Application of System Dynamics to the Study of a Religious Experience

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ABSTRACT

This paper informs the scientific and religious communities about a breakthrough in the study of religion: System Dynamics is being used to model and simulate the experience of a mystic during the time when he traversed the dramatic road to mystical union. The paper briefly presents how this modelling task is being approached and some of the key insights being made by focusing on the dynamics of the important dark night of the soul phase which preceeds mystical union. This gives a synopsis of the essence of my book manuscript, *A Meditation on Mystical Union*.

I. Introduction.

During 1960 to 1962 when I was going through a crisis in my life and, in addition, working under stress as a project engineer, I went through a series of states of mind and heart eventually culminating in the state of mystical union. Starting with obsession the series of states in order of appearance included renunciation, spiritual fire, concentration, absorption or flow, Dark Night of the Soul, and eventually the far-from-equilibrium state of mystical union (1). Since 1962 I have been trying to understand that sequence and its overwhelming culmination because the experience had brought about a conversion and had become central to my life. During the rest of the 1960s and throughout the 1970s I read mystics from major world religions, visited monasteries, and listened to holy men. While I gained some sense of the nature of holiness and gathered knowledge of various religious systems during that important period, it was only in late 1984 when I hit upon applying the causal loop diagram concept from system dynamics that I began to gain analytical depth in my understanding.

Starting with the rememberance of an experience during the sequence, I would ask myself what had caused or preceeded it and what had followed from it. Reflecting in this way with the aid of the causal loop diagram as a meditating tool, I slowly unearthed from long term memory the details underlying the sequence and from that laid down important causal loops controlling the sequence. This unearthing of the memories of that period released psychic energy and resulted in a heartfelt narration of the events of the sequence which I call *An Engineer's Story*. Continuing in this meditative way(2) during the past seven years, I have begun to develop flow diagrams and, eventually, to model and simulate the sequence. It has been and continues to be a labor of love.

A. The Nature of Mystical Union.

When one experiences mystical union there appears to be a sudden cessation of all movement within. The mystic is aware that his heart has suddenly stopped beating and that the train of his thoughts and the sense of time itself has suddenly ceased. There is no panic. His heart is fully open and his mind one-pointed, completely absorbed in the present moment within. He cannot recall from memory or cause himself to think. His mind is watching and recording into memory the quality of his state: He is aware that he is in union with the ground state of his being. This union is accompanied by an experience of the essence of freedom, which is a release from bondage to the body, to thought, and to time. In union the mystic is also aware of a trueness in the connection between his mind and his being, a trueness that reveals a supreme integrity at the core of his being. He is aware of this as a revelation. Some mystics who experience it call it union with
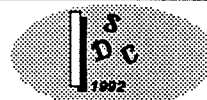
God. It was the culmination of the author's long desperate search for salvation and a great blessing. His system knew that it had found the ground upon which to build a sound life.

B. The Nature of Time: the key to modelling and simulating the culmination.

In order to model and simulate such a mystical experience a certain philosophical issue must be made clear: Time can exist only when there is movement(3). The mystic cannot model and simulate his cognitions and his perceptions after the cessation, because time, the very essence of simulation, did not exist for him after the cessation of inner movement. However, he can model and simulate his cognitions and perceptions before the cessation.

The period before the cessation is known in mystical literature in the West as the Refiner's Fire, the Dark Night of the Soul, or purgation. During that period, which in my case was 10 or 11 hours, the mystics' heart opens and is purified and his mind becomes one-pointed. This period prepares him for mystical union. Important teachings of religions throughout the world are based on insights that mystics have brought back from their experiences of the Dark Night of the Soul and mystical union. If there existed an accurate model and simulation of an experience of the Dark Night, deep insights could be available to peoples of all religions and to students of philosophy, as well as to cognitive scientists, neurologists and other scientific disciplines. Such a model could also give insights about mystical union because it could tell us about the mystics' state at the moment just before the cessation when he passes into union.

All the models of the sequence, including the Dark Night, use metaphorical/ perceptual or cognitive terms. The next section presents how such terms are being used to develop a system dynamics model of the key Dark Night phase of the sequence.

II. Modelling the Dark Night of the Soul

"But who may abide the day of His coming,
And who shall stand when He appeareth?
For He is like a Refiner's Fire." **Malachi 3:2**

A. Model of the Opening Heart

In the initial stage of the Dark Night the heart begins to open. Our model of the opening heart is given in perceptual terms by the system dynamics flow diagram in Figure 1. It is concerned with the psychic stress produced as the opening heart encounters knots.

