

# **A Dynamical Model of Church Growth and its Application to Contemporary Revivals**

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# **A Dynamical Model of Church Growth and its Application to Contemporary Revivals**

## **ABSTRACT**

The Christian church has grown substantially since its beginnings in the first century AD, with much of that growth coming through conversion into the church. This paper sets up a dynamical model of such church growth, based on the methods of systems dynamics, capable of giving qualitative analysis and quantitative simulations of growth.

The model investigates the claim that conversion growth is driven by a sub-class of church members called enthusiasts who alone are active in the conversion of others. These enthusiasts make contact with unbelievers leading to some being converted. Some of these new converts also become enthusiasts. A further claim is that enthusiasts only retain their conversion potential for a fixed length of time after which they become inactive church members playing no further part in recruitment.

The effect of enthusiasts on the growth of the church can be quite dramatic, following a similar pattern to that of an epidemic. Although substantial growth is possible it eventually “burns” itself out due to a lack of enthusiasts. This behaviour is similar to the patterns of growth seen in religious revivals of the past. The model is applied to such recent phenomena as the Toronto Blessing and the Alpha course.

## INTRODUCTION

There is no doubt that the Christian church has grown substantially since its birth around 30 AD. It started with a few hundred people in and around Judea and after 2000 years has exceeded 1000 million people, some 28% of the world's population (Brierley 1999 Table 1.2.1, figure 1.3.2). Often this type of growth is described as "exponential". But what is exponential growth?

True exponential growth assumes the population, in this case the church numbers, increases at the same rate each year. Consider the following situation. A church has a guest service where everybody in the church is asked to bring one new person. If all those people come and stay then clearly the church doubles! Now say that the church had started with 100 people and has one such guest service each year. After the first year the church has 200 people. After the second year that becomes 400, if all the new converts recruit the same way. In subsequent years it becomes 800, 1600, 3200 etc. This is exponential growth. The rate, "multiply by 2", is the same each year. The growth becomes explosive.

What has been constructed here is a model, in this case the exponential model. It can be described using mathematics, and is one of the simplest models of population growth that can be constructed. Such a model can give insights into the quantitative growth of a church. As yet such quantitative models have played little part in the study of church growth.

Church growth studies can be divided into two strands: The Church Growth Movement within the Christian church; and the social science strand within academia (Inskeep 1993). The Church Growth Movement was pioneered by Donald McGavran at Fuller Theological seminary but is now pursued in many other seminaries and by specialist organisations. The work was developed in order to service the growth needs of the Christian Church, particularly in the light of the decline seen in many older denominations. As such much of its work is at the popular level and qualitative in nature (McGavran 1990; Pointer 1984; Wagner 1987). Quantitative work is restricted to data gathering and interpretation (see for example Brierley 1999).

The Social Science strand grew very much as a reaction to a book originally published in 1972 by Kelley (1995). Kelley stated the thesis that conservative, or strict, churches are strong and hence grow, whereas the more liberal churches are weak and hence decline. This has led to a flourish of research to either prove or disprove Kelley's thesis and explain the continued strength of religion in the USA. As such there has been a move away from secu-

larisation theory, which saw religion as something that would wither away in a modern progressive society (Berger 1969; Wallace 1966), towards serious attempts to understand why churches grow. This paradigm shift in the sociology of religion is described by Warner (1993), and is seen in the work of Stark (1996), Stark and Bainbridge (1985; 1987), and Iannaccone (1992; 1994).

Much of the church growth modeling in the social science strand is empirical in nature using statistical methods (Hoge and Roozen 1979; Roozen and Hadaway 1993). However Stark (1996:7) produced an arithmetic model, similar to the above exponential one, for growth in the early church, based on similar ideas in Stark and Bainbridge (1985, Chapter 16). Iannaccone, Olsen and Stark (1995) produced a model of church growth along economic lines, however none of these sought to derive the dynamics of the growth from the underlying causes.

In a true dynamic model assumptions are used to construct the model, which in turn leads to growth or decline. In the case of the exponential model the assumption is that every person brings someone new to the church in a set period of time, and keeps doing so over similar periods of time. This leads to a growth rate that is constant per person, i.e. the rate of growth is proportional to the number in the church. The exponential solution is the inevitable result of the original, highly idealistic, assumption. The accuracy of the result only depends on the accuracy of the assumptions!

More recently Hayward (1999) presented a mathematical model of church growth, which assumed that only some of the church members were involved in the conversion process (called enthusiasts or active believers), and their enthusiasm, or conversion potential, only lasted for a limited period of time. The result was behaviour similar to an epidemic, where growth could be explosive but always burned out eventually. This approach showed the advantage of using a mathematical model as the consequence of making these assumptions could be worked through precisely. If the resulting behaviour was not seen in church growth then clearly other factors must be at work. Indeed it is easy to see factors that are missing by asking questions of the above scenario: “What if only some new converts bring in others?”; “What if some of the people fall away?” Tackling such questions is one of the advantages of mathematical modeling.

However this mathematical approach had a distinct disadvantage in that many of the people interested in church growth are not mathematicians so would not be able to follow the

technical mathematics used in the paper. In order to widen access to the dynamic modeling of church growth a different approach is needed. Systems dynamics, or systems thinking, is one such alternative approach. It was originally developed by Forrester (1961) and has been successfully used in such diverse fields as business modeling, ecology, organisational strategy, psychology and sociology (Goodman 1989; Senge 1992; Sterman 2000).<sup>1</sup> Such systems dynamics models are capable of simulation with specialist software.

This paper has three aims:

- To convince church growth practitioners and sociologists of religion that a systems approach to modeling church growth is worth considering;
- To make clear the consequences of the assumption that churches grow through enthusiasts, who are a subset of the church, and whose enthusiasm doesn't last indefinitely;
- To re-express the mathematical model of church growth of Hayward (1999) in systems format, extending it so that not all converts become enthusiasts.

As such a number of models will be developed. In each model it will be possible to:

- State the assumptions underlying the model;
- Establish the consequences of these assumptions;
- Establish principles of growth;
- Identify the parameters in the model and determine their effect.

Each model will be presented using the causal loop diagrams of systems thinking, the qualitative side of systems dynamics. The technical details of the systems dynamics models are given in Hayward (2000) and on the author's website.<sup>2</sup>

## **MODEL OF CONVERSION GROWTH**

### ***Systems Thinking***

Systems thinking reduces the dynamics of a problem to the relationship between cause and effect, between conditions and actions. Once some causal assumptions are made a quanti-

tative model follows. As an example consider how the exponential church growth mentioned in the introduction follows from a causal model of conversion growth.

The *conditions* are the number of people in the church called the *believers*. The *actions* are that each person brings someone into the church, which will be called the *conversions*. The more believers there are the more conversions occur. It may be that the believer has brought the person to a service where some truth, when heard, results in the conversion. It maybe that the believer has told the unbeliever that such services exist or they have been a “good advert” for the beliefs of the church. These points are discussed in Hayward (1999).

Of course the conversions now result in an increase in the number of believers. More conversions yield more believers. These links can be represented in a causal loop (figure 1).



Figure 1: Causal loop diagram for the conversion process - positive feedback

The plus sign indicates the change in the effect is in the same direction as that of the cause. If one increases so does the other. Because both links are positive the result is a reinforcing loop, also called positive feedback, represented by the “R”. It is this process that drives the exponential growth.

