The logical possibility of time travel.

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THE LOGICAL POSSIBILITY OF TIME TRAVEL

2 VOLUMES (VOLUME 2)

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VOLUME CONTAINS CLEAR OVERLAYS

OVERLAYS SCANNED SEPERATELY AND OVER THE RELEVANT PAGE.

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Chapter 6

Conclusions

This thesis has covered a great many topics in order that it might qualify as a thorough analysis of the popular system of time travel. It would therefore be of use to briefly summarise the nature of each subject's contribution to this conclusion.

The introduction of the personal/external time frame distinction was necessary both to resolve the most immediate and obvious contradiction attributed to time travel, and to ensure that information regarding future origins could be preserved during a journey into the past. A system of identity was then specified that could accommodate for the peculiar circumstances of a time traveller entering his own causal past, enabling him to exist before his birth relative to the external time frame, and to communicate with himself should the need arise (a common feature of science fiction novels concerned with time travel). The problems of freewill and determinism introduced two distinctions that have been built on in the chapter on causality: one between the number of occurrences of a given particular event (i.e. one) and the number of experiences possible of that event using a time machine (as many as will fit into a lifetime); the other between a necessary condition and a sufficient condition for determining causal relations. It was shown that time travel need not be incommensurate with freedom of will, but a certain intuitive discomfort led to the

consideration of possible worlds. The nature of causal relations between a traveller interfering in the past, and an earlier person-stage existing in the external future relative to that event, were examined, and it was shown that the logical possibility of time travel depended on a breakdown of the causal chain generated by his initial arrival in the past: if the traveller can exist in the past without any causal consequences propagating to an earlier person stage lying in the future, time travel as defined is possible; if, on the other hand, it is a matter of fact that one cannot transmit information, in any form, into the past within one possible world without the generation of closed causal chains, then time travel cannot occur. This is because it will engender a logical contradiction in which any given event will occur once relative to the external time frame but an infinite number of times relative to the personal time frame in the same external space-time position.

Time travel within one world revealed a need for a 'higher' time dimension in order to accommodate for sequences of events whose origins lie in the future. It was indicated that possible worlds might also require additional time frames (with the potential for infinite regress), and associated with this was the question of proving that time travel itself -- and not just inter-world travel -- had occurred. A further consequence was the high improbability of a time traveller ever reappearing in his world of origin

at any moment after his departure (external time), and the concomitant problems of proving time travel, or even inter-world travel, as opposed to the mere destruction of the traveller under such circumstances. Finally, an examination of relative time travel within one possible world proved to be restricted by the same logical and probabilistic constraints as had been previously encountered. From these results it was concluded that the popular system of time travel is at best highly improbable and, depending on the nature of causal relations, logically impossible, while the introduction of a system of possible worlds to resolve these problems requires the assumption of ever more dubious qualifications that must be resolved before such a 'solution' may be considered practical.

In the course of this thesis, however, considerably more has been achieved than the bare answer to the question posed in the Introduction. Through the manipulation of the temporal direction experienced by a hypothetical character there has been revealed the fundamental importance of an asymmetrical 'arrow of time' to our perception of our own identity, our assumptions about the nature of freedom, and our understanding of causal relations. While our inability to move through time leads us to refrain from including references to our experience of it in our conversation and thought, the fact of our experience has a powerful but subtle effect on our theorising.

A great deal has also been revealed regarding the

subconscious assumptions of those who would claim time travel into the past is possible. 'Realism' about time is essential, as is the assumption of 'higher dimensions' as dictated by the requirements of the 'Myth of Passage'. This last image must be finally laid to rest if further investigation into the nature of time is to make any progress, but its pervasive influence (witness Gödel's error) makes such a task considerably more complex than might be imagined.

The importance (and not just the fact) of those distinctions made between experience and occurrence, and between necessary and sufficient conditions for both freewill and causal relations has been highlighted. Once again, this study has indicated the propensity to assume, rather than to test, the effect of time on our understanding. It has often been suggested that time travel would be possible if freewill were abandoned, but using these distinctions it has been shown that there is no need to abandon freewill, and that whether or not it is preserved has no effect on the logical contradictions arising from the generation of closed causal chains. Human choice cannot affect whether or not a time traveller accidently crushes a plant or insect whose existence is vital to the subsequent structure of the world, nor can it hinder the absorption of light or the respiratory processes, both of which are necessary features of human existence, regardless of the individual's temporal location (breathing apparatus might be

used, but if its presence were anachronistic it might create more problems than it solved).

David Lewis's claim that possible worlds must lack spatio-temporal relations gained some measure of support from the difficulties encountered in attempting to relate different possible worlds in time and space, but generally the concept of possible worlds fared poorly. This study has helped to bring out the complexity of any attempt to analyse concepts with which we can have no direct or indirect contact -- the difficulties of providing a logical structure becoming ever more complex as *ad hoc* solutions were provided to the obstacles that arose.

As to the matter of further study, the nature of time, and its effect upon our thinking processes, is such that its examination cannot be exhausted in a thesis of this size. What has been provided within these pages is an examination of the problems associated with one specific aspect of time, with a view to resolving one question. Further investigation into the interaction of time and metaphysical issues, and the importance of an asymmetrical arrow of time to human perceptions, will continue, but of all the concepts studied here, it is the nature of causal relations that have revealed themselves most in need of further investigation. Such a study may also help to reveal the relationship between time and causality, and the nature of time itself.

This thesis has shown that time has effects incommensurate with claims that it is merely a concept

imposed by human beings, with no real substance or existence: reverse causation, and any other process except time, and while the world may appear strange to us -- violating all previously accepted probabilistic norms -- it will not lead to contradictions; reverse time and every other process, such that a person or object only ever reveals information appropriate to his or its temporal position, and ceases to exist when it should become necessary, and, once again, no contradictions will be generated; but reverse our passage through time while preserving information regarding our temporal origins, by keeping the causal passage positively ordered with respect to the person travelling, and very real problems develop. Time and the temporal order are neither unreal nor arbitrary, but their true nature remains to be determined.

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DIAGRAMS

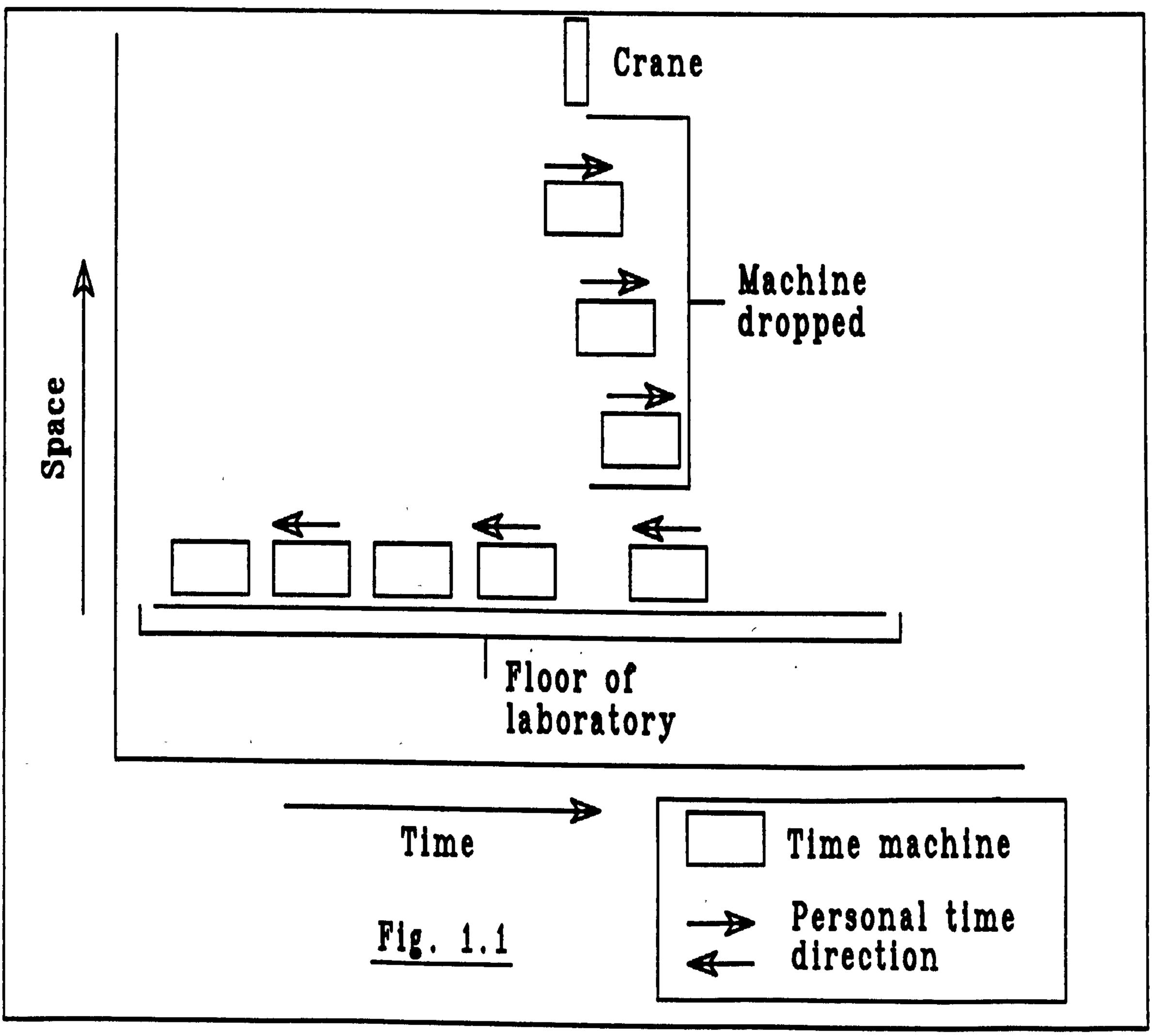

Crane
Machine dropped
Space
Floor of laboratory
Time
Time machine
Personal time direction

Fig. 1.1

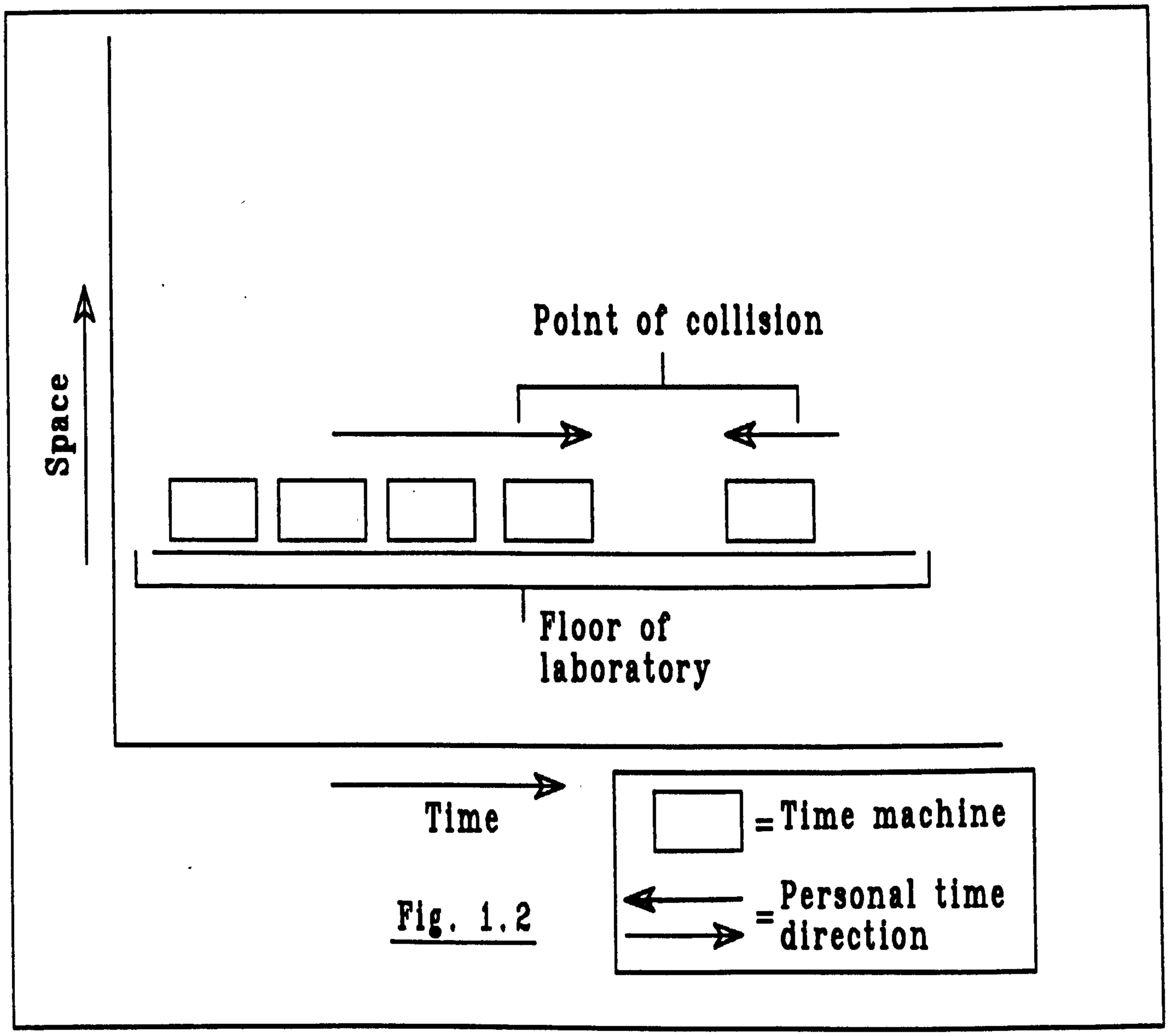

Space
Point of collision
Floor of
laboratory
Time
= Time machine
= Personal time
direction

Fig. 1.2

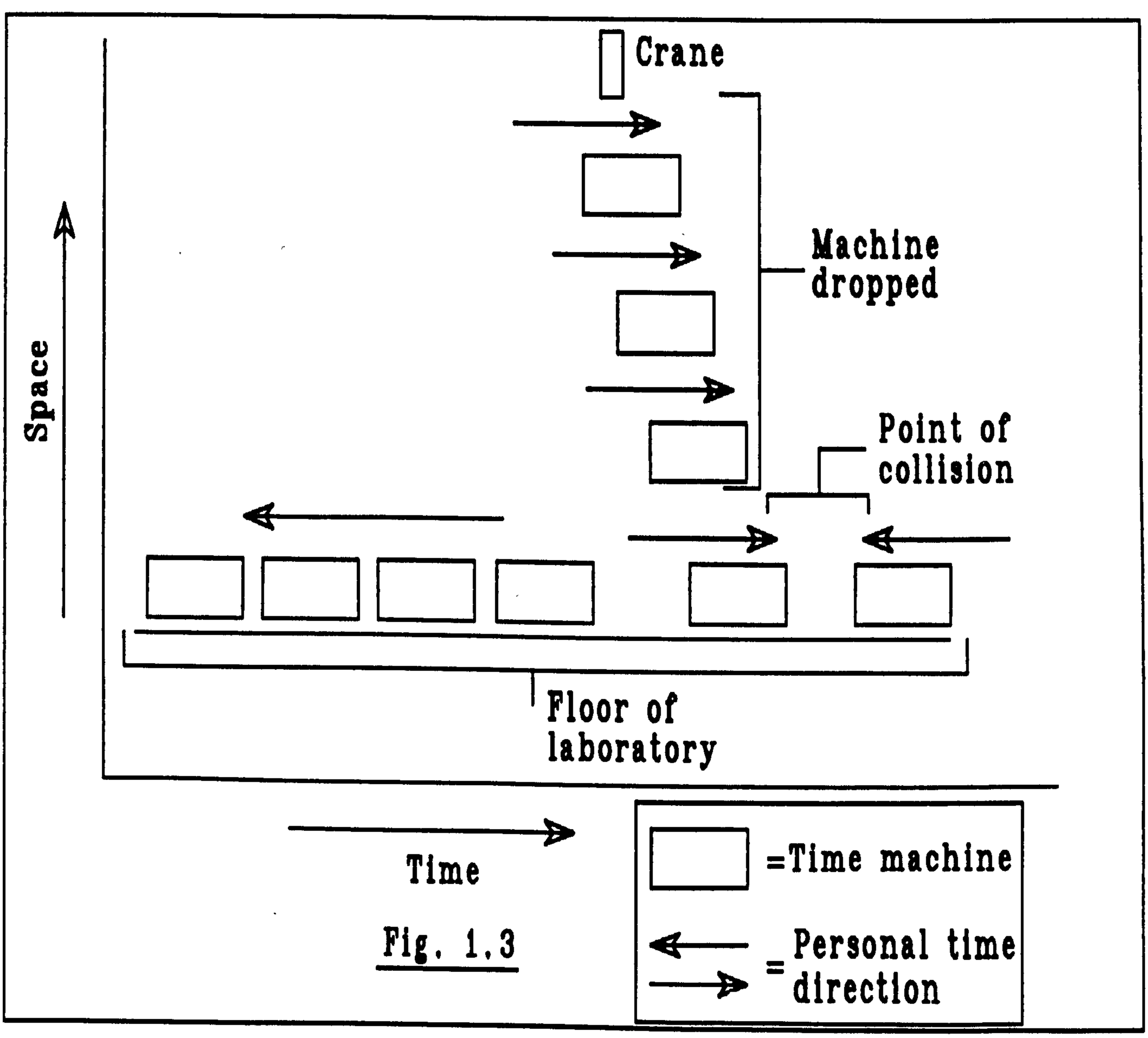
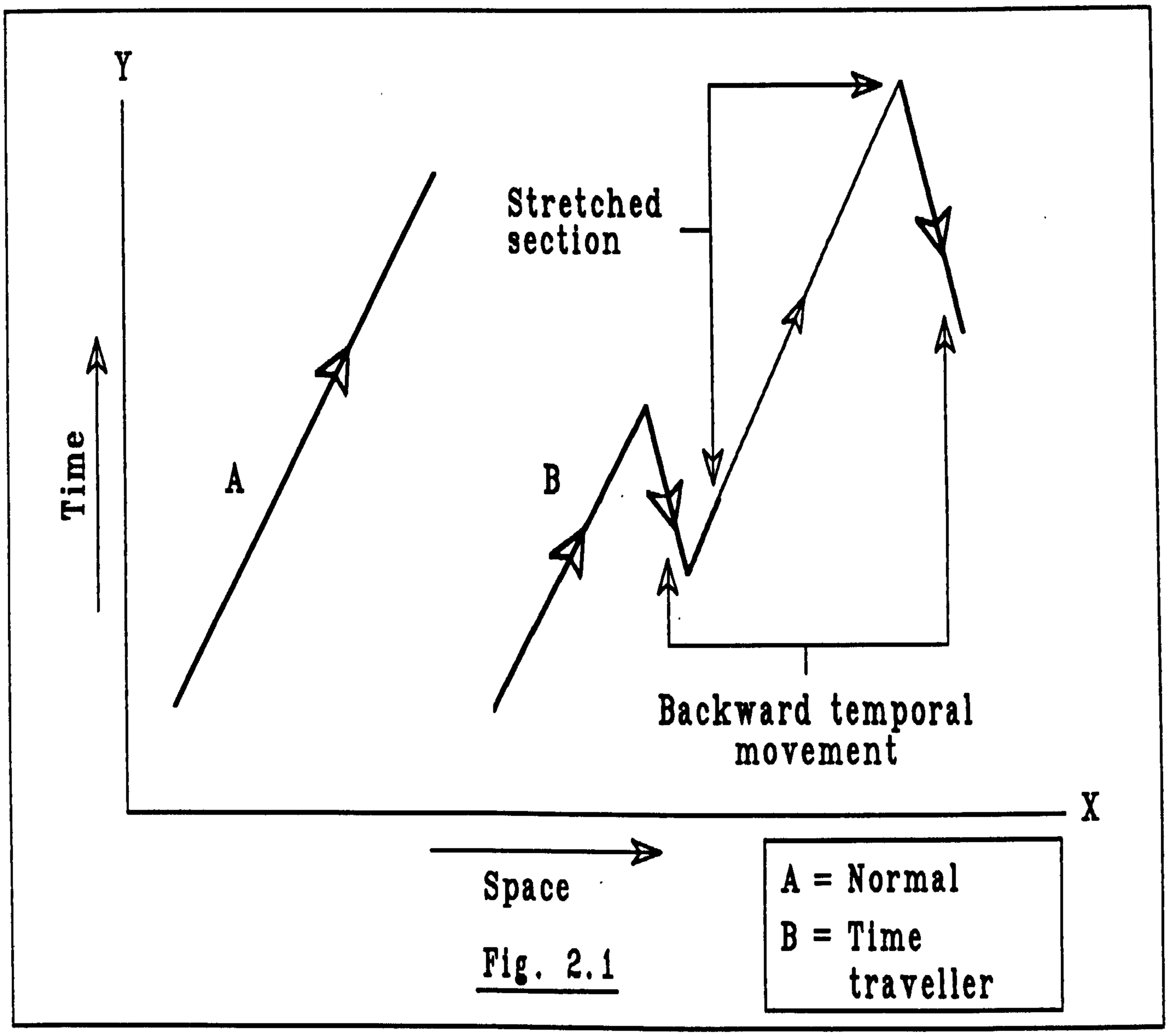

Crane
Machine dropped
Point of collision
Space
Floor of laboratory
Time
=Time machine
= Personal time direction

Fig. 1.3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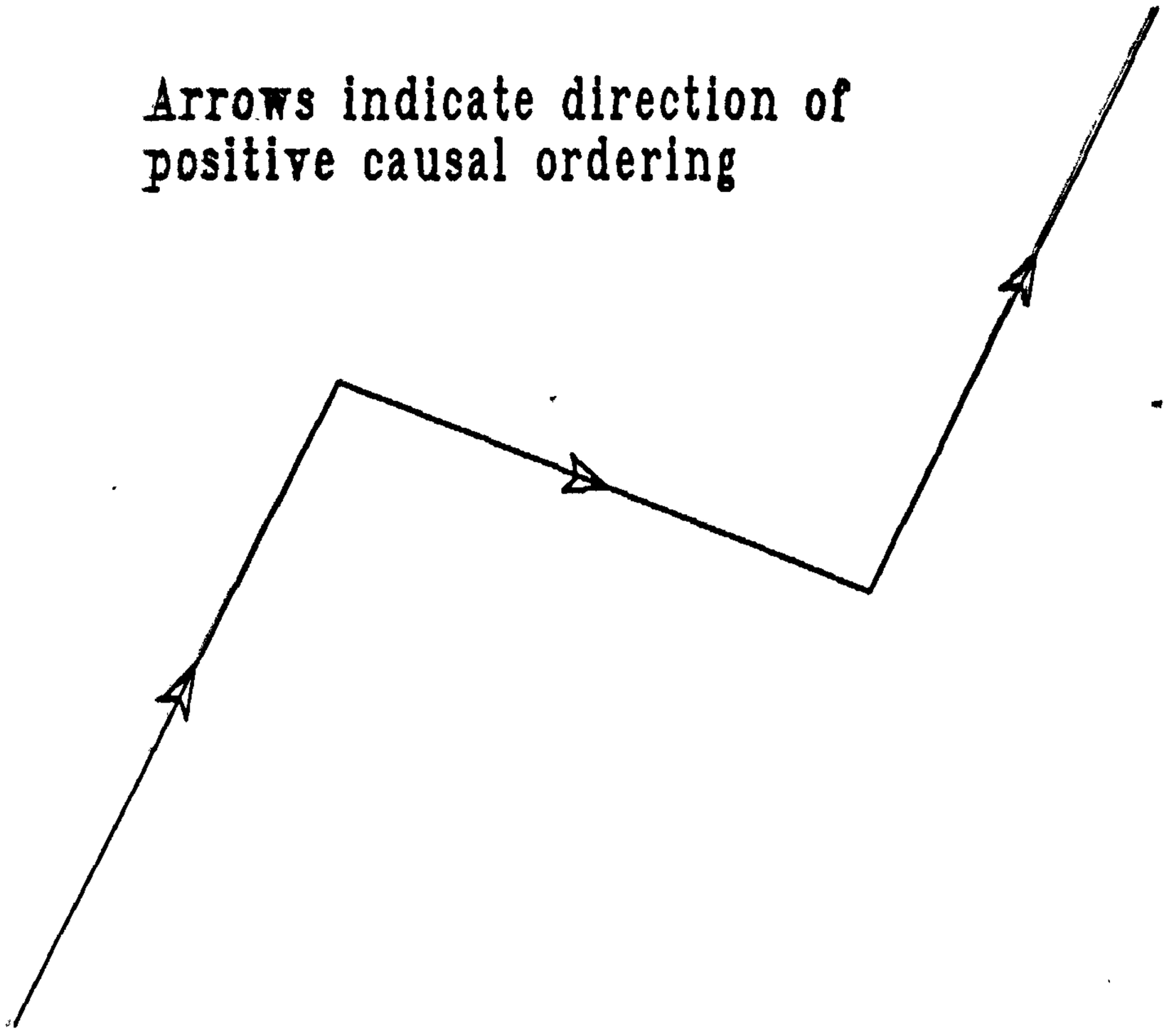
A
B
Stretched section
Backward temporal movement
X
Space
A = Normal
B = Time traveller