The virtue of a model formulated in this metaphorical way using perceptual terms is that it (a) reflects actual perceptions of the mystic-to-be during the Dark Night phase of his mystical experience, (b) utilizes terms sometimes used in classical mystical literature and therefore aids in communicating knowledge of the phenomenon, and (c) has analogies to widely known mechanical phenomena, an example of which is an expanding balloon crimped with stays which can be unloosened one by one under extreme pressure. However the problem with such a metaphorical/ perceptual model is that it does not lead directly to advancement of a hard science of mystical experience. The more direct scientific avenue would be that of a physiologist who would formulate the model as follows: "the cardiovascular and neuroendocrine systems interact resulting in an altered state which is perceived as an 'opening of the heart'".

With this in mind let's proceed with the explanation of the perceptual model in the flow diagram in Figure 1: At the beginning of the simulation (time = 0) there is probably a bifurcation causing a sudden jump in the Opening Pressure from 5% to 80%. This acts on the Heart Unfoldment Rate to increase the Heart Openness (4). As the heart unfolds it produces Rapture. But as it opens it also slowly increases the internal Psychic Stress. Psychic Stress is possibly a local
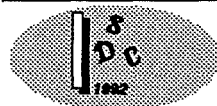
stress in that part of the autonomic nervous system and cardiovascular network associated with a particular region of the heart. It is due primarily to the opening heart working against both the knot in the heart and the knot's associated complex in the mind.

AveragePsychicStress could represent the average stress in the neurocirculatory network calculated during an AveragingTime of 25 minutes. As AveragePsychicStress rises it acts to restrain, or lessen, the Heart Unfoldment Rate. When it rises in the knotted heart to equal the Opening Pressure, the Heart Unfoldment Rate becomes zero so that Heart Openness will not open further and cause more stress (see the equation for HeartUnfoldRate in the Appendix A). The Heart Adjustment Time roughly approximates the time constant for the opening heart.

I assume that at the beginning of the simulation my Heart Openness was 5% and my normal Psychic Stress was 5%. Maximum would be 100%. These values are estimates based on my experience during the Dark Night of the Soul. They compare the normal state with what it is like to have a fully open heart and a maximum tolerable psychic stress. Perhaps in the Homeric Age or in the Age when the human being was evolving into its present form, the normal Heart Openness was greater than 5%, but now, to avoid turbulent interrelations among people in the Modern Age, social systems probably condition people to have a normal Heart Openness of only 5%.

Figure 2 shows a computer simulation for this model during a 480 minute period. It shows the HeartOpenness, PsychicStress, and Average Psychic Stress I was experiencing during that time period as a percent of maximum. The simulation matches my perceptions. This is known in system dynamics as matching the reference mode. No knots were removed from the heart during this initial period of the Dark Night. The overshoot of Psychic Stress in Figure 2 is due to the fact that AveragePsychicStress controls the HeartUnfoldmentRate and lags PsychicStress by about 25 minutes. The result is that the shutting down of the HeartUnfoldmentRate is too slow in its reaction to the rapidly rising PsychicStress, thus producing the overshoot. This overshoot is perceived by the mystic-to-be as a loss of control and produces a fear of death and great anxiety. This great anxiety leads to the intense prayer of the Dark Night of the Soul. Fear of death and prayer will be dealt with in the next section where in Figure 3 we extend the model in Figure 1.

B. Model of the Dark Night of the Soul:

Figure 3 shows a simplified flow diagram model of the entire Dark Night. It includes the previous model of the opening heart in its lower section. The following are some comments on the model:

1) The model of the mind, indicated by the parallelogram, is quite tentative at present and as a result its details are not discussed here but its flow diagram is included in Appendix B. The equations for the model of the mind are included in Appendix A. It is based in part on cognitive science, in particular the classical cognitive science paper by G. A. Miller (5) and some studies on retrieval memory strength (6), and in part by the necessity of matching the reference mode. It is discussed more fully in chapter 4 of my book manuscript, *A Meditation on Mystical Union*.

2) Appendixes A and B list all equations and the complete flow diagram, respectively, underlying a more detailed model of the Dark Night. A step time of 0.005 minutes gives smooth output but the same results can be obtained more quickly with a step time of 0.2 minutes, although the latter output shows some mathematical instability in the solution routine.

