

A model of time for physics and theology

Anthony P. Stone

<stone-catend@ntlworld.com>

(Working Draft revised 8 January 2001)

Status of this version

This version has been developed from a paper given at the Christians in Science Day Conference *Time, Eternity and the Cosmos*, held at St Pauls' Church, Robert Adam Street, London, England, on 7 October 2000.

Part I explains a model of time [1] developed over some years. Its essential points are (a) the distinction between 'chronos' (time in physics) and 'kairos' (time as a sequence of presents), (b) a model of how time progresses.

Part II begins to apply the model to some topics in theology. It does not argue for any particular theology. This Part is preliminary and tentative, and work is in progress. Feedback will be welcome.

The 'model' may take various forms in its various applications.

I. Time in Physics and Philosophy

1. Introduction

We start with a question: "Now that you are reading this, what is happening on the planet Pluto?" Many people think this question has no answer. In terms of our clock time, certain things happen on Pluto at the same time as other things happen here. But according to Einstein's relativity, if we use some other clock- such as the clock in a space rocket - the set of things which are simultaneous becomes slightly different. So simultaneity cannot give us a universal, objective present.

In fact, Einstein said, "There is no such thing as simultaneity of distant events" [2]. This has led many people to despair of finding any objective present, or 'now'. Einstein probably agreed, but what he said simply means that the basics of relativity theory involve no present or 'now'. There is nothing against introducing the present as an *application* of relativity; and that is what one or two people have done.

It's like a computer - a computer has an **operating system** on which everything else depends, and there are **applications** which do an endless variety of things, such as word-processing, financial accounting, and so on.

This sort of discussion usually makes use of the concept of an event at a particular point of space and a particular instant of time: this is known as a 'point event'. So by 'event' I shall mean a point event.

Because of relativity, we just have to accept that the present is not defined by clock time. So, what events are in a present?

If two events are 'copresent' (that is, in the same present), then neither event can influence the other. The fastest possible influences have the speed of light. So two copresent events are arranged in space and time in such a way that it would take a

speed greater than the speed of light to travel between them. Since there are many such speeds, there is a lot of leeway for the present. (The technical term for such a present is a ‘space-like hypersurface’.)

So, the present can be a set of events which is the same for everybody, with one event at each point of space. (Although present is not defined by simultaneity in clock time, that is a possible special case.) This idea is not new. It was explicitly proposed by Nicholas Maxwell in 1985 [3]. Subjective experience of the present was treated fictionally on the same basis by Fred Hoyle & Geoffrey Hoyle as early as 1963 [4].

2. Two kinds of orderings of events in time.

Clock time, which we have been thinking about, may be called time as *chronos*.

‘Chronos’ is a Greek word for time, and I am using it here as a technical term. It is any kind of time which may be ordered by earlier-simultaneous-later -- such as clock time, time coordinates, and time in physical processes.

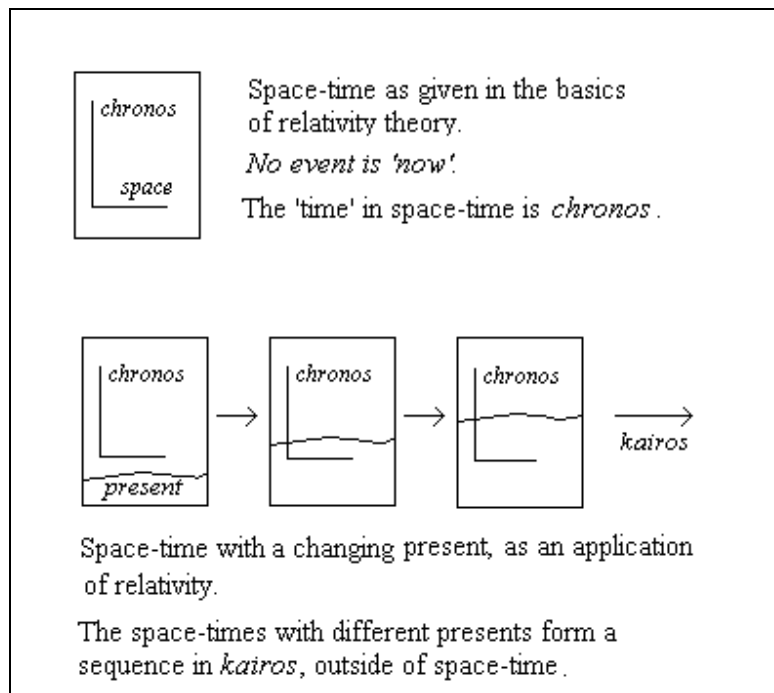


Fig. 1.

