WHY THE PENTAGRAM?

By Darklight

The pentagram is one of the most recognizable and most misunderstood symbols in use today. Many Christians associate the pentagram with Satanic practices. While the few actual Satanists that do exist may use the pentagram (usually in its inverted, point-down position), the vast majority of those who claim the pentagram as their own – that is, contemporary Witches and other Pagans – have nothing to do with Satanism, of course. But the lack of understanding by mainstream society is hardly helped by the fact that many Pagans do not understand the origins and meaning of their own symbol. This paper is written for modern day Pagan folk who would like to know more about the pentagram.

Why is the pentagram the most common pagan symbol? The quick answer is that it was used by the followers of Pythagoras, the Greek mathematician and mystic. It was seen as a perfect shape that embodied natural harmony that could be expressed mathematically. Since that time it has been used by students of the esoteric to convey natural perfection.[1]

"OK," you say. "By why did Pythagoras use it? What makes it such a perfect shape?" I'm glad you asked.

Before we get going, I need to warn you that there is some math involved. "What?!?" you say. "We're pagans. We're the poets, the artists, the mystics. We were in the drama club and the band, not the math club. (That was another flavor of geek entirely.) We don't need no stinkin' algebra." Well hold onto your pointy little hats. First off, math is a good thing. Second, I'm no math whiz, so I've made this as easy as possible, because if I didn't, I'd confuse myself. And third, you just might learn something. (For instance, I finally understand the quadratic formula. But more on that later.)

THE GOLDEN NUMBER

To understand the mathematical underpinnings of the pentagram, we need to understand Phi, Φ. Phi is an irrational number. Another example of an irrational number with which you are probably more familiar is Pi, π. Phi is the key to the pentagram.

Phi, Φ, is called the Golden Number, or the Golden Section, or Golden Ratio, or even the Divine number, and is seen in all sorts of unusual places – art, architecture, geometric forms like the pentagram, and most interestingly, in natural occurrences. More on that later. But first, some math….

Phi is defined as a number that when squared is equal to that number + 1.

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[1] Interestingly, the pentagram has also been used by Christians as a symbol of the wounds of Jesus, but this practice has been abandoned and forgotten, apparently. Moreover, the cross and the fish, other Christian Symbols, also have Pagan origins.

That is,

$$\mathbf{\Phi^2 = \Phi + 1}$$

To give you a quick preview, and to put it in terms of an actual number that you can think about a bit, I'll tell you that it is demonstrated below that

Phi, Φ = 1.618 or -0.618

Actually, these are only approximations. 1.618034 is closer to it. But actually you can carry out the numbers to the right of the decimal place forever. It will never repeat or terminate.

We will also be dealing with a closely related number which we will call φ, which is lower-case Φ.

$$\varphi = \mathbf{1}/\varphi - 1$$

Below it is demonstrated that

φ = **0.618 or -1.681.**

Note also that these numbers are the inverse of one another.

$$\mathbf{1}/\varphi = \Phi$$
$$\mathbf{1}/\Phi = \varphi$$

And just for kicks,

$$\mathbf{\Phi = \Phi / \varphi - 1}$$

Throughout this discussion we will be considering the importance of Φ and φ as lengths of measure. While -1.618 and -0.618 have some interesting mathematical properties, we can't have negative lengths. So, we will be concerned with φ, 0.618 and Φ, 1.618.

After showing how these numbers are derived, we will show how the pentagram can be constructed from them, and then, more importantly, show how these numbers pop up all through the natural world.

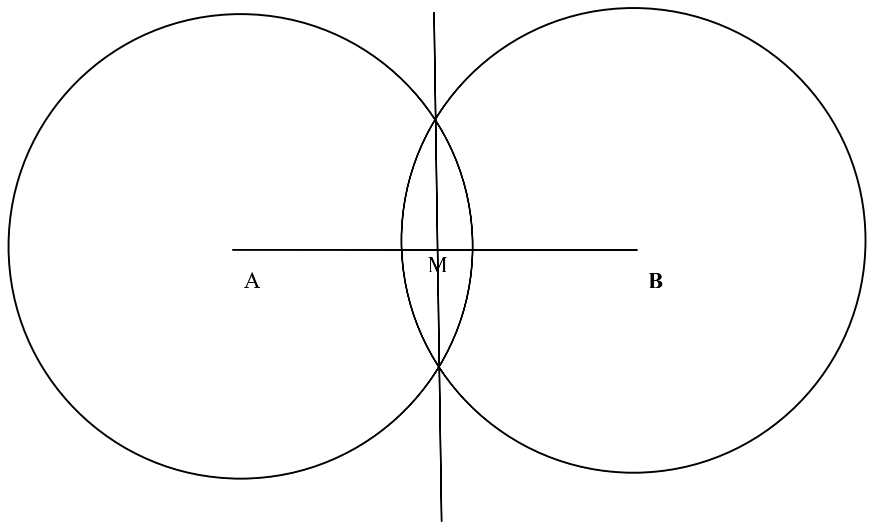
Finding Φ

Constructing Φ geometrically

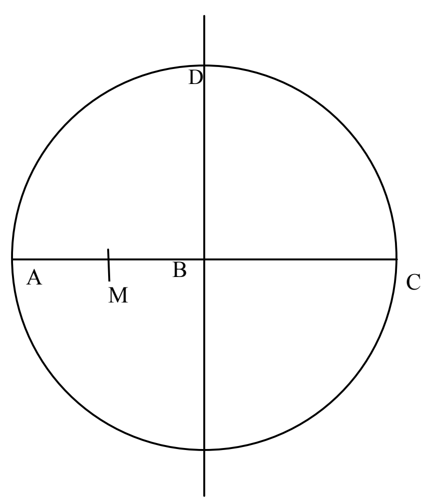
Suppose we have a line segment AB that has a length of 1. We want to extend AB to point G so that segment AG has a length of Φ, 1.618034….

Using only a compass and a straight edge we can create AG from AB so that it has a length of 1.618.

