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The Extinction of π

by Miles Mathis
mileswmathis@yahoo.com

bye-bye π

In a previous paper, http://milesmathis.com/pi.html, I have shown that π is really an acceleration. In that paper I showed that the corrected equation $a = v^2/2r$ is analogous to the equation $C = 2\pi r$ or $\pi = C/2r$. This allowed me to discover many interesting things not commonly known. In this paper I will show that if we define π as the relationship between the diameter and the circumference, the correct value of π is 4.00. In other words, the current numerical value of π is nothing more than a mathematical error: it is the standard margin of error, caused by a fabulously false postulate.

The Pythagoreans had some inkling of this. They were never happy about the irrational number π , just above the number 3. We have been taught that the Pythagoreans were unhappy about π due to the fact it was not rational. But their unease was likely caused by a more fundamental problem.

They seem to have had an intuitive sense that something was wrong here. Meaning, it was not the *value* of π that bothered them, much less its status as rational or irrational. No, they didn't even spend much time seeking a precise value for it, since they had no respect for π to start with, regardless of how you categorized it. Had it been rational, they would have had no more respect for it. They had no respect for π because they suspected it was an outcome of bad or incomplete math. They did not want *any* rational or irrational number slightly above 3, no matter what it was, because they felt the right answer must be 3. What bothered them most is that they could not complete the math. I will do that now. Unfortunately, although I will show that their unease was justified, their intuition was faulty. The correct number is not 3 but 4.

In that previous paper, I showed that classical geometers have sought solutions by ignoring the time variable completely. The equations of geometry happen at some imaginary instant. Not only are we at a limit with regard to length (since all lines have no width, etc.), we are at a limit with regard to time. We have reached the limit where t=0, since time is not passing. We don't take into consideration how long it takes to draw the lines or curves, we simply take them as given. We do not imagine traveling along those lines, or imagine seeing them traveled by a point. The circle is not an orbit, for instance, it is just a circle, existing all at once.

But, as I also pointed out in that other paper, geometry cheats in this, since geometry is supposed to represent the external world, but the external world never exists in this way. Never once in the history of the universe has a circle drawn itself or existed all at once. Currently we assume that π exists in the real world, but I will show that π exists only in abstract geometry, and that abstract geometry is physically false. That is to say, π does not and cannot exist in physics or applied mathematics, except as a fudge factor. We require it so often in our equations only because our equations are incomplete or misdefined. If our equations contained all the proper logic and transforms, π would be extinct. In fact, it is unknown or forgotten by those smarter than us, and will be extinct in the near future. Not only is π *not* an interesting piece of esoterica, it is an albatross worn by the mathematically ignorant.

Let me first explain what I mean by that in a bit more detail. The number π is a relationship. We already know that. Currently we think it is a relationship between the diameter and the circumference. The problem is, we treat the diameter and the circumference as equivalent mathematical entities, when they are not. One is a line and one is a curve. If we study the line and the curve with a bit more rigor, we discover they aren't directly comparable. To state it yet another way: we assume that we can straighten out a curve like a piece of string, measure it as a straight line, and then compare that new length to any line we like. Physically, this turns out to be a false assumption. The only place we can do that is in abstract geometry, where time does not exist, and where lines and curves can be "given", rather than drawn or created in any physical sense. If we are given lines and curves, and if we can ignore time, then we get π as the relationship between the diameter and the circumference. The number π *only* exists when we are given absolute pre-existing values, when the circumference is treated as a simple length, and when we ignore time. But since with any real circle both these assumptions are necessarily false, π does not exist in any real circle. In any real circle, the relationship between the diameter and the circumference is not π , since the circumference may *not* be thought of as a straight-line distance. Because the circumference cannot be created with a single velocity vector (and the diameter can), the two numbers cannot be compared directly.

But let us start at the beginning. By definition, a velocity vector cannot curve. A velocity takes place in one dimension or direction only. In a velocity, there is only one distance in the numerator and one time in the denominator. These times and distances are also vectors, and may not curve. But to create a curve, either mathematically or physically, requires at least two velocities happening over the same interval. Or, to put it another way, it requires two distances measured over the same time interval. If we sum these velocities over the same interval, we achieve an acceleration, and thereby—assuming the two velocities are at an angle—a curve.

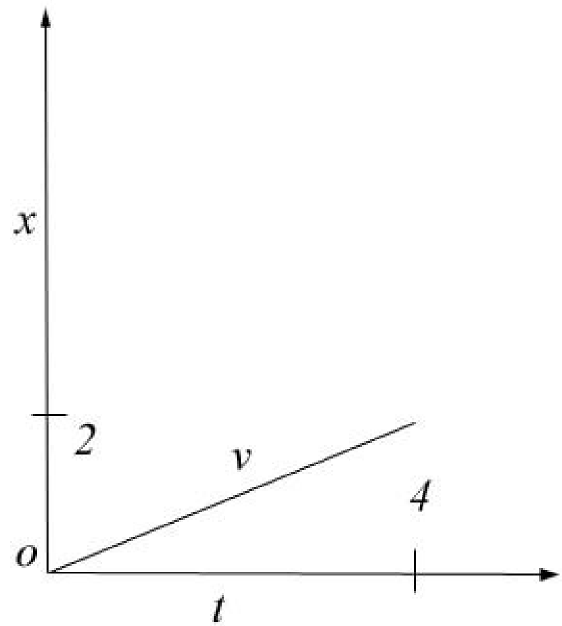
If we bring time back into the problem of the circle, we find that every line or distance becomes a velocity and every curve becomes an acceleration. So the diameter becomes a velocity and the circumference becomes an acceleration. All we have to do is imagine the lines being drawn. The pencil must have some velocity or acceleration as it moves along the line or curve. Likewise with a planet drawing out an orbit, or any other possible creation of a circle in the real world.

Once we do this, we see that in comparing the diameter to the circumference in any real circle we are comparing a velocity to an acceleration. But you cannot directly compare two numbers, when one is a velocity and one is an acceleration. Or, you can if you like, but the new number you get from the ratio is not going to be a number that carries any real meaning in it. It is certainly not the same as comparing one distance to another. For example, if you compare one distance to another by putting them into a fraction and achieving a new number, this new number will contain useful information. It will tell you how long one line is compared to the other, obviously. But if you compare a velocity and an acceleration, what information do you get? Say you achieve the number 5, which tells you the acceleration is five times the velocity. Does that tell you anything about distances? Yes, it might, if you develop a transform. But without a transform and a bit of thinking, the number 5 isn't telling you anything. It certainly isn't telling you that some distance is 5 times some other distance.

