Calculus

by MILES MATHIS

Contents

I GENERALITIES 1

1 CENTRAL DISCOVERIES 3

2 DEATH BY MATHEMATICS 25

3 ELEVEN BIG QUESTIONS 35

4 A REVALUATION OF TIME 47

5 ANGULAR VELOCITY 57

6 UNIFIED FIELDS IN DISGUISE 65

7 THE KINETIC ENERGY EQUATION 71

8 THE EQUATION $V = V_0 + AT$ 77

II CALCULUS **85**

9 A REDEFINITION OF THE DERIVATIVE **87**

9.1 *The Groundwork* 91
9.2 *Historical Interlude* 103
9.3 *The Rest of the Groundwork* 111
9.4 *The Algorithm* 114
9.5 *The Derivation* 119
9.6 *Application to Physics* 123
9.7 *The Second Derivative – Acceleration* 126

10 THE CALCULUS IS CORRUPT **133**

11 DERIVATIVE FOR POWERS **139**

12 DERIVATIVE FOR EXPONENTIALS **151**

13 DERIVATIVE FOR ln AND 1/x **179**

14 DERIVATIVE FOR log **195**

15 VARIABLE ACCELERATION **199**

16 CALCULUS SIMPLIFIED **211**

17 TRIG DERIVATIVES **233**

18 ANOTHER FATAL FLAW **239**

19 NEWTON'S LEMMAE **245**

20 THE EQUATION $a = v^2/r$ **257**

20.1 Newton's Derivation 259

20.2 The Current Solution 264

20.3 Feynman's Variation 268

20.4 My Solution 272

20.5 Implications 281

21 CLARIFICATION OF $a = v^2/r$ **287**

PREFACE

It has been known for millenia that the Earth rests upon the back of a giant turtle. Only in recent centuries has this knowledge been added to. In 1794, in one of the high valleys of the Himalayas, one of the wise was asked, "Master, what does the turtle rest upon?" The Master answered: "It is turtles all the way down, my son." But now that scientists have finally succeeded in mapping the universe, a turtle controversy has arisen. It turns out that level 7,484,912 is occupied not by a turtle, but by a man dressed as a turtle. It is not known how this will affect our other equations.

You probably aren't used to having a book on science and math open with a joke. But a sense of humor is crucial to existing in a world where even our greatest accomplishments contain large elements of the absurd. Some contemporary thinkers are of the opinion that we are very near to a complete understanding of the universe. I am far from agreeing with them. We have made some wonderful discoveries and are due a small dose of pride, I suppose. But the things we don't know so overwhelm the things we do that any talk of a full understanding is just bombast. Worse, it is hubris. It may even be a scientific sacrilege, with real curses attached to it. When we become too secure in our knowledge, we stop questioning. Failure to question is the ultimate scientific failure. Answers quit coming precisely when they aren't sought, and they aren't sought precisely when they are (erroneously) thought to be in hand. We are like the dog who discovers how to use the little flap-door and now considers himself master of the house.

He lies in front of the fire and congratulates himself for his cleverness. He would be better outside chasing rabbits.

In this book I propose solutions for several of the greatest errors currently existing in physics and mathematics. I do not propose to solve all the greatest errors, of course, or even to know what they are. I only present the ones that have become known to me in my years of research. Many may find my list surprising or even shocking, since I do not seem to choose problems that are commonly acknowledged to exist. Rather I choose problems that are believed to have been solved. This, I realize, can have the appearance of caprice or insolence, but I have simply gone where my nose leads me. I suspect that the whole history of science has moved in much the same way, so I will not apologize for seeing problems where I see them.

Lest I be dismissed as a crank before my first equation hits the page (and this sort of dismissal has become pandemic in the field), I rush to add that I am not a so-called classicist, bent on refuting Relativity and Quantum Mechanics simply because they disturb my sense of balance or my love of Newton.[1] I attack Newton as well, long and – I like to think – shockingly. Beyond that, I am convinced of time dilation and length contraction and the necessity of transforms. I simply do not believe that Einstein provided the correct transforms. Likewise, I believe in the accuracy and usefulness of many of the equations of QED. But QED is still in large part a heuristic math posing as a theory. Even Feynman admitted this before he died, to the chagrin of most in the field. QED is not "the final solution" until it is fleshed out with a coherent theory. I believe, contra current wisdom, that QED *will* be provided with a coherent theory, one that makes sense even in the macro-world.

I am not a classicist, nor am I in any of the other dissenting groups that are opposed to the standard interpretation of Einstein. That is to say, I am not proposing supra-luminal theories or any other theories that go beyond the math and theory

[1] I am also not any sort of conspiracy theorist. I do not believe that Einstein plagiarized anyone, not even his own wife. I have no special regard for German philosophy or special disregard for Jewish scientists. I am not here to bury Einstein or to praise him. I am here to mathematically evaluate his equations. I find it a shame that the field has already been so muddied by politics and other petty misunderstandings that an objective critique has become a near-impossibility.

of Einstein. I am not proposing any new particles, forces, fields, or maths. All the major chapters and findings in this book deal with straightforward mathematical analysis of famous historical papers and theories. For the most part, this analysis is high-school level algebra applied to these papers. In critiquing the calculus, some rather subtle number theory is used, but no higher math at all. This means that this book is unlike anything you have read or heard of before. It is not allied to the status quo, but it is also not allied to any of the dissenting groups. It is completely outside the 20th century argument, since it cannot be said to be ultimately pro-Einstein or contra-Einstein, pro-Newton or contra-Newton. It is pro-Einstein in that his theory (and Lorentz's and Poincare's, etc.) is shown to be correct in many important ways. However, it is contra-Einstein in that my algebraic corrections falsify some fundamental assumptions and equations. How you would classify my correction is therefore more a matter of your own allegiances than mine, since I have none.

This book differs from all the other critiques I have seen of current theory in that my arguments are not mainly philosophical or even theoretical. They are mathematical. I rerun the original equations in the original papers and show where the specific mathematical errors are. In this I believe I may be the first. Especially as regards Relativity, there has been a massive amount of criticism and absolutely no mathematical proof to back it up. A few mathematical variants have been put forward, some with a certain amount of validity; but no one has shown where Einstein's math is wrong in itself. Herbert Dingle, perhaps the most famous critic of Einstein in the 20th century, said in the 60's that he was astute enough not to search for mathematical errors in the theory. Whether his astuteness was based upon the recognition of his own mathematical limitations or upon some other factor is less clear. I suppose current wisdom is that because they are assumed to have been combed by everyone from Bohr to Feynman, the equations must now be unassailable. But nothing in this world is unassailable, as Einstein's refutation of Newton was supposed to have proved. Newton survived two hundred years of geniuses before Einstein appeared. If Einstein had been cowed by genius, I would now have nothing to critique. But Einstein did not see problem-solving as an attack upon genius or upon the status-quo, or as the solution to his career aspirations; he saw it simply as problem solving, let the cards fall where they may.

My critique of Relativity was begun to solve a problem – that of the Pioneer

Anomaly. I therefore approached the problem as both mathematician and physicist. I saw the final equations of Einstein as applied mathematics. Not esoteric theory, but physical equations. They therefore must be made to make sense not only as abstractions but as predictors of motion. In this they were failing. The physical community had finally been forced to admit this in 1999, when, after almost 30 years of fiddling, they had still been unable to solve the Pioneer Anomaly. So the Jet Propulsion Lab allowed *Newsweek* to report on the anomaly. Unfortunately, from the point of view of theoretical physics, this only brought the final cranks out of the closet. Physicists were inundated with new theories but none of them were seen to be at all promising. A good percentage were apparently written on the back of paper napkins, if the horror stories we hear are to be believed. So the walls went back up, and this time they were forbiddingly high and reinforced. The physical community wanted to waste no more time with paper napkins.

In some ways this was understandable. In other ways it was tragic. It has become a common feature of modern life in almost all fields – publishing, art, science, airport security, etc. The presumptions and unmannerly behavior and outright sociopathy of some have restricted the communications and movements of all. We all of us have had so many bad experiences that we begin to doubt the possibility of a good one. And there are other factors, ones which the physical community must take responsibility for. Closed doors and closed minds are not found only in town councils and corporate meetings.

For this reason and many others, Relativity is now the strangest sub-field in all of physics. In the universities, it barely exists. As a living field, it does not exist at all. What I mean by that is there is no sub-department of Relativity at most universities. It is not taught as a sub-field that you can enter and hope to make a contribution to, like all other sub-fields in physics. Relativity is taught as dogma – as a finished field. You learn it only to use in other fields. At the university and research level, Relativity is only a defensive field. Most of the work now done in the field is in keeping away pests. Look at *Physical Review Letters* or *ArXiv*, and their positions regarding Relativity. No research papers are published. None. None are even considered. In the past two decades, the editors of most journals have fortified all means of approach, in order to fend off invaders. These invaders, rather than give up, have instead multiplied. The internet has allowed for the mutual support of a vast sub-culture of doubters, nay-sayers and theorists. As would be expected of any large group, most are deluded. But the sheer size and persistence of this group has forced the status quo to extreme measures, including blacklisting. The major journals have blacklisted not only pesky outsiders, but also marginal characters from within the field. As part of this blacklisting, the field of physics has quite simply shut the sub-field of Relativity.