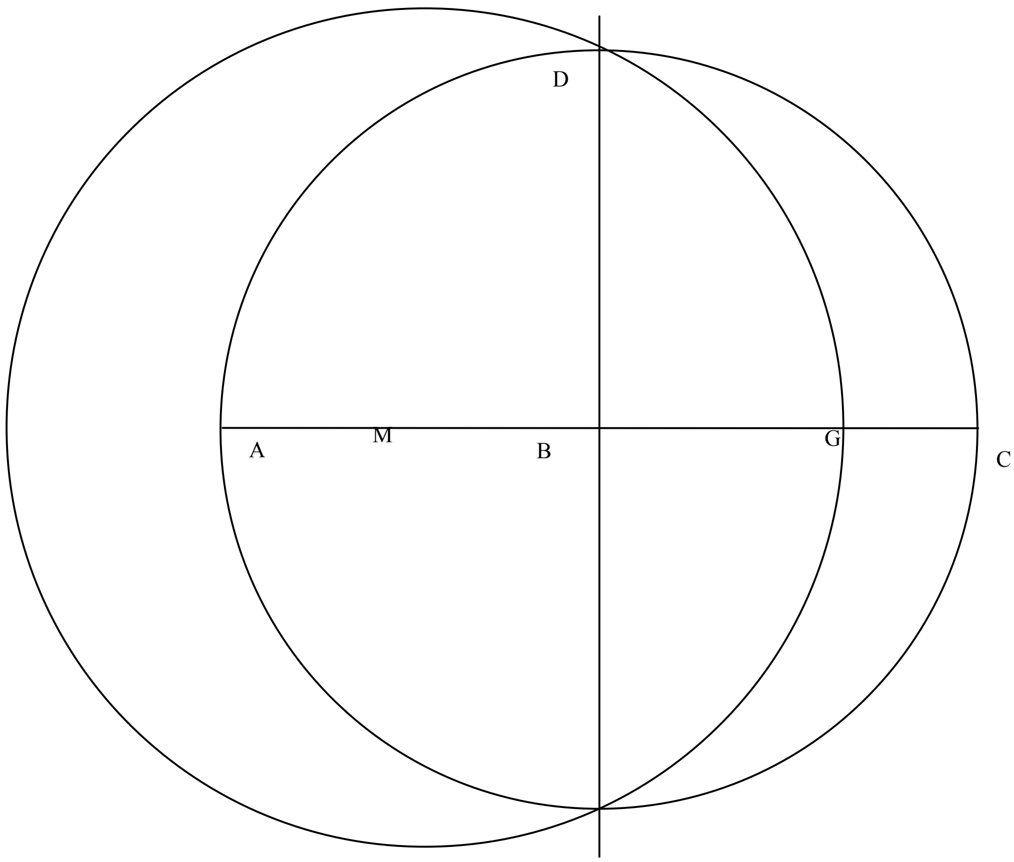
First we bisect AB. To do this you use your compass. Open the compass so that it is about 2/3 the length of AB. Put the point of the compass on A and scribe a circle. Then put the compass point on B and do the same thing. Then draw a line between the two points where the circles intersect. You'll have divided AB perfectly in half. We'll call this midpoint "M."



Once you've found M you need to create a line perpendicular to AB through B. To do this simply extend AB using your straight edge so that your new line is a little over twice as long as AB judging by your eye. Then place your compass point on B and the other end on A. Draw the circle with B at the center and A at the edge. At the place where this circle crosses your newly-extended line, which we'll call point C, you now have a segment that is twice as long as AB. Point B is the midpoint of AC. Simply bisect AC as we did AB above. Note that AB = BD, and BD is perpendicular to AB.



Finally, place your compass point on M and scribe a circle through D. The point where this circle crosses AC is G, the Golden point. AG will be Φ times as long as AB. If AB is 1, then AG is 1.618034, Φ.



Proving Φ algebraically

OK, its one thing to draw a picture. But how does that prove that G is at Phi? Once we draw the pictures we need to do the math to prove it.

We said AB was 1. BD was equal to AB. M is the midpoint of AB, so MB is ½. Using the Pythagorean theorem, $x^2 + y^2 = z^2$, we can find the length of MD.

$$\mathbf{½^2 + 1^2 = z^2}$$

$z = (1.25)^{1/2} = 1.118034$.

(Recall that raising something to the ½ is the same as taking the square root of it.) So MD = 1.118034. MG = MD. AB = 1. M is the midpoint of AB, so AM is ½. AM + MG = AG = 1.118034 + .5 = 1.618034 = Φ.

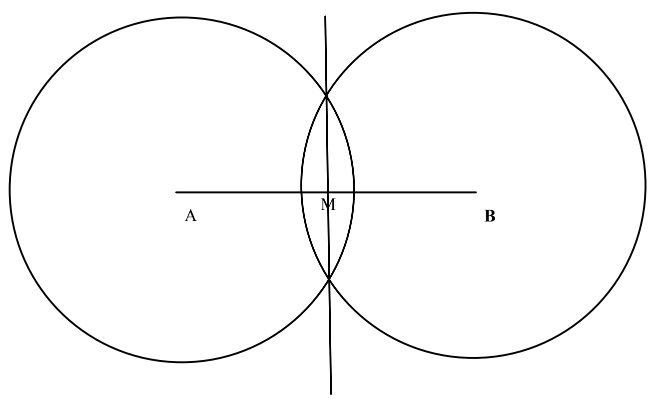
See, that wasn't so bad. Now on to φ.

Finding φ

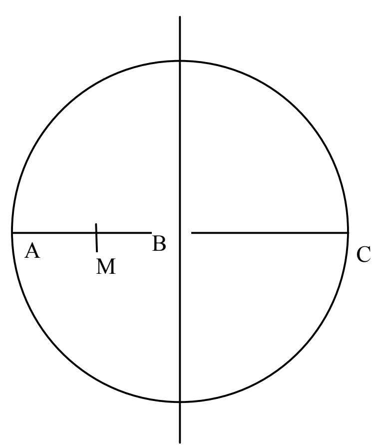
Constructing φ geometrically

Suppose we have a line segment AB that has a length of 1. We want to divide AB at point G so that segment AG has a length of φ, 0.618034….

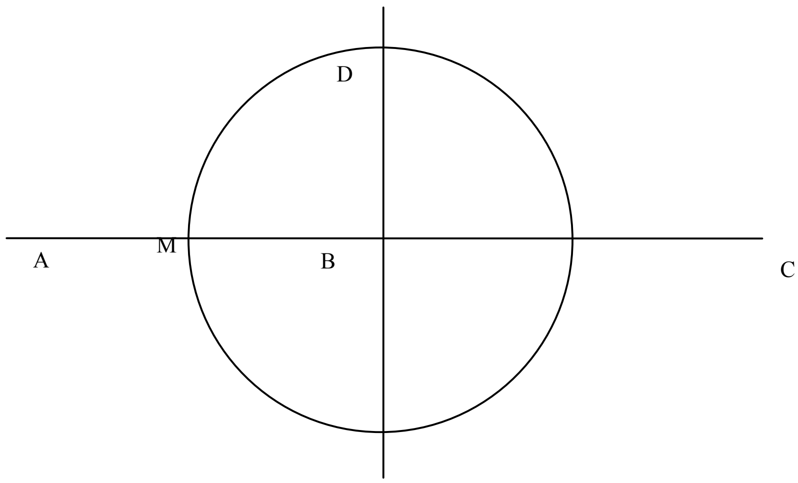
First we bisect AB as we did above. M is once again the midpoint.