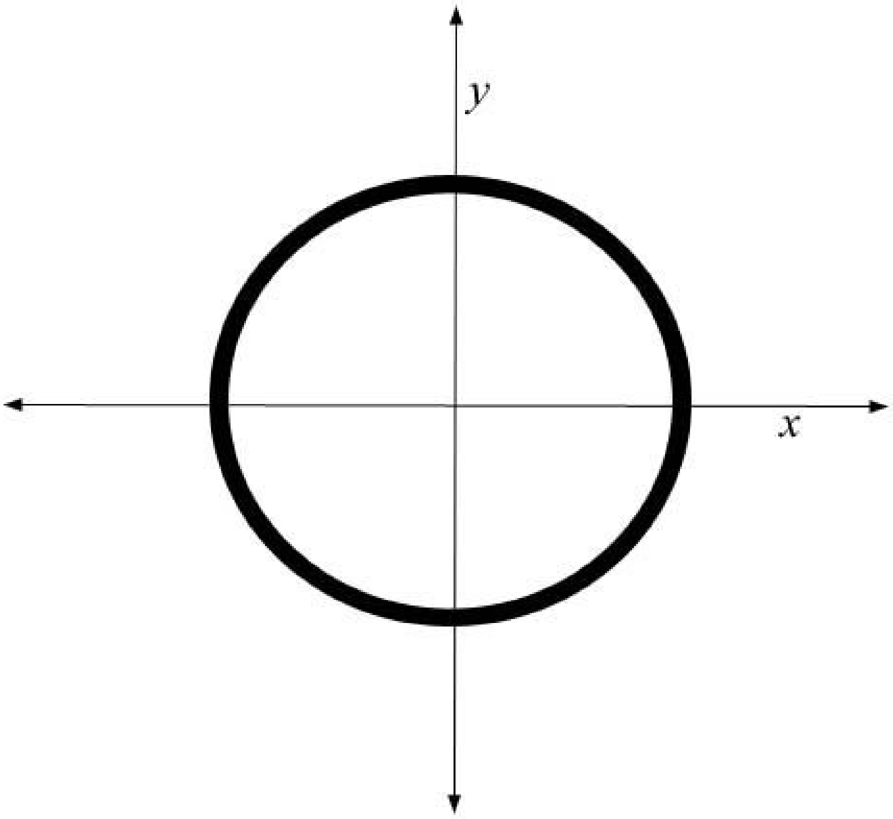
To give a specific example, what if my acceleration is 3 and your velocity is 1. Can we compare those two numbers directly? No, we cannot put them into a fraction or any other equation without doing some more work upon them. We cannot claim that I have done anything three times as much as you. With an acceleration of 3, my velocity could be anything at a given interval, and my distance traveled likewise. What if my acceleration is π and your velocity is 1? Is π the value of any real relationship between us? No. You can't compare an acceleration to a velocity. You need more information.

This is important because this is precisely what we think π is telling us. We *think* it is telling us that the circumference is 3.14 times the diameter. But it isn't. About real circles, π is telling us nothing. About abstract circles, π is telling us that *if* the circumference were a straight line, it would be π times the diameter. But since the circumference is not a straight line, π is telling us nothing useful there either. In reality, π is precisely as useful as some numerical relationship between apples and oranges, one that began with the postulate "if oranges were apples" and finds "then oranges would be π times redder than they are." All very edifying I am sure, but since oranges are not apples, any number found is just a ghost.

To show this more clearly, let me give you another example, with a diagram.



Here we have a Cartesian graph of a velocity, with axes labeled x and t. As we know, a velocity on such a graph is a straight line. The line stands for or represents the velocity. But what does the length of that line represent? In this example, x = 2 and t = 4, so v = x/t = .5. But the length of line v is much longer than .5 units. The length of line v can only be found by the Pythagorean Theorem, and it turns out to be about 4.47. Now, we can ask what is the ratio of line v to line x, and we will find it is about 4.47/2 = 2.236, which is an irrational number. An esoteric ratio? Of course not, since the length of v is not only a meaningless length here physically, it is not even the real velocity. By the definition of velocity, the velocity is the distance over the time, so using the Pythagorean Theorem to find the length of v is just foolish. I claim that, in a physical situation, comparing the length of the circumference of a given circle to the length of its diameter is just as foolish.



We can draw a circle on a Cartesian graph, too. We can't make one of our axes a time axis, but we know we can draw a circle on an x/y graph, since a well-known equation comes with it ($x^2 + y^2 = r^2$). Here we are taught that the circle represents an acceleration, as all curves are accelerations on Cartesian graphs. But what about the length of the circumference of this circle: what does it represent? Just as with the line representing the velocity in the first illustration, it represents nothing here. You wouldn't think of comparing that "length" to the radius or the diameter in this illustration, so why would you do it when you take away the graph?

Of course, this analysis begs the question: what "graph" is a real circle drawn on in the real world? When a planet "draws" an orbit around a star, what mathematical background are we using? Put that way, this problem starts to look very complex. We have three dimensions, x, y, and t, and a complex motion. The orbit is not just a velocity *or* an acceleration, it is a simultaneous velocity *and* an acceleration. To draw out the circle, the planet has to be expressing both a tangential velocity and a centripetal acceleration over every dt. We are told that the planet will have an "orbital velocity", but that wording is criminally reductive and misleading. Not only does the planet NOT have an orbital velocity, it does not precisely have an orbital acceleration either. It does have a sort of acceleration, but that acceleration is not like any first-degree acceleration we are accustomed to measuring. No, it is a very odd beast altogether. It must be called an acceleration for two reasons: 1) It curves. A velocity is a vector and cannot curve. 2) It requires a constant force. A velocity is achieved with a single force. An acceleration requires a continuous force. A circle requires both a single force and a continuous force, therefore it must be the expression of some sort of acceleration. But it is a unique compound acceleration, compounded of both an acceleration and a velocity.