3) Figure 4 shows a simulation of the model for the 16 hour (960 minute) period that the Dark Night of the Soul and mystical union lasted. The first knot came unloosened at the 575th minute; the last knot was removed at the 626th minute. Mystical union occurred during the 630th minute. Figure 5 examines the critical 10 minute period just before mystical union from the 620th to the 630th minute.

4) Complexes represents in my case sins or hatreds which reside in the mind. There is a one-to-one relationship between a knot in the heart and a complex in the mind. A knot can be removed by forgiveness, either by forgiveness of an enemy or by being forgiven by the One to whom prayer is directed. Then the complex or sin or hatred associated with that knot is deenergized.

5) The forgiveness occurred when the mystic-to-be focused his attention on the knot in the heart and prayed with great urgency and intensity because of fear and anxiety, indicated by PrayerBasedOnFear, and with keen insight concerning the nature of the specific knot or sin, indicated by PrayerDueToInsight. Both forms of prayer of the heart are needed to raise PrayerQuality to a value equal to 100%. Then the blessed Forgiveness occurs. This is shown by Figure 6 and the equation for PrayerQuality in Appendix A.

6) When a knot or complex was removed PsychicStress and FearOfDeath suddenly decreased and then slowly the heart opened further. Then PsychicStress, FearOfDeath, and PrayerBasedOnFear rose again in this Dark Night as the cycle repeated itself relentlessly, knot by knot, complex by complex until all (about 12) knots were removed. Figure 7 shows how FearOfDeath becomes extreme just before a knot is removed from the heart. Figure 8 shows this more clearly for a two minute period from the 620 to the 622 minute mark during which three KnotsInHeart were removed. When PrayerQuality reaches 100% Forgiveness occurs, a knot is removed, PrayerQuality and FearOfDeath drop sharply and then begin to rise again as the heart continues to open. Notice in Figure 8 that as the knots are removed and complexes are deenergized, TruenessOfMind is slowly dawning.

7) The cycle time shortened as the knots were removed because the heart was becoming less rigid [HeartRigidity Factor] and hence more pliable, resilient, or responsive (see Figure 6). This reduces the time constant [Heart Adjustment Time] of the opening heart.

8) As Concentration increased, thoughts and feelings arising in, or sensed by, the mind were more quickly perceived causing PrayerDueToInsight to arise more quickly. As the number of compexities in the mind decreased toward zero and TruenessOfMind emerged, concentration became so absorbed and so smooth and intense that there was hardly any delay between sensing and perceiving [DelaySensToPerceive] as shown in Figure 5.

9) Then, when all knots had been removed from the heart and, correspondingly, all complexes had been removed from the mind causing the mind to become one-pointed, all internal movement appeared to be stilled. The Dark Night had become the silent night. The mystic was now in mystical union, fulfilling the saying: "Blessed are the pure in heart, for they shall know God".

III. Summary.

This paper informs the scientific and religious communities about a breakthrough in the study of religion: System Dynamics is being used to model and simulate the experience of a mystic during the time when he traversed the dramatic road to mystical union. The sequence of states of that experience in order of appearance were obsession [tanha], renunciation [pratyahara], spiritual fire [tejas], concentration [dharana], absorption or flow [dhyana], dark night of the soul [samskaras], and eventually the far-from-equilibrium state of mystical union [samadhi]. The paper has briefly presented how this modelling task is being approached and some of the key insights being made by focusing on the dynamics of the important dark night of the soul phase which preceeds mystical union. This gives a synopsis of the essence of my book manuscript, *A Meditation on Mystical Union*, which I have been working on for the past seven years.

The models and ideas in the paper open up deep levels of religion, philosophy, psychology and cognitive science as focuses for the application of various analytical methodologies including the
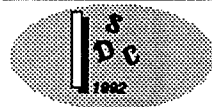
system dynamics methodology. The paper will also be of interest to a growing body of scientists and theologians who are trying to bridge the gap between science and religion. While a lot of scientific endeavor is already being devoted to constructing that half of the bridge from perception and cognition to its correspondance with activity at various sites in the neuroendocrine and circulatory systems, this paper attempts to construct the more difficult other half of the bridge from the cognitions and perceptions to the heart of religion.