Once you've found M you need to create a line perpendicular to AB through B, again, as we did above.

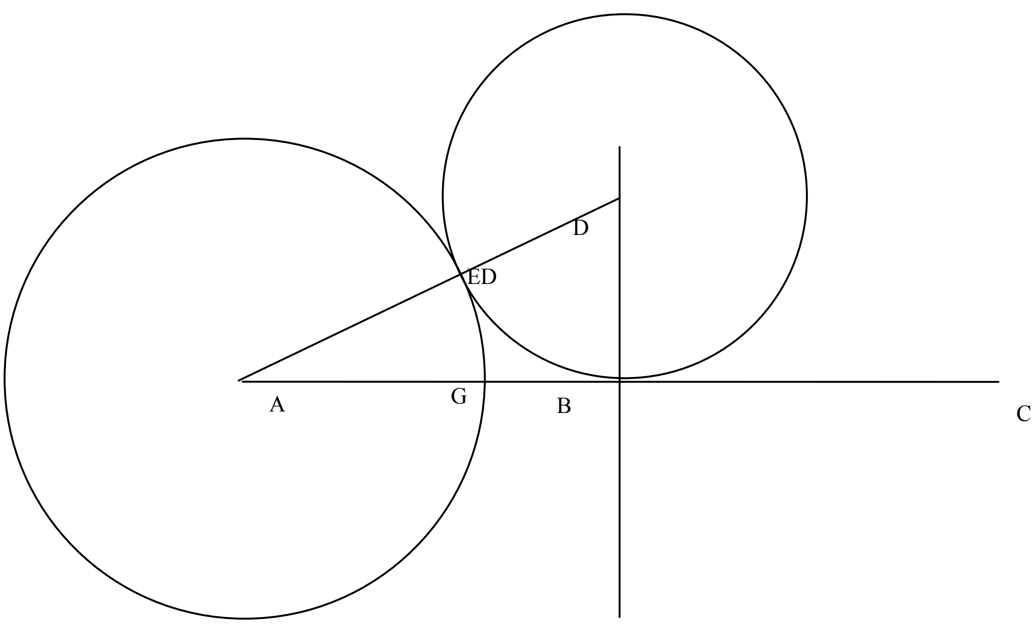


Now place your compass point on B and scribe a circle through M. The resulting segment BD will be the same length as BM. It is half the length of AB and at a right angle to it. So far this is pretty close to what we did to find Φ.



Here's the new stuff…

Using the straight edge, create segment AD. Put your compass point on D and scribe a circle with B at the edge. Point E is where this circle crosses AD. Put your compass on A and scribe a circle through E. Where this circle intersects AB is G. And G is what we've been waiting for. G is the Golden Point! Point G is 0.618 of the way along AB. AG is φ.



Proving φ algebraically

Again, we need to prove that G is at φ.

AG is φ and AB is 1. We stated above that

φ = 1/φ – 1

If AG is in fact at φ then it will be true that

AG = 1 / AG – 1,

Or for clarity's sake, we'll call AG "x". Hence

$$x = 1 / x - 1$$

Or to make it more clear, in case you've forgotten the order of operations …

$$x = (1/x) - 1$$

Adding 1 to both sides…

$$x + 1 = 1/x$$

Multiplying each side by x…

$$x^2 + x = 1$$

And subtracting 1 from each side…

$$x^2 + x - 1 = 0$$

This is a quadratic equation, which has the general form

$$ax^2 + bx + c = 0$$

A Word on Quadratic Equations

Now at this point most people are shaking with the thought of quadratic equations and formulas, and bad memories of some high school math class, and nuns with rulers. (Well, maybe not the last bit. But that's my memory and I'm sticking with it.) However, it is really much easier than it seems.

Suppose you have a formula in the form of $ax^2 + bx + c = 0$. What you are trying to do, in general, is find some constant that you can add to each side of the equation to make each side a *perfect square*. (Hence the quad in quadratic – you're making it square.) Once you have made each side square you can easily take the square root of each side and solve the equation.

But looking at the equation and knowing what that constant is is darn near impossible most of the time. Fortunately, there is an easy way to find it. Enter the quadratic formula .

The quadratic formula is

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Remember that? Now you know what its for: learning about pagan symbols. No, the nun with the ruler would not be pleased.

Anyway, we've found that

$$\mathbf{x^2 + x - 1 = 0}$$

And that's a quadratic equation. In this case…

a = 1
b = 1
c = -1

So plugging these into the quadratic formula…

$$x = \frac{-1 \pm \sqrt{1^2 - (4 \cdot 1 \cdot -1)}}{2 \cdot 1}$$

$$x = \frac{-1 \pm \sqrt{5}}{2}$$

x = -1.618 or 0.618

Tada! While it has some interesting mathematical properties, we don't worry about negative lengths in art, architecture, etc., as was stated above. So, $\varphi = 0.618$. If you're really interested, you can also go back and prove that Φ is 1.618 using the quadratic formula.

An alternative algebraic solution

Another property of φ is that if G is φ along AB, then the ratio of the short section, GB, to the long section, AG, is the same as the ratio of the long section, AG, to the whole darn thing, AB. In other words,

GB / AG = AG / AB

Or…

$$(1-x) / x = x / 1$$

$$1-x = x^2$$

$$x^2 + x - 1 = 0$$

and solve with the quadratic formula as above to find φ = 0.618.

And yet another alternative algebraic solution

If AB is 1 then BD is ½. We can find AD with the Pythagorean theorem, $x^2 + y^2 = z^2$.

$$1^2 + ½^2 = z^2$$

$$z = (1.25)^{½}$$

$$z = 1.118034…$$

DE is the same length as DB, which is ½, so AE = 1.118034 – .5 = 0.618034, and AE is equal to AG.

Other Ways of Finding Φ

As was noted at the outset, Φ has the strangest way of popping up all over the place. Here're a few more ways we can get to Φ. (And then I promise, we'll be on to pentagrams and the like.) Using a spreadsheet, you can try these calculations for yourself really easily.

Invert and add 1

Start with x. Take the inverse of x (that is 1/ x) and then add 1. The result will be y. Then take the inverse of y and add 1. Repeat infinitely….

Or more realistically, start with 1. Divide 1 by 1 and add 1. You get 2. Divide 1 by 2 and add 1. You get 1.5. Repeat. Here's what the series looks like…

1
2
1.5
1.666666667
1.6
1.625
1.615384615
1.619047619
1.617647059
1.618181818
1.617977528
1.618055556
1.618025751
1.618037135
1.618032787
1.618034448
1.618033813
1.618034056

The more times you repeat this operation, the closer you get to Φ. Or, as actual mathematicians might say, the function approaches Φ in the limit.

