Clearly objects do move forth and back in space. Thus, for instance, Jackson walks from home to the corner drugstore and then walks back home. But do objects also move forth and back in time? And if not, would it be logically possible for them to do so? Indeed, what would even constitute a proper description of an object's moving forth and back in time? My aim in this paper is to answer these perplexing questions.1

Richard Taylor has developed a procedure for constructing spatio-temporal analogies which enables us to find straightforward answers to these questions.2 According to his procedure, in order to obtain a description of an obscure temporal notion, one first produces an exact description of the analogous spatial notion, and then one derives from that description, by substituting temporal for spatial terms and vice versa, a description of the temporal notion. Naturally this procedure will generate correct results only if space and time are radically similar to each other. For the purposes of this paper I shall assume that they are so.

Now Taylor contends, on the basis of a spatio-temporal analogy which he develops, that objects do move forth and back in time, and that they do so in a certain uncontroversial manner. In this paper I shall, first of all, undermine Taylor's contention by showing that the analogy which he develops does not succeed in capturing the notion of an object moving forth and back. Secondly, I shall examine, and show to be unsuccessful, three other attempts at constructing the correct analogy for the notion of an object moving forth and back. Each of these unsuccessful analogies, including Taylor's, is infected by one or the other of two mistakes: either (a) such an analogy gives a mistaken description of the spatial notion in question; or (b) it commits a procedural mistake in generating the temporal analogue (i.e. the description of the analogous temporal notion) from the description of the spatial notion. Finally, I shall state and defend the correct analogy which, it will be seen, involves the quite controversial notion of time-travel.
Let us begin, then, by examining Taylor's analogy. He describes the fact that an object 0 moves forth and back in space in the following way:

(IS) 0 is at place\(_1\) both at time\(_1\) and at time\(_2\). 0 endures from time\(_1\) through time\(_2\). At time\(_k\) within the interval time\(_1\)-time\(_2\) 0 is at place\(_k\) (≠ place\(_1\)).

More precisely, this purportedly describes the fact that during the temporal interval time\(_1\)-time\(_2\) an object 0 moves from place\(_1\) to place\(_k\) and then back again to place\(_1\). Rewriting this description according to the specified procedure, Taylor derives this temporal analogue:

(IT) 0 is at time\(_1\) both at place\(_1\) and at place\(_2\). 0 extends from place\(_1\) through place\(_2\). At place\(_k\) within the interval place\(_1\)-place\(_2\) 0 is at time\(_k\) (≠ time\(_1\)).

Admittedly if description (IT) correctly depicts the fact that during the temporal interval time\(_1\)-time\(_2\) an object 0 moves from place\(_1\) to place\(_k\) and then back again to place\(_1\), then objects do move forth and back in time, and they do so in an uncontroversial manner. As an example of an object to which description (IT) applies, Taylor portrays an earthquake which at time\(_1\) occurs "in two nearby towns, which we may refer to as place\(_1\) and place\(_2\), and ... it occurs everywhere between these two towns, but at one of those intermediate places at a time other than time\(_1\)."

However, description (IT) cannot be accepted as a correct description of the notion that an object moves forth and back in time since description (IS), from which it is derived, is incorrect. As Taylor himself implies, description (IS) constitutes an exact description of the relevant notion only if "any object 0 whose behavior fits that description is one that moves from its place and returns to it, and one that, therefore, can be described as 'moving forth and back in space.'"

Now some objects whose behavior description (IS) fits cannot be described as moving forth and back in space. Consider this example. Two towns, Middletown and Springfield, are situated one mile apart. Before noon on a certain day Wilson parks his two-mile long train in such a way that it occupies the tracks both in Middletown and in Springfield, as well as the tracks in between the two towns, and he leaves it parked there throughout the afternoon. During the afternoon the train does not move from one town to the other and then back (it does not move at all), yet description (IS) applies to this case.
So, description (1S) is not a correct description of the fact that an object moves forth and back in space. It must be concluded, therefore, that Taylor's analogy fails to capture the notion we want.

Why is it, though, that Wilson's train cannot properly be described as moving forth and back between the two towns? What I shall call the part analogy provides an answer to this question which is based on the following observation. When an object moves forth and back in space, the whole object (i.e. all of its spatial parts) is in one place at one time, it is in a second place at a later time, and it is back in the first place at a still later time. Thus, according to the part analogy, Wilson's train cannot properly be described as moving forth and back between the two towns because the whole train did not occupy two different places during the afternoon, but rather the whole train remained in one place throughout the afternoon. Obviously the part analogy will be formulated in terms of spatial and temporal parts.

