CAERDROIA

THE JOURNAL OF MAZES & LABYRINTHS

: XXXVI :

CAERDROIA 36

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The Journal of Mazes & Labyrinths

36th Edition

Established 1980
Published Annually
Produced by and

Fivefold Labyrinth design, projected from high on the adjacent building, on the pavement outside the Tourist Information Office in Cork City Centre, Ireland, for the "Labyrinths - Pathways of Light" Festival, December 15 - 21, 2005.

CAERDROIA 36

The Journal of Mazes & Labyrinths

October 2006

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Caerdroia 37 is due for publication October 2007, submissions by July 2007 please

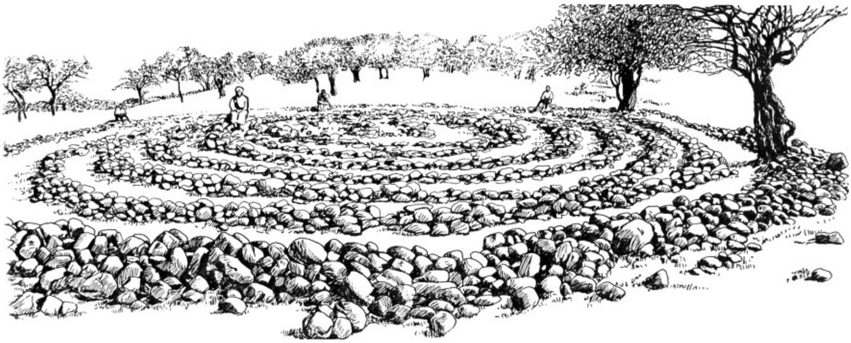
Editorial - Caerdroia 36

Jeff Saward, Thundersley, October 2006

Welcome to the 36th edition of Caerdroia, after the delays with the last edition, relatively hot on its heels, at least by the standards of Caerdroia! With the production schedule once again back on track, this edition contains several items that I have long been looking forward to publishing. For many years there has been considerable discussion about the little known labyrinths to be found in India, and following the note about the newly discovered prehistoric labyrinth petroglyph in Goa in the last edition, this time we have news of recent labyrinth fieldwork in the south and west of India. Evidently, more discoveries await in the Indian sub-continent, and new chapters on the history and distribution of labyrinth in this region will also need to be written.

Beginning in the Spring of 2007, Kimberly and I will be editing and publishing a new annual publication from the Labyrinthos stable. Provisionally titled ***Labyrinth Pathways***, it will focus on labyrinths in the fields of Spirituality, Health, and the Arts. Further details and submission guidelines will be posted on the Labyrinthos website in due course and copies will be available from both Labyrinthos and The Labyrinth Society. The Caerdroia and Labyrinthos website is also in the process of being extensively updated and revised, so look out for that sometime early in 2007 also. Meanwhile, on with Caerdroia 36…

Jeff Saward - E-mail: jeff@labyrinthos.net - Website: www.labyrinthos.net



The former stone labyrinth at Sitimani, Karnataka, India (see page 60)

Erratum

A quirk of file formatting between different versions of software inadvertently deleted the numbers of the rules laid out in Tristan Smith's paper "A Daedalus for the 21st Century" in Caerdroia 35. Consequently, readers should insert the numbers 1, 2 and 3 before the second, third and fourth paragraphs in the section marked "Terms and notation" on p.27, the number 4 before the second paragraph on p.30, and the number 5 before the two paragraphs beginning a) and b) directly below. My apologies go to Tristan, and to readers who were in any way confused. My version of MS Word has been suitably reprimanded!

The Labyrinth on Coins & Tokens

Jeff Saward

Labyrinths have been appearing on coins for some time now. The coins issued at the Greek town of Knossos on the island of Crete during the 3rd to 1st centuries BCE, are well known. While the vast majority are decorated on their reverse side with a square 7-circuit/8-wall labyrinth of the "classical" design, a few varieties with circular and five or three circuit designs are also recorded, some with blundered designs containing paths that dead-end, apparently the work of engravers unskilled in the correct technique, or simply experimenting with alternate forms of the labyrinth symbol.

Left: Reverse of a coin from Knossos, with an unusual five-circuit blundered design. BMC: 82-6-6-69

Right: Reverse of a bronze coin, 19 mm diameter, issued by Augustus (27 BCE - 14 CE), with a square classical design. Labyrinthos Collection

There were also coins, likewise decorated with the labyrinth, issued by the Roman Emperor Augustus (reigned 27 BCE - 14 CE). His long reign was a period of peace and recovery after many years of rival leadership and wars, and he undertook many public works and building programs that united much of the Empire under the *Pax Romana*. During this time he issued many coins with depictions of famous buildings from around the empire, as well as extensive series of local issues featuring exotic animals and geographical themes, both real and mythological. The labyrinth coins fall firmly in this category; clearly they were inspired by the coins of Knossos produced in previous centuries, and indeed were probably issued on Crete, or at least in Greece.

Some 1500 or so years later, several royal medals were struck by Queen Kristina of Sweden (reigned 1644-54). Although not really coins as such, they were also inspired by an original labyrinth coin from Knossos, which is known to have been in the Queen's coin collection at that time.[1] This is proven by a depiction of the coin in question in a catalogue of the collection, subsequently published in 1742. The square, seven-circuit, eight-wall classical labyrinth on these medals is accompanied by the inscription FATA VIAM INVENIENT - *the fates will find the way*, a motto from Virgil's *Aeneid*, that also appeared alongside a labyrinth in Claude Paradin's book of emblems and heraldic symbols, *Devises Héroïques*, first published in 1551.[2]

Right: smaller type of Queen Krisitna's labyrinth medals. Myntkabinettet, Stockholm

During 2006 Labyrinthos has acquired two coins, of sorts, for its collection, that also feature a labyrinth on their reverse, neither of which has previously been noted in the labyrinth literature.

The first is a French jeton, dated 1678. Jetons were originally used during the medieval period as counters on reckoning boards, used to keep account of financial transactions and the like. However, by the 17th century their function changed from being counters to becoming popular gifts or presentation pieces produced for specific functions or bodies like the Royal Household, Chambers of Commerce, and military regiments, etc.

They were usually minted in copper, bronze, silver, and (rarely) gold, and are often fine works of art in their own right. Mintage numbers were generally in the low thousands, and in some parts of Europe they also circulated as token coinage, particularly during periods when there was a shortage of regular coinage.

Many of these French jetons from the late 17th & early 18th century show scenes from the Classics, with Latin quotes adapted from editions current at the time, famous dramatic locations, military scences and other allegorical themes. The example recently aquired by Labyrinthos for its collection was issued in the French region of Burgundy, but was almost certainly minted in Paris, in 1678. Made of copper, it measures 28 mm (a little over an inch) in diameter.[3]

The obverse bears an armorial shield and the inscription ORDINUM BURGUNDIA DILIGENTIA, denoting that it was issued by the Armoury of the Duke of Burgundy, in Dijon. The reverse has the inscription NEC TENUI FILO EXTRICATUR - *nor thin thread can disentangle*, surrounding a depiction of a man standing at the doorway of a stone building. The curving lines of the open roof clearly denote that this is the labyrinth of legend, and the man is Theseus, clutching Ariadne's Thread in his hand, paid out from the doorway.

In 1678, Burgundy was on the frontier of Eastern France, at the height of Louis XIV's expansionist campaigns along its northern and eastern borders, and many of these jetons issued at this time in Burgundy obviously served as objects for propaganda and political commentary. The adjacent territory of Franche-Comté, centred around Besançon, was seized from the Holy Roman Empire in the same year. As such, it is not difficult to see the depiction of Theseus and the labyrinth on the reverse of this jeton as a comment on the complex military and political situations in the area.

Copper jeton issued in Burgundy, France in 1678, depicting Theseus and the labyrinth on the reverse. Labyrinthos Collection

The accompanying inscription might appear to derive loosely from Ovid's *Metamorphosis* (8.169-175), by far the most popular text source for the labyrinth story during the 17th century. Many of the illustrated editions of the Metamorphoses published during the 16th & 17th centuries feature woodcuts and engravings of the labyrinth, with various characters from the Theseus and Minotaur myth alongside. At the same time, the labyrinth (often drawn as little more than a few concentric gapped circles) was a popular theme in books of emblems and impresas, and indeed one of these, in Paolo Maccio's *Emblemata*, published in Bologna in 1628 might be considered a model for the depiction of the labyrinth with Theseus at its entrance that appears on the Burgundy jeton.[4] Obviously the labyrinth has been simplified to little more than a few looping circuits, but the basic form of the building, and in particular the stance of Theseus and the portrayal of the thread, is quite similar.

Engraving from Paolo Maccio's book* Emblemata*, published in Bologna in 1628. The accompanying motto reads* Antequam incipias opus est consulto *(think before you start something), typical of the moral guidance associated with labyrinth emblems in such works of this period.

The depiction of Theseus paying out the thread from the entrance of the labyrinth is quite similar to the portrayal on the Burgundy jeton, possibly this was the inspiration for the design?

The second item under discussion here, from the end of the 18th century, is certainly quite unique. This is a so-called love token, a coin on which one, or both sides, have been smoothed down and engraved with initials, names, phrases and scenes. These were often given to young ladies as tokens of love by their sweethearts, especially soldiers and other servicemen, leaving on duty, and also by convicts about to be deported. It would appear that the practice originated in Britain in the late 1700's, and migrated to the United States of America in the mid-1800's. Similar love tokens are also found at this time elsewhere in Europe, especially Austria and Germany.[5]

The token itself is a smoothed down George II or III copper halfpenny, to judge by its size - 26mm (one inch) in diameter. While the origin is clearly somewhere within the British Isles, it is not possible to determine exactly where the token was made. The resulting blank disc has subsequently been engraved on the obverse with the initials "RN" in florid capital script, surrounded by decorative patterns including what appear to be the letters "so" and "ne," and finally the date 1791 below. On the reverse is an engraving of a classical labyrinth with a small hollow at the centre. Alongside the labyrinth is the name "Neeves," facing out from the entrance of the labyrinth the word "at," and a few letter-like decorative squiggles to fill the frame.

Copper love token, dated 1791, with a labyrinth on the reverse.
Labyrinthos Collection

As the inscriptions on these tokens are generally rather formulaic, it could be argued that a certain Miss Neeves was in a proverbial labyrinth, to be found by her sweetheart 'RN' whose initials appear on the other side, or that R. Neeves, the engraver, was himself in a labyrinthine situation. Either way, the exact meaning of the symbolism intended here is difficult to determine, although the use of the classical labyrinth symbol on a simple item such as a love token in late 18th century Britain is clearly of interest.

Turf labyrinths were widespread in the British Isles at this time. Often constructed by town councils, educated landowners and scholars, a number of examples (i.e. Hilton in Cambridgeshire and Saffron Walden in Essex) date from the second half of the 17th century and there is evidence for their continued construction through until the mid-19th century (i.e. Stuartfield, Scotland and Dalby, North Yorkshire). These may have provided the inspiration for the use of the labyrinth on this token, but it is also clear that the classical labyrinth symbol was in widespread "folk custom" usage throughout this period.

The chalked labyrinth graffiti in the underground passages of the Chaldon stone quarry in Surrey date from the 1720-30's, a labyrinth laid in cobblestones in the floor of a farmhouse at Castletownroche in County Cork, Ireland, dates from the 1790's. Likewise, the two labyrinths carved on a rockface in Rocky Valley, Cornwall, although difficult to date and the subject of much contention, are probably from the period between c.1750 and c.1860. The antiquarian P. Roberts records in 1815 that shepherd boys in Wales would draw labyrinths and cut the design in turf, and the Rev. Trollope, writing in 1858, records school children in Scotland drawing the labyrinth on writing slates and tracing them in wet sand on the beach.[6]

This love token from 1791 is yet another example of the widespread and common knowledge of the labyrinth symbol, and how to draw it successfully, amongst the general population of the British Isles at this time.

However, before moving on, it is interesting to note that a careful study of the tiny labyrinth (only 18 x 16 mm) engraved on this token provides clues to its construction method. In common with other "freehand" labyrinths, drawn quickly, with little or no further embellishment, these often retain evidence of the drawing sequence and the initial layout technique. This process can often be determined for labyrinths preserved as graffiti on buildings, painted on ceramics or as frescos on walls and ceilings, where invariably the central "seed-pattern" can be discerned at the centre, with a series of concentric circuits then added to complete the design.

On initial inspection, the small pit at the centre of the labyrinth and the circular form of the circuits, would suggest that much of the design has been engraved into the soft copper with a simple engraving bit attached to a compass, rotated around the central pin-hole. However, closer examination reveals rather more of the story.

Examining the engraved lines of the labyrinth under a microscope shows a number of places where lines overlap each other, especially where the ends of two lines meet, and this provides valuable information about which line was created first – the latter line obviously overlying the former. It also suggests the direction in which certain lines were engraved, striations on the edges of the grooves point in the direction of progress and occasional skips of the engraving bit show signs of correction from a new starting point. It is also apparent that the original coin had been lightly hammered before the surfaces were smoothed prior to engraving.

It is clear that construction started with the central cross – the horizontal stroke first, followed by the vertical, the groove of which overlaps the previous line. A small depression just above the intersection of the lines, was presumably formed by the blunt point of a small rest, placed to steady the hand of the engraver, while placing the four arcs within the angles of the cross to create the next stage of the "seed pattern." Surprisingly, there is no evidence of initial dots or dashes within any of the four arcs, unless they took the form of simple scratches, subsequently erased by the engraving process.

The concentric lines were then engraved, and despite their apparent circularity, most of the circuits deviate from true circular arcs, ruling out the use of a compass. Instead they would appear to have been drawn essentially freehand, probably pivoted on a hand rest of some kind, around the deep depression to the right of the uppermost point of the central cross. Starting with the innermost circuit, drawn clockwise from the top of the cross and joining the top edge of the top right arc, the next circuit was drawn in an anticlockwise direction, starting in the middle of the top right arc. To judge from the overlaps of lines and the points where circuits meet arcs, the remaining concentric circuits may have been constructed in an alternating clockwise/anticlockwise fashion, although several of the outermost circuits show skips of the engraving point and clear evidence that a second attempt was made to enhance or improve lines that presumably didn't engrave well at the first try.

Central portion of the labyrinth hand-engraved on the reverse of the 1791 love token. Notice the two small hollows and how the concentric lines sometimes join the central cross and arcs smoothly, and other times miss or overlap.

As is common with hand drawn classical labyrinths of this type, there are several occasions where the circuit lines join awkwardly with the seed pattern. In this example this is readily apparent on the top right and lower right arcs and the lower tail of the central cross. In contrast the connections on the left side of the labyrinth are much cleaner. All in all, despite the occasional glitches in the process, the unknown engraver of this token has created a remarkably precise rendition of the labyrinth, especially at this small scale. Clearly he was familiar with construction of the labyrinth design.

Two pesos coin issued by Argentina in 1999 to commemorate Jorge Luis Borges.

More recently, Argentina has issued coins commemorating the centenary of the birth of Jorge Luis Borges (1899-1986), whose labyrinth themed writings are famous worldwide. The coin itself depicts Borges on the obverse and a simple hexagonal maze with a sundial at the centre on the reverse. Silver and gold proof finish versions of this coin were produced for collectors, but an everyday version in base metal, denominated 2 pesos, circulates in Argentina.

Labyrinths, and now mazes, have been appearing on coins for well over two thousand years now, and the trend seems set to continue…

Jeff Saward; Thundersley, England, 2006

Notes:

[1] "The Queen's Medals" by John Kraft in *Caerdroia* 28, p.24-25.

[2] *Through the Labyrinth* by Hermann Kern (English edition, Prestel, 2000), no.363, p.200.

[3] This token is catalogued as type No.9813 in the standard reference work of F. Feuardent, published in 4 volumes in 1914, that lists over 15,000 varieties of jetons. A more accesable guide is *Jetons, Medalets and Tokens*, Vol.2: The Low Countries & France, by Michael Mitchener, Seaby 1991.

[4] *Through The Labyrinth*, by Hermann Kern, especially chapters 12 & 13, has much more on these emblems, impresas and the symbolic use of the labyrinth during this period.

[5] The standard reference work on love tokens is *Love Tokens as Engraved Coins* by Lloyd L. Entenmann, privately published, 1991. The Love Token Society is an international organization of love token enthusiasts: www.lovetokensociety.org.

[6] *Labyrinths & Mazes* by Jeff Saward, Gaia/Lark Books, 2003, especially p.120-129, has more on these labyrinths found in the British Isles.

How To Solve A Maze

Michael Behrend

"The subject of the solution of mazes has been examined by various mathematicians, in their lighter moods," says Matthews (1922). This article looks at some methods of solution from before and after Matthews' time, without going into the (not always light) mathematical details. Interested readers may also like to refer to the articles by Jearl Walker (1986) and Robert Abbott (1998). Here we are concerned only with exploring a plain maze when no plan is available. We do not consider "mazes with rules," such as those devised by Robert Abbott and Adrian Fisher. Different methods are required for these, since not only are they more complicated, but solvers can usually see the plan, either on paper or at their feet as a pavement maze.

A maze can be seen mathematically as a *graph*, in the sense of a collection of nodes (alias vertices) joined together by a collection of alleys (alias edges).[1] Matthews (1922, p.187) shows how the plans of two English hedge mazes, those at Hampton Court and Hatfield, can be unwrapped as graphs. Another English hedge maze, at Chevening House, is shown as a plan in figure 1 and as a graph in figure 2. This maze, by the way, dates from the 1820s and is said to be the first in which the hedge was split into several parts or "islands," thus defeating the "hand-on-hedge" method for reaching the goal.[2] The seven islands in figure 1 correspond to the seven areas (including the outside) cut off by the alleys in figure 2.

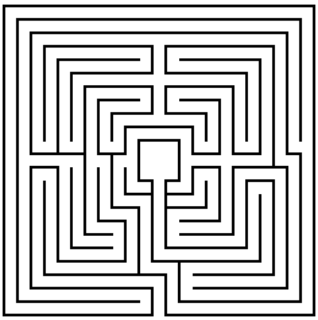


Figure 1. Conventional plan of the hedge maze at Chevening, Kent, England. Lines represent hedges.

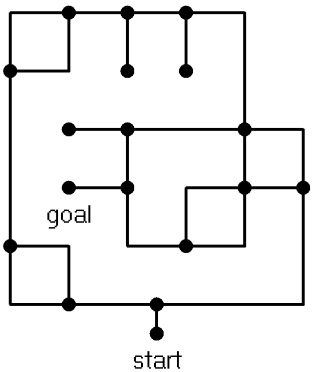


Figure 2. The Chevening maze unwrapped as a graph with 18 nodes and 23 alleys. Lines represent alleys.

When "solving" a maze, we may be trying to reach a goal from the outside, or we may be lost in the maze and trying to find a way out. From a mathematical viewpoint, it amounts to the same thing. In the mathematical literature algorithms that ensure every node is visited solve the problem. This condition is necessary to ensure that the goal is not missed. Once we have reached the goal, we can break off the algorithm if we wish.

We are allowed to leave marks, e.g. numbers or coloured flags, at the ends of the alleys, to serve as a guide when a node is revisited. Writers on the subject tend to assume that we have only local information. This means that marks at one node cannot be seen from another (the term "myopic algorithm" is also used). One can imagine problems that allow more than local information, e.g. a maze that has straight alleys and where on visiting a node we are allowed to leave some conspicuous object, such as a road cone, to be visible from neighbouring nodes. But as far as I know, such problems have not been treated in the literature.

An important result of assuming only local information is that when the algorithm finishes there cannot be any node with an unexplored alley leading out of it. For if there were, we should have no guarantee that the node at the far end of that alley had been visited. So, with only local information, solving a maze amounts to walking every alley at least once.

Put in this way, the problem is related to the well-known problem of the seven bridges of Königsberg (now Kaliningrad). Citizens used to discuss whether it was possible to take a walk that would cross each bridge once and once only. The famous mathematician Leonhard Euler (Swiss, 1707–1783) heard of the problem when he was a professor in St Petersburg, and proved that it was not possible (Euler 1736). He gave rules by which one can decide, for any configuration of bridges, whether such a walk exists,[3] and thus founded what is now called graph theory. But he did not investigate mazes as such.