The diagram also shows the changing present. This aspect of time is ordered by past-present-future. It is assumed to be outside space-time. This kind of time will be called *kairos*, using another Greek word for time as a technical term.

Fig. 2 shows how orderings by *chronos* and *kairos* relate. Each line in Fig. 2 represents a 3-dimensional space containing events. *S* is any particular event. The curved lines represent different presents. The horizontal lines show events ordered in a particular *chronos* (measured by *t*), and the curved lines show events ordered in *kairos*.

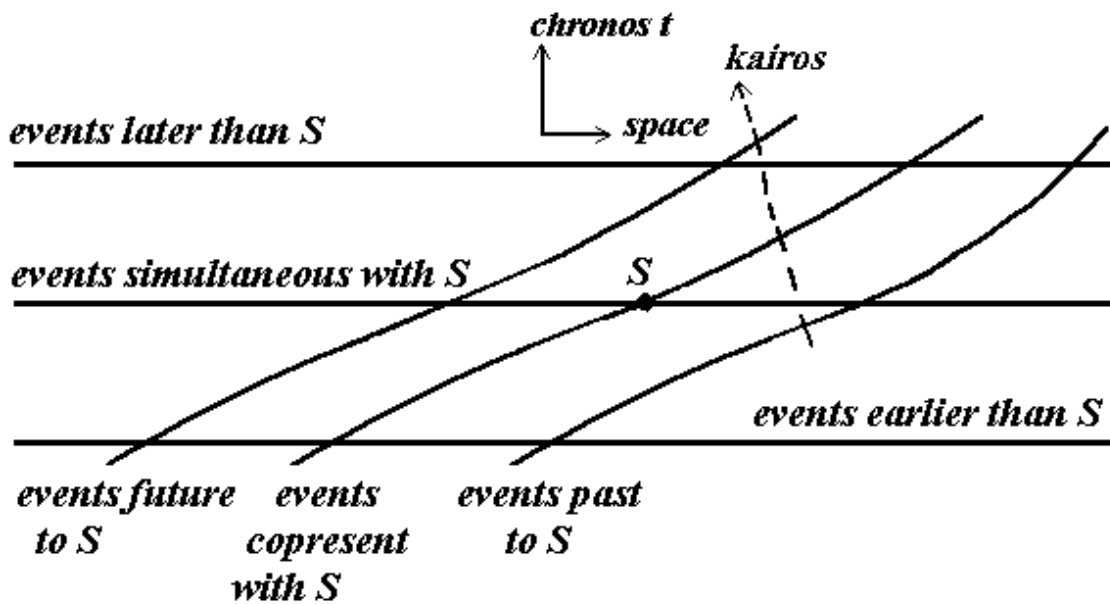


Fig. 2. The time orderings of chronos and kairos

The diagram shows that an event later than S may be future to S, copresent with S, or past to S. Similarly, we can have every combination of future, copresent and past with simultaneous or earlier. So these relations between events are completely independent of each other. In relativity there are many cases of chronos, and these reckon different sets of events to be simultaneous. But there is only one kairos.

Linguistic usage, when being precise:

earlier, simultaneous, later refer to **chronos**;
past, copresent, future refer to **kairos**;
before, after are **not used** with either term.

Fig. 3.

(Thus 'at an earlier time' is more precisely 'at an earlier chronos'; and 'past times' is more precisely 'past kairos'.)

3. The open future

Relativity treats events as being in 'space-time'. When we think of relativity in this context we should have in mind general relativity, which deals with gravitation, rather than special relativity which does not. In general relativity, a particular space-time contains the totality, throughout time and space, of the physical events in a certain universe. This may be called a *possible space-time*.