According to the part analogy, the fact that an object \( O \) moves forth and back in space should be described as follows:

\[
\text{(2S)} \quad \begin{align*}
\text{All of the spatial parts of } O \text{ are at place}_1 \text{ both at time}_1 \text{ and at time}_2. \\
\text{All of the spatial parts of } O \text{ endure from time}_1 \text{ through time}_2. \quad \text{At time}_k \text{ within the interval time}_1 - \text{time}_2 \text{ all of the spatial parts of } O \text{ are at place}_k \\
\end{align*}
\]

From this the part analogy obtains the following temporal analogue:

\[
\text{(2T)} \quad \begin{align*}
\text{All of the temporal parts of } O \text{ are at time}_1 \text{ both at place}_1 \text{ and at place}_2. \quad \text{All of the temporal parts of } O \text{ extend from place}_1 \text{ through place}_2. \quad \text{At place}_k \text{ within the interval place}_1 - \text{place}_2 \text{ all of the temporal parts of } O \text{ are at time}_k \quad (\neq \text{time}_1).
\end{align*}
\]

At first glance description (2S) seems to describe correctly the fact that an object moves forth and back in space. Shortly, though, we shall see that it does not correctly describe this fact. Let us first consider its temporal analogue, description (2T). According to this description, all of the temporal parts of an object exist at one time and these same temporal parts exist at another time. But this clearly is a logical impossi-bility.
Suppose, for example, that all of Anderson's temporal parts exist during the twentieth century. Now supposing that Anderson moves forth and back in time, as this is construed by the part analogy, then all of his temporal parts exist also at some time other than the twentieth century, say, during the sixteenth century. Of course, this is logically impossible. The identity of a temporal part is a function of the times through which it endures, so that if a temporal part exists at two different times, then at each of those times only some part of that temporal part exists. (Thus, if Johnson suffers from pneumonia in 1970 and in 1974, then the temporal part of Johnson, distinguished by the fact that during its endurance Johnson suffers from pneumonia, exists in 1970 and 1974; but in each of those years only a part of that temporal part exists.) So, if all of Anderson's temporal parts exist in the sixteenth and twentieth centuries, as is implied by the supposition that all exist in each of those centuries, then during each of those centuries only some (i.e. not all) of his temporal parts exist. But this contradicts the supposition that during each century all of his temporal parts exist. Therefore, it must be concluded that description (2T) describes a logical impossibility.

Returning now to description (2S), it can be seen on a closer inspection that this description does not correctly describe the fact that an object moves forth and back in space, but rather it describes, as its temporal analogue does, a logical impossibility. The part analogy, because it divides objects into spatial and temporal parts, requires that objects be viewed as four-dimensional entities—as entities with three spatial dimensions and one temporal dimension. Hence each spatial part and each temporal part of an object is itself a four-dimensional entity.

Notice that since description (2T) asserts that all of the temporal parts of an object exist at two different times, it therefore implies that all of the spatial parts of that object exist at those two times. Similarly, but perhaps not so obviously at first glance, since description (2S) asserts that all of the spatial parts of an object exist at two different times, it therefore implies that all of the temporal parts of that object exist at each of those two times. Yet, as shown above, it is logically impossible for all of the temporal parts of an object to exist at each of two different times.

I conclude, then, that description (2S) portrays a logical impossibility and thus cannot be the correct description of the fact that an object moves forth and
back in space. So, the part analogy fails to capture the notion of moving forth and back.

The observation underlying the part analogy seems plausible enough: When an object moves forth and back in space, the whole object occupies different places at different times. This is plausible, though, only if objects are regarded as changing three-dimensional entities, as entities which can be divided into spatial parts but not into temporal parts. But, of course, the terminology of spatial and temporal parts demands that objects be regarded as unchanging four-dimensional entities. What we are doing, in formulating our spatio-temporal analogy in terms of spatial and temporal parts, is translating a three-dimensional notion—the notion of moving forth and back—into the four-dimensional idiom. In order to represent this notion accurately, the translation must be complete.

What I shall call the four-dimension analogy provides such a complete translation. This analogy reconstrues the observation underlying the part analogy in the following way: When an object moves forth and back in space, one temporal part of the object exists in one place at one time, another temporal part exists in a second place at a later time, and yet another temporal part exists in the first place at a still later time.