My particular version of that half of the bridge may not be definitive, but it nevertheless indicates that system dynamics can be used, up to a point, to explore and probe a religious experience. It can do that by structuring or modelling the mystics' perceptions and cognitions on the road to mystical union as a multiloop nonlinear feedback system, and then, utilizing the highly developed system dynamics methodology, analyze the characteristics of the model simulation to find the key factors determining its behavior. From a more personal point of view, system dynamics can be used by the mystic as a form of meditation to help him understand and integrate his religious experience into his life and philosophy.

The model shows the link between the mind and the heart and how this particular experience of mystical union occurred when the mind became one-pointed in tandem with a fully opening heart. Some of the elements of the model are heart openness, psychic stress, prayer quality, and forgiveness. There are also detailed elements of the mental apparatus in the model such as retention time [delay between sensing and perceiving], concentration and working memory.

Thus, under the assumption that mystical union lies at the heart of religion, the paper shows a way to get at the essence of religion and philosophy, how to explore and probe the experience upon which belief and faith are founded, and opens the way to a link between science and religion.

References and Notes

(1) Mystical union seems to be a phenomenon that is experienced by mystics from every culture or religion. It is variously called enlightenment by the Buddhists, samadhi by the Hindus, devekut or "heaven and earth kiss each other" by the Jews, fana by the Moslem Sufies, satori by the Zen Buddhists, etc. For a discussion of this commonality see, for example, Huxley, Aldous. 1944. *The Perennial Philosophy*. New York: Harper & Row.

(2) For clarification on how models can be used to meditate on a phenomenon, see: Forrester, J. W. 1985. A Model Versus a Modeling Process. System Dynamics Review 1: 133-134. The phenomenon under examination could be modeled and meditated upon from a number of points of view: metaphor, perception, cognition, or neuroendocrine and circulatory science.

(3) Spinoza, *Ethics* V, pr 21-42; Augustine, *Confessions* XI, ch XI: *City of God* XI, ch VI; Plotinus, *Enneads* III, 7; Aristotle, *Physics* IV, ch 11, 219a30; Plato, *Timaeus* 37d,38a.

(4) See "An Engineer's Story" to get an idea of how this step up or bifurcation in OpeningPressure came about for me. It is chapter 1 of my book manuscript, *A Meditation on Mystical Union*.

(5) Miller, G. A. 1956. The Magical Number Seven, Plus or Minus Two: Some Limits on Our Capacity for Processing Information. The Psychological Review 63:81-97.

(6) Wickelgren, W.A. 1979. *Cognitive Psychology*. Englewood Cliffs, N.J: Prentice-Hall. pp270-271.

Acknowledgements.

Figure 1: Flow Diagram Model of the Opening Heart
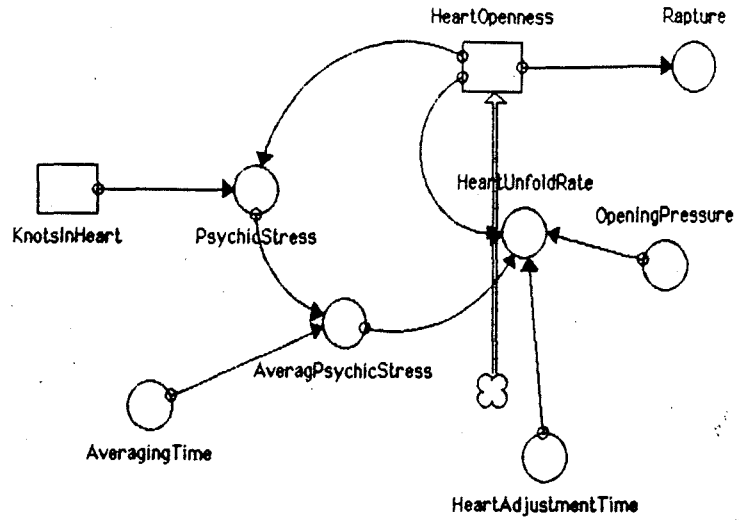
Figure 2: Simulation of the Model of the Opening Heart

