneous tensed sentences express the same thing in virtue of referring to the same specious present, this account of tenses and their role in agreement fails to allow for changes in the world to correspond to changes in truth-value assignments to tensed sentences. And that difficulty seems especially embarrassing in view of the fact that one of the most interesting features of tensed sentences is that most such sentences can change in truth-value with time.<sup>2</sup>

*Case 2:* This case should be especially useful for those who can detect contradictory sentences more easily than sentences expressing the same thing. The scene is later at the party mentioned in case 1. Jones, feeling the effect of the amphetamine, is circulating among the guests with great zest and conviviality. During this time, two party-goers engage in conversation. The first, A, having last seen Jones

asleep in the easy chair, and believing him still to be asleep, says to B, 'Have you seen Jones?'. B, having last seen Jones involved in an animated discussion in the kitchen, and believing him still to be in that room, says (at M) 'Yes. Jones is in the kitchen'. A, understandably incredulous, and also mindful of B's reputation as a practical joker, replies 'Jones is *not* in the kitchen'.

Now first of all, this is surely a paradigm case of the occurrence of a pair of contradictory sentences in ordinary discourse. For one thing, the members of such sentence-pairs are hardly ever produced simultaneously. One would think, then, that any remotely adequate analysis of contradictory tensed sentences would not be stymied by the fact that they are produced at different times. Interestingly, however, this is precisely where the traditional accounts of contradictories go awry. To bring their stark artificiality clearly into the open, consider the following additional features of case 2. Suppose that when B says

(5) Jones is in the kitchen

Jones is in the kitchen but that when A says

(6) Jones is *not* in the kitchen

Jones had returned to the living room.

How are we now to understand this case? First of all, I submit that knowledge of Jones' whereabouts is irrelevant to determining whether (5) and (6) are contradictories. It is obvious that A is denying what B expressed; that was clear before I mentioned where Jones was. But it also seems as if each of their sentences is true. Jones is in the kitchen when B utters (5), and is not in the kitchen when A utters (6). But then contrary to the received view of contradictories, it seems as if the contradictoriness of (5) and (6) is independent of the truth-value assignments we make to the sentences.

It seems ironic that defenders of (iv<sup>''</sup>) should have difficulty handling nonsimultaneous contradictories. Presumably, they would accept the received view that contradictories must have different truth-values. And in order to assign opposing truth-values to (5) and (6), they would relativize the sentences' truth-conditions to the same specious present M<sup>''</sup>. (5) would be true, I suppose, just in case Jones is in the Kitchen throughout M<sup>''</sup>. But what are the truth-conditions of (6)? Is (6) true just in case Jones is not in the kitchen throughout M<sup>''</sup>? The problem is that this statement of (6)'s truth-conditions is ambiguous. It could be stating the truth conditions of either

(6') Jones is not in the kitchen at some time during  $M''$

or

(6'') Jones is not in the kitchen at any time during  $M''$

Now if (5) is true just in case Jones is in the kitchen *throughout*  $M''$ , then one would think that A's denial of (5) would have the truth-conditions of (6'') — i.e., that his sentence (6) has the force of

(7) Jones is in a different room (throughout  $M''$ )

or

(8) Jones is out of the kitchen (throughout  $M''$ )

But in that case (5) and (6) need not have opposite truth-values. In fact, if Jones is in the kitchen for only *part* of  $M''$ , both sentences are false. Only if (6) is understood to have the truth-conditions of (6') must (5) and (6) have different truth-values. Unfortunately, however, this seems to require an arbitrary difference in the way we interpret (5) and (6). We don't take (5) to mean 'Jones is in the kitchen at some time during  $M''$ '. And I submit that it would be suspicious in the case described to give (6) the truth-conditions of (6'). (6) *does* seem to have the force of something like (7) or (8), and the case does seem to require that we give parallel analyses of the truth-conditions of (5) and (6).

But can it be acceptable, my opponent might wonder, to allow sentences expressing the same thing to differ in truth-value, and to allow contradictory sentences to have the same truth-value? I grant that at first this might seem like a crazy thing to take as a given about ordinary language, since it seems to call into question much of a deservedly well-entrenched theoretical framework in logic. But it doesn't seem so outrageous when we reflect that we are dealing with *nonsimultaneous* pairs of sentences. For example, the traditional and familiar notion of contradictories applies to sentences *abstracted* from the temporal restrictions placed on their truth-conditions. But then there is no reason to expect that this venerable notion of contradictories will apply to the richer notion of a *tensed* sentence. Since tensed sentences can be adequately understood only in a temporal context, and since they do have their truth-conditions relativized in some way to their times of production, it is not surprising that nonsimultaneous contradictory tensed sentences can have the same truth-value. A satisfactory analysis of a tensed natural language simply requires a notion of contradictories different from the standard Aristotelian notion. So