Wiener's Algorithm

The first writer to treat mazes mathematically was the German scientist and mathematician Christian Wiener (1826–1896). In a short paper (1873) he supposes you are lost in a maze, and explains how to find the exit. He assumes that you are marking the maze so that you have a way of retracing your steps, and, on arriving at a node, a way of telling whether it has been visited before.

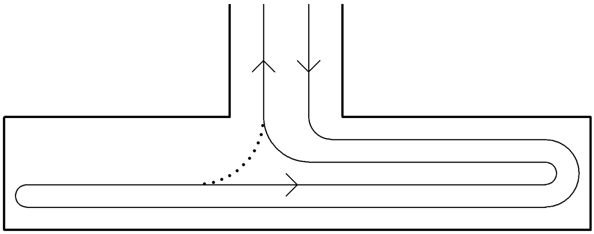
One method is to have an Ariadne's thread which is fastened at the starting node and paid out as you go along. Or, keeping to the principle of marks at the nodes, you might mark an X at the starting node and mark the exits from the alleys 1, 2, 3, and so on, in succession. This allows you to retrace your steps by following the numbers in reverse order.

Now, says Wiener, begin by following alleys at random until you reach a dead end or a node that has been visited before. Here you must retrace your steps, but still pay out the thread, until you reach a node with an unused alley. Then advance along that alley (making a random choice if there is more than one) until forced to retreat again, and so on. Eventually you will retreat to the starting node and still not be able to find a node with an unused alley. When that happens, the algorithm is finished and every alley has been walked at least once. Alternatively, of course, you can stop as soon as you reach the exit.

Wiener's algorithm works, but has rightly been criticized as inefficient. Suppose you are retreating and come across an alley that you have already traversed in both directions. Wiener apparently intends you to go in and out once again. Later, perhaps, you might have to retrace both excursions, making four in all, and so on. For example, a computer study showed that when Wiener's algorithm is applied to the Chevening hedge maze there are 32768 possible solutions.[4] If lucky, you might make only 64 walks along the alleys; if unlucky, 2468 walks, i.e. over 100 walks per alley on average. Without a plan of the maze, Wiener's algorithm provides no way to choose a short solution: the length depends on choices that have to be made at random.

To stop the repetitions piling up, all that is needed is a rule that if, while retreating, the thread you are following goes into an alley and out again, then you skip over that alley (figure 3). With this modification, it will be found that when the algorithm finishes you have traversed every alley exactly once in each direction. Indeed, the modified algorithm is identical to Trémaux's algorithm, to be described next. The thread left in the maze is a record of your route.

Figure 3.* *A drawback of Wiener's algorithm, and (dotted) how it can be avoided.



Trémaux's Algorithm

Around the end of the 19th century several mathematicians published books of mathematical recreations that have since become classics: Lucas in France, followed by Ball in England and Ahrens in Germany. In his book, Lucas (1882) published the next advance in maze algorithms, which was sent to him by a Monsieur Trémaux and soon copied by other writers.

Trémaux's algorithm does not rely on Ariadne's thread, but on marks made at the ends of the alleys. He (or Lucas) makes the concept of local information quite clear. Given a plan of the maze on paper, take a sheet of cardboard and cut in it a peephole (*oculaire*) large enough to show all the marks at one node, but too small to show more than one node at a time. By moving the cardboard over the plan, you get the same information, and no more, as if you were walking and marking a tall hedge maze. This device is a forerunner of the "maze simulator" supplied with the book by Adrian Fisher and Howard Loxton.[5]

Trémaux's scheme of marking is very simple: every time you traverse an alley, add a mark at each end. There is no need to record the direction. The rules for using the marks are more complicated.

(1) On arriving at a node that has not been visited before, i.e. has no earlier marks:

- (a) if the node is a dead end, then retreat along the alley just traversed;
- (b) otherwise, leave by any alley except the one just traversed.[6]

(2) On arriving at a node that has been visited before:

- (a) if the alley just traversed has no earlier marks, retreat;
- (b) failing that, leave by an unmarked alley, if there is one;
- (c) failing that, leave by an alley that has only one mark, if there is one;
- (d) failing that, stop. The algorithm is finished and you are back at the initial node, having traversed every alley exactly once in each direction.

The analysis of Trémaux's algorithm is rather tricky. Lucas's proof is faulty, as is that of Ahrens (1901). The first correct proof is I think that of Tarry (1895). After proving his own algorithm (see below), he proves that it includes all the routes that can be found by Trémaux's.

Although Trémaux's algorithm means that he is often mentioned in the literature of graph theory, little seems to be known about him, not even his first name. Lucas (1882) describes him as "ancien élève de l'Ecole Polytechnique et ingénieur des télégraphes." Perhaps some reader with access to French records could find out more.

Rosenstiehl's algorithms

Pierre Rosenstiehl, of the Centre d'Analyse et de Mathématiques Sociales in Paris, has written on mazes from both the mathematical and cultural viewpoints. For example, maze algorithms can be described in terms of a network of identical automata, placed one at each node of the maze and communicating along the alleys. Such networks of equal co-operating automata can solve a surprising number of problems in graph theory, and one may see implications for the organization of human society.[7]

Rosenstiehl gives two maze algorithms, which he describes by whimsically splitting Ariadne into two sisters, "Ariane sage" and "Ariane folle."[8] One algorithm, Maxirepli or maximum recoil, is (as he points out) essentially the same as Trémaux's.[9] We can also equate it to Wiener's thread algorithm with skipping (see above). Here Theseus, guided by the prudent Ariadne, always retreats from a previously visited node, even if it has unused alleys. On the other hand, if he listens to the rash Ariadne he will press on through unexplored alleys as long as he can, retreating only when he reaches a node where all the alleys have been used. This is the Minirepli algorithm. Rosenstiehl proves that it works, and that (as with Maxirepli/Trémaux) all the routes derived from it can also be derived from Tarry's algorithm.

Tarry's algorithm

This is the most elegant of the "classical" maze-exploration algorithms, i.e. those in which every alley is walked exactly twice. Its French inventor Gaston Tarry (1843–1913) was an accountant in the Algerian civil service, whose mathematical work was nevertheless published in academic journals. His algorithm (Tarry 1895) includes all the solutions that can be derived from Trémaux's rules, and is rather easier to remember. I have simplified it slightly from the form in which he gave it.[10]

We need two kinds of mark, which I will call red and green, though of course they could be anything: in real life perhaps sticks and pebbles, or bottles and cans, etc. It is even possible to use (say) one stick for red and two sticks for green, since in our version a mark once made is not added to. Here are the rules.

(1) On leaving the initial node choose any alley, and mark the entrance with red.

(2) On arriving at a node that has not been visited before, i.e. has no marks, make a green mark on the alley by which you entered.

(3) On leaving a node:

  (a) if there are unmarked alleys, take any one and mark the entrance with red;

(b) failing that, take the green-marked alley, if there is one (don't add another mark);

(c) failing that, stop. The algorithm is finished and, as with Trémaux, you are back at the initial node, having traversed every alley exactly once in each direction.

Tarry's algorithm is easier to prove correct than Trémaux's. For instance, it is obvious that the algorithm can only stop at the initial node, since every other node will have an alley with a green mark.

One deduction from analysing the algorithm is that after leaving a node by the green-marked alley you will never visit that node again. So in real life this is an opportunity to take away all the markers at that node. When you arrive back at the initial node for the last time, there will be no litter left in the maze. Another advantage of Tarry's algorithm is that you can break off at any time and return to the initial node by following the green marks.

Traversing every alley twice may seem inefficient, but it could be useful when inspecting or clipping a hedge maze. Since the traverses are made in opposite directions, you need only concentrate on (say) the right-hand side of the path, and eventually the whole hedge will have been covered. As Euler showed in his work on the Königsberg bridges, it may not be possible to traverse every alley just once, even if the plan of the maze is known in advance.

Fraenkel's principle

The Israeli mathematician Aviezri Fraenkel modified Tarry's algorithm so that alleys are not necessarily traversed twice (Fraenkel 1970/1). His method departs from the principle of local information, since it relies on a counter that we keep track of as we walk through the maze. Analysis of his paper reveals a principle that might be used in conjunction with other maze algorithms, not just Tarry's.

Let us call a node white if none of the alleys there have been traversed (in either direction), black if all have been traversed, and grey otherwise. What Fraenkel does, in effect, is to keep count of the grey nodes. Initially the counter is zero, since all nodes are white. Arriving at or leaving a white node will change it to grey (or black if it's a dead end); arriving at or leaving a grey node may change it to black. It's assumed we are marking the maze in such a way that these changes can always be detected. We can thus update the counter if necessary on arriving at a node, and again on leaving.

Now walk the maze by any algorithm, or even at random. If after arriving at a node and updating the counter you find that it is now zero, then you must have traversed every alley of the maze. The proof is not difficult. Note that when the counter becomes zero you are not necessarily back at the initial node. If you want to return there you need some way to retrace your steps; in Fraenkel's paper this is provided by the marks from Tarry's algorithm.

A computer study showed that Fraenkel's modification is rather disappointing in practice. It is not guaranteed that the walk will be any shorter than by Tarry's algorithm, and the average saving is small. To use the Chevening hedge maze again as an example, Tarry's algorithm provides 73728 solutions, all of which have 46 walks along the alleys because each of the 23 alleys is walked exactly twice. With Fraenkel's modification there are 29696 solutions; the shortest has only 32 walks along the alleys, but the longest still has 46, and the average is 44.19. The results would however look better if we dropped the requirement that the route must end at the initial node.

Ore's algorithm

Another maze algorithm was devised by the Norwegian graph theorist Oystein Ore (1899–1968). He supposes (Ore 1959; Walker 1986) that you are lost after wandering only a short way into a large maze, and wish to return to the entrance quickly rather than explore deeper into the maze. The idea is to first visit all nodes that are only 1 alley away from the initial node, then all those that are only 2 alleys away, etc. Since the entrance is only a few alleys away, it will soon be found. Some of the alleys, however, will have to be traversed several times, not just twice as in the classical algorithms.

In Ore's algorithm each alley at a node is one of three kinds:

(1) The entrance, i.e. the alley by which this node was first reached;

(2) An open exit, to which a mark is added every time it is used;

(3) A closed exit, which is no longer used.

An alley is of course marked closed if it leads to a dead end. But also, if an alley is found to join two nodes that have already been reached, it is redundant and is marked closed at each end to save time. The algorithm in full is rather complicated, so my understanding of it is presented as a flowchart (figure 4).

If the algorithm is run to "Finished" the whole maze will be traversed, but rather inefficiently, as the algorithm is meant to break off as soon as the user has found an escape.

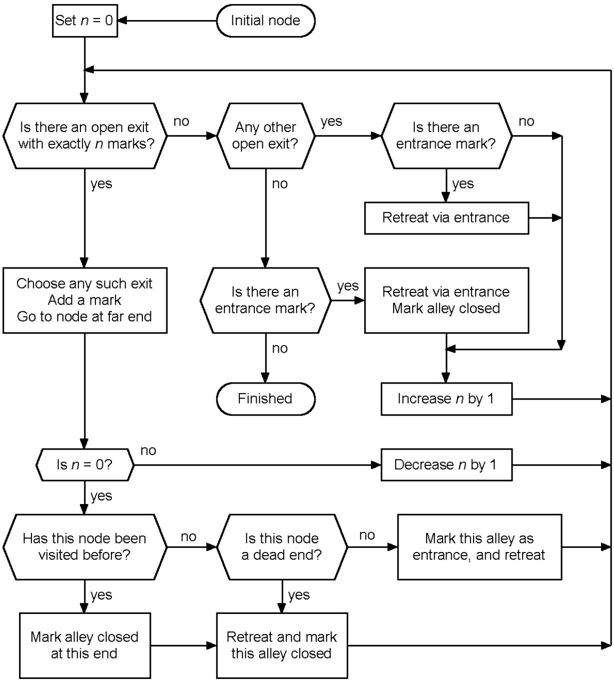


Figure 4. Flowchart for Ore's algorithm.

Conclusion

While this article has looked at some well-established algorithms that have appeared in print, there is still work to be done on maze-solving algorithms. One theoretical problem is to find the number of solutions for a given maze and algorithm: Tarry (1886) might be of interest here. More practically, how can one improve on Fraenkel's method to avoid traversing every alley twice, as in the classical algorithms? Again, little has been done on mazes with more than local information, e.g. in which marks at a node can be seen from neighbouring nodes as well. On the Internet there is a large, and growing, amount of material, not included here. At the time of writing, a Google search for "maze-solving algorithms" produced nearly 400 hits, though not all of them are based on the same assumptions as this article.

Michael Behrend; Somersham, Huntingdon, England, August 2006

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Notes:

1 To be exact, a maze is a finite connected graph. "Vertex" and "edge" are the usual terms, but "node" and "alley" are more descriptive when discussing mazes. I prefer "alley" to "path," which might also mean a route consisting of several alleys.

2 Field, R. (2001). *Mazes, Ancient and Modern*, 2nd edn, p. 43.

3 In many books of mathematical recreations, or see Walker (1986).

4 That is, exactly 2^{15} solutions, but it isn't obvious why.

5 Fisher, A. & Loxton, H. (1997). *Secrets of the Maze*, Thames & Hudon, London.

6 Some writers just say any alley, but retreating must be disallowed here.

7 Mathematical results in e.g. Rosenstiehl *et al.* (1972); social criticism touched on in Rosenstiehl (1980).

8 The two Ariadnes in Rosenstiehl (1980); formal mathematical treatment in Rosenstiehl (1971).

9 It seems to me that Maxirepli may differ from Trémaux's algorithm if the maze has a loop, i.e. an alley that begins and ends at the same vertex. I was unable to get in touch with Prof. Rosenstiehl to clarify the point.

10 Our red and green marks correspond to Tarry's double and triple marks respectively. His single mark is useful in the mathematical analysis, but can be dropped when applying the algorithm.

The Classical Maze & the Octaëteris

Lance W. Latham

Abstract

Mazes traditionally have been associated with calendric knowledge in legend and anecdote. This paper establishes definite multiple connections between the 'Classical Maze' of antiquity and the calendric pattern known as the *octaëteris*.

1. Introduction

The efforts of humans to understand and order the world often began with the construction of pictures and physical structures used in religious ritual. One of the oldest and most enduring symbols is the maze, used for millennia to convey ideas about the nature of life and the cosmos. In addition, the field of archaeoastronomy has provided us, over the past several decades, with a new picture of the central role played by calendric knowledge in the organization of monumental architecture, cities, works of art, and religious ceremony. That the two ideas – mazes and calendars – should have intimate and deep connections is not surprising.

This paper explores the relationship between the most common maze known in the ancient Western world, the Classical or 'Cretan' Maze; and a very old pattern for relating lunar months to solar events known as the *octaëteris*, or *ogdoas*. Evidence is adduced that the maze is a uniquely identifying physical template for the calendric pattern, and that physical construction of the maze was done for the purpose of organizing ritual processions scheduled by the *octaëteris* calendric pattern.

The origins of both the maze and the *octaëteris* are lost in prehistory. This paper does not attempt to specifically date the origins of either, but does indicate a generally consistent chronology that suggests Bronze Age origins in the Aegean area. This endeavour is necessarily speculative in parts, and the discussion attempts a clear demarcation between fact and speculation.

2. Octaëteris

This section defines the *octaëteris* calendar pattern, describes several consequences of the pattern, and examines its role in mythology.

2.1. Luni-solar calendars and LSD

Calendric systems are commonly divided into a number of categories. One of the most common categories is the luni-solar calendar, which makes use of both apparent lunar motion and apparent solar motion to define a calendar. Luni-solar calendars are obvious choices for dividing time into months by the moon and into years by the sun, using the two most obvious and visible celestial bodies. Not surprisingly, such calendars are a frequent choice among traditional societies.

Use of these convenient natural celestial markers comes at a price, however. The length of the solar year is not a simple integer multiple of the length of the lunar month, with the inevitable consequence that a year composed of lunar months is either too short or too long, compared to the year measured by the sun. Some scheme for 'balancing the books' is required, since virtually all societies typically must know the relative time of year in order to conduct essential activities.

Various schemes for matching some number of lunar months to some number of solar years have been invented over the centuries. One famous such scheme is the Metonic cycle, which equates 235 lunar months with 19 solar years, an approximation known to the Chinese several centuries before Meton.

In this paper, specific values will be used for the length of the solar year (SY) and the synodic lunar period (SLP), which is the amount of time that the moon, viewed by an observer at a location on earth, requires in order to return to the same phase. The SLP is the length of the lunar month, for calendric purposes.

The length of the solar year has different values according to the definition employed, and the event used to mark the length. This discussion uses the common value of 365.2422 days, which is the current value generally accepted as an "astronomer's average". The average length of the synodic lunar period is known to be 29.530588 days. Both of these values are known to change slowly over the course of centuries.

Thus, we have the following average lengths for solar year and lunar month:

SY = 365.2422 days

SLP = 29.530588 days

One immediate consequence of these values is the fact that a lunar year of twelve lunar months has an average length of:

LY = (12 x 29.530588) = 354.3671 days

leaving a lunar year short of a solar year by approximately:

LY – SY = (354.3671 - 365.2422) = -10.8751 days.

This discussion introduces the notation 'lunar-solar difference' (LSD) to signify this discrepancy, which can have slightly different values, depending upon the assumptions and method of calculation chosen.

Every year of operation of a luni-solar calendar in which months are reckoned as actual lunar months thus accumulates an LSD; in the first year, the shortfall is roughly 11 days; in the second year, roughly 22 days; in the third year roughly 32 and a half days; and so on. Clearly, if one both wishes to use lunar months and to plan events in the solar year, the LSD must be known and accounted for. Every society that uses a luni-solar calendar encounters this same situation.

Since the LSD involves a shortfall by the lunar reckoning, the most obvious method of correction is occasionally to insert a thirteenth month, to restore the lunar day count to rough parity with the solar day count, according to some scheme. This process is generally known as *intercalation*.

It is possible to maintain a degree of stability in a luni-solar calendar, relative to solar events, with an intercalation scheme that simply renames the lunar month following a given 'month X' as 'second month X', a method discovered by several societies, including the Greeks. Such a calendar can function relatively satisfactorily over the course of several decades.

2.2. Classical *octaëteris*

In order to obtain greater predictability of solar events using luni-solar calendar dates, however, it becomes necessary to adopt a schematic calendar, in which months are assigned fixed lengths of 29 or 30 days, and intercalation is performed according to a regular schedule. The classical *octaëteris* pattern equates 99 lunar months with 8 solar years. Each common year consists of alternating months of 29 and 30 days, for a total of 354 days; embolismic years intercalate a thirteenth month of 30 days. Intercalation occurs in the third, sixth and eighth years of the cycle. The following table illustrates the operation of the octaëteris over the course of its eight-year cycle. Note that the LSD has a different value for a schematic calendar, which reckons by unit days.

Year	12 lunar months	Length of solar year	Accumulated LSD (in days)
1	354.0	365.2422	-11.2422
2	354.0	365.2422	-22.4844
3	354.0	365.2422	-33.7266 + 30.0 = -3.7266
4	354.0	365.2422	-14.9688
5	354.0	365.2422	-26.2110
6	354.0	365.2422	-37.4532 + 30.0 = -7.4532
7	354.0	365.2422	-18.6954
8	354.0	365.2422	-29.9376 + 30.0 = +0.0624

The calculations show in detail the actual relation for the *octaëteris*, namely that ((96 x 29.5) + (3 x 30) =) 2922 days in lunar months, versus (365.2422 x 8 =) 2921.9376 days in solar years. The discrepancy at the end of the octennial cycle is 0.0624 days, which amounts to one day in 16.0256 octennial cycles, or about 128.2051 years. Thus, the average error is comparable to that of the Julian calendar, when viewed in this way.

2.3. Variants and accuracy

The octaëteris can be calculated and perceived in different ways, depending upon the astronomical and calendric knowledge base of a society. For Greeks of the sixth century B.C., the length of the solar year was 365 days, and lunar months were taken as alternating between 'full' months of 30 days and 'hollow' months of 29 days, yielding an effective average of 29.5 days. The octaëteris in this conception thus equates (8 x 365 =) 2920 solar days with (29.5 x 96 + 3 x 30 =) 2922 lunar days, yielding a table more like the following.