This type of analysis is called systems thinking and is the qualitative approach to systems dynamics often used in business organisations (Senge 1992).

## Model Construction

Clearly exponential growth cannot continue indefinitely as the population is finite. Thus the conversion model is, as yet, incomplete.

The fundamental assumption of conversion growth is that converts result from contact between believers and unbelievers. The more contacts there are between these two groups of people then the more conversions occur.<sup>3</sup> “Believers” refers to those in the church, and “unbelievers” are those outside it.

It is further assumed that believers do not target unbelievers, nor do they shun them, so that their likelihood of contact with a person is independent of whether that person is a believer or not. This is often referred to as homogeneous mixing and is assumed extensively in the theory of the spread of disease (Anderson and May 1987). It means that being a church member does not stop a person having a mixture of contacts throughout society. Homogeneous mixing is discussed in Hayward (1999).

Thus, for a conversion to occur, not only must the believer make a contact with another person, the person must be an unbeliever. As people can only hold down a fixed number of relationships in a given time the probability of contact with an unbeliever will go down as the number of unbelievers gets less. Indeed the probability is the proportion of unbelievers in society:

$$\text{Probability of finding unbeliever} = \frac{\text{Unbelievers}}{\text{Unbelievers} + \text{Believers}} \quad (\text{equation 1})$$

Thus a causal loop diagram can now be constructed for the situation (figure 2).

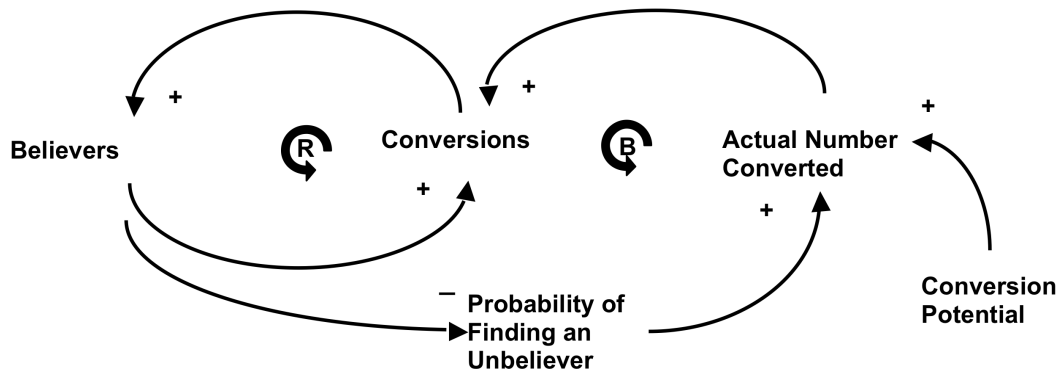


Figure 2: Causal loops for the conversion process in a population of fixed size

The original reinforcing loop giving the exponential growth is still present, however there is now an additional process: as believers *increase* the probability of finding an unbeliever gets *smaller*. This is a negative link indicated by the minus sign. Negative links indicate the effect changes in the opposite direction to that of its cause. The decrease in this probability reduces the number of actual conversions per person in a given time period and hence the total number of conversions into "believers". Tracing all these causal links from "believers" through the probability back to "believers" shows a net negative effect due to the

one negative link. Thus this additional process is a balancing loop, or negative feedback, indicated by the “B”, slowing down the increase in believers as the church grows.

### **Model Simulation**

The model can be simulated using appropriate software. This paper uses software called Stella.<sup>4</sup> For a simulation to take place values need to be provided for the number of believers and unbelievers at the beginning of the time period. The time period of the simulation also needs to be set.

Any parameters in the model also need setting. In this model there is only one parameter: the potential number of people a believer is responsible for converting per year, or conversion potential. The conversion potential is only the same as the actual number converted if all the rest of the population are unbelievers.

If the church is small its growth is initially exponential, due to the reinforcing loop, but slows down as it gets bigger due to the balancing loop becoming more important. Essentially as the pool of unbelievers gets less, believers spend more of their time with each other and the conversions start to dwindle. Thus the actual number converted per year by each believer gets less as their effort is “wasted” on the growing number of believers. This type of curve (the curve called "Believers" in figure 3) is called the S-shaped or logistic curve. Notice that all of the population gets converted. The number of conversions is at its maximum when the two populations are equal.

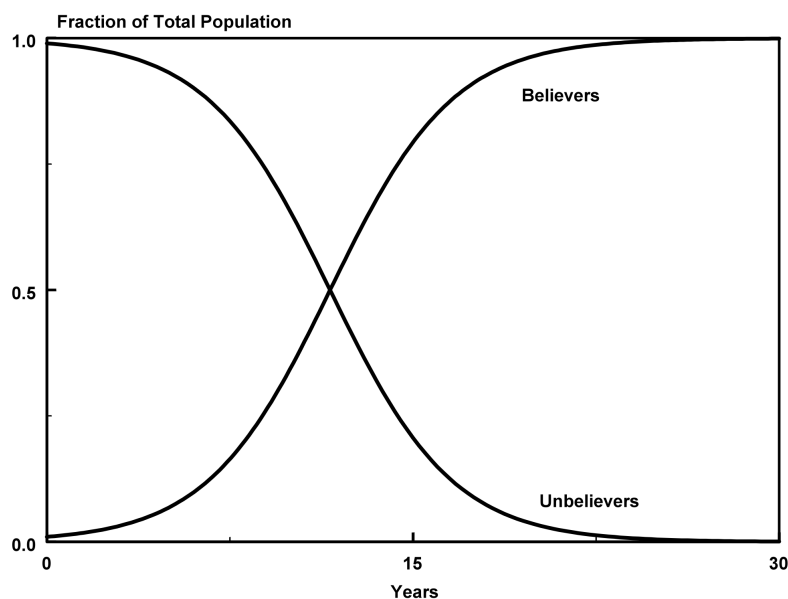


Figure 3: *S-shaped growth of the church, represented by “Believers”*



The model is sometimes called the simple epidemic model, where conversion is the equivalent of acquiring the infection. It is equivalent to the logistic model of population growth, which accounts for the similar S-shaped behaviour. Likening the spread of social phenomena to that of an infection is not new. The model was discussed by Coleman (1964) and similar models are used for the diffusion of innovations throughout society (Kumar and Kumar 1992).

### ***S-Shaped Growth***

S-shaped growth is typified by a slow increase in numbers early on, with the fastest increase in the middle period of the growth, followed by a slowing down. Early on in the growth there are few contacts, and thus few conversions, because the percentage of believers is so small. Because growth is the main factor through which new churches, and revivals in existing ones, are first noticed, it can mean that such a work can be underway for some time before it comes to the attention of the population at large. This was true of the early Christian church which remained small for the first 200 years. E.g. only 2% of the city of Rome was Christian by about 250 AD. Yet by 300 AD the church was so widespread further persecution by the still Pagan state became impossible (Stark 1996:10). Similarly, in Egypt, in the first few centuries, estimates of the size of the Christian church based on inscriptions of Christian names shows similar slow then rapid growth (Bagnall 1982; Stark 1996:12).

A similar slow start can also be seen in the charismatic renewal in the USA and UK through the 1970's which had not been really noticed except by those who were directly involved. However in the early eighties there was rapid growth in the number of independent charismatic fellowships, and other new paradigm churches, most of whom had been operating at a smaller level since the early days of the renewal (Brierley 1999, table 2.10.4; Miller 1998). It was only after they had increased substantially that they drew widespread attention to themselves.