1 HeartOpenness   **2** PsychicStress   **3** AveragPsychicStress
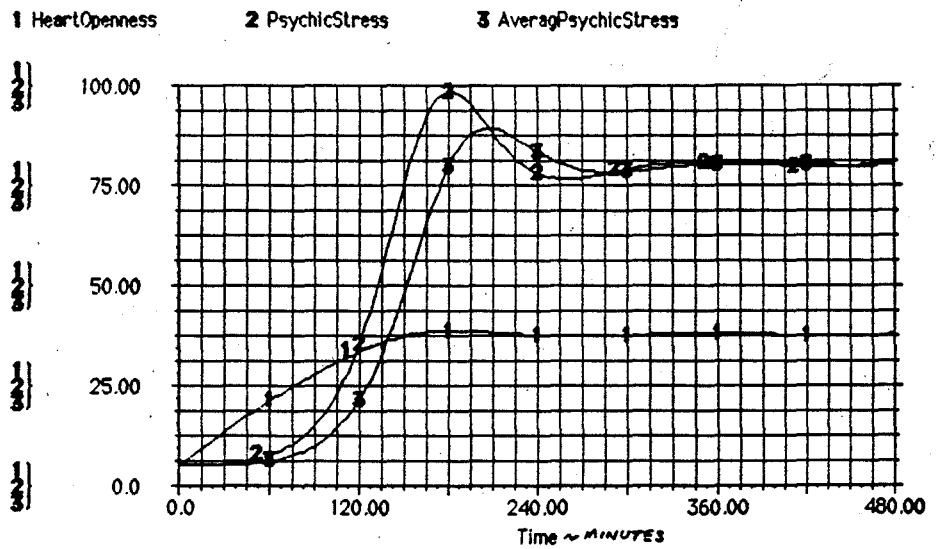
Figure 3: Simplified Flow Diagram Model of the Dark Night of the Soul.
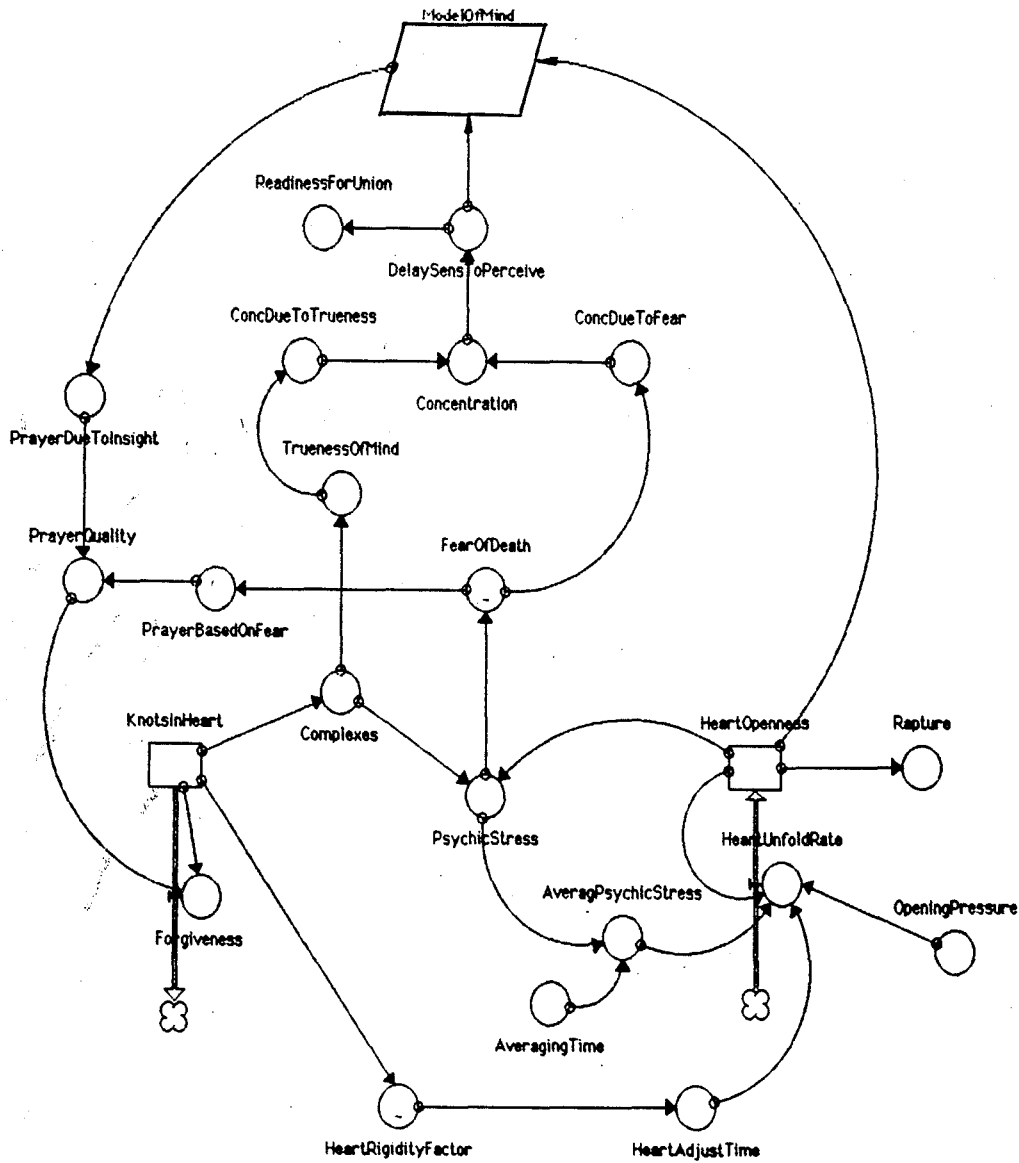
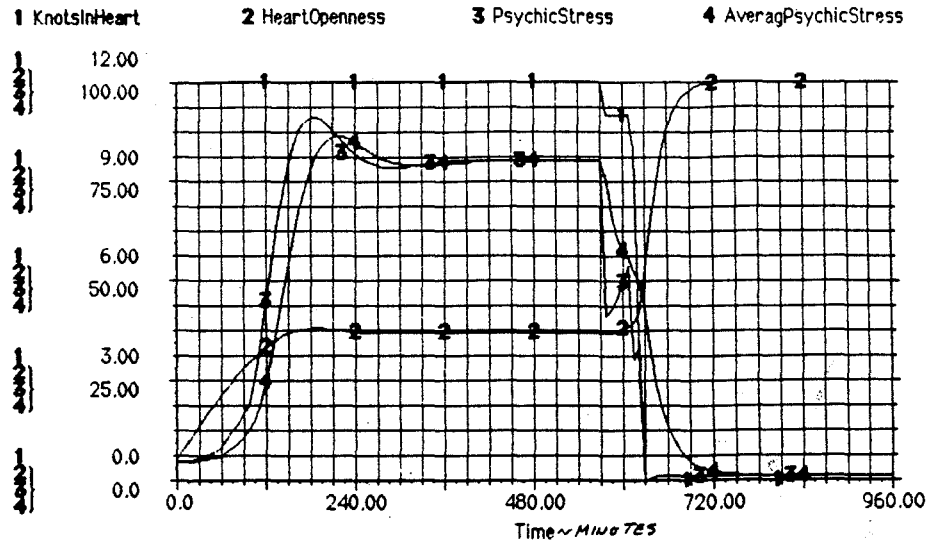**Figure 4**: Simulation of the Model of the Dark Night of the Soul.