Add 1, take the square root

Similarly you can start with 1 (or any number), add 1, and take the square root. This series is

1
1.414213562
1.553773974
1.598053182
1.611847754
1.616121207
1.617442799
1.617851291
1.617977531
1.618016542
1.618028597
1.618032323
1.618033474
1.61803383
1.61803394

1.618033974
1.618033984
1.618033987
1.618033988
1.618033989

Again we are approaching Φ in the limit.

The Fibonacci series

The Fibonacci series is created by starting with 1. The next number in the series is the sum of the two numbers before it in the series. The number before 1 is 0, so the next number in the Fibonacci series is also 1. The series looks like …

0	
1	
1	(1+ 0)
2	(1+ 1)
3	(2 + 1)
5	(2 + 3)
8	(3 + 5)
13	(5 + 8)
21	(8 + 13)
34	(etc….)
55	
89	
144	
233	
377	
610	
987	

If we look at the ratios of successive Fibonacci numbers (2 to 1, then 3 to 2, then 5 to 3, etc.) we find that we approach Φ.

1	(1 to 1)
2	(2 to 1)
1.5	(3 to 2)
1.666666667	(5 to 3)
1.6	(8 to 5)
1.625	(13 to 8)
1.615384615	(etc.)
1.619047619	
1.617647059	
1.618181818	

1.617977528
1.618055556
1.618025751
1.618037135
1.618032787
1.618034448

Again we are approaching Φ in the limit.

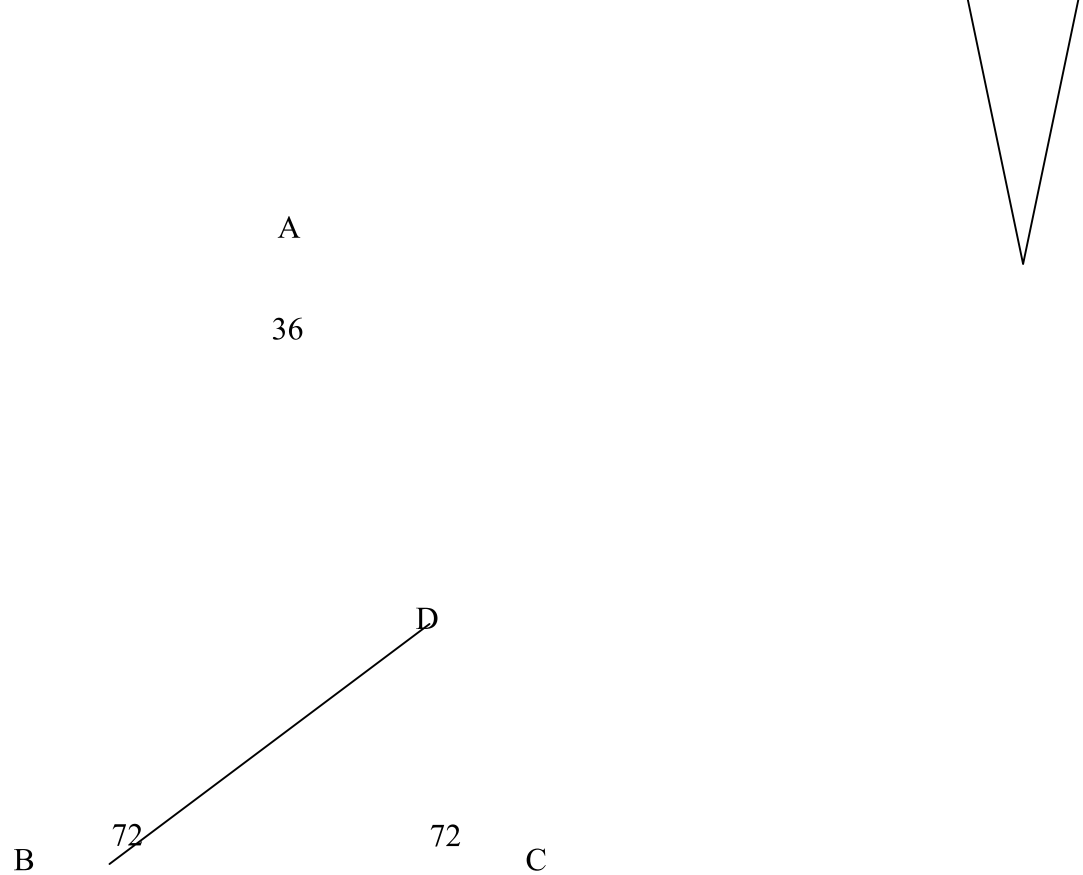
OK, I PROMISED WE'D GET TO THE PENTAGRAM …

I thought you'd be glad to hear that. Also, I'll forego proving everything algebraically and just get on with the more interesting demonstrations.

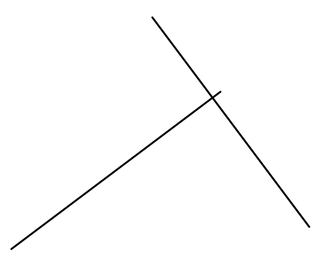
As stated at the outset, pentagrams are considered to be a perfect, harmonious shape. One reason that pentagrams are considered to be so lovely is that you can draw them without lifting your pencil; that is, they are "unicursal." Another is that they are constructed with Φ and φ.

Suppose you have an isosceles triangle with a 36° angle at the top, and 72° angles at the bottom. Angle B can be bisected with a compass (though I won't go into how to do this) into two 36° angles. The resulting line BD crosses AC such that AC is divided by D at φ, and AC is Φ times as long as AD.

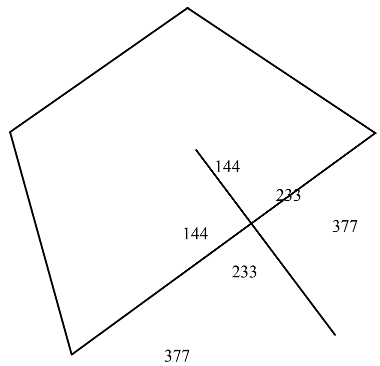
Moreover, if line AB has a length of 1, BC and BD will have lengths of φ. Alternately, if BD and BC have a length of 1, then AB and AC have lengths of Φ.



It doesn’t take too much imagination to see how the figure above is turned into a pentagram. Below I simply take the figure above, copy it, rotate it, and overlay it on the original.



If you kept doing this you'd end up with



It's easy to see how many of these segments are now proportional to Φ and φ. We've also seen how we can derive Φ from the Fibonacci sequence. Because of this, the proportions of the lengths of the segments that make up the pentagram are equal to consecutive Fibonacci numbers. Here it is illustrated with 144, 233, and 377. The farther along you are in the Fibonacci series, the more precise your measurements will be.