The present which is actually happening is called *now*. Model 0 for time is explicitly constructed so as to allow for more than one possible future at a given 'now'. We therefore have to consider many possible space-times. These will agree up to 'now' and differ from 'now' onwards; i.e., they agree on the past but have different futures.

Since the present is a fixed set of events in space-time, all these possible space-times may be combined into one structure which has a single past and which branches at 'now' to give many possible futures. Such a structure is called a 'tree'. This is illustrated diagrammatically in Fig. 4, where space-times are represented as one-dimensional. (N.B. All such diagrams, in this and the next Section, show only a few of the many branches.)

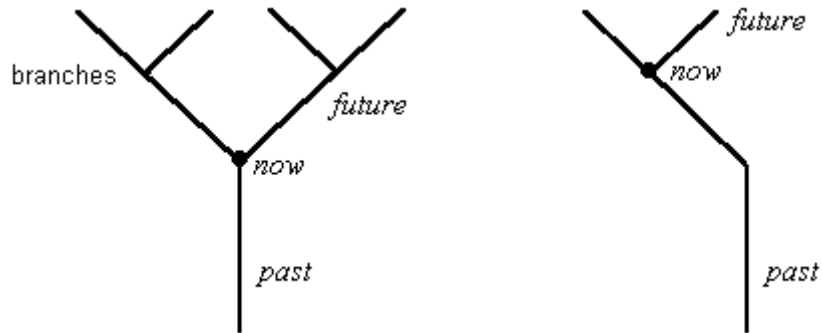


Fig. 4. Tree of possible space-times, at two kairoi

One important use of such trees is in giving the usual logical definitions of 'necessary' and 'possible', which will be used later:

*At a particular kairos,
 a particular future event is **necessary** if and only if it occurs in
 all future branches of the tree;
 a particular future event is **possible** if and only if it occurs in
 at least one future branch.*

Fig. 5. 'Necessary' and 'possible'

4. The changing 'now'

Possible space-times allow for an open future, but how is the future chosen? The answer to this question puts the dynamic into any theory of time. Model 0 does it by something analogous to a computer program running in kairos.

The program will be referred to as 'the program for becoming', where 'becoming' is a semi-technical term meaning 'coming to be'. The program in outline is as follows, where P, Q are variable presents:

The program for becoming

1. Choose some initial present I
2. Put the variable present P = I
3. Put Q = a present very near P and future to P
4. 'Now' changes monotonically and continuously from P to Q
5. Put P = Q
6. Go to 3

Fig. 6.

Fig. 7 shows how chronos and kairos relate as the program runs. Outside space-time, kairos is the independent variable; but within space-time it is chronos which is the independent variable.

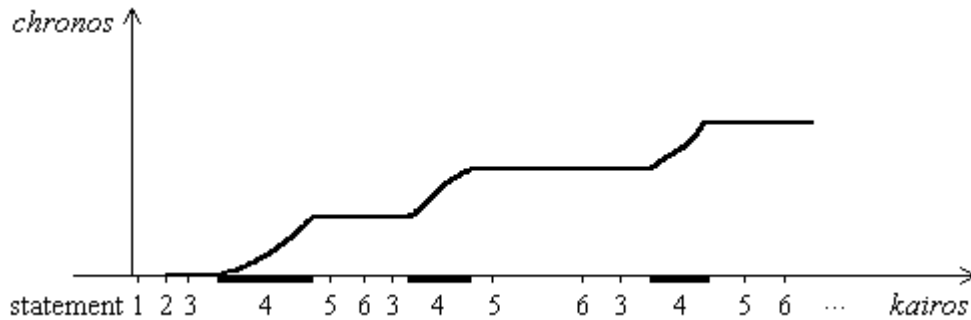


Fig. 7. Running of the program

The main variations in this model will probably come from the details of how the present Q is chosen at statement 3 of Fig. 6. This will be important for Part II.