The S-shaped growth is typical of the type of growth seen in religious revivals. A point comes when the growth of the church explodes because there are so many enthusiasts whose contacts are resulting in the conversion of unbelievers, many of whom also become enthusiasts. Such behaviour can be seen in the Welsh revival of 1904, where 100,000 people were converted in just over a year. Likewise the current revival in South America is seeing explo-

sive growth. Nevertheless no revival, however powerful, has ever resulted in the conversion of a whole population. Thus some changes to the model are required.

## ***Summary of the Conversion Growth Model***

### **Assumptions and their Consequences:**

If there are no losses from the church; if births and deaths can be ignored (or even if the birth rate is equal to the death rate in the population); and if all believers are involved in making contacts at the same rate through their lifetime, then all the population ultimately gets converted.

### **Parameters:**

There is one parameter: the number of people per year one believer is responsible for bringing into the church assuming the whole population are unbelievers. This is called the potential number converted per believer per unit of time, or conversion potential. The actual number of converts per person depends on the proportion of unbelievers in society.

### **Principles Established:**

1. The whole population gets converted whatever the conversion rate. If the conversion rate is lower it just takes longer to convert the whole population. The complete conversion of society is a result of the assumptions not any particular values for the rates. If in practice the whole of society does not get converted then some of the assumptions must be changed.
2. The bulk of the conversions occur in the middle period of the growth, with early growth being slow.

### **Limitations of the Model:**

Requires all believers to be recruiters throughout their lives. The model will not apply with anything less than this. It is also limited to time scales short enough that births, deaths and reversion can be safely ignored, up to about 15 years.

## **LIMITED ENTHUSIASM**

### ***Model Construction***

The consequences of the model of conversion growth do not reflect reality - churches do not grow to take over all of society. Thus the assumptions need to be changed. The funda-

mental thesis of Hayward (1999) was that only a subset of believers are ever responsible for the conversion growth of the church.<sup>5</sup> Many believers, although playing an active part in church life, play no part in recruitment to its ranks. Recruitment is in the hands of a normally much smaller group of enthusiasts, also called active believers, because they alone are active in the conversion of others.

It was further assumed in Hayward (1999) that active believers cease to be active after a length of time. Their enthusiasm is limited in duration, after which they become inactive believers, although still members of the church. It is recognised that new converts are often the most active in the conversion of others (Stark and Bainbridge 1985:363). However this enthusiastic phase rarely lasts for a number of reasons:

1. The active believers have been recruiting through their network of friends and relatives which is now exhausted. There are three scenarios:
  - The people in this network have become believers themselves;
  - People in this network have become immune to any further pressure to join the church;
  - The active believers have ceased to have meaningful contact with unbelievers. Many new converts find after a year or so that they have a new set of friends in the church and their old unbelieving set have drifted away. Often the new convert does this subconsciously because being part of the church means taking on a new set of values leaving them uncomfortable with the values of their old friends. In strict churches they may even be encouraged to distance themselves from the world, inadvertently losing their recruitment potential.
2. Churches do not just recruit or evangelise. After a while new converts find other work to do within the church and spend less time on recruitment activities.
3. In periods of intense growth the pastoral demands of dealing with new converts prevent ministers from spending as much time on evangelism as they might like and thus their recruitment potential drops.
4. Often believers run out of enthusiasm for recruitment and settle into a more subdued version of belief where the zeal to see new converts has declined to the point of inactivity. Again there are a number of scenarios behind this:

- The believer has forgotten why they converted from unbelief to belief. They now have no desire to see others converted;
- Often the believers gain status within the church and lose the real reasons why they joined in the first place. Any enthusiasm they now have is centred on their own advancement within the church;
- In non-strict churches the lifestyle is so close to the world that the new convert quickly sees little point in attempting to win people to the church. Believers are so similar to unbelievers that they have little to offer and so stop seeking converts;
- The believers may find the church so enjoyable that their enthusiasm is for their own experience of it, or of God, rather than to see others converted;
- It may be that the church has not lived up to expectation and the believer has lost enthusiasm for anything to do with its beliefs. Instead they have settled into a nominal church life.

Many of these reasons are summed up in Wesley's Law of the decline of pure religion: "Taking up the religion has produced benefits which makes missionary zeal too costly to engage in" (Kelley 1995:55).

Thus there are now three categories of people in the population: unbelievers, active believers (called enthusiasts) and inactive believers. As an extension to Hayward (1999) it will also be assumed that not all the new converts become active believers. Some start inactive straight away and remain so. There are a number of reasons for this:

1. They may be naturally shy and unwilling to engage in any form of recruitment;
2. They may be a social isolate and have virtually no network of friends to influence;
3. They may be a secondary convert, the spouse or child of a primary convert, who has "converted" for social reasons. It was common practice in the early church for the pagan husbands of Christian women to "convert" to the church (Stark 1996:111-115). Often such secondary converts have little real enthusiasm for the actual faith;
4. It is possible for people to be converted to the ethos of the church - its services, customs, and morality - without ever being converted to the truth of the faith. As such they may have little desire to see others converted. Their "conversion" has been a purely social phenomena rather than one of deep religious conviction. Nevertheless they are part of the church, albeit an inactive believer.

Thus the flow between the 3 categories takes people from "unbelievers" to "inactive believers", some having gone via "active believers" (figure 4).

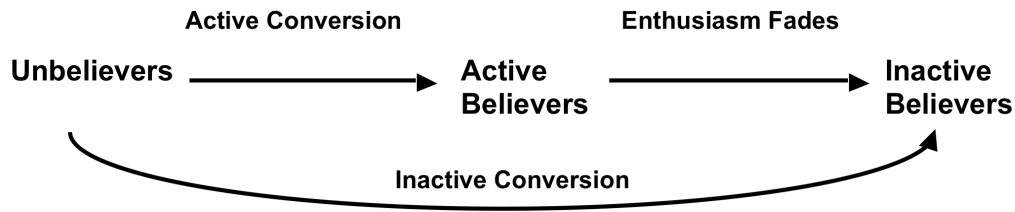


Figure 4: The flow of people, via conversion, into a church that grows through enthusiasts

In terms of causal loops the active believers are still subject to the reinforcing loop of the conversion process and the balancing loop of the reducing contacts with unbelievers, as outlined in figure 2. (In figure 2 replace “believers” with “active believers”.) However there is now an additional balancing loop as the active believers lose their enthusiasm and “flow” into the inactive believer category.

Because the enthusiastic phase lasts for the same length of time for each active believer (taken as an average figure), the drain from this category is proportional to the number of active believers. This assumes they were all converted at uniformly different times. E.g. if the enthusiastic phase is one year and there are 12 such active believers then in one month one will be lost. If there are 24 active believers then in one month two will be lost etc. Thus the number of active believers positively affects the number of people who lose their enthusiasm in a given time. However these losses also affect the number of active believers negatively as people flow out of this category. This gives an additional balancing loop to figure 2, as shown in figure 5.