Fig. 2.1

Arrows indicate direction of positive causal ordering



&
Personal
time

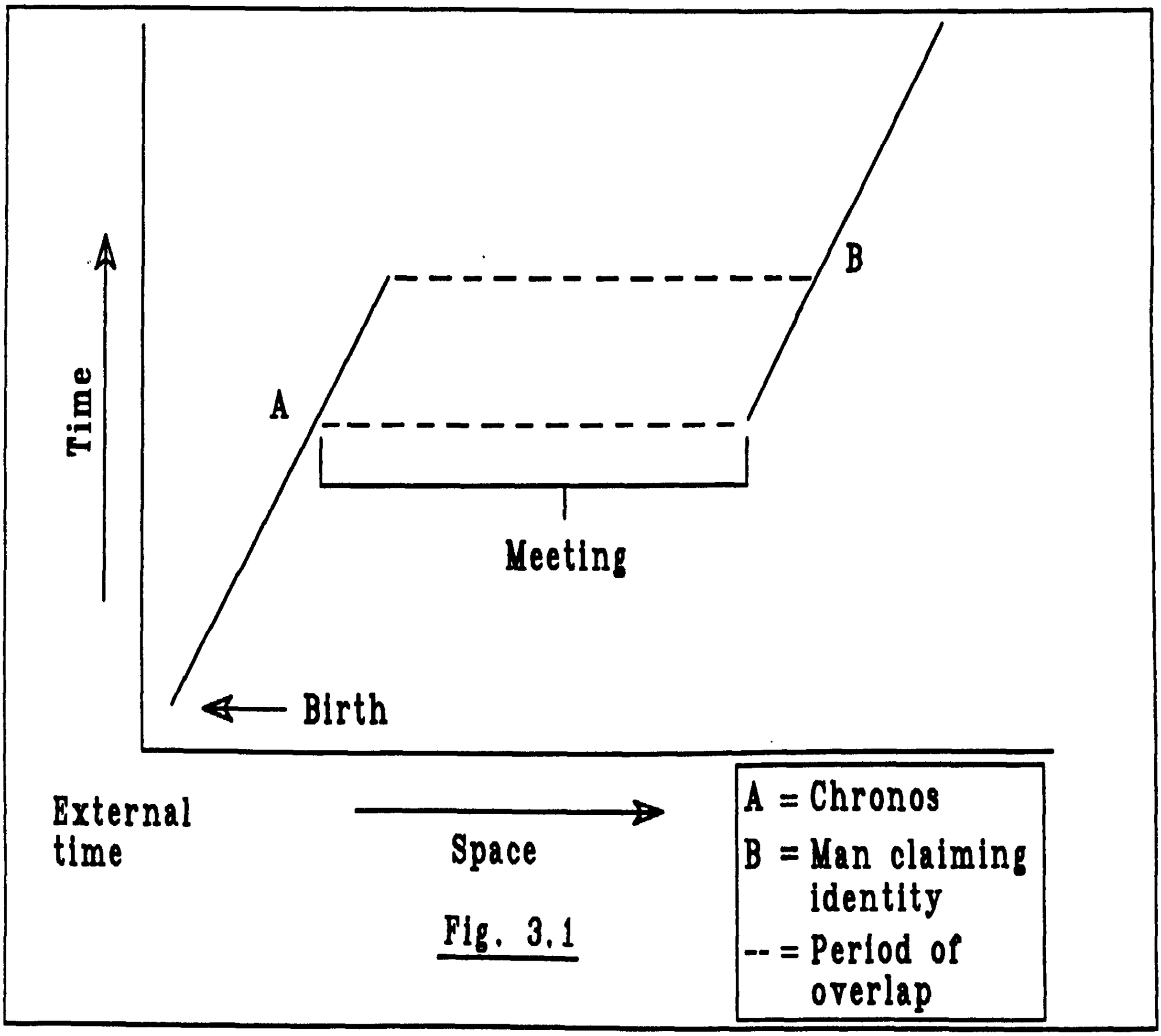

Time
A
B
Meeting
Birth
External time
Space
A = Chronos
B = Man claiming identity
-- = Period of overlap

Fig. 3.1

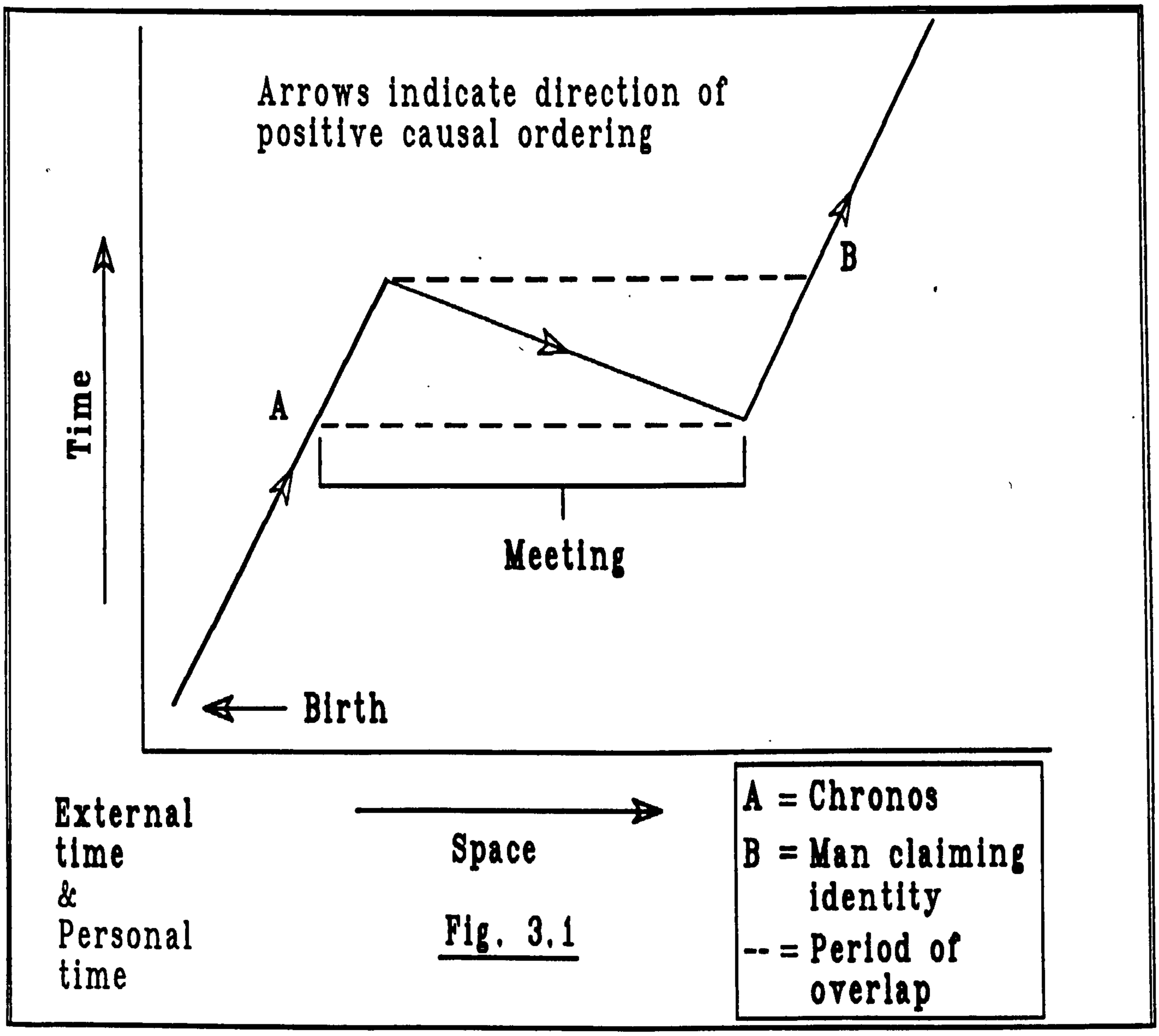
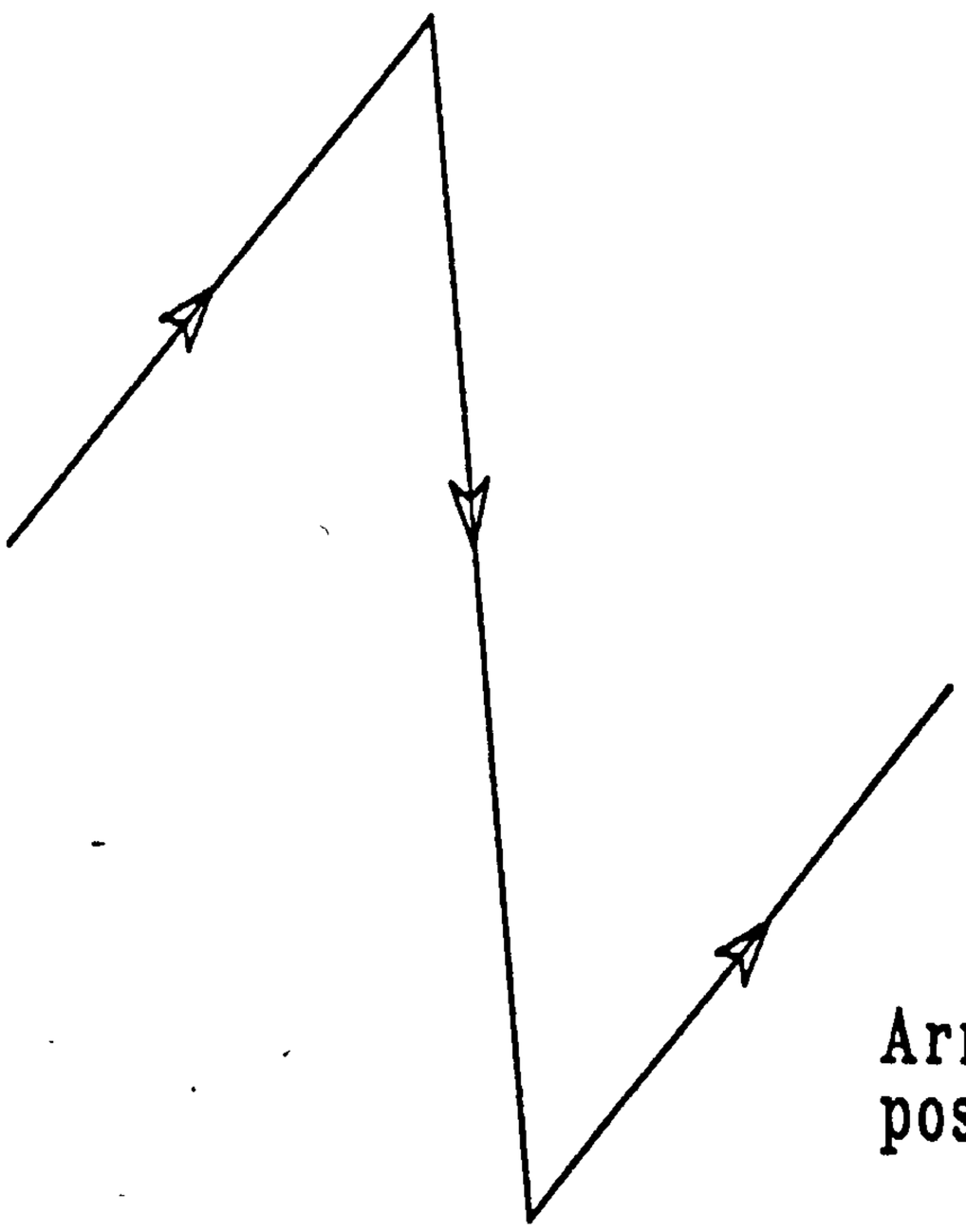

Arrows indicate direction of positive causal ordering
Time
A
B
Meeting
Birth
External time & Personal time
Space
A = Chronos
B = Man claiming identity
-- = Period of overlap

Fig. 3.1



Arrows indicate direction of positive causal ordering

&
Personal
time

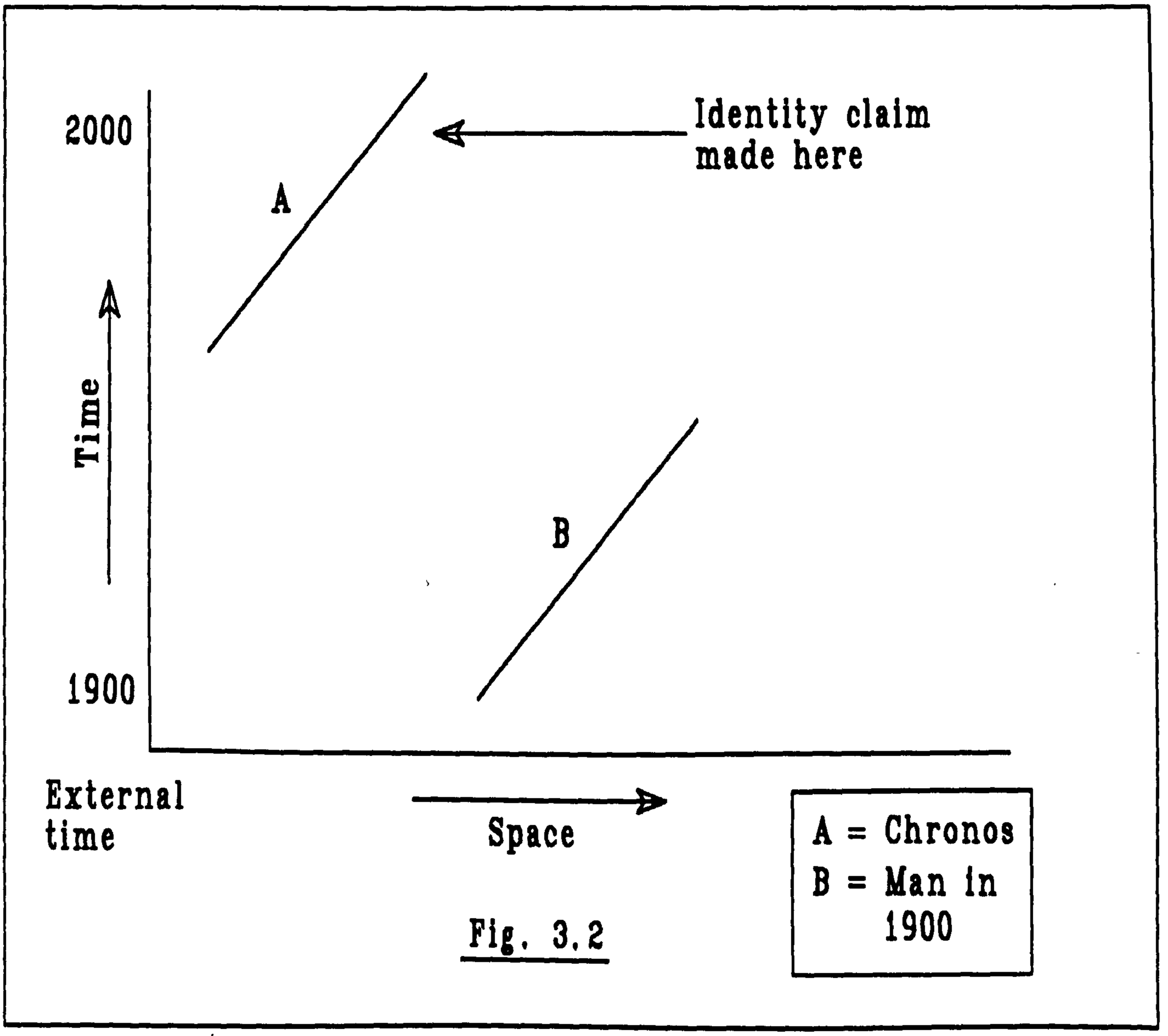
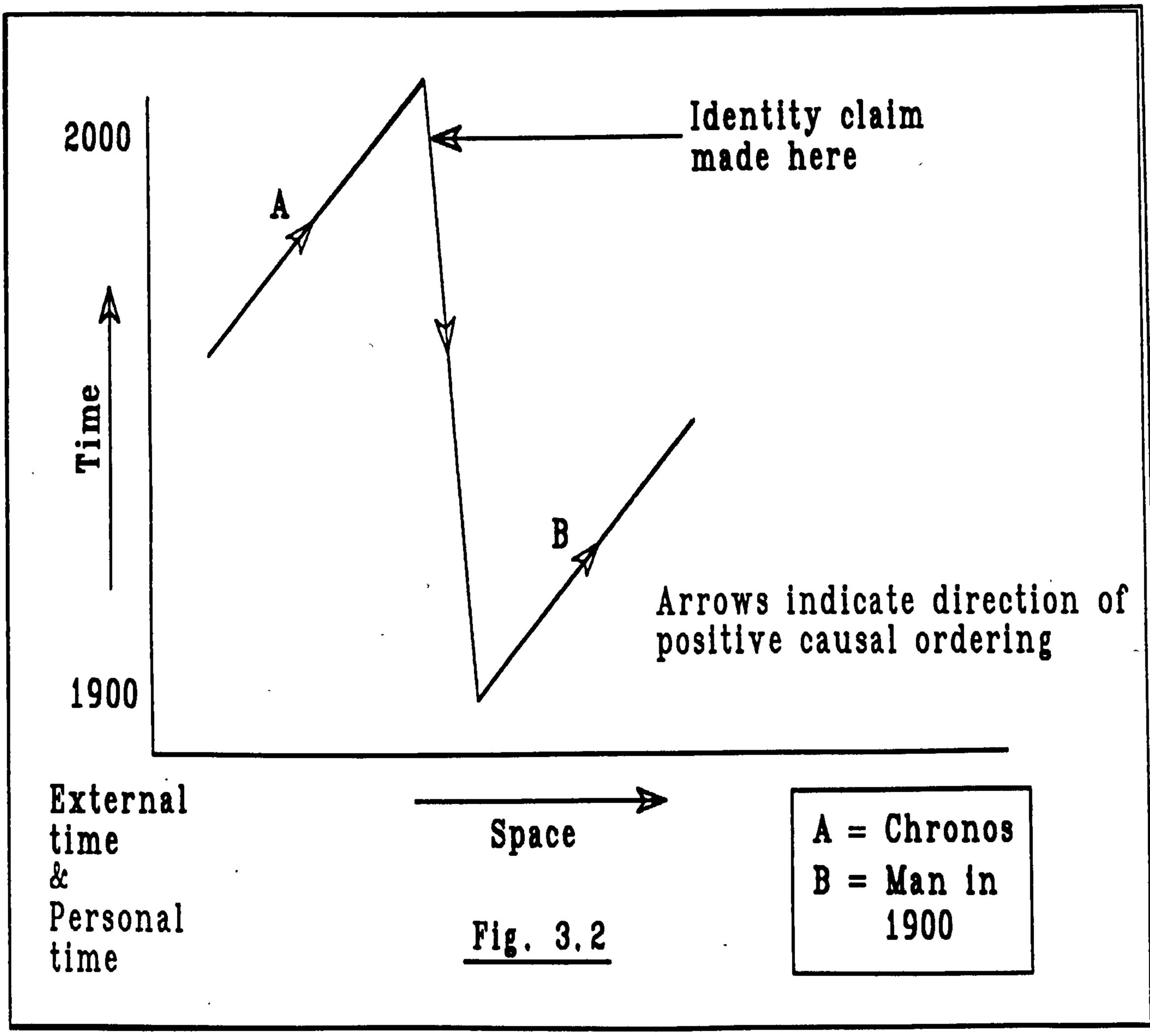

2000
1900
Time
A
B
Identity claim made here
External time
Space
A = Chronos
B = Man in 1900

Fig. 3.2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1900
Time
A
B
Identity claim made here
Arrows indicate direction of positive causal ordering
External time & Personal time
Space
A = Chronos
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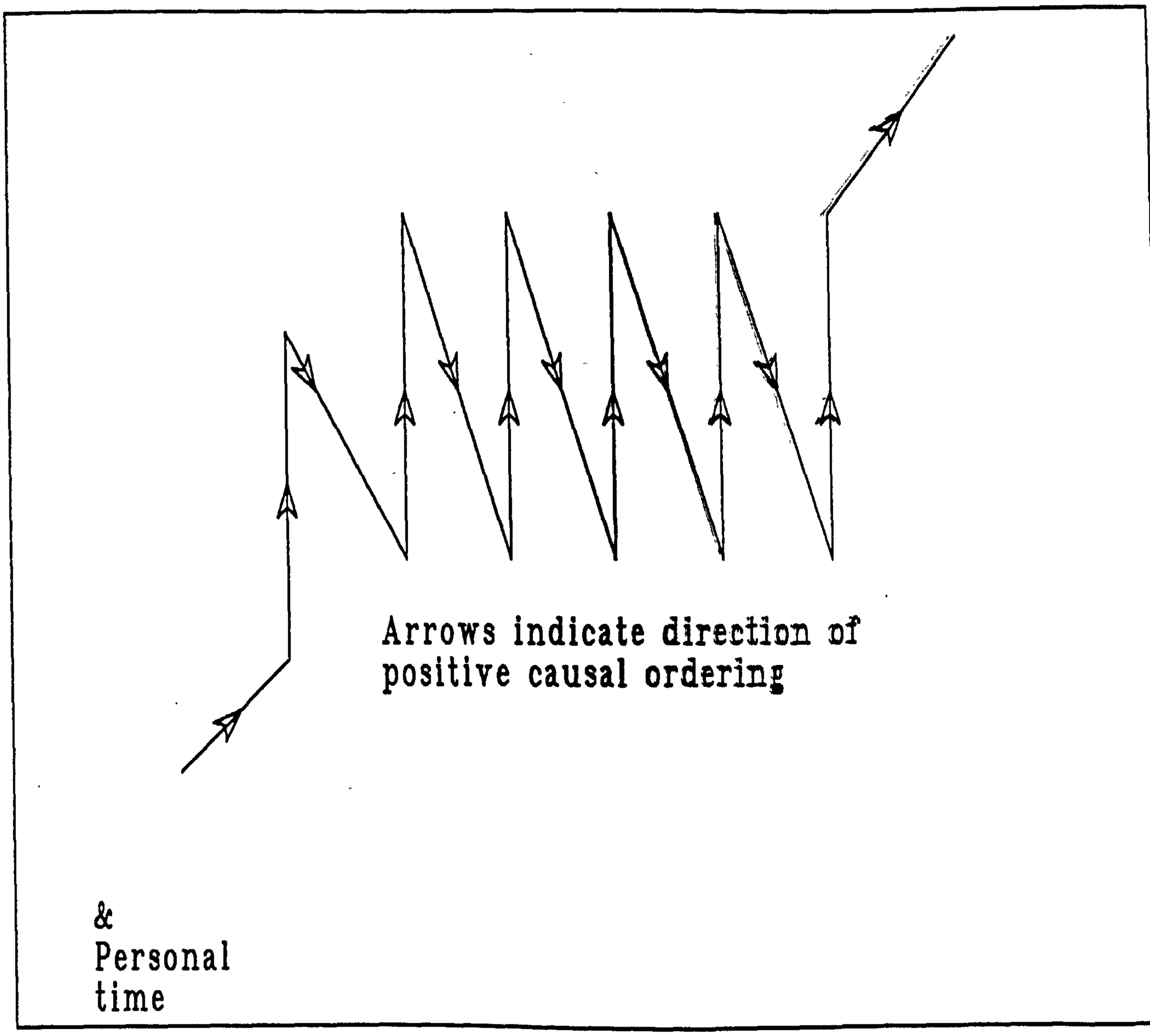
Fig. 3.2