And there's no reason to limit ourselves to just 2 dimensions. Here's what Pythagoras did, as drawn by Da Vinci

A truncated icosahedron (Source: http://members.telocity.com/stephenssmith/UCSC/papers/Paper.html)

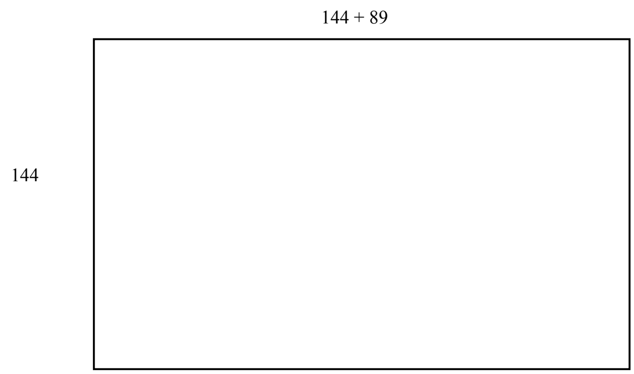
The Fibonacci or Golden Rectangle

In addition to pentagrams, we can also construct rectangles with Φ built in. It is really easy to see this by using the related Fibonacci numbers.

We can construct a rectangle such that the ratio of the long side to the short side is Φ.

Long / Short = 1.618034…

This is known as the Golden Rectangle. One way to do this is to have the long side as Φ and the short side as 1. Another possibility is if the short side has a length of a Fibonacci number, the long side has a length of that Fibonacci number plus the preceding Fibonacci number…



The Root-5 Rectangle

The Root-5 rectangle is a related figure. Remember above from our solution to the quadratic equation we said that

$$x = \frac{-1 \pm \sqrt{5}}{2}$$

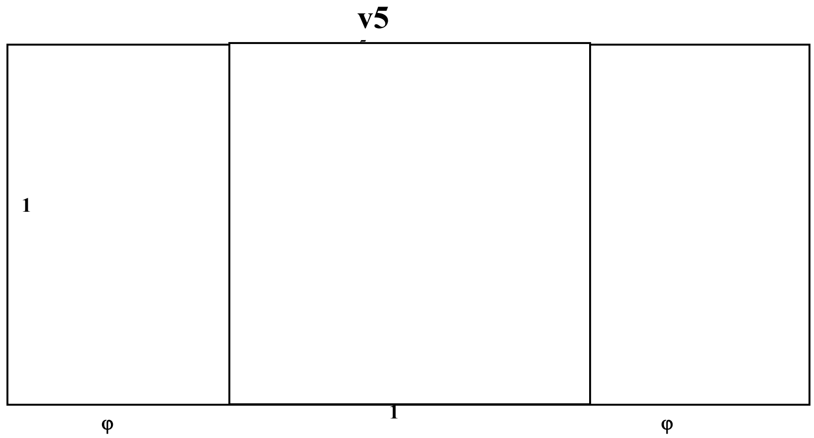
and solved to find that x = φ = 0.618. Another way of writing this is would be

$$2\varphi + 1 = \sqrt{5}$$

or

$$\varphi + 1 + \varphi = \sqrt{5}$$

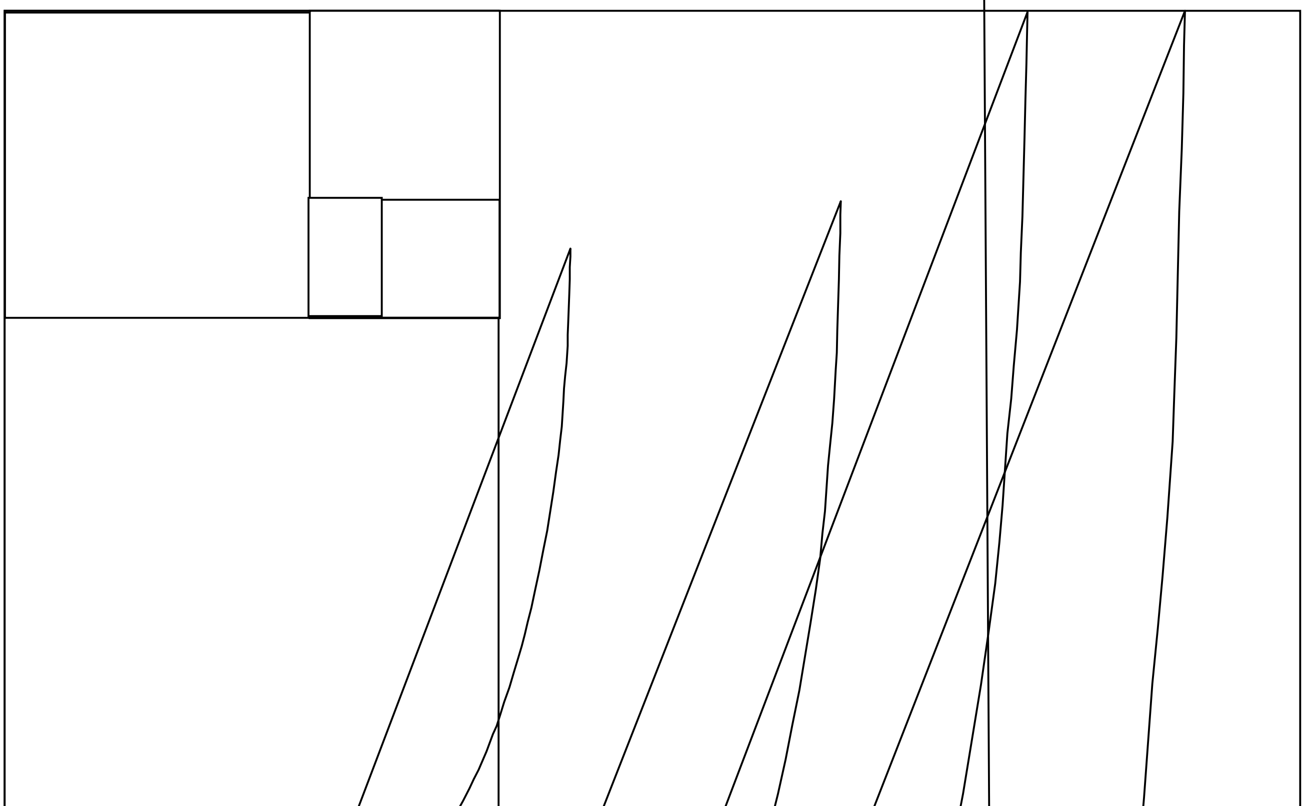
Create a rectangle with the short having a length of 1 and the long side having a length of v5. Then create a 1 x 1 square within the rectangle…



The resulting rectangles formed on the right and left of the square are Golden rectangles**.**

The Fibonacci Spiral

Finally, by placing Golden Rectangles within one another and connecting the corners with arcs, we can construct a Golden or Fibonacci Spiral…



- That bisecting the base angle of a 36-72-72 isosceles triangle will divide the triangle's leg at φ
- That the pentagram can be constructed from such triangles, or alternatively, from segments that are of the length of successive Fibonacci numbers

- That Golden Rectangles can be constructed from Φ and φ or Fibonacci numbers
- That Root-5 Rectangles, which are based on φ, contain a square and two Golden Rectangles
- That Golden or Fibonacci spirals can be constructed from Golden Rectangels

"BUT SO WHAT?!?" YOU SCREAM…

Great. But where has any of this gotten us? Are these just elaborate geometric tricks? How does this prove that pentagrams have some sort of harmony with the natural world?
This is where it gets cool.