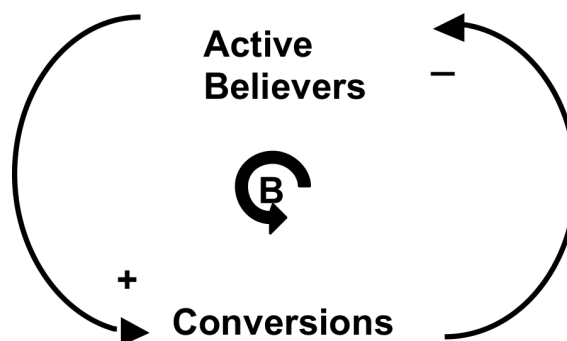
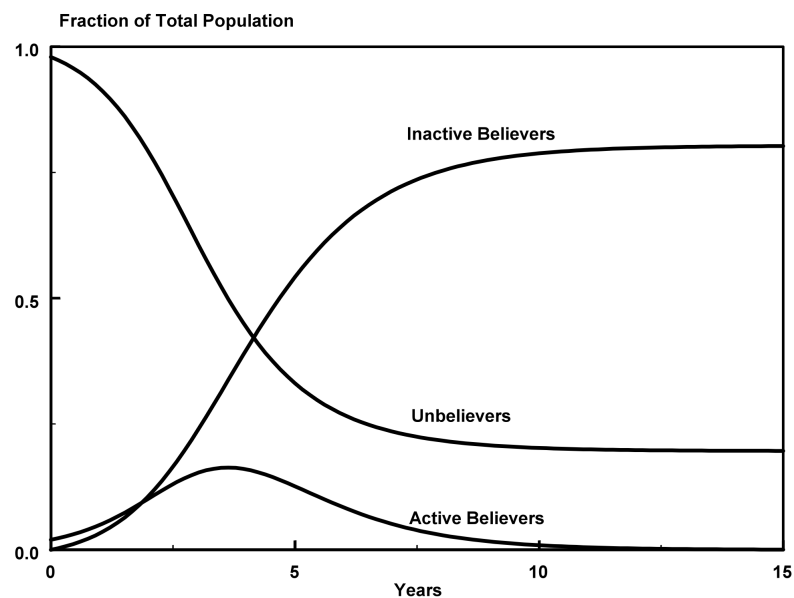


Figure 5: Causal loop diagram describing the reduction in the number of active believers – negative feedback

If there are more active believers then more of them lose their enthusiasm. The loss of enthusiasts is a percentage loss. In turn the loss of enthusiasm drains the active believers, causing their numbers to decline. As it is a percentage loss it continues until no active believers are left. Thus the initial growth in active believers, due to conversion, is eventually drained away until they become zero. This happens before all the population is converted. Thus the growth of the church has been restricted by the limited enthusiastic period of the enthusiasts.

### **Model Simulation**

A typical simulation of the limited enthusiasm model is given in figure 6. Clearly the numbers in the total church, eventually reflected by just the number of inactives, is limited and the church has failed to convert the whole population. This was the result discovered by Kermack and McKendrick (1927) where they showed that even in an epidemic the infection didn't spread through the whole population. It burned itself out due to a lack of infected people who had less and less contact with those susceptible to the disease and more with those already immune.<sup>6</sup> In the church growth case the growth has run out due to a lack of enthusiasts caused by their limited enthusiastic period.



*Figure 6: Revival-type growth in the limited enthusiasm model. Duration of enthusiastic phase is 1 year and the conversion potential is 2. All converts become enthusiasts.*

Bartholomew (1983) used a stochastic model for the spread of a rumour with equations similar to the epidemic model. Recently Gladwell (2000) has argued for a range of phenomena, such as fashion and crime, spreading like an epidemic. He identified three sorts of enthusiasts: those with many contacts, those who gather and pass on information, and those who are salesmen. In the limited enthusiasm model the behaviour of all these types of enthusiasts is averaged in the category called active believers.

### ***Threshold of Revival-Type Growth***

In this model the church can only grow, or standstill. This is also true with the spread of a disease. However the spread of a disease becomes an epidemic if the number of infectives increases for a time. In this case the disease spreads rapidly. The condition for this to occur is when the number susceptible to the disease exceeds a threshold based on the likelihood of infection.

A similar result holds in the limited enthusiasm model. If the number, or fraction, of unbelievers exceeds a threshold determined by the conversion potential and the fraction of converts who become active then the ensuing growth is rapid, following the pattern of figure 6. If the initial fraction of unbelievers, is under this threshold no such rapid, or revival-type, growth occurs. The exact relationship was shown in Hayward (1999; 2000) to be:

$$\text{Initial Fraction of Unbelievers} > \text{Threshold} = \frac{1}{\text{Conversion Potential} \times \text{Fraction Who Become Active}}$$

(Equation 2)

Essentially if the fraction of unbelievers multiplied by both the potential number converted per active believer, and the fraction of converts who become active, is bigger than 1 then revival-type growth will occur.

This can be simulated for the model by varying the conversion potential and comparing results (figures 7 and 8). In this simulation the unbelievers were initially 50%, or 0.5, of the whole population, and all converts became enthusiasts. Thus a conversion potential of 2 converts per active believer during their enthusiastic phase, which gives a threshold of 0.5, is equal to the fraction of unbelievers.<sup>7</sup> Thus the church is just on the threshold of revival-type

growth. Anything above 2 converts will see the number of enthusiasts increase for a period (figure 8) and thus produce rapid growth in the total church (figure 7). Increasing the conversion potential to 2.25 and then 2.5 has lowered the threshold to less than 0.5 in each case and increased the growth in enthusiasts and the resulting effect on the final size of the church.

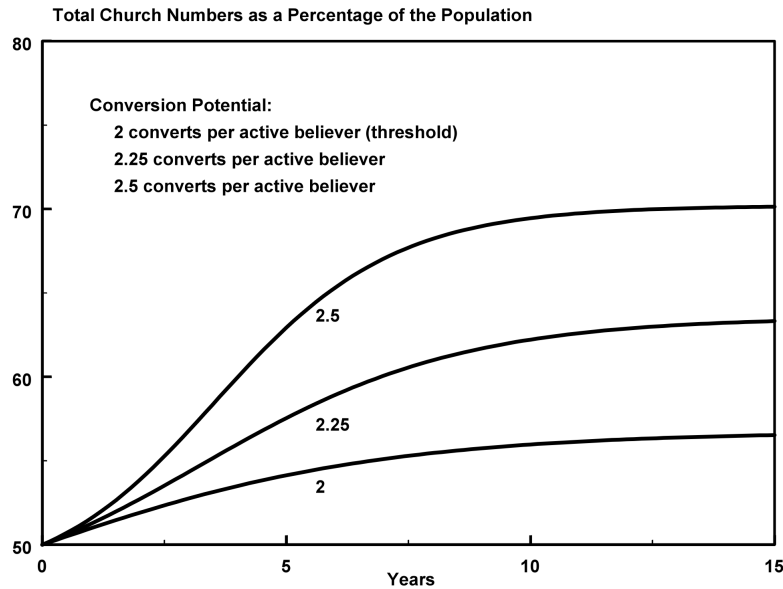


Figure 7: Effect on total church of increasing the conversion potential in the Limited Enthusiasm model. Church initially 50% of society, duration of enthusiastic phase is 0.5 years, all converts become enthusiasts.