&
Personal
time

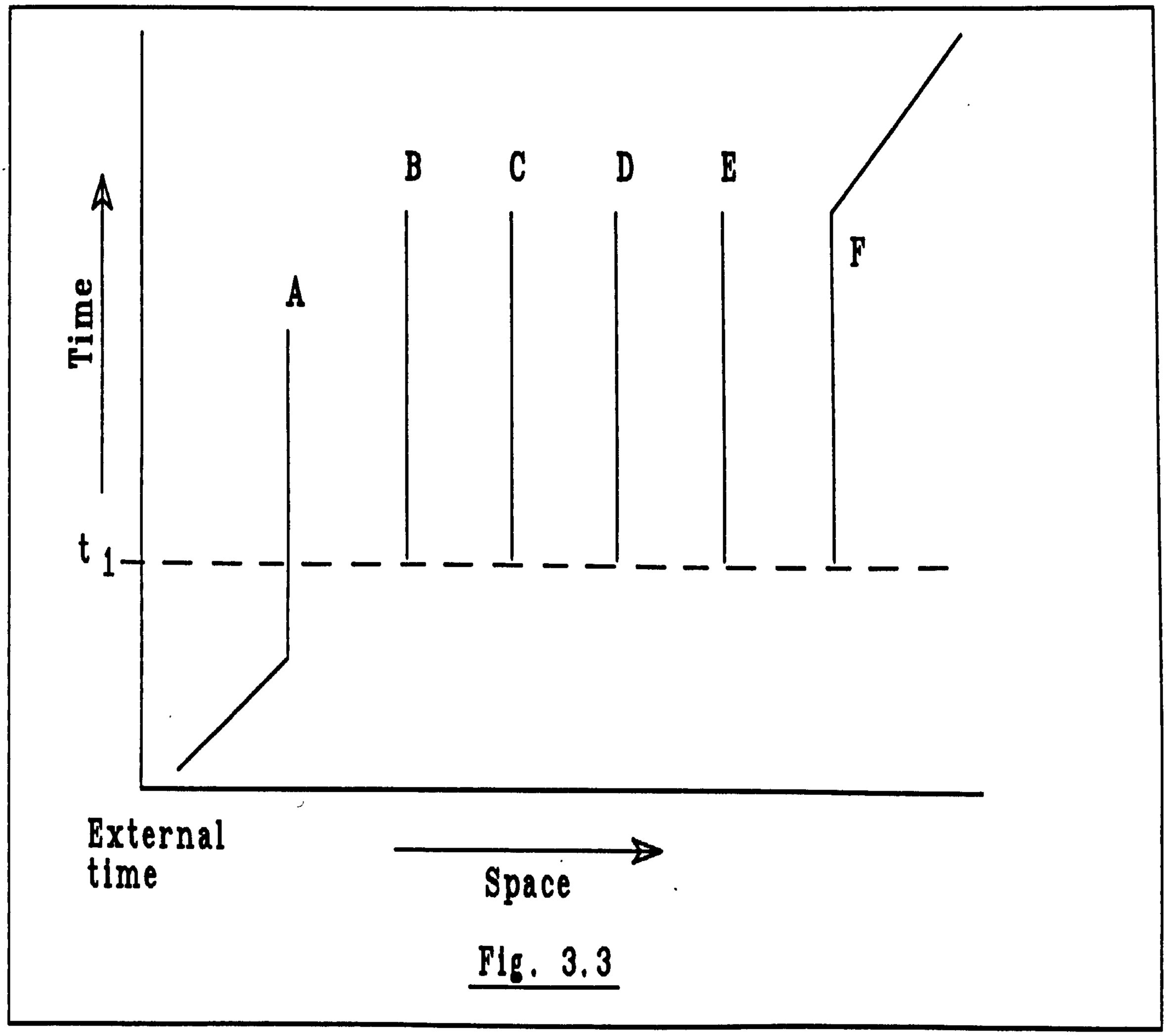


Fig. 3.3

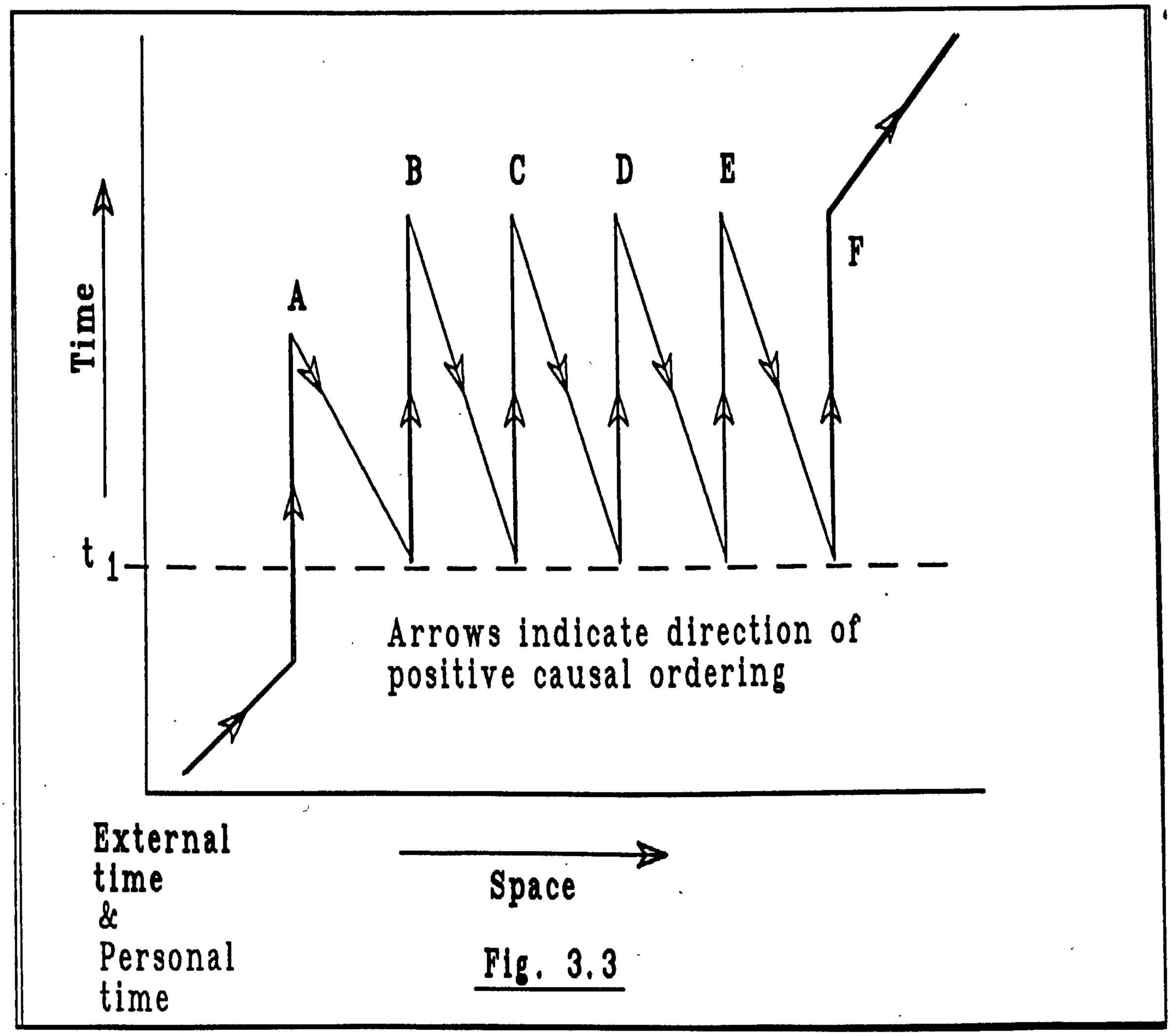
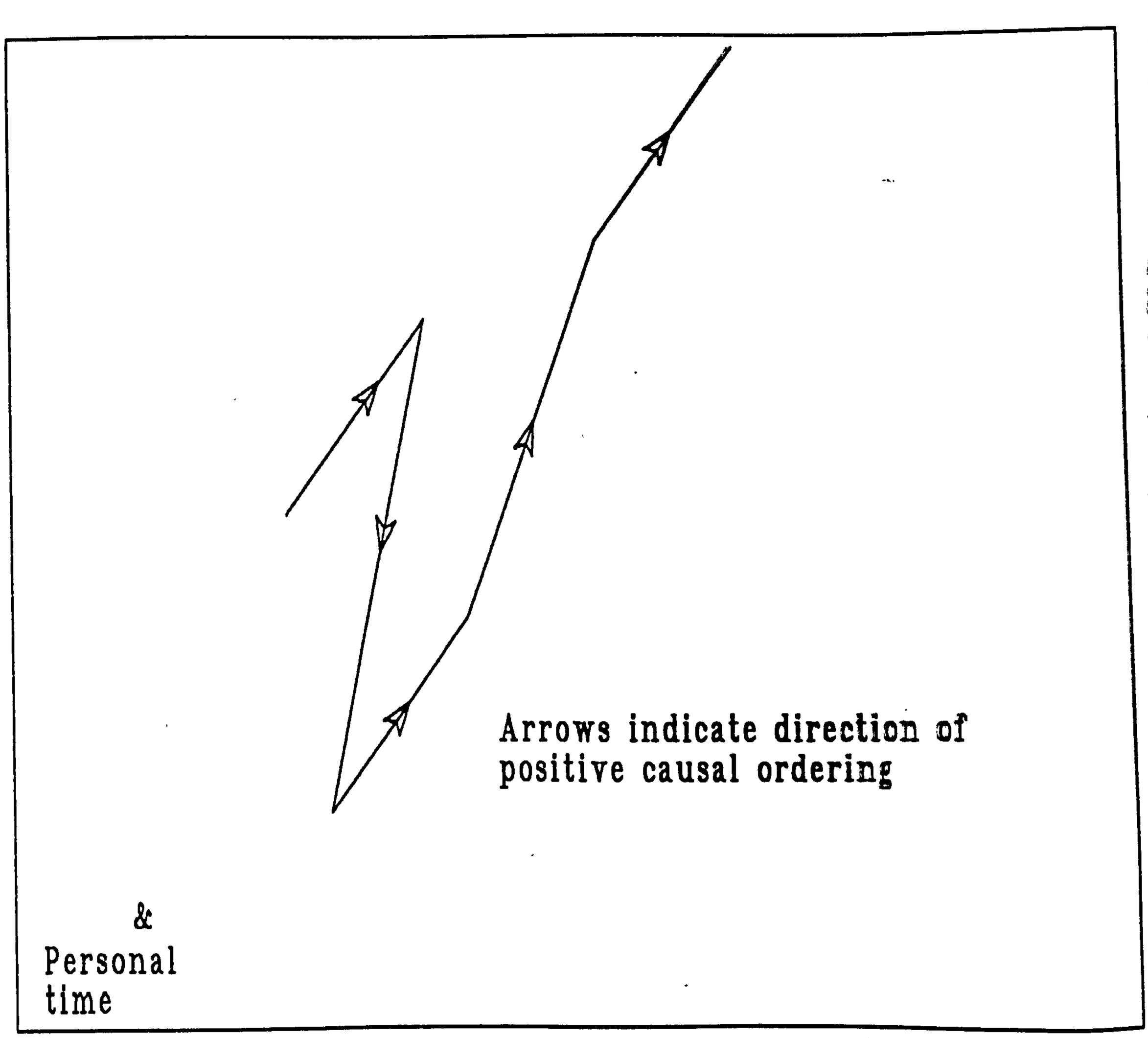

Time
A
B
C
D
E
F
t_1
Arrows indicate direction of positive causal ordering
External time & Personal time
Space

Fig. 3.3



&
Personal
time

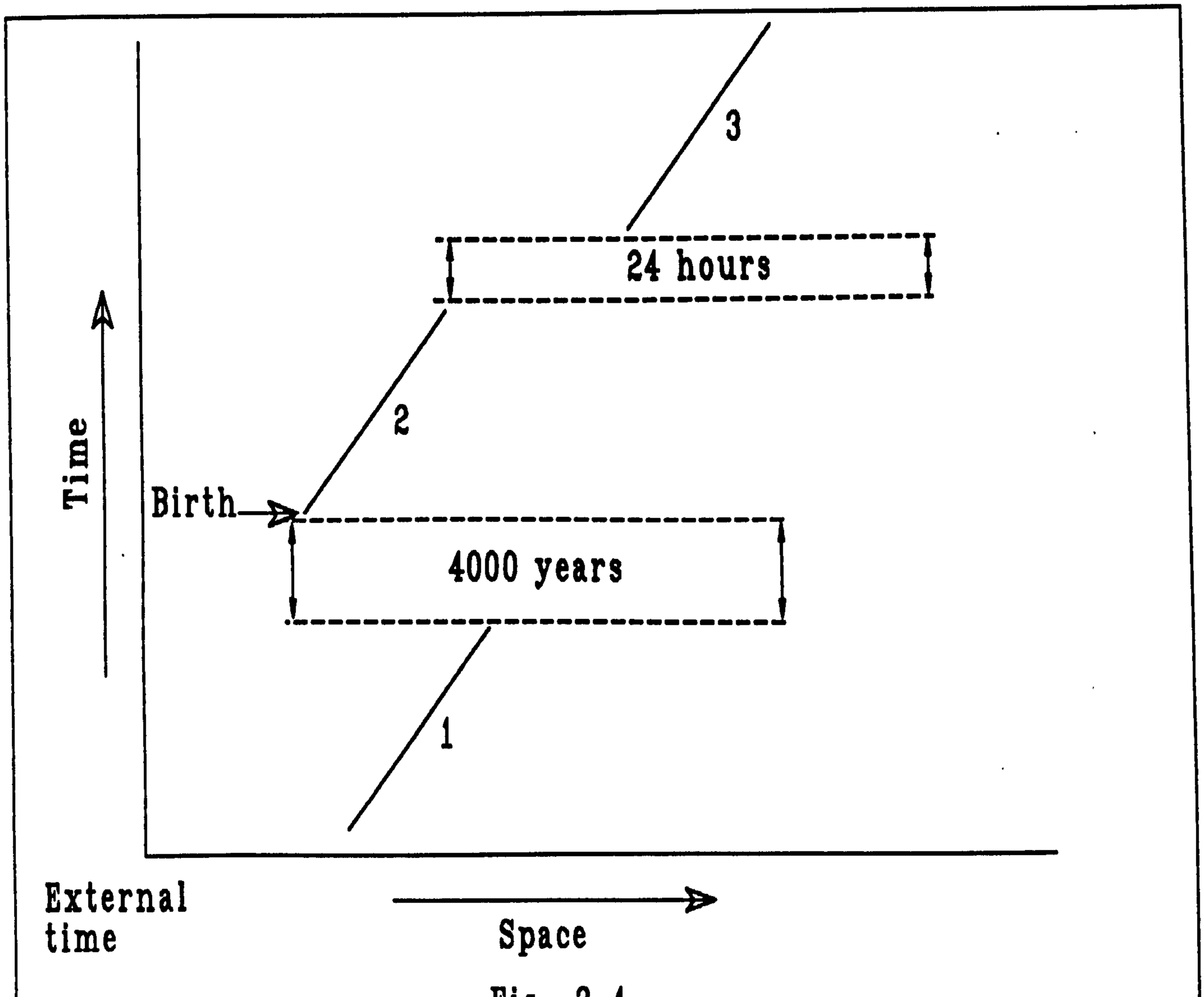


Fig. 3.4

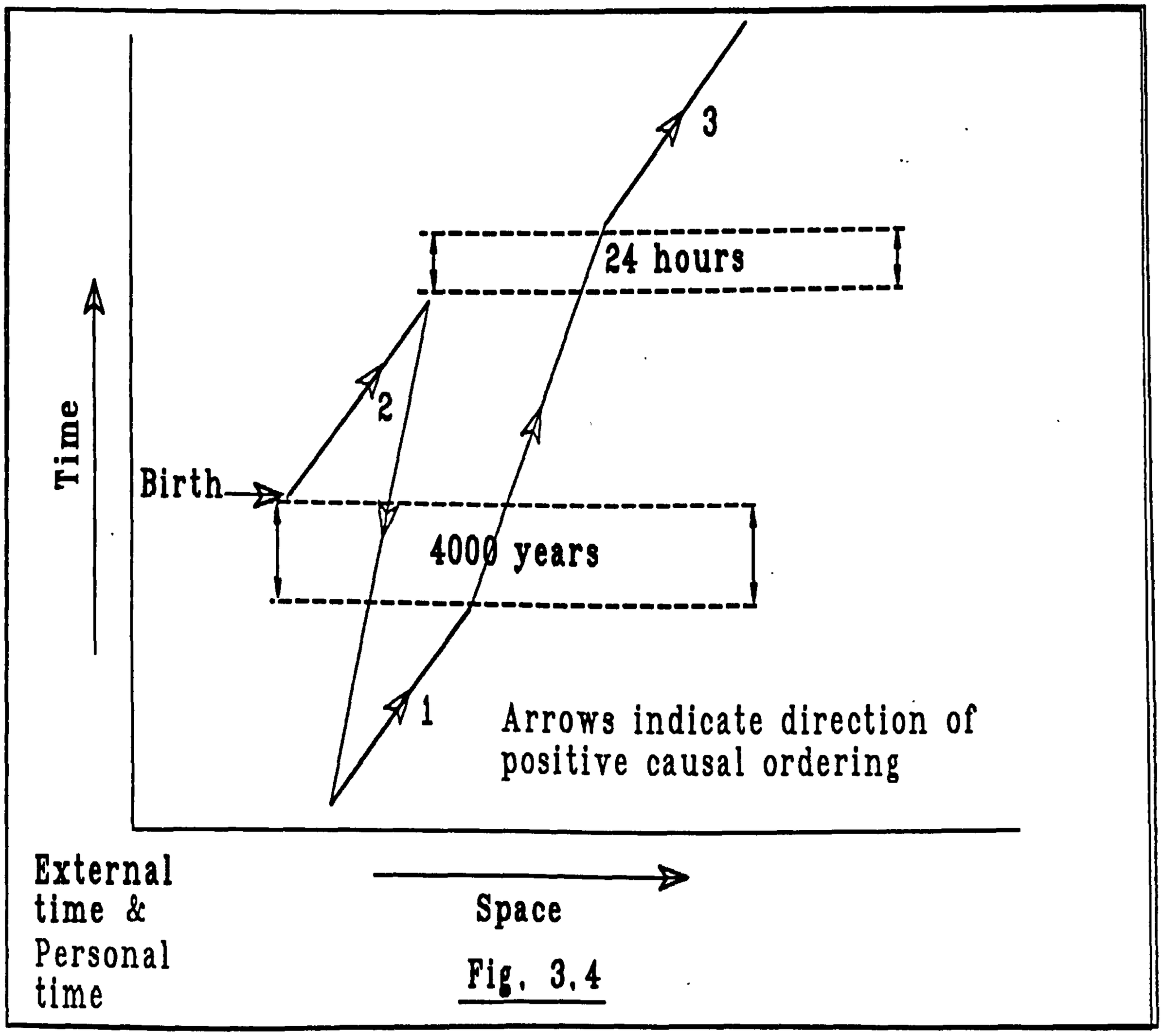

Time
Birth
24 hours
4000 years
1
2
3
Arrows indicate direction of positive causal ordering
External time & Personal time
Space

Fig. 3.4

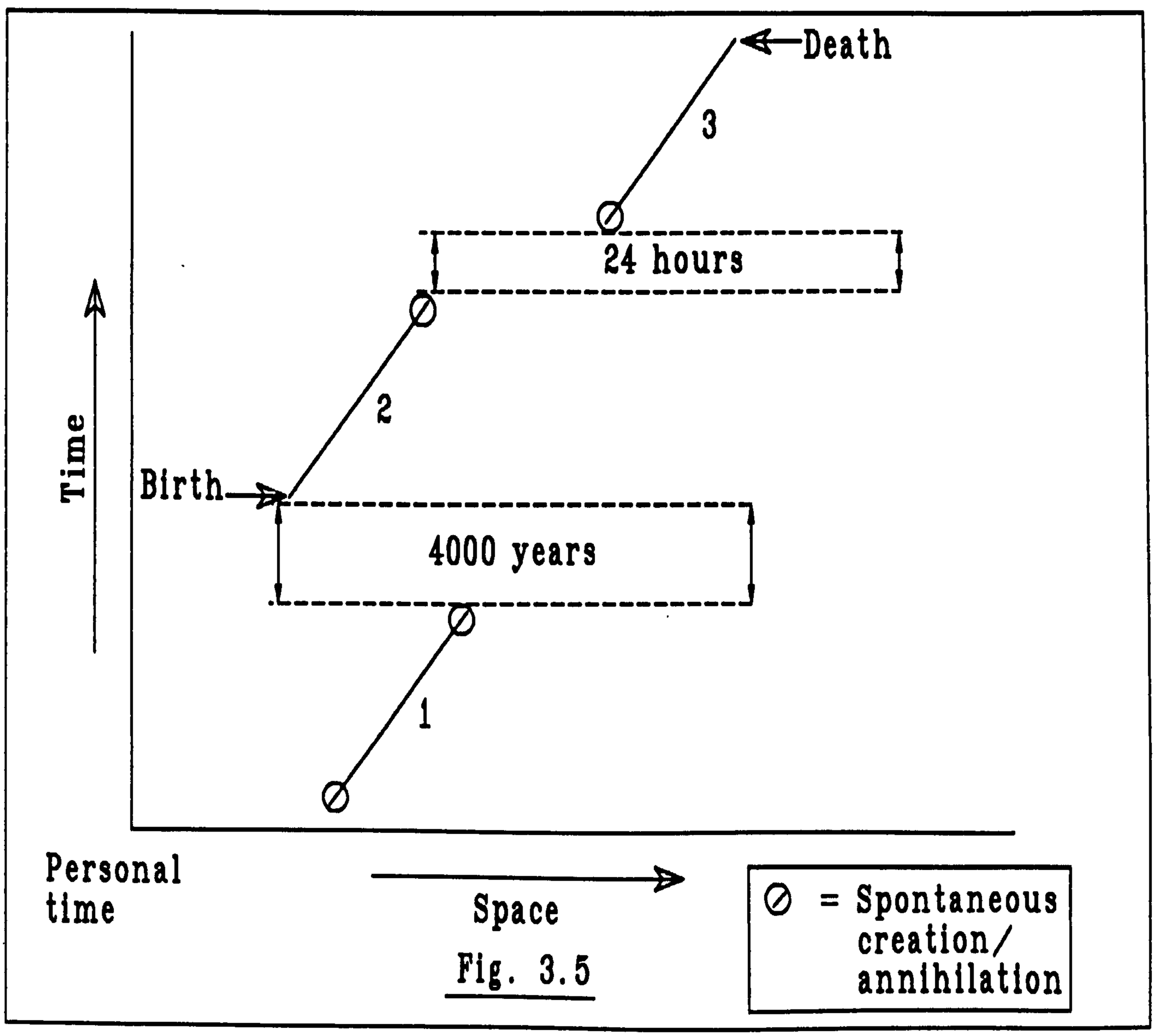

Death
3
24 hours
2
Birth
4000 years
1
Time
Personal time
Space
⊘ = Spontaneous creation/ annihilation

Fig. 3.5

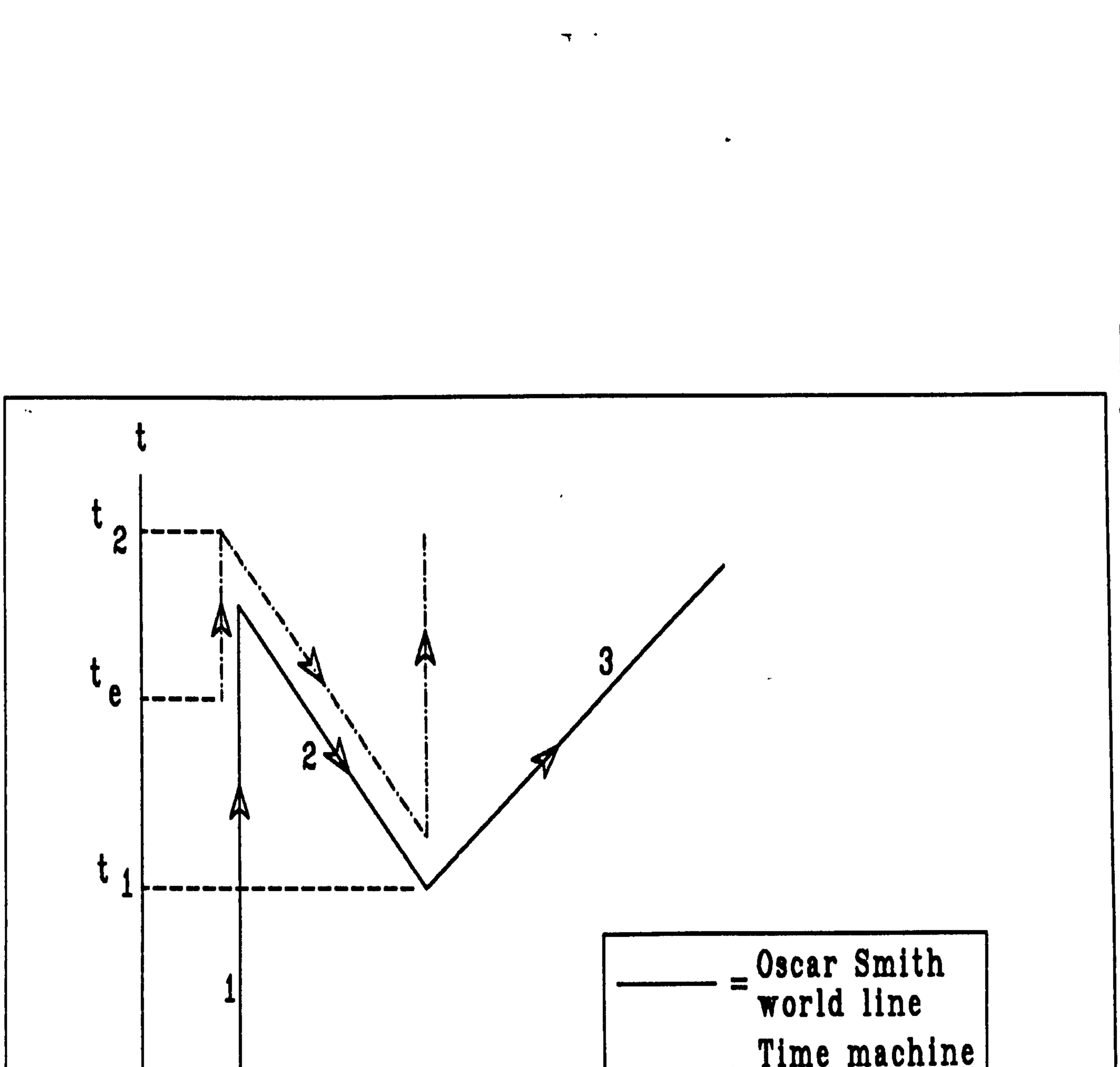
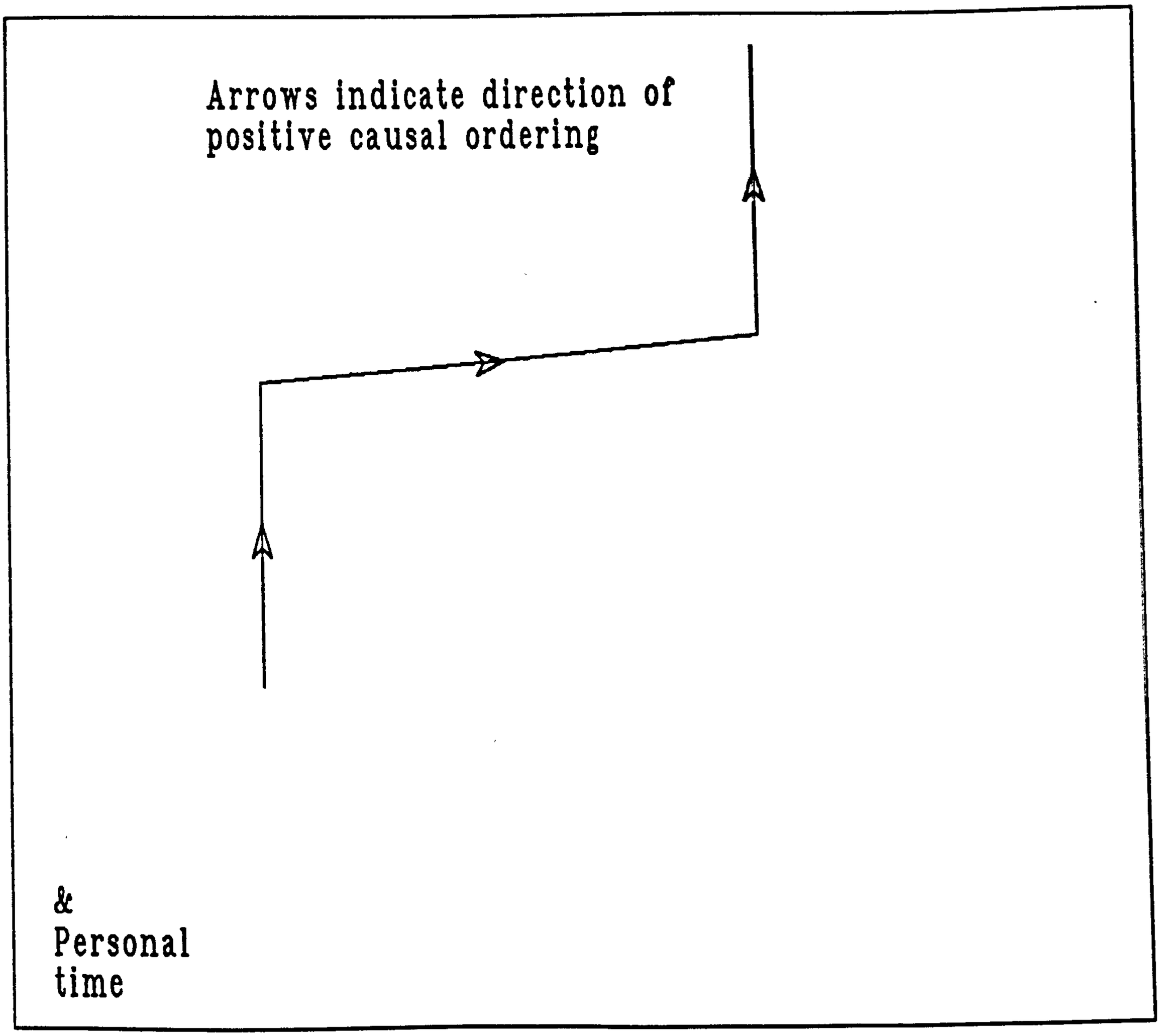