My original suggestion was that there are agents in space-time and also agents outside space-time, all of whom give input about their choice of the presents Q, which is moderated by ‘the highest agent’.

For our purposes in Part II, the highest agent is God. My original suggestion implies that God is directly involved in every aspect of the time-development of the world, so that ‘laws of nature’ are (in simple terms) the regularities in God’s working in the physical world. Events conforming to the laws of nature and any which do not (such as some miracles), are on precisely the same footing.

Such a suggestion may be modified by postulating that much input is through God-given ‘laws of nature’ (hence through second causes). Any event not conforming to the laws of nature arises from God’s moderation of the choice of the present Q.

5. The realm of kairos

The model is still missing one vital ingredient: how kairos changes. It is postulated that there is a ‘realm of kairos’, outside of space-time. A source of variation in the model is the mode of advance of kairos.

My original suggestion was that each agent in this realm has their own ‘time-line’ with a linear sequence of kairos, reaching only up to their own ‘now’. This sequence is further extended by the agent’s thought and action, and also by what happens to them from outside. The collection of all individual ‘nows’ constitutes the present in kairos.

A simpler possibility is that the present in kairos is advanced by the highest agent alone.

Kairos also differs from chronos in that so far, we do not need to apply any measure to kairos - only linear ordering.

This completes the description of some forms of Model 0.

6. Technical applications in physics & philosophy

6.1. Time's arrow

The arrow of time is an integral part of the model, in that the program runs forwards in kairos.

6.2. Empirical effects of the present

In principle, the model does allow observable effects of the present. So far, no practicable experiment has appeared.

6.3. Wave-function collapse

Wave-function collapse happens at an instant: if this is taken to be an instant of chronos, the collapse is seen differently by different observers, and many problems arise. However, if collapse is taken to occur at an instant of kairos (i.e., at a present), it is the same for all observers.

6.4. Justification of tense logic

Tense logic deals with various logical systems involving past, present and future. If there were no objective and universal present, this enterprise would be flawed. The model justifies tense logic in that it shows such a present to be possible even in relativity.

II. Time in Theology

7. Theological models for time

7.1. The Highest Agent

Particular theological models for time are obtained by making some modifications to Model 0, principally that God is the 'highest agent'. (Of course, God is more than an agent, but he is also an agent.)

7.2. Possible worlds and feasible worlds

A *possible world* will mean an abstract, total course of events, physical, mental and spiritual, in our universe. We do not insist on general relativity but leave the physics open, except that a possible world must possess a family of presents.

A *feasible world* is a possible world from which God can input a present in the program for becoming (either because it is the only world available or because he allows a choice). When feasible worlds branch according to choice, they represent a limited form of libertarian freedom. Otherwise, branching of feasible worlds could represent quantum mechanical properties of the universe.

An *unfeasible world* is a possible world which God could actualise, but has eternally decided that he will not.

Possible worlds are well known in the logic of necessity and possibility, and feasible worlds – in some definition or other – in the philosophy of religion. We may distinguish two kinds of necessity here (cf. Fig. 8):

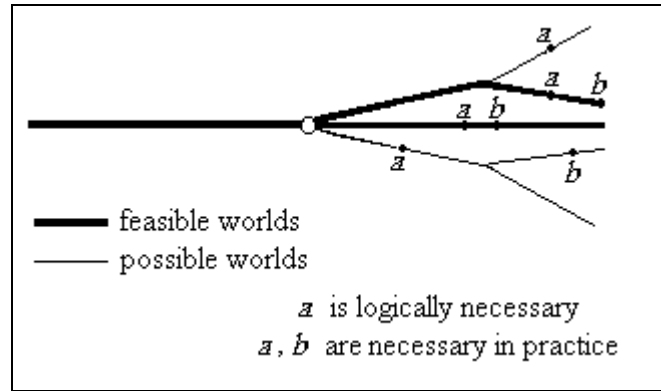


Fig. 8

- If some feature is present in all possible worlds, then it is *logically necessary*.
- If some feature is present in all feasible worlds, then it is *necessary in practice*.

7.3. Specification of a model

A theological model for time, on the lines being considered, is specified by a tree of feasible worlds and the program for becoming.