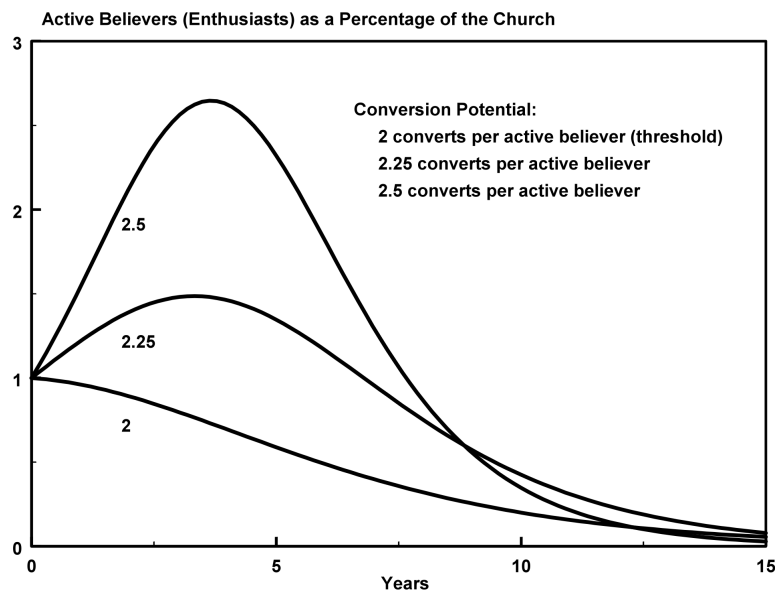


Figure 8: Effect on the number of enthusiasts of increasing the conversion potential in the Limited Enthusiasm model. (Parameters are the same as figure 7)



Increasing the conversion potential, by increasing the number of contacts, for example, is enough to “tip” the growth into epidemic behaviour. It is for this reason that Gladwell (2000) calls his book “The Tipping Point”. He argues that the presence of enthusiasts with a very high number of contacts tips the balance. In the Limited Enthusiasm model such people would give an increase in the conversion potential as they are “averaged” in with the other enthusiasts.

The *number* of enthusiasts present has no influence on the threshold of revival-type growth. It is purely the conversion potential, the fraction who become enthusiasts and the number of unbelievers, i.e. the potential converts, that determines this type of growth. Thus revival-type growth will occur even with a very small number of enthusiasts as long as the potential number converted (and made enthusiasts) by them times the fraction of unbelievers in society is bigger than 1. Simulations show that with a smaller number of enthusiasts at the beginning the revival-type growth takes longer to get going (figure 9). However the affect on the final church percentage is marginal. With 5% of the church initially active the church ends up at 82% of the population, whereas with 0.2% initially active the church becomes 79%. So, even though the former situation has a higher peak in the number of enthusiasts (figure 9) than the latter situation of 0.2% initially enthusiastic, the total number of conversions is more or less the same. For the higher initial values of enthusiasts the revival growth burns out quicker. For the lower ones it lasts longer with a lower peak.

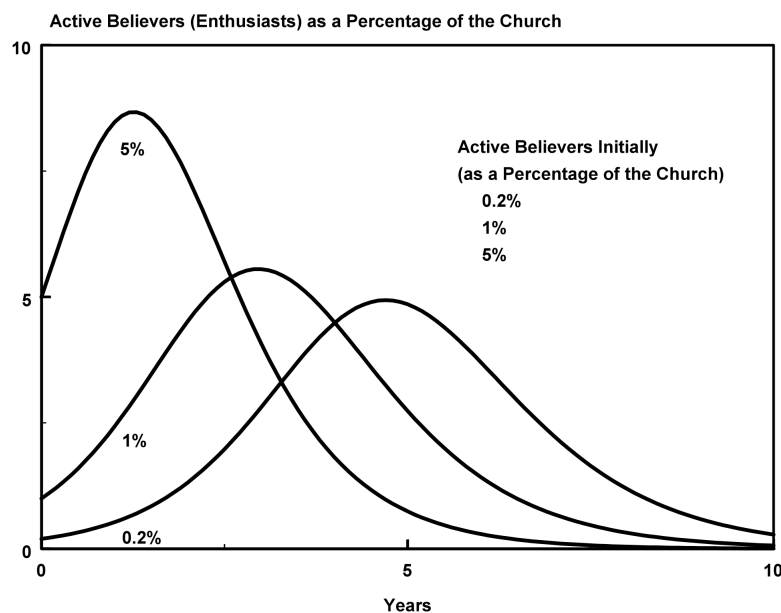


Figure 9: Effect on the number of enthusiasts of varying the initial number of enthusiasts in the Limited Enthusiasm model. (Conversion potential of 3 with other parameters the same as figure 7)

## **Summary of Limited Enthusiasm Model**

### **Assumptions and their Consequences:**

If there are no losses from the church; if births and deaths can be ignored; if only a sub-category of believers - the enthusiasts or active believers - are responsible for the conversions; and if their enthusiastic phase is limited, then not all the population gets converted and the church eventually runs out of enthusiasts.

### **Parameters:**

1. The potential number of people converted by one active believer during their enthusiastic phase - the conversion potential;
2. The duration of the enthusiastic phase;
3. The fraction who become active believers (enthusiasts) on conversion rather than inactive.

Simulations show that growth is more sensitive to the number converted per person than it is to the actual number of enthusiasts. The fraction who become enthusiasts on conversion affects the size of the revival-type growth.

### **Principles Established:**

1. The number of unbelievers must exceed a threshold for revival-type growth to occur. This threshold only depends on the conversion potential and fraction who become active. Thus increasing the potential number converted, or the fraction who become active, will lower this threshold, making revival-type growth possible. The length of the enthusiastic phase does not affect the threshold or the size of the growth, only how long it takes for growth to occur.
2. The threshold of revival-type growth does not depend on the number of enthusiasts. However small the number of enthusiasts, the growth will occur eventually, it just takes longer to do so.
3. The peak in the number of enthusiasts occurs before the growth in the church has even reached the halfway point. Thus over half of the growth comes *after* the number of enthusiasts has started declining (see figure 6). Thus measures of church growth alone may mask the fact that the *means* of the growth is already waning. A knowledge of the number of enthusiasts may give advance warning that action is needed to stem future decline.

### **Limitations of the Model**

Only applies on time scales short enough that births, deaths and reversion can be safely ignored, up to about 15 years.

## **APPLICATIONS TO RECENT REVIVAL-TYPE MOVEMENTS**

### ***General Considerations***

The sudden growth behaviour of the limited enthusiasm model is typical of times of religious revival both at the local level, and at a national or international level. Examples of such local growth in the Christian church are well documented: New England in the 1730's (Edwards 1974); Hebridean Islands Scotland, 1949 (Edwards 1990); and more recently Pensacola Florida from 1995 onwards. Examples of such national growth include the First Great Awakening 18th century USA and UK (Edwards 1990), and the Second Great Awakening of the early 19th century USA. Much faster revivals occurred in the USA 1857-8; Wales, Scotland and Northern Ireland in 1859; and Wales in 1904-5. A much longer revival in the twentieth century has been the growth of Pentecostalism especially in South and Latin America.

For revival-type growth to take place in a population the threshold needs to drop, or the number of unbelievers that can be reached needs to rise in a fairly small time scale (equation 2). In the current climate of general church decline in the western world some phenomena have seen growth, such as the Alpha Course and the Toronto Blessing. Both of these are examined for possible reasons why this balance between the number of unbelievers and the conversion potential may have changed.