Year	12 lunar months	Length of solar year	Accumulated LSD (in days)
1	3540	365	-11
2	3540	365	-22
3	3540	365	-33 + 30 = -3
4	3540	365	-14
5	3540	365	-25
6	3540	365	-36 + 30 = -6
7	3540	365	-17
8	354	365	-28 + 30 = +2

2.4. A simple rule and its consequences

A simple and obvious rule exists that can originate with the simple counting of days and observation of solstices and equinoxes that are associated with the first attempts to construct a calendar. That rule is, 'if the lunar-solar difference at the end of 12 months is greater than the length of an average lunar month, add a month of 30 days'. Note from Table 1 that this *octaëteris* rule produces the *octaëteris* pattern. This is a simple and critical observation.

2.4.1. Mathematical skill requirements

A common objection to the attribution to traditional societies of calendric schemes that achieve relatively high accuracy is that such schemes necessarily require mathematical skills beyond the capabilities of the societies that allegedly invent them. The *octaëteris*, however, clearly requires only two skills: basic counting to about 30, and the ability to accurately observe events such as the solstices and equinoxes. Both of these skills are demonstrably within reach of many societies, including nomadic groups traditionally regarded as 'primitive'.

A recent example [Garcia 1997] illustrates this point. Garcia found that Canarians (Berber inhabitants of Grand Canary Island) systematically recorded calendric and astronomical data by means of geometrical figures such as squares, circles and triangles painted on wood planks and cave walls. The Canarians used a simple 3 x 4 grid called the 'acano' to represent twelve lunar months. On this grid, solstitial, equinoctial and eclipse moons 'move across the board with very simple and stable patterns'. Garcia notes that, 'These patterns provide a safe and clear mnemonic guide for performing on the acano an easy arithmetical calculus of seasonal and eclipse moons over extended periods of time.' Garcia also states that the 'calculus establishes the octaëteris and the 135-moon eclipse cycle as basic periods of the acano.'

One conclusion that may be drawn is that a reasonably accurate calendar can be constructed, for which the sole requirements are patience, observational ability and rudimentary counting skills. Indeed, if Marshack's [1972] conclusions concerning the origins of clusters of incisions on Upper Palaeolithic bones is anywhere near the mark, humans have been concerned to observe and record lunar cycles since approximately 27,000 B.C.

A brief digression is warranted to establish a relevant point in this context. An often-accepted model for the origins of calendric knowledge is the 'hieratic city-state' (e.g., [Campbell 1969]), which presupposes the existence of agriculture and geographically fixed communities. This model entirely ignores the fact that nomadic hunting and gathering societies have a great need to know about the rhythms of prey animal behaviour, the annual returns of migratory fowl, and the seasonal availability of fish, berries, eggs, nuts and other food resources. Hunters must know the time of year with accuracy in order to plan long-range hunts, and avoid being trapped by winter storms. If anything, hunter/gatherer societies have an even greater need for calendrically related information, since their food resources vary significantly over the course of the year, often having an availability period measured in days.

A summary conclusion, then, is that discovery of the *octaëteris* requires minimal mathematical skills; its invention and use at a relatively early stage in the course of a society's development would not be inconsistent with known facts.

2.4.2. Consequences of the *octaëteris* rule

Use of the *octaëteris* rule has a number of consequences.

1. The first consequence of the rule is the *octaëteris* pattern, and the *octaëteris* itself.

2. The second consequence is the potential for calendric accuracy.

3. A third, and very important, consequence is a blurring of the distinction between recording events and predicting events. As Marshack [1985] has shown in a discussion of Winnebago calendar sticks, an artefact that records astronomical events such as new moons, solstices, etc., over a period of several years can also become a tool for predicting such events in the future. More important, the existence of such a tool later can be taken out of cultural context to imply that the creating society possessed calendric knowledge that it did not necessarily have.

   The functional resemblance of such 'calendar sticks' to the Canarian acano should be noted. Likewise, the later 'primstaves' and 'runestocks' of Scandinavia served similar purposes, and are generally accepted as belonging to a tradition that is much older than the earliest existing thirteenth century exemplars.

4. A fourth consequence is that the utter simplicity of the rule means that it can be discovered independently by many societies. It is not necessary to postulate any communication between two geographically and/or temporally separated societies in order to account for the appearance of the *octaëteris* in either.

5. A fifth consequence, important to the thesis of this paper, is the fact that the numbers three and eight necessarily assume great importance not only in calendric matters, but also in matters that are intimately associated with calendric knowledge in early and traditional societies, including religious and esoteric matters, cosmology and myth, matters generally relating to time, and matters relating time to space.

2.5. Distribution of usage

The *octaëteris* was widely distributed. This fact can be directly attributed to three of its major features – simplicity, relative accuracy, and synchronization of three major celestial bodies.

A few examples suffice to indicate the extent of the distribution of the pattern. The octaëteris is attested for Greece and Babylon, although some reputable scholars dispute the latter location. It was discovered independently by the Maya in the context of Cytherean cycles, and apparently discovered by the Canarians as well [Garcia 1997]. The Zuñi have a traditional reckoning of time of three, five and eight years that matches the octaëteris [Bunzel 1929]. Bede's description of the traditional Anglo-Saxon calendar (e.g., [Wallis 1999]) readily leads to a reconstruction based on the *octaëteris* as well.

2.6. Chronology

The actual historical origins of the *octaëteris* are not clear. Classical scholarship usually attributes the invention of the *octaëteris* to Cleostratus of Tenedos (ca. 500 B.C.) and Eudoxus of Cnidus (390 – ca. 340 B.C. The usual classical attributions are not definitive.

Heath [1991, p. xvii] claims that the *octaëteris* was 'in use in Babylon' from 528 B.C. to 505 B.C., noting that the time frame matches that alleged for Cleostratus.

Ginzel [1911, p. 498] claims that the *octaëteris* was used in Babylon after 534 B.C. until 381 B.C., when the Metonic cycle was introduced. Neugebauer, however, generally disputes this conclusion, stating [1975, vol. 1, p. 354] that the octaëteris is 'not attested' in Babylon. Bowen and Goldstein, in a careful work [1988], conclude that a nineteen-year cycle was used to regulate the Babylonian calendar as early as 498 B.C. Since the 'Metonic cycle' appears to be a logical extension of the octaëteris and since the Metonic cycle is unlikely to have arisen without a simpler precursor, then any use in Babylon of the *octaëteris* would appear to have been confined to the sixth century B.C. and earlier by their reckoning.

Ginzel places the first use of the *octaëteris* in Greece to between 900 B.C. and 700 B.C., while Samuel [1972] concludes that the first use in Greece was somewhat later, around 500 B.C.

Willetts [2004, pp. 126-7] concludes that, 'Much evidence from literary, mythological and archaeological sources indicates a connection between the octennium and ancient Bronze Age kingship.', and adds that, 'There is also much evidence in support of the view that this luni-solar calendar, based on an octennial cycle, goes back into the Minoan period.' This conclusion is sustained by the work of Thomson [1955] and others.

In summary, the bulk of the available evidence dates Greek use of the octaëteris possibly as early as 900 B.C., and no later than 500 B.C. Bronze Age origins in the Aegean are thus very likely, but dating is very approximate.

2.7. Mythology

One reason for accepting an origin of the *octaëteris* pattern in the Bronze Age of the Aegean area is the fact that the *octaëteris* figures prominently in myth. Here, perhaps ironically, one is on firmer documentary ground. A number of Greek legends are calendric stories, or are connected to early calendars. Several of the most pertinent ones are examined here.

2.7.1. Ritual dance, competition, and procession

An excellent starting point is the origin of the Olympic games, since it relates several key elements. The legend of Pelops involves many of the usual devices in a calendric myth - twelve preceding events, sacrificial death, the death and replacement of an old king by a new, the 'marriage by capture' of the king's daughter, and a chariot race. According to Pindar in the fifth century B.C., the race was the origin of the Olympic games.

Significantly, according to legend and early Greek history, the Greeks began keeping the octaëteris calendar with the start of the Olympic games in 776 B.C. Later, according to legend, the 99-month *octaëteris* period was divided into two periods of 49 and 50 months, called 'Olympiads'. The Menai, the fifty daughters of Endymion (who represents the setting sun) and Selene (the Moon), are generally regarded as the fifty months of the Olympiad.

The Olympic games were a movable festival. The actual dating of the games has vexed scholars for some time. The only extant information concerning a precise date appears to be from an Egyptian scholion on the Olympionikai. The text is difficult to read; Ginzel [1911, 354] gives divergent readings by different scholars. The most cogent of these indicates that the first games occurred eight months after the Elean month of Thosytias, which starts the year and occurs at the winter solstice. Ginzel [1911, 355] argues that the reading describes the start of a scheme involving the *octaëteris*. By this account, the Olympic games have their origins in an inaugural festival for the start of a new year.

A second Greek myth concerning the relation of sun and moon is the story of Atalante, an athletic girl raised by a bear, who is a virgin and a huntress. She is therefore a version of Artemis, a moon goddess. Atalante was an excellent runner, who agreed to marry any man who could defeat her in a foot race. Aphrodite intervened in the matter, and helped Hippomenes to 'fix' the race by giving him three golden apples, with the instructions to drop them each time Atalante starts to overtake him. By this stratagem, Hippomenes barely won the race and the girl.

The golden apples in the story symbolize the three intercalary months that are inserted when the moon 'overtakes' the sun. The apples are golden, i.e., of solar origin. Hippomenes barely wins the race; a reflection of the actual situation in the *octaëteris* calendar, in which the difference between the solar count of days and the lunar count changes sign by a relatively small amount, just at the end of the cycle.

The interesting and important feature of this story, however, is the role of Aphrodite, which provides an extremely important astronomical clue. The *octaëteris* is a luni-solar pattern, but it is much more; it is also a close match for the time required for the sun and Venus (Aphrodite) to match cycles. A period of eight solar years is very close to the period of five Cytherean synodic cycles (approximately 583.92 days), a period of about 2919.6 days. This pattern of 5 and 8 is actually a consequence of resonance between the orbital periods of the planets Venus and Earth. The *octaëteris*, then, has triple significance, as it involves synchronization of three major celestial entities, not just two.

The earliest Olympic games consisted of a single event, a foot race, which was the only competition during the first twelve games. Evidence exists that the foot race began as, or was a variation of, a ritual procession to an altar led by the person representing the new year, the 'replacement king'. Chariot racing was not introduced until 680 B.C. The dating is significant, because it corresponds to the time when the *octaëteris* was allegedly replaced by the four-year Olympiad. This addition has been widely taken to represent a shift from the lunar octaëteris calendar to a solar calendar, since the chariot or horse race is associated with the sun, while foot races are associated with the moon. The festival known as 'Daphnephoria' was held in Thebes on an eight-year cycle; the description by Proclus leaves little doubt that the festival is specifically calendric in nature.

One concludes that several myths that concern the theme of racing and that are recognized as calendric myths, specifically concern the *octaëteris*.

2.7.2. Kings, bulls, and sacrifice

Frazer [1942], in *The Golden Bough*, describes a relationship between the *octaëteris* and the term of rule for kings that is important for the concept of the calendric pattern. Frazer asserts that a very common practice among many early societies was the celebration of a new year or a new period of time by means of a ritual procession led by the person representing the new year, who was the new or re-confirmed king. As many early societies believed that a ruler represented their connection to divine power, Frazer argues, so it follows that rulers were either dispatched at the first sign that their powers had begun to wane, or were replaced after a fixed term of time.

In this regard, Frazer notes that a rule of the Spartan constitution required that the Ephors should choose a clear and moonless night every eight years, and watch the sky in silence. If they saw a meteor, this was taken as a sign that the king had sinned against the gods, and he was suspended from office until the Olympic oracle should reinstate him.

Regarding the eight-year period, Frazer writes, 'The reason is probably to be found in those astronomical considerations which determined the early Greek calendar...an octennial cycle is the shortest period at the end of which sun and moon really mark time together after overlapping, so to say, throughout the whole of the interval.' The connection between the start of new luni-solar cycle and the replacement of a king readily follows, notes Frazer, writing, 'When the great luminaries had run their course on high, and were about to renew the heavenly race, it might well be thought that the king should renew his divine energies, or prove them unabated, under pain of making room for a more vigorous successor.'

This information directly bears on the relation of the Cretan labyrinth and the *octaëteris*. Frazer notes that Minos 'is said to have held office for periods of eight years together. At the end of each period he retired to the oracular cave on Mount Ida, and there communed with his divine father Zeus…'. Frazer further surmises that the tribute of Athens of seven youths and seven maidens, sent to Knossos every eight years, was connected to the renewal of kingly power for another *octaëteris* cycle

Andrews [1969] suggests that the myth of Europa and Minos is yet another astronomically based legend, in which Europa as a sun goddess emerges from the eastern shore, riding on the back of the Bull of Heaven at the time of the heliacal rising of the Pleiades, the 'shoulder' of the constellation of Taurus, and is brought to bed in the evening in the west. The legend is thus an extended instruction concerning the structure of a year that starts with a new moon that appears when the sun rises with the Pleiades. That event would occur at the end of April in 1500 B.C. Andrews explicitly connects the *octaëteris* with this Minoan year, noting that 'Minos' would represent a Moon god in this interpretation.

The evidence linking the *octaëteris* to ritual sacrifice or replacement, bulls to ritual sacrifice, and kings to bulls is pervasive and accepted by many scholars; considerations of length permit only a brief summary.

3. The Classical Maze

This section introduces the Classical Maze and elucidates the structural and mathematical features that contribute to its unique role.

3.1. Uniqueness in antiquity

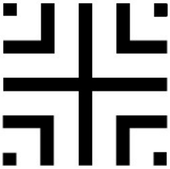
Literally millions of possible maze patterns exist for consideration. The pattern known as the Classical Maze is not only very old and widely distributed, but it appears to have been selected as virtually the only representation of the concept of the maze in antiquity. It has been accurately described [Wolfram 2003] as 'for probably three thousand years … the single most common design used for mazes'. Saward [2003, p. 28], in a comprehensive review of mazes, states that, 'Practically all labyrinths prior to the first few centuries BCE are of this type', noting its occurrence in Europe, North Africa, India, Indonesia, South America and the American Southwest.

Given the very large number of possible maze patterns, the ease with which a maze figure may be constructed by doodling, and the prevalence of meander and concentrically organized figures in Stone Age petroglyphs, it is very difficult to argue that a single figure was selected by coincidence in various parts of the world and depicted to the exclusion of millions of other choices. The strong suspicion must be that some external considerations compelled the choice and use of this single representation for centuries.

3.2. Figures

The Classical Maze is best described by a diagram. The figure to the left represents the maze in its usual rounded form. A rectangular form is also known from several sources, including the Pylos tablet.

The construction of the Classical Maze is traditionally begun by first scribing or constructing a 'nucleus', shown in the figure to the right.



The nucleus above has been used to create the Classical Maze, using a simple rule that has apparently been passed from one person to another for millennia [Saward, 2003, p.16]. The construction rule is, start with any of the four tips of the two lines forming the central cross figure, and work around the nucleus figure in a counter-clockwise motion, connecting each line tip or dot to the next line tip or dot available in the clock-wise direction. Each arc so drawn will thus be longer than its predecessor, and each is drawn in a clockwise fashion.

Interestingly, the nucleus is a gammadion figure, and hence related to the swastika and fylfot, which are themselves symbols of solar motion (vide, e.g., [Nuttal 1901]). It can be taken as a representation of an eight-fold division of time, and the number of its endpoints is twelve. The number of arcs drawn to complete the figure is eight, so the creation process itself may have a relation to the *octaëteris*.

3.3. Chronology

A general difficulty encountered with dating physical artefacts is the variable durability of materials; stone and ceramics are among the few materials that survive for millennia. Dating techniques for petroglyphs normally rely on accompanying text or an analysis of the evolution of a pattern over time. In the case of a an isolated Classical Maze figure incised in stone, however, the pattern does not change over time, so dating necessarily relies on other adjacent symbols or a datable archaeological context.

Labyrinths drawn in Galicia have been ascribed to the late Bronze Age or early Iron Age, based on comparisons with labyrinths in Val Camonica (Italy), yielding dates of 750 to 500 B.C. Recent work [Goberna *et al*, 1999], however, suggests dates in the late Neolithic to early Bronze Age, thus making these labyrinths possibly the earliest known examples (late 3rd to early 2nd millennium B.C.).

The earliest secure date for the Classical Maze is *circa* 1200 B.C.; a clay tablet recovered in 1957 from the excavation of the Mycenaean palace at Pylos (Greece) bears a very clear incised depiction, which appears to have been constructed with the nucleus figure as a starting point by an unknown scribe. The opposite side of the tablet bears Linear B script inventorying a temple offering. A second possible candidate for an early dating consists of a pair of pottery shards excavated at Tell Rifa'at (Syria) in 1960, found at a level corresponding to *ca.* 1200 B.C. The possibility of Roman disturbance of the site exists, however, and the dating of the shards themselves cannot be certain.

A pair of Classical Mazes scratched on the wall of a building excavated at Gordion (Turkey) can be dated to *ca.* 750 B.C. An Etruscan oinochoë, or wine vase, was discovered in Tragliatella [Deecke 1881], that clearly depicts a ritual procession of armed figures, copulating couples, several figures making offerings, and the Classical Maze together with the inscription 'Truia', commonly taken to mean 'Troy'. The artefact has been dated to 660-630 B.C. Many examples from later antiquity can be enumerated; the focus of the present discussion is on establishing an early date.

In summary, the Classical Maze can be securely dated to 1200 B.C., when it appears to have been a figure for which a standardized means of construction was known and distributed, and which was readily and fluidly repeated as a doodle on the back of a inventory tablet. Less certain dating may place the origin of the Classical Maze a full millennium earlier; the nature of the Pylos example strongly implies an origin prior to 1200 B.C.

3.4. Mathematics

This section defines a bit of necessary mathematical background for mazes generally, and discusses the unique properties of the Classical Maze in particular. The level of discussion in this section is somewhat informal. A mathematical formalism is presented in Appendix A.

3.4.1. S.a.t. mazes

The Classical Maze belongs to a class of maze known as 'simple, alternating transit mazes' or s.a.t mazes. The term 'transit' refers to the fact that the path of the maze courses without bifurcation. That is, there are no 'decision' points in a transit maze. Some recent authors have attempted a distinction of 'maze' from 'labyrinth' (e.g., [Saward 2003, pp. 26-7] on this basis. Such a distinction is well reasoned, since the term 'labyrinth' is of ancient origin and used to describe figures like the Classical Maze. The term 'maze' derives from another word in English, and has been used indiscriminately in that language since Tudor times. Thus, the distinction is not universal, consistent with traditional English usage, or accepted. Adding to this confusion, the field of mathematics has chosen to use the term 'maze' to describe unicursal labyrinths. For the purpose of consistency here, the term 'maze' has been retained. Given the analytical utility of definitions based on mathematical features, the imposition of a distinction based on verbal reasoning would be counter-productive.

The term 'alternating' refers to the fact that such mazes are structured as levels, with the maze path reversing direction at each level. A level is a portion of the path, contained between two walls, such that a secant line drawn perpendicular to a wall shared by two portion of the path crosses the path in two different places. Intuitively, a level is essentially a complete circle of the maze that starts and ends when the path makes an abrupt 90-degree or 180-degree turn. Levels become progressively smaller in size as one nears the centre of the maze; the level at the centre simply consists of a short path segment following the final turn in the path. The term 'simple' refers to the fact that the maze path essentially makes a complete circle at each level. In particular, the maze path traverses each level exactly once.

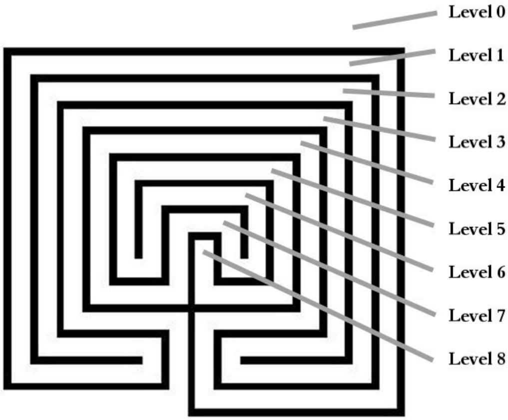
3.4.2. Level sequences

The topology of an s.a.t. maze is completely determined by its level sequence. The levels of an s.a.t. maze can be numbered, starting with the integer '0' on the outside of the maze, and proceeding inward to the centre, numbering each successive level with the next higher integer. The level sequence of an s.a.t. maze is the sequence of integers generated by a maze traversal from the outside of the maze to the centre, marking each level as it is encountered.