long as we are concerned with the temporal aspects of language (and tensed sentences in particular), the concept of contradictories can no longer be explained in terms of opposing truth-values. My suspicion is that an adequate notion of contradictories for an analysis of natural languages will be (at least partly) pragmatic rather than wholly semantic. Perhaps it will have to be spelled out in terms of such things as intentions, presuppositions, or even Gricean implicatures. I am therefore, not renouncing our logical framework. Rather, I am suggesting only that its application has certain hitherto unacknowledged limitations. Still, it is definitely an embarrassment to the standard accounts of tenses that they fail to represent these interesting features of language.

Nevertheless, I imagine that few will be easily swayed to my point of view. Most will be tempted to try to explain away the anomalous situations characterized above rather than scuttle or severely limit the use of familiar and otherwise apparently viable logical tools. But I think this would be a mistake. In fact, it may succeed only in creating additional serious problems. To see why, consider the following challenge to my remarks about cases 1 and 2 above.

Some might urge that it was wrong from the start to claim that I expressed the same thing both times I uttered

(2) Jones is feeling tired

They would contend, quite sensibly, that *person B* can agree with *person A* even though *A* and *B* do not express the same thing. For example, in case 1, some might argue that the respect in which I agree with myself when I repeat (2) is that my later remark abbreviates a sentence like

(9) Jones was feeling tired *then* [i.e., when I uttered the first sentence] and still is

In that case, I would have been uttering an implicit *conjunction* the second time, and the reason my sentence is false at that time is simply that the second conjunct is false.

Now while I agree that some cases of agreement can be handled along these lines, many — including case 1 — cannot. First of all, I don't think we would have been inclined to understand my sentence at *M'* this way *before* learning about the change in Jones' condition. And remember, *ex hypothesi*, neither my host nor I knew Jones had taken an amphetamine. Any my host didn't ask me (say) whether Jones' condition was stable; he was incredulous about my assessment of Jones' *present* condition. Hence, the correct interpretation of my

second sentence is what I think would have been our initial interpretation — namely, that I expressed about Jones neither more nor less than what I expressed earlier.

Moreover, it is preposterous to claim that people cannot express the same thing with nonsimultaneous tensed sentences, simply because the sentences are produced at different times. A language with that feature would be a failure as a natural language. Human languages are presumably designed to facilitate communication, not to force it into convoluted patterns satisfying the canons of old-fashioned logical analysis. Barring cognitive or linguistic limitations, we can express whatever we want, whenever we want. The passage of time imposes no limits on what we can express; nor does it limit what we can say using the present tense. The passage of time may, however, determine what can be said *truly*.

Apparently, then, by trying to explain away the odd features of cases 1 and 2, we return to the implausible position which earlier forced us to consider the view that tenses refer to a specious present. The problem with the initial interpretation of (iv) — i.e., (iv') — was that it could not help explain how nonsimultaneous tensed sentences could express the same thing. We accordingly modified that view by understanding the time referred to as a specious present. But that view still left it a mystery how speakers could agree on a specious present, and it also could not explain how tensed sentences expressing the same thing could differ in truth-value, and how contradictory tensed sentences could have the same truth-value. And now, in order to explain away these interesting (and unheralded) facts of ordinary language, proponents of the referential analysis of tenses seem forced to retreat back to the deeply unsatisfactory view that nonsimultaneous tensed sentences necessarily express different things.

The view that tenses refer to times thus appears to be far less attractive than we might have thought initially, and seems to lead to extremely implausible descriptions of ordinary discourse. What, then, are we to make of the cases thought by many to support the referential analysis? Let us now turn our attention to that topic.

#### IV

One kind of case apparently supporting a referential analysis of tenses is exemplified by Burge's example

(3) My body is too weak for dancing

As we observed earlier, (3) can be used appropriately as a reply not only to 'Why aren't you dancing?', but also to 'Why didn't you attend the dance last month?'. Since (3) can serve as an answer to this

second question, Burge and others conclude that the *present* referred to in (3) can extend a month into the past.

This line of reasoning conceals several mistakes. The first is the failure to see that even if (3) does implicitly contain a reference to a time, we are not compelled to attribute that referring role to its tense structure. Since this mistake figures also in another case discussed below, I will postpone my comments about it until then.