8. God's time

This is one of the most difficult topics, but it needs to be considered briefly at this stage

8.1. Jesus' life on earth

The incarnation brought Jesus into chronos. But the involvement of the godhead in time is clearest when Jesus on the cross cries out, "My God, my God, why have you forsaken me?" There was a breaking of the fellowship between Father and Son, for a certain length of chronos.

This seems to provide an example of a sequence of events in the godhead: a state in which Father and Son are not in fellowship cannot coexist with the usual state in which they are in fellowship.

8.2. New heaven and new earth; resurrection body

What would be the point of these if there is no sequence in the future state?

8.3. Timelessness

Paul Helm [5] has argued for the timelessness of God. Many of his arguments may be interpreted as showing that God is not in chronos, while leaving open the possibility that God is in kairos (at least in some sense).

Thus if Ps. 90:2 shows that 'God exists *timelessly*; [and] the creation he brings forth is subject to *time* and change', then *time* here should be read as chronos. Similarly in the deductions that 'whatever is created is in *time*' and 'whatever is the creator is outside *time*'.

It may be that God's incommunicable attributes include timelessness in some way, while his communicable attributes include working in kairos in some other way.

8.4. God and the realm of kairos

The theological model(s) will assume that kairos is, in some way, God’s time. Kairos must then be beginningless. This may pose a difficulty: In the case of chronos one can argue that it must have a beginning, because it is not possible to pass through an infinite number of finite intervals of chronos. Does this argument apply to kairos, or not? It might not! The following example suggests that the situation in kairos may be different.

We first note that a distance of 1cm includes points at distances ..., 1/4 cm, 1/3 cm, 1/2 cm, 1 cm from one end (omitting zero; see Fig. 9). This is a beginningless infinite series of points, but it can easily be traversed by stepping over it.

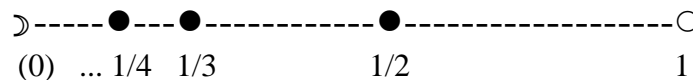


Fig. 9

Now suppose that in some unit of measurement the boundaries of a sequence of finite events in kairos have the values

... 1/4, 1/3, 1/2, 1, 2, 3 ..., omitting 0.

Up to 1 there is an infinite number of events, but no first event. Although we cannot imagine how, it does not seem as difficult to cover the kairos between 0, 1 as it would be to cover an infinite length of past kairos.

Kairos also provides the ‘time-line’ written about by Oscar Cullman [6].

9. God’s action in the world

This is built into the models through the program. God has the final say about the future. The laws of nature, and miracles, have been mentioned in Sec. 4.

10. Divine sovereignty &c: Model 1 - Only one feasible world

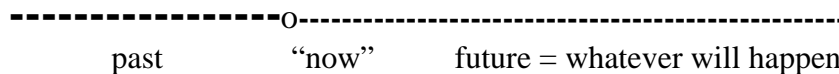


Fig. 10. Only one feasible world

10.1. Calvinism – God’s sovereignty

Calvin wrote, ‘nothing happens but what he [God] has knowingly and willingly decreed’ [7]. This corresponds to Fig. 10 - only one feasible world.

This means that no-one has ‘power to contrary’ [8], or libertarian freedom as to what they will think or do. One person may want to sin, approve of sin, and actually sin, thus becoming guilty, but had no alternative - there is no other feasible world. Another person may want to do right, enjoy doing right, and actually do right, but with no power to contrary.

Calvinists describe this by saying that we act according to our nature unless aided by divine grace; and our nature and its acts were decreed by God. Sinful acts are decreed in God's permissive decree. This also means that our petitionary prayers are also decreed.

Calvin also remarks that what God has decreed is still not logically necessary. He gives the example that Jesus' 'bones were capable of being broken, and yet it was impossible that they should be broken', because of the prophecy in Ps. 34:20, quoted in Jn. 19: 36 [9]

he protects all his bones, not one of them will be broken.

In other words, Calvin holds that Jesus' bones are broken on the cross in some unfeasible worlds, but not in the actual world. So it was necessary in practice that Jesus' bones were not broken.