The level sequence of the Classical Maze is:

0 3 2 1 4 7 6 5 8

The levels of the Classical Maze are illustrated in the figure opposite, with which the level sequence may be verified. Following the maze path, one proceeds from the entrance at level 0 to level 3, then to level 2, and so on, terminating in the centre at level 8.



Level sequences for s.a.t. mazes obey very specific rules. Indeed, as noted above, the topology of an s.a.t maze is entirely determined by its level sequence. The level sequence of an s.a.t. maze always starts with 0 and always ends with the number associated with the level at the centre of the maze, which is the depth of the maze. Level sequences for s.a.t mazes always alternate between even and odd numbers. And, of course, level sequences contain exactly one occurrence of each integer from 0 to N, where N is the maze depth. An s.a.t. maze also obeys one more rule, called the 'no crossing' rule. Its elaboration is not relevant here.

3.4.3. Combinatorial aspects

The elaboration of a maze involves a series of choices of direction, level and so on, which makes the description of a maze very much a combinatorial problem, even if the following of the path of an s.a.t. maze is a simple affair. The combinatorial aspects of the Classical Maze are an important clue to its function and purpose.

A first task for the mathematical understanding of the Classical Maze is to identify it and note any special features that it might possess. Phillips [1995] has explored the question of the number of s.a.t. mazes M (n) for a given depth n, and has produced an enumeration of mazes and a count of M (n) for small n. Phillips claims an upper bound on M (2n) is $((2 + \sqrt{3})^{2n}$), so M (n) grows rapidly and exponentially. For n = 22, for example, M (n) = 73,424,650.

Fortunately, M (n) for n = 8 is a small and manageable number, 42. Even smaller is the number of interesting mazes I (n), where an 'interesting' maze is one that cannot be constructed from a maze of shallower depth by adding trivial levels at the top or bottom. Another term for such a maze might be 'essential'. For n = 8, I (n) = 22. This value is derived in the following way. The number of basic maze patterns of depth 8 is 14. This number must be multiplied by 2, to account for duals of each pattern, yielding a total of 28 possible mazes of depth 8. Six of these patterns, however, are self-dual, i.e., they are their own dual, so one member of the dual pair must be subtracted in each case, leaving (2 x 14) – 6 = 22 interesting mazes of depth 8.

3.4.4. Level changes

This number is small enough that the different cases can be completely enumerated. In this regard, we introduce another useful symbolism with regard to level sequences, which is the description of the value of a level change, using the simple notation 'ΔL'. If a level sequence changes from level 2 to level 6, for example, then ΔL = (6 – 2) = 4. For any s.a.t. maze, one may write down all of the values of ΔL in its level sequence.

As a relevant example, the level changes of the Classical Maze are:

3 – 0 = 3
2 – 3 = -1
1 – 2 = -1
4 – 1 = 3
7 – 4 = 3
6 – 7 = -1
5 – 6 = -1
8 – 5 = 3

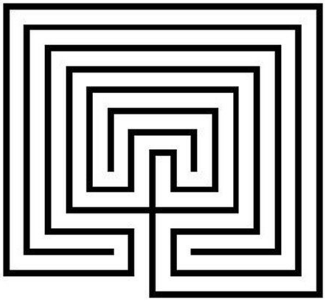
3.4.4.1. Depth-8 s.a.t. mazes

Performing these calculations for the 22 interesting s.a.t. mazes of depth 8 produces the following table:

Maze Number	Level Sequence	ΔL Values	V (ΔL), Number of ΔL values	V (ΔL), w/o |Δ L| = 1
1	032147658	+3,-1	2	1
2	034567218	+3,-1,+1,-5,+7	5	3
3	034765218	+3,+1,-1,+7	4	2
4	036547218	+3,-1,-5,+7	4	3
5	054367218	+5,-1,+3,-5,+7	5	4
6	056723418	+5,-1,-5,+3,+7	5	4
7	056741238	+5,+1,-3	3	2
8	056743218	+5,+1,-3,-1,+7	5	3
9	072345618	+7,-5,+1	3	2
10	072365418	+7,-5,+1,+3,-1,-3	6	4
11	072343618	+7,-5,+3,-1,	4	3
12	074325618	+7,-3,-1,+3,+1,-5	6	4
13	074561238	+7,-3,+1,-5	4	3
14	074563218	+7,-3,+1,-1	4	2
15	076123458	+7,-1,-5,+1,+3	5	3
16	076125438	+7,-1,-5,+1,+3,+5	6	4
17	076143258	+7,-1,-5,+3	4	3
18	076321458	+7,-1,-3,+3,+1	5	3
19	076345218	+7,-1,-3,+1	4	2
20	076523418	+7,-1,-3,+1	4	2
21	076541238	+7,-1,-3,+1,+5	5	3
22	076543218	+7,-1	2	1

3.4.4.2. Unique features of the classical maze

The table reveals that the Classical Maze (Maze 1 in the previous table) is unique among s.a.t. mazes of depth 8 in three ways. First, it is the only maze of the set that restricts its ΔL values to +3 and -1 only. Second, it is the only maze of the set that advances only by a ΔL value of 3.

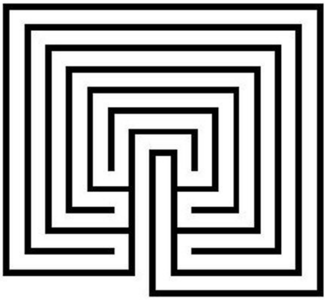


Maze 1 – level sequence 032147658

The third unique feature of the Classical Maze requires some qualification and explanation. The total number of s.a.t. mazes of depth n = 8 is M (n) = 42. Of these, 20 are discarded as not 'interesting'. A maze fails to be 'interesting' when it consists of level changes |ΔL| = 1. That is, mazes in which the path simply moves inward or outward by one level are trivial, both in nomenclature and fact. With respect to the table above, one notes that only two mazes have the property that V (ΔL) = 1, when trivial level changes are disregarded, and these are the first (the Classical Maze) and the last, Maze 22.

Examining Maze 22, the behaviour of its path is quite obvious – it jumps directly to level 7, works outward in a series of trivial changes, and then jumps back to level 8 to finish. The essentially entirely trivial nature of this behaviour can be easily seen by considering an entirely trivial s.a.t. maze of depth 8, identified by the level sequence (0 1 2 3 4 5 6 7 8). If the subsequence consisting of all of the integers, except the first and last, (1 2 3 4 5 6 7), is simply inverted to obtain (7 6 5 4 3 2 1), and reinserted in place, then the level sequence of Maze 22 is produced (0 7 6 5 4 3 2 1 8).

Maze 22 is, in fact, as close as it possible to come to being a completely trivial maze and still qualify as 'interesting' under the definition. It is, for all intents, a trivial maze. If Maze 22 is disregarded from further consideration on that basis, then it become clear that the Classical Maze is also unique in a third respect, which is that it identifies a single number (3) by its level changes.



Maze 22 – level sequence 076543218

Thus, one may conclude that the Classical Maze is, in effect, a unique physical statement of the combination of the numbers three and eight. It is much more, as will soon be made apparent.

3.5. Mythology

The legend of Theseus, as it concerns the Classical Maze, has been recounted in various sources. Here one follows the version given by Plutarch in the first volume of 'Lives', and summarizes pertinent features for the purpose of this discussion. Plutarch worked in the latter half of the first century A.D., and drew upon a stock of stories that figured in popular legends of the era. His information appears to have been drawn from the accounts of earlier Greek authors, including Bacchylides (5^{th} century B.C.), Cleidemus (*ca.* 420-350 B.C.) and others, including Philochorus (*ca.* 306-260 B.C.).

The essentials of the story are that a King Minos reigned at Knossos in Crete, and had a son who was allegedly killed in Attica. Minos imposed a penalty upon Athens in the form of a tribute to be paid once every nine years, consisting of seven youths and seven maidens. Minos employed at his court a clever engineer named Daedalus, who is credited with originating a number of inventions. In particular, Daedalus built a structure, the Labyrinth, in which dwelled the Minotaur; a being that was half-bull and half-human. The Athenians sent to Knossos as tribute were delivered into the Labyrinth one at a time, where they were killed and devoured by the Minotaur.

Theseus, who had been living with his mother in a distant place, arrived at the court of his father, King Aegeus of Athens, only to learn that the time for the third tribute to Knossos was approaching. Theseus volunteered to be sent to Knossos, promising to slay the Minotaur and end the tribute. In due course, Theseus arrived at Knossos, where he charmed the daughter of Minos, Ariadne, who in turn provided him with a sword and a thread to unroll as he advanced into the Labyrinth. Theseus encountered the Minotaur, slew it, and then returned to the entrance using the provided thread to navigate the Labyrinth. By some means, Theseus then contrived to free the other prisoners, obtain possession of the tribute ship and abscond with Ariadne, setting sail for Athens.

On the return voyage, the crew stopped at various islands. On the island of Delos, they performed a peculiar dance called the 'Geranos', or 'Crane Dance', in which the dancers imitate the motions of navigating the Labyrinth. This particular story ends after Theseus abandons Ariadne on the island of Naxos, and omits to change the colour of sails of his ship as requested by his father; with the consequence that Aegeus hurls himself into the sea in despair, believing his son to be lost.

The features of the story that are relevant to a consideration of the maze and calendar are the following.

1. The tribute (sacrifice) is due every eight years in the accounts. Plutarch states nine, but counts cyclic time in the traditional inclusive fashion of the ancients.

2. The trigger for action in the stories is the approach of the third tribute.

3. The numbers of sacrificial victims given in the stories have traditional lunar associations. Seven youths and seven maidens total fourteen, the nominal number of days between new and full moons. Seven days nominally elapse between each of the four traditional lunar phases, and the prior two years of tribute have accumulated twenty-eight victims, the nominal length of a lunar month.

4. The structure of the labyrinth is a secret. In traditional societies, astronomical and calendric knowledge is religious knowledge, and such knowledge is powerful and often secret knowledge. The Gnostic 'Abraxas' as a code for the year length is an example.

5. The insistence of the legend on interrupting the return of Theseus to Attica to perform a specific dance imitative of the labyrinth structure clearly indicates the importance of traversing the maze in ritual dance or procession. Significantly, Homer also credits Daedalus with construction of a 'choros', or 'place of dance' for Ariadne.

6. The Minotaur, named 'Asterios', is a semi-divine bull figure. The existence of a bull cult on Crete is well attested, as is the ritual sacrifice of bulls on Crete in Dionysiac rites [Frazer, p. 390], and the 'bouphonia' of Athens [Frazer, p. 466].

7. The figure of Daedalus plays a key role in the entire cycle of related stories. He is credited with designing a great hollow cow for the wife of Minos, Pasiphaë, who had conceived an unnatural passion for a great white bull as a consequence of the refusal of Minos to honour a promise to sacrifice that animal. The results were the birth of the Minotaur, and the displeasure of Minos, who imprisoned Daedalus in the Labyrinth. As the inventor of the labyrinth, Daedalus is the figure who knows its secret.

4. Relation of the classical maze and *octaëteris*

Given the general conclusion from the foregoing evidence that mazes function as structural guides or templates for ritual processions or dances conducted at specific times of the year, the specific question can be put, is the Classical Maze a guide or template for the structure of a particular calendric system? The central importance of the numbers three and eight in the Classical Maze suggests that the maze encodes the 'secret' of the *octaëteris* pattern. If this is so, what is the evidence?

4.1. Evidence for *octaëteris* coding

The major points to be made concerning the coding by the Classical Maze of the *octaëteris* are:

a) The structure of the Classical Maze requires entrance and immediate passage to the third level, suggesting an important role for the number three. The ΔL result for the Classical Maze confirms that three is the only non-trivial number that appears as a level change.

b) The maze consists of exactly eight levels.

c) The Classical Maze is an s.a.t. maze. Its traversal requires no decisions. Thus, traversing the maze is a process that unfolds according to the structure of the maze itself, without human decision or intervention. While the concept of the 'labyrinth' has been used by generations of authors as a 'metaphor for life' (e.g., [MacGillivray 2003]), the single maze known in antiquity, which was almost certainly the conceptual model for any Greek notion of mazes at that time, requires no decisions at all. If the Classical Maze is a 'metaphor for life', it does not involve the modern concern for life's complexities and decision requirements, but rather the ancients concern to reflect cosmic order on earth.

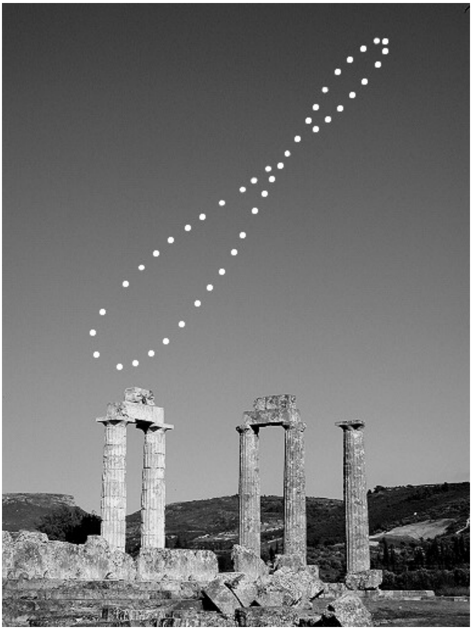
d) Each level of the Classical Maze is simple, and essentially constitutes a complete circle. Levels are therefore equivalent units by the logic of the maze, in the sense that each starts with a reversal of direction, makes a complete circuit of the maze, and ends with another reversal. Each successive circuit repeats the action of the previous circuit, but in the opposite direction.

e) Each level begins and ends with a reversal of direction. Traversal of the Classical Maze requires one to slow down as one approaches a reversal point and then reverse direction before proceeding to the next circuit.

f) Taking points (a) through (e) together, one observes an essentially exact correspondence between the number, position and role of the reversal points in the Classical Maze, and the solstices in the *octaëteris* pattern. That is, the Classical Maze is essentially a schematic model of apparent solar motion for an eight-year period, with reversal points in the maze marking the position and role of the winter and summer solstices.

4.2. Solstice representation

Since this is an important point, it bears some elaboration. Considering first the apparent motion of the sun near a solstice, for a period of roughly two weeks the sun slows in its motion, stops ('sol stetit'), and then reverses direction for another complete circuit of the pattern. Traversal of the Classical Maze requires a physical repetition of this very motion at each change of level.



The analemma traced by the motion of the sun during the year, photographed over the ruins at Nemea, Greece. Photo: © Anthony Ayiomamitis

The figure traced by the apparent motion of the sun over the course of one year is known as the *analemma*, the 'figure-eight' device often found on older globes. That figure can be reproduced by careful multiple-exposure photography capturing the position of the sun at the same time of day over the course of a year, at calculated intervals. This particular figure attempts equal interval spacing, and therefore does not illustrate the slower apparent motion at the solstices, but does illustrate the shape, position and orientation of the figure. The top of the upper loop corresponds to the summer solstice, while the bottom of the lower loop corresponds to the winter solstice.

The *analemma* figure illustrates the essential concepts that solstices represent points of reversal of direction of motion and slowing of motion, and that apparent solar motion occurs in a cycle of repeated reversals between the solstices. To represent not one, but eight, such figures in one figure implies a different level of graphical organization, in which the *analemma* figure is un-twisted into a simple loop, and multiple repetitions of that figure are then joined end to end in a circular plan of multiple levels.

One also observes that the first reversal occurs at the very beginning of the Classical Maze, implying that the period involved begins with a solstice. In fact, a very common year-starting scheme among many societies that employ luni-solar calendars is the choice of the winter solstice.

As we have seen above, the start of the Olympic games was likely measured from the winter solstice, and this dating is specifically connected to the invention of the *octaëteris* pattern. The logic of this arrangement, however, applies with equal force to Greek or Minoan calendars that started the new year near the summer solstice.

The process of traversing a circuit in the Classical Maze is repeated eight times as one enters. The maze has no separate exit, so one must reverse direction and retrace one's steps to exit, thus executing another eight reversals, for a total of sixteen reversals before literally returning to the place of beginning, a total of exactly eight solar years. Traversal of the maze ritually enacts the procession of the sun in its dance, terminating with a reunion with the moon. In this model, then, each circuit of the maze represents a half-year period between two solstices, and clearly depicts each level as requiring motion in exactly the opposite direction as the preceding level and the next level. The half-year interval is well known as a time unit among societies that use an eight-fold division of time (e.g., [Hastrup 1985]).

The careful reader may note a potential objection to the level encoding hypothesis. This objection is described, addressed and eliminated in section 4.3., which is made available separately on the Labyrinthos web site (www.labyrinthos.net/latham.htm), owing to its detailed and largely logical argument.

A number of other fields of study are related to the study of mazes, suggesting that a formalism may connect calendars, mazes, various areas of topology and tessellation theory, the medieval computus, chord diagrams, and 'dipping games'. This notion is briefly explored in a separate section 5, also available separately (www.labyrinthos.net/latham.htm).

6. Conclusions

The relation between the Classical Maze and the *octaëteris* described here posits a structural basis to support a number of associations that have been simply noted in the past (vide, e.g., [Elderkin 1910], [Tarry 1895], [Trollope 1858]), and suggests an answer to some puzzling questions. A summary of conclusions, then, is best organized as a list of associations or questions that are explained by the Classical Maze-*octaëteris* relation.

Taking first the associations, one enumerates the following:

1. The association of the Classical Maze with ritual procession and dance. It is not coincidental that the inventor of the Labyrinth is the builder of Ariadne's choros as well. Numerous authorities have commented on the dominance of the theme of ritual dance in Minoan art. In its origins, the Classical Maze was deeply connected to religious ceremony as an expression of cosmic order. This association was later conflated in Roman times with the legend of Troy into the 'Ludus Trojae' (vide Pliny and Virgil), and by the time of Nero had evolved into a type of military procession (vide Suetonius).

2. The association of the Classical Maze with calendar myths. The legend of Theseus has long been recognized as having strong calendric elements, but a structural connection to calendric knowledge has been missing. The legend of Europa has likewise been recognized as calendric in its origins, but a specific connection to Cretan calendric knowledge has been missing. Likewise missing until recent years has been a re-examination of the Knossos site in an archaeoastronomical context, but vide [Goodison 2001] for solstice alignments.

3. The specific association of the Classical Maze with bulls and sacrifice. The emerging view of Minoan culture is somewhat different from that pictured by Evans (e.g., [Evans 1902], [Evans 1914]) in the early twentieth century. One sees a dominant female deity in Early and Middle Minoan culture, undoubtedly with Phoenician roots; a male consort only develops in Late Minoan, beginning life as a 'dying god' of vegetation, similar to Dionysus.

Frazer makes a clear case for ritual, calendrically-based sacrifice or replacement of kings in imitation of the natural cycle, and a clear case for the bull as a vegetation symbol to be ritually sacrificed and consumed. If kings were indeed sacrificed according to the *octaëteris* pattern, then the Classical Maze is a structural pattern for ritual sacrifice. The conflation of the ancient customs in the later legend of Theseus produces an interesting reversal of the Dionysiac rites in which a living bull was torn to pieces and consumed by worshippers.

Turning attention to the list of questions, one enumerates the following:

Q1. The question, why the Classical Maze was the unique choice for a maze pattern in early antiquity. The Classical Maze is a unique physical representation of the *octaëteris* that, it is argued here, was a common and dominant calendric pattern for many early societies. As such, its choice was not arbitrary, and its exclusive use as a symbol of calendric structure and religious ceremony was assured for centuries.

Q2. The questions, why the *octaëteris* and Classical Maze are roughly coeval, and why the maze pattern survived longer. Neugebauer wisely and rightly cautions [v2, p. 621], 'It seems best to leave the question of the origin of the octaëteris unanswered', since its ease of discovery makes it unlikely to be documented as a noteworthy achievement. It is speculated here, not claimed, that the *octaëteris* was discovered in the Mediterranean basin area in the Early Bronze Age, and that the Classical Maze was its physical representation. Such an association obviously cannot be proved by any evidence of a documentary nature; one must look to constraints, synchronicities and structural arguments to deduce a possible connection. If the connection is valid, origin of the *octaëteris* must pre-date 1200 B.C., a date even earlier than Ginzel's.