This all goes to say that it is a very different world intellectually than the world Einstein entered when he began publishing with *Annalen der Physik* in 1901. The field of physics had not yet closed itself off from “amateurs.” It was remembered then that Newton was an amateur – a self-taught mathematician and physicist – as were many of the greatest scientists and mathematicians of history. Einstein was a bit of an amateur himself, as the stories of his patent office imaginings confirm. The “university professional” was still a thing of the future. Forty years later amateurs still existed, though in fewer numbers. Karl Popper was resented maybe, but he was respected by most. Einstein himself understood the necessity of philosophy in the intellectual sciences, and he tied his theory early on to various epistemologies and metaphysics. He found it just as important to learn to speak of Kant and Hume as to learn the equations of Riemann. He was the last to do so.

The next two generations of physicists would lose all respect for the past. First Relativity and then Quantum Mechanics were seen to supercede all the theories of the past, and history became a clean slate. Richard Feynman could speak of philosophers with open disdain, and even Einstein was given only lip service. Einstein’s “regression” into philosophy and his quarrel with the Copenhagen interpretation of QED made him a dinosaur in his own lifetime. TIME magazine may have voted him the most important person of the 20th century, but physicists considered him a befuddled old classicist by the 1940’s.

My mathematical critique of Special Relativity therefore arrives at a rather inauspicious time. It could not be less welcome. This is ironic considering the mixed respect that Einstein has in the field of physics. He is believed to have been mistaken about almost everything important, in the grand scheme of things; and yet the equations of Relativity are sacrosanct. They are sacrosanct not because they are understood and admired – they are sacrosanct because they are the foundation of so much current research. Relativity theory is a miniscule part of modern physics. Very few people know anything about it. The few that do are working on billion-dollar projects – to discover the graviton or launch the next satellite. The last thing they want is some theoretical controversy to get in the way of funding. Even these scientists know very little about the theory. Most are glorified engineers. Theoretical physicists do not work in Relativity, since there is believed to be nothing left to do. The big names are in QED, especially in string theory and other esoteric modeling. They are also not interested in Relativity. It is no longer sexy. It is a settled question. It is not up for discussion.

So you can see that the field, despite seeming to be at a very creative time historically – due to the theoretical freedom that the top physicists would seem to have – is actually quite rigid and dogmatic. There are certain things you do and certain things you do not do. Superstring theory is prestigious. Looking at basic algebra is not. Looking into the distant future is progressive. Looking at old dusty papers is not. Tying esoteric theory to time travel and science fiction and Star Trek and the Dalai Lama is *au courant* and cool. Tinkering with ancient history is not. Stephen Hawking can claim that physics will be over in ten years, since ten years is still in the future (and apparently always will be, by some paradox), and not break any unstated laws. But a scientist who claims that Einstein or Newton or Feynman may have made a verifiable mathematical error is seen as monomaniacal and anti-social.

Despite all that, I am confident that my math will speak for itself with those who have eyes to read. It is to be hoped that I have left very little room for argument in my equations. Metaphysics may allow for endless bickering, but algebra was invented to finalize the argument. Even the tensor calculus may allow for some movement: there are places to hide amongst the matrices. With algebra there is no shelter as large as a shrub to huddle beneath.

Concerning my critique of the calculus itself, my argument there is likewise unobstructed. A chart that lists differentials is not open to much interpretation or misinterpretation. I do not open myself up to deconstuction. Even if you don't like my comments regarding the historical method, or my explanation of graphing, it is hard to deny that I have solved the calculus "without the calculus". This, by itself, is news on a grand scale.

I began this book when I stumbled across the first great error many years ago, in reading Einstein's *Relativity*. Although it soon became apparent that the error was both elementary and profound, I thought at the time that it was an isolated error. But my naivete evaporated as I subsequently reread other important theoretical papers, and my awe of the past evaporated with it. What I came to realize, with rising disbelief (as well as some excitement), is that my faith – the faith of all scientists – in the basic theory and math of physics has been unfounded. It became apparent that the theory and math of many famous and influential papers, both classical and modern, had never been checked closely – or not closely enough for my taste at any rate. Buried in these papers were algebraic and geometric errors of the most basic kind. Suffocating beneath dense, often impenetrable theories and unnecessarily difficult equations of so-called higher math were errors that a high school student could understand, were he or she presented with them in a straightforward manner.

My goal became to do just that. To strip physics of its mystifying math, its unnecessary proliferation of variables and abstract concepts, its stilted language and dry jargon, and to speak in clear everyday sentences and simple equations. Einstein is famous for stating that a theorist should be able to explain his theory to an eighth grader, but he did not practice what he preached. Like his precursors, he could not explain his theory even to his peers. Relativity has remained uncorrected for a century not because it is flawless but because, as written, it has been impervious to understanding. Nor was this imperviousness an accident. Some might argue that Einstein simply fell a little short in places – no theory is born in complete and perfect form. But this belief cannot hold: Einstein imported the tensor calculus into Special Relativity himself, though it was completely unnecessary and ill-advised. He did this mainly as a public relations move, to impress the mathematical elite, to dress his theory up for the trip to Princeton. But this move has been disastrous, since it buried the math of the 1905 paper, making any correction almost impossible, *especially* by those who had taken the time to learn the new math. Those most likely to be able to correct the initial mistakes – the brightest minds in the field – had been diverted. They have been diverted ever since. No one who had spent five years learning General Relativity and its math would want to waste any time looking at basic algebra. It would be like Mozart stooping to think about scales. The math of Minkowski was another unfortunate addition to the mess, as I show in my paper on him. The false symmetry he gave to the time variable, and then the loss of that variable altogether, further cloaked the theory and algebra of Relativity. Very early in its history Relativity had already become the most esoteric of esoterica, and, despite its inherent mathematical simplicity, it was sold to the world as if this were its strong point. Bohr said that by the '20's only six people understood it. I now know that he overstated the case by six. Anyone who had understood its theory would have corrected its math, since the mathematical errors are so simple.

As incredible as it may seem that errors have remained uncorrected in Relativity for a century, that time period is actually quite small compared to other errors I will relate here. The errors of Newton have persisted untouched since he made them, traveling unnoticed beneath the noses of the greatest mathematicians in history. And the errors embedded in the calculus are older still. We have to go back to ancient Greece to find the theoretical underpinning of Newton's and Leibniz's calculi. This theoretical underpinning was often improved upon in the 2000 years between Archimedes and Cauchy – which makes it all the more amazing that it is false. Mathematicians spent two millennia refining an error. The calculus is true, but its theory is false. It does not work the way anyone has ever thought it does, or for the reason anyone has ever thought it does. It has nothing to do with infinitesimals or limits. But I am giving away the ending of a great story.

It was fortunate that I discovered early on the soft underbelly of modern math, for it allowed me the rare privilege of transcending it. I saw almost from the beginning that esoteric maths such as the tensor calculus had become obstructions to true understanding. If the tensor calculus could build its greatest structure on the false math of Relativity, then it must be an overrated tool. An architect who knows his job does not build a palace on a sand pit, and the mathematician is a fool who spends his college years diddling with a math better done on computers, when he doesn't understand algebra or geometry.

As a tonic to this chaos, I have tried at each point in my proofs to use the simplest math possible. This runs counter to current dogma, which tells us to impress each other with the most difficult math imaginable at all times. Simple math is considered neither sexy nor imposing. It also cannot be used as ballast, as misdirection, or as obfuscation. It is therefore not of much use to the modern theorist. Careers are advanced by advanced math; nothing is propelled by simple algebra, it is thought. Despite this, I have found that algebra is the first and most useful tool for unraveling the mathematical mystifications of the past. In the beginning, Special Relativity was proved by Einstein with algebra. The 1905 paper has only one line of calculus in the proofs of the transforms, which line is redundant padding. These transforms are exactly the same ones proved today with the tensor calculus. But the obvious tool to critique algebra is better algebra.

In correcting the foundation of the calculus I did not need calculus or any math evolved from it. I only needed basic number theory, which basic theory is now so elementary as to be forgotten. The modern mathematical method for solving any problem is to come at it from above, with more and more abstract math. My method is to come at it from below, questioning the fundamental postulates and often simple math that have been lost to view over time. As an example, the problem of gravity is being attacked now with superstring theory, which preens itself on its mathematical complexity and its theoretical density. But I believe that gravity will be solved by unlocking simple algebraic relations among classical variables. There is very much in the existing theories of Einstein, Lagrange, Hamilton, Newton, Kepler, Galileo, and even Euclid that has not been resolved. Leaving these mysteries in the trash in order to concentrate on new mathematical paradoxes is a grave error in judgment.