### ***The Alpha Course***

The Alpha course is a world-wide phenomena within the Christian church, currently operating in over a hundred countries. The intention of the course is to teach the basics of the Christian faith to unchurched people in a series of ten meetings and a weekend using videos and books. The course originated in Holy Trinity Brompton Church London, a parish church of the Church of England, who produce the videos and books that resource the course. Although originating within a specific denomination it is used by churches of many denominations including a number within the Roman Catholic church. Theologically it is evangelical and charismatic yet it is endorsed by church leaders who would not normally fit into these categories. Although aimed at unchurched people it also acts as a "refresher" course for existing Christians and is a significant vehicle for spreading charismatic renewal.

It is impossible to estimate accurately how many people have been through an Alpha course. Alpha's own estimates are that 1.5 million people had attended a course world-wide by 1998.<sup>8</sup> However the number of courses operating is better known. It started with one course in the late 1980's in Holy Trinity Brompton. By 1994 this had become 4 courses operating in different centres. A year later, after making the course national in the UK, there were 200 courses operating, rising to 750 the year after. So far in 2001 there are over 15,000 courses operating around the world, most in English speaking countries.<sup>9</sup> As such it is a significant revival-type movement within the Christian church, yet only recently has received much media attention outside of the church itself.<sup>10</sup> Thus it is possible to be reasonably confident the course has not grown through secular media exposure. Indeed it is not clear *how* so many churches came to know about the course so quickly. Its initial exposure probably came through adverts in the growing Christian magazine market, the large number of Christian conference/holiday weeks in the UK, and personal contacts between clergy.

The main mechanism of growth within each course is that the people in the church who run the course invite friends and relatives onto the course. Some courses are advertised locally but anecdotal evidence suggests this brings little in the way of recruitment to the course. Although the Christian teaching comes from the video presentation, the course is intensely relational. The evening starts with a meal with much opportunity for conversation. The invited people have an easy opportunity to widen their circle of friends, which will now include more Christian people. After the video, people are split into small groups and the video content is discussed. There is no attempt to coerce people to believe what they have been taught, but to find out what they think of it and compare it with their current beliefs. It is part of the ethos of the course that a person's own views are respected and not belittled in any way. Those who become converted are encouraged to help on the next course and invite their non-church friends.

In terms of the model presented in this paper the enthusiasts are those that run and help on the Alpha course.<sup>11</sup> The unbelievers are the unchurched people who, if converted, become enthusiasts themselves helping on the next course inviting their friends. The success of the course is twofold:

Firstly, the potential number converted is higher as Alpha is a more intelligible meeting to invite non-church friends to, compared to a Sunday service. As such there is a greater possibility of believers being converted or at least being retained by the church even if only part of a fringe. Thus even if a believer invites the same number of people to Alpha as they

do to Sunday services, their conversion potential is higher, and the threshold of revival type growth is lower.

Secondly, the initial number of potential unbelievers is higher. One feature which sets the Alpha course apart from other church based courses is that it is beneficial to both believers and unbelievers alike. Most other courses are aimed exclusively at either one or other categories, either purely renewal meetings or purely evangelistic ones. Those aimed at renewing, or teaching, believers are not conducted in a way that are meaningful to an unbeliever, so few unchurched people get invited to such meetings. There were many such renewal meetings in the charismatic movement of the seventies and eighties but they burned themselves out as their potential pool of recruits did not include many unbelievers. The other sort of meetings, aimed purely at evangelising unbelievers, fail to attract or hold believers, who receive little benefit from it themselves. As such the meetings can run out of believers to help and recruit before enough unbelievers have been converted. Even worse, the new converts often take no further interest in the course, thus failing to tap their contacts with unbelievers.

By contrast a typical Alpha course starts with nearly all believers, injecting them with new enthusiasm for the faith. Many of these stay for the second and later courses, enthusiastically bringing their unbelieving friends along, yet still receiving benefit from the course themselves. Any converts resulting from the second course remain with subsequent courses, because of the benefits obtained, as well as bringing their unconverted friends. Indeed the course can become the "spiritual home" for new converts for some length of time. Thus the pool of potential converts is much larger than the more specialist courses, enough to push the growth over the threshold of revival-type growth. The ability of the course to "infect" existing believers, while being meaningful to unbelievers, could be the key to its success.

Enthusiasm cannot last indefinitely as people run out of non-church friends to invite, or they can only take helping on so many Alpha courses before repetition and exhaustion make them change their commitments.<sup>12</sup> According to the model the numbers attending the Alpha course will peak at some point and start to decline. The course will not be maintained indefinitely and will burn out for a lack of enthusiasts. Thus Alpha would find it helpful to keep a record of the number of leaders and helpers on the courses, both nationally and locally, to look for their decline as an early sign of the course burning itself out. Alternative ways of "re-infecting" existing Alpha helpers to make them more effective could substantially improve its future prospects.

In order to sustain growth on the course either the threshold needs to be reduced - enthusiasts to have a higher conversion potential - or the number of unbelievers that could be reached must be larger. The decision by Independent Television to broadcast the Alpha course on national television in the UK in the fall of 2001 (Alpha News 2001) might well open up a much larger pool of untapped unbelievers taking their numbers well over the current threshold of revival-type growth. If these broadcasts also infect believers with enthusiasm to participate in Alpha the growth of the course later in 2001 might well be explosive.

### ***The Toronto Blessing*<sup>13</sup>**

The “Toronto Blessing” is a name given to a world-wide phenomena that is associated with its starting place: the Toronto Airport Church.<sup>14</sup> The phenomena, which includes fainting, shaking and extremes of emotion, started in a series of meetings at that church in January 1994. Although such phenomena had been seen in a number of Christian churches over previous years, and was seen in the ministries of people who had an influence on the Toronto church, these meetings were set apart by the intensity of the phenomena and the fact that the church decided to carry on the meetings indefinitely. Throughout the next few months the Vineyard and Charismatic “grapevines” buzzed with the news of events at Toronto and the church saw a steady stream of visitors from Canada, the USA and abroad. Similar phenomena were seen on a smaller scale in a number of other churches. At this point news of the phenomena appeared to be only travelling by word of mouth, presumably including phone calls.

In May of 1994 one British visitor to Toronto brought the phenomena to a prominent London Anglican church which brought immediate Christian and secular media attention in the UK and subsequently in the USA.<sup>15</sup> Indeed the secular media in the UK, who coined the expression “Toronto Blessing”, initially appeared more sympathetic than the main-stream Christian church (Poloma 1997). After this date the spread of the phenomena became much faster, and many churches, charismatic and otherwise, came under its influence. In time other centres of similar revival phenomena appeared, such as Pensacola in Florida and Sunderland in the UK, however there are many others. Although actual attendance data is patchy, it is from the increasing appearance of these centres that the extent of the phenomena can be judged. It would appear that the media interest fuelled its spread.

However 1994 also saw vast strides in the spread of Internet and email usage. Improvements were being made in web browsers almost monthly and the technology was moving from being university-based to personal and commercial uses. At the end of 1993 the Internet

barely existed with 623 web sites. However by the end of 1994 there were 10,000 sites, with 100,000 a year later.<sup>16</sup> The churches which were central to the phenomena quickly acquired websites, indeed they were among the first churches to do so. People could then read daily accounts from the places where these events were occurring without them being “slanted” by the secular and mainstream Christian media. An early website defending the Toronto Blessing, at the Champaign Vineyard Illinois, was receiving 800-1000 hits per day during 1994 (Jackson 1999:287).