t
t 2
t e
t 1
t 0
A
B
X
1
2
3
Oscar Smith world line
Time machine world line

Fig. 3.6


Arrows indicate direction of
positive causal ordering
&
Personal
time

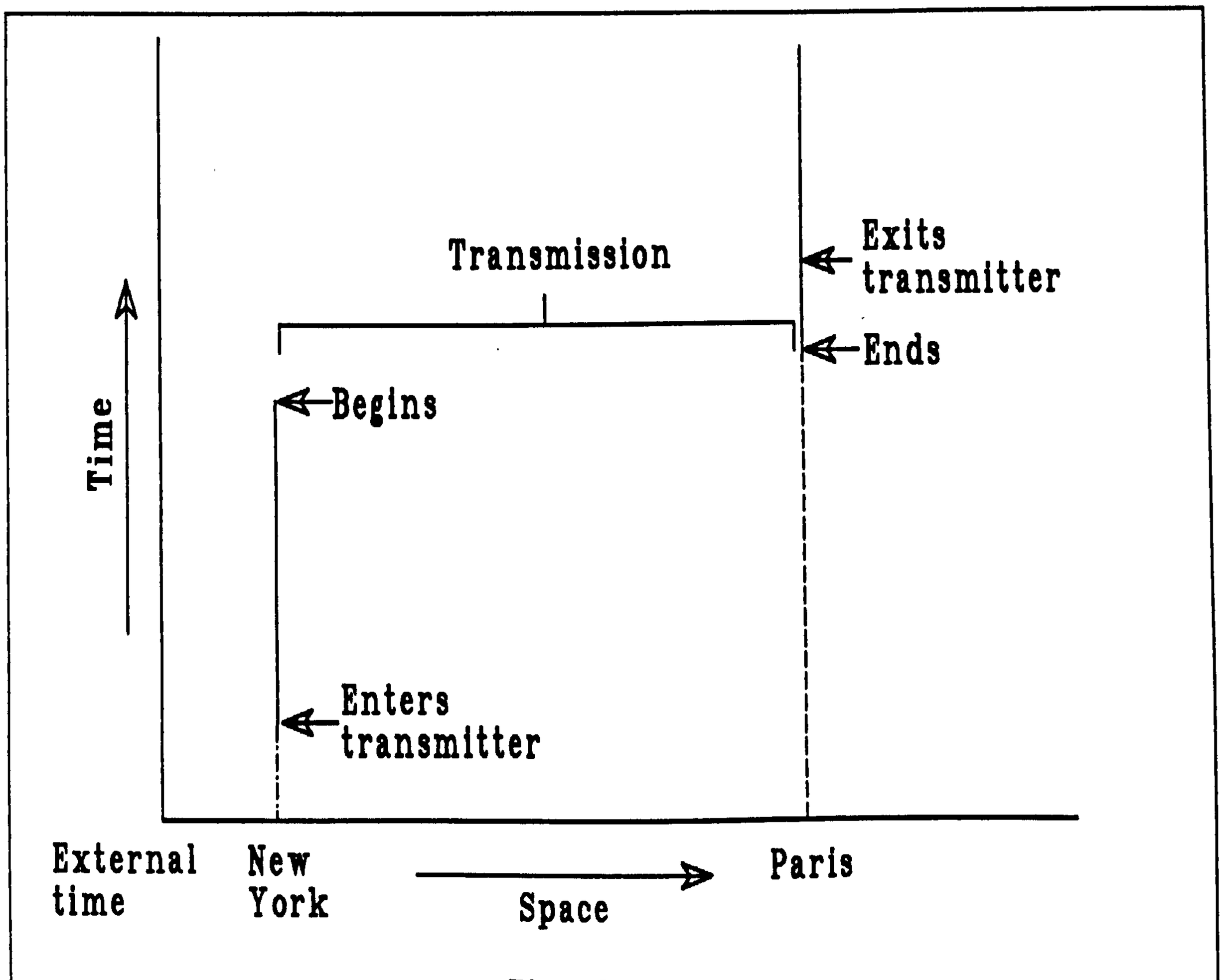

Transmission
Exits transmitter
Ends
Begins
Time
Enters transmitter
External time
New York
Paris
Space

Fig. 3.7

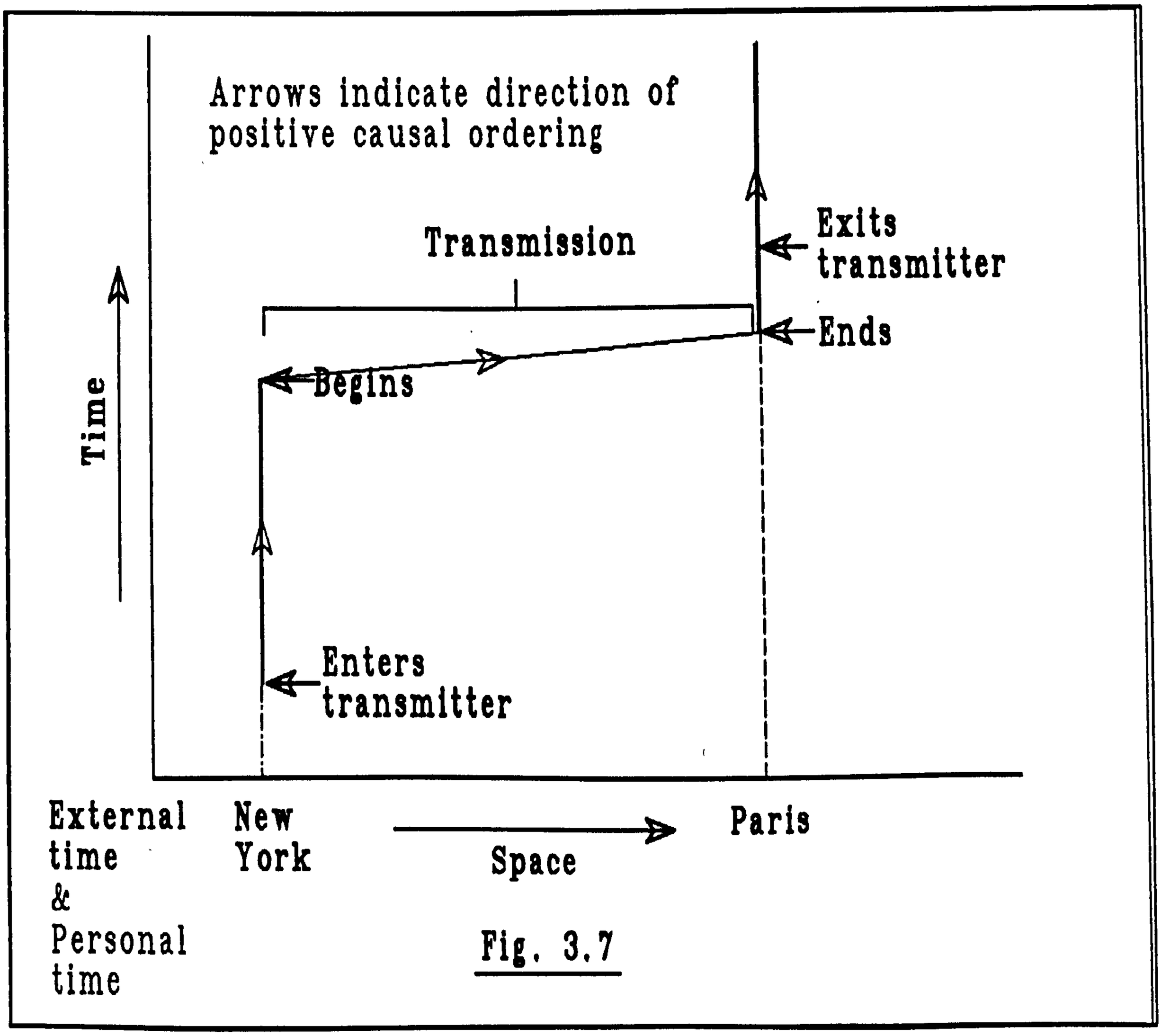
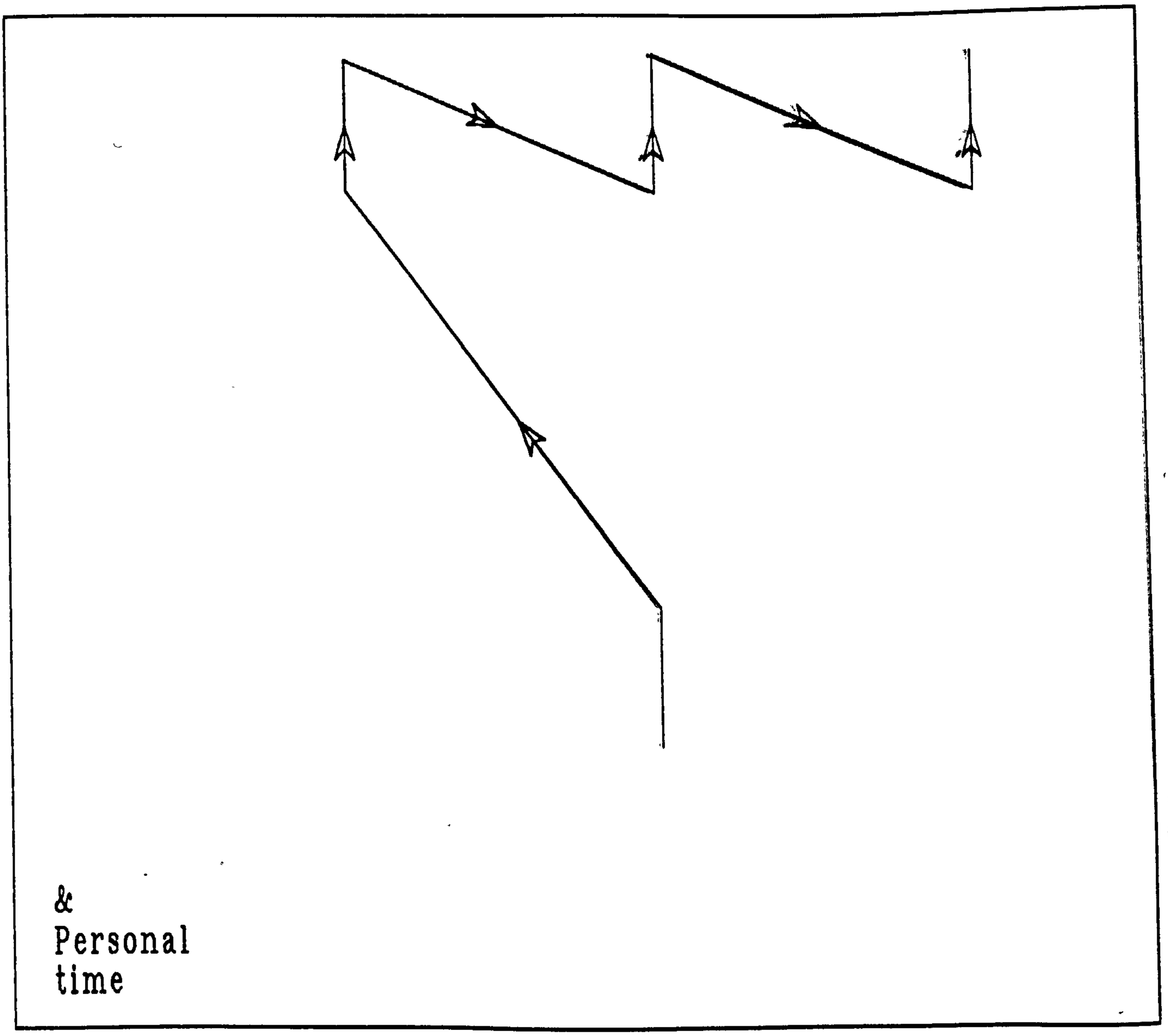

Arrows indicate direction of positive causal ordering
Transmission
Exits transmitter
Ends
Begins
Time
Enters transmitter
External time & Personal time
New York
Paris
Space

Fig. 3.7



&
Personal
time

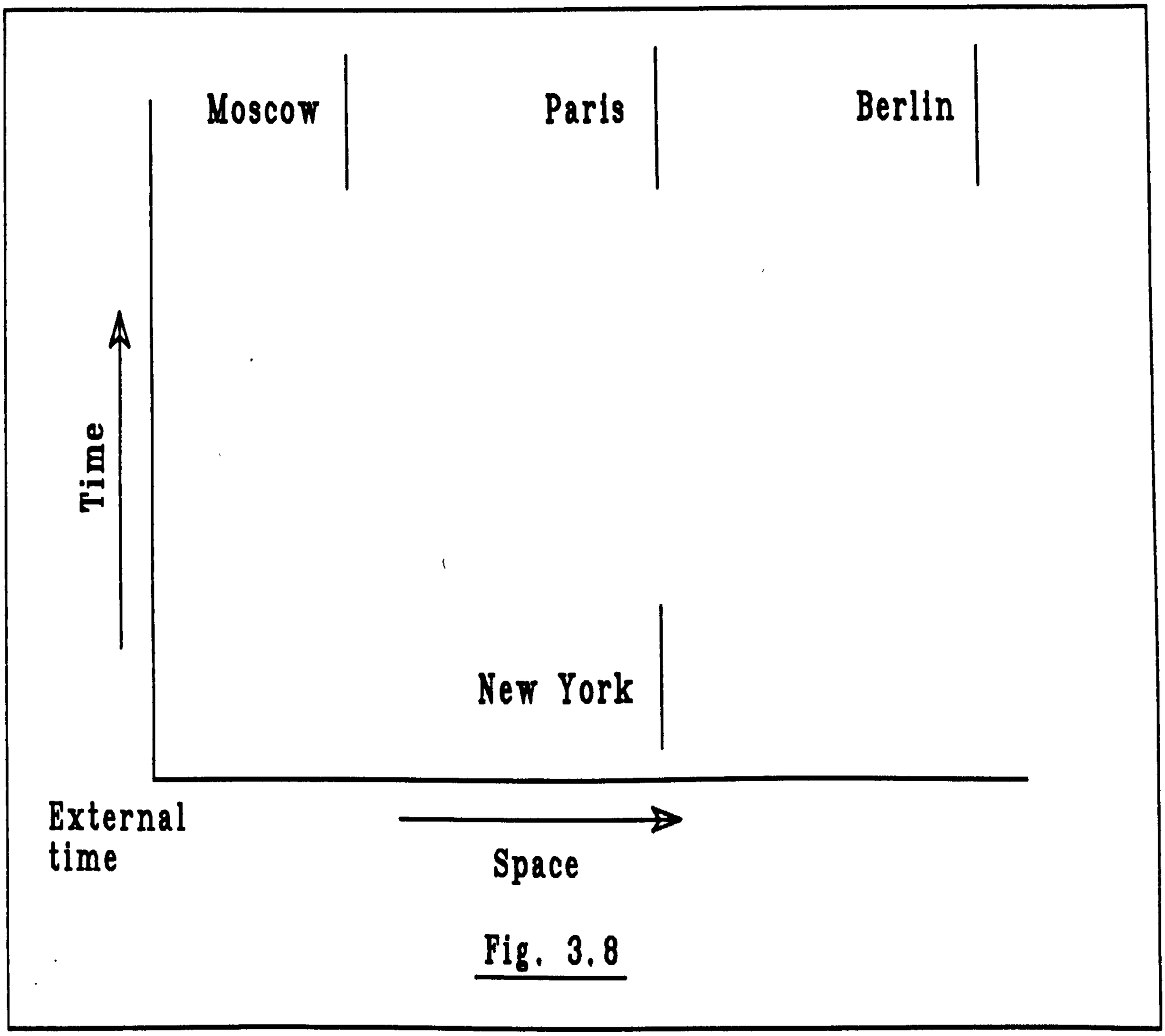


Fig. 3.8

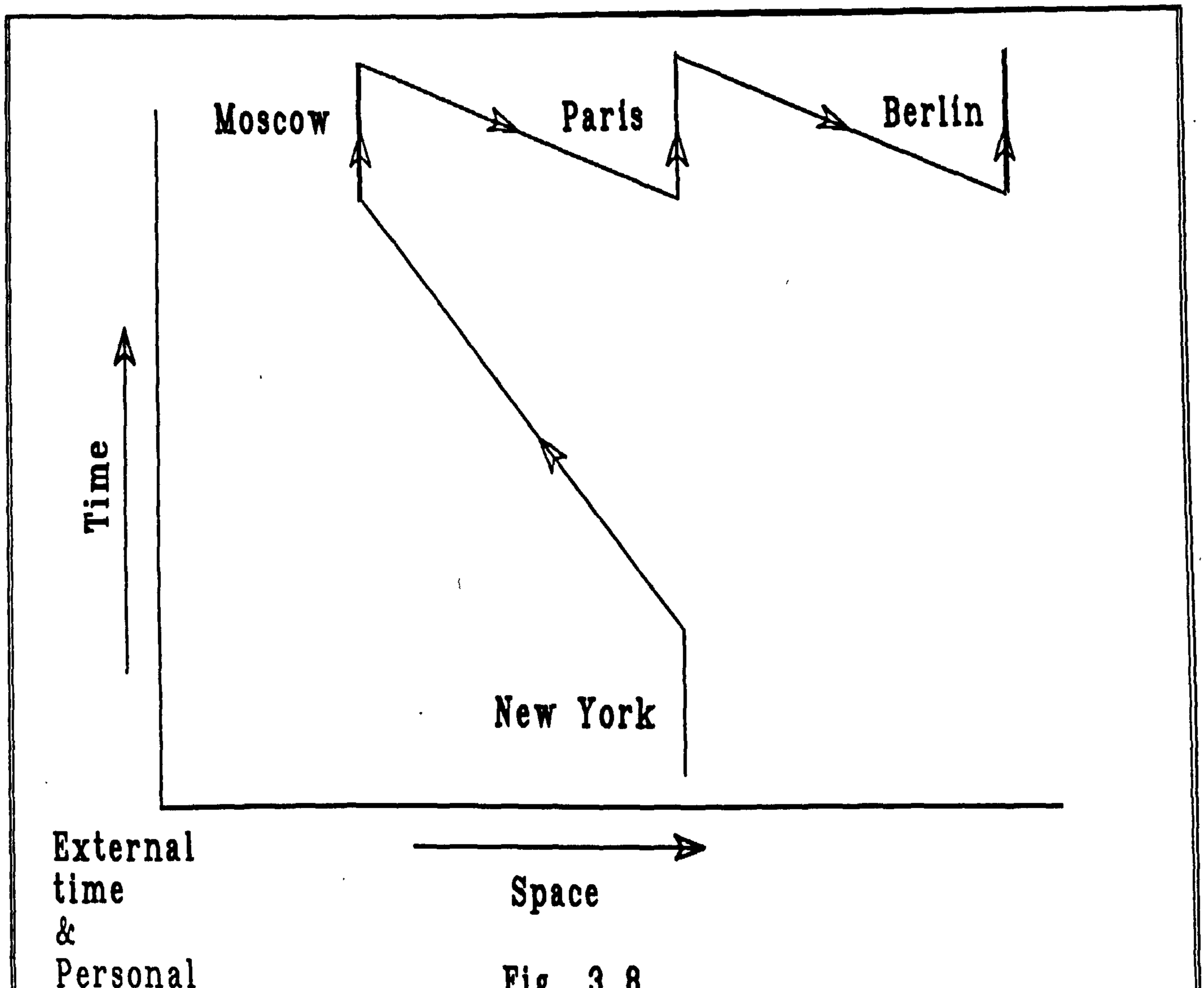
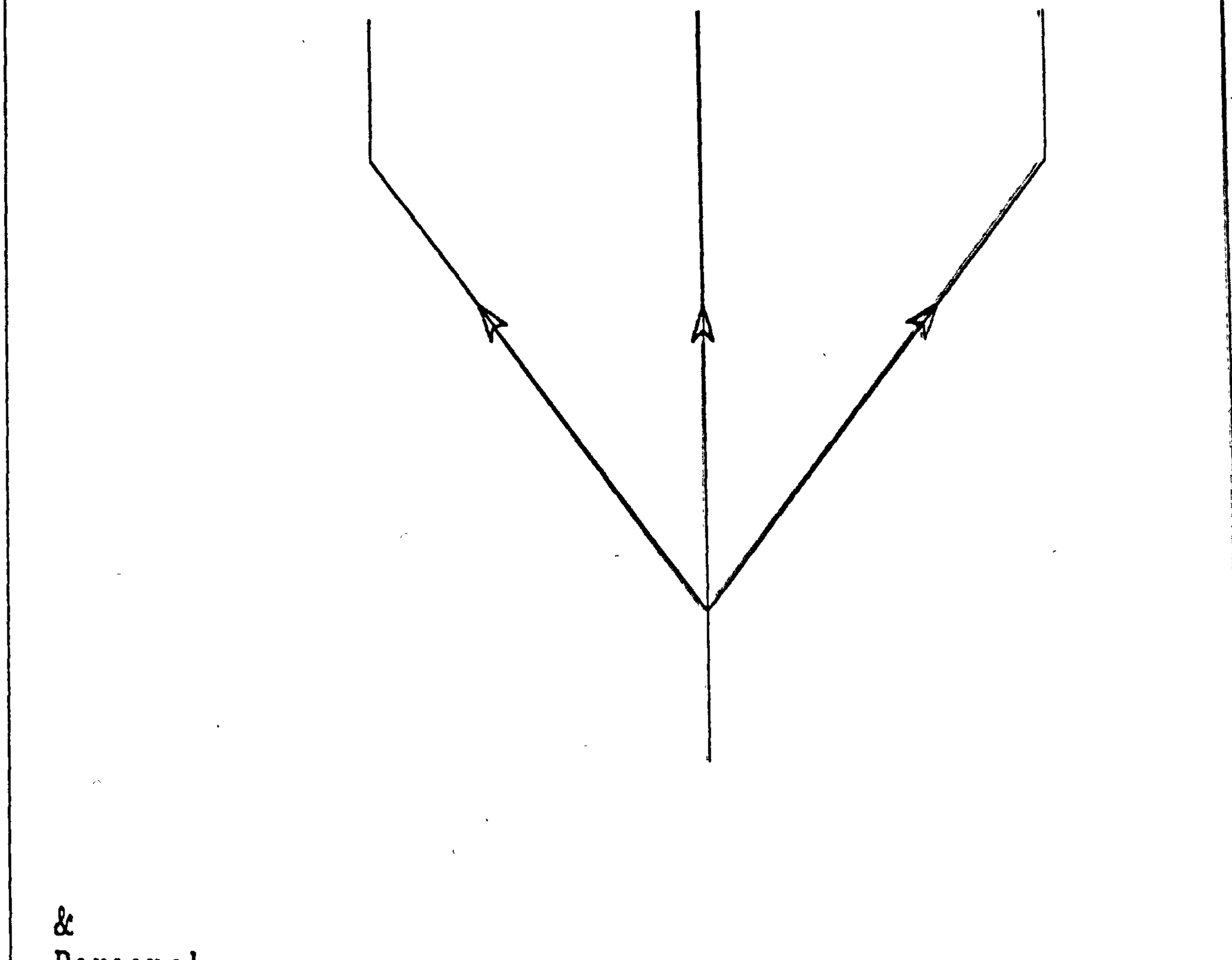