Descartes (who also missed seeing the fundamental error of the calculus, by the way) said in his *Meditations* that he had reached a point of absolute doubt. He felt he could rely on nothing around him. He must start over from the beginning, taking as true only what he could prove himself. Most philosophers now believe that Descartes was only using a convenient method of argumentation, one that did not seem so unique, or so egotistical, in the 17$^{\text{th}}$ century. But I believe he was in earnest. I find his doubt highly plausible, even beyond its usefulness in critiquing the unsupported beliefs around him. As more and more of the pillars of my certitude fell, I too reached a point of near-infinite doubt. I found that I could no longer look at any theory or equation, no matter how self-evident it seemed, without checking the math from top to bottom. No more would I take any proof on faith, assuming, as an example, that a short series of equations by Richard Feynman must be correct, simply because I knew that he was famous for being a great mathematical physicist. I have since found absurdly simple mistakes everywhere I looked. In fact, it has been rare that I have checked anyone's math and found it correct. I have gone through textbooks, finding algebraic errors on nearly every page. The calculus is almost universally misused, even beyond its cardinal error in claiming to find instantaneous values. The newer maths, many of them offshoots of calculus, are likewise flawed in many fundamental ways, from set theory to topology to Cantor's theory of infinities.

I know that most will be shocked at my presumption, and the rest will question my credentials. But I can only answer that physics has never, in the whole history of science, had anything to do with credentials or false humility. It has to do only with truth. If my equations are faulty, then I am abashed. If my theory is incomplete, I am vulnerable. But no one should have to apologize for having the courage to question, or to present his findings. The overly socialized and pressurized milieu we live in, where intelligent and earnest people are dismissed for the flimsiest of reasons, or for no reason, and where most people are cowed into permanent silence, has more to answer for to history, or to the gods of physics and math, than I ever will for my boldness.

Part I

GENERALITIES

Chapter 1

THE CENTRAL DISCOVERIES OF THIS BOOK

a top-ten list

nullius addictus iurare in verba magistri[1]

[1] "I am not required to accept the word of any master." [Lat.] This is the motto of the Royal Society of Science in England, meant to assert the independence of science from various author-

It is no longer common for mathematicians or scientists to publish entire books full of new information or theories. Due to specialization, the normal procedure is to publish experimental findings augmented by very limited theoretical suggestions. By and large, theory is left to a select and limited number of specialists. Those in the center of the field would claim that this is a sign of their maturity, humility, or other positive quality, suggesting that those on the margin who are rash enough to have their own ideas must be immature, immodest, or otherwise deluded. In doing this they neglect to notice that the entire history of science has proceeded along other lines, and that the contemporary hierarchy would be seen as abnormal, inefficient, and ridiculously regimented by anyone from the past, even by those from the recent past like Einstein and Planck and Maxwell.

This is as much as to admit that I know that my book must seem an anomaly as well as an anachronism. Both its form and its content must seem strange to a modern reader. To counteract this I have found it necessary to write this general overview. In it I will briefly describe the highlights of my research, hopefully whetting the reader's appetite for the longer papers. None of my papers contain difficult math or esoteric ideas, but here I will simplify even further, offering the sort of critical gloss a publisher or editor might make a hundred years from now, assuming my ideas are correct. Most of these papers are now several years old, and already I have a bit of hindsight regarding them. This makes it possible for me to rank my findings in order of importance, and to contextualize them for you as I list them. This may give you a place to start in your readings, or it may supply you with a clearer understanding of what I think I have achieved. Either way, given that the book has now gone past 1,200 pages, I think it has become a PR necessity, if nothing else.

I am probably most widely known online for my algebraic analysis of special relativity. Many readers, if they were writing this, would probably begin there. But I am going to start with other things here. I do this for two reasons. One is that many readers coming to a new website will be prejudiced against relativity naysayers. I am not a normal relativity naysayer since I accept time dilation and

---

ities; but ironically we must now apply it to them, the various academic societies in the US, and to the standard model worldwide, which has taken over the dictatorial powers of the old Church and Monarch that Galileo and Newton had to resist. Mainstream science has itself become the authoritative and tyrannical magister or master.

the basic claims of SR. All I do is fine-tune the transforms, so that they match the latest experiments. But once people peg you as a naysayer of SR of any kind or in any amount they have great difficulty taking anything else you say seriously. This is a fact I have been forced to accept, whether I agree with it or not. It is a sign of the times and cannot be ignored. The second reason is that I believe a number of other findings of mine will be considered to have more lasting importance than the relativity corrections. These findings are both more fundamental and more inventive. To add yet another level of tidiness, I will begin with the oldest problem I have solved: meaning the problem that had persisted for the most amount of time before I solved it.

That oldest mistake is one that Euclid made. It concerns the definition of the point. Entire library shelves have been filled commenting on Euclid's definitions, but neither he nor anyone since has appeared to notice the gaping hole in that definition. Euclid declined to inform us whether his point was a real point or a diagrammed point. Most will say that it is a geometric point, and that a geometric point is either both real and diagrammed or it is neither. But all the arguments in that line have been philosophical misdirection. The problem that has to be solved mathematically concerns the dimensions created by the definition. That is, Euclid's hole is not a philosophical or metaphysical one, it is a mechanical and mathematical one. Geometry is mathematics, and mathematics concerns numbers. So the operational question is, can you assign a number to a point, and if you do, what mathematical outcome must there be to that assignment? I have exhaustively shown[2] that you cannot assign a counting number to a real point. A real point is dimensionless; it therefore has no extension in any direction. You can apply an ordinal number to it, but you cannot assign a cardinal number to it. Since mathematics and physics concern cardinal or counting numbers, the point cannot enter their equations.

This is of fundamental contemporary importance, since it means that the point cannot enter calculus equations. It also cannot exit calculus equations. Meaning that you cannot find points as the solutions to any differential or integral problems. There is simply no such thing as a solution at an instant or a point, including a solution that claims to be a velocity, a time, a distance, or an acceleration. Whenever mathematics is applied to physics, the point is not a possible

[2] Chapter 9

solution or a possible question or axiom. It is not part of the math.

Now, it is true that diagrammed points may be used in mathematics and physics. You can easily assign a number to a diagrammed point. Descartes gave us a very useful graph to use when diagramming them. But these diagrammed points are not physical points and cannot stand for physical points. A physical point has no dimensions, by definition. A diagrammed point must have at least one dimension. In a Cartesian graph, a diagrammed point has two dimensions: it has an x-dimension and a y-dimension. What people have not remembered is that if you enter a series of equations with a certain number of dimensions, you must exit that series of equations with the same number of dimensions. If you assign a variable to a parameter, then that variable must have at least one dimension. It must have at least one dimension because you intend to assign a number to it. That is what a variable is – a potential number. This means that all your variables and all your solutions must have at least one dimension at all times. If they didn't, you couldn't assign numbers to them.

This critical finding of mine has thousands of implications in physics, but I will mention only a couple. It has huge implications in QED, since the entire problem of renormalization is caused by this hole in Euclid's definition. Because neither Descartes nor Newton nor Schrodinger nor Feynman saw this hole for what it was, QED has inherited the entire false foundation of the calculus. Many of the problems of QED, including all the problems of renormalization, come about from infinities and zeroes appearing in equations in strange ways. All these problems are caused by mis-defining variables. The variables in QED start acting strangely when they have one or more dimensions, but the scientists mistakenly assign them zero dimensions. In short, the scientists and mathematicians have insisted on inserting physical points into their equations, and these equations are rebelling. Mathematical equations of all kinds cannot absorb physical points. They can express intervals only. The calculus is at root a differential calculus, and zero is not a differential. The reason for all of this is not mystical or esoteric; it is simply the one I have stated above – you cannot assign a number to a point. It is logical and definitional.

This finding is not only useful in physics, it is useful to calculus itself, since it has allowed me to show that modern derivatives are often wrong. I have shown that the derivatives of ln(x)[3] and 1/x are wrong, for instance. I have also shown that many problems are solved incorrectly with calculus, including very simple problems of acceleration[4].

This finding also intersects my first discoveries in special relativity, which I will discuss in greater detail below. The first mistake I uncovered in special relativity concerned Einstein's and Lorentz' early refusals to define their variables. They did not and would not say whether the time variable was an instant or a period. Was it t or Δt? Solving this simple problem[5] was the key to unlocking the central algebraic errors in the math. Once it was clear that the time variable must be an interval or period, at least two of Einstein's first equations fell and could not be made to stand up again.

Next is my Unified Field Theory[6], just added to this list. I haven't put it above the correction to the point, since the correction to the point determined a part of my UFT. At the heart of my UFT is the discovery that Newton's gravitational equation is a compound equation, one that already includes the foundational E/M field or charge field. I show that the current "messenger photon" cannot be virtual and that the field must be both real and mechanical. This means that Einstein's field equations are also compound equations. Einstein already had a UFT and didn't know it. But my theory goes far beyond this, since I don't just pull the lid off Newton and Einstein and then stand back. I segregate and simplify their equations, showing many many new things, including a correction to the perihelion of Mercury[7], a mechanical solution to the Metonic Cycle[8], and a new theory of tides[9]. I also show that the universal gravitational constant G[10] is a transform between the two constituent fields of Newton's equation. This allowed me to solve the dark matter problem, including the galactic rotation problem[11] and the bullet cluster problem[12], by showing that the charge field outweighs

[3] Chapter 13
[4] Chapter 15
[5] http://milesmathis.com/long.html
[6] http://milesmathis.com/uft.html
[7] http://milesmathis.com/merc.html
[8] http://milesmathis.com/meton.html
[9] http://milesmathis.com/tide.html
[10] http://milesmathis.com/g.html
[11] http://milesmathis.com/mond.html
[12] http://milesmathis.com/bullet.html

normal matter by 19 to 1. Dark matter is not non-baryonic, it is photonic.