IT'S A Φ WORLD AFTER ALL…

Natural Occurrences of Φ [2]

The mind blowing part of this exercise is the way in which Phi pops up all over the place in the natural world! The basis of the pentagram is apparently built into the structure of the universe itself. Conversely, the pentagram is a model of the universe itself.[3] It truly is a microcosm. As above, so below.

Let's look at *some* of the places we find Phi. (There are many more that I'm leaving out, mind you.)

The Plant Kingdom

Seed Heads (Source: James Wilson, University of Georgia. http://jwilson.coe.uga.edu)

¡°Logarithmic Spirals can also be seen in the arrangement of seeds on flowerheads. Here is a diagram of what a large sunflower or daisy might look if magnified. The centre is marked with a black dot.

¡°You can see that the seeds seem to form spirals curving both to the left and to the right. If you count those spiralling to the right at the edge of the picture, there are 34. How many are spiralling the other way? You will see that these two numbers are neighbours in the Fibonacci series.

¡°The same happens in real seed heads in nature. The reason seems to be that this forms an optimal packing of the seeds so that, no matter how large the seedhead, they are uniformly packed, all the seeds being the same size, no crowding in the centre and not too sparse at the edges. If you count the spirals near the centre, in both directions, they will both be Fibonacci numbers. The spirals are patterns that the eye sees, "curvier" spirals appearing near the centre, flatter spirals (and more of them)appearing the farther out we go.¡±

Coneflower

Picture Source: Tim Stone
(http://www.mcs.surrey.ac.uk/Personal/R.Knott/Fibonacci/fibnat.html)

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[2] At this point I'm going to illustrate the point using other people's work. I've culled these from cool web sites on mathematics. I can't really provide proper documentation, but I will provide links to the sites where I get them. Of course these are subject to change. Sue me.

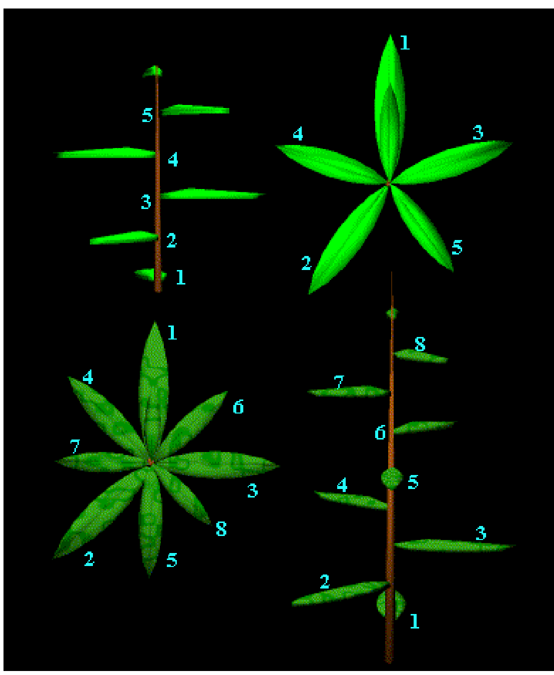
[3] Or at least some really amazing parts of it. I'm not claiming that Φ explains everything. Just that it is amazingly prevalent in the natural world, and the basis of the pentagram.

Flower Petals: (Source: R. Knott,
http://www.mcs.surrey.ac.uk/Personal/R.Knott/Fibonacci/fibnat.html)

"On many plants, the number of petals is a Fibonacci number: buttercups have 5 petals; lilies and iris have 3 petals; some delphiniums have 8; corn marigolds have 13 petals; some asters have 21 whereas daisies can be found with 34, 55 or even 89 petals.

3 petals: lily, iris
Often lilies have 6 petals formed from two sets of 3.
5 petals: buttercup, wild rose, larkspur, columbine (aquilegia)
The humble buttercup has been bred into a multi-petalled form.
8 petals: delphiniums
13 petals: ragwort, corn marigold, cineraria,
21 petals: aster, black-eyed susan, chicory
34 petals: plantain, pyrethrum
55, 89 petals: michaelmas daisies, the asteraceae family

Leaf arrangements: (Source: R. Knott)



"[M]any plants show the Fibonacci numbers in the arrangements of the leaves around their stems. If we look down on a plant, the leaves are often arranged so that leaves above do not hide leaves below. This means that each gets a good share of the sunlight and catches the most rain to channel down to the roots as it runs down the leaf to the stem….

"The Fibonacci numbers occur when counting both the number of times we go around the stem, going from leaf to leaf, as well as counting the leaves we meet until we encounter a leaf directly above the starting one.

"If we count in the other direction, we get a different number of turns for the same number of leaves.

"The number of turns in each direction and the number of leaves met are **three consecutive Fibonacci numbers**!

"For example, in the top plant in the picture above, we have **3** clockwise rotations before we meet a leaf directly above the first, passing **5** leaves on the way. If we go anti-clockwise, we need only **2** turns. Notice that 2, 3 and 5 are consecutive Fibonacci numbers.

"For the lower plant in the picture, we have **5** clockwise rotations passing **8** leaves, or just **3** rotations in the anti-clockwise direction. This time 3, 5 and 8 are consecutive numbers in the Fibonacci sequence.

”We can write this as, for the top plant, **3/5 clockwise rotations per leaf** (or 2/5 for the anticlockwise direction). For the second plant it is **5/8 of a turn per leaf** (or 3/8).

“The above are computer-generated "plants", but you can see the same thing on real plants. One estimate is that 90 percent of all plants exhibit this pattern of leaves involving the Fibonacci numbers.