And that begs another question: is $2\pi r/t$ a velocity? No, since a velocity cannot curve. Is it an acceleration? No, since you can't achieve an acceleration by dividing a distance by a time. What is it? It is a floating heuristic device, a piece of fake math that misdirects us. It causes us to think of the orbit as an abstract geometric shape, where time can be stirred back in in a sloppy manner at the end. But neither the orbit nor the circle should be thought of that way. As I will show in more detail below, $2\pi r/t$ is actually a variable or second-degree acceleration, of the form x/t^3. This is because π is already an acceleration itself. This gives $2\pi r/t$ the dimensions of $x/t^2/t$, which reduces to x/t^3. This is logical, since we need the three t variables in order to express the simultaneous tangential velocity and centripetal acceleration that makes up the orbit. The velocity contributes one t variable and the acceleration contributes the other two. The orbit is neither a velocity nor a simple acceleration. It is a second-degree acceleration.*

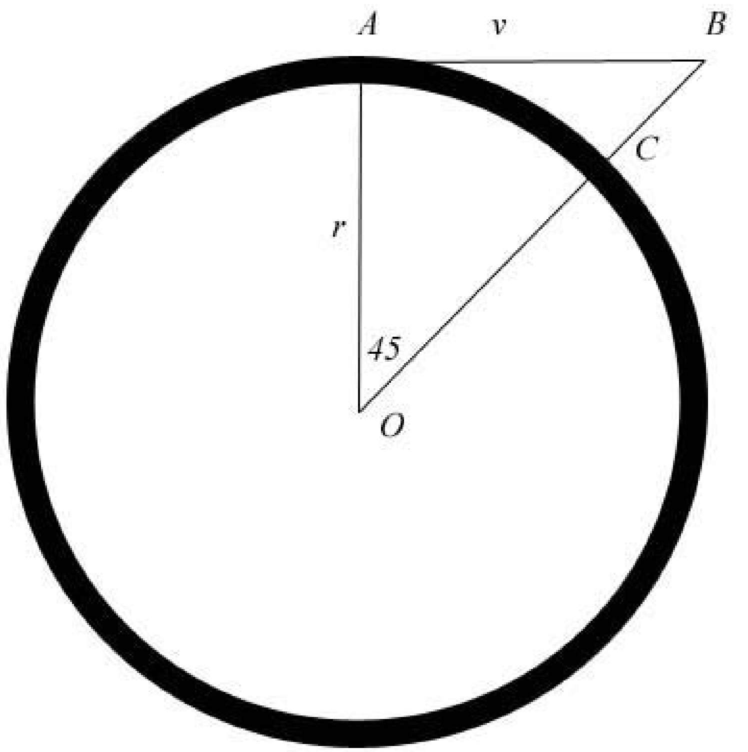
Now, hopefully, you begin to see the problem. Historically, we have been seeking a relationship between distances, and historically we have thought that π has been an expression of that relationship. But it isn't. The number π is an expression of the relationship between two lengths that exist only in abstract geometry, and abstract geometry is physically false. In the real world, if we want to know the relationship between the diameter and the circumference, we have to look at the relationship between a velocity and a *second-degree* acceleration.

You will say, "But surely that acceleration will give us a distance, as will the velocity. Are you saying that the distance given by that acceleration is not $2\pi r$?" Yes, that is precisely what I am saying. If you use straight-line motion to measure everything (which is what we do physically), then a curved string must be longer than a straight string. And the very simple reason for that is that it must take longer for any real body to travel along the curve than along the straight line.

One key term in that last paragraph is this one: "straight-line motion." Notice that I do not say, "the straight line." In reality, we do not use a straight line to measure, we use straight-line motion. We use a velocity vector to measure the real world. This can be seen very clearly in my explanation above: The real world includes time. In physics, you simply never have a distance divorced from time, like you have in geometry. Every distance comes with a time, and cannot be separated from it. When we insert time back into the circle equations, all the lengths become velocities. The diameter is not a length, it is a velocity. Now, if we compare the diameter to the circumference, what we are really doing is *measuring* the circumference with the diameter. So, if we are measuring with a velocity, and it takes longer to travel a curve than a straight line, the curve must be longer. This must be true even when the curve and the straight line have the same length in abstract geometry.

Another key term in the paragraph before the last one is this one: "it must take longer." When measuring a curve with a straight line or an acceleration with a velocity, we are not measuring with x so much as we are measuring with t. Look at it this way: if you have a constant velocity, then the distance traveled is simply a function of time. If you travel two lengths, the one that took longer will be longer. Since a curve is not equivalent to a straight line, we should measure them with time instead of length. We can tell how long the curve is by seeing how long it takes us to travel it.

Finally, remember that the distance traveled by an acceleration is never just the velocity times the time. So neither an orbital velocity nor an orbital acceleration could be expressed by the term $2\pi r/t$. If you are given a normal acceleration and seek the distance traveled in some time, you must use the equation $x = at^2/2$. But we don't have a normal acceleration; we have a variable acceleration, one that is not linear, and we seek the distance traveled in some time. What equation do we use? We are in new territory here, since there is no standing equation to plug into. We must create it from whole cloth.



To arrive at that equation, let us first look at some other thought problems. These thought problems, with their accompanying illustrations, may give us a clue how to proceed. As our first thought problem, let us say you are in a spacecraft traveling at velocity v. You are approaching a planet. You happen to know its gravity precisely, so you arrange to intersect its field at precisely the right angle and distance, so that your velocity creates a stable orbit. In real life, this maneuver would require some adjustments, but we will assume you can slip right in there. To make this even more interesting, let us say that your orbit has a radius of fifty miles and you are going fifty miles per hour. The planet is very small and happens to have a gravity vector that makes this stable. Both logic and Newtonian mechanics tell you that it will take you eight hours to orbit (see the illustration below). Let us imagine further that you are an alien from some planet that knows nothing of π and that does physics a bit differently, and you calculate the orbital distance like this: your velocity was the same both before and after entering orbit; your engines are in the same state as they were before, both as regards direction and strength; you haven't throttled up or down or moved a tail fin. Since distance is velocity times time, you calculate the orbital distance to be 400 miles.

Are you wrong?

According to abstract geometry and π, of course you are. The circumference of the orbit is about 314 miles, not 400. Your orbital velocity is about 39 mph, not 50. And what is slowing you down is gravity, which tends to pull you back slightly, working against your engines.

But there are a lot of problems here. If we use general relativity, our mechanics is immediately out the window, since there is no centripetal force. The curvature pre-exists in the orbit: it is not caused by a pull, so only your velocity exists. If your velocity is the only motion that exists, and if a straight line is equivalent to a curve, there is absolutely no reason you should not calculate the orbital distance to be 400 miles. There is nothing pulling you back or working against you engines, so if you aren't being slowed down, you must be going the same speed. If you are going the same speed for the same time, you must go the same distance. If you aren't being slowed down, then your "orbital velocity" cannot be less than your original velocity.

But it is even worse than that, from a physical viewpoint. Let us ask if it is possible to apply a centripetal force without affecting a tangential velocity. Let us assume there *is* some force turning the spaceship, either Newton's gravity or some real force that is "warping" space. The problem with this is: the spaceship's engines are off! When glossing the standard model response, I said that gravity was working against the spaceship's engines, slowing it down. But a constant velocity requires no engines in space. Does the Moon have engines? No, all we require is an *initial* force, to get the Moon or spaceship going. After that it coasts at a constant velocity (this is all according to the standard model and the historical interpretation).