1 KnotsInHeart   **2** HeartOpenness   **3** PsychicStress   **4** AveragPsychicStress

Figure 5: Simulation of the 10 minute period (620 to 630) just before
mystical union during which the last 6 knots are removed from the heart,
concentration goes into an exponential rise, delay between sensing and
perceiving approaches zero, and readiness for mystical union goes off to
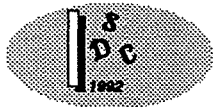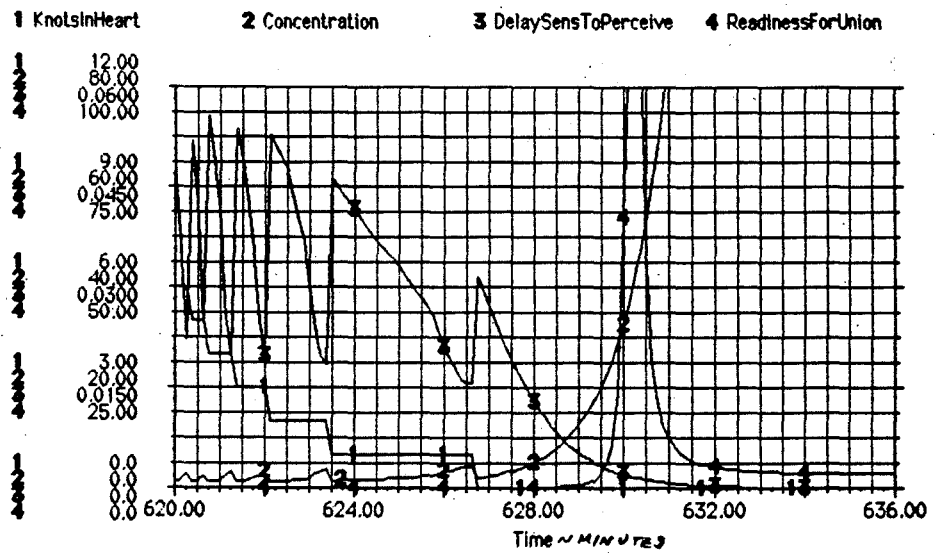infinity between the 630 and 631 minute marks.