“Some common trees with their Fibonacci leaf arrangement numbers are:

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1/2 elm, linden, lime, grasses
1/3 beech, hazel, grasses, blackberry
2/5 oak, cherry, apple, holly, plum, common groundsel
3/8 poplar, rose, pear, willow
5/13 pussy willow, almond
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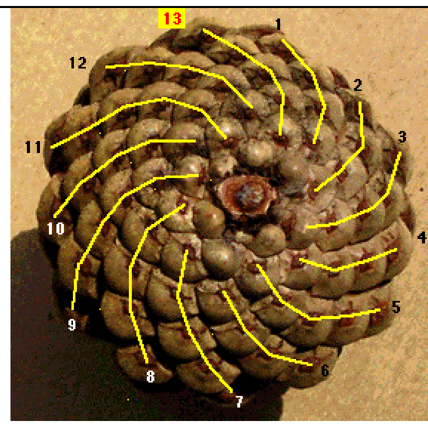
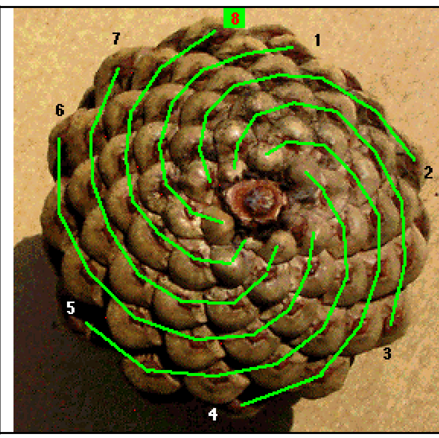
where t/n means each leaf is t/n of a turn after the last leaf or that there is there are t turns for n leaves.

Pine Cones (Source: R. Knott)





Three pictures of the same pine cone. Notice the spiral form as well as the Fibonacci number of spirals (8 and 13) on this single cone.

Four views of another pine cone

“Cactus's spines often show the same spirals as we have already seen on pine cones, petals and leaf arrangements, but they are much more clearly visible.

Some final thoughts about the plant world and Fibonacci numbers: (Source: R. Knott)

“[N]ote that, although the Fibonacci numbers and golden section seem to appear in many situations in nature, they are not the only such numbers. H S M Coxeter, in his **Introduction to Geometry** (1961, Wiley, page 172) - see the references at the foot of this page - has the following important quote:

> *it should be frankly admitted that in some plants the numbers do not belong to the sequence of f's [Fibonacci numbers] but to the sequence of g's [Lucas numbers] or even to the still more anomalous sequences*
>
> *3,1,4,5,9,... or 5,2,7,9,16,...*
>
> *Thus we must face the fact that phyllotaxis is really not a universal **law** but only a fascinatingly prevalent **tendency**.*

“He cites A H Church's **The relation of phyllotaxis to mechanical laws**, Williams and Norgate, London, 1904, plates XXV and IX as examples of the Lucas and the latter two sequences and plates V, VII, XIII and VI as examples of the Fibonacci numbers on sunflowers.

“The Lucas numbers are formed in the same way as the Fibonacci numbers - by adding the latest two to get the next, but instead of starting at 0 and 1 [Fibonacci numbers] they start with 2 and 1 [the Lucas numbers]. The other two sequences he states above have other pairs of starting values but then proceed with the same rule as the Fibonacci numbers.

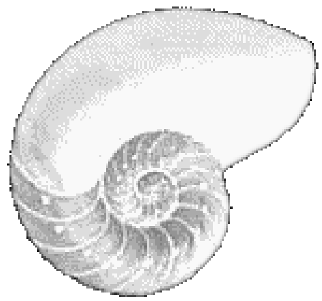
"An interesting fact is that, for ALL series that are formed from adding the latest two numbers to get the next, and, starting from ANY two values (bigger than zero), the ratio of successive terms will ALWAYS tend to Phi!

"So Phi is a more universal constant than the Fibonacci series itself." (emphasis added)

The Animal Kingdom

Shells (Source: James Wilson, University of Georgia. http://jwilson.coe.uga.edu)

The most obvious place we see the Fibonacci spiral is in the shell of the chambered nautilus.



Human Embryo (Source: James Wilson, University of Georgia. http://jwilson.coe.uga.edu)

¡°This is the hardest example of the Equiangular (Logarithmic Spiral) in nature to visualize. If you'll look at the spine, you will see somewhat of a spiral. While this is not exact, it does have a close relationship to the Golden Spiral.

¡°Why does it appear?

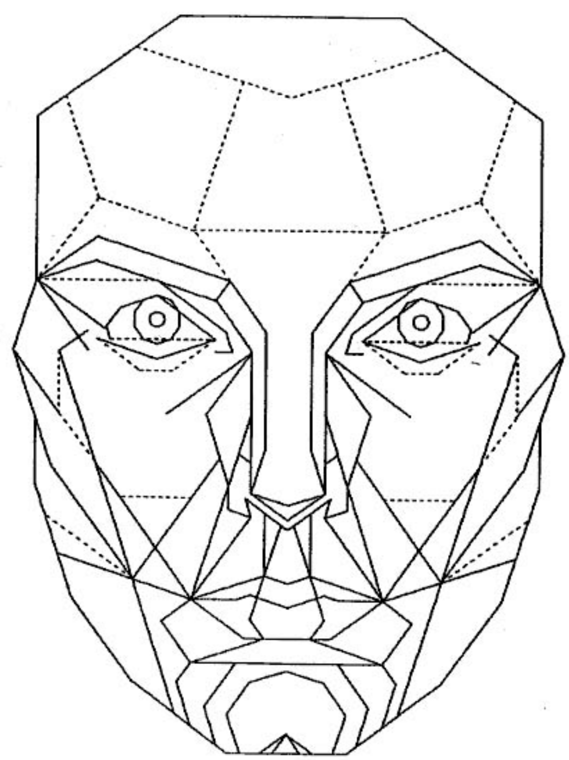
¡°The spine lays the foundation for the shape of the rest of the body. Because the spine is designed as a Golden Spiral, it allows for the fetus to take up the least amount of space in comparison to its size. If this were not so, and the embryo were too big, the mother would have much more trouble staying active. This would not be healthy for the mother or her child.

The Human Face: Is beauty in the eye of the beholder?

Phi doesn't disappear from the embryo once it grows up. In fact, we are full of examples of Phi. I recently saw a program on The Learning Channel that had been produced with the BBC. I was so fascinated that I started researching the subject in depth. This paper is the result. You can learn more at http://www.bbc.co.uk/science/humanbody/humanface/beauty_golden_mean.shtml.

The program was about a plastic surgeon, Dr. Stephen Marquardt, who helps accident victims and people with facial malformations. He was bothered that in some cases he would fix what was mechanically wrong with someone's face (most often in the jaw and nose area), but they actually *looked worse* after surgery. He wanted to derive some objective measures so he could plan the facial reconstruction better.