To make this problem even clearer, let us say we want to create the appearance of an orbit using just the power of the spaceship. Meaning, we want to draw a circle in space without a central body. Theoretically, we should be able to do this with just two engines: one to get us started in the forward direction, and one to push us constantly toward some chosen center. This second engine will run all the time with a constant thrust, and its direction will change every moment. I hope you can see the problem. Even if we could build a directional thrust to the engine that could change smoothly and accurately, we could not keep this thrust from interfering with the original velocity. You can neither push nor pull on a real object at a true perpendicular to the line of motion of that object, since a real push or pull is never instantaneous. Our push here, like gravity, must be continuous, which must create some real time interval, which must create some non-tangential component, which must interfere with the initial velocity of the spacecraft. Any real pulling or pushing force, even one at a tangent, must tend to dissipate an initial velocity.

Circle mechanics makes this even clearer, since the force of gravity is not strictly perpendicular anyway. To create the circle or the orbit given an initial straight line velocity requires some backward component to the central force. You can see this immediately just by comparing the tangential velocity and the "orbital velocity". As I showed above, and as every engineer knows, the orbital velocity is *less than* the tangential velocity. This alone proves that there is a component of force backward along the line of the tangent, for if there weren't, the tangential velocity would have to be equal to the orbital velocity. In other words, gravity must pull down *and back*. If it just pulled down, no circle or orbit would be created. *Because* the spaceship is moving forward, gravity must pull down and back. Look at the illustration below. BC is the gravity vector. To go to the limit, we make the triangle ABC as small as we can. We cannot make it zero, since AB must have some length. If AB has no length, then the spaceship has zero velocity. If the spaceship is moving, then AB has some length. If AB has some length, then BC must have some backward component. If BC has some backward component, it must tend to diminish the velocity AB. QED, gravity must tend to diminish the tangential velocity of the spacecraft or the "innate motion" of the Moon.

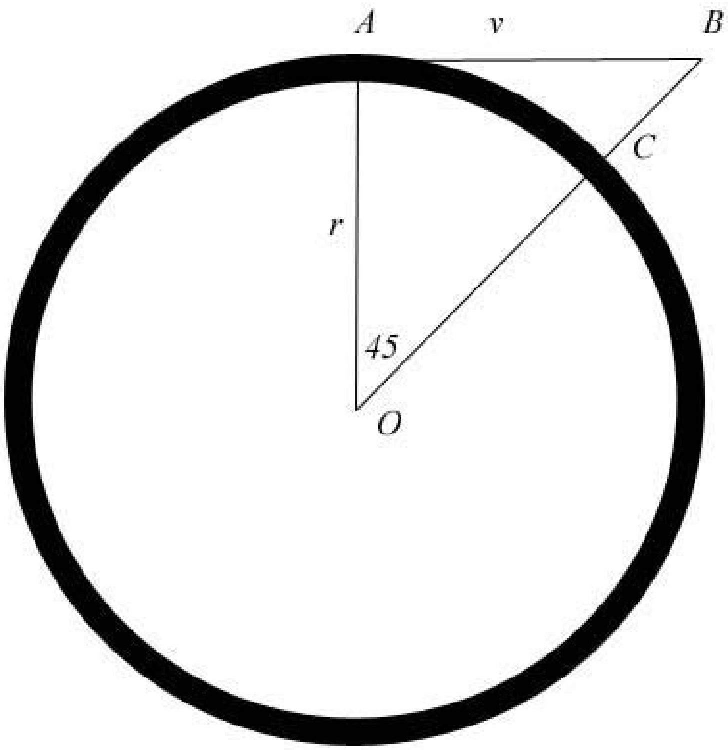
The standard model response here is that I am wrong: the centripetal force must be completely perpendicular to the initial velocity at all times, therefore there is and can be no "backward" component to the force or the acceleration. I will be told that this is why the Moon's innate motion does not dissipate. But if this is true, then why is the orbital distance less than the distance that would have been traveled at the original velocity? As the illustration shows clearly, a tangential velocity of r would create a distance traveled of 4d, not πd. If the centripetal force does not work *against* the tangential velocity, as a vector, then how can πd be less than 4d? To put it another way: if the centripetal force is completely perpendicular to the tangential velocity—even while we sum the times involved in a complete orbit—then the tangential velocity must be unchanged. If the tangential velocity is unchanged over each dt and the sum of all dts, then how is it that the orbital distance is not the same as the expected straight-line distance? And how is it possible that the orbital velocity is less than the tangential velocity?

I say that in order for the compound or "orbital" velocity to be less than the original or tangential velocity, the centripetal force must be working against it, in a vector sense. This is the only possible way the orbital distance (the circumference) could be less than 4d. But if the centripetal force is diminishing the total distance traveled, it must be diminishing the tangential velocity. And if it is diminishing the tangential velocity, that velocity must be dissipating, and the innate motion of the orbiter must be dissipating as well.

In fact, if we accept the standard-model interpretation, the orbit would be a sort of perpetual motion machine. Without perturbations and other orbital imperfections, a planetary orbit would be perfectly stable, according to both Newton and the current standard model. It would not tend to change either inward or outward. The standard model allows for such a possibility in the real world, since neither the tangential velocity nor the centripetal acceleration is a cause of orbital instability. Theoretically, a perfectly round planet in a perfectly round orbit around a perfectly round star, at a distance from all other planets and stars, might orbit forever. And since in General Relativity, curvature is given rather than created, this motion conserves energy. Since it both conserves energy and creates potential energy, it must be a perpetual motion machine. Remember, we have a non-dissipating curve here! That is not only perpetual motion, that is a perpetual machine: a perpetual source of power.

Now, I have not put the analysis in these terms in order to sell a perpetual motion machine. I have put the analysis in these terms to show that the standard model is contradictory and flawed. I need to get back to π, so I will tell you the end of this story and move on. The short answer to this problem is that circles and orbits aren't created this way physically or mechanically. We can analyze the circle mathematically in this way if we do it right (which historically we haven't), but in the real world circles and orbits are never created with simple tangential velocities or "innate motions". A protractor does not draw a circle using a tangential velocity, a boy whirling a ball on a string does not use a tangential velocity, and no other circle is ever created in this way. The protractor and the boy and the tilt-a-whirl and so on make use of constant tangential forces, not just centripetal forces, and they would have to do so even if friction were not a factor. Regarding celestial orbits, the mechanics fails there, too. Velocities would dissipate, planets are not self-propelled, and the balance could not be maintained. As I show in a series of other papers, celestial orbits are more complex than we have been taught. They include the E/M field, for a start, which acts as both a balance and an engine. And we have to reverse the gravity vector, which makes it neither a push nor a pull. It is a real acceleration of the central body, so it causes no forces and no dissipation in the Newtonian sense.