1 KnotsInHeart   **2** Concentration   **3** DelaySensToPerceive   **4** ReadinessForUnion

Figure 6: How PrayerQuality, composed of PrayerBasedOnFear and PrayerDueToInsight, rises to 100% at the 575 minute mark causing the first knot to be removed from the heart; how the heart becomes less rigid [HeartRigidityFactor] as knots are removed.
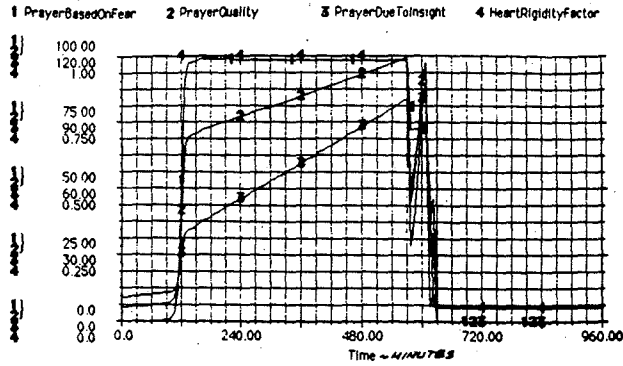
1 PrayerBasedOnFear   2 PrayerQuality   3 PrayerDueToInsight   4 HeartRigidityFactor

Figure 7: How FearOfDeath rises just before a knot is removed from the heart during the Dark Night of the Soul

1 KnotsInHeart   2 Concentration   3 FearOfDeath   4 ReadinessForUnion
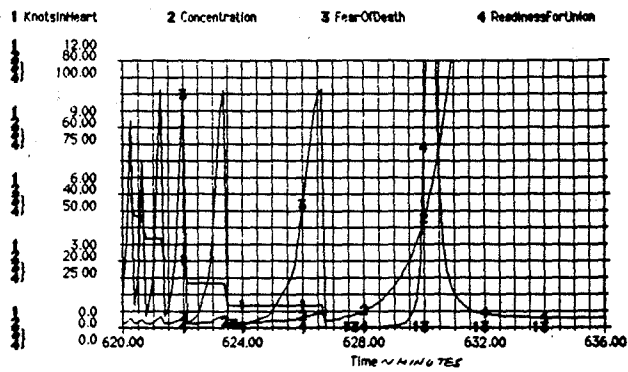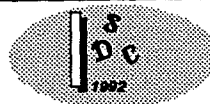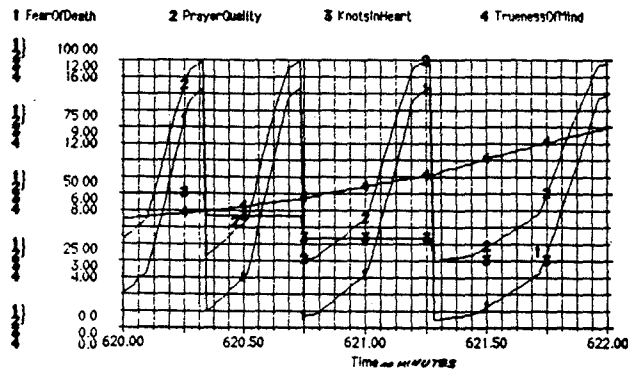

Figure 8: How FearOfDeath and PrayerQuality rose just before Forgiveness occurred and a knot was removed; how TruenessOfMind slowly emerges as knots are removed during this Dark Night of the Soul.