Moscow
Paris
Berlin
New York
Time
External time & Personal time
Space

Fig. 3.8



&
Personal
time

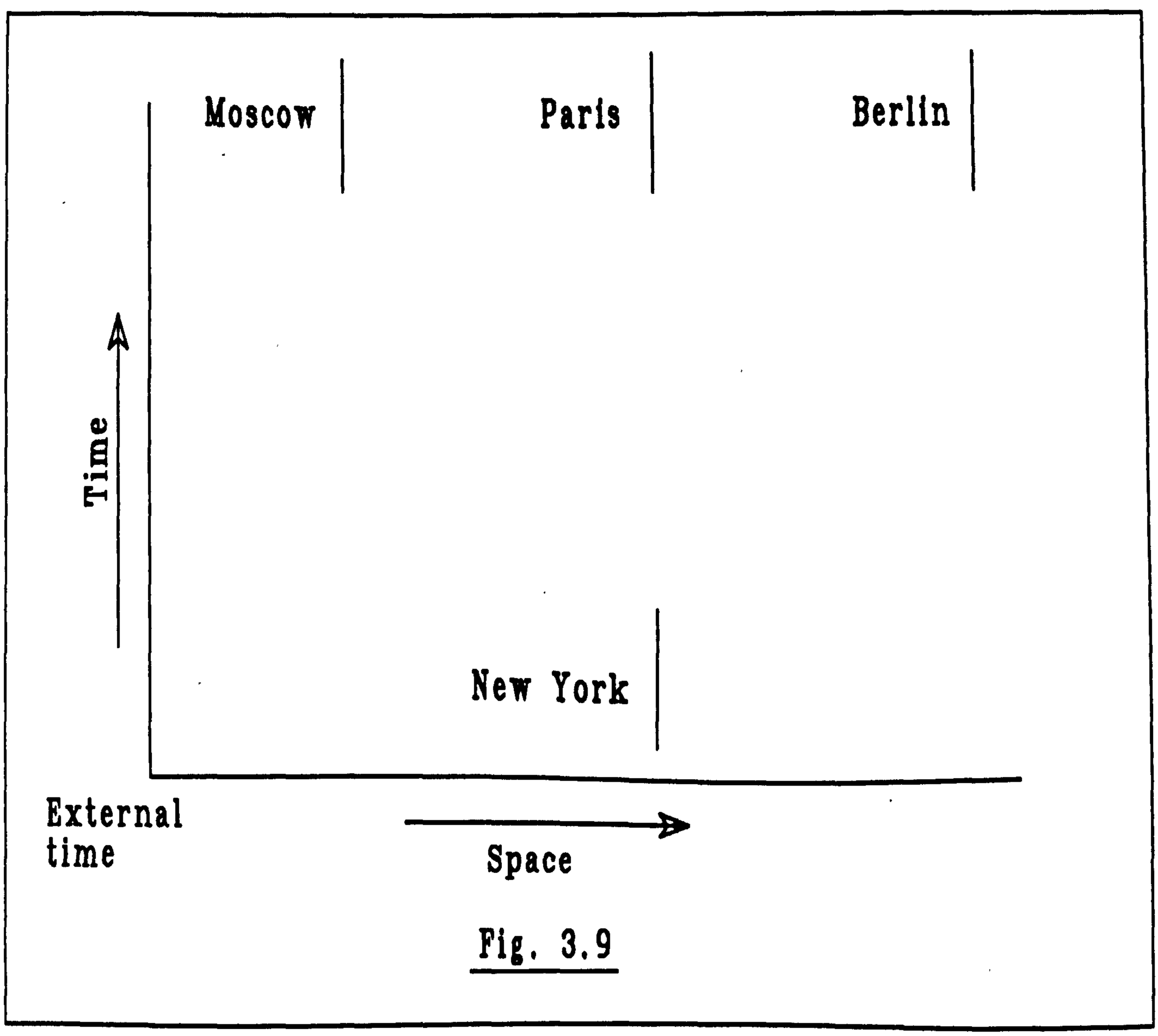


Fig. 3.9

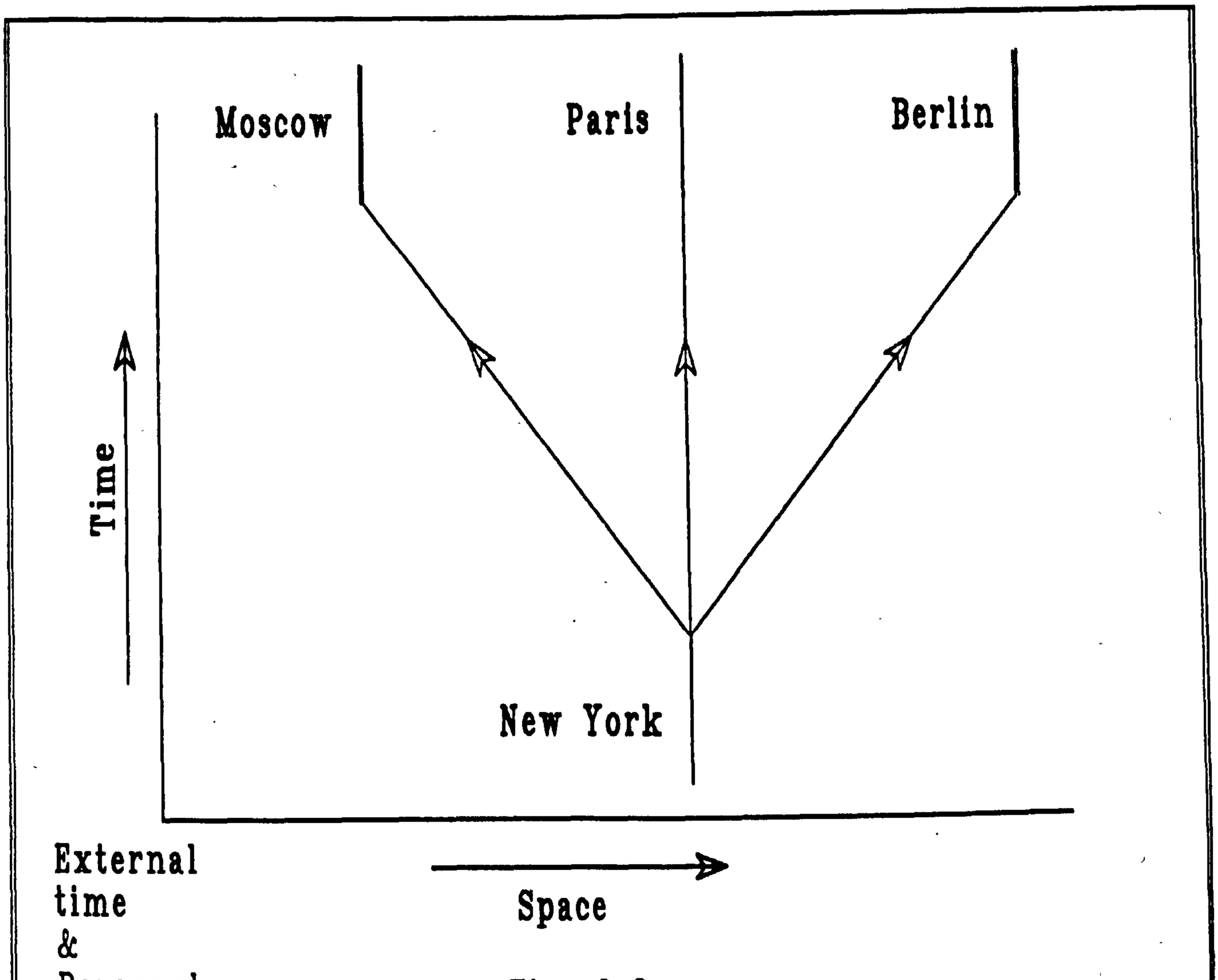

Moscow
Paris
Berlin
New York
Time
External time & Personal time
Space

Fig. 3.9

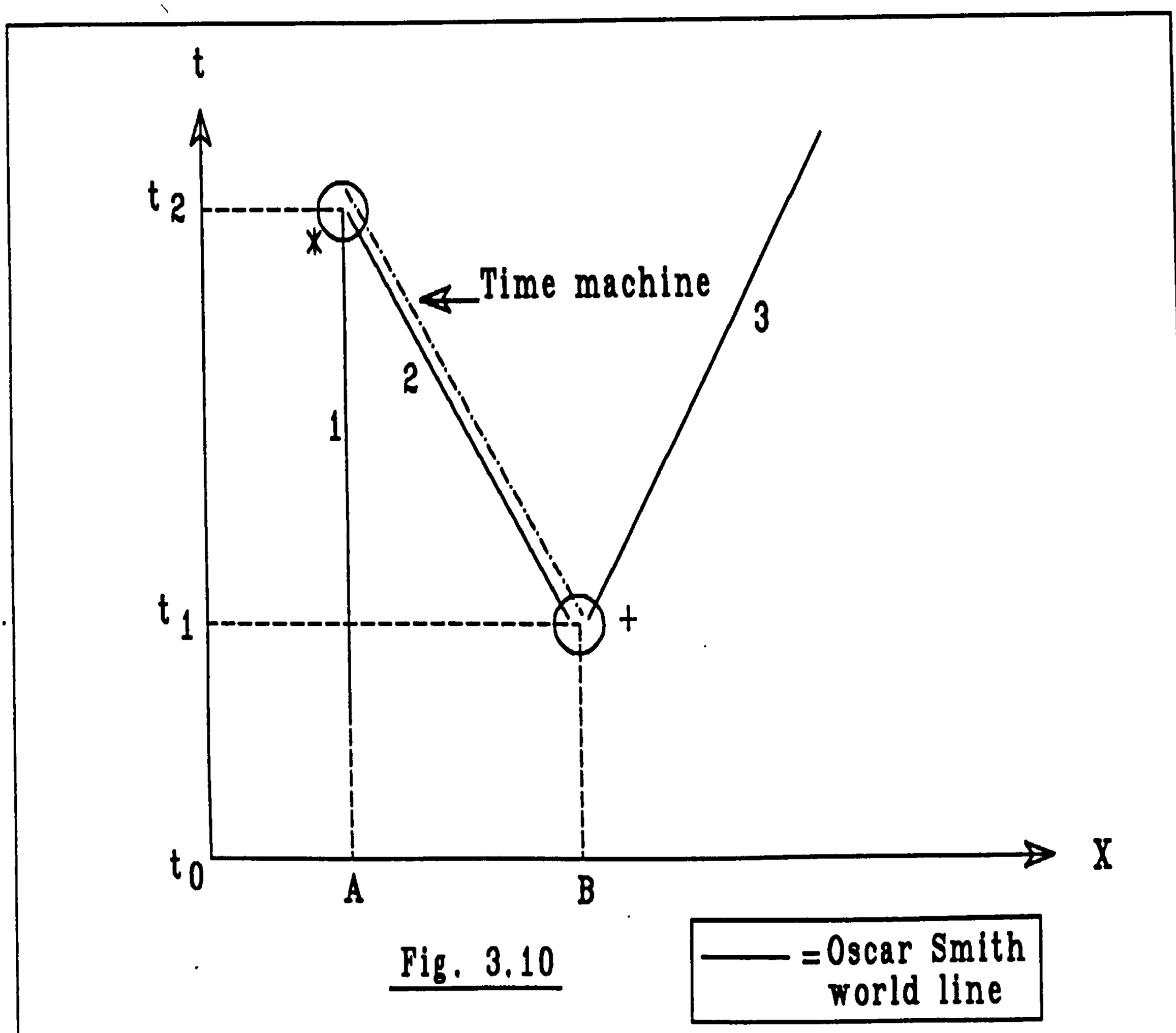


Fig. 3.10

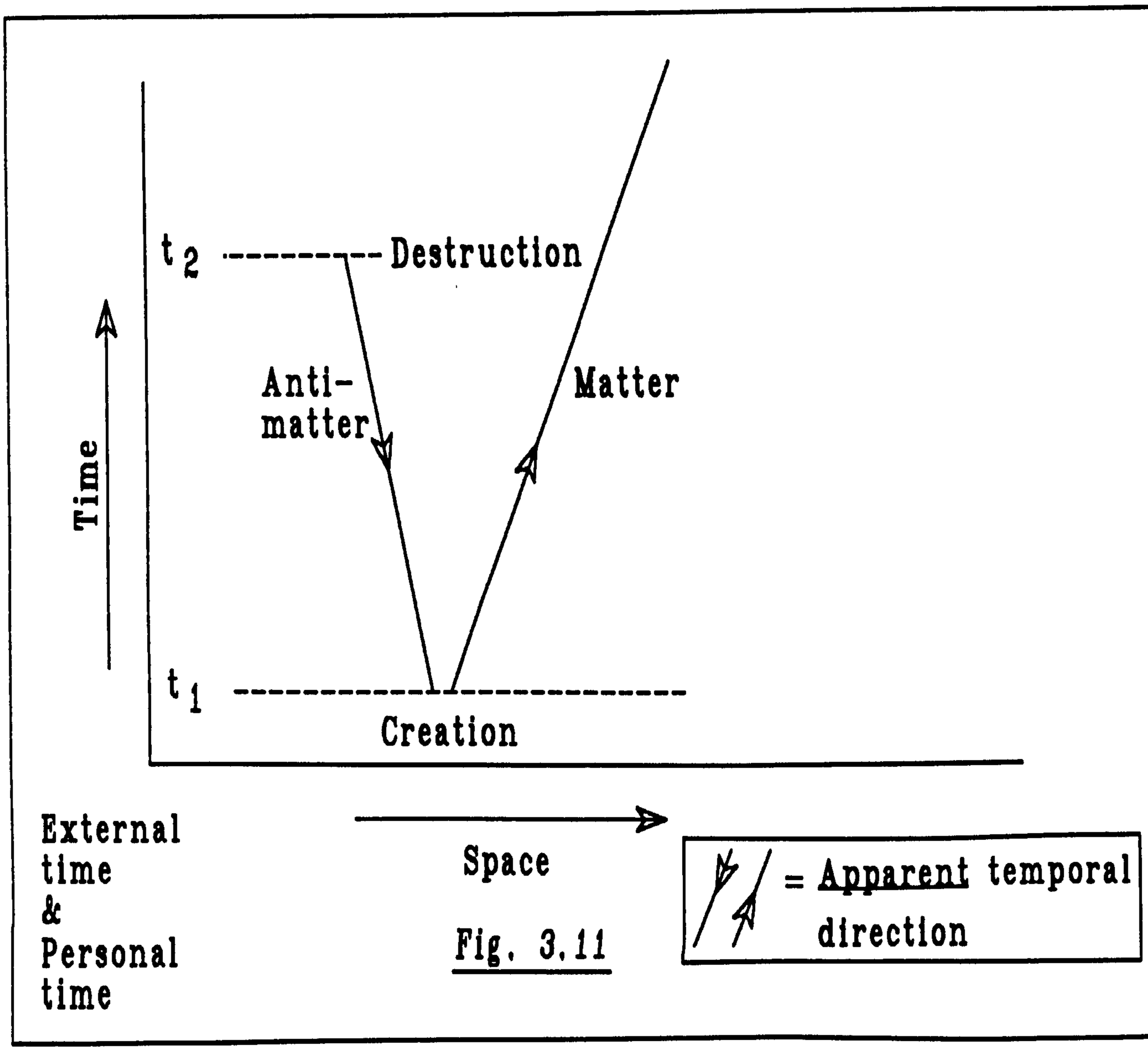

t 2
Destruction
Anti-
matter
Matter
Time
t 1
Creation
External
time
&
Personal
time
Space
= Apparent temporal
direction

Fig. 3.11

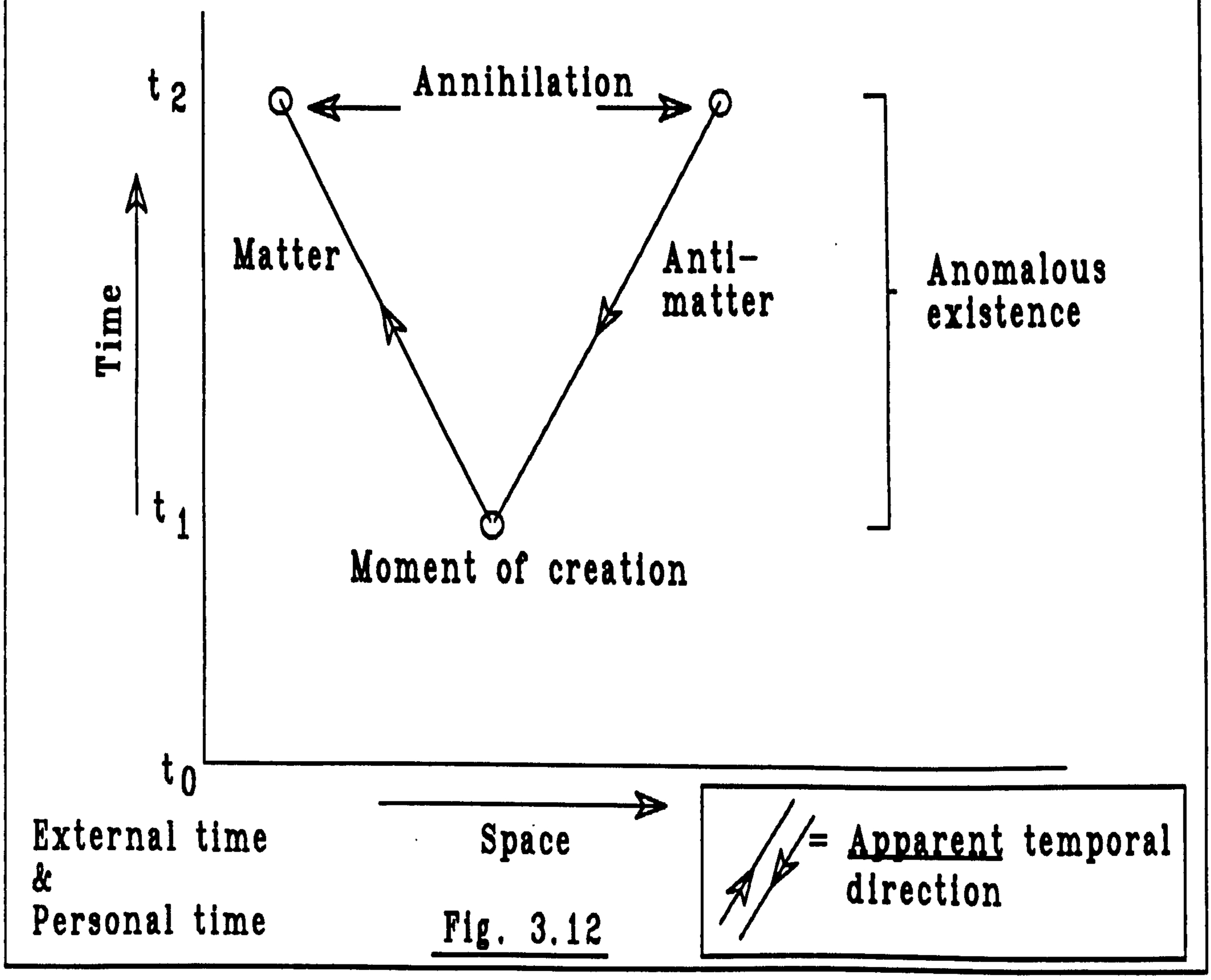

t 2
Annihilation
Matter
Anti-
matter
Anomalous
existence
Time
t 1
Moment of creation
t 0
External time
&
Personal time
Space
= Apparent temporal
direction

Fig. 3.12

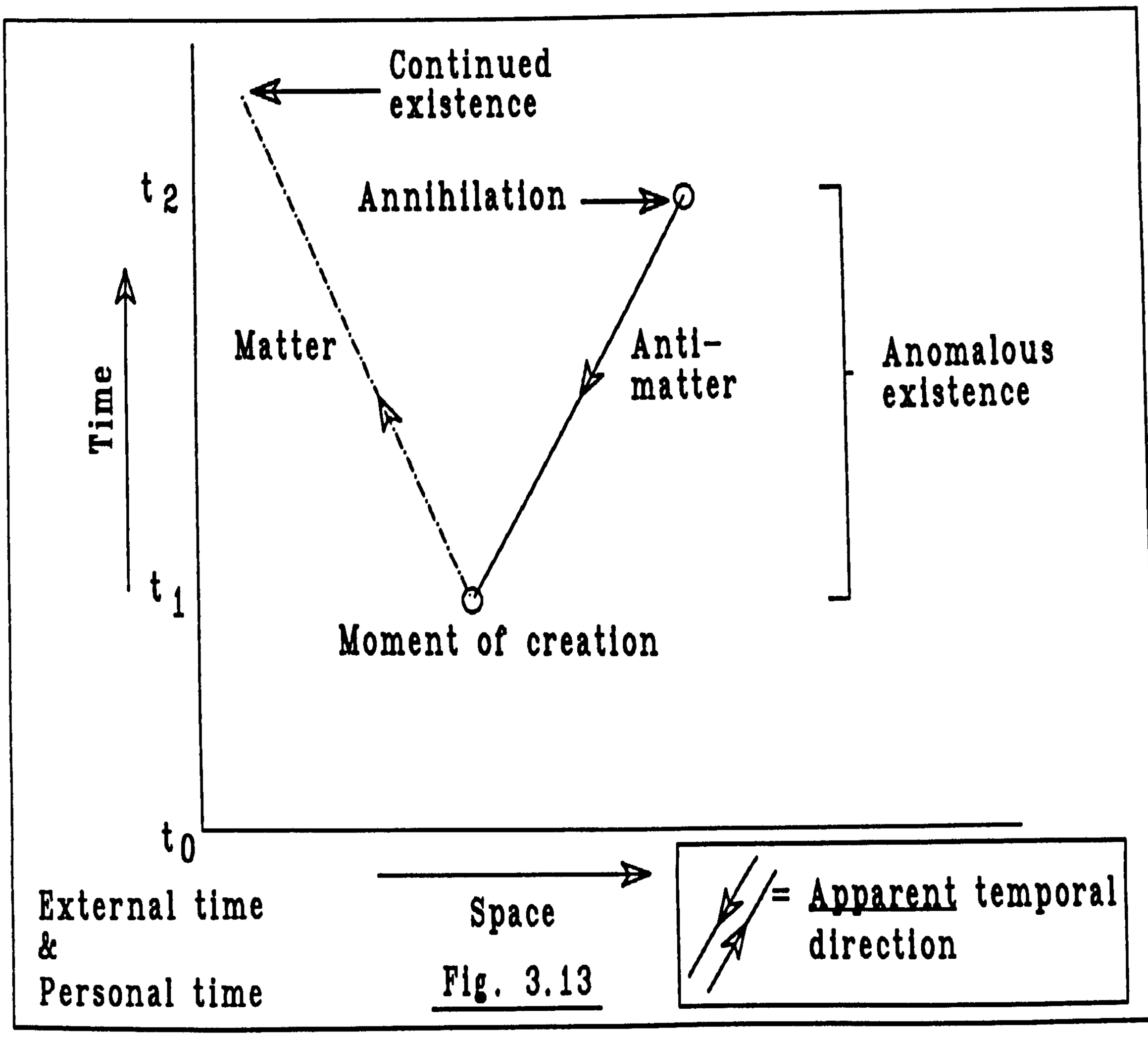

Continued existence
Annihilation
Matter
Anti-matter
Anomalous existence
Time
t_2
t_1
t_0
Moment of creation
External time & Personal time
Space
= Apparent temporal direction

Fig. 3.13

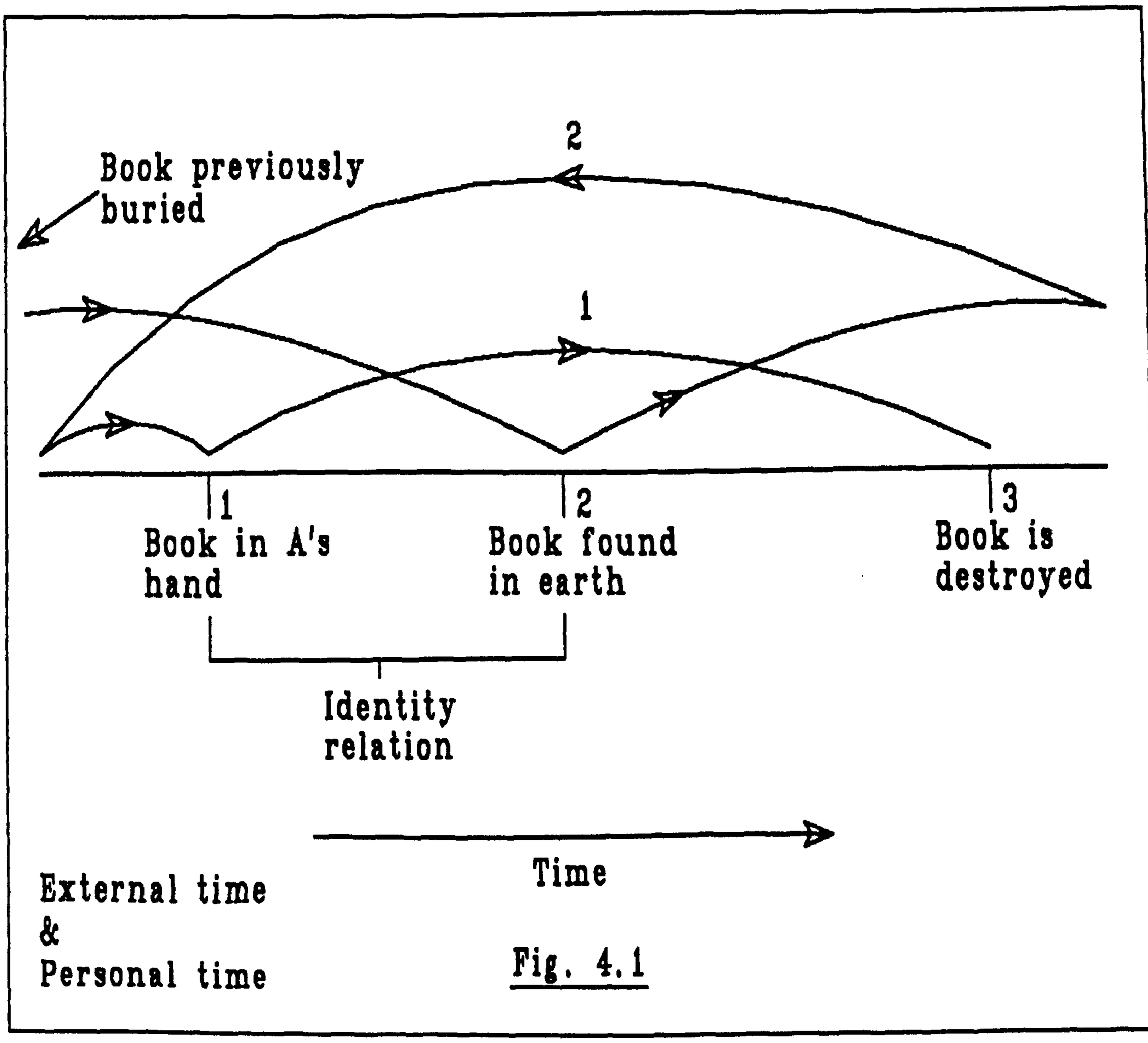

Book previously buried
2
1
1
Book in A's hand
2
Book found in earth
3
Book is destroyed
Identity relation
Time
External time & Personal time