Similarly, the thought is that in the actual world - the one decreed by God - someone sins, but there are unfeasible worlds in which they do not sin. So while it is not logically necessary for someone to sin on a particular occasion - because it is possible for them not to sin - yet God may have decreed that they sin, in which case this is necessary in practice. See Fig. 11.

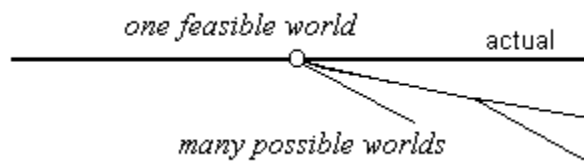


Fig. 11. One feasible world and many possible worlds

A logical axiom for Calvinistic theology, derived from Fig. 11, is thus:

If a certain event occurs, then it is necessary in practice that it occurs.

10.2. Election

In Calvinistic theology, the elect are a certain set of individuals in the one and only feasible world.

Jim Packer [10] says, 'It has ... become common to define predestination as consisting of election and reprobation together. It is disputed whether reprobation ought to be thus included ...'.

As Birkhoff [11] claims, the *logic* of Calvinistic theology entails reprobation. An elect person cannot be lost. Suppose a non-elect person is finally saved; then this was eternally decreed by God, and that person is in fact elect. Hence the elect and non-elect are identical with the finally saved and the finally lost, respectively. But maybe logic is not everything! Or, we may not know all the relevant premises.

10.3 *God's knowledge of the future*

In Model 1, God has complete knowledge of the future.

11. Model 2 - More than one feasible world

11.1. *God's sovereignty*

There are also theologies in which God has not determined every detail of what happens [12]. This corresponds to Fig. 8, with more than one feasible world.

There are many aspects of life which appear to be slightly variable without producing any effect on other things.

- a. Reading a book at 1mm to the left of its actual position, when this does not affect anything.
- b. Raising one eyebrow rather than the other when it has no significance, no-one sees, and any small effects are quickly dissipated.

Why should there not be power to contrary in these cases? This would mean that many feasible worlds exist.

To get a definite model (Model 2, say), we shall assume that events in feasible worlds are restricted to fixed possibilities created by God. There are some constraints on these possibilities. For instance, when I was born, there is unlikely to have been a feasible world in which I become Prime Minister.

People will often have a choice of feasible worlds; but God's fixed purposes are eventually attained - so that at some stage certain events become necessary.

We end up with a distinction between two kinds of human freedom. In Model 1 there is the freedom to act in the way God has decreed, and where Model 2 has branching to non-necessary actions, there is the freedom to choose between actual possibilities; but there is not freedom of choice in every situation.

Calvin's example of Jesus' bones not being broken, goes through as before: Jesus' bones are broken in some unfeasible worlds, but not in any feasible world.

11.2. *God's knowledge of the future, and human freedom*

Some who believe in an open future hold that the future does not exist, so that in this respect there is nothing for God to know.

However, in Model 2 the future is open (to an extent), but God has complete knowledge of all feasible worlds.

In Model 2, in which many actions are not necessary in practice, does God know which feasible world he will actualise? No; because -

1. Suppose I perform a particular action A in some feasible worlds, but not in others.
2. It is logically necessary that: if God knows that I will perform A, then I will perform A.
3. If God knows that I will perform A, then I will perform A. (2, $\Box p \Rightarrow p$)
4. If I will perform A, then God will actualise a world containing A. (Model 2)
5. If God knows that I will perform A, then God will actualise a world containing A. (3, 4)
6. If God knows that I will perform A, then a world without A is not a feasible world. (5)
7. God does not know that I will perform A. (6, 1)

So God does not know what my choice will be until I make it. This result is provable because of God's direct involvement in the program for becoming (at 4), i.e. in the running of the universe.

What God does know in Model 2 includes all feasible courses of events - because he has created them - and he knows that things which are necessary in practice are certain.

11.3. Election

11.3.1. A simple example

Suppose that at a certain kairos a person who is one of the elect is alive but is not a Christian. Then in all feasible worlds at that kairos this person becomes a Christian, but the events leading up to this may differ widely in different worlds (see Fig. 12).