Assuming the validity of this connection, then it can be expected that the physical symbol will be repeated by generations who have long since forgotten the original reasons for its design. Examples of such degenerative use can be found in the use of the labyrinth in Roman tile mosaics as 'apotropaia', devices to guard doorways [Saward, p.52] (and vide [Phillips 1992] for background); and later by Swedish fisherfolk as 'traps' for 'trolls' [Saward, p. 141].

Q3. The question, why the Classical Maze appears in a wide variety of places and times. The *octaëteris* is easily discovered; the Classical Maze is its unique representation among maze patterns and the meander patterns that are common to many societies. The question whether similar patterns found among, e.g., Native peoples of the American Southwest are indigenous or obtained via contact with early Spanish explorers may never be resolved. It stresses credulity to believe that separate cultures would independently invent precisely the same figure as a representation of the *octaëteris*; it is easy however to accept the idea that the Classical Maze, introduced to a culture already using the *octaëteris* calendric pattern, would quickly adopt the maze pattern as its representative.

In this connection, it is perhaps noteworthy that the Maya, while familiar with the *octaëteris* as a pattern, were familiar with it in an indirect way, as a consequence of calculation within the context of their own calendric system, which was not based on the *octaëteris*. To date, no representation of the Classical Maze is known to exist among genuine Maya artefacts.

One final set of evidence merits brief mention in this summary; a more detailed treatment is planned for a later date. The 'turf' mazes of England and 'stone' mazes of Scandinavia cannot be securely dated to earlier than medieval times; the notion of Roman origin is largely discredited [Matthews 1970:98-9]. Available evidence indicates that the turf mazes were 'trod' at specific times of the year, and maintained periodically against effacement by the elements. At least some of the stone mazes are known to have specific calendric associations as well, but the data concerning age and function is less clear. The variety of such maze patterns, however, indicates that while the notion of the maze as a template for physical procession was retained, the concept of the connection between a specific maze pattern (Classical Maze) and a specific calendric pattern (*octaëteris*) was either lost, or never initially transferred to these areas.

It is speculated here that the Germanic tribes that occupied these territories were the vector for that connection, and were responsible for introducing both the *octaëteris* and mazes into those areas. Christian missionary efforts, however, to introduce the Julian calendar were largely successful by *circa* A.D. 800. Use of that solar calendar would have severed the conceptual connection between maze and calendar, leaving the maze to drift into a variety of patterns unconstrained by calendric function, and a variety of social functions that continued to evolve until, by Tudor times, 'treading the maze' was simple a form of amusement whose origins had been long forgotten.

Lance W. Latham; Green Island, New York, USA, June 2006

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Kota Labyrinths in Southern India

Klaus Kürvers

In 1982 the first edition of the standard work on labyrinths, by the art historian Hermann Kern, documented an "incised drawing in a Kota village in the Nilgiris," that represented a game. The accompanying illustration shows the "Ariadne's Thread," the line representing the course of the path that leads into the centre of a classical or "Cretan" labyrinth, similar to those on the Cretan coins, but drawn differently around a central circle. Kern reproduced this drawing from an essay by the English anthropologist John Layard, published in 1937, with the following comment:

> "Ariadne's thread of a Cretan-type, seven-circuit labyrinth, incised on the wall of a house in a Kota village, Nilgiris. The game is called Kótē, 'fortification,' and the object of it would seem to be to reach the centre."

The Kota labyrinth as depicted by Layard and Kern.

The drawing remains puzzling. Is the path of the labyrinth incised, or its encircling rings – the walls? Is the concentric form an abstraction by the artist, or is the labyrinth really like this? Which wall and house, and where exactly is this carving? What about the game, who plays it and what does the fortress symbolise? Is it identified as the entire labyrinth or does it lie in the centre, surrounded by the seven paths?

If we question Kern's source, an essential observation emerges; it is established that Layard did not report from his own experience. He describes the drawing thus:

> "…labyrinths carved on the stone walls in front of houses among the Kota of the Nilgiris. One such… is recorded by Breeks as having been seen by him incised on a stone wall in front of a Kota house." (Layard, p.175)

Therefore, the labyrinth is apparently not on the walls of a house, but on a stone wall in front of a house. Although Layard is given as Kern's source, he does not reference the description of James Wilkinson Breeks, from 1873, from which the drawing derives. The report of Breeks is therefore the only one based on viewing the location:

> "On several of the stones, forming the wall in front of the rows of houses in Kuruvōje (Padugula), I found that lines had been chiselled for the games of Hulikotē and Kotē. The former is played with pieces, two of which represent tigers, and the remainder sheep; the latter is a kind of labyrinth, the problem being to get into the centre." (Breeks, p.41)

The Kotē labyrinth therefore is located, together with a Hulikotē petroglyph, on different stones of a wall in the village of Kuruvōje (Padugula), in front of a row of houses, and both figures are understood to be games. The possibilities of the existing literature are apparently exhausted, but Hermann Kern added to his documentation of the Kotē, drawn by Breeks, another remark that takes us further:

> "The labyrinth continues to play an integral role in the lives of the Kota; Jean-Louis Bourgeois, who travelled throughout India in search of labyrinths, found numerous labyrinth petroglyphs there, as he reported to me in letters of 19 March and 9 May 1979."

Kern also reproduces two photographs by Carollee Pelos, conveyed to him by Jean-Louis Bourgeois, the American architecture historian, in 1979. They were taken in the "Kota village of Padugula" and show a stone partially overgrown by grass, incised with a seven-circuit labyrinth 16.5 cm in diameter. The path that leads into the centre stands in relief and a small hollow is carved before the entrance of the labyrinth. Based on correspondence from Bourgeois, Kern describes the surroundings of the stone as:

"A shrine (temple) in the shape of a small dolmen is located in the immediate vicinity and measures 40.6 cm x 101.6 cm x 109 cm. Four additional small labyrinth petroglyphs are within a 10 m. radius of the temple." (Kern 2000, no.620-621, p.291)

The age of this structure is difficult to assess. Megalithic structures like these have been built since the South Indian Iron Age, 1st millennium BCE, and are still erected by the Kota to the current time.

Photographs of the Padugula labyrinth inscription taken by Carolle Pelos, 1979.

The labyrinth design photographed by Pelos at Padugula corresponds quite exactly with those found on the coast of Galicia in northwest Spain, in Cornwall and Ireland, as well as in the Caucasus, certainly in construction and style. Dating these stone carvings is extraordinarily difficult and often based on supposition alone or nearby finds and comparisons. The creation of the Galician petroglyphs is given by Kern as approximately 900-500 BCE, the age of the two carvings in Cornwall as 1800-1400 BCE and the example in the Caucasus as from the end of the 2nd millennium BCE (Kern 2000, p.67-72). More exact studies of the locations often lead to very different datings. For instance, Abegael Saward in her examination of the famous labyrinth petroglyphs of Rocky Valley in Cornwall, gives convincing reasons for their formation not in the Bronze Age, but approximately 200 years ago in the 18th or 19th century (Saward, 2001). The function and meaning of these labyrinths in Europe are also largely unknown.

The two photographs, first published by Kern, have been reproduced many times and appear in many more recent books on labyrinths as proof of the world-wide spread of this symbol. However, a more detailed report by Bourgeois and Pelos about their discoveries is not included in the bibliography, and apparently has never been published. Questions also remain whether the village of Padugula is the same location that Breeks visited more than 100 years earlier.

In Search of Padugula

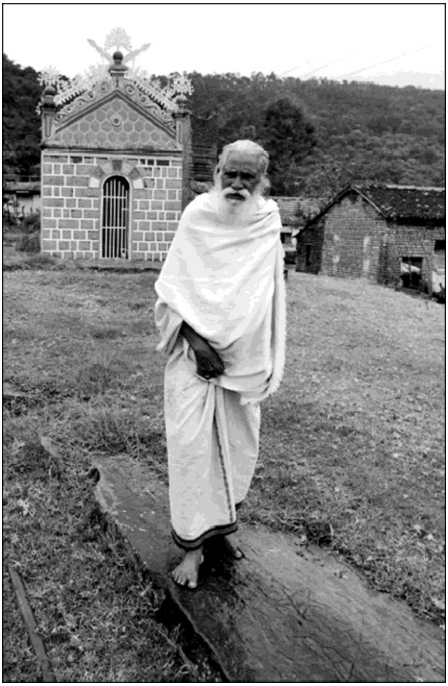
The labyrinths of the Kota in Southern India are interesting not only because of their distance from those in Europe, but above all, because they seem to have preserved until modern times an active relationship and meaning for the villagers where they are found. In order to learn more about these petroglyphs, I undertook, together with the photographer Jürgen Hohmuth and our well-informed local guide and interpreter Nova Thomas, a trip into the mountain region of the Nilgiris, also known as the "Blue Mountains," from Cochin in Kerala in November 2004. We equipped ourselves with copies of the old photos and detailed geographical maps of the Nilgiri District to help in our search. Ooty (also known Ootacamund or Uhagamandalam) is the central town of this district, in the northwest of the state of Tamil Nadu and sits on a plateau at 2,268 meters (7,440 feet) above sea level, at latitude 11° north and 77° East. It was here that J.W. Breeks (1830-1872) lived as "ridge escort to the British colonial administration of the Nilgiris High Commissioner" and his book, from which we owe our knowledge of the labyrinths of the Kota, was written during his ethnological exploration of this region.

At the Tribal Research Centre at Palada (near Ooty), the museum and documentation centre for the native cultures of the region, the stone-carved labyrinths of the Kota were unknown. In our search for the village of Padugula, that was not to be found on any of our maps, we drove first to the small town of Kotagiri, 28 km east of Ooty, which we had learned was still occupied by members of the Kota tribe. At the local police station, we learned that Mr. K.M. Shanmugkampkattan, the secretary-general of the Tamil Nadu Adhivasi Welfare Association would know about these things. Belonging to the Kota tribe, he acts as a speaker for the tribal peoples of the Nilgiris, and therefore knows the villages in the region very well.

He immediately recognised the stone in the photo, knew that is was the Kotē symbol and was sure that this stone was to be found in his home village of Kil Kotagiri (Little Kotagiri), previously known as Padugula. He also remembered having seen similar petroglyphs in other Kota villages, but besides the name, he knew nothing of their meaning. He was rather astonished that we were asking about this ancient and almost forgotten thing, and the long journey we had untaken to get here.

In the company of Mr. Shanmugkampkattan we drove to Kil Kotagiri. However, we were unable to locate the rock and the dolmen photographed in 1979. Several inhabitants of the village, including the oldest person in the village and the priest, remembered the stone and the dolmen, which should have been set in a lawn within the grounds of the Shiva temple, to judge from the old photos. The Shiva temple lies on a grassy hillside, facing north, opposite the Parvati temple. Even if the Kota consider themselves Hindus, they still practice their old nature religion. Shiva corresponds to Ayynor, the sun god, Parvati to the moon goddess Ammnor. The temples, which can only be entered by adult men, are surrounded by grass lawns, which can only be stepped on barefoot.

The village priest of Kil Kotagiri standing on the rock with a pentagram and a tiger game board. Photo: Jürgen Hohmuth



"Some years ago," the two temples were the subject of a state program of village redevelopment and were replaced by new buildings. To judge from the 1979 photographs, the stone with the labyrinth has become completely overgrown and presumably the dolmen was removed at that time. Another stone that still juts out from the lawn surface has different inscriptions, similar to those we would later find in other villages: a pentagram and four diagonally crossed squares filled with a triangular line structure, used as a board for the Tiger Game, "Puli Attam."

The houses of the village were linked to the temple hill by a wall, also replaced during the redevelopment. Several petroglyphs of labyrinths are supposed to have been on some of the stones of this wall. We found some of the stones from the old wall scattered around the village, but none with a labyrinth inscription. But on one of these stones, two linear figures, which were explained as game boards, were incised. One consisted of ten squares, arranged in two rows, and the other was the tiger game we had previously seen at the temple. According to the villagers, most of the rocks that previously formed the temple wall were re-used in 1997 to build a new embankment for the village stream and washing place, and are now buried beneath a blanket of cement.

In Kil Kotagiri, the labyrinth symbol is known as Kotē and it is remembered that it was connected with the Shiva temple. However, its function and meaning were unclear. Some inhabitants had heard from their grandparents that it was supposed to be a game, whose rules were forgotten. The temple priest thought it was a magical emblem for the protection of the village, above all from the members of the local Kurumba tribe who had special powers at their disposal. The disappearance of the stones left him indifferent - their protective function is required no more - he explained to us that the police manage this today. However, we were undecided in the circumstance whether this answer had to do with the presence of our leader, who functions as a mediator between the villages and the police!

The village of Kil Kotagiri, before the local infrastructure was improved was known as Padugula. Since then, it has been regarded as a suburb of Kotagiri. Padugula is the Kota name for a trackless or wild place and there was another village known by the same name, now called Sholur Kokkal. The old Kota name of the village was Kurgo:j, and it was this village that was visited by Breeks. It was there, and in two further villages of the Kota, that we would find labyrinths in the following days.

The Seven Villages of the Kota

In the Tribal Research Centre we had discovered that the 1999 census recorded 1,984 individuals belonging to the Kota tribe, living exclusively in the Nilgiris. Living alongside the Irula (350,000), the Badaga (300,000), the Kurumba (250,000) and the Toda (1,000), the Kota are natives of this mountain region. Each of these five tribal groups speaks their own language, all belonging to the Dravidian, and therefore to the Indo-European language family, but nevertheless they are clearly distinguished from each other. The agreed "lingua franca" is the Bagada language, although Tamil is increasingly spoken and also English, which every child now learns in primary school.

The Kota are above all craft persons, and live together in a working symbiosis with the other groups, in seven far-scattered villages. These all lie in the proximity of a village of the other tribes, but nevertheless strictly apart from them. Apart from the somewhat larger Kotagiri, the Kota villages consist of two or three streets of houses, called "keri," of 30 to 60 houses in rows. They marry only within their own tribe, and live in extended family units. Along with their Anglicised Badaga placenames, there are also Kota names, (shown below in brackets), and the seven occupied villages, some containing only a few families, are named as follows:

Gudalur Kokkal (Kala:c); Trichigadi (Ticga-l); Kotagiri (Porga-r); Kil Kotagiri (Kina-r), Padugula, Sholur Kokkal (Kurgo:j); Padugula, Kollimalai (Kolme-l) and Kunda Kotagiri (Me-na-r).

The spelling of the village names is not uniformly regular, and only a few are noted on maps or street signs; without a local guide it can be difficult to find them.

The Forgotten Game of Kotē

We visited all seven of the Kota villages and found stone-carved labyrinths, all with diameters of 15 - 25 cm, in three of them, Sholur Kokkal, Trichikadi and in Gudalur Kokkal, the oldest village of the Kota. With help from our guide and the copies of the old labyrinth photos, we questioned the villagers, and above all the oldest persons and priests, about the Kotē symbol. In all three villages, someone immediately recognized the design and led us to the stones or boulders with the engravings, usually after expressing astonishment over the reason for our visit. They were mostly hidden under a thin layer of rain-washed clay, and would have been hard to casually discover. After they were cleaned with water, one could clearly recognize the lines engraved into the stone.

In all three villages, several labyrinth carvings exist, always located within the grounds of the Ayynor or Shiva tempels, also known as "Surya" or sun temples. Except for the temple priest in Kil Kotagiri, who held the symbol was a protective device, the villagers were united over its function: it is supposed to have been a game, played only by high-ranking persons, but nobody knows the rules anymore. Most called it Kotē (fortress), but in Gudalur Kokkal, the name Kota attam (Kota game) was given. Some of the elderly assured us that their grandfathers would have known nothing more about this game. In all cases, when we were shown the labyrinths, they were traced by one of the men with their index finger, from the outside to the centre. The width of the path corresponds to that of a fingertip so exactly; one would like to assume that the Kotē were created expressly for this purpose. But what is so difficult about this game? Or was it purely a meditative, concentration or relaxation practice?

Gudalur Kokkal

Today, only a single extended family live in the oldest Kota village of Gudalur Kokkal, on the western edge of the mountain region. Here we found two labyrinths on the edge of a rock in the former Shiva temple grounds, together with a tiger game, the Puli attam. One of the two labyrinths is poorly drawn and not at all accomplished, however, the other is perfectly constructed, with the winding path defined by deeply carved lines.

The rock at Gudalur Kokkal, inscribed with two labyrinths and a tiger game board.

Photo: Klaus Kürvers, November 2004

Besides those on this rock, there are two other labyrinths on individual stones built into the traditional "Kalaval," the meeting place of the men within the temple grounds. Each Kota village owns such a place, as with the Shiva and Parvati temples. It is the venue for village advice, the "Koot", at which the oldest persons of the clans or extended families of the village, the "Keri", meet under the leadership of the "Kokkal Gottukaran," chosen by them. They discuss laws, determine the dates of holidays and decide the other issues involving the village community. Beside the village meetings, there is another meeting of the Kokkal Gottukaran of all seven villages, which meets in the village of Kollimalai, in order to discuss encroachment of tribal land issues. The temple district in Gudalur Kokkal is a historic place, but the Shiva temple was transferred to another site a long time ago, without the stone engravings being repositioned there.

Sholur Kokkal

In Sholur Kokkal, the wall that was mentioned in the 1873 description of the stone carvings by Breeks still exists. It belongs, as at Kil Kotagiri (where it has been torn down and rebuilt), to the sacred district of the Shiva temples and delimits this from the areas of housing. No temple stands in the area today; it was transferred to another place in the village "a long time ago" - exact dates are never certain from the conversations with the villagers. However, the former temple district remains sacred and the taboo, that it may only be entered barefoot by adult men, remains. The old stone engravings are only found in these places, not in the grounds of the newer temples - an indication of their considerable age.

On the flat upper side of a stone block set in the western wall of the former temple district, we discovered four incised designs. Two game boards, of similar form to those noted at Kil Kotagiri and Gudalur Kokkal, are located between two classical labyrinths with diameters of 21.5 cm and 15.5 cm, called Kotē by the villagers here. Besides these two labyrinths, we also noticed another on a single stone half buried in the temple lawn, however, from respect for the sacred ground, we gave up on attempting to dig it up.

Left: the carved rock at Sholur Kokkal, with two labyrinths and two game boards. Photo: K. Kürvers

Below: demonstrating the tiger game. Photo: J. Hohmuth

Above: the labyrinth-inscribed stone still buried in the temple lawn.

Right: tracing the Kotē labyrinth with a fingertip.

Photos: K. Kürvers

Both of the linear structures are variations of the Puli attam or Nay attam, the tiger or dog game. It is played by two individuals or groups, the tigers and the dogs. On the board, small stones mark the dogs; bigger stones symbolize the tigers. The smaller game, in which a triangle is overlaid by a rectangle, is played with 3 tigers and 10 dogs, the larger with 5 and 15. At the start of the game, the tigers have set home positions and the dogs are freely positioned, one at a time, on the intersections of the lines. The tigers can 'eat' individual dogs by jumping clear over them, but for the dogs the object is to hold the pack together. While they cannot 'eat' the tigers, through skilful manoeuvring, the pack can hold the tigers in place and stop them moving. The tigers win if all of the dogs are eaten; the dogs win if the tigers can make no further moves.

This game is both popular and widely known amongst the Kota and at the annual meeting of the seven Kota villages, a championship is held. The Puli attam is played not only by the Kota, but is widespread in India, with varying rules and game board layouts. One finds such game grids commonly at temples and also incised in moist concrete, or marked with a stick in the sand or clay ground, in mundane street areas. The anthropologist Siegbert Hummel has studied these variations of the tiger game, with wolves against goats and sheep, and also people symbolized by the gaming stones. He holds that all variations of this game have a prehistoric origin, probably in the regions where sheep and goats were first domesticated; therefore they probably originated and spread from the vicinity of the Hindukush, the Karakorum Mountains and the Pamir area (see Hummel, p.221). These strategic games of two unequal opponents are also widespread in Europe and are often similarly referred to as "fortress games". This connection between the tiger game and the Kotē labyrinth game, by its juxtaposition on the stones in the mountain villages of the Kota, has not been previously noted.