So, according to the four-dimension analogy, the fact that an object 0 moves forth and back in space can be exactly described as follows:

\[(3S)\] Temporal-part$_1$ of 0 is at place$_1$ at time$_1$. Temporal-part$_2$ of 0 is at place$_1$ at time$_2$. The series of temporal-parts of 0 from temporal-part$_1$ through temporal-part$_2$ fills the interval time$_1$-time$_2$. At time$_k$ within the interval time$_1$-time$_2$, temporal-part$_k$ of 0 is at place$_k$ (≠ place$_1$).

Rewriting, the four-dimension analogy derives this temporal analogue:

\[(3T)\] Spatial-part$_1$ of 0 is at place$_1$ at time$_1$. Spatial-part$_2$ of 0 is at place$_2$ at time$_1$. The series of spatial-parts of 0 from spatial-part$_1$ through spatial-part$_2$ fills the interval place$_1$-place$_2$. At place$_k$ within the interval place$_1$-place$_2$, spatial-part$_k$ of 0 is at time$_k$ (≠ time$_1$).
Now description (3S) does constitute an exact
description of the fact that an object moves forth and
back in space. However, description (3T) is not the
appropriate temporal analogue, for some procedural
mistake has occurred in generating description (3T)
from description (3S). I shall show later precisely
what this mistake is. First, though, I want to examine
an analogy which is closely similar to the four-
dimension analogy.

What I shall refer to as the event analogy takes
description (3S) to be the correct description of the
fact that an object moves forth and back in space, but
the temporal analogue which it generates from this
description is quite different from the temporal
analogue of the four-dimension analogy. This difference
is due to an assumption which the event analogy makes,
but which the four-dimension analogy does not make,
about the construction of spatio-temporal analogies.
According to this assumption, when constructing a
spatio-temporal analogy one must replace in the descrip-
tion of the spatial fact all spatial terms by temporal
ones and all temporal terms by spatial ones.

As Taylor correctly remarks, "object" is a spatial
term and "event" is the temporal term corresponding to
it. Taking this into consideration, the event analogy
maintains that the following description is the appropri-
ate temporal analogue to description (3S):

(4T) Spatial-part\(_1\) of event E is at place\(_1\) at time\(_1\). Spatial-part\(_2\) of E is at
place\(_2\) at time\(_1\). The series of spatial-
parts of E from spatial-part\(_1\) through
spatial-part\(_2\) fills the interval place\(_1\)-
place\(_2\). At place\(_k\) within the interval
place\(_1\)-place\(_2\) spatial-part\(_k\) of E is at
time\(_k\) (\(\neq\) time\(_1\)).

Now it is plainly absurd to suppose that description
(4T) presents us with a description of the notion that an
object moves forth and back in time. Rather, what it
presents us with is, at best, a description of the notion
that an event moves forth and back in time. In short, it
does not give us what we want. Where the event analogy
goes wrong is in its assumption that in the construction
of a spatio-temporal analogy one must replace in the
description of the spatial fact all spatial terms by
temporal ones and all temporal terms by spatial ones.
Consider for a moment the following statement:

(S) An object moves forth and back in space.
One can derive seven different temporal analogues for this statement by distinguishing the following seven "replacement-versions" (only the underlined terms in a replacement-version are subject to replacement by the analogous spatial or temporal terms in the construction of a spatio-temporal analogy):

(a) An object moves forth and back in space.
(b) An object moves forth and back in space.
(c) An object moves forth and back in space.
(d) An object moves forth and back in space.
(e) An object moves forth and back in space.
(f) An object moves forth and back in space.
(g) An object moves forth and back in space.

Obviously the spatio-temporal analogy which we are attempting to construct is based on replacement-version (a), for we want to know what it is like for an object to move forth and back in time, rather than in space. But the event analogy is based on replacement-version (g). I conclude, then, that the event analogy fails to capture the notion we want. Its failure lies in the procedural mistake which it makes by virtue of using an incorrect replacement-version in deriving the temporal analogue.

Now I want to return to the four-dimension analogy in order to expose the procedural mistake which is involved in it. This mistake, like the one involved in the event analogy, is due to its using an incorrect replacement-version in deriving the temporal analogue. Exposing this mistake requires that we first examine two contrasting views concerning change and movement. I shall call these the temporalist and the spatio-temporalist views.