That being said, we can still analyze the orbit and the circle in much the way Newton taught. We can use his equations, we just have to clean them up a bit. To do this, lets us look again at the last illustration. This drawing requires a more rigorous analysis, both as it applies to orbits and as it applies to circles created in any other ways. If you have studied this problem at all, you have probably seen hundreds of drawings, with polygons inscribed and superscribed on circles and so on and on. But all those drawings are misdirection. The important drawing is this one.

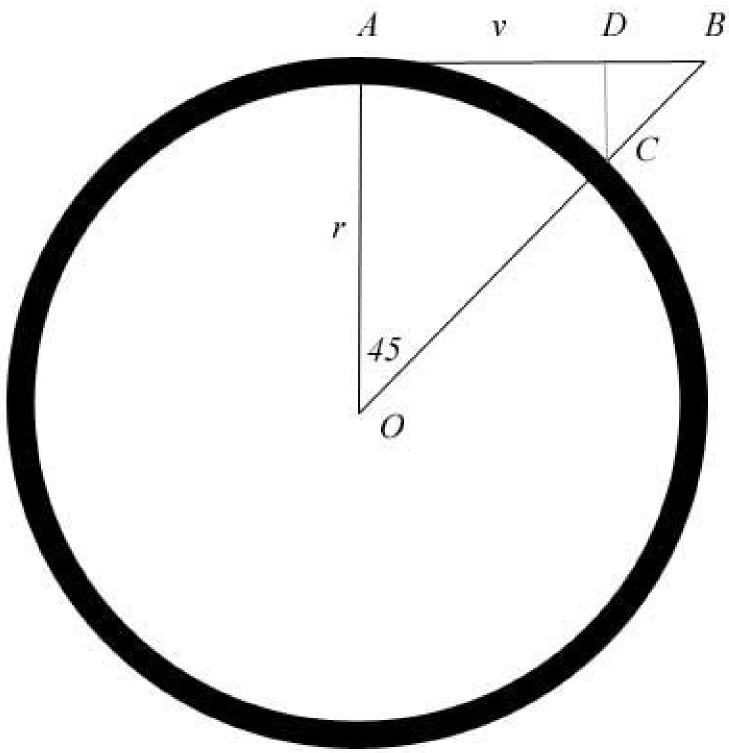


Here we measure the circle with the radius directly. We treat the radius as a velocity instead of a distance, and then begin our trip from some point on the circle. I am starting at point A in this drawing. In the drawing, the length of the vector stands for the velocity, and I must draw it at a tangent. Meaning, the angle at A must be 90 degrees. So, if you give me the same time to travel as I took to draw the radius, then I will end up at point B.

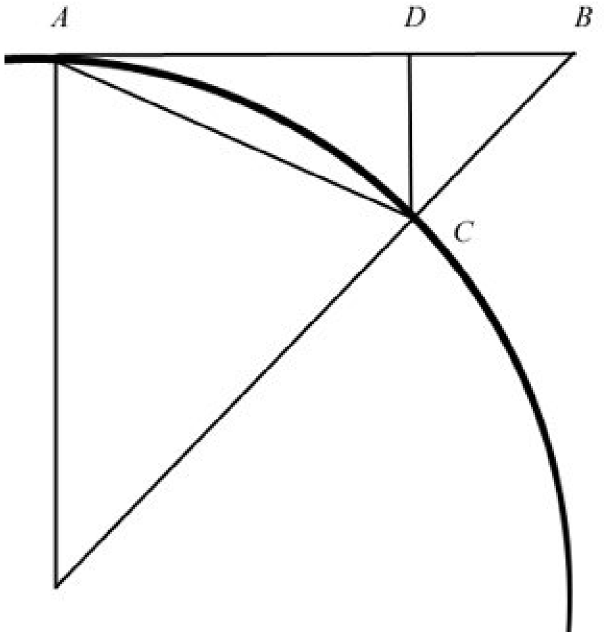
But if we want to draw a curve, we must keep the pencil on the circle, and here I am way off the circle. How do we solve this? Let us solve the way Newton did, by inserting a second motion. To create any real curve requires at least two simultaneous motions. As we know from classical orbital mechanics, this second motion must be a vector pointing at the center. This motion will take us from off the circle to back on the circle. To get us back on the circle, we can postulate a constant force over the interval of motion, and this would give us an acceleration, just as in gravitational mechanics. Or, to avoid that variation, which mathematically would require the use of calculus, we can just postulate all our force at the end. In that case, the final velocity is the acceleration, since we have a change from zero. The acceleration can be found just by drawing a line from B to O. The length of the line BC then represents the centripetal acceleration of our pencil over the interval AC.

Those two motions or velocities happen over the same interval, so the two times superimpose. Whatever time it took us to draw the radius initially, is the same time it now took us to go from A to C. Therefore we have measured the circumference using the radius.

But how does this give us a circumference? Before I show you the full math, let me show you the conceptual shortcut. Go back to the drawing above. You can immediately see that we have carved out a piece of pie that is 1/8 of the circle. AO = AB, so the angle at O is 45 degrees. Eight pieces of pie means we use eight radii to measure the whole circle. That is 4 diameters. Problem solved. It takes us four times as long to travel the circumference as to travel the diameter, given the same velocity. If the velocities are equal, and the times are directly comparable, then the distances are directly comparable. Velocity is d/t, so if it takes us four times as long, the distance must be four times as much also. That is the only real way to compare a velocity and an acceleration, or a straight line and a curve. Every other analysis is incomplete and faulty, since every other analysis ignores the time variable.



Now let us do the full math. Let us go back to the illustration, to start. Let us drop a perpendicular from point D so that it hits point C, as above. Since the angle at B is 45°, DB must equal DC. And now I will prove very quickly that AD + DC is equal to the curve AC, in length. As I do that, I will have also proved that AB is equal to the curve AC, in length, which will prove my assertions above concerning the falsity of π . If I can prove that, it will prove that the circumference is 8AB, not 2πAB.