Trichikadi

In Trichikadi, the sacred district of the Ayynor temples is not bordered by a wall alone, but also by a road. On a rock, located on the Kalaval, the meeting place within the area, are five perfectly constructed labyrinths, one with two strange "tentacles" in front of the entrance. Another pentagram and a large and small tiger game, played with five stones, are also carved on the rock, along with two further small ornamental carvings whose meaning remains unclear. Here the stone engravings generally lie within the temple district, and cannot be touched by women and children. This temple district and the Kalaval are still in use today, unlike at Gudalur Kokkal and Sholur Kokkal, and three large upright stones slabs are located here, the "Mandhukal," which each man that wishes to speak before the Koot must touch and swear that he speaks the truth (see Chellaperumal).

The "Kalaval" (the men's meeting place) at Trichikadi; the inscribed stone is on the left side of the circular stone structure. Photo: K. Kürvers

The inscribed rock at Trichikadi, with five labyrinths, tiger games and other geometric figures. Photo: K. Kürvers

To summarize our findings in these three villages, we determined that the labyrinths carved in stone, known as Kotē (fortress) or Kota attam (Kota game), are generally considered to be a long-forgotten game. They are always found in connection with the sun temple, and with the meeting place of the men. Considered the most important social place in the villages, this is also where the tiger game was played. The custom is apparently very old, because they are located not only in the oldest of the Kota villages, but also exclusively in the older temple districts, even when the location of the temple was subsequently moved to a new site. None of the villagers could ever remember a visitor asking about these engravings before our visit. Above all, the elderly hold that they are connected exclusively with the ancient tribal tradition of the Kota - when they learned from us that there is similar tradition of stone-carved labyrinths in Europe, they were confident that the Europeans must have inherited this idea from the Kota!

The tiger games are still played today as an entertainment. By reason of their situation, and the historic and ethnological research into the history of similar games, it can hardly be assumed that they were positioned specifically for this purpose. They could have had a function in the context of the administration of advice and justice that was practiced at these meeting places, and could have been used as neutral instruments for the judgment process or decision making (see Riemschneider 1959 & 1968; Hummel; Huizinga). The question of whether the "fortress game" labyrinths can be brought into context with such a judicial practice cannot reasonably be answered from this sparse tradition for the moment.

Dating the Kota Labyrinths

If one wishes to appraise the age of the labyrinth carvings in the Nilgiris, one must first ask about the age of the Kota villages and the settlement history of the region. Mr. Shanmugkampkattan, our Kota guide, informed us that the oral tradition of tribal history amongst the Kota tells that they settled here in the Nilgiri Mountains "a long time ago" to "escape from warlike Moslems." Various anthropologists are of the same opinion (e.g. Reddy & Balaji Rao; Hockings 1980). Not only the Kota, but also four other tribes, are supposed to have settled here at different times. The first were the Kurumba, followed by the Irula. Later came the Kota and Toda, settlers from the northeast of Kerala and the plateaus around Mysore. Finally, the Badaga arrived, and their settlement story is precisely known through the long-time research of the American anthropologist Paul Hockings.

The Badaga also came from the plateaus of the former kingdom of Mysore, in the south of the present-day state of Karnataka, in several waves of emigration to the Nilgiris and have been settled here since the second half of the 16th century. The political and cultural starting point for the emigration of the Badaga is supposed to have been the conquest of the Hindu Vijayanagara Kingdom and the destruction of Vijayanagara (today known as Hampi) in the year 1565, by the unified Muslim Deccan Sultanate. The succeeding independent kingdom of Mysore, established under the Hindu dynasty of the Wodeyar, was again under the reign of Muslim conquerors, Hyder Ali and his son Sultan Tipu, between 1761 and 1799. Further movements of the Bagada into the rugged Nilgiris Mountains took place until this time, a process only finally halted during the English colonial period, when the kingdom of Mysore was re-erected, and formed the forerunner of the present-day federal state of Karnataka.

However, the escape of the Badaga "before the Moslems" was a different event to that of the Kota, they were already living in the Nilgiris when the Badaga arrived. The emigration of the Kota, also from Mysore, has been linked to the end of the Hoysala Dynasty (1040 to 1345), and the destruction of their capital Dvarasamudra (modern-day Halebid) in the year 1327 at the hands of Sultan Muhammed Tughluk. The dynasty of the Hoysala was subsequently replaced by the kings of Vijayanagara (Hampi) in 1345. During the Hoysala Dynasty, the well-known temples at Belur and Halebid were erected. On our journey, we also visited Halebid, in order to see two labyrinths that are carved, along with many other figures, on the stone facades of two temples. We also searched in vain, with help of a local guide and an archaeologist from the Indian Antiquities Authority, for a third labyrinth, which should be on a later, unfinished temple. However, a casual remark by the archaeologist that the destruction of the city in the year 1327 clearly interrupted work on the building site has bearing on the oral tradition of an earlier Kota village on the site.

The Kota tradition of escape "from the warlike Moslems," is coupled with the main professions of the Kota that live in the Nilgiris today; above all they are craft persons and artists. The women master weaving and ceramics, the men work as musicians, instrument and toolmakers, carpenters and smiths. They still have command of an ancient knowledge of metal extraction and specialization of the smith's craft, from fine gold and silverwork to the production of iron tools. At Halebid and Belur, such experienced craft persons were supposed to have lived and worked on the temple building sites, before their exodus into the mountains. Gudalur Kokkal lies 200 km (125 miles), a four-day march, southeast from Halebid. As for the dating of the earliest Kotē labyrinths in the Nilgiris (probably those at Gudalur Kokkal), a possible date in the first half of the 14th century would seem well founded, however, the labyrinth symbol was probably already well known to the Kota.

The Chakra-Vyūha Labyrinths at the Halebid Temples

The Hoysaleshvara temple in Halebid (Dvarasamudra), was started in about 1121 by the architect Kedaraja and completed during the reign of Narasimha I (c.1142 – 1173), the sixth of the Hoysala kings. It is a double installation, two linked temples dedicated to Shiva and his spouse Parvati. The facades are decorated with stone carved friezes, approximately 30 cm high, including a pictorial representation of the Mahabharata, one of the oldest of the Indian oral folk-epics passed down over the centuries and already written down before the 4th century AD. The description of a battle that lasts for 18 days, between the rival dynasties of the Kauravas and the Pandavas, is an essential part this story. On the 13th day of the battle, Drona the magician and the Kaurava General arrange their army into a complicated circular formation called "Chakra-vyūha." Followed only by Bheema, his father's brother, Abhimanyu, a youthful prince of the ultimately victorious Pandava, succeeds in penetrating the unconquerable formation with his chariot and kills a number of the Kaurava troops. But the plan that Bheema should secure the retreat fails, and the Chakra-vyūha becomes a trap in which Abhimanyu is killed. This tale reminds one of the tiger game and its variations, where it also about the fight of unequal opponents, strategic formations, killing and obstruction. The Chakra-vyūha battle formation is displayed on two temple facades in Halebid, and takes the form of a labyrinth which has the inner section drawn as a spiral.

The sculptors here at Halebid were faced with the task of creating a pictorial representation of the Chakra-vyūha, previously only verbally described. It is the earliest known depiction of this battle formation, although it is doubtful whether the strategic military formation actually took the form as given here, or whether it was really a labyrinth as shown. Possibly, the sculptor had fallen back on his knowledge of the Kota attam as the solution to the problem put to him, since the form in the text is only described as a complicated ring formation. The possibility that the sculptor had contact with the toolmakers of the Kota, or may have been of that tribal group, remains a possibility.

The spiral modification of the inner circuits of the labyrinth could be explained as technical necessity, in view of the task of depicting numerous warriors and chariots, and the battle formation, within a limited field on a frieze, only 30 centimetres (12 inches) high. A second, similar, but somewhat more roughly worked Chakra-vyūha is located on the smaller Kedareshvara temple, built approximately 50 year later for King Vira Ballala II (1173-1220).

The Chakra-vyūha friezes from (above) Hoysaleshvara, and (below) Kedareshvara, Halebid. Photos: K.K.

The Stone Labyrinth near Kundani

In connection with our sightseeing at the temples in Halebid, and the discovery of an unexpected possible connection between the temples and the Kota, until now not mentioned in the literature, we also went in search of a labyrinth-shaped stone installation, also documented and illustrated by Layard in 1937 essay (Layard, p.175). We found this in Tamil Nadu, 67 kilometres southeast from Bangalore, north of Krishnagiri. This is some 237 kilometers (148 miles) southeast from Halebid and 219 kilometers (136 miles) northeast of Gudalur Kokkal. Apart from a similar stone installation in the federal state of Orissa (Kern, no.619) this is possibly the single walkable labyrinth known in India. It resembles the Trojaborg labyrinths from Scandinavia, however, as with the Chakra-vyūha carvings on the temples in Haledid, the inner part is formed as a spiral.

The stone labyrinth is situated beside the Baire Gauni, a natural feature developed into a water reservoir. This is on the Devarakundani malai, a sparsely overgrown, elevated rocky area not far the temple of the ruined town of Kundani. The town was destroyed, according to the locals, by a fire, caused by lightning, "a long time ago." The fire was interpreted as a sign from the Gods and a new settlement was built some kilometres from the temple.

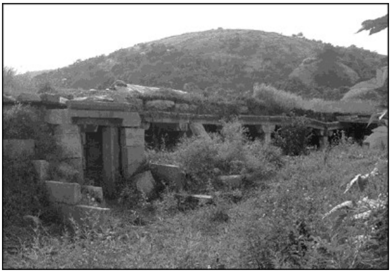
The "Kota" stone labyrinth at Baire Gauni, Devarakundani malai, Tamil Nadu, India.

Photo: J.Hohmuth

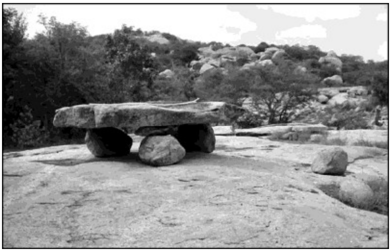
The present-day inhabitants of Devarakundani belong to the Kurumba tribe, who also live in the Nilgiri Mountains. However, they told us that the Kota lived here before them. One of the oldest villagers, a former shepherd that we met at the temples and asked for directions to the stone setting, with help from a copy of the drawing published by Layard, immediately remembered the stone construction on the hillside.

He arranged for a young guide to lead us on foot to the location, half an hour away on the Devarakundani malai. He didn't have any idea, like all inhabitants we questioned, about the function or meaning of the stone setting, however the old shepherd could remember its traditional name - he called it "Kota," the same name as the former inhabitants of Devarakundani. So, we discovered an unexpected example here, again not previously mentioned, of a connection with the Kota as the possible builders of this stone labyrinth.

Right: The temple ruins at Kundani.
Photo: K.Kürvers



There is little to be found in the literature about the temple ruins at Kundani, despite good documentation of temples elsewhere in Tamil Nadu. Some are cave-like and often overgrown, but nevertheless still used by the people living in the surroundings as temples. Much simpler and more archaic than those we saw at Halebid, they are only sparsely decorated. The names of the temples refer to the Mahabharata. One is dedicated to the five brothers of the Panadava, another to their mother Kunthi, the grandmother of Abhimanyu who was killed in the Chakra-vyūha of the Kauravas, indeed the name of the town, Kundani, derives from her. Around the Baire Gauni, the water reservoir on the Devarakundani malai, there are erected several dolmens, formed of large flagstones, three to four meters long, resting on rounded stone blocks. These megalithic constructions are similar to those in Europe, but if, as Layard reports, they were called "Pandava gudi" (Pandava temples), we cannot confirm this, as it is the temple ruins lying in the valley that are so-named; a specific name for the megalithic stone structures on the other hand appears unknown.



Above: "Dolmen" on Devarakundani malai.
Below: The flagstone standing by the labyrinth.
Photos: K.Kürvers

From the Kota labyrinth there is an extensive view to the far horizon. Over a wide river valley in the east, a mountain range approximately 6 kilometres distant has a prominent cut between two mountains, ideal to observe sunrise at the time of the equinoxes. Exactly to the south, a prominent dome-shaped mountain stands on the horizon and to the north of the labyrinth, a towering flagstone approximately two metres high stands before the entrance. This corresponds with the Mandhukal that we saw at the men's meeting places in the Kota villages. Behind it lies a small Shiva temple in the form of a stone box formed from large rock slabs, with an entrance in the east. Standing in the labyrinth and looking westward, our local guide explained that a long stone wall at the foot of the mountains was the border of the former Pandava territory.

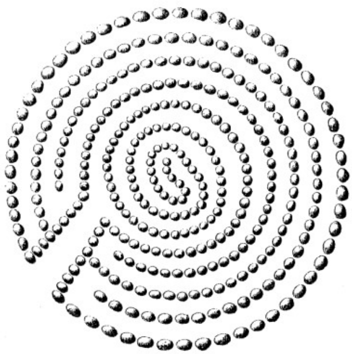
The Kota labyrinth has a diameter of approximately 8.5 meters, with its entrance in the north, and is constructed from a multitude of small flat stones set in the ground. This place seems not to be generally known among the inhabitants of the surrounding villages and it was the shepherds who led us there. This place is puzzling for them; like the temples in the valley, they consider it to be ancient, but as for the meaning of the labyrinth, nothing more seems to be known.

One suspects that that the area around Baire Gauni, with its upright flagstone and stone tables, as well as its location and altitude on the Devarakundani Malai, is an old meeting place of the former Kota settlement at Devarakundani, connected with the temple and town of Kundani. The spatial connection of the Kota stone labyrinth with this meeting place, as well as the nearby Shiva or sun temple, reminds one of the situation of the stone engravings in the Kota villages of the Nilgiris. The spiral-shaped variation of the inner area of the labyrinth, on the other hand, clearly reminds one of the Chakra-vyūha on the temple facades at Halebid. All three locations, approximately equally far from each other, have a reference to a settlement history by the Kota.

We are not able without further knowledge gained by archaeological or anthropological research to assess whether the temple ruins at Kundani are older or younger than those at Halebid. The archaic forms don't necessarily point to a greater age. It is possible that refugees created them after the destruction of Dvarasamudra, and merely reflects a decay of the craftsmanship. It would seem that a cult place of the Pandava was erected here at Kundani - a materialisation of the Mahabharata, to have lain at the base of its foundation – and it is possible that the archaic temple forms have been consciously historicised. The labyrinth-shaped stone setting on the Devarakundi Malai consequently could represent the Chakra-vyūha in which Abhimanyu was killed. While we don't know anything about the function of this stone setting, in view of its spatial situation, it is possible that it was used as dance place in the framework of a ritual performance of the Mahabharata.

The question, whether it was created after the model of the temple representations in Halebid, or was itself a model for the Mahabharata sculptors, must remain unanswered for the moment. The spiral-shaped distortion of the labyrinth could be explained as a technical necessity for the sculptor in Halebid, but if the stone setting near Kundani were supposed to have created earlier than the temples in Halebid, an explanation would be required for the spiral.

On the other hand, it must be remarked that this spiral-shaped transformation of the classic labyrinth form is not unknown, as it also appears in Northern Europe. In 1838 the zoologist and naturalist Karl Ernst von Baer (1792 - 1876) discovered a similar example on the uninhabited island of Wier in the Gulf of Finland, likewise with a walkable stone lined path. However, it seems at the moment unjustified to construct a connection between these exceptional forms on grounds of their formal similarity.



"Stone Arrangement on the Island of Wier"
engraving by E. von Baer, 1844.

Our expedition to enlarge our knowledge of the labyrinths of the Kota in the Nilgiris can justify the supposition that they have some connection with the labyrinths on the temple facades at Halebid, and also with the stone labyrinth near Kundani. The original function of these labyrinths, however, still remains unclear. Equally as uncertain, remains the connection between the classic labyrinth form found amongst the Kota, and those in the Mediterranean and Northern Europe. An invention, independent of each other, appears to be an improbable explanation in view of the complicated construction of the labyrinth.

For the labyrinth is Southern India, however, we can name a number of associations following the conclusion of our field research: sun temples, meeting and justice places, symbolic fortresses, battlefield formation and military strategy, protection magic, finger games and concentration exercises, an age-old strategy game connected with the domestication of sheep and goats for the protection of the herd and the Chakra-vyūha of the Mahabharata, an impregnable fighting formation that turned into a deadly trap for the opposing forces. Further detailed investigation of these individual labyrinths could possibly add more to these findings, which will make it possible to better understand the puzzling phenomenon of labyrinths.

Klaus Kürvers; Berlin, Germany, September 2006

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Mazes and Mysteries

David Ellis

Mazes and labyrinths have been linked with mystery and mayhem since the ancient legend of the Minotaur. Half-man, half-beast, this shameful monster was confined by the king of Crete in an elaborate enclosure built by Daedalus, the all-purpose artificer of the time. The Minotaur was killed by the Athenian prince Theseus, aided by a clew or clue - that is, a ball or hank of thread - that he attached to the entrance to the creature's lair and unwound to mark his way through its tortuous passageways. As well as demonstrating how evil and terror could be overcome by a resolute hero, this enduring myth established an association between mazes and labyrinths and dark secrets, hidden monsters and the threat of death. And Theseus's clue developed into the essential requirement for those aiming to penetrate mysteries as the word evolved to mean some crucial item, fact or circumstance pointing to the truth.

Whatever the labyrinth constructed by Daedalus may have been like; today most people's idea of a maze is probably a narrow twisting walkway between tall dense hedges.[1] In Britain such mazes appeared in the sixteenth century and over the years were increasingly to be found in the grounds of stately homes, country houses and public pleasure gardens. The most famous example is the one at Hampton Court Palace, southwest of London, originally planted between 1690 and 1695. Jerome K. Jerome recorded a disastrous excursion there by "Harris" in Chapter 6 of ***Three Men in a Boat*** (1889), a Victorian comic episode that reflected a contemporary perception of the hedge maze far removed from the ominous Cretan labyrinth, reinforcing instead the role mazes had acquired as places for innocent amusement.

Harris's day out is hinted at by M. R. James, the doyen of the ghost story, in his tale ***Mr Humphreys and his Inheritance*** (1911).[2] However, James summoned up recollections of the good humour of Jerome's anecdote in order to sharpen the contrast with the markedly different mood of the maze into which he led his own readers in this piece. For despite its setting in the East Anglian countryside around 1895, James's maze is not at all cosy or inviting:

> "It was a yew maze, of circular form, and the hedges, long untrimmed, had grown out and upwards to a most unorthodox breadth and height. The walks, too, were next door to impassable. Only by entirely disregarding scratches, nettle-stings, and wet, could Humphreys force his way down them ... The dankness and darkness, and smell of crushed goosegrass and nettles were anything but cheerful."

This is a maze of mysteries. Why is it surrounded by a high wall? What is the significance of the motto above the padlocked entrance? And why is there a queerly engraved metal globe on the stone column at its centre? Adding to the general eeriness, Mr Humphreys happens upon a strange labyrinthine fable, complete with a reference to Theseus, in an antique book in his library.

Because James's tale concerns the supernatural then even though it contains, in addition to a clew of twine, other clues that lead to a shocking discovery, the account of Mr Humphreys's alarming experience is not reckoned to be a detective story. Nevertheless, it was a reminder to his readers that mazes did not just puzzle and tease but might also provoke and disturb. James showed that this feature of the country house garden could be a stage for very unsettling events indeed. "Mr Humphreys and his Inheritance" was an influential text and some at least of the later mazes that provide the settings for subsequent skulduggery can be seen as offshoots from James's dank and sinister hedges.

When creating his demonic maze, James may have been partly inspired by the globe-topped pillar in the circular turf labyrinth at Hilton, west of Cambridge. It would be interesting to know whether any actual location prompted J.J. Connington to write ***Murder in the Maze*** (1927). Or could it be that James's story played some part here? Is it simply coincidence that Connington sited his hedge maze at "Whistlefield," the first half of this name being only a minor re-arrangement of the first six letters of Mr Humphreys's village of "Wilsthorpe"?