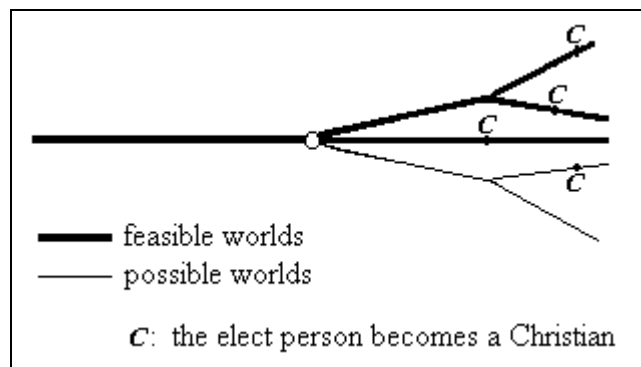


Fig. 12

11.3.2 Cyrus

At the kairos of Isaiah's prophecy about Cyrus [Is. 45:1sq], all future feasible worlds contained a ruler named Cyrus. The way this came about in the different worlds may vary (even in the date and time of birth).

11.3.3. The elect as particular individuals

Since God created all feasible worlds, he knows what individuals are born in each of them. On the interpretation that the elect are particular individuals, one model of election is that all elect individuals are born in all feasible worlds. That imposes many limitations on these worlds. Assuming that an individual is defined by ancestry, each of the elect would have the same ancestry in every world.

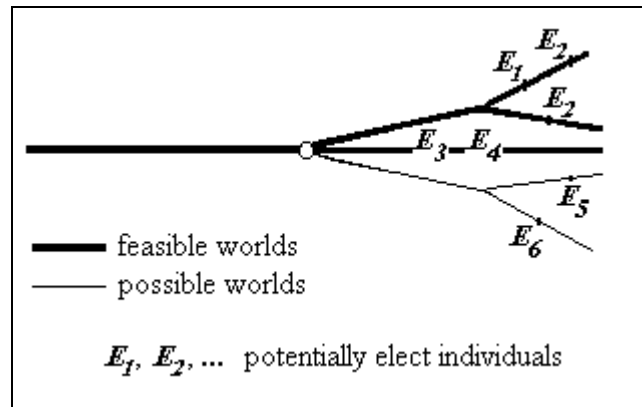


Fig. 13

We can have another model of election, which seems not to be contradicted by the Bible, in which certain individuals are 'potentially' elect and become elect if they are born. In this model, which is a form of Model 2, not all the potentially elect are born in all worlds. This allows a degree of freedom about who is born. This is illustrated in Fig. 13.

* * *

References

- [1] Anthony P. Stone, 'A program model of becoming'. *Physics Essays*, **10**, 1997, 150-163
- [2] Albert Einstein, 'Autobiographical notes' in Paul Schilpp, *Albert Einstein, Philosopher-Scientist*, 1949, 61
- [3] Nicholas Maxwell, 'Are probabilism and special relativity imcompatible?', *Philosophy of Science*, **52**, 1985, 23-43
- [4] Fred Hoyle & Geoffrey Hoyle, *Fifth planet*. William Heinemann, London, 1963, vii
- [5] Paul Helm, *Eternal God*. Clarendon Press, Oxford, 1989; 3, 19
- [6] Oscar Cullman, *Christ and Time*³. SCM Press, London, 1962
- [7] John Calvin, *Institutes of the Christian Religion*. Tr. Henry Beveridge, 1.16.3
- [8] D. A. Carson, *Divine sovereignty and human responsibility: Biblical perspectives in tension*. Marshall, Morgan & Scott, London
- [9] John Calvin, ref. 6, 1.16.9
- [10] J. A. Packer, 'Predestination/ III. Election and Reprobation', *NBD*¹, 1026
- [11] L. Berkhoff, *Systematic theology*. Banner of Truth, reprinted 1963, 117
- [12] E.g. Roger Forster & Paul Marsden, *God's strategy in human history*. Highland Books, 1989, 28-30 on Eph. 1:11