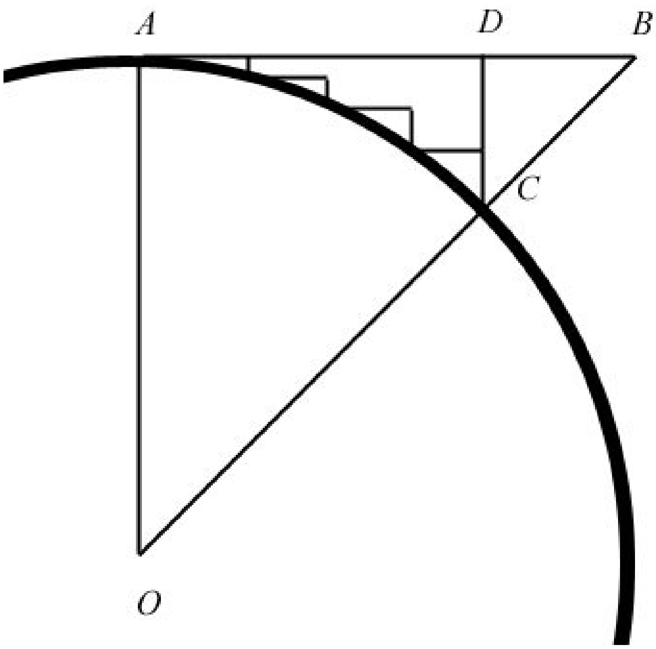


The historical way of finding the length of arc AC is by exhaustion or by calculus. We look at smaller and smaller subarcs until we reach the limit where the arc equals the chord. The chord is simply the straight line from point to point: for example, the straight line from A to C is the chord AC. If we can straighten out the arc, we will have measured it, and we can use that length to compare to other straight lines. So we let C approach A. At the limit, it is assumed that the chord AC is the length traveled. The Greeks used this analysis and these assumptions in solving this problem over 2000 years ago, using the idea of exhaustion (which I will return to in a moment). Later, when the calculus was formalized, we went to an ultimate ratio, as Newton called it; and then we went to a limit, with Cauchy. But in all the historical solutions, the assumptions were as I have stated them in this paragraph. The main assumption being that we were taking the arc to the chord: approaching the chord in some way or fashion.

But all this is false. The very simple fact is that the distance traveled never approaches the chord. The distance does not approach anything, since it never diminishes. The distance is the same whether we draw it large or draw it small. Since it doesn't change as we "exhaust" it, it cannot approach a limit. Watch closely as I prove this in my diagrams, with simple logic.

In my analysis above, I showed that the centripetal force must pull down *and back* in order to take any object—either a pencil tip or an orbiting spacecraft—out of its original path and into a circular path. The simplest way to think of this is to think of the original velocity as AB. Then the centripetal force creates two other velocities: a velocity of size DB, which pulls the body back from B to D; and a velocity DC, which pulls the body down to its final destination of C. This is how we break down our curve into straight velocity vectors. The motion of the body from A to C is a summation of these three vectors. All three velocities happen over the same time interval, so we sum them. It is that simple.

You will say, "That makes some sense, until we look at the actual lines. Any idiot can tell that AD + DC must be longer than the curve AC. The curve AC never goes out to point D, for a start. If you want to solve by exhaustion, you have to "push" the point D closer and closer to the curve, by dividing that curve into lots of little segments or steps. That is how the Greeks actually solved it, you foolish person. You can't just take any large arc like this and run perpendiculars: you have to go to a limit. You have to get small."



OK, well, let us do that, then. In this diagram, I will push D closer to the curve AC. I will begin both the exhaustion and the "approach" to an infinitesimal or limit. We will start by dividing the curve into 4 equal parts or steps. And yes, we are much closer to the curve already, as you see, with just 4 divisions. We don't find ourselves anywhere near the distance from the curve of the original point D. It already appears that if we continue to do this, we will "approach" the curve AC very fast, so our method appears to be the right one. It does what we want it to, and it mirrors the method of the Greeks and Moderns.

The problem is, it doesn't change the distance traveled *at all*. If you add up those eight little lines segments along the steps, you find that they equal AD + DC. We have changed our path, but we have not changed our distance! We can draw eight steps or 64 steps or an infinity of steps, and it will not change a thing. With our logical little method here, we are not "approaching" any new distance, we are only approaching a new path. The distance is the same at the limit as it was in the beginning: AD + DC.

Therefore, at the limit, the *path* AD + DC is equal to the path taken by the curve AC, which does indeed solve our problem. But the *distance* has not changed by going to this limit. So if AB is the same length as the radius, and we have defined the radius as .5, then AC must .5 also, and the circumference is 4.

It turns out the aliens were correct again. I said above that they had no idea of π, and that they simply used their tangential or original velocity to measure the circumference of the orbit. I have just shown why they are correct and why we are and always have been wrong.

Let me round out this "full math" by answering a couple of questions. I have shown the simplest full math, and it may not convince some people. I will be told, "It appears that your method of 'exhaustion' can be used to show that any curve from A to C is of the same length. Beyond that, it would appear that even the chord AC can be shown to be equal to AD + DC, by your method. What makes the circle arc AC special, and why should your method work upon it and upon no other arc or line between A and C?"

It is a good question, admittedly, or I would not include it here. To make this method—which I have called exhaustion but which might just as easily be called approaching a limit—work, we have to push D toward the curve in a rigorous manner. In short, all of our steps have to be approaching the curve at the same rate, or the method will not work. For instance, if we draw a different curve from A to C, one that bulges out very near to D, and then we draw our steps, we will not be able to make those steps even. Or, to put it another way, we will not be able to push D toward the curve in an even manner. Our exhaustion will not "go to infinity" at the same rate all long the curve; therefore our method will not work, mathematically or physically. But it will work with the circle arc AC, and it works for the physical reason I have shown above: both the tangential velocity and the centripetal force are constant. The arc AC is created by a constant and unvarying process, therefore that arc can be approached by the (right) orthogonal vectors in a logical and rigorous manner. In fact, the arc AC is the only curve from A to C that can be exhausted in this manner, given AD and DC. All other curves are varying curves, and cannot be approached as a limit or exhausted in this direct way.

To show why the chord AC cannot be approached like this, we use much the same analysis. At first look, it appears that you could draw steps along the chord AC in the same way, "exhaust" them in the same way by increasing the number of steps higher and higher, and find by this magic that the straight line AC was the same length as AD + DC. The reason you cannot do this is because once again you cannot approach the chord AC in an even manner from the point D. Therefore all your steps won't go to the limit at the same rate, and your "method" won't work. You will say, "Gosh, it seems like the straight line would be the easiest thing to approach in an even manner, since it is even to start with!" But try it and you will soon see this is not the case. The straight line is actually the most difficult thing to approach, and the impossibility of this approach is actually the easiest to discover. For instance, draw four equal steps along AC, then look at them from the point D. There isn't any way you could have approached those four equal steps from D. In the method, you aren't just drawing any steps you like. You are supposed to be drawing steps that would occur if you pushed the line AD + DC toward AC. Exhausting a process or going to a limit is not a willy-nilly process, it is a defined and rigorous process. You will find, if you try, that you can't approach a line evenly from *any* point, using this method. No matter where you place D along the line AB, it will not approach AC at the same rate, with steps logically defined in any possible way. And it may eventually become clear to you why this is so: the distance of a line cannot be approached from off the line, because the line is already the distance itself. It is "even to start with"; therefore, it cannot be approached evenly (except by a parallel line of the same length).