As the second part of this Unified Field Theory, I have also deconstructed Coulomb's equation[13]. I show that Coulomb's constant k is tied to the Bohr diameter, and that when applied to quanta we can drop this constant from the equation. Like G, k is a scaling constant, and at the quantum level we have no need to scale. Among other things, this changes the force between electron and proton by a factor of 10-19. The charge part of this unified field has also allowed me to easily solve Bode's Law, resolving all the error, and to show the physical cause of axial tilt. Neither Bode's Law nor axial tilt are coincidences, as we have been told.

For the next important discovery we will stay in the 20th century and look at the central problem of QED, which is superposition. The Copenhagen interpretation has assured us that quantum experiments cannot be explained in a logical mechanical way. That is, no possible visualization can explain various interactions of quanta or various mathematical and statistical outcomes. I have disproved this by explaining it all mechanically and by drawing a picture[14]. Rather than focus on statistics or math, as most or all have done up to now, I focus on the mechanics of spin. Given an x-spin, I remind my reader of the gyroscope and show that y-spin must be about an external axis. Meaning, if the radius of the x-spin is 2, the radius of the y-spin must be 4. This not only creates the mechanical and physical wave motion, it explains the statistical outcomes of all mysterious experiments. Because the spins must be orthogonal to eachother, only one can be an experimental constant. If you maintain an experimental view that keeps the x-spin clockwise, for instance, the y-spin will vary with time. The x-spin will be clockwise 100% of the time, but the y-spin will be clockwise only 50% of the time. I show this with an easy visualization. I also draw the superimposing physical waves and show the simple mechanical reason for the variance. I explain precisely how this solves the biggest statistical problems.

Using these same stacked spins, I am then able to create all the known particles, including the electron, the proton[15], the neutron, and all mesons and bosons[16].

[13] http://milesmathis.com/coul.html
[14] http://milesmathis.com/super.html
[15] http://milesmathis.com/elecpro.html
[16] http://milesmathis.com/meson.html

I am able to develop a simple quantum equation with which I can predict the masses of all known particles. These spins then replace the quark model of QCD[17], and I am able to show precisely why the quark model must fail, including the loss of the weak force[18], the strong force[19], asyptotic freedom[20], broken symmetries, and all the rest. With this same quantum equation, I am able to unify the photon[21], show how it creates its own wave with spin[22], and show how Planck's constant[23] is hiding the mass of the photon.

You would think this would also solve the double slit experiment[24] mystery, but that mystery is actually solved by the foundational E/M field. This second field in Newton's equation is emitted by the central wall in the double slit experiment. The slits create an interference pattern in this field. So the interference pattern actually exists, in a real field, before any particle is sent through either slit.

A problem I recently solved is the perihelion precession of Mercury[25]. This problem has been thought for a century to have been solved by Einstein, but I have shown major errors in the initial derivations of the field equations. The central error is applying the curvature of the field directly to the precession. Einstein achieved a number (.45) which he admitted was the field curvature at the distance of Mercury's orbit. To assign this curvature to precession requires a good deal of math, including a time assignment, and Einstein mistakenly assigned his number per Earth year. It should be assigned per one orbit of Mercury, which is a Mercury year (88 days). Then the curvature precession has to be compared in a vector analysis to the Earth's curvature precession, and Einstein ignores that as well. Finally, the precession due to perturbations has to be refigured using the new field equations, and that has never been done. I show that a correct analysis of the GR field requires a 4% correction to the historical perturbation number, and this correction was ignored by Einstein and is still ignored. This means that

---

[17] http://milesmathis.com/quark.html
[18] http://milesmathis.com/weak2.html
[19] http://milesmathis.com/strong2.html
[20] http://milesmathis.com/gross.html
[21] http://milesmathis.com/photon.html
[22] http://milesmathis.com/photon2.html
[23] http://milesmathis.com/fine.html
[24] http://milesmathis.com/double.html
[25] http://milesmathis.com/merc.html

all the current numbers are wrong. I have corrected them and achieved the right totals, without using the tensor calculus (and explaining the mechanics at every step).

A much older problem I have solved goes all the way back to Archimedes. It is closely tied to the one concerning the point. The pre-calculus was invented by the Greeks and perfected by Archimedes. Archimedes solved what we would call calculus equations by using infinite series and exhaustion. We don't use exhaustion anymore, but, via Leibniz and Newton and Cauchy, we have inherited the basic method of Archimedes. That is, we use an infinite series. This method was so difficult to put a foundation under because Newton and all the others kept trying to introduce the point into their equations. Not only did they try to introduce it into their axioms, they tried to force it to exit the proofs as well, so that they could claim to find solutions at a point and instant. The equations and proofs kept rebelling and continue to rebel to this day. The proofs do not work, but we moderns have decided to ignore that. After a century or more of worrying and arguing about it, with little to show for it, we decided to let Cauchy put a lid on it, and we have refused to open the pot since.

To solve this problem I re-invented what is now called the calculus of finite differences. Although I did not know it at the time, this form of the calculus has been around for centuries. It solves all the same problems as the infinite calculus, but it is quite easy to prove and to use. This form of the calculus falls like an apple out of an elementary number table, and students can follow this table and see for themselves how and why the calculus works, without any mystification. I have strongly recommended the replacement of the infinite calculus with the calculus of finite differences, not just for educational reasons, but because it solves many of the problems of QED and General Relativity. I have already shown how it impacts renormalization, and it does the same sort of housecleaning on GR. Most of the foundational inconsistencies in Einstein's expression of GR immediately evaporate once we jettison the point and define all space and time on intervals or non-zero differentials.

The next important problem I have solved is another one made famous by Newton, although this time he invented it without much help from the Greeks. By analyzing a diminishing differential applied to the arc of a circle, Newton claimed to prove that as the arc length approached zero, the arc, the chord, and the tangent all approached equality. I have shown[26] that Newton's analysis is false. Newton monitored the wrong angle in the triangle created, which skewed his analysis. He did not notice that another angle in the triangle went to its limit before his angle, assuring that the tangent remained longer than the arc and chord all the way to the limit. This solves, all at once, many of the mysteries of trigonometry. Newton's ultimate interval, which became the infinitesimal and then the limit, is proved by me to be a real interval, where the variables do not go to zero and they do not go to equality. This is the reason we find real values for them. Even at the limit, the tangent is not zero and it is not equal to the arc or chord. The tangent and the arc are expressed by two different (perhaps infinite) series of differentials, and these series do not approach zero in the same way. In fact, one reaches zero after the other one, which makes it a lot easier to understand why the equations work like they do.

Because Newton misunderstood circular motion in this way, he also misunderstood the dynamics of circular motion itself, and the equation that expressed it. His basic equation $a = v^2/r$, which is still the bedrock of circular motion, is wrong. If you express the orbital velocity as $v = 2\pi r/t$, then the equation must be correct, of course. We know that from millions of experiments. The problem concerns the fact that that variable cannot be a velocity. A velocity cannot curve. The circumference of a circle cannot be expressed by a simple velocity, even though the apparent dimensions of the variable (m/s) would imply that it could. Velocity is a vector, and there is no such thing, mathematically or physically, as a curved vector. By definition, a velocity can have only one spatial dimension. Any curve must have two spatial dimensions. Of course a velocity has a time in the denominator, which gives it two total dimensions. A circumference or orbit must have at least three dimensions (x, y, t).

Flying in the face of this very simple fact, for some reason Newton assigned $2\pi r/t$ to his velocity. To add to this error, he conflated the tangential velocity with the orbital velocity. Going into the series of equations that proved $a = v^2/r$, he defined v as the tangential velocity. That is, it was the velocity in a straight line, a vector with its tail touching the circle at a 90° angle to the radius. But at the end, he assigned v to the orbital velocity, which curved. Any elementary analysis must show that the orbital velocity is a compound made up of the tangential

[26] Chapter 19

velocity and the centripetal acceleration. In fact, Newton said so himself. It is a fact we still accept to this day, and it is taught in every high school physics class. If so, it cannot be the tangential velocity and it should not be labeled v.

This is of paramount importance for any number of reasons, but I will mention only a couple. Since contemporary physics has inherited this confusion of Newton and utterly failed to correct it or notice it, all our circular fields are compromised. I have shown that Bohr's analysis[27] of the electron orbit is affected by this mis-labelling, and that the equations used to calculate the velocity of quanta emitted by electrons must be falsified. Huge problems have also been caused by the ubiquitous equation $ma = mv^2/r$. The form of that equation has led many to think that the numerator on the right side is a sort of kinetic energy, but the mv^2 comes from Newton's equation, and the velocity is not really a velocity. It is not a linear velocity, but it is also not an orbital velocity. It is simply a mis-defined variable. It is not a velocity of any kind. It should be labeled as an acceleration. By correcting Newton's proof[28], I discovered that

$$\begin{aligned} vt^2 &= a^2 + 2ar \\ a_0^2 &= 2a_c r \\ a_c &= \frac{a_0^2}{2r} \end{aligned}$$

Where a_0 is the orbital acceleration, replacing the misnamed orbital velocity, and a_c is the centripetal acceleration.