A second mistake may simply be the failure to remember that the *grammatical* and *semantic* tenses of a sentence need not be the same. For example, suppose you ask the grocer about the price of his fruit, and he replies,

(10) Those melons will be 89 cents each

Although this sentence is grammatically inflected in the future tense, it is clearly a present-tense sentence semantically. Or suppose I ask you, 'What are you doing tomorrow?', and you reply

(11) I'm flying to Chicago

Your reply should clearly be understood to be in the future tense, even though your sentence is grammatically inflected in the present tense (this particular discrepancy between grammatical and semantic tenses is, of course, common in German).

Similarly, I suggest that (3) is not a semantically present-tense sentence, or at least *not only* a semantically present-tense sentence, as an answer to 'Why didn't you attend the dance last month?'. In that case (3) might plausibly be understood as equivalent to one of the following.

(12) My body *was* too weak for dancing and still is

(13) My body *is often* (or *is usually*) too weak for dancing

(12) is a conjunction of a past- and present-tense sentence, and (13), whose principal temporal operator is 'It is often (or usually) that case that...', clearly has truth-conditions more complicated than those for a simple present-tense sentence.

In any event, that (12) and (13) are indeed plausible translations of (3) in this case reminds us that what a sentence expresses is partly a function of the way it is embedded in a bit of life. That is why we can know what a sentence expresses only after knowing certain facts about the sentence's context of production. That is also why many sentences of ordinary language can be paraphrased in certain contexts by longer and more explicit sentences. Hence, when Elmer Fudd says 'She



waved at him', he might be expressing what those of us who can pronounce the letter 'r' would express with 'She raved at him'. Cases of irony or sarcasm furnish somewhat more relevant examples. Thus, in some contexts, 'That was an interesting remark' might express what one would more straightforwardly express with 'That was a dull remark'. Finally, to take a case similar to Burge's dancing example, suppose I ask you, 'Why did Professor Jones try to burn down his elementary school when he was 8 years old?' and you reply

(14) He did it because he is crazy

Presumably, the grammatically present-tense 'he is crazy' in (14) abbreviates something like 'he has always been crazy' or 'he has been crazy for a long time'. This is perhaps clearer still when we reflect on the oddity of answering 'Why *didn't* Professor Jones help his classmates burn down the school when he was 8 years old?' with

(15) He is very mature

A different sort of case, purportedly supporting a referential analysis of tenses, is the following. This case is supposed to show that tenses can refer to rather *specific* times. Suppose I ask you, 'Why didn't Mary attend last week's party?', and you reply by saying

(16) Mary was sick

Burge and others have maintained that the past tense in (16) refers to a specific time in the past — namely, the time of the party. If (16) were true just in case Mary is sick at *some* time or other prior to (16)'s production, then it could be true even though Mary was not sick at the time of the party. But in that case (16) would not be a proper reply to the question. Thus, we are told, (16) is best understood as equivalent to

(16') Mary was sick *then*

where the demonstrative 'then' is understood to refer to the time of the party.

But in neither this case nor the case of (3) must we suppose that some (possibly covert) feature of a sentence's tense structure is referring to a time, simply because that sentence abbreviates another sentence containing explicit temporal references. The equivalence of (16) and (16') in certain situations does *not* suggest that something in the tense structure of (16) is doing the job of 'then' in (16'). Rather, it suggests simply that in those contexts the explicit use of 'then' is

unnecessary. The reason we can economize and utter (16) is because in context it is clear what we are saying. Given the background of shared presuppositions required for the occurrence of (16) to be intelligible and appropriate in the conversational context we are considering, an explicit reference in (16) to the time of the party would be gratuitous. The study of the suppression of the demonstrative in (16') thus seems to be a matter for the pragmatic analysis of conversational contexts, rather than the semantic analysis of tenses.

Context, then, often supplies information which we can omit from our overt pronouncements without hindering communication. Proponents of referential analyses of tenses apparently overlook this vital fact in some cases, and in so doing, attribute more structure to our language than it actually has.

## V

We see, then, that despite our refusal to attribute a referring role to tenses, we can still plausibly account for the familiar linguistic episodes in which this role is allegedly manifest. But denying that tenses refer has serious and far-reaching consequences for the philosophy of language. We can best see this by considering first just what tenses apparently do, given that they do not refer.