As one more short demonstration of this, say we place D on the line AB so that it is equidistant from A and C to begin with. You may think we could make it approach AC in an even manner in this way. But no. If we draw smaller steps in the middle and larger ones toward A and C, we can force one set of steps to act right. But we cannot make our next set of steps act right, both in regards to D and in regards to our first set. To make our next set of steps diminish evenly, we would have to vary the rate of change along the steps, and this isn't allowed. An approach to a limit must progress in a defined way, else the approach won't happen. An approach that progressed unevenly would create "bumps" as the limit was approached, and the limit would not be the curve we see. It is one thing to approach a limit that is a point, and another to approach a limit that is a line or curve. In approaching a line or curve, the approach has to be the same at all places along the curve, and to achieve this the approach must be monitored all along the curve, as I am showing you.

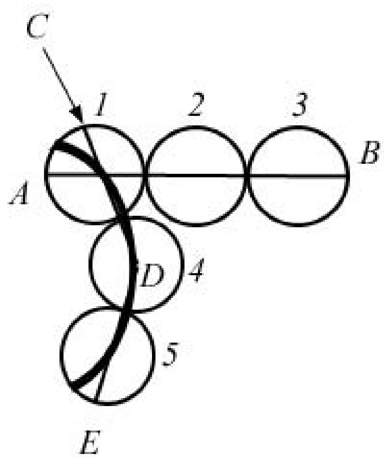
There are more abstract ways of stating this, in various mathematical symbolisms, but because math is always shorthand for the explanation, I prefer to give the explanation. If you don't comprehend the explanation, you won't ever comprehend the math. To ever understand the curve or calculus, you have to study diagrams and do some real pushing and pulling of lines, just like this. A limit is not an abstract thing. It is not a concept you can use like a hammer, without finesse. You have to understand that a limit is always approached in a rigorous and defined manner; and if it is not approached in a rigorous manner, you will get the wrong answer. The same thing applies to exhaustion. Mathematically, exhaustion is a rigorous process. It is not just drawing more and more steps; it is drawing steps that increase in number and size in a defined manner.

The very shortest answer to this question is that you can approach the circle arc AC from the line AD + DC because those vectors created the arc AC to begin with. Those vectors physically created the curved path. They are not just orthogonal vectors, chosen because they were handy. They are THE orthogonal vectors that define the path of the curve. The arc AC is approached smoothly from D because it was in some sense created from D. D is the physical balance of O, given the interval AC and motion from A to C. D was guaranteed to approach the arc AC smoothly and evenly, which is why I use the method without explanation in my gloss of this paper.

Now, some may ask what this has to do with my whole analysis of time, earlier in this paper. I spent many pages telling you that time changed the whole problem of the circumference and its measurement and then I offered a "full math" that didn't once mention time. Here we get into some difficulty I wanted to avoid. I have been trying to avoid bringing calculus into the problem here, since I have already been forced to redefine the calculus in another paper. Bringing all that into this paper was something I hoped to skirt, retaining a transparent explanation to the end. For some readers I will have achieved that already. For others (the ones asking about time now) I won't. For these I will attempt a transparent explanation that still avoids a full use of the calculus, either the historical treatment, or my own. When I say that we must monitor the rate at which D approaches AC, that rate is time. Whenever someone says "rate" you should hear "time". In any physical situation, time is always underneath all our distance measurements. We can draw a circle and refuse to monitor the time involved in drawing it, but time is there regardless. It is there when we remember that all distances are velocities or accelerations; and it is also there when we remember that limits must be approached in some real and rigorous way. The curve AC cannot be straightened out like a piece of string because that curve is a curve made up of both distance and time. If you straighten it out and measure it like string, you are measuring the distance but not the time, and so you get the wrong answer.

There are two ways to think of this. One is to think of time as an actual length itself. Say you have a curve and a line that are equal lengths, according abstract geometry or the string method. The curve will have more time "embedded" in it. It would take you more time to travel it at the same velocity (as the standard model already admits with its "orbital velocity"). Therefore, when you straighten it out, you should monitor both the distance and the time. If you do this, the time will add to the distance, and your curve will be appreciably longer than you expect. You can actually add the difference in time to the end of the line and get the correct answer, so thinking of time as embedded in the curve is not just a pretty visualization. It is mathematically true.

Another way to think of it is to think of the line and curve as made up of atoms. Let the atoms be the distance and the separation between atoms be the time. If you straighten out a curve, you must compress the atoms, losing somewhat of the separation. If you have lost this separation, then you have lost part of the "time" and therefore the distance. A curve cannot be straightened out without affecting its real length. This is not just a visualization either. It is physically true. The best way to see it is again with a diagram:



We want to straighten the piece of curved string 1-4-5 out into the piece of straight string 1-2-3. Although it is clear that the curve is longer than the straight line, let us follow the standard model and define both strings as equal length and see what happens. I use this diagram because some will say that no real compression is involved if we imagine a string with no width. They will say that a real piece of string will be compressed only on the outside, as you straighten it, but that the inside of the curve will be stretched. They will say that a one-dimensional string will not be compressed as you straighten it. This diagram shows that is false. Even a piece of string composed of only one line of atoms, with the distance between adjacent atoms always only 2r, will be compressed. To see this, all we have to do is roll ball 5 up to ball 3. If we do that, the mark that is the curve must leak out the ends, showing that compression took place. This is obviously because the line AB is equal to CDE, not to the curve. The curve is longer than CDE, and must be compressed to equal AB.

Those who are especially prickly will say, "Well, if the curve is longer than AB, then the two strings were not the same length. You should define the curve as equal to AB." But if we do that, we have the opposite problem, in that we can't make the balls the same size in the curved string as in the straight one. If we define the curve as equal to AB, then we have to make our balls bigger along the curve. So that when we roll ball 5 up to meet ball 3, we again get compression. No matter how you look at it, you cannot straighten out a curve without materially, and therefore mathematically, affecting it.

Some will say that this analysis assumes non-continuity, but it doesn't. It doesn't even require a quantum view of matter. Those balls don't have to stand for atoms. They can stand for little number 1's if we like. They can stand for anything at all, physical or mathematical, real or abstract, except zero or its equivalent. No matter what the balls represent, compression is the logical result.

But let us return to time. Time is central to this last visualization as well. A second variable always supplies us with the rate of change, and thereby the curve, and in the real world, time is always present: it determines this rate of change, no matter what other variables are present. Time is the reason that the curve does not equal AB in this example. The difference between the two is the difference in time. And the difference is large. The difference between π and 4 is not small. Historically, we have mis-measured the length of a curve by a large margin.