According to the temporalist view, the notion of change is an essentially temporal notion. Temporalists maintain that change can occur only over an extent of time. Nelson Goodman, for instance, says that "change is concomitant variation in time and some other respect. Since time is always one of the variant factors in change, we speak of change in whatever is the other variant factor in the given case." Let us say that the temporalist notion of change is the notion of temporal change. So, an object undergoes temporal change with respect to a property just in case its temporal parts differ with respect to that property.
On the other hand, according to the spatio-temporalist view, our notion of change is not an essentially temporal notion. Spatio-temporalists contend that besides the notion of temporal change there is also a notion of spatial change. Thus, Taylor says that "something, such as a wire, might be blue at one end and red at the other, and perhaps various other colors between these two places. This would accordingly be an example of spatial change."

An object undergoes spatial change with respect to a property, then, just in case its spatial parts differ with respect to that property.

Movement, of course, is a kind of change. To say that an object moves in a frame of reference (e.g. space or time) is just to say that it changes its position in that frame of reference. Using the two notions of change, we can distinguish two notions of moving forth and back: to say that an object moves temporally forth and back in a frame of reference is just to say that it undergoes temporal change forth and back in its position in that frame of reference; and to say that an object moves spatially forth and back in a frame of reference is just to say that it undergoes spatial change forth and back in its position in that frame of reference. Furthermore, since the frame of reference may be space or time, we can distinguish the following notions of moving forth and back:

1. An object moves temporally forth and back in space.
2. An object moves temporally forth and back in time.
3. An object moves spatially forth and back in space.
4. An object moves spatially forth and back in time.

Temporalists would maintain, of course, that notions (3) and (4) are not legitimate notions of moving forth and back since they presuppose the notion of spatial change. At any rate, it is not necessary for us to settle the dispute between the temporalists and the spatio-temporalists. Which view is the correct one does not have a direct bearing on which analogy is the appropriate spatio-temporal analogy. Yet this dispute does help us to see what the appropriate analogy is.

Recall that the sense of moving forth and back in space in which we are interested is expressed by notion
(1). Thus, when Jackson walks from home to the corner drugstore and then back home again, he is moving temporally forth and back in his position in space; that is, he is moving temporally from one spatial position to another and back to the first position. Now as remarked earlier, our spatio-temporal analogy should be based on this replacement-version:

(a) An object moves forth and back in space.

Or, more precisely, it should be based on the following replacement-version:

(a') An object moves temporally forth and back in space.

It follows from this that the temporal analogue which we generate should be a description of notion (2).

We are at last in a position to see what is wrong with the four-dimension analogy. Description (3T) of the four-dimension analogy is a description not of notion (2), but rather of notion (4). Description (3T) speaks of spatial-parts being at places, whereas the correct temporal analogue should instead speak of temporal-parts being at times. It must be concluded, therefore, that the four-dimension analogy does not capture the notion of moving forth and back in which we are interested.

What I shall call the time-travel analogy does capture this notion. This analogy is constituted by description (3S) and the following temporal analogue to it:

(5T) Temporal-part₁ of 0 is at time₁ at time₂. Temporal-part₂ of 0 is at time₁ at time₂. The series of temporal-parts of 0 from temporal-part₁ through temporal-part₂ fills the interval time₁-time₂. At timeₖ within the interval time₁-time₂ temporal-partₖ of 0 is at timeₖ (≠ time₁).

At this point, assuming that only one temporal frame of reference is being referred to in description (5T), it is tempting to conclude the notion of moving forth and back in time is in part contradictory and in part meaningless. To see why this is so, consider the following example to which description (5T) applies. Let us distinguish three of Anderson's temporal-parts: his 1976-temporal-part endures only throughout 1976, his 1977-temporal-part endures only throughout 1977,

Now what is so troublesome about this case is that Anderson's 1978-temporal-part is in 1976 in 1978. Given the way in which we defined Anderson's 1978-temporal-part, it is contradictory to say that his 1978-temporal-part is in 1976. And it is meaningless to say that something is in 1976 in 1978. Indeed, if all of the times mentioned in description (5T) refer to the same temporal frame of reference, then it must be concluded that the notion of moving forth and back in time is in part contradictory and in part meaningless.