By cleaning up our variables and definitions, we can avoid many problems. Just as a starter, the equation $ma = mv^2/r$ must become $ma = ma_0^2/r$. That keeps us from thinking about kinetic energy when we look at the right side, and solves many many errors, including several of Bohr, Schrodinger and Feynman.

Another interesting find[29] that intersects my book at this place is the fact that π is itself an acceleration. That is, I have shown that $C = 2\pi r$ is a distillation of

[27] http://milesmathis.com/bohr.html
[28] Chapter 20
[29] http://milesmathis.com/pi.html

$v_0^2 = 2ar$, where π stands for the acceleration and C stands for the summed orbital velocity or orbital acceleration. They are the same equation; the C equation is just the orbital equation without its full time components. Plane geometry ignores all time components, so that it allows for this simplification. Divide both sides of the C equation by t^2 and you will begin to see what I mean. It is fascinating.

In a related paper[30] I finally show that π, understood as the number 3.14, is false. In kinematic or dynamic situations, where time is a factor, π is not 3.14 but 4. Since the circumference is an acceleration, as in the orbit, it cannot be compared directly to the diameter, which is a velocity. The line and curve cannot be compared one to one, since the first has one implied time variable and the second has at least two. Once we expand them physically, it turns out that 3.14 is no longer applicable. In physics, it is not an esoteric number, it is simply a mathematical error. In physics, you cannot straighten out a curve like a string and measure it: straightening out a curve changes it both mathematically and physically. Obviously this must impact a large number of equations and a good deal of engineering.

Now we can look at my corrections to relativity. The first major correction comes from my discoveries on the point. As I said above, the time variable in SR must be a period. Einstein even admitted this in later math, when he began writing it as Δt.[31] But once the time variable is admitted to be a period, that variable must grow larger as the time dilates. Einstein admits this also.[32] Dilation means "to grow larger" and Einstein admits that as length contracts, the numerical value of t grows larger. That is why he called it time dilation, in fact. But of course this puts the two variables x and t in inverse proportion. This is important since Lorentz and Einstein both use two light equations as axioms.

$$\begin{aligned} x &= \mathrm{c}t \\ x' &= \mathrm{c}t' \end{aligned}$$

The problem is, you see, that the variables in these two equations are directly proportional, not inversely proportional. One of them must be wrong. One must

[30] http://milesmathis.com/pi2.html
[31] See The Meaning of Relativity, eq. 22.
[32] See Relativity, XII, last paragraph.

be wrong because the two equations are not analogous. In the second equation, the variables are defined as measurements within the system S'. But in the first equation, the variables are defined as those same variables as seen from S. Let me put it another way: the variables in the first equation are not defined as measurements *within* S. This would be the analogous definition, one that was equivalent in all ways to the first one. But that is not what we have. One equation describes how a system looks to itself. The other equation describes how one system sees another system. So they don't balance, definitionally. And this makes the first equation false, given the second.

You can make the first equation true, if you define it as the way S sees itself. But then you can't solve the problem of Relativity, since you have no link between the systems. The long and short of it is that Lorentz and Einstein have used a false equation.

This is not the only smashing error of SR. The other axiomatic equation of SR, used by everyone from Einstein to Russell to Feynman and beyond, is

$$x' = x - vt$$

That equation is also false. We are told that it is the Galilean or Newtonian expression of relativity, and that the Lorentz transform resolves to that equation if you make the speed of light infinite. But that is false. This may be the greatest error in the whole history of science, since it is both spectacularly wrong and transparently obvious, and yet it has survived in full view for more than a century. It is not so stunning that Einstein made the mistake, since everyone knows he was a poor mathematician. What is stunning is that it has not been discovered by any of the towering geniuses of the 20$^{\text{th}}$ century. What the Lorentz transform really resolves to if the speed of light is infinite is

$$x = x'$$

All you have to do is think about it for a moment. If x' is not equal to x, then you have a difference in length. A difference in length is defined as length contraction. But you can't have a length contraction according to Galileo or Newton.

It is impossible. That is the whole reason that relativity was invented, to formalize length contraction. And yet Einstein and everyone else has accepted that $x' = x - vt$ is not relativistic. It is relativistic, by definition, since x is not equal to x'. There is no way around it. And if it is relativistic, then Einstein's proof must be circular. He is deriving a relative transform from an equation that is already a relative transform.

If light's speed is infinite, that must mean that you see everything that I do at the same time I do, no matter how far away we are from eachother and no matter how fast we are traveling relative to eachother. Galileo and Newton didn't need a transform of any kind precisely because they thought that light had an infinite speed. The whole universe was a single system. Everyone knows that, or should. Therefore, you can't have two x's or two t's in a Galilean system. Velocity just doesn't have anything to do with it. Prime variables are disallowed in a Galilean equation, because here the prime variable applies to a second system. A velocity in Galileo's time didn't create a second system.

Fortunately, special relativity is easily solvable even without these three equations. Once I corrected these errors, and several others, I found new transforms that were close in form and output to the ones we have, which explains why SR has been confirmed despite being wrong mathematically. My corrections also allowed me to discover what I call First-degree Relativity. Einstein skips an entire co-ordinate system, jumping directly into Second-degree Relativity. That is, he finds transforms for his man moving on the train, but neglects to find transforms for the train itself. We know that all motion causes contraction and dilation, and his train is moving; but with current transforms we cannot go from numbers on the platform to numbers on the train. Interestingly, the first-degree transform is equivalent to the simple frequency transform in optics. But the second-degree transform is not *gamma* and does not include *gamma*.

I showed that relative motion toward an observer must cause time contraction, rather than dilation. Relativity is the Doppler Effect applied to clocks, and clocks moving toward us will be blue-shifted, not red-shifted. This was already known experimentally from observing binary pulsars, though no one has made the connection until now. This fact explodes the Twin Paradox. My new solution to SR also solves the Pioneer Anomaly and other anomalies.

Next I took my finding into a review of mass increase, where I discovered that once again all the equations were wrong[33]. The basic theory was correct, the equations were nearly correct, but they were compromised by many errors in many places. By making several fairly subtle tweeks, I found that Newton's equation for kinetic energy was not only an approximation, it was a precise equation. That is, if you defined the mass correctly, and used the correct transform, Newton's equation would resolve out of the mass transform equation in perfect form.

What is more, I discovered that *gamma* didn't apply to mass increase either – although here the form of the equation was a near match. We don't have the square root of *gamma*, and we have an additional term in the numerator. But you can see that we have that familiar differential in the denominator.

$$E_T = m_r c^2 \frac{1+(v/2c)}{1-(v^2/c^2)}$$

This correction to the mass transform also allowed me to propose a cause for the 108 limit to the mass increase of the proton in the accelerator, a limit that has always remained a mystery.

Next I jump to General Relativity[34], where I use Einstein's theory of equivalence to solve field equations without the tensor calculus. Simply by reversing the central field vector (gravity), I am able to create a rectilinear field that may be expressed with high school algebra. I use this method to solve Einstein's bending of starlight by the sun problem. In five lines of math I solve a problem that took him 44 pages, and I get the same answer.

$$s = \frac{at^2}{2}$$

$t =$ time for light to travel from the tangent of the sun to the earth

[33] http://milesmathis.com/emc.html
[34] http://milesmathis.com/gr.html

$=$ light distance from sun to earth + light distance of the radius of the sun

$$\begin{aligned}
s &= \frac{(9.8\,\text{m/s}^2)\,(501.32\,\text{s})^2}{2} \\
&= 1,231,477\,\text{m} \\
\tan\theta &= \text{opposite/adjacent} = \frac{1,231,477\,\text{m}}{1.50696 \times 1011\,\text{m}} \\
\theta &= 1.686\text{''}
\end{aligned}$$

I also show that his analysis of the spinning disk is false, as well as his analysis of the bending of light. Perhaps most importantly, I show that even Einstein's four-vector field is homogenous and rectilinear at the limit. He gives us this equation,

$$\sqrt{-g} = 1, \quad \text{so that } d\tau' = d\tau$$

And he says, "The invariant $\sqrt{-g}\,(d\tau)$ is equal to the magnitude of the four-dimensional element of volume in the 'local' system of reference". This is extraordinary, because if the volume of every infinitesimal is equal at the limit, then that means that everything is equal at the limit. Time and distance must be equal at the limit, which means that space is homogenous at the limit. No one has yet realized what this means. It means that the "local" system does exist, even according to Einstein. What is more, all local measurements are equal – not just as metaphysics, but as math. The standard model likes to treat relativity as if there is no way to assert or prove that all local measurements are equal. But Einstein admits right here that it is one of the assumptions of the entire theory. It is a mathematical axiom. An axiom belongs to logic, not to metaphysics.