Fig. 4.1

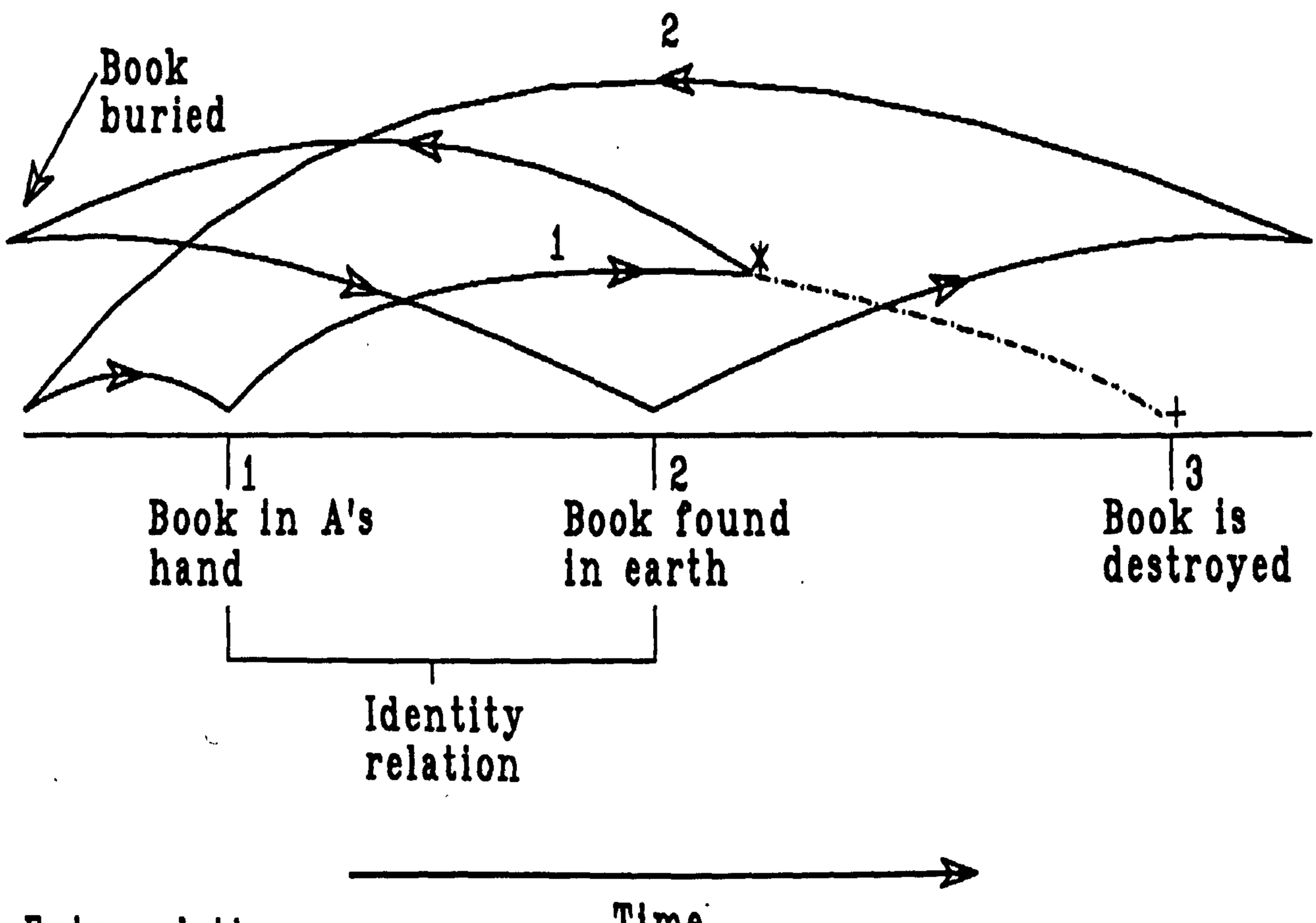

Book
buried
2
1
1
Book in A's
hand
2
Book found
in earth
3
Book is
destroyed
Identity
relation
Time
External time
&
Personal time

Fig. 4.2

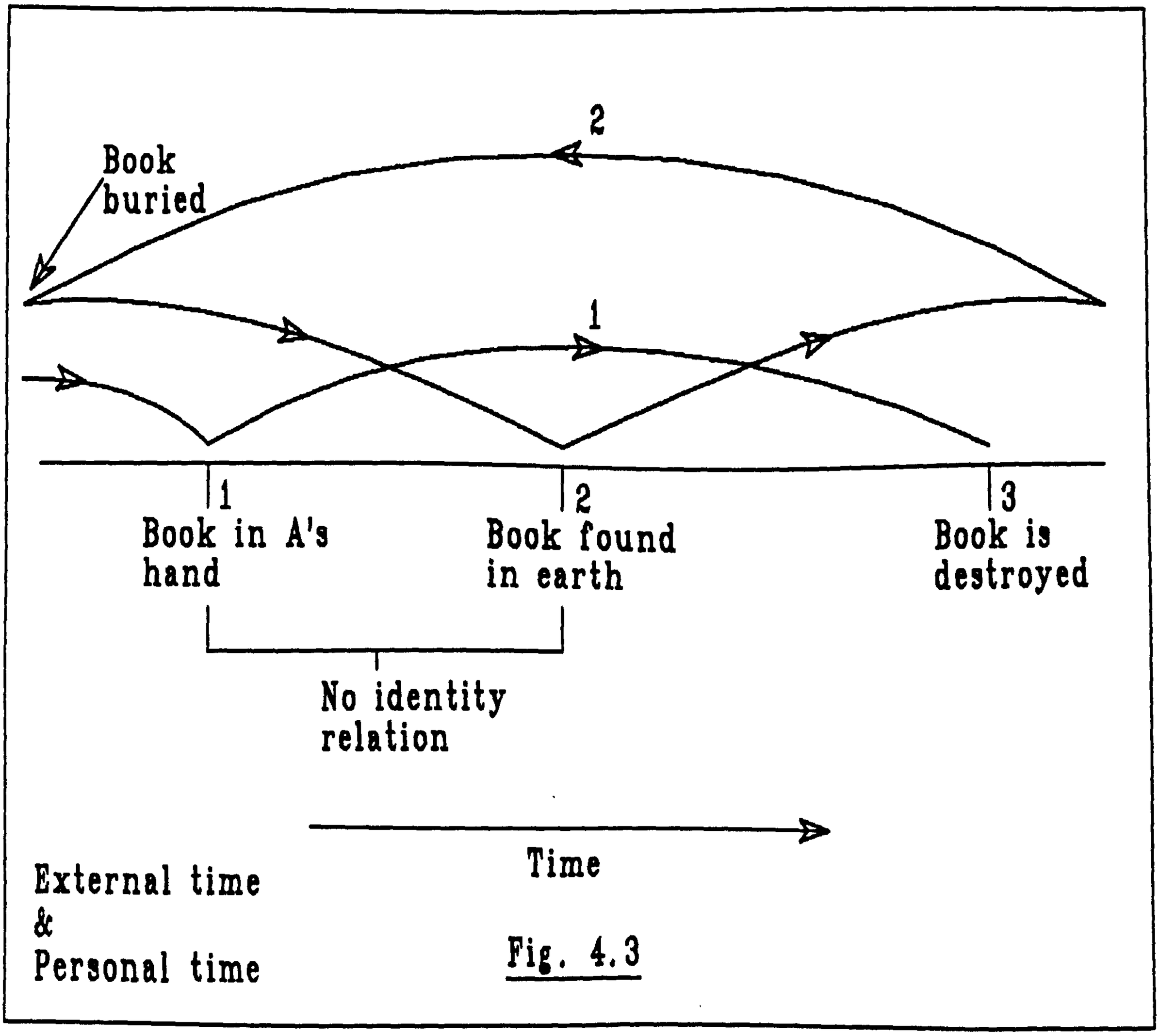

2
Book
buried
1
1
Book in A's
hand
2
Book found
in earth
3
Book is
destroyed
No identity
relation
Time
External time
&
Personal time

Fig. 4.3

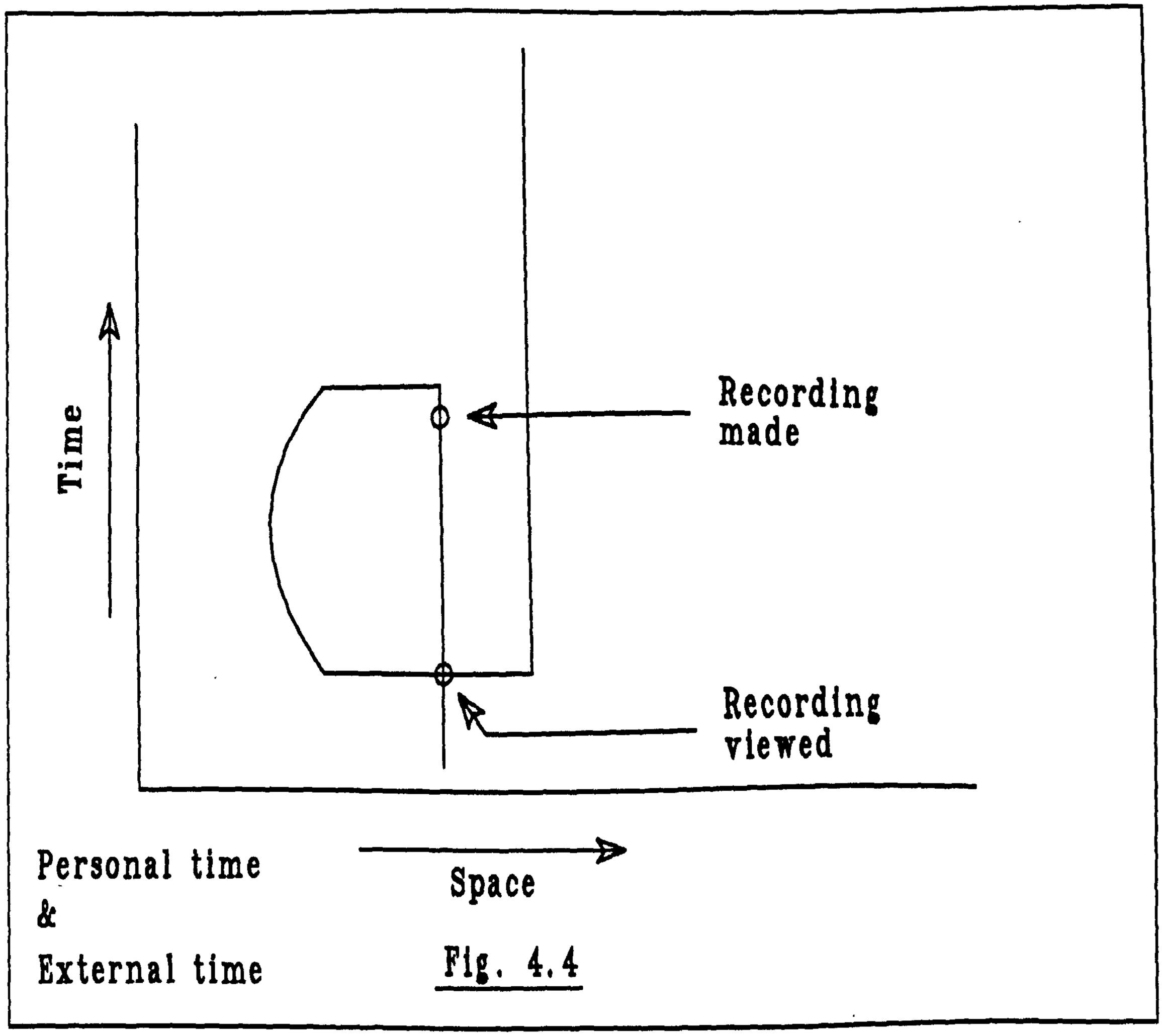

Time
Recording made
Recording viewed
Space
Personal time
&
External time

Fig. 4.4

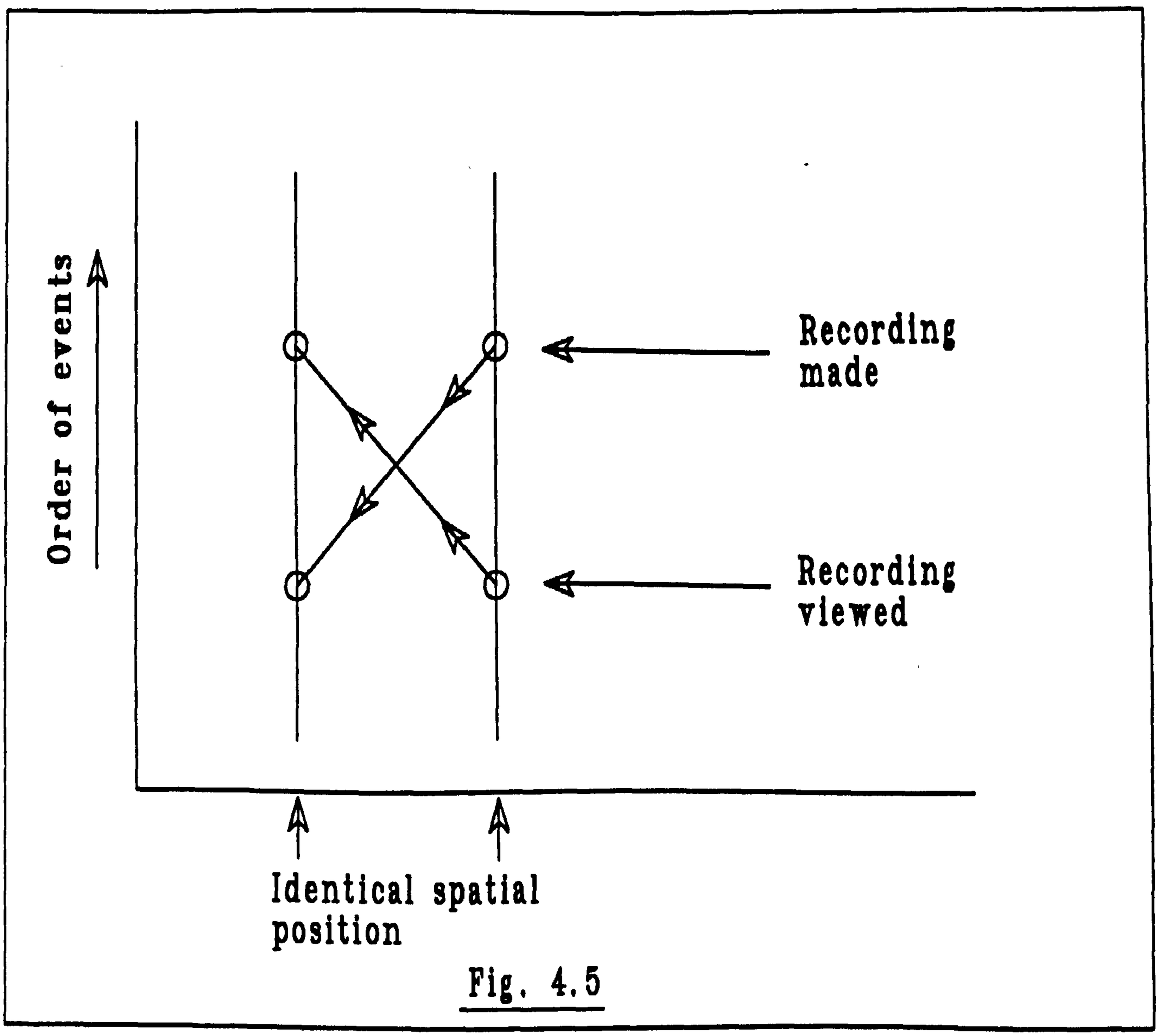
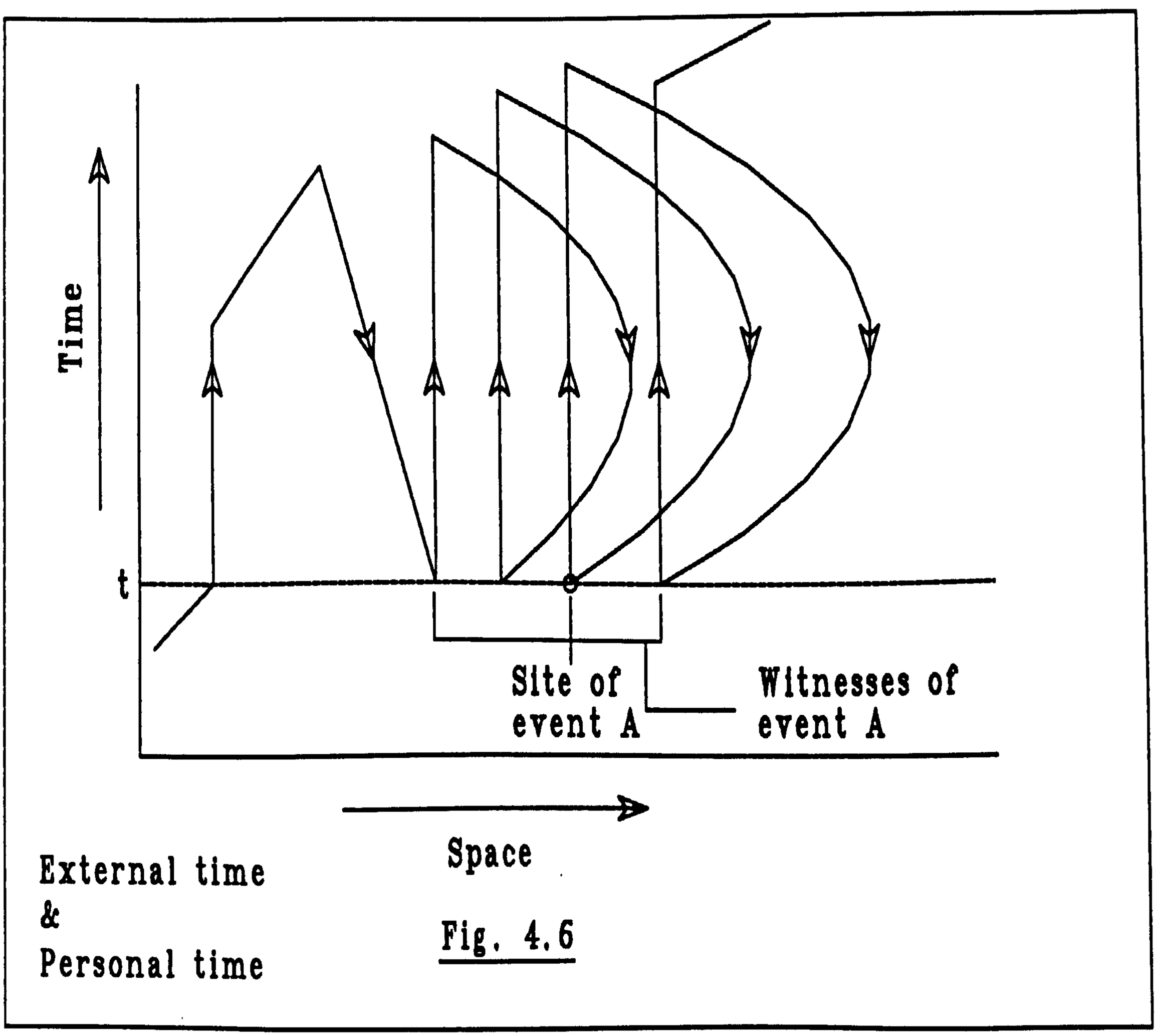