But we need not assume that all of the times mentioned in description (5T) refer to the same temporal frame of reference. In fact, since description (5T) portrays the notion of an object moving temporally forth and back in time, it is quite natural to assume that two temporal frames of reference are involved: an objective frame of reference, to which the italicized temporal expressions in description (5T) refer, constituted by the time-lines of those objects which, so to speak, move equably forth through time; and a proper frame of reference, to which those temporal expressions not italicized in description (5T) refer, constituted by the time-lines of the object 0_12

When description (5T) is construed in this way, as referring to an objective and a proper frame of reference, the notion of moving forth and back in time no longer seems either contradictory or meaningless. To see this, consider the following example to which description (5T), as now construed, applies. Let us distinguish three of Thompson's temporal-parts: his thirtieth-temporal-part endures only throughout the thirtieth year of his life; his thirty-first-temporal-part endures only throughout the thirty-first year of his life; and his thirty-second-temporal-part endures only throughout the thirty-second year of his life. We can assume that description (5T) applies to Thompson in this manner: his thirtieth-temporal-part is wholly within 1976 in the thirtieth year of his life; his thirty-second-temporal-part is wholly within 1976 in the thirty-second year of his life; the series of his temporal-parts from his thirtieth-temporal-part through his thirty-second-temporal-part
fills the interval between the thirtieth and thirty-second years of his life; in the thirty-first year of his life, within the interval between his thirtieth and his thirty-second years, Thompson's thirty-first-temporal-part is wholly within 1977 (#1976).

What is disturbing about this case is that each of two separate temporal parts of Thompson supposedly occupy the whole of 1976, and if this were the case some disturbing things conceivably might happen—for instance, the older Thompson conceivably might kill the younger Thompson. At any rate, however disturbing it may be to assert that each of two different temporal-parts of an object occupy the whole of one and the same time, clearly it is neither contradictory nor meaningless. Naturally it would be contradictory to assert that Thompson's thirtieth-temporal-part occupies the whole of 1976 wholly within one place and that his same temporal-part occupies the whole of 1976 wholly within a separate place; and it would be meaningless to assert that Thompson's thirtieth-temporal-part is in 1976 in 1977. But these kinds of situations are not envisioned in this example, and they do not fall under description (5T) as it is now construed.

I conclude, then, that description (5T), as construed with two temporal frames of reference, correctly describes the notion of moving forth and back in time, and that it is logically possible for objects to move forth and back in time. It is an incontestable fact, of course, that objects do not move forth and back in time, for we simply never observe objects behaving in such a way that description (5T) can properly be applied to them.
The notion of moving forth and back should be understood not as the notion of moving forward and then backward, but rather as the notion of moving from one position to another and then back again. So, if Wilson were to back away from a lion, pick up his gun, and then move forward to where he first stood, this would count as moving forth and back in space.


See Metaphysics, p. 76.

Ibid.

Ibid.

J. J. C. Smart makes this point in his article "Spatializing Time," Mind, LXIV (1955), pp. 239-41; this is reprinted in Richard M. Gale, ed., The Philosophy of Time (Garden City, N.Y.: Doubleday, 1967), pp. 163-67. Smart writes: "What we must be careful to avoid, however, is mixing our terminologies, and talking of enduring, changing, and not changing, in the context of our four-dimensional representation" (p. 165).

Taylor does not explicitly endorse this assumption, but it seems that he is implicitly committed to it. For a discussion of this, see J. W. Meiland, "Temporal Parts and Spatio-Temporal Analogies," American Philosophical Quarterly, 3 (1966), p. 66.

After mentioning this distinction between "object" and "event," Taylor sloughs over it, saying, "no such distinction is necessary and none will be made here" ("Spatial and Temporal Analogies," p. 381). So, for Taylor even events are "objects." Interestingly enough,
the examples which he gives of "objects" which move forth and back in time are events, whereas the examples which he gives of "objects" which move forth and back in space are what we ordinarily call objects. At any rate, I am concerned with the notion of an object (which is not an event) moving forth and back.

9 Later it shall become evident that the event analogy is based on replacement-version (g) rather than replacement-version (e).


11 Metaphysics, p. 78.


13 Paul Horwich provides a convincing rebuttal of some standard arguments against time-travel (and hence against the notion of moving forth and back in time) in his paper "On Some Alleged Paradoxes of Time Travel," The Journal of Philosophy, LXXII (1975), pp. 432-44.

14 I have defended the view that objects move forth through time in a paper entitled "The Passage of Time," in Richard Taylor, ed., Readings in Metaphysics, forthcoming.