This brings us to my paper on Minkowski[35]. Since he relied on the basic assumptions of Einstein – which I have shown are false – his math must fall as well. Minkowski's numbers, like Einstein's, are not correct. Which means that

[35] http://milesmathis.com/mink.html

his math is useless no matter how elegant it is perceived to be. It would be useless even if Einstein's equations had been true, since his axioms are false. Minkowski allows the time variable to travel at a right angle to the other variables, but this is false. It does not do so, in fact, and cannot do so. Therefore his method must be false at the axiomatic level. If your assumptions are incorrect, then your logic is incorrect, even in the case that your deductions are true. A true physical theory requires that both the assumptions and deductions are unfalsifiable. Minkowski's assumption is not just an unknown, and therefore a possible assumption. I show that it is known to be false.

Tying into this critique of Minkowski is my critique of 20th century math in general. I have shown how non-Euclidean fields[36] are used to fudge equations, how the complex number plane hides the mechanics of the electrical field, why gauge math[37] is intrusive and misdirecting, and how tensor fields[38] are misdefined and misused.

Another important part of my work in relativity has been the analysis of the Michelson/Morley interferometer, and with it the Light Clock[39]. Both ideas rely on the same basic diagram, and I show that this diagram is false. Everyone from Poincare and Lorentz to Dirac and Feynman have used an analysis of the right triangles created in these diagrams to explain time dilation, relative motion, and the speed of light. Like Newton, they have used a trigonometric diagram to prop up their theory. But also like Newton, they have failed to draw or imagine the correct diagram. In particular, the creators and viewers of the interferometer diagram seem to believe that the scientist collecting data from the machine is connected to the ether, instead of connected to the interferometer. Mostly, they leave the observer out of the diagram altogether, but when his presence is implied by the equations and the motions, it always turns out that the observer is imagined to have no velocity. In other words, the interferometer is in the ether stream, but the observer is on the shore.

But this is not how the real interferometer worked, in operation. In order to

[36] http://milesmathis.com/euclid.html
[37] http://milesmathis.com/weak2.html
[38] http://milesmathis.com/tensor.html
[39] http://milesmathis.com/lc.html

collect data from the interferometer, Michelson and Morley[40] had to sit very near it, and move as it moved. They did not let the interferometer move with the earth while they got off the earth and sat still relative to the imagined ether. Because they had the same velocity as their machine, Michelson and Morley should not have expected any fringe effect. Their expectation of such data was simply a false expectation, based on a false diagram. The interferometer could only provide a null set.

The same analysis destroys the Light Clock, since the position and velocity of the clock's observer is never defined. Exactly the same triangle is created in the diagram, and it is analyzed in precisely the same faulty ways. The Light Clock does not explain time dilation, and it leads the viewer into false equations like the ones Einstein used.

Of course, since time dilation is true, my attacks on the Light Clock and interferometer are not fatal to Einstein or relativity. My cleaner, more transparent analysis, combined with my better illustrations, allow me to show that relativity is actually much simpler and much more reasonable than we have been led to believe. It contains no paradoxes, requires no leaps of faith, and may be expressed with simple equations that anyone can comprehend.

My next major contribution to physics concerns the unseen hole in orbital mechanics[41]. This hole is a direct outcome of Newton's mistake above. To explain the orbit, Newton created a balance between the centripetal acceleration and the tangential velocity. But because he later failed to differentiate between the tangential velocity and the orbital velocity, both his and Kepler's analyses of orbits have come down to us hiding magnificent messes. Physicists now commonly sum the motions in the circuit to show that the orbit is closed, but the problem is with the differentials. In any problem with three or more bodies, Newton's balance between the two motions cannot be maintained. An analysis of the differentials must show a variation in the tangential velocity of all orbiters, in order to correct for forces outside the main two. But orbiters cannot vary this velocity. They are not self-propelled. Newton told us that this tangential velocity was innate; an innate motion cannot vary. We have not shown any mechanism or cause

[40] http://milesmathis.com/mich.html
[41] http://milesmathis.com/cm.html

of this variance, therefore we cannot let it vary. To put it another way, the variance is totally unexplained and unsupported. It has been covered up, possibly on purpose.

What this means is that orbital mechanics is just magic. The mechanics we have doesn't work and we haven't even tried to replace it with one that does. General Relativity has nothing to say about this problem, doesn't solve it, and doesn't address it. GR supplies us with an orbital math that includes the finite speed of light, but it doesn't even try to correct the mechanical foundation of the orbit. Courtesy of the tensor calculus, the problem is just buried deeper, under a heavy mathematical blanket.

Kepler's ellipse[42] has the same hidden problem, a problem caused by the general ignorance of the difference between orbital and tangential velocity. Kepler's ellipse doesn't work mechanically, since his second focus is uninhabited. The orbiter is forced to vary its tangential velocity to suit the math of the summed circuit, but no explanation of how it could do this is offered.

I solve this problem by using the E/M field as a third component. Orbits are not caused only by gravity and innate motion. They require a third motion, and this motion is caused by the combined E/M fields of all bodies involved. With this third motion, it is possible to fully explain all the motions we see.

For the same reason, Laplace's equations[43] for Jupiter and Saturn also fail. Laplace "solved" the Great Inequality between the two planets mathematically, but his mathematics has no mechanical underpinning. I show that the foundational E/M field is required once again to explain the resonance that Laplace's math contains.

Tides also enter this revolution in theory, since tides are not simply gravitational either. In a long paper[44] I show that current tidal theory has huge fatal holes in it, holes that can only be filled by the E/M field. Saltwater is a very good conductor, and you will have to let that fact lead you into the longer paper, since I will not address the full theory here. Suffice it to say that the idea of the barycenter is a critical part of my analysis, and that I diagram and analyze that idea even more

[42] http://milesmathis.com/ellip.html
[43] http://milesmathis.com/laplace.html
[44] http://milesmathis.com/tide.html

fully than Feynman was able to do. This proves that the field between the Earth and Moon is a unified field.

Finally, I think I must mention my critique of String Theory[45], if only as a nod to current physics. I do not think my critique of String Theory will actually have any long lasting effect, since String Theory will have no long lasting effect. However, my critique is as sharp and amusing as anything I have written, and many readers have recommended it as one of their favorites. If you need something a bit lighter to break up your more serious reading, this might be one place to go.

To recap:

1. I show that you can't assign a cardinal number[46] to a point, which begins the revolution in both physics and mathematics. The point and the instant are jettisoned from physics, and all math and science since Euclid must be redefined.

2. In my Unified Field Theory[47], using Newton's gravitational equation as a compound equation, I separate out the foundational E/M field and then reunify, including Relativity transforms. In a related paper[48], I show that G acts as a transform between these two fields. Likewise, I pull apart Coulomb's equation[49], showing that it is another unified field equation in disquise. In another related paper[50] I show that this foundational E/M field is emitted by the central wall in the double slit experiment, creating the interference pattern before a single photon moves through the apparatus.

3. Superposition is explained mechanically[51] and visually, in a rather simple manner. Using the gyroscope, I physically create x and y spins and draw the physical waves created. This explains the wave motion, it dispels many statistical mysteries, and it falsifies the Copenhagen interpretation. Using

[45] http://milesmathis.com/string.html
[46] Chapter 9
[47] http://milesmathis.com/uft.html
[48] http://milesmathis.com/g.html
[49] http://milesmathis.com/coul.html
[50] http://milesmathis.com/double.html
[51] http://milesmathis.com/super.html

this same spin model, I am able to show the make-up of all fundamental particles, including the electron and proton, without quarks. I am able to unify the electron, proton, neutron[52], and all mesons[53], by developing a simple spin equation. With four stacked spins I can produce all known particles and effects.

4. I correct all the numbers involved in the perihelion precession of Mercury[54], proving that Einstein's analysis was very incomplete.

5. Calculus is redefined on the finite differential, which will revolutionize the teaching of calculus as well as QED and Relativity. In fact, the fields of all higher math must be redefined. This discovery ultimately bypasses renormalization, making it unnecessary.

6. I show that many of Newton's important lemmae are false, including his basic trig lemmae. His proof of $a = v^2/r$ is compromised by this, which forces us to re-analyze circular motion. The mechanics of his orbit also falls, which requires us to hypothesize a third motion to stabilize the orbit in real time. I have shown that this motion must be caused by the E/M field. This also applies to Kepler's ellipse. And it explains the mechanics of tides.

7. I also redrew the line between tangential velocity and orbital velocity[55], showing that the orbital velocity must be an acceleration. This requires a rewriting of many basic equations and cleans up many errors and mysteries, including a few of those in renormalization.

8. I solved the problem of relativity[56], finding the simple and basic algebraic errors at their inception. I offered corrected transforms for time, length, velocity, mass, and momentum. I exploded the twin paradox, and did so by showing incontrovertibly that relative motion toward causes time contraction, not dilation. I solved the Pioneer Anomaly. I also proved that Newton's kinetic energy equation is not an approximation; it is an exact

[52] http://milesmathis.com/elecpro.html
[53] http://milesmathis.com/meson.html
[54] http://milesmathis.com/merc.html
[55] Chapter 20
[56] http://milesmathis.com/adp.html

equation. I explain the cause of the mass limit for the proton in accelerator.