My position on the matter is that tenses are nothing more than very general sorts of restrictions placed on sentences' truth-conditions. They determine the very general respect(s) in which a sentence's truth conditions are relativized to its time of production.<sup>3</sup> For example, generally speaking a past-tense sentence of the form 'S was O' is true just in case S is O prior to its time of production [the sentence to the right of the biconditional is tenseless]. When a sentence 'S was O' abbreviates a sentence 'S was O at t', then the sentence is true if and only if S is O at t and t is before the sentence's time of production. But in such a case it is not the tense of the sentence that is responsible for the increased specificity of these truth-conditions. What is responsible is the modifier 'at t', the explicit production of which may be unnecessary in that context. The past tense of 'S was O' merely imposes a certain general kind of temporal restriction on the sentence's truth-conditions. For the sentence to be true, what it reports must occur *before* its time of production, rather than *after* or *at* that time, as in the case of the future and present tenses, respectively.

Of course, in making general claims about tenses and tensed sentences, some abstracting from the intricacies of ordinary discourse is inevitable. In fact, the truth-conditions of tensed sentences are rarely this straightforward. For example, 'Jones is sick' and 'Jones is smiling' might differ in truth-conditions in virtue of the sorts of beliefs about being sick and smiling we presuppose in discourse. Consider:

how long must Jones be in some appropriately abnormal state for a replica of 'Jones is sick' to be true? One would imagine *at least* as long as the sentence's (presumably rather brief) time of production. But if Jones' condition lasts *only* that long, we might be reluctant to say that he was sick. On the other hand, Jones might smile only during the sentence's time of production, and that would be sufficient for an ordinary instance of 'Jones is smiling' to be true. But these complications in the truth-conditions of tensed sentences are due to pragmatic presuppositions about being sick and smiling. As in the case of suppressed specific references to times, they are not complications in the sentences' tense structure.

According to this non-referential account of tenses, therefore, although the tense of a sentence determines how the sentence's truth-conditions are relativized to its time of production — that is, whether what the sentence reports must occur before, during, or after its time of production (or more complicated sorts of relationships as in the case of compound tenses) — this is not accomplished by means of covert references to times made in the sentences. Granted, in stating a tensed sentence's truth-conditions we refer to moments of time. But truth-conditions are expressed in a meta-language, and the level of abstraction at which we state a sentence's truth-conditions is far removed from the everyday contexts in which object-language sentences are usually produced. The statement of a sentence's truth-conditions deals with the way that sentence functions within a certain linguistic context, and there is no reason whatever to insist that every temporal reference in the metalinguistic statement of a tensed sentence's truth-conditions corresponds to some temporal reference in the associated object-language sentence. Hence, tenses are not like the referring singular terms 'now' and 'then', which typically refer to times in object-language sentences. But once we grant this, we must seriously reconsider other widely-held views about language.

To begin with, we have seen that nonsimultaneous replicas of a tensed sentence can have different truth-conditions but express the same thing. For example, successive replicas of

(1) J.F.K. was assassinated

produced at moments  $M$  and  $M'$ , can express the same thing, as we know from ordinary discourse. But the replica produced at  $M$  is true just in case J.F.K. is assassinated before  $M$ , while the later replica is true just in case J.F.K. is assassinated before  $M'$ . Thus the period of time in which J.F.K. must be assassinated for a replica of (1) to be true changes from  $M$  to  $M'$ . In this respect, the replicas of (1) have different truth-conditions. But while this change appears minimal, it is nevertheless significant, since it is this variability of truth-conditions

which enables the replicas to differ in truth-value — for example, when J.F.K. is assassinated sometime between M and M'. In any case, since replicas of (1) expressing the same thing can differ in truth-conditions, we must abandon the familiar view that a change in a sentence's truth-conditions determines a corresponding change in what it expresses.

Taking a non-referential approach to tenses may also force us to reconsider another of the familiar views about propositions mentioned at the beginning of this paper — namely, that propositions have truth-values. We know from ordinary language use that nonsimultaneous replicas of a tensed sentence like (1) can express the same thing. But we also know that these replicas have different truth-conditions and can differ in truth-value. But what about the propositions they express? If the sentences express the *same* proposition, and if propositions have truth-values, then we would presumably be in the awkward position of claiming that a true and a false sentence can both express the same true (or false) proposition. We also saw that pairs of contradictory sentences can have the same truth-value. What do we say about this? Do contradictory tensed sentences express contradictory propositions? If so, and if contradictory propositions have opposing truth-values (as one would expect), then if two false sentences (say) are contradictories, one of these false sentences will express a true proposition.