Connington's maze has very particular specifications: it is rectangular and covers about half an acre; has four separate entrances (with iron gates and padlocks like the way into Mr Humphreys's maze); its thick twelve-foot high hedges enclose more than half a mile of winding pathways; and, most importantly, there are two centres. The maze has to be large because when the murderer strikes in Chapter II it must accommodate five people distributed around it. Two centres are needed for the separate sites of the deaths of Roger Shandon and his twin brother Neville, each killed by an air-gun dart tipped with curare. The book does not contain a map but the jacket of the American first edition carried a plan that conforms to the author's requirements very convincingly. The murders are investigated by Sir Clinton Driffield who combines intelligence and guile with astonishing recklessness and an incredible disregard of the obligations of his office of Chief Constable.

Not long afterwards, Margery Allingham introduced a hedge maze into ***Mystery Mile*** (1930), her second escapade for Albert Campion. Part of an isolated estate on the Orwell estuary in Suffolk, it is "a great square of yew, the dense bushes, which had once been trimmed as square as marble blocks, now overgrown and uneven." When, in chapter 11, Judge Crowdy Lobbett, hiding from a criminal mastermind, enters the maze and disappears, the level of suspense is ratcheted up. The reader's expectations rise along with it only to be let down by the banal explanation disclosed in chapter 24. The fictional village of Mystery Mile was based on Mersea Island in Essex, known to Allingham since her childhood. There was no maze on the island but it may be significant that in 1922 an overgrown Victorian maze was recorded in the riverside village of Mistley in the same county.[3]

Mazes and labyrinths fascinated the Argentinean writer Jorge Luis Borges, so much so, that in 1962 a selection of his writings was published under the title ***Labyrinths***. This contains two of his unorthodox and provocative mystical mystery tales "The Garden of Forking Paths" (1941) and "Death and the Compass" (1942). In the first, set in England in 1916, the learned Sinologist Dr Stephen Albert solves the riddle of an ancient Chinese labyrinth before being murdered for a motive that may well be unique. In the second tale, detective Erik Lönnrot's investigation of a series of curious murders in a strange dreamlike city reveals a pattern that leads him to his own rendezvous with death. For some reason this collection does not include "Ibn Hakkan al-Bokhari, Dead in his Labyrinth" (1951), Borges's story of an impossible crime in a labyrinthine house in Cornwall, a tale with references to the Minotaur and echoes of Edgar Allan Poe and G. K. Chesterton.

In ***Frequent Hearses*** (1950), his seventh novel featuring Gervase Fen and one of the most artfully constructed, Edmund Crispin devoted several pages to a dramatic pursuit in an overgrown hedge maze. A young woman's growing terror in the gathering darkness is vividly conveyed, with the effect achieved in part by her recollection of creepy excerpts from "Mr Humphreys and his Inheritance". Fen attempts a rescue, unwinding a ball of string behind him like a latter-day Theseus while recalling (he is after all a Professor of English Language and Literature) two fictional predecessors:

> "He has confessed since that he was far from liking the atmosphere of the place, and that although for obvious reasons he was not so strongly affected by the story as was Judy, Dr James's ill-advised jewel-hunter kept incongruous company with the egregious Harris in the literary quarters of his mind."

The Chinese Maze Murders was the first novel written by Robert van Gulik about the Chinese detective Judge Dee. It was first published in Japanese in 1951, but although an English version was produced in 1956, the first UK edition did not appear until 1962. The maze in question is in the grounds of an abandoned mansion outside the remote north-western city of Lan-fang and it has degenerated into a tangled swampy wilderness that looks to be impenetrable. Through his ingenious interpretation of a picture of an elaborate landscape, Dee finds the overgrown path through the maze and discovers a hidden pavilion that contains a long-lost document and a headless corpse. It was van Gulik's practice to embellish his books with "illustrations drawn by the author in Chinese style," and in this volume the drawings include both the cryptic painting and a plan of the maze, a distinctive design developed, he explains in his postscript, from the cover of an incense-burner.

Nearly seventy years after the publication of *Three Men in a Boat*, John Dickson Carr re-visited the Hampton Court maze in his story ***All in a Maze*** (originally published as ***Ministry of Miracles*** (1956)), featuring Sir Henry Merrivale. With a characteristic flourish, he dispelled the light-hearted aura left by the tale of Harris to conjure up an air of menace:

> "Illumined in brilliant green and dead shadow by the sickly light, it loomed up less as a place of comedy than as a secret, malicious trap."

But although there is a chase through the maze, culminating in a life-or-death fight, the really mysterious events occur elsewhere. Whereas the story opens at St Paul's Cathedral, because Carr had thought of a way to make use of the Whispering Gallery there ("a voice speaks where no voice could have spoken"), Hampton Court is just a colourful backdrop to the unmasking of the murderer.

Ten years earlier Carr had written: "What would be one of the best possible settings for violent death? J.J. Connington found the answer with *Murder in the Maze*."[4] It is strange that the master of the impossible crime did not attempt to outdo Connington and fully exploit the opportunities offered by a maze: for example, the victim murdered in an otherwise empty maze under observation; the alibi established by being seen to enter a maze just before a crime is committed at some other place; the victim who disappears elsewhere but is found dead in the centre of a maze; the vanishing of someone observed to enter a maze (a variation of the James Phillimore problem posed by Conan Doyle). A number of the scenarios in Carr's novels could have been developed around a maze but he chose not to use "one of the best possible settings".

Mary Fitt's ***Mizmaze*** (1959) begins very promisingly with the corpse of Augustine Hatley found, on the very first page, in the centre of the ancient maze in the grounds of his country house. The maze, formed of high yew hedges, is large and complex (though no plan is provided) and the legend of Theseus and the Minotaur is quickly invoked. But the narrative's assertion that only two other characters know the route to the centre (repeated in the blurb for the Penguin edition) is not only misdirection, but a downright falsehood, since it emerges that the details have been published in a volume available in the local library![5] As for the ending, Barzun and Taylor in ***A Catalogue of Crime*** (1971), are over-generous in describing it as "perfunctory and almost ludicrous".

The problem of the victim who vanishes from a maze and is found dead elsewhere was tackled by Victor Gunn (an alias for the phenomenal one-man word factory Edwy Searles Brooks) in ***Devil in the Maze*** (1961). The case, located at Richmond, just a few miles down the Thames from Hampton Court, is investigated by Chief Inspector Bill Cromwell of Scotland Yard. Readers might beat "Ironsides" to the solution if they recall an episode from ***The Incredulity of Father Brown*** (1926). This is despite the fact that even though the maze can be a powerful metaphor to illustrate a range of moral lessons, G.K. Chesterton never caused his perceptive priest to find the way through a maze-based mystery. Disappointingly, Father Brown's declaration in *The Head of Caesar*, "What we all dread most is a maze with no centre", is uttered in a case not about labyrinths, but coins.

1980 saw the publication of the most accomplished labyrinth mystery, Umberto Eco's ***II Nome della Rosa*** which appeared in English in 1983 as ***The Name of the Rose***. One of the mystery masterpieces of the twentieth century, it describes the remarkable events that take place in an unnamed abbey in the mountains of northern Italy during seven days in November 1327. A visiting English Franciscan, Brother William of Baskerville, a former inquisitor who finds "the most joyful delight in unravelling a nice, complicated knot", is asked to examine the suspicious death of a young monk, and soon he is following the lethal trail of a mysterious ancient text as murder follows upon murder in a plot of labyrinthine complexity.

To uncover the abbey's secrets William has to solve the mysteries of its library, the greatest in Christendom and built centuries before to an obscure plan intended to safeguard its contents from imprudent scrutiny. As the abbot declares:

> "The library defends itself, immeasurable as the truth it houses, deceitful as the falsehood it preserves. A spiritual labyrinth, it is also a terrestrial labyrinth. You might enter and you might not emerge."

It is one of the novel's many pleasures that the reader is shown each step of William's reasoning as he reveals the library's ingenious layout and maps its baffling passageways. On the seventh day he opens the door into its hidden chamber and like Theseus confronts the malign figure waiting within.

In his follow-up essay ***Postille a Ii Nome della Rosa*** (1983), translated as ***Reflections on the Name of the Rose*** (1985), Eco disclosed that he had named his abbey's blind librarian Jorge of Burgos in honour of Jorge Luis Borges. He also revealed that devising a library-labyrinth that would satisfy the demands of his plot had taken him two to three months, his design being based on the medieval pattern that had once been marked out on the floor of Rheims Cathedral.

Floor-labyrinths from two other French cathedrals, at Amiens and Chartres, feature in J.G. Sandon's convoluted thriller ***Gospel Truths*** (1992). The book's plot is driven by the assertion that they hold the key to the hiding place of a secret gospel that could undermine the authority of the Catholic Church. But in contrast to Eco, Sandon fails to present a satisfactory solution to the problem he has posed, resorting instead to gobbledygook:

> "By following the white path to the centre of the labyrinth, you run a kind of topological journey. And if you apply that same topological journey or transformation to the basic numerical structure of the cathedral, it brings you to a specific point at the heart of the labyrinth"

With its mix of symbolism, secret societies, bankers, Masons, priests and assassins, *Gospel Truths* can be seen as a forerunner to Dan Brown's best-selling adventures of Robert Langdon in ***Angels and Demons*** (2000) and ***The Da Vinci Code*** (2003).

There has been a resurgence of maze building around the world since the 1980's, and perhaps this has helped to bring forward further maze-based mysteries. In 1993 the title used by Connington re-appeared with the publication of Sarah J. Mason's English village mystery ***Murder in the Maze***. In the fictional county of Allshire, Detective Inspector Trewley and Sergeant Stone investigate the murder of the wife of a local doctor, in a hedge maze, during the annual fete in the manor house garden. Nine years later the body of another woman is found in another yew maze in Catherine Aird's fictional county of Calleshire. Detective Inspector Sloan asks the questions in ***Amendment of Life*** (2002).

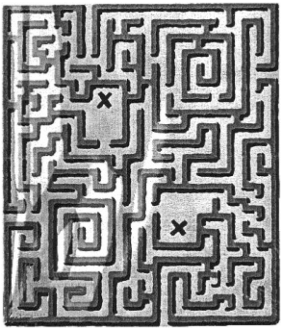
The growing number of historical mysteries in recent years has included novels based on mazes. ***The Thorne Maze*** (2003) is the fifth book in Karen Harper's series in which Elizabeth I is the detective, set in 1564, in the run-up to the marriage of Lord Darnley to Mary Queen of Scots, and begins with murder in a possible sixteenth-century predecessor of the present maze at Hampton Court. It culminates in an extraordinary scene in the thorn maze of the title, formed from shrubs planted in floating barrels in Sir William Cecil's garden in Hertfordshire, where Elizabeth behaves more like a Tudor Nancy Drew than England's monarch.

The action of ***A Maze of Murders*** (2003) by C.L. Grace (another manifestation of the prolific Paul Doherty) takes place in and around Canterbury in 1473. Even before Chapter 1, Sir Walter Maltravers is beheaded in the centre of his vast (and historically somewhat precocious) hedge maze at Ingoldby Hall. It was the old soldier's custom to toil along the pathway on his knees, as a penance for a past crime, and only he knew the complete route. He left a cryptic clue to the secret of the maze, but readers are not shown the plan for themselves. The murder is solved by Grace's apothecary-detective Kathryn Swinbrooke, who is kept busy unravelling a tangle of connected mysteries, including a locked-room problem, with a high tally of corpses.

The legend of a twelfth-century labyrinth is retold in Robin Paige's ***Death at Blenheim Palace*** (2005). The principal action of the book is set in 1903 against the background of the breakdown of the marriage of the 9th Duke of Marlborough and his Duchess, the former Consuelo Vanderbilt. Also involved are the Duke's mistress, Gladys Deacon, a young T. E. Lawrence and Winston Churchill. For Paige's investigators, Charles and Kate Sheridan, aspects of the case seem to parallel the tragic story of Rosamund's Bower, once located on the same site, in which King Henry "is said to have concealed his young mistress from the wrath of his formidable wife Eleanor of Aquitaine."

Since J.J. Connington's ***Murder in the Maze*** a variety of mazes and labyrinths have appeared in mystery stories. Hopefully there will be many more as the plot possibilities of these intriguing sites have surely not been exhausted. Caerdroia readers may not find it difficult to nominate titles to add to the mysteries noted here.[6] The puzzle that follows is harder. The Caerdroia office is located less than a mile away from the headquarters of Crime and Detective Stories (CADS),[7] a leading UK journal for the subject, in South Benfleet. Mazes and mysteries virtually side by side in the same corner of Essex! Just what is the secret of this remarkable locality?

David Ellis; Winchester,
England, April 2006



Right: the maze illustrated on the cover of J.J. Connington's "Murder in the Maze" (1927).

Notes:

1. "Maze" and "labyrinth" are often used interchangeably but a maze is usually a multi-path puzzle made from hedges or fences or, more recently, fields of maize. Other forms such as winding paths edged with stones or inlaid in floors or pavements are generally called labyrinths.
2. Mr Humphreys has the vexing experience of being unable to lead a guest to the centre of his maze even with the help of his bailiff and gardener. While this incident mainly serves to indicate that some dark force is at work and foreshadows worse things to come, for many readers in 1911 it would have brought to mind Harris's famous misadventure. The allusion is strengthened in the penultimate paragraph of James's story when Mr Humphreys's butler is reminded of his aunt who "had been lost for upwards of an hour and a half in the maze at Covent Garden, or it might be Hampton Court."
3. See W.H. Matthews, *Mazes and Labyrinths, their History and Development* (1922, reprinted 1970).
4. From "The Grandest Game in the World" written in 1946 as an introduction to a projected anthology of mystery novels but not published until 1963 in the March edition of Ellery Queen's *Mystery Magazine*.
5. Was this volume suggested by the "Book of Mazes" that in James's story was being compiled by Mr Humphreys's neighbour Lady Wardrop? Or had Mary Fitt seen Matthews's pioneering survey mentioned above?
6. But not Kate Mosse's *Labyrinth* (2005). Although this has mystery/thriller elements, plus some discussion of labyrinths, it is technically a romantic-historical-adventure-fantasy.
7. CADS, 9 Vicarage Hill, South Benfleet, Essex, SS7 1PA. England. For more details, contact the editor, Geoff Bradley – Geoffcads@aol.com – this article first appeared in CADS 49 (April 2006), and thanks go to Geoff Bradley for permission to republish it in Caerdroia.

Notes & Queries

Our regular round up of matters labyrinthine brings together short contributions and notes from Caerdroia readers, also items from the Archives that need further research, or simply deserve recording. Similar notes, and queries, are welcomed for future editions.

Labyrinths in Western India — Jeff & Kimberly Saward

In February 2006 we were fortunate to be invited to lecture at the Indian Institute of Technology (IIT) at Powai on the northern outskirts of Mumbai, India, and also help create a labyrinth in the grounds of the Shri Devi Padmavati Temple (on the shore of the Powai Lake), which stands within the campus. The temple was founded during the 10th century CE, and while most of the current temple structures are from more recent times, the temple staff, with support from IIT, are currently renovating the buildings and surrounding grounds. It was with this in mind, and ably assisted by Kathy and Sonia Ruyts and Rashmi Misra (to whom our sincere thanks go for making it all possible), that we, and a considerable number of locals and Institute staff and students, all turned up on the morning of Sunday 5th of February to build a labyrinth from whatever materials came to hand.

Despite the initial chaos, a plan was soon formulated, and the design of a "Chakra-vyūha" style labyrinth marked out in the garden in front of the temple. Willing helpers gathered rocks, sticks, string, banners, flags and paint-pots. Teams of men and boys were assigned the task constructing the labyrinth while the young women created a staked fence to surround it. Meanwhile, the local women practiced the art of drawing labyrinth designs from a seed pattern while the temple elders drew up a set of rules to govern the new labyrinth's use… including the admonition not to walk the labyrinth at night. When we questioned this rule, it was explained to us that after nightfall leopards, crocodiles, and snakes frequent the area. We hastily agreed with the new rule! By late afternoon the labyrinth was complete, and the last few workers rushed to give the stones a coat of white paint and an Indian flag was planted in the centre.

The entire temple community, including all the helpers from the afternoon plus a few distinguished visitors, gathered that evening to dedicate the new labyrinth, and in a ceremony led by a visiting guru, the labyrinth was blessed and walked for the first time. It has since been reported to us that the labyrinth continues to be well used and much loved; there are even plans to create a more permanent installation at some stage in the future.

The new "Chakra-vyūha" labyrinth at the Shri Devi Padmavati Temple, Powai.

Following our successful labyrinth construction in Mumbai, we took the opportunity to travel to Bijapur, in the north of Karnataka state, to investigate the whereabouts and current condition of a little known and poorly documented stone labyrinth in the village of Sitimani. Apart from a couple of old photographs of the labyrinth in the archives of the American ethnographer Carl Schuster (1904-1969), provided to him by the Office of the Government Epigraphist in Madras, presumably sometime in the late 1940's or early 1950's, practically nothing is recorded about this location apart from the brief notes that accompany these in the annotated catalogue of Schuster's archive (Carl Schuster. *Social Symbolism in Ancient & Tribal Art*, ed. Edmund Carpenter, Rock Foundation, New York, 1988; vol.3, p.290/1).

Composite of two photographs of the Sitimani "Lakshmana-mandal" stone labyrinth, taken sometime in the late 1940's or early 1950's. Courtesy of the Carl Shuster Archive, Basel.

Known locally as the "Lakshmana-mandal," this large labyrinth, c.20 metres in diameter to judge from the photographs, was formed from substantial mounds of stones, rather than the usual single lines of rocks, and was supposedly in the vicinity of some megalithic ruins – a proximity noted at other stone labyrinths recorded in India. The design is likewise difficult to determine from the photographs, taken from the 'back' side of the labyrinth, although it appears to have seven or eight concentric walls surrounding the centre.

Schuster was thwarted in his attempt to visit the location during his travels in India during the early 1950's (ibid, vol.3, p.259), but we were more determined to succeed. Finding Sitimani was a challenge, as it didn't appear on any maps of the area, but enquiries in Bijapur revealed a railway station of that name, some 60 km SSE of the city, although apparently it was currently closed due to the rebuilding of the rail tracks. Approaching by road instead, we took highway 13 south from Bijapur, through Nidgundi, to the bridge over the Krishna River. Crossing the river, it was obvious that a major construction project, the Almatti Dam, a kilometre or two to the west had seriously altered the landscape. Ajaz, our trusty guide and driver, stopping at regular intervals to ask for directions, soon determined that Sitimani village was situated on the southern bank of the Krishna, a little to the west of the dam. However, it soon transpired that we had probably arrived ten years too late to find the labyrinth.

The original village of Sitimani, and the Lakshmana-mandal labyrinth, is now submerged beneath the Almatti Dam, completed and flooded in 1996. This has brought much-needed reliable water and electricity supplies to the area, and a compensation program has allowed the villagers to rebuild their homes on higher ground overlooking the huge lake that now fills the valley below.

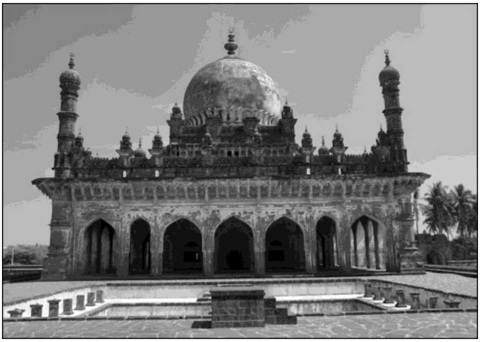
Our questions about the former location of the Lakshmana-mandal lead us to the Krishna Itagi Vanktesh Temple, also rebuilt during the mid-1990's, on the hillside above the new village of Sitimani, to replace the original temple. Here we met Mr. Madava Charay, the village priest for 24 years, whose father and grandfather had held the position before him. Once his initial disbelief that we had travelled to Sitimani in search of a pile of stones had subsided, he told us a little more about the former labyrinth.

Mr Charay informed us that he had walked the labyrinth many times before the site was flooded; indeed he could still remember the design and proceeded to draw it for us on a scrap of paper. Interestingly, he drew not the walls of the labyrinth, but the course of the path, as this was the pattern he could remember. His wife then dug out an old desk diary where he had made several sketches of the labyrinth, several years after its destruction, in case he should forget it in future.