The growth of the internet also spawned the growth of email usage, which became an additional way of spreading information concerning the Toronto blessing. The “New Wine” discussion list, dedicated to news on the blessing, was set up that year and others distributed email newsletters of its progress. The accounts were not academic treatise but testimonies of personal experience, encouraging others to seek the same, and thus spreading interest in the phenomena. Prior to this date the use of such technology would have reached few outside the academic community.

Although the primary means of spread of the Toronto blessing has been personal contact, these contacts have undoubtedly been enhanced by the use of the Internet and email. This may well have been enough to increase the conversion potential and thus lower the threshold of revival-type growth to enable this substantial growth to occur. In addition, the fact that the technology involved is instantaneous, and worldwide, has enabled the phenomena to become truly global rapidly. In fact the same phenomena had been widespread in Argentina prior to 1994, but never influenced the world because the enthusiasts’ contacts were confined to personal ones alone. Only when they influenced the people of the Toronto church, in a country where the new technology was emerging, was there the possibility of a rapid influence on an international scale.

## ***Numerical Results***

Data for revival movements is not easy to come by. For many of the past revivals mentioned little attendance or membership data exists, although anecdotal evidence illustrates the characteristic rapid rise in numbers with the growth eventually burning itself out. However reliable membership data does exist for the Welsh Revival of 1904-05, and for a revival in Nagaland India in the 1970’s.

In 1904 the combined total membership for Welsh churches stood at 48.94% of the total population and rose to 53.43% by the end of 1905. The bulk of the 100,000 converts came in

a period of about 12 months (Hayward 1999; Church Growth Modelling Website<sup>2</sup>). Simulations show that the potential number converted per active believer was just over 2 with the duration of the enthusiastic phase about 1 week, assuming all converts became active. The actual number converted is thus 1 per active believer.

At present it is not possible to tell how many of the converts also became active believers. If it was only 10% then the conversion potential would have to be much higher, around 18, and the enthusiastic phase longer, about 1 month (Hayward 2000). In reality these parameters could vary widely for different active believers, with the model yielding their average value.

Orr (2000) describes a revival in Nagaland India where the Baptist church rose from 130,000 in 1976 to about 200,000 in 1982. A simulation of the model again shows a conversion potential of around 2 with a longer enthusiastic period than the Welsh revival, of around 1 month, assuming all converts became active (Hayward 2001). The same number of converts per believer over a longer period of time extends the length of the revival.

## CONCLUSION

This paper had three aims:

- To convince church growth practitioners and sociologists of religion that a systems approach to modeling church growth is worth considering;
- To make clear the consequences of the assumption that churches grow through enthusiasts, who are a subset of the church, and whose enthusiasm doesn't last indefinitely.
- To re-express the mathematical model of church growth of Hayward (1999) in systems format.

In each of the models assumptions were stated and the dynamical consequences investigated. Thus it was clear that if all in the church recruited indefinitely through contact, the whole population became converted. However if that enthusiasm was limited in time and to certain people then the conversion of the whole population was not possible. Thus one advantage of the method is that the validity of the assumptions can be measured by the resulting effects on the growth of the church.

A second advantage of this method is that alterations to the assumptions can be made easily. Consider the assumption concerning homogeneous mixing. If it were believed that believers didn't mix evenly through the population but spend more time with other believers, or



alternatively deliberately sought out unbelievers, then a modification to the probability in equation 1 is all that would be required. The model can then be analysed and results produced for each changed assumption in order to explore the consequences of the actions.

A third advantage is that additional categories of people can be built into the model. If for instance active believers dropped to a lower level of activity - semi-active believers - before becoming inactive, this extra category can be easily incorporated into the model. This model building process was seen as the model progressed from the exponential model, to the conversion model without limits, then into the limited enthusiasm model.

A fourth advantage, not explored in this paper, is the ability to model variables that are not easily quantifiable. For example it would be possible to have a variable representing the tension between a church and the surrounding society and model its evolution as the church grew and perhaps became more accommodating to that society. This in turn could be fed back into modifications of the conversion potential.

As for the model itself it is seen that the assumption that church growth is driven by enthusiasts who eventually lose their conversion potential can give growth similar to that of an epidemic. Such behaviour is seen in the various revivals that have taken place throughout the history of the church. The fact that the enthusiastic phase is limited prevents the whole population from being converted, as does the presence of any losses from the church. The failure to make all converts enthusiasts lowers that limit further.

The key parameters are the conversion potential, and the proportion of converts who become enthusiasts. They control the threshold of revival-type growth. As such any improvement in the contact rates, assuming such contacts lead to conversion, can tip a church from stagnation to revival-type growth. It is thus possible in an age where inter-personal communications are increasing through email, internet and other media that revival movements, especially those on a global scale, become more frequent. It does not take a large change in these parameters to tip into revival-type growth, thus the onset of such global revivals may not be easily predictable.

## **FURTHER WORK**

With a modeling methodology in place it is now possible to examine the effects of additional processes on the growth of the church. The following is not exhaustive but represents some possible extensions to the model:

1. To include births and deaths and reversion in the model.
2. A process by which inactive believers can become enthusiasts again without having to fall away from the church. This process is often referred to as renewal. Historically revivals have started because people *within* the church have had their faith and zeal renewed and then become active in evangelism and witness;
3. The media may have a role in making converts or enthusiasts directly. In countries where the Christian church is illegal the church relies on converts through radio broadcasts;
4. The number, duration and nature of contacts between believers and unbelievers could be included to give a more realistic model of the conversion process;
5. As a church increases it may become a threat to society, resulting in persecution;
6. There may come a point where a church is such a large part of society that it becomes socially acceptable to join. Persecution ceases and a greater proportion of inactive believers are recruited leading to a dilution in the evangelism of the church;
7. All societies are composed of different churches and religious groups. As well as competing for converts from society there is also transfer growth as people switch their church allegiance. Such transfers form a significant part of the growth of conservative churches (Perrin, Kennedy and Miller 1997).

The accuracy of the models presented here needs to be tested by data which measures the number of enthusiasts within churches and their level of enthusiasm in terms of their recruitment potential. It is hoped that these issues will be examined in future publications.

## NOTES

- 1 The Systems Dynamics Society website, <http://www.systemdynamics.org/> contains further information about systems dynamics.
- 2 The author's church growth modeling website is <http://www.churchmodel.org.uk/>
- 3 Many people are not converted on a first contact with a believer, but following a series of contacts. Incorporating the number, duration and nature of such contacts into a model would require a degree of sophistication beyond the scope of this paper. However such models could be developed using the systems dynamics method.
- 4 Stella is manufactured by ISEE Systems <https://www.iseesystems.com/>
- 5 The limited enthusiasm model of church growth was called the simple church growth model in Hayward (1999).
- 6 The spread of infection and disease is modelled mathematically by Anderson and May (1987) and Bailey (1975).
- 7 Of course this is the *potential* number only. The actual number converted during the enthusiastic phase is only 1 because half of the enthusiasts' contacts are with believers who are already converted.
- 8 As quoted on the Alpha USA Web Site, <https://alphausa.org/> in 2002.
- 9 For example the USA has 2360 courses, Australia has 1590 courses and Canada has 1325 courses. However some non-English speaking countries have significant numbers: Germany has 280; Netherlands 410 and Norway 350. (Figures based on those published in Alpha News No 24, 2001.)
- 10 For example Time magazine recently ran an article on the course (Time 1999). Most media attention has been confined to the UK, in the religious slots of television and newspapers.
- 11 It could also be argued that the "enthusiasts" are the Christians who influence other churches to run the course. However most people who start a course in their church will have been on a course in an existing "Alpha" church first, if only to get the feel of the course. Thus the stated interpretation of the model holds.