1 FearOfDeath   2 PrayerQuality   3 KnotsInHeart   4 TruenessOfMind

Appendix A: Mathematical Model

☐ CollectedAwareness = CollectedAwareness + dt * (Flow)
INIT(CollectedAwareness) = 0
☐ Complexes = Complexes + dt * (-Catharsis)
INIT(Complexes) = 12
☐ HeartOpenness = HeartOpenness + dt * (HeartUnfoldRate)
INIT(HeartOpenness) = 5
☐ KnotsInHeart = KnotsInHeart + dt * (-Forgiveness)
INIT(KnotsInHeart) = 12
☐ PerceivedInfo = PerceivedInfo + dt * (InnerPercepRate)
INIT(PerceivedInfo) = 0
☐ UnperceivedInfo = UnperceivedInfo + dt * (LossRate)
INIT(UnperceivedInfo) = 0
☐ WorkingMemory = WorkingMemory + dt * (InnerSensRate - InnerPercepRate - Flow - LossRate)
INIT(WorkingMemory) = 7
○ AdditionalOpenPress = 75
○ AveragingTime = 25
○ AveragPsychicStress = SMTH1(PsychicStress,AveragingTime)
○ Catharsis = Forgiveness
○ ConcDueToFear = FearOfDeath
○ ConcDueToTrueness = TruenessOfMind
○ Concentration = (ConcDueToFear+ConcDueToTrueness+36)/40
○ DelaySensToPerceive = NormDelaySensToPerc/Concentration
○ Flow = IF (RetrieveMemStrength^2<0.0001) THEN InnerSensRate ELSE 0
○ Forgiveness =IF (KnotsInHeart^2 < 01) THEN KnotsInHeart/DT ELSE IF (KnotsInHeart^2 > 9) AND (PrayerQuality>100) THEN (1/DT) ELSE 0
○ HeartAdjustTime = 2.40*HeartRigidityFactor
○ HeartUnfoldRate = (OpeningPressure - AveragPsychicStress)*((100-HeartOpenness)/100)/ HeartAdjustTime
○ InnerPercepRate = (WorkingMemory*RetrieveMemStrength*RecodingFactor/DelaySensToPerceive)
○ InnerSensRate = 2000
○ IQ = 100
○ KnowlogQualOfPrayer = 1*InnerPercepRate
○ LossRate = InnerSensRate-InnerPercepRate-Flow
○ MaxPossPsycOpenness = 10/Duplicity
○ NormDelaySensToPerc = 4/60
○ NormOpenPressure = 5
○ OpeningPressure = NormOpenPressure+AdditionalOpenPress
○ OpennessRatio = PsychicOpenness/MaxPossPsycOpenness
○ PrayerBasedOnFear = FearOfDeath
○ PrayerDueToInsight = KnowlogQualOfPrayer
○ PrayerQuality = 5*(PrayerBasedOnFear+PrayerDueToInsight)
○ PsychicEnergy = 100-HeartOpenness
○ PsychicStress = 100*OpennessRatio^2
○ Rapture = HeartOpenness
○ ReadinessForUnion = 00001/(DelaySensToPerceive-(1/600))^2
○ RecodingFactor =(PsychicEnergy*IQ*((PerceivedInfo)^(2/3))/27000000)+1
○ TruenessOfMind = 50/SMTH1(Complexes,1)
⊘ Duplicity = graph(Complexes)
(0.0,0.0100),(1.20,1.70),(2.40,3.20),(3.60,5.50),(4.80,8.40),(6.00,12.00),(7.20,19.00),(8.40,29.00), (9.60,44.00),(10.80,66.00),(12.00,100.00)
⊘ FearOfDeath = graph(PsychicStress)
(0.0, 0.0),(10.00, 0.0),(20.00,1.00),(30.00,5.00),(40.00,20.50),(50.00,85.50),(60.00,97.00), (70.00,98.00),(80.00,98.50),(90.00,99.00),(100.00,99.50)
⊘ HeartRigidityFactor = graph(KnotsInHeart)
(0.0,5.00),(1.20,5.00),(2.40,5.00),(3.60,6.00),(4.80,7.00),(6.00,11.00),(7.20,17.00),(8.40,28.00), (9.60,44.00),(10.80,67.00),(12.00,100.00)
⊘ PsychicOpenness = graph(HeartOpenness)
(0.0,0.0220),(10.00,0.02220),(20.00,0.0270),(30.00,0.0440),(40.00,0.110),(50.00,5.20), (60.00,49.00),(70.00,100.00),(80.00,100.00),(90.00,100.00),(100.00,100.00)
⊘ RetrieveMemStrength = graph(DelaySensToPerceive)
(0.0, 0.0),(0.00500, 0.0),(0.0100, 0.0),(0.0150,0.600),(0.0200,0.850),(0.0250,0.940), (0.0300,0.965),(0.0350,0.975),(0.0400,0.985),(0.0450,0.990),(0.0500,1.00)

Appendix B: Complete Flow Diagram