Order of events
Recording made
Recording viewed
Identical spatial position

Fig. 4.5



External time
&
Personal time

Fig. 4.6

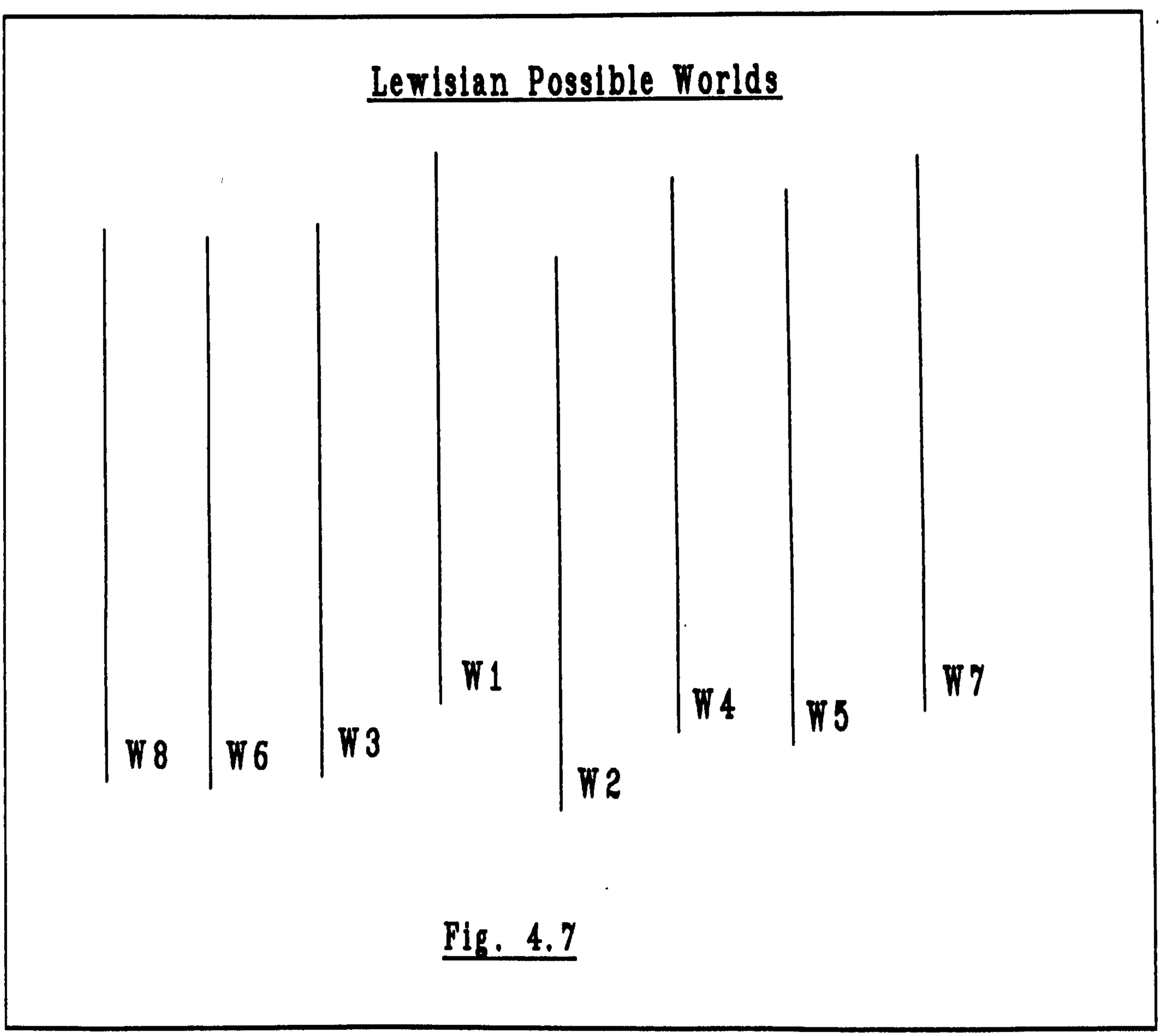


Fig. 4.7

Branching Possible Worlds

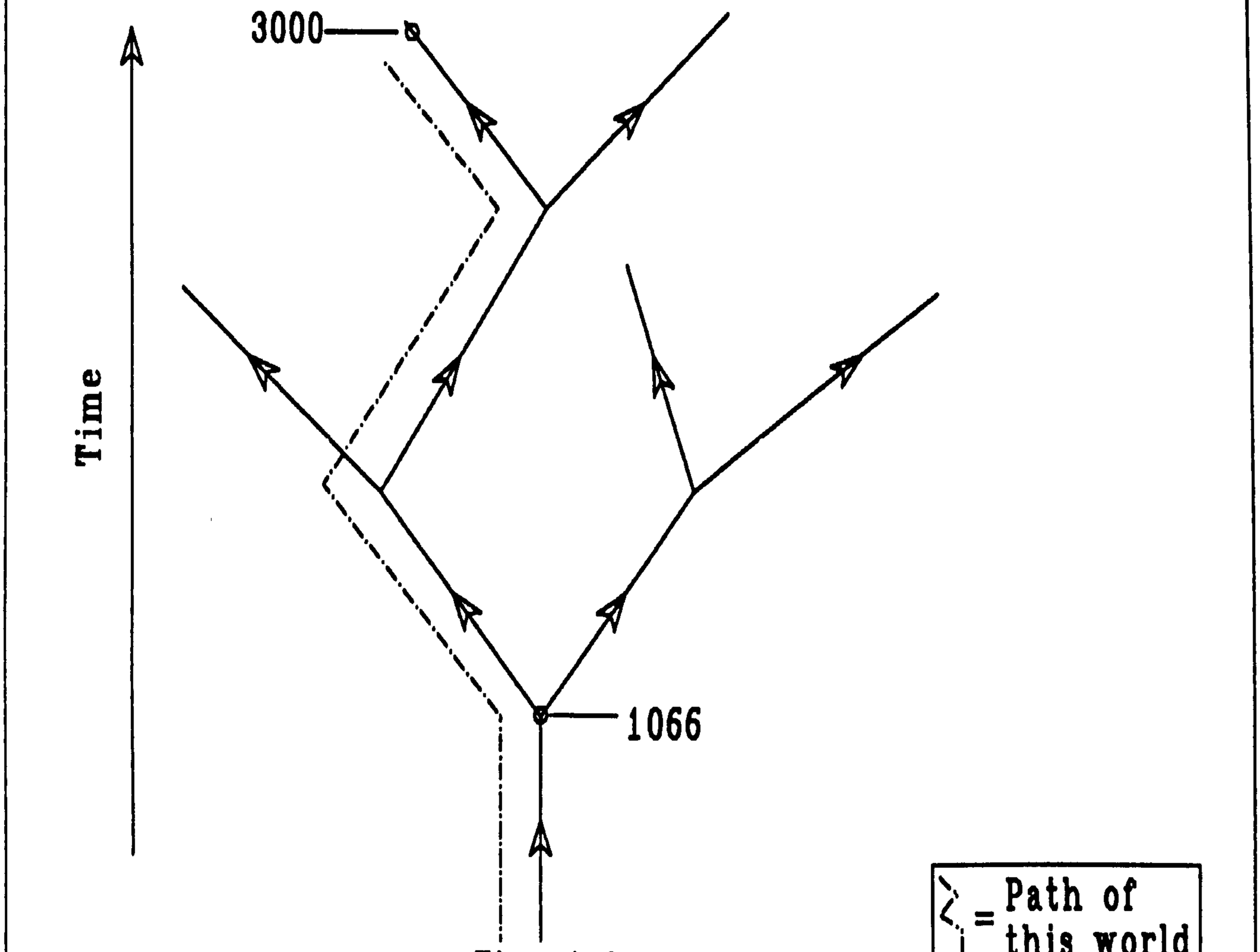


Fig. 4.8

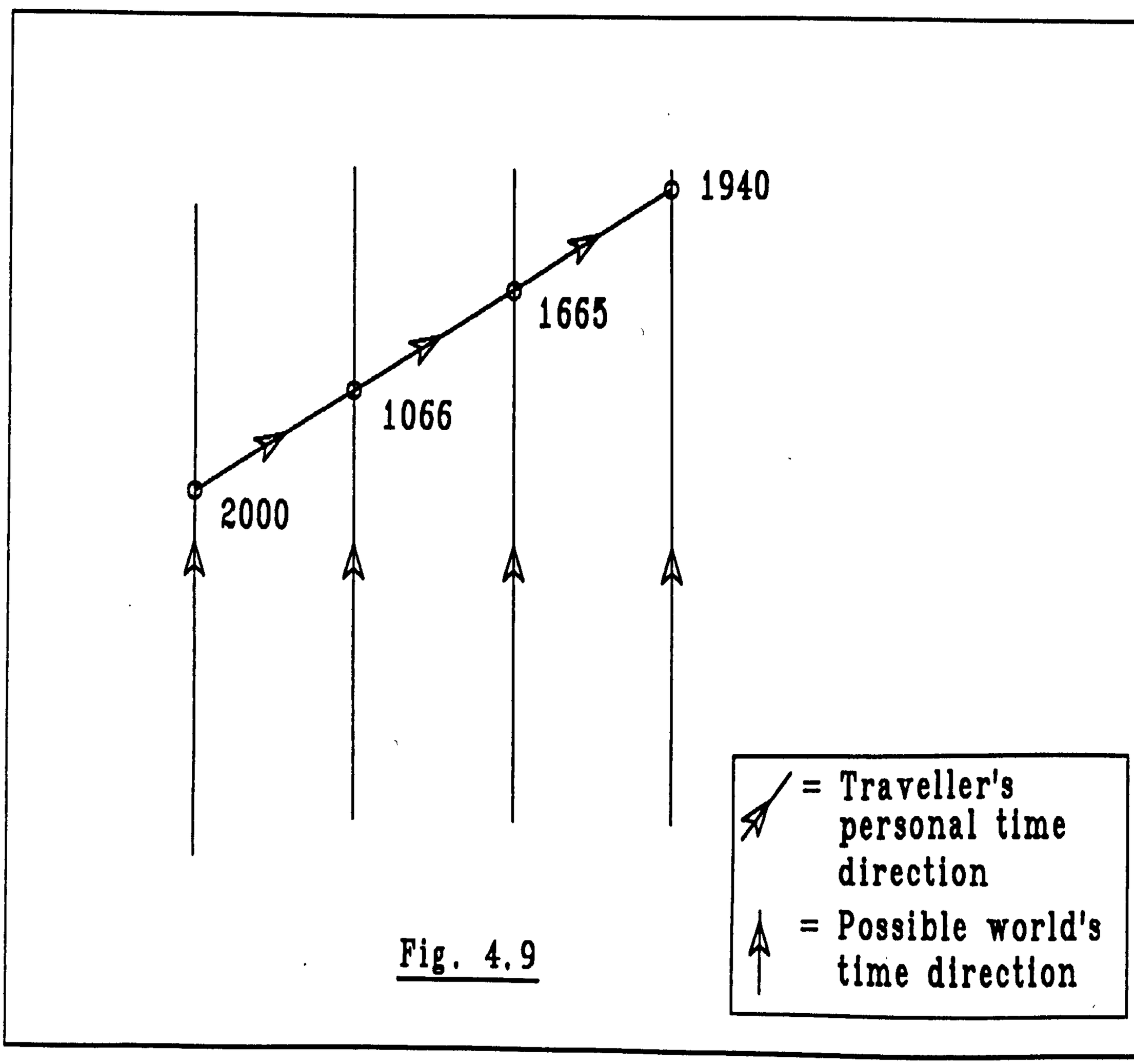

1940
1665
1066
2000
= Traveller's personal time direction
= Possible world's time direction

Fig. 4.9

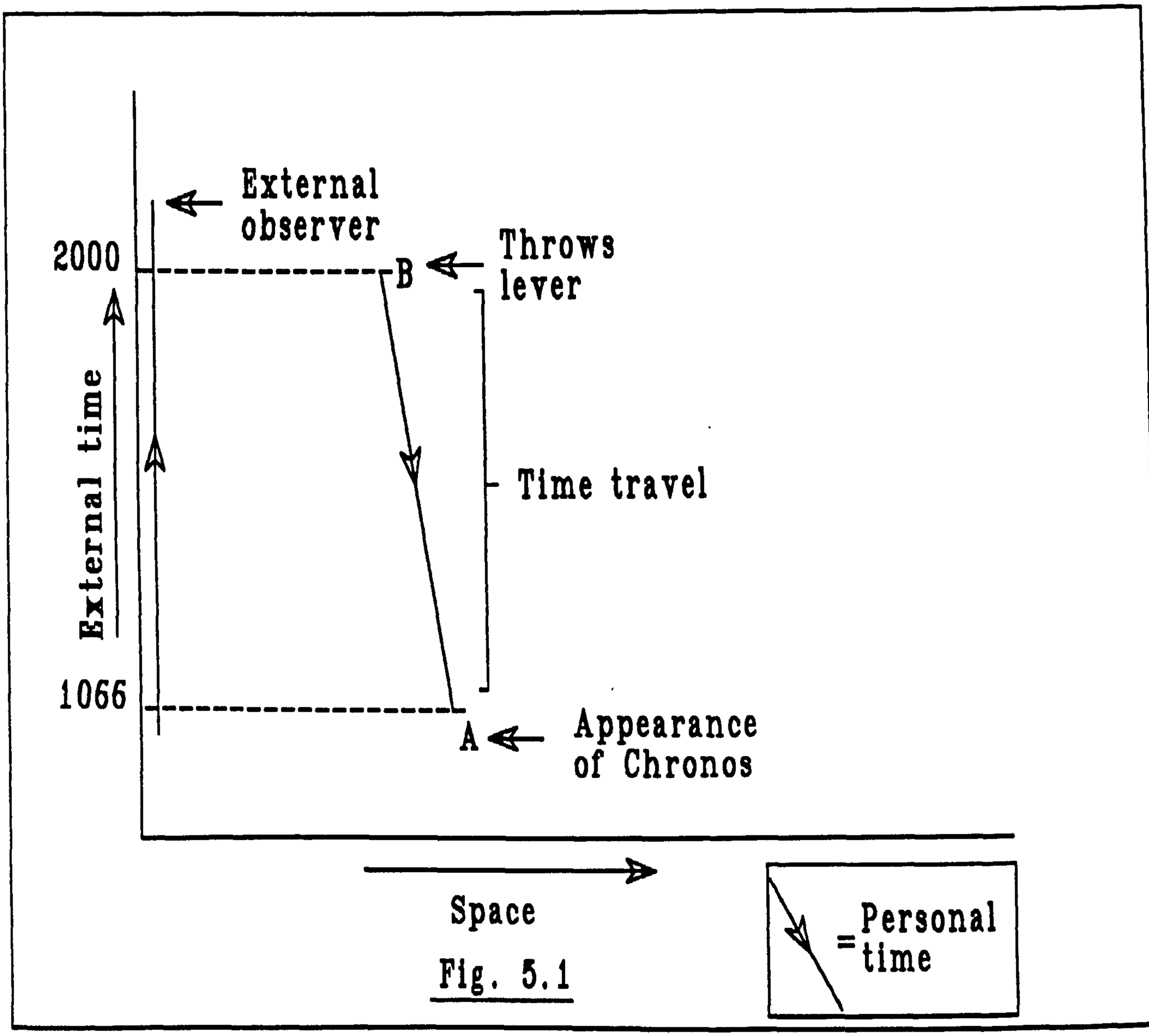
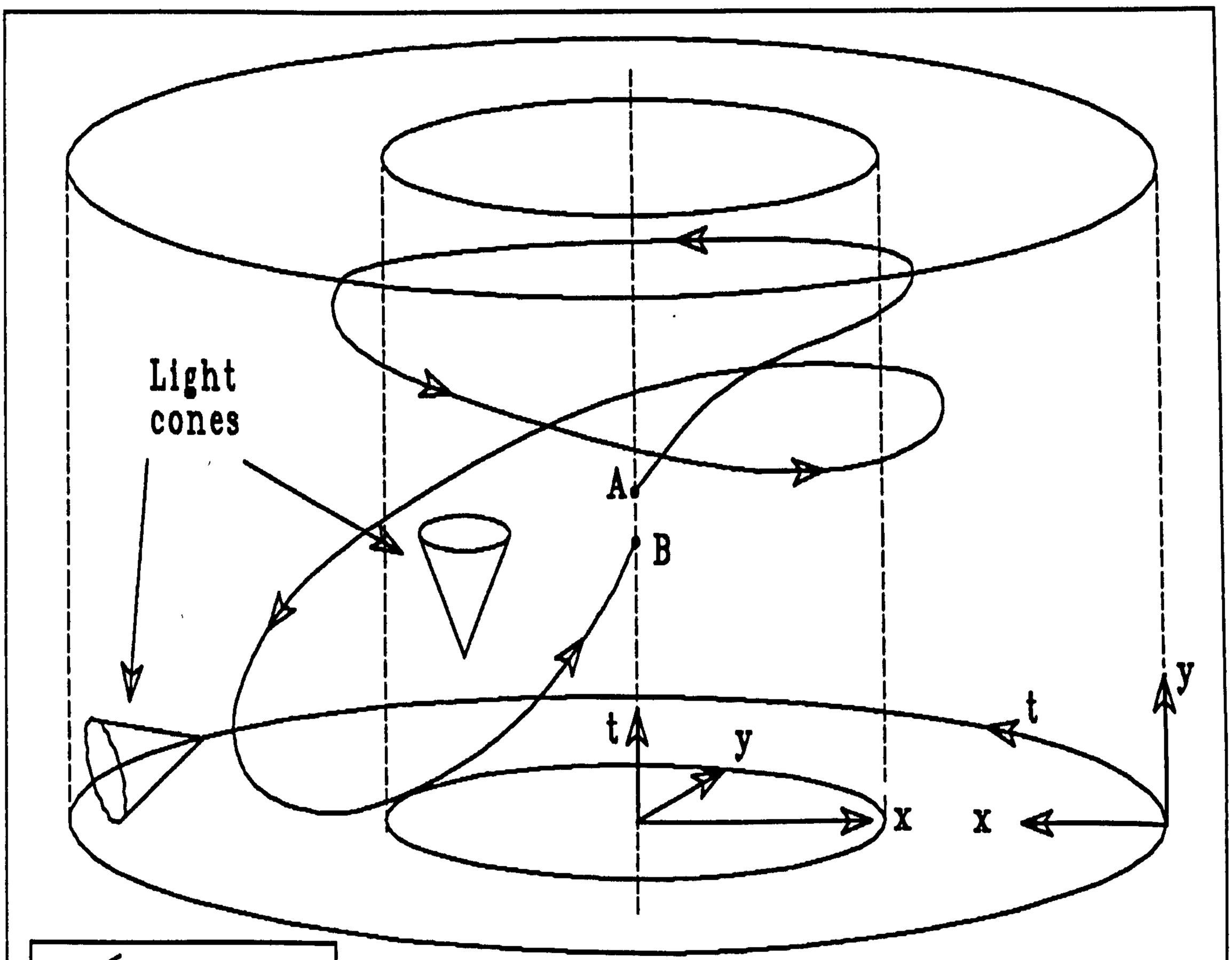

External observer
2000
B
Throws lever
External time
Time travel
1066
A
Appearance of Chronos
Space
= Personal time

Fig. 5.1



= Route of traveller

Fig. 5.2

A = Journey begins
B = Journey ends

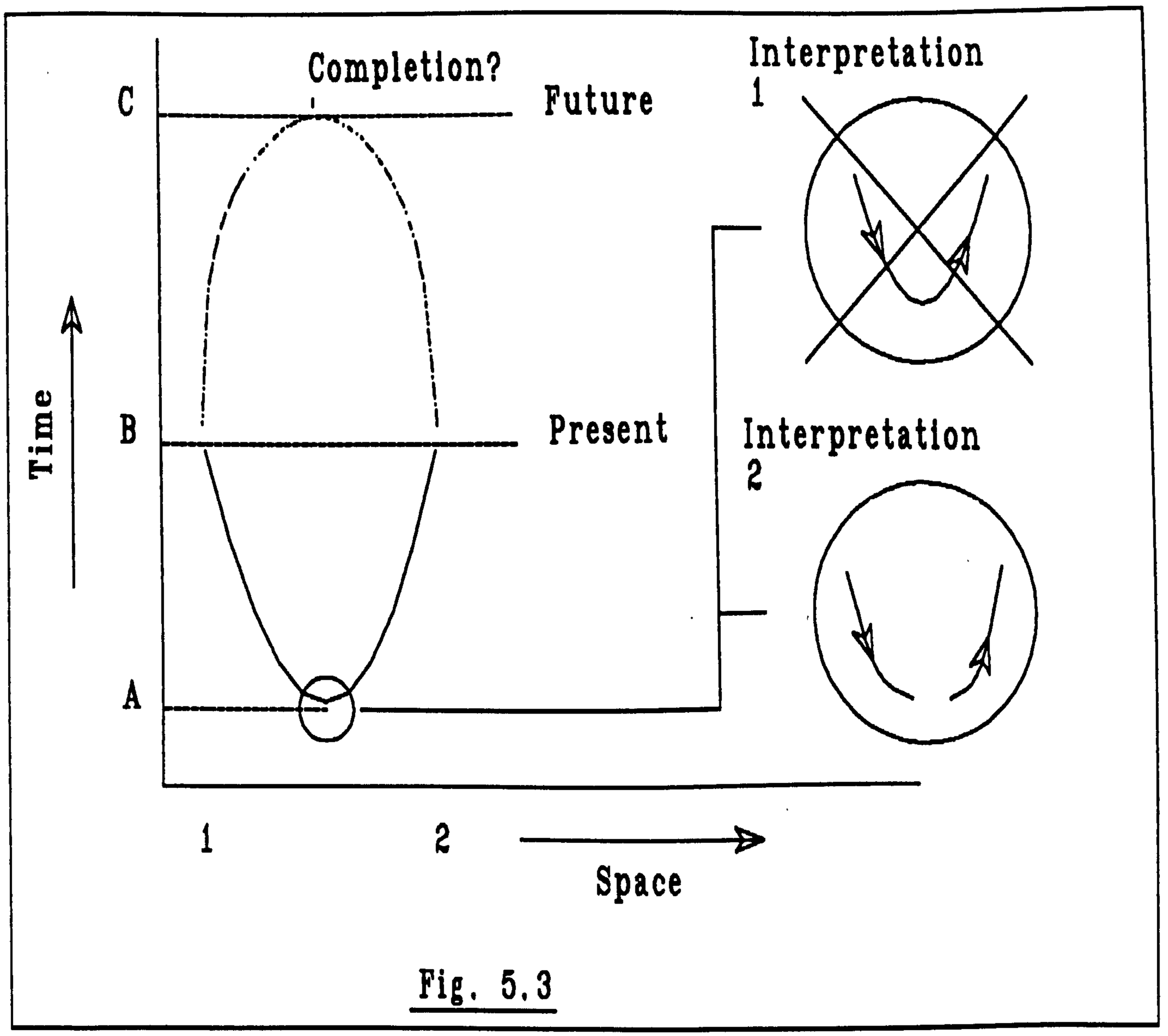

Completion?
C
Future
Time
B
Present
A
Interpretation
1
Interpretation
2
1
2
Space

Fig. 5.3

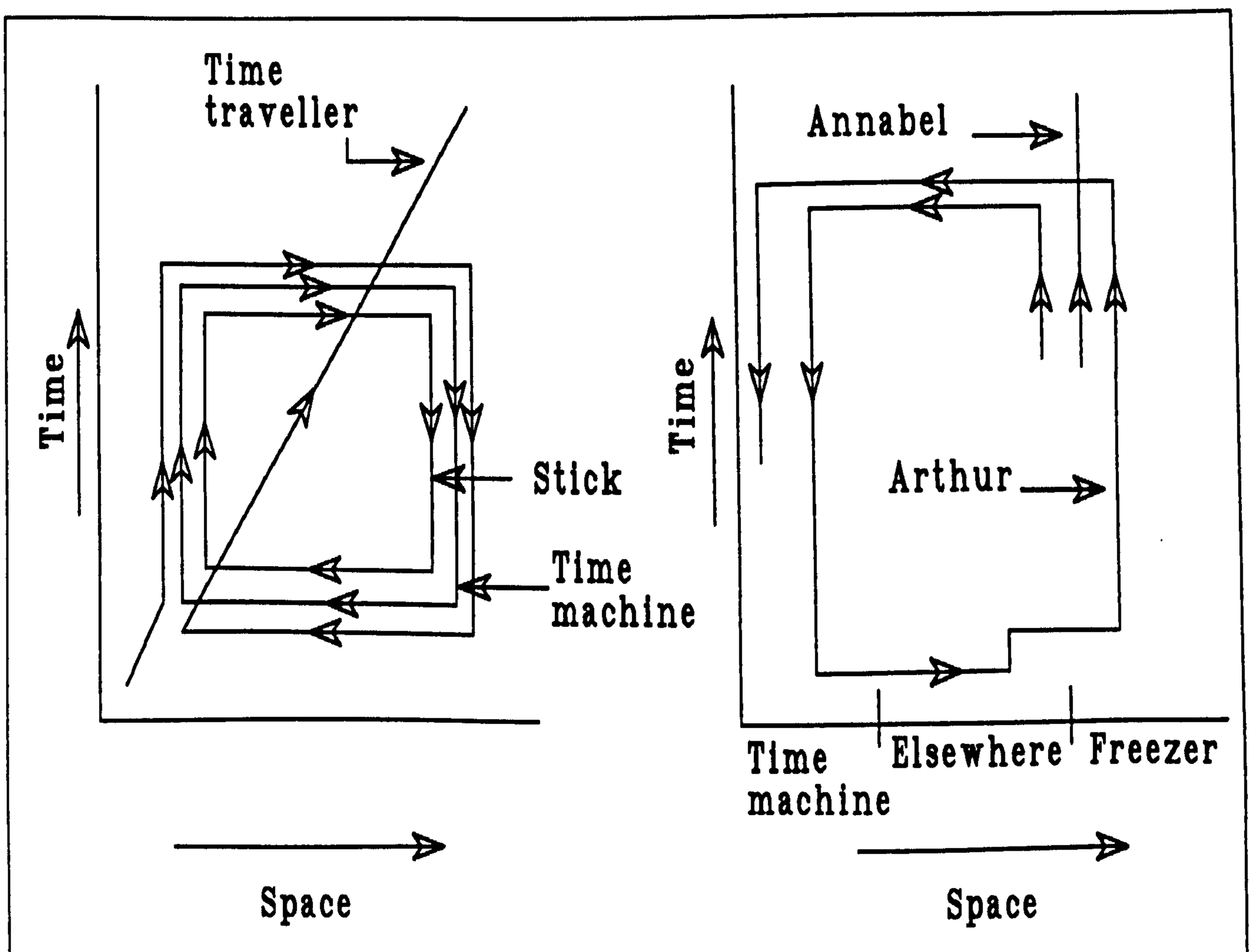

Time
traveller
Time
Stick
Time
machine
Space
Annabel
Time
Arthur
Time
machine
Elsewhere
Freezer
Space
A
B

Fig. 5.4

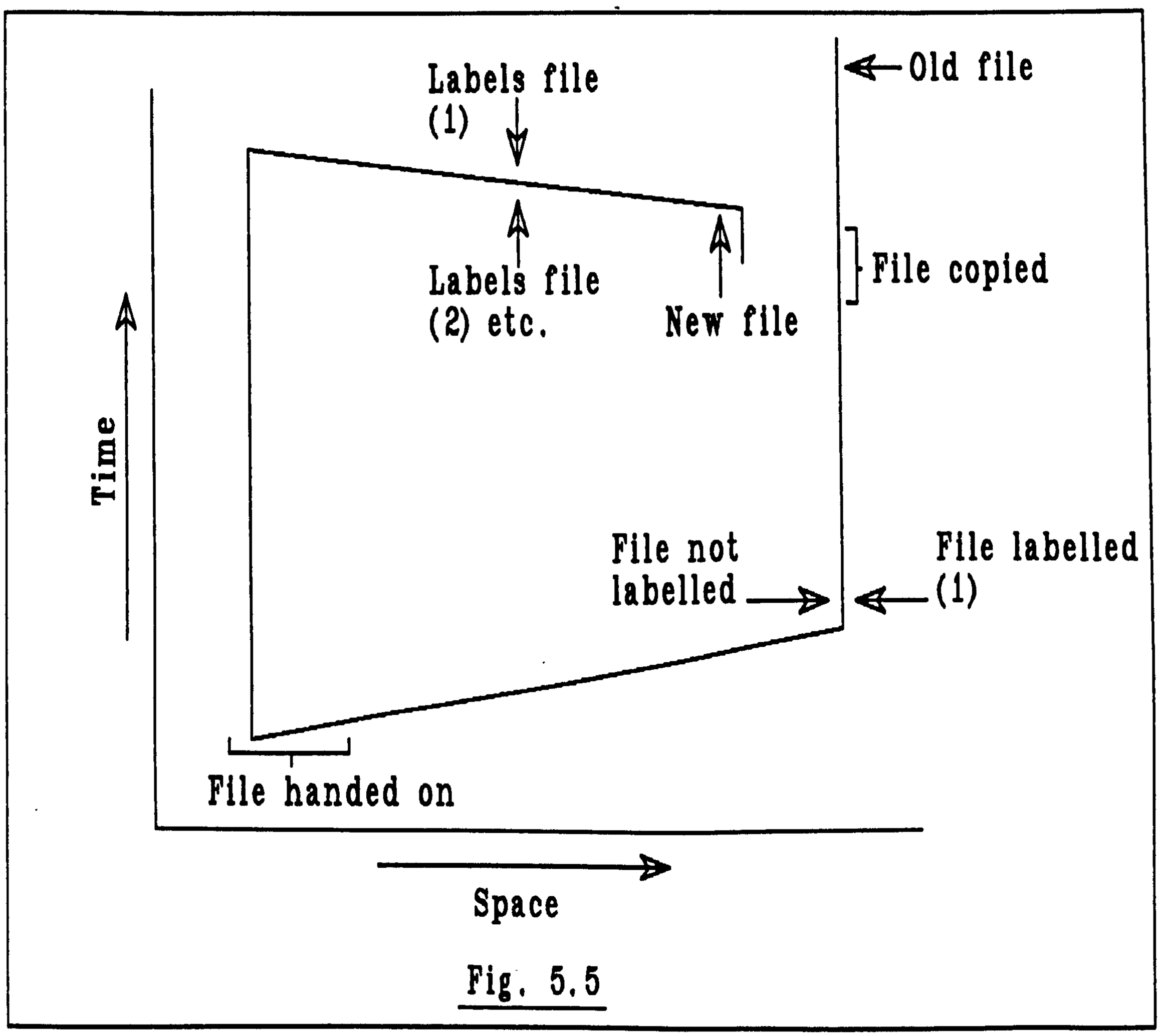

Old file
Labels file
(1)
Labels file
(2) etc.
New file
File copied
Time
File not
labelled
File labelled
(1)
File handed on
Space