Professional mathematicians will not be happy with all this for several reasons. One, they will not like to see π treated with so little respect. Something with such a long history should not be looked at this closely. It is like looking at your grandmother with a magnifying glass: impolite and impolitic, if nothing else. Only a monomaniac would even entertain the idea that all of history was wrong, about any idea at all. Two, They will not like all this talk. If I have some new math to relate, I should just plop down the equations and see if they can remain standing under fire. This is the expected route to take. Three, they will not like my "misuse" of the calculus, even if I never claim to be orthodox. I will appear to them to be taking things to limits in very strange ways, and explaining myself in even stranger ways. Given Newton and Cauchy and the rest, I will simply be seen to be doing calculus *wrong*. In response, I point out that the invention of the calculus historically went hand in hand with analyzing curves, and it was invented to analyze geometric curves, not kinematic curves. What I mean by that is that calculus and trigonometry and the orthodox use of limits was used in an analysis that ignored time. Newton assumed that a circular orbit could be thought of just like a circle given in geometry, with no monitoring of time or velocity. In this he was actually even more reductive than the Greeks themselves, who at least asked if the point on the curve had a velocity. Some of their analyses toyed with this idea. But Newton never questioned that the distance around the circle was a raw distance, like the geometric circumference. This is why he wrongly called the orbital velocity a velocity, and this is why we still do it. We don't include time in the curve, we just try to add it back in at the end. This is why we retain the ridiculous habit of writing the orbital "velocity" as a length over a time, even though, as I have shown in great detail, and as was already understood long ago, the orbital motion is made up of three separate velocity vectors. Historically, common wisdom may have been that there were only two velocities over each dt, but in any case it was known that the orbital motion is not a simple velocity.

The calculus since Newton has been an algorithm that is able to describe a curve, given x and y changes. What does it find? The differential calculus finds the slope at the tangent, which we are told is the velocity at that point. Problem is, I have shown that whatever is at that point doesn't have a velocity. It has an acceleration, at the least, and in the circle it has a second-degree acceleration (three t's in the denominator). So Newton's algorithm must fail. If it works at all, it can only work on a geometric circle, where time is not passing. But a kinematic circle is not equivalent physically or mathematically to a geometric circle, so the calculus must be reworked.

Now, I have never claimed that the calculus is wrong, *in toto*. Newton was right about most things, and the calculus is a true and useful algorithm, used correctly. It works great on geometric curves, and it can be used to find π in a geometric circle. It solves one of the problems Newton wanted to solve. But as it is used now, it does not solve the problem of physical circles, because physical circles are not geometric circles. Their curves are not equivalent mathematical entities. This being so, I must show how they differ and how the foundations of circle analysis must change. Clearly, I cannot do this with raw equations. Reworking an entire algorithm takes a good deal of groundwork, and that groundwork requires a good deal of explanation. You cannot rewrite two and a half millenia of history with a half page of raw equations. If I want to make a major correction, I must first convince that the correction is necessary. I hope I have done that, at the least.

The Greeks got us off on the wrong track by assuming that the arc approached the chord as we exhausted the series (Archimedes actually let smaller and smaller chords approach the circle, in the form of polygons, but the idea is much the same, in reverse). Newton and others solidified this error by formalizing it with their calculi, and Cauchy covered up the error with an even less physical formalization. For the past 200 years, this error has been unrecognized because it was unrecognizable. As the calculus—and thereby the curve—is now taught, no one could possibly uncover any of this. Both the calculus and circle geometry are taught as a series of increasingly abstract equations, not as logical steps, physically grounded. But when you return to the diagrams, as I have here, it is shockingly easy to see that circular motion is another big mess.

Quantitatively, this may be THE biggest error in all of math and physics, since every single physical equation with π in it must now be thrown out and redone. The transform π must be jettisoned from all of kinematics and dynamics.

You may ask how physics has existed with such errors for so long. Shouldn't all engineering be impossible with errors of this magnitude? Shouldn't all of our machines immediately break and crash? Not necessarily. Because we make the same mistakes in all our equations, the equations are correct relative to each other. Most of engineering is concerned with relative numbers, not absolute numbers. For example, it is more important in physics—at least as a matter of engineering—that we know the how the gravity of Venus compares to the gravity of Mars, than that we know the real gravity of either one. If we are wrong about all of them in the same amount, most of our machines will still work. Only rarely will a mistake in absolute numbers affect engineering of any kind. I could show this with specific examples, but I believe it is clear enough regardless.

Now to sum up. You should take from this paper several things: 1) There is no such thing as an orbital velocity. An orbital "velocity" is actually the summation of three separate and separable velocities. In the diagram above, the orbital motion is AB - BD + DC, which is obviously the same as AD + DC. 2) A curve may not be measured by straightening it out like a piece of string. In any physical situation, the distance traveled along a curve is found by running perpendiculars and in no other way. As I have shown, you do not have to go to any limit: all you have to do is draw the largest perpendiculars. In the example above, you do not need to draw lots of little steps and go to a limit: just draw AD and DC. As long as AB equals AO, AB will always equal AC. 3) The circumference equation is now C = 8r = 4d. This means that π is extinct.

All the thousands of mathematicians who have been chasing more and more precise values for π have been chasing a phantom. For, although their equations may be correct in most ways, their assumptions are wrong. Their first assumption has always been that Newton understood circle geometry and that he understood how to do calculus. Mathematicians and physicists since Newton have simply taken his postulates as true: they have taken his algorithm and attempted to fine tune it. But the algorithm is faulty at the foundational level, and has been for millenia. Newton's first and fundamental lemmae—which are themselves based on the assumptions of the Greeks—are all false. At the limit, the tangent is not equal to the arc or the chord, as I have shown elsewhere. The chord is never approached by either the arc or the tangent, or by any other mathematical entity in trigonometry or calculus. In creating or measuring the circle, we are not exhausting polygons, either inscribed or superscribed, so the chord is immaterial. To create or measure the circle, we should do it as I have done it here: with orthogonal vectors. If we choose the correct vectors, we do not have to approach any limit. We can use a sort of exhaustion, but we do this only to show that the largest vectors are correct to begin with. I "exhausted" a process of measurement above (by increasing the steps along the arc), but this exhaustion did not take our distance to a limit. It only showed that, *as a distance*, one path was equivalent to another. Since this was what we were seeking with the circumference, it gave us a very simple and quick method. By choosing precisely the right analysis and interval, we were able to solve without calculus, without limits, without infinitesimals, without ultimate ratios, and without integration or differentiation. In a nutshell, I returned to the pre-calculus analysis of the Greeks, which lay under all modern analyses. By correcting that analysis in a simple but crucial way, I have changed and corrected every piece of circular math and analysis since then. This means that π is now a relic (except perhaps in scalar equations, like area and so on). Some will be distraught that so much earnest work has been wasted, both in mathematics and physics; but rather than hone an error to the end of time, surely it is better to discover the simple truth at last.

For experimental proof of this paper, you may go to Proof from NASA that π is 4.

*For more on this, see my paper on the calculus.