- 12 The Alpha course is a large commitment for those who help: one meeting a week; prayer meetings; training evenings and a weekend. Some churches run the course three times a year, the recommended number. This can leave little time for any other activities in church.
- 13 Historical material for this section is taken from "History of the Awakening 1992-1995" website: [http://www.banner.org.uk/tb/history\\_riss.html](http://www.banner.org.uk/tb/history_riss.html), Dixon (1994), and Jackson (1999).
- 14 The church was a Vineyard church until the end of 1995 when it left that movement and dropped the word Vineyard from its title.
- 15 Holy Trinity Brompton, the home of the Alpha course. <http://alpha.org/>. There is much scope for work on the relationship between the Alpha course and the Toronto Blessing.
- 16 Data quoted from "Hobbes' Internet Timeline" website:  
<https://www.zakon.org/robert/internet/timeline/>. There are currently around 30 million websites (2002).

## REFERENCES

- Alpha News. 2001. No 24. published by Holy Trinity Brompton, London.
- Anderson, Roy M., and Robert M. May. 1987. *Infectious Diseases in Humans: Dynamics and Control*. Oxford: Oxford University Press.
- Bagnall, Roger S. 1982. "Religious Conversion and Onomastic Change in Early Egypt." *Bull. of the American Soc. of Papyrologists*. 19: 105-124.
- Bailey, Norman T. J. 1975. *The Mathematical Theory of Infectious Diseases and its Applications*. London: Griffen.
- Bartholomew, David J. 1983. *Stochastic Models for Social Processes*, Third Edition. New York: Wiley.
- Berger, Peter L. 1969. *The Sacred Canopy: Elements of a Sociological Theory of Religion*. New York: Anchor.
- Brierley, Peter. 1999. *Religious Trends 2000/2001 Number 2*. London: Christian Research.
- Coleman, James S. 1964. *Introduction to Mathematical Sociology*. New York: The Free Press of Glencoe.
- Dixon, Patrick. 1994. *Signs of Revival*. Eastbourne, UK: Kingsway Publications.
- Edwards, Brian H. 1990. *Revival*. Durham, UK: Evangelical Press.
- Edwards, Jonathan. 1975. *The Works of Jonathan Edwards Vol. 1*, reprinted. Carlisle PA: Banner of Truth. Including: *A Narrative of Surprising Conversions*, 1736, p.334; *An Account of the Revival of Religion in Northampton 1740-1742*, 1743, p. lvi.
- Forrester, Jay W. 1961. *Industrial Dynamics*. Waltham MA: Pegasus Communications.
- Gladwell, Malcolm. 2000. *The Tipping Point*. New York: Little, Brown and Company.
- Goodman, Michael R. 1989. *Study Notes in System Dynamics*. Waltham MA: Pegasus Communications.
- Hayward, John. 1999. "Mathematical Modeling of Church Growth." *Journal of Mathematical Sociology*. 234: 255-292.
- Hayward, John. 2000. "Growth and Decline of Religious and Subcultural Groups." In *Sustainability in the Third Millennium - Proceedings of the 18th International Conference of the Systems Dynamics Society*. Cambridge MA: Systems Dynamics Society.

- Hayward, John. 2001. "Modelling Church Growth - Mathematically." *Church Growth Digest*. 23(1): 3-5. Bedfordshire UK: British Church Growth Association.
- Hoge, Dean. R., and David A. Roozen (eds.) 1979. *Understanding Church Growth and Decline 1950-1978*. New York: Pilgrim Press.
- Iannaccone, Laurence R. 1992. "Religious Markets and the Economics of Religion." *Social Compass*. 39 (1): 123-131.
- Iannaccone, Laurence R. 1994. "Why Strict Churches are Strong." *American Journal of Sociology*. 99(5): 1180-1211.
- Iannaccone, Laurence R., Daniel V.A. Olsen and Rodney Stark. 1995. "Religious Resources and Church Growth." *Social Forces*. 74(2): 705-731.
- Inskip, Kenneth W. 1993. "A Short History of Church Growth Research." Pp. 135-148 in *Church and Denominational Growth*, edited by David. A. Roozen and C. Kirk Hadaway 1993. Nashville: Abingdon Press.
- Jackson, William. 1999. *The Quest for the Radical Middle: A History of the Vineyard*. Cape Town, South Africa: Vineyard International Publishing.
- Kelley, Dean. [1972] 1995. *Why Conservative Churches are Growing*. Macon, GA: Mercer University Press.
- Kermack W.O., and A.G. McKendrick. 1927. "A Contribution to the Mathematical Theory of Epidemics" *Proceedings of the Royal Society*. A115: 700-721.
- Kumar, Vinod, and Uma Kumar. 1992. "Innovation Diffusion: Some New Technological Substitution Models." *Journal of Mathematical Sociology*. 172-3: 175-194.
- McGavran, Donald. A. 1990. *Understanding Church Growth*. Grand Rapids, MI: Eerdmans.
- Miller, Donald E. 1998. "Postdenominational Christianity in the Twenty-First Century." *Annals of the American Academy of Political and Social Science*. 558: 196-210.
- Orr, J. Edwin. 2000. *The Outpouring of the Spirit in Revival and Awakening and its Issue in Church Growth*. Bedfordshire, UK: British Church Growth Association.
- Perrin, Robin D., Paul Kennedy and Donald E. Miller. 1997. "Examining the Sources of Conservative Church Growth: Where are the New Evangelical Movements Getting their Numbers?" *Journal for the Scientific Study of Religion*. 36(1): 17-80.

- Pointer, Roy. 1984. *How Do Churches Grow*. Basingstoke, UK: Marshall Morgan and Scott.
- Poloma, Margaret M. 1997. "The Toronto Blessing: Charisma, Institutionalization, and Revival." *Journal for the Scientific Study of Religion*, 36(2), pp.257-271.
- Roozen, David A. and C. Kirk Hadaway (eds.) 1993. *Church and Denominational Growth: What Does (and Does Not) Cause Growth and Decline*. Nashville: Abingdon Press.
- Senge, Peter M. 1992. *The Fifth Discipline: The Art and Practice of the Learning Organisation*. Doubleday.
- Stark, Rodney. 1996. *The Rise of Christianity*. Princeton, NJ: Princeton University Press.
- Stark, Rodney, and William W. Bainbridge. 1985. *The Future of Religion*. New Brunswick, NJ: Rutgers University Press.
- Stark, Rodney, and William W. Bainbridge. 1987. *A Theory of Religion*. New Brunswick, NJ: Rutgers University Press.
- Sterman, John D. 2000. *Business Dynamics: Systems Thinking and Modeling for a Complex World*. New York: Irwin McGraw-Hill.
- Time Europe Magazine. 1999. "Alpha to the Rescue." Nov 22, Vol. 154, No. 21.
- Wagner, C. Peter. 1987. *Strategies for Church Growth*. Ventura: Regal Books.
- Wallace, Anthony F. C. 1966. *Religion: An Anthropological View*. New York: Random House.
- Warner, R. Stephen. 1993. "Work in Progress toward a New Paradigm for the Sociological Study of Religion in the United States." *American Journal of Sociology*. 98(5): 1044-93.