He found several important things. First, symmetric faces look better than asymmetric faces. Second, faces that are proportional to Φ look better. Third, people – including babies -- of all cultures will rate symmetric, Φ-proportional faces as more beautiful than asymmetric disproportional faces. It seems that there *is* some universal standard of beauty. (Which raises all sorts of interesting questions on Plato's forms and Jung's archetypes.)
Based on his findings, Dr. Marquardt constructed this mask of a symmetric, Φ-proportional face.



This mask is copyright to Dr. Stephen Marquardt
It is available for personal use only and is not to be
used for any commercial purpose

The lines that make up this mask are all based on 1, Φ, and φ. It can then be laid over a photograph of a face. The more closely the face matches the mask, the higher people rank it relative to faces that don't match the mask. Racial type is irrelevant.

Moreover, historical era doesn't seem to matter. Based on classical sculpture and painting, our forebearers seem to have found the same types of faces beautiful.

		Queen Nefertiti of Egypt, (1400 BCE) Whether or not Nefertiti really looked like this is irrelevant. Political leaders are often made to look better than they do in real life. The important thing is that they thought it would be good if she looked like this.
		(1505 A.D.) Raphael, The Small Cowper, Madonna
		Marilyn Monroe, 1957

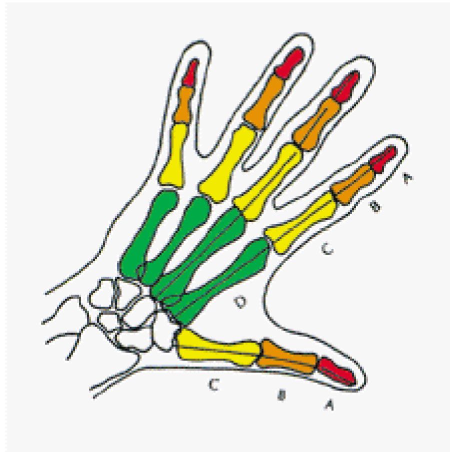
Sorry for the male bias here. Dr. Marquardt's site doesn't have any male faces, though the principal is the same.

Paula Zahn and Golden Rectangles…

Dr. Marquartd's web site is http://www.beautyanalysis.com/index2_mba.htm.

Other Anatomical Bits…

Hands… (Source: http://www.sacredgeometry.com/golden%20ratio%20i.htm)



"The length of the bone segments in the fingers of our hands can be measured in this way. Consider the length of the first segment of any finger as the standard measurement for that finger. The length of the second segment will measure a close approximation of 1.618 times longer than that. The third segment will closely approximate 1.618 times longer than the second, and the fourth segment 1.618 times longer than the third

"The bones of the entire human anatomy relate with one another according to the golden ratio, although in a more complex manner than in the hand. Not only the human form, but all creatures and natural forms can be measured in terms relating to the golden ratio."

Teeth: (Souce: http://www.beautyanalysis.com/mba_image01_page.htm)

Other Animals

The dolphin is broken into segments of 1, Φ, and φ.

(Source: http://www.beautyanalysis.com/mba_dolphin_page.htm)

Φ in Art and Design

(Source: http://members.telocity.com/stephenssmith/UCSC/papers/Paper.html)

Leonardo da Vinci pursued these themes throughout his life as an artist and inventor. Many of his mechanical designs reflect the Golden Ratio. Below is Leonardo da Vinci's *Aerial Screw*- his version of the helicopter, where the Fibonacci Spiral is incorporated as well.

It is difficult to find a painting or illustration by Leonardo da Vinci that does not have the proportions of the Golden Ratio, or the numbers of the Fibonacci series incorporated in some way. For the purpose of this paper, I will focus on *The Vitruvian Man*.

The Vitruvian Man (Source:
http://members.telocity.com/stephenssmith/UCSC/papers/Paper.html)

"The Vitruvian Man is the work that Leonardo da Vinci used to explore several mathematic concepts, including Divine Proportion, and a concept known as the Quadrature of the Circle. Many analyses have been made, applying different geometric representations of the Golden Ratio and the Fibonacci numbers to the Vitruvian Man. We will deal with a few of these cases first.

"The most common representation of the Golden Ratio in Renaissance art is through the Golden Rectangle. The Golden Rectangle is constructed with sides in the ratio 1:1.618. These shapes are said to be the most pleasing rectangles, and can be seen everywhere in Renaissance art and architecture. Leonardo, believing that the human form followed these proportions, designed the Vitruvian Man to reflect this. Divide the rectangle that inscribes the man at his navel, and you have a Golden Rectangle.

"In the figure on the next page, lines have been drawn on the right side of the page that correspond to important places in the Vitruvian Man. In order to see where the lengths are taken from, draw a horizontal line into the sketch.

"In the above illustration, the line segments in the painting have been labeled A-E. By analyzing their ratios, we find that they are in fact golden.

D: E = E: B = B: C = C: A = Φ = 1:1.618…

"Leonardo was trying to analyze the geometric layout of the perfect human body by comparing the ratios of different body parts in action and at rest. Since perfect occurrences in nature of flowers, pinecones, rock formations, shells, etc followed these patterns; perhaps God's idea of the perfect human body would as well? The rectangles in the above figure is another way to compare lengths that also results in the Golden Ratio. "

Man on Pentagram: (Source:
http://www.angelfire.com/id/robpurvis/pentagram.html#NUMBER5)

Other Possibilities:

"Our reality is very structured, and indeed Life is even more structured. This is reflected though Nature in form of geometry. Geometry is the very basis of our reality, and hence we live in a coherent world governed by unseen laws. These are always manifested in the natural world. The **Golden Mean** governs the proportion of our world and it can be found even in the most seemingly proportion-less living forms.

Clear examples of geometry (and Golden Mean geometry) in Nature and matter:

- All types of crystals, natural and cultured.
- The hexagonal geometry of snowflakes.
- Creatures exhibiting logarithmic spiral patterns: e.g. snails and various shell fish.
- Birds and flying insects, exhibiting clear Golden Mean proportions in bodies & wings.
- The way in which lightning forms branches.
- The way in which rivers branch.
- The geometric molecular and atomic patterns that all solid metals exhibit.

Another, less obvious, example of this special ratio can be found in Deoxyribonucleic Acid (DNA) - the foundation and guiding mechanism of all living organisms:

***The geometry of DNA** - source: Dan Winter*

The Universe (Source: James Wilson

"Look at the beauty of this galaxy and see the equiangular spirals clearly! (At this point I am shocked and this much example is enough to believe)"

CONCLUSIONS

The problem is not where to look for Φ, but where to stop. It can drive you a bit mad. The point is, the pentagram's structure is not just nifty, but it is based on some fundamental organizing principles of the universe.

Blessed Be…