Fig. 5.5

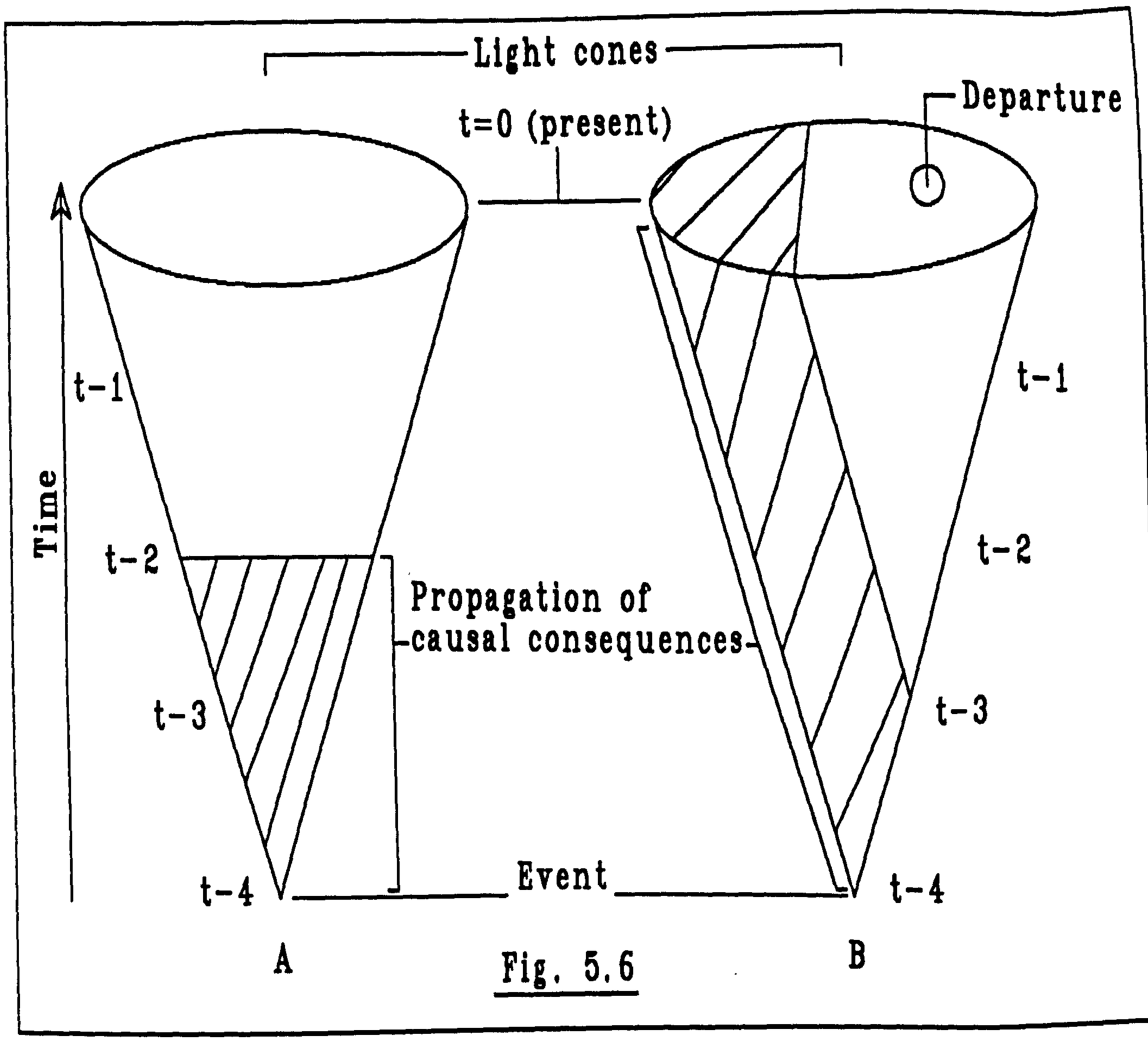

Light cones
t=0 (present)
Departure
Time
t-1
t-2
t-3
t-4
Propagation of
causal consequences
Event
A
B
t-1
t-2
t-3
t-4

Fig. 5.6

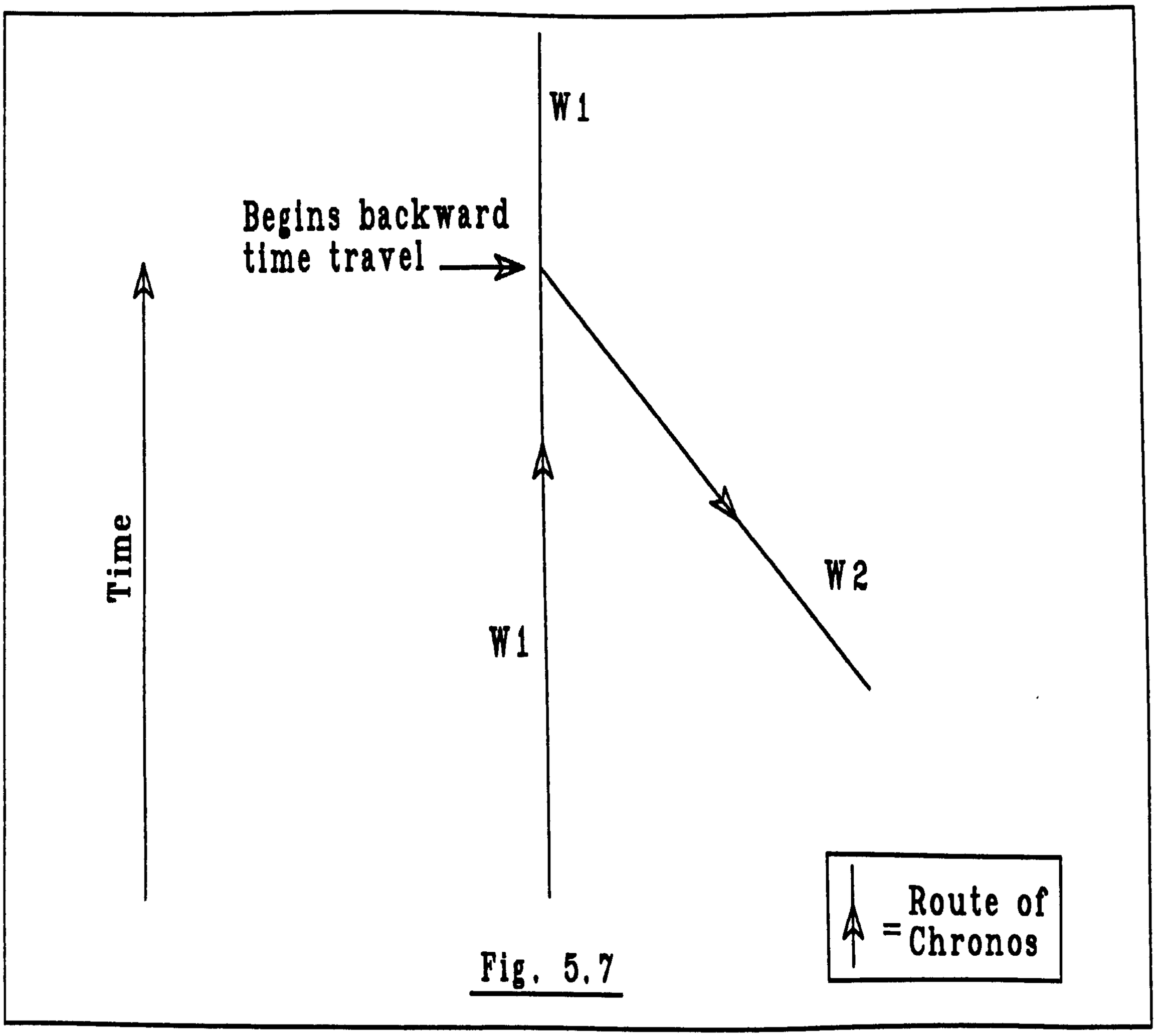


Fig. 5.7

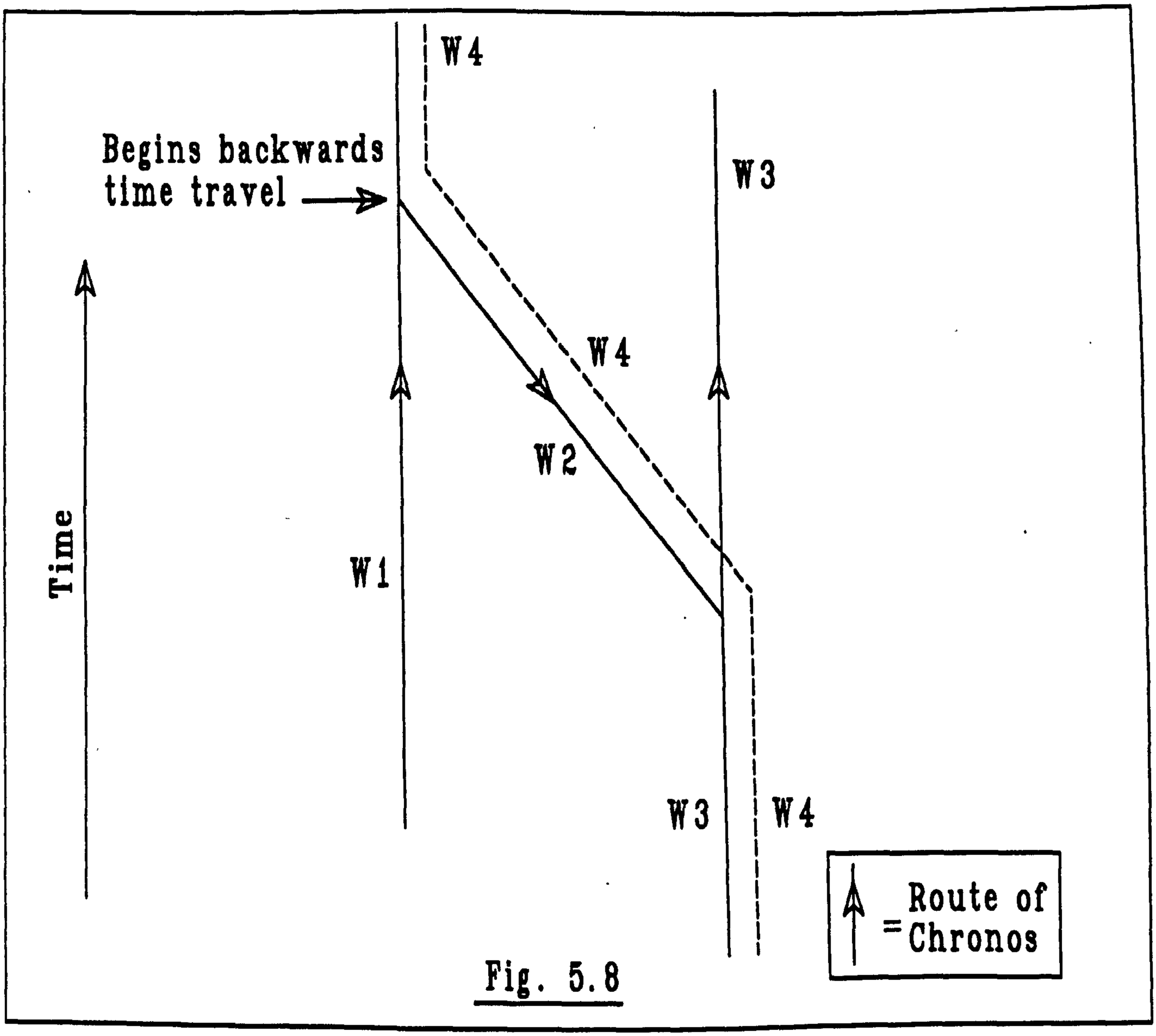

W4
Begins backwards
time travel
W3
W4
W2
W1
Time
W3
W4
Route of
=Chronos

Fig. 5.8

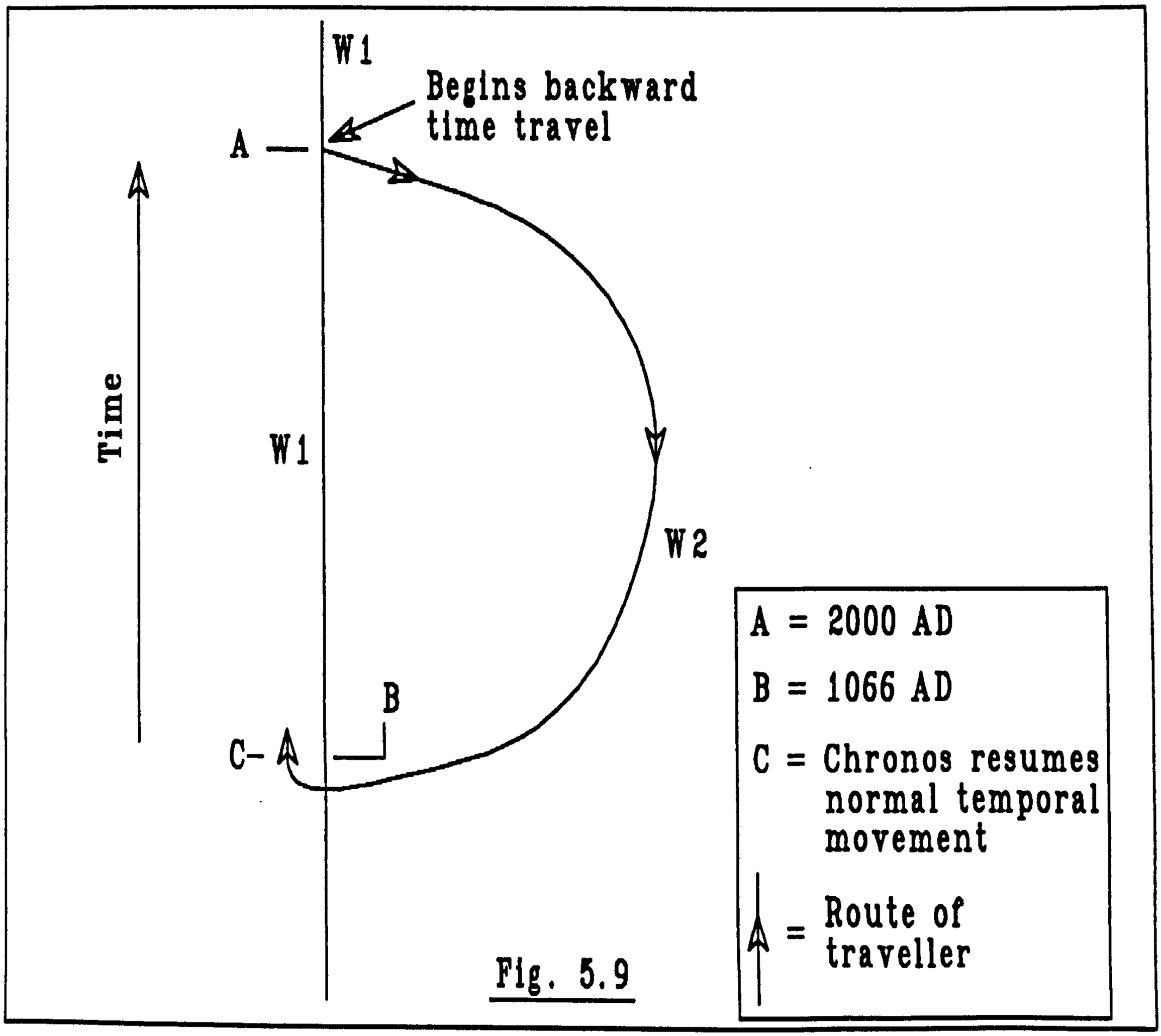

W1
Begins backward
time travel
A
Time
W1
W2
B
C
A = 2000 AD
B = 1066 AD
C = Chronos resumes
normal temporal
movement
= Route of
traveller

Fig. 5.9

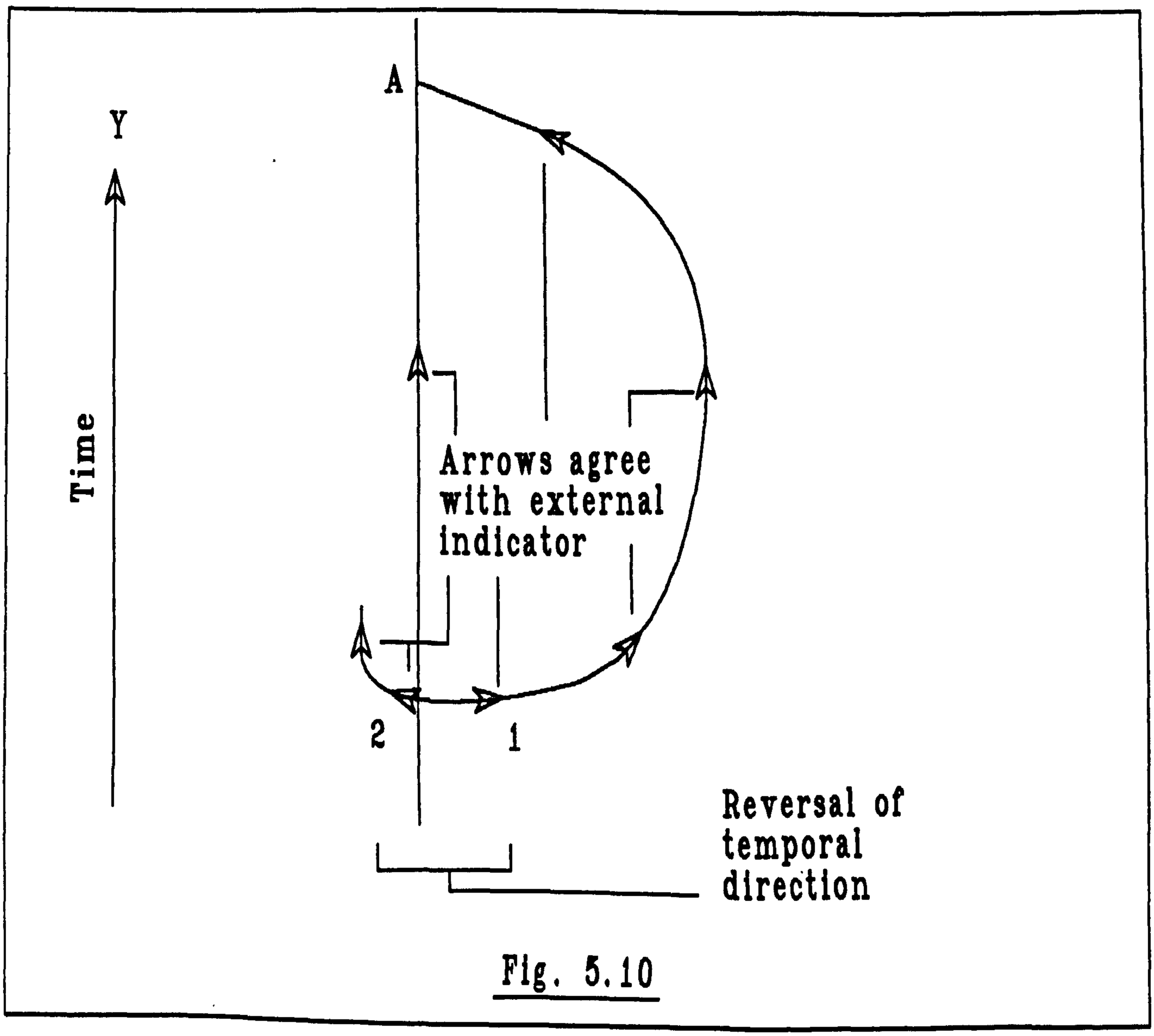

A
Y
Time
Arrows agree
with external
indicator
2
1
Reversal of
temporal
direction

Fig. 5.10

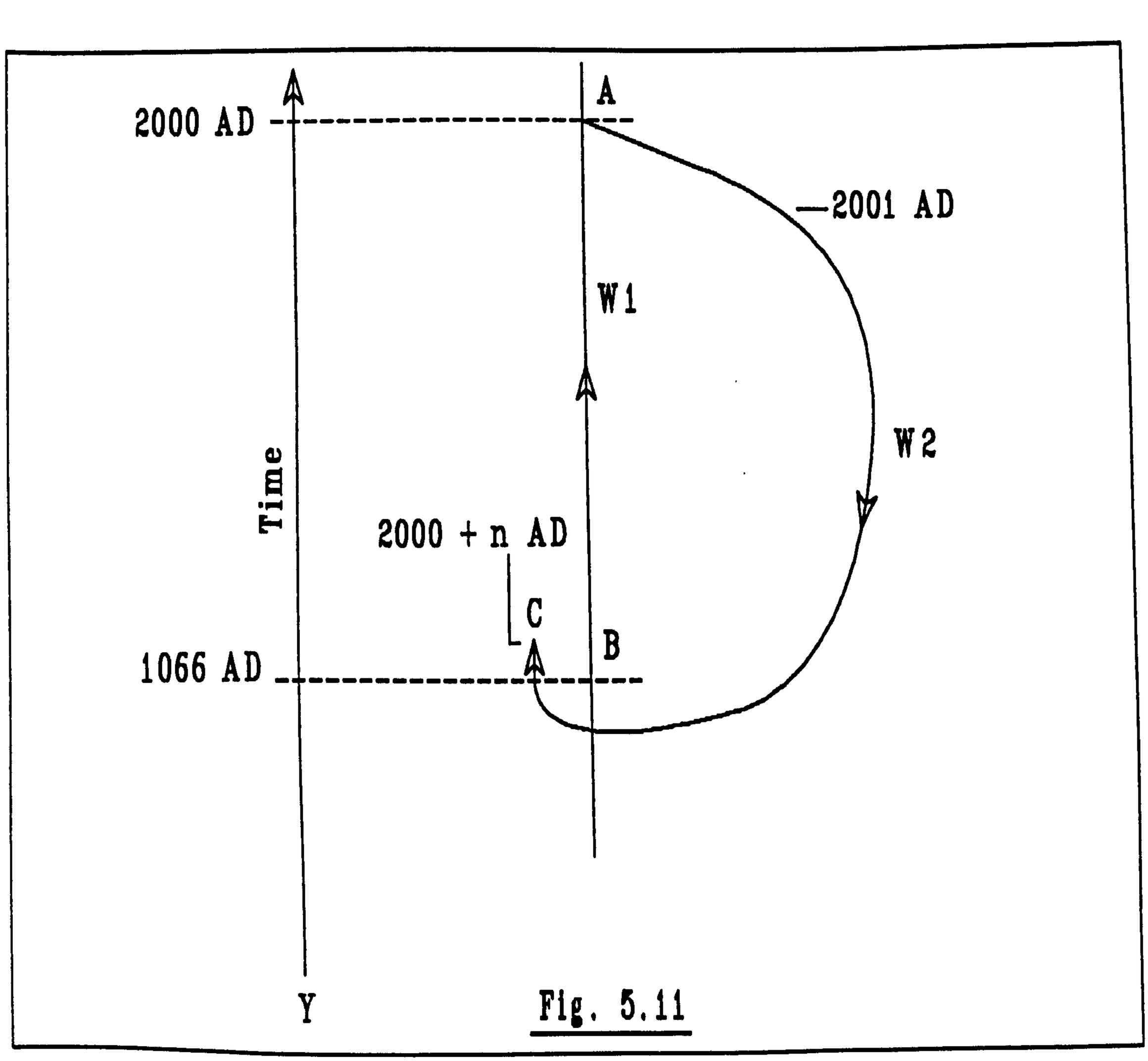


Fig. 5.11

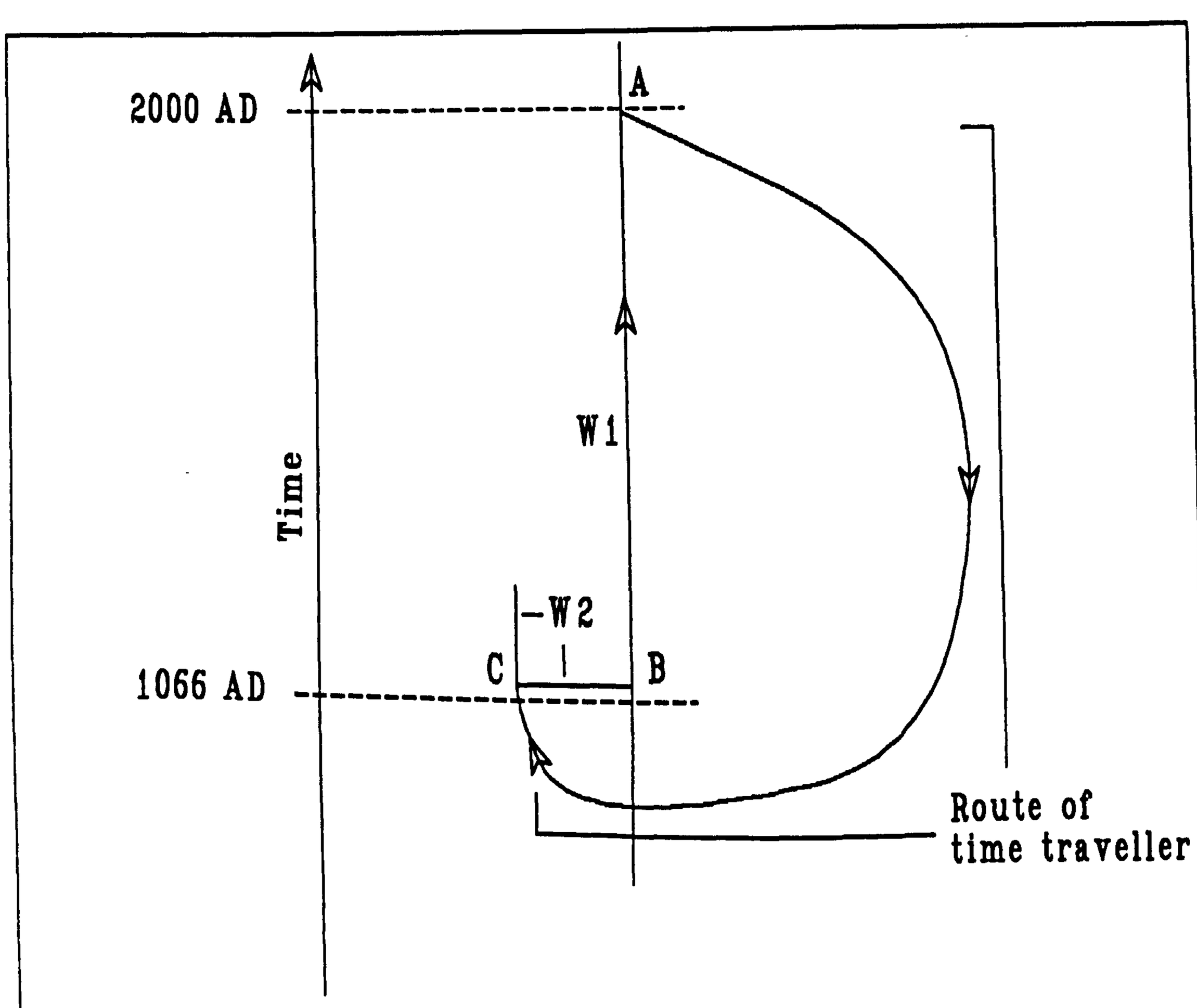


Fig. 5.12