9. I show the error in the interferometer[57] and light clock diagrams[58], proving that no fringe effect should have been expected. The light clock creates the same mathematical triangle and falls to the same argument.

10. Minkowski's four-vector field[59] is shown to be false, not only because it uses Einstein's false postulates and axioms, but because its own new axiom – that time may travel orthogonally to x,y,z – is also false.

    (a) I prove that General Relativity[60] is falsely grounded on the same misunderstandings as the calculus, which is one reason it can't be joined to QED. I prove that curved space is an unnecessary abstraction and that the tensor calculus is a mathematical diversion, a hiding in esoterica. I prove this by expressing the field with simple algebra, taking five equations to do what Einstein did in 44 pages.

    (b) As a bonus, I prove that String Theory[61] is an historical embarrassment.

[57] http://milesmathis.com/mich.html
[58] http://milesmathis.com/lc.html
[59] http://milesmathis.com/mink.html
[60] http://milesmathis.com/gr.html
[61] http://milesmathis.com/string.html

Chapter 2

DEATH BY MATHEMATICS

The state of learning now is like Scylla of the old fable, who had the head and face of a virgin, but a womb hung round by barking monsters, from which she could not be delivered. – FRANCIS BACON

In the 20th century, physics underwent a transformation. No one would deny that. But normally the transformation is credited to Relativity and Quantum Mechanics. And normally the transformation is seen as a great advance. In this paper I will argue the opposite. The transformation was due more to a transformation in mathematics, and that transformation has been almost wholly deleterious.

This transformation due to mathematics began in the 19th century, but it did not engulf physics until the 20th century. In the 19th century the stage was set: we had several abstract mathematical fields that reached "fruition", including a math based on action variables and principles, a math based on curved space, a math based on matrices, a math based on tensors, a math based on i, and a math based on infinities.

As I have shown, 19th century mathematics inherited many unsolved problems from the past, including problems from Euclid and Newton. It made no progress in solving these problems because it did not recognize them as problems. It had already given up on foundational questions as "metaphysics", and it preferred instead to create more and more abstract systems. The more abstract the mathematical system became, the more successful it could be in avoiding foundational questions.

The clearest example of this is the field of applied mathematics based on action variables. For the last hundred years we have heard an ever-increasing level of praise of action variables, culminating in the propaganda of Feynman. But action variables are just an abstraction of Newtonian variables. By abstraction, I mean that they do not add clarity, they cloak disclarity. Newtonian variables were never very rigorously defined, but action variables are very good at hiding Newtonian variables. Action variables do not replace Newtonian variables, as some appear to think. Action variables *contain* Newtonian variables. Action variables restate Newtonian variables in what is considered to be a more efficient form. But action variables are utterly dependent on Newtonian variables. If it were discovered that Newtonian variables were false, action variables would be, too, by definition. The action concept developed directly out of Newtonian mechanics, and action assumes the absolute validity of Newtonian mechanics. Action does not transcend Newton in any conceivable way, it only compresses his method. Just as velocity is a compression of distance and time, the Lagrangian is a compression of kinetic and potential energy. Each compression is a mathematical abstraction, because the individual variables are no longer expressed singly. They often do not appear in the equations at all. They are included only a parts of greater variables.

From an engineering standpoint, this is a real advance. As long as the greater variables express the changes of the individual variables in the right way, abstract systems like this can save a lot of time. But from a theoretical standpoint, abstract mathematics can be a great danger. Since the individual variables are no longer in the equations, it becomes much more difficult to see when they are being misused. Abstract mathematics must assume that all its original assumptions are applying with each new application, and with many new applications this may not be so. If time and distance are not behaving in normal ways, then the equations have no way of correcting for that, since they don't have any way to express it. The equations rely on original definitions and assignments, and modern mathematicians and physicists do not usually bother to check to be sure that all these definitions and assignments hold for each new application. They don't do this for two reasons. One, they often don't know what the original definitions and assignments were. The mathematical systems are taught as abstract systems, where foundations are considered to be moveable. In the case of the Lagrangian, for instance, we are taught that the variables are general coordinates that we can apply to almost anything. Well, this is true to only a limited degree, and the limits have been ignored. Two, definitions and variable assignments are considered to be metaphysical, and therefore beneath the notice of mathematicians and scientists. Modern scientists cannot be bothered to look at foundational questions, since math is only the equations themselves. If you have mastered the manipulations, you have mastered the math, they think.

To be very clear, it is not action variables I object to. What I object to is their misuse. They are misused when they are applied to systems that do not match the time and distance assignments they were created for. I also object to the implied superiority of action variables. They are very efficient in some uses. But because they are abstract, they are prone to misuse. In this way they are actually inferior. They are inferior because they are less transparent than Newtonian variables. Newtonian variables are not always transparent either, but action variables are *always* less transparent. Action variables are the first cloaking of physics. And in some cases this cloaking is not an accident. Action variables and the math surrounding action is not always used to generate efficient solutions in familiar situations. It is now often used to blanket over holes in theory or math. Like many other mathematical systems, it is now used to mask purposeful fudges.

The next mathematical system that invaded physics is that of Gauss and Riemann, invading through the door of General Relativity. This was really the first major invasion, and the most important. Up until then, physicists had been wary of allowing mathematicians to define their fields, especially with the new abstract systems. The action principle had not yet invaded physics on a full scale, and would not until the arrival of quantum mechanics. Einstein himself was very wary of abstract math, purposely avoiding it until 1912. Put simply, he "did not trust it." But in that year he discovered Gauss, and called on his friend Grossman to help him with the math. A couple of years later Einstein was hired in Berlin, and there he got even better help, from Hilbert and Klein, no less. Einstein had asked the wolf in at the front door.

I don't think it is an accident or coincidence that the first thing the wolf tried to do is take over the house. Hilbert, after schooling Einstein on all the latest techniques, tried to beat Einstein to the punch by publishing the theory of General Relativity two weeks before him. He didn't succeed in this dastardly trick, but amazingly history has not held it against him. Einstein quickly forgave him, and now Hilbert is treated as the greatest mathematician of the 20th century. But to me, this incident perfectly presaged the way the 20th century would go. The mathematics department, invited to consult, would see its opportunity to steal the show, and it has since stolen the show. Someone like Feynman could throw barbs at the math department, but this was only misdirection. The top mathematicians could look back over their shoulder in feigned opposition, only because they had already taken over the physics department. Feynman was not smirking at mathematics, he was smirking at mathematicians who were too narrow to crossover and become famous, like he had. It was as if to say, "We now own physics, the queen of the sciences and the modern kingmaker, and you guys prefer to argue over trivialities like Fermat. That will never win you a Nobel Prize or a trip to the White House."

Einstein's success with the tensor calculus called all the present demons out of the closet, invited them all into the kitchen, and gave them control of the fire. He showed the road to fame, and the first stop on that road was enlisting a new abstract mathematics. That has been the road ever since, and it defines the current low road of string theory[1], which had planned to awe all opposition with a math

[1] http://milesmathis.com/string.html

so great and so abstract there was no beginning or end to it (its plan is not moving as planned). Quantum Mechanics was the first to learn this lesson, though, and Heisenberg was the greatest student. Heisenberg understood first and best how to use mathematics to impress and cow the audience. He also understood first and best how to use mathematics as a tool of propaganda. A math of proper abstraction and complexity could be used to hide all error, to divert all effort, to deflect all criticism. It could be used like a very heavy, very highly decorated quilt, covering the bedbugs beneath. This new abstract math would come not with a foundation, but with a manifesto. It did not have axioms, it had public relations. It was not sold with an explanation, but with an "interpretation", and this interpretation was to be accepted on authority.

The takeover in the 20th century was very quick once it began. The mathematician Minkowski reworked Special Relativity before the presses had even cooled on Einstein's paper, expressing the field in complex and abstract terms. This reworking was completely unnecessary, but it was accepted just as fast as it was offered. The novelty of it was enough to complete the sale, although the price was steep indeed. The problem with Minkowski's math is the same as the math of action: the danger is all in the loss of transparent variables. Again, I have nothing against complex math as long as it is used with discretion and complete honesty. But Minkowski fails miserably on both counts, as I have shown[2]. The symmetry is a manufactured symmetry, and the loss of the time variable has been disastrous. The subtle errors in Einstein's math were immediately cloaked under an abstract math, and that abstract math was in no way more elegant than the simple algebra of Einstein's original paper. Einstein's paper was dense, but that was Einstein's fault, not the algebra. Minkowski's unstated axioms were not only unstated and unnecessary, they were false. The time dimension does not travel orthogonally to the other three, and this is not a metaphysical subtlety. It is a physical and mathematical fact, easily proved[3]. Even Einstein called Minkowski's math "superfluous erudition." He was only half right. Minkowski's math was certainly superfluous, but it was false pedantry, not erudition. It was sciolism.

Even this unnecessary abstraction and obstruction was not enough to satisfy. Another level was soon added by the tensor calculus, a blanket ten times as heavy as

---

[2] http://milesmathis.com/mink.html

[3] http://milesmathis.com/hyper.html

the blanket of Minkowski. Although I have shown that General Relativity can be expressed with Newtonian variables, a Euclidean field, and high-school algebra, the worthies of the time preferred to express it with an undefined curved field and a hatful of unwieldy tensors. In his previous mood, Einstein had said, "You know, once you start calculating (with abstract mathematics) you shit yourself up before you know it." But suddenly, in 1912, he developed a fondness for this mess. Perhaps he saw darkly what Heisenberg would see very clearly: the 20th century would have a love affair with shit. The century proved this in every field, from art to math to science to war to politics to entertainment to sex. The century loved nothing so much as watching someone foul himself in public, as long as that someone could sell the spectacle as a transcendent event.

Once again, a Gaussian field and tensors and all that has followed can be made to work. In some situations it is actually useful. I am not arguing that these fields or manipulations are necessarily false. What I am arguing is that physics doesn't need them. The physical field is not that complex. We have invented maths that are much more complex than we need, and we have gotten lost in their mazes. The problem with the math of General Relativity is that it cloaks the mechanics involved. It is too abstract by several degrees. This means that although Einstein sometimes found a way to get the right answer with all this math, he just as often got the wrong answer. The math is so difficult that almost no one can sort through it and tell when the answer is right and when it is wrong. Even worse is the fact that the opacity of the math makes it impossible to unify it with any other math. The primary events are buried so deep and are so poorly defined that there is no hope of expressing them with the mathematical tools available, or isolating them so that they can be located in other fields. The mathematical manipulations become the primary events, and the mathematical field becomes reality. The math ends up usurping the mechanics. [See my paper on Non-Euclidean fields[4] for more on this.]

This opacity causes another problem. Because the primary variables are buried under so many abstract layers, they cannot be studied when problems arise. Later repairs cannot be done at ground level, they have to be done in end-math that adds complexity. In QED this end-math is called renormalization. In GR it is called other things, but in either case it leads to an endless scholasticism and an

[4] http://milesmathis.com/euclid.html

endless and unsightly tinkering. It ends up providing physics with equations that are post-dictive instead of pre-dictive. Every new experiment requires a new fix, and each new fix is pasted over all the others. You then end up with what we have: a physical math that is burdened with so many fields and operators and manipulations and names that it makes Medieval biblical exegesis look like a cakewalk. And it leads to the absurd situation of having physicists who invoke Occam's razor and the beauty of simplicity offer us a proliferation of fields and manipulations that is truly mind-numbing. When I see a string theorist invoke Occam's razor, I can't help feeling queasy. It is like Fox News invoking honesty in reportage.

*

* *

Next came Quantum Mechanics. Heisenberg saw Einstein's success with the matrices and voila, the matrix moved to QM, making it even more famous than GR. But this time we got a confluence of new abstract maths: the turn of the screw. It was feared the matrix would not be enough to wow the world, and so the matrix was joined by the Hamiltonian and Hilbert Space and Hermitian operators and eigenvalues and so on. It was never explained why quanta could not travel in Euclidean spaces under transparent variables, just as it was never explained why gravity required tensors. It was never explained because no one needed an explanation. All were quite satisfied to have new things to do. The new math was the main draw. It gave the theory a required ballast and made everyone look smart. What was there not to like?

Well, there was the fact that everything was based on probabilities, that the mechanics was contradictory and unfathomable, that many insoluble paradoxes were created, and that the math required an infinite renormalization that was basically "hocus pocus." But I mean, other than that, what was not to like? If we could just learn to accept that Nature no longer made sense, we would be just fine. After all, the math was big enough to make up for everything. What was Nature next to a math that could fill blackboards? [For a full critique of the math of QED, gauge theory, see my paper on the Weak Interaction[5].]

[5] http://milesmathis.com/weak2.html

As David Politzer, Nobel laureate and inventor of asymptotic freedom put it,

> “English is just what we use to fill in between the equations”.[6]

Which may explain why the equations have gotten ever longer and the English evermore tenuous and fleeting. Theory must be stated in English – we have no theory – therefore we need no English. Equations will do.

And now that QED is "perfect", we graduate to the even bigger blackboard that is string theory[7]. Since a huge unfathomable math was so successful in QED, string theory naturally developed an even huger and more unfathomable math, one with exponentially more paradoxes and contradictions and ad hoc fixes. If QED requires an infinite renormalization, string theory requires a trans-infinite renormalization. Since QED so successfully ignored mechanics, string theory ignores it even more thoroughly. QED had to state out loud that it was going to ignore mechanics, as a matter of some sort of principle (we are not sure what principle). But string theory goes to the next level of ignorance, which is ignoring that mechanics exists or ever did exist. Like Mephistopheles, the string theorist can call up any entity he likes, just by a simple conjuring. He doesn’t need an axiom or a proof or even a definition. All he needs is a need. Science is now defined by desire more than anything else. "I desire a ten-dimensional donut with spikes like a pufferfish, and a gauge theory in the shape of a wombat sitting in the corner smoking a cigar, therefore the universe and this computer model must supply me with one. Oh, and all this exists beneath the Planck limit. Except for the cigar, which disappears in the presence of a scanning microscope."

Yes, modern physics has become a neo-scholasticism. It is the avoidance of real questions in the pursuit of trivial methodology. It is the memorization of an endless list of names and manipulations in lieu of understanding mechanics. It is the setting up in some black data hole and extemporizing on an endless string of evermore ridiculous hypotheses instead of looking at known physical problems closer at hand. It is the knee-jerk invocation of authority and the explicit

[6] http://pr.caltech.edu/periodicals/CaltechNews/articles/v38/asymptotic.html

[7] http://milesmathis.com/string.html

squelching of dissent. It is the hiding behind tall gates and a million gatekeepers, and euphemizing it as "peer review." It is the institutionalized acceptance of censorship and the creation of dogma. Grand Masters like Feynman say "shut up and calculate!" and everyone finds this amusing. No one finds it a clear instance of fascism and oppression. An internet search on "against Feynman" or "Feynman was wrong" or "disagree with Feynman" turns up nothing. The field is monolithic. It is completely controlled and one-dimensional. All discussion has been purged from the standard model, and all debate has been marginalized. Any non-standard opinion must be from a "crank" and blacklisting is widespread. Publishing is also controlled, both in academia and in the mainstream. Einstein already found science publishing too controlled for his taste in the 30's, refusing to work with *Physical Review*. What would he think now? Can anyone imagine his early papers getting published in the current atmosphere?

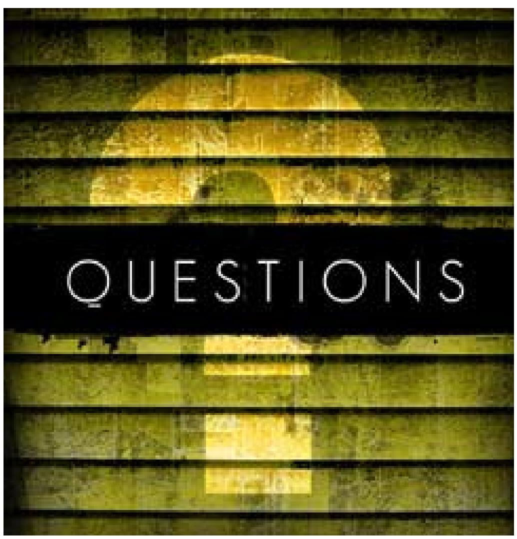
If you are an insider at a major university, you can publish anything, the more absurd the better. You can say anything without fear of contradiction or analysis, since science most wants right now to be creative, and it thinks (like modern art) that absurdity is the most creative thing possible. The paradox is the highest distinction, the contradiction the surest sign of elevation. The contemporary physics paper has become like Dubuffet's *La Lunette Farcie*, a purposeful mockery of all convention, a nothing packaged as a something. Soon the physicist may be expected to follow Duchamp, publishing a toilet seat as a TOE.

Contrary to what we are told, contemporary physics is not booming. It is not very near to omniscience, it is not the crown jewel of anything. In fact, it is near death. It has been damaged by any number of things, only a few of which I have mentioned by name here. But the prime murderer has been abstract mathematics. Physics has succumbed to a suffocation. It is the victim of a strangulation. It is in a not-so-shallow grave, and piled on top of it like dirt are a thousand fields and operators and variables and names and spaces and terms and eigenvalues and dimensions and criteria and functions and coordinates and conjugates and bases and bijective maps and automorphism groups and abelian gauge fields and Dirac spinors and Feynman diagrams and so on *ad nauseum*. The only way the grave could be any deeper and darker, in fact, is if we allowed Deconstruction to dump its transfinite dictionary of onanic terms on top of this one.

The only road out of this grave is to start digging in the upwards direction, clearing away all this schist. The sort of math that physics requires is a math of rigorous definitions and transparent variables, with as little abstraction as possible. We don't need spaces of infinite dimensions, since we don't have infinite physical dimensions. We don't need abstract operators, we need direct representation of motions and entities. Taking the advice of Thoreau, we must "simplify, simplify, simplify." That is our only hope of a Unified Field and a mechanical explanation of the universe.

Chapter 3

ELEVEN BIG QUESTIONS YOU SHOULD HAVE FOR THE STANDARD MODEL



We get a constant line of bald propaganda from physics now, claiming a near-complete knowledge of the universe. This propaganda is not new