The peculiarity of these claims is perhaps not reason enough for rejecting the view that propositions have truth-values. It may be intelligible to say (for example) that a false sentence can express a true proposition (though I doubt it). But once we grant (say) that contradictory sentences can have the same truth-value, it is far from clear that there is anything to be gained by assigning truth-values to the things sentences express. So long as we continue to maintain that a sentence is true when its truth-conditions are satisfied, then the truth-conditions of sentences would not be correlated in any straightforward way with the truth-conditions of the propositions which the sentences express. We would, in fact, have to provide two theories of truth, one for sentences, and another for propositions. And the latter, it appears, would be implausibly independent of the former.

I suppose some might argue that the need for two such theories of truth is precisely what we should expect. After all, they might say, since a sentence is a kind of linguistic event, and since what a sentence expresses is not, why should we expect to be able to correlate their truth-conditions in any neat way — if, indeed, they may be correlated at all? In fact, we should remember that propositions have traditionally been regarded as language-independent in some significant respect. That is why philosophers have wanted to say, for example, that the proposition that 7 is a prime number is true whether or not

anyone ever expresses it.

I shall not attempt to resolve this issue here. Even so, we can at least see that a decision in favor of treating propositions as truth-bearers will not restore our familiar account of the relationship between sentences and propositions, since on the traditional account sentences have the same truth-value as the propositions they express. Often, on these accounts, sentences are taken to have truth-values derivatively, rather than primitively. That is, propositions are regarded as the primary truth-bearers, and sentences are true or false only insofar as they express true or false propositions, respectively. But this approach turns on the plausibility of the view that a change in a sentence's truth-conditions determines a corresponding change in proposition expressed — a view which I have tried to show in untenable. If my observations about tenses and their role in agreement are correct, then, we have persuasive reasons for abandoning this picture of the relationship between sentential and propositional truth-value.

Indeed, we have grounds for rethinking seriously the concept of a proposition. If propositions, the things sentences express, are not the sorts of things that have truth-values, what kinds of things are they? Here, we come to one of the deeper issues lurking beneath the surface of this paper; let me comment on it briefly. I suggest that we should not take too literally the pre-theoretical intuition that sentences express *things* (whether or not we call these things 'propositions'), or that a sentence means *something*. Although these are very natural ways to describe what sentences do, they foster the illusion that the successful use of a sentence does some *thing* which we can then describe in a reasonably exhaustive or complete way. Although I cannot defend the view here, I suggest that the meaning of (or proposition expressed by) a sentence is no more clearly or exhaustively specifiable than would be the *humor* or *sensitivity* of a sentence.<sup>4</sup> How a sentence is humorous or sensitive can be roughly and incompletely specified by choosing some description of the context in which the sentence is produced. But little more can be said about what a sentence means or expresses. We can offer some description of the context in which the sentence is produced, and thereby point to certain features of its use — e.g., how it is a response to what preceded it, what effect it produced, etc. But such accounts are fated to be incomplete, and ultimately no more precise than the bit of language they are intended to explicate. We can say what a sentence means or expresses only by producing another sentence, and at no point can we fall back on a bit of language whose meaning is any more precisely explicable than the one we wanted to explain initially.

But if it is a mistake to suppose that what a sentence expresses is exact or clearly specifiable, then perhaps one reason nonsimultaneous replicas of a tensed sentence can so easily express the same thing is

that sentences generally do not express something precise. The convoluted attempts examined earlier to explain how tensed sentences can express the same thing or contradict one another (e.g., by means of reference to the same specious present) are simply examples of the sort of theorizing one tends to engage in by supposing that natural languages are kinds of calculi, more or less precise vehicles for communicating. Of course, philosophers have for some time been arguing that this general approach to language is deeply mistaken. The foregoing discussion is merely an attempt to make the same point in a different way.<sup>5</sup>

#### Notes

- <sup>1</sup> Buridan comes to discussing them in his *Sophisms* (my cases are modeled after some of those he presents — see Scott, 1966). But Buridan resolutely refuses to abandon the traditional concept of contradictories, as well as the view that tenses refer. He also seems to embrace the view that we use tenses to refer to a specious present (see, e.g., chapt. 7, sophism 3).
- <sup>2</sup> Contrary to what some have believed, not all tensed sentences can change in truth-value with time. See Braude, 1973.
- <sup>3</sup> See Braude, 1973 for an explanation of this position from a somewhat different point of view.
- <sup>4</sup> For a good defense of this view, see Goldberg, 1982. Also, Braude, 1979: 152-174, 205ff.
- <sup>5</sup> I am grateful to many people for stimulating and helpful discussions of this topic, and for criticisms of ancestors of this paper. In particular I wish to thank Bruce Goldberg, Scott Weinstein, Alan Tormey, Tyler Burge, and Steven Davis.

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