Sketches of the Lakshmana-mandal in Mr. Charay's diary. Despite the variations, he told us that the example lower right was the most accurate.

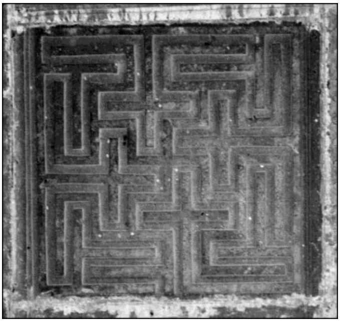
From his recollections and the sketches, it is clear that the Lakshmana-mandal was formerly of the common "Classical" form, although it is unclear exactly how the path terminated at the centre. Mr. Charay seemed quite insistent that the final inner circuit spiralled around the goal, but the several slightly different plans in his old diary seem to correspond well with the layout visible in the old photograph of the site. When questioned about the history of the labyrinth, he assured us that it was very old; indeed the local tradition was that Rama and Sita had built it when they passed through the area, thousands of years ago!

However, our journey to Bijapur was not without reward. During a morning visiting some of the architectural gems of the city, we stopped to see the Ibrahim Rouza on the west side, beyond the Makka Gate. This remarkable building has a separate sepulchre and mosque, built either side of a central enclosure with a reservoir and fountain, and was formerly surrounded by gardens, now kept as grass lawns. Built in the 1620's by Ibrahim Adil Shah II (1580-1626), the sixth sultan of the Adil Shah dynasty, as a mausoleum to his wife Taj Sultana, the sultan, his queen and four other members of his family are buried in the eastern sepulchral building.



The eastern building of the Ibrahim Rouza, Bijapur.

Carved ceiling panels on the Ibrahim Rouza.



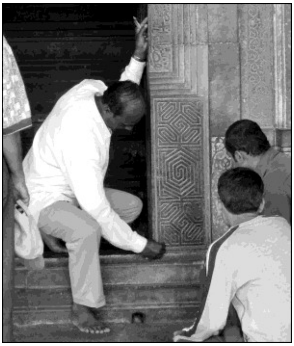
The ceiling of the colonnade around the exterior of the eastern mausoleum building is lined with carved stone panels and rosettes. Sixteen of these, four on each side, are of a distinctive swastika-meander form with a carved channel leading from the base of the design, around a number of interlocking meanders arranged around a swastika, ending back alongside the start point. The same design also occurs on a smaller scale, 24 cm wide, carved into black marble decorative slabs set on either side of two of the four doors of the shrine, alongside some exquisite carved and perforated stonework with Quaranic texts.

This design is found in several other locations, with connections to labyrinth related stories and purposes. The most obvious of these is found in the Dattatreya temple in Bhaktapur, Nepal, where the design represents the labyrinthine defences of the legendary city of Scimangada (see Staffan Lundén, "A Nepalese Labyrinth" in *Caerdroia* 26, pp.13-22). Another example, of this same design, was recently shown to us by a private collector of Indian antiquities. This took the form of a carved water feature, from an unknown location in Rajasthan, in Northern India, and probably dating from the 17th or 18th century. The deep, square cut channels of the swastika-meander in the black marble slab are designed to allow water to flow around the design from an entry point on the lower perimeter to a small exit gully alongside.

While there were no obvious clues of a labyrinthine connection to be seen here at Ibrahim Rouza, noting our obvious interest in the panels, several of the locals and temple staff gathered, and tracing the grooves of the meanders with a stick, explained to us that the designs on the panels on either side of the doors are supposed to represent the plans of secret tunnels that run under the city, to link the major temples, mosques and other important buildings built by the Adil Shah sultans. An unlikely tale, perhaps, but these swastika-labyrinths from India and Nepal form an interesting group of often small, largely decorative features, worthy of further study. Undoubtedly, more examples of this distinctly Indian group of labyrinths remain to be discovered and reported.

Left: the carved panels flanking the doorways.

Right: the locals tracing the meander patterns with a stick to illustrate the story. Photo courtesy of Kathy Ruyts

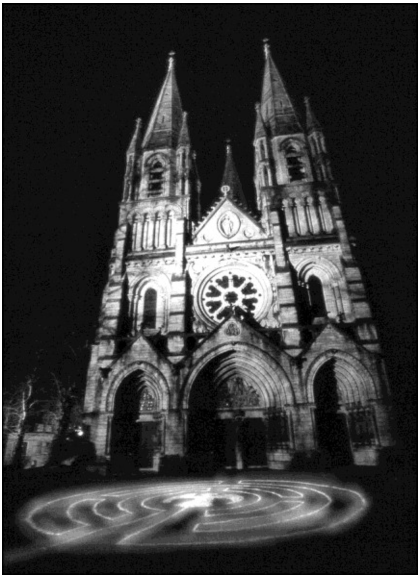


In 1996, when Copenhagen in Denmark was designated the "European City of Culture," there were a number of labyrinths constructed in and around the city, and several labyrinth themed artistic events were held (see *Caerdroia* 28, p.51). In 2005, the city of Cork in Ireland took on the mantle of "City of Culture," and alongside the various literary and artistic events staged throughout the year, likewise chose the labyrinth as a central theme for a specific week of activities from the 15th to 21st of December.

In the darkness of the midwinter solstice week, as part of the wider "Solas - Festival of Light" celebrations that ran from late November to New Year, Cork hosted a magical festival entitled "Labyrinths - Pathways of Light," in which some 50 or so temporary labyrinths were installed around the city - some that were in place all week, others for just a few hours. Involving both local and international labyrinth creators and artists, the project specifically invited local businesses, churches, schools and community groups to design and create labyrinths of many kinds, at indoors and outdoor locations, to take part in the festival. And what an event it turned out to be…

The process started in early November when Helen Raphael Sands and Jeff flew to Cork to meet with Niall Horgan and his team at the Cork 2005 Office to plan the event and give several introductory workshops about labyrinths to artists, teachers, church staff and volunteers who had already expressed an interest. In the following weeks a number of plans and ideas began to crystallize, and various labyrinth installations and artworks began to take form. A labyrinth resources page was added to the official Cork 2005 website to help participants find ideas and designs, and a budget set to fund the events and installations.

Beginning on 15th December, a number of temporary labyrinths began to appear on the streets of Cork city centre. A number of walkable labyrinths were created on sidewalks and open paved areas with 'temporary' paints, including one in front of St. Finnbarr's Cathedral, many of which were then used for scheduled performances or group activities, including candlelit walks and Christmas carolling by local schoolchildren. Large labyrinths painted on waterproof fabrics were installed in shopping centres and hung on the sides of buildings adjacent to notorious traffic bottlenecks in the city. Several artistic installations were created in parks and along the riverside. After nightfall, labyrinths of light, projected from high on adjacent buildings, lit up the pavements in the main shopping streets, adding to the Christmas lights and holiday displays. A labyrinth formed from strings of Christmas lights adorned the entrance to the Crawford Art Gallery. Playing on the theme of 'Journey,' other labyrinths greeted travellers at the airport, railway and bus stations.



St. Finnbarr's Cathedral, Cork.

Above: labyrinth outside Cork Council Offices.

Left: canvas labyrinth in Mahon Shopping Centre.

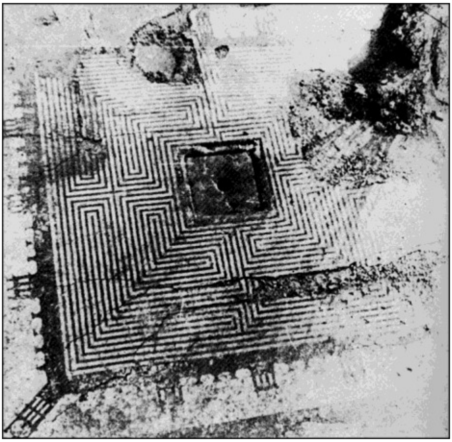
Temporary labyrinths appeared in various locations around the city. A double-spiral labyrinth constructed from small candles set in paper sacks greeted council workers as they left their offices one evening, and many paused to walk the pathway before rushing home as darkness fell. A "Wish Labyrinth" formed of paper on which young people had written their deepest desire was laid out in a public hall, and a beautiful quilted labyrinth was displayed in the city library. A display of "Disco Sheep" dancing a labyrinth appeared in a shop window, and a labyrinth laid out on a pavement with large potatoes added a distinctly Irish note to the celebrations! Throughout the week, various presentations and labyrinth walks were also held in schools, nursing homes, convents and neighbourhood centres, ensuring a wide participation amongst the community.

This week of labyrinths culminated in a showcase event at the City Hall on the evening of 21st December, Solstice Night, presided over by the Lord Mayor. At the reception, several canvas labyrinths were laid out, a collection of photographs of the many labyrinths constructed during the week was displayed, and an impromptu, and surprisingly attractive, labyrinth formed from spare leaflets and brochures and strings of Christmas lights was taped to the floor and draped from the ceiling to greet the attendees. Following performances by local musicians and dancers, certificates of participation were handed out to all of those involved in the festival, and the party went on until late in the evening, before everything had to be cleared away and tidied up! All in all, this was surely one of the most remarkable labyrinth-themed events ever, and thanks must go to the good folk and officials of the City of Cork and the visionaries who dared to dream that it might happen, especially Niall Horgan and his hard working, dedicated event team.

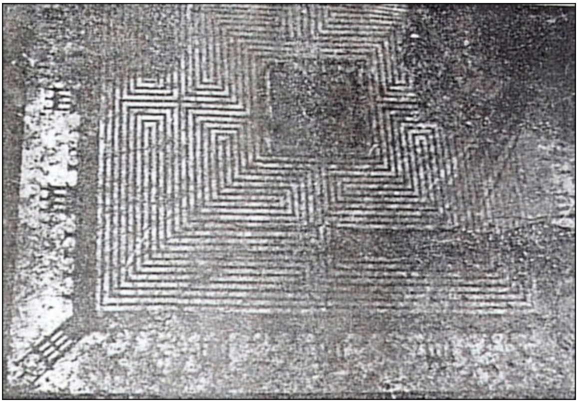
Closing Event, Cork City Hall.

Croatia has never figured highly in the list of countries with labyrinths, and indeed its only well-known historic labyrinth, the remarkable Roman mosaic labyrinth from Pula, was reburied soon after excavation for protection. Pula, today, is a large town situated on the Istrian peninsula along the Adriatic coast and has a wonderfully preserved Roman amphitheatre and temple built by Augustus, remains of its Roman city walls and gateways, as well as a number of important early churches and other monuments that document its lengthy history.

The Pula labyrinth mosaic, discovered in 1953 during excavation of a villa site within the city, was 4.3 metres square, and is one of the most unusual labyrinth mosaics known. Dating from the 2nd century CE, its design is quite unique, as it has a separate entrance and exit and a path leads in to the centre and back out again, via 22 concentric coils. When excavated, around a quarter of the design had been damaged, and despite some photographs of the mosaic taken at the time, the exact details of the design have always remained puzzling.



Two views of the labyrinth mosaic at Pula, Croatia, photographed in 1953.



The labyrinth itself is surrounded by a decorative border representing a city wall, complete with a gateway over the entrance and exit, and towers at the four corners and along the walls, with T-shaped parapets in between. The mosaic now lies buried beneath a city park, but the possibility remains that it may one day be re-excavated and placed on display. It is, without doubt, the most complex Roman labyrinth ever discovered.

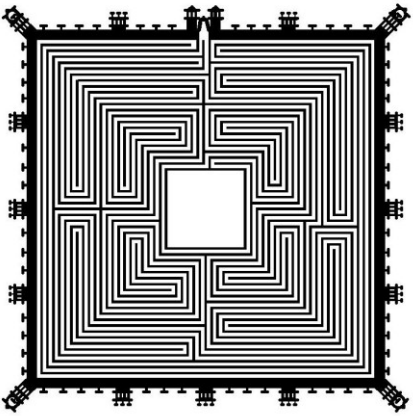
Another labyrinth mosaic was supposedly discovered at Pula in the late 19th century, although details of its design are currently unknown, and several other labyrinthine mosaics have been reported from Roman sites in Croatia, including several notable examples in the Euphrasian Basilica at Poreč, although the majority are formed from repetitive meander and swastika patterns, and are not true labyrinths as such.

However, despite the fact that the Roman labyrinths at Pula are no longer visible, there are certainly labyrinths to be seen in Croatia today! The island of Cres, off the Croatian coast, has many ancient churches, villages and monuments and is home to many rare species of animals, birds and plants. This is a place where ancient time is connected to a unique natural beauty. The northernmost part of the island, Tramuntana, is largely still covered in ancient forest, and in the town of Beli, on the west coast, is situated the Eco-centar Caput Insulae Beli, an environmental centre dedicated to preserving the local cultural heritage, flora and fauna, including the rare Griffon Vultures that breed on the island, and promoting sustainable tourism to this area.

From the Eco-centar, marked hiking trails lead out into the Tramuntana Forest, and during the last three years a total of seven labyrinths have been created in the forest, one alongside each trail, with rocks gathered from the surrounding areas, by the staff and volunteers from the centre. The labyrinths are of various designs and each is named after an old deity or spirit, in the hope that discovering and walking these labyrinths will reconnect the visitor to the Spirit of Nature.

Vesna's Labyrinth, Tramuntana Forest, Cres, Croatia, built June 2003, 27 m. diameter.

The most recent addition, Lada's Labyrinth, completed in June 2006, is a replica of the Pula mosaic labyrinth design, but created at ten times the original size, to make it suitable for walking. With dimensions of 43 x 43 metres, it covers an area of almost 2000 square metres, is formed from over 12,000 stones, and takes at least 45 minutes to walk from the entrance to the centre and back to the exit. Before building this (with help from over 100 volunteers!) we sought the advice of Jeff Saward to create a reconstruction of the original design of the Pula labyrinth, which had never been previously determined to a satisfactory degree, and this reconstruction was used for the layout.



Left: Reconstructed plan of the Pula labyrinth by Jeff Saward.

Below: Lada's Labyrinth, the official opening 24th June 2006.

Come and visit our labyrinths on the beautiful island of Cres, and return to yourself and to nature! Visit our website for further details - **www.caput-insulae.com**

The Labyrinth Society

Kimberly Lowelle Saward

The Labyrinth Society, affectionately known as TLS, was founded in 1998 to support all those who create, maintain, and use labyrinths and to serve the global community by providing education, networking, and opportunities to experience transformation. Though it is based in the USA, it is an international organization with members all over the world. Membership in the Society not only connects labyrinth enthusiasts to a worldwide community, but also supports the websites and other labyrinth projects that provide labyrinth information and resources to the world at large. As founding members of the society, Jeff and I have long believed that TLS is an excellent community for labyrinth enthusiasts the world over, and would recommend membership for anybody working with, or interested in labyrinths.

TLS stages an annual Gathering and Conference in the USA each autumn. These gatherings are an opportunity to meet with fellow enthusiasts from around the world and participate in a weekend of labyrinth-related presentations, workshops and activities. The 2006 Gathering was held just outside San Antonio, Texas and the 2007 event will be held in Missouri. Additionally, smaller regional events are held from time to time to support local enthusiasm and networking. In 2006, such events were held in Oregon and Indiana, and following the success of the events previously held at Glastonbury and Breamore in England, the same team currently has plans afoot for another event in England in 2008.

The ties between Labyrinthos and TLS are increasing. The TLS Board of Directors have voted to offer Caerdroia as a member benefit and have commissioned Labyrinthos to publish a new annual journal, focusing on the labyrinth from a perspective of Spirituality, Health, and Art. This new journal, tentatively titled *Labyrinth Pathways*, will make its debut in Spring 2007. Copies will be available from both Labyrinthos and The Labyrinth Society.

The Worldwide Labyrinth Locator Website, a joint project between TLS and Veriditas in San Francisco, provides information about labyrinths, new and old, around the world. While donations are encouraged to defray costs, the service is free to the public. This user-friendly database can be searched by anyone with access to the Internet, and allows individuals to upload information about their local labyrinths, both public and private. The locator now lists more than 2000 labyrinths, with more being added each week, and recent upgrades to the software have made it more searchable and useful than ever. It can be accessed through the websites of either organization: **www.labyrinthsociety.org** or **www.veriditas.net**

On online directory of labyrinth related products and services is due to be launched very soon, hopefully in time for holiday gift-giving. Other projects in the pipeline include an online information resource for those using labyrinths in schools and similar community settings, and the online discussion forum on the TLS website is a great place to ask your questions, seek advice and get involved. Visit the website **www.labyrinthsociety.org** for full information and details, or write to: The Labyrinth Society, PO Box 736, Trumansburg, NY 14886-0736, USA.

Kimberly Lowelle Saward Ph.D; TLS President

Labyrinth Reviews

Review copies of maze and labyrinth related books, publications and CD's, etc., are always welcome for inclusion in future editions of Caerdroia.

Praying the Labyrinth: A Pilgrim's Guidebook : by Jill Kimberly Hartwell Geoffrion. The Pilgrim Press: Cleveland, Ohio, 2006. ISBN 0-8298-1715-8. Paperback, 156 pages, colour photographs. USA $24.00, Canada $29.00.

Pilgrimage combines attention to one's inner journey with travel in the outer world; this is a guidebook for the inner journey. Based on the author's many visits to Chartres Cathedral, this book offers spiritual guidance that can apply to any pilgrimage. Beautifully illustrated, it brings the Chartres experience to life as it weaves the transcendent beauty of the cathedral with the deep experience of being human and seeking a spiritual path in a foreign land. Poetically succinct, the author poses questions to open the heart and direct the mind and suggests practices to enrich the connection to the cathedral and its labyrinth. This is a delicious book, one to be used and savored while on the journey and as a tool for unpacking the experience long after the pilgrim returns home and the suitcases are emptied. Do not be mislead into thinking that this book is only for pilgrims to Chartres Cathedral, however. Though it is set against that context, it would make a valuable companion for all spiritual pilgrims, no matter what their destination.

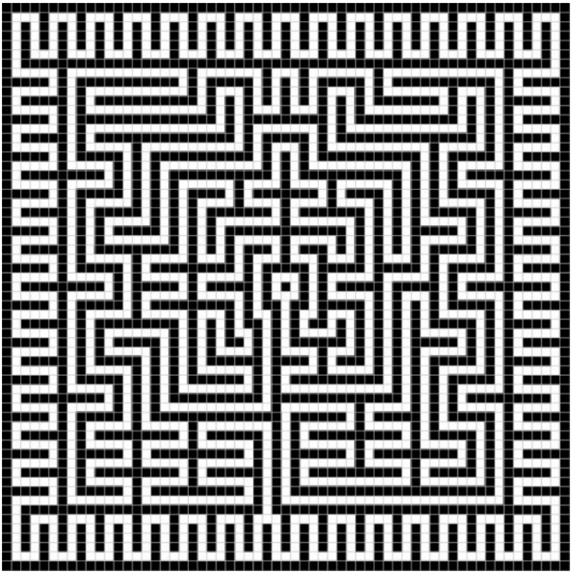
Make no mistake, this book will not lead you to the perfect hotel or tell you how to order a sandwich in French, but will prove to be an invaluable guide for traversing inner landscapes, flagging little signs and indications about how one's experience might be deepened or where distractions might occur. Its small size allows it to be tucked into a pocket or backpack for instant inspiration. I will be recommending this book to anyone traveling with Labyrinthos; it can help to transform ordinary travel into a pilgrimage. And for those of you who have traveled to Chartres in the past, this book may lead you to find new meaning in old memories.

Kimberly Lowelle Saward

Awestruck: A Skeptic's Pilgrimage : A memoir by Joan Weimer. Dog Ear Publishing: Indianapolis, Indiana, 2006. ISBN 1-59858-114-7. Paperback, 214 pages.

This very personal memoir is about far more than an experience of the labyrinth, though the labyrinth figures into the story both literally and metaphorically, thus warranting a review in this journal. For me, this was a story that articulately relates a transformational mid-life experience with clarity and insight. Other mid-life themes figured as prominently as the labyrinth, particularly those of encountering the Black Madonna and embarking on a pilgrimage in search of meaning and personal healing. I read every word, allowing the author's journey to shed light upon my own.

Kimberly Lowelle Saward



CAERDROIA

Caerdroia is an independent journal for the study of mazes & labyrinths

Established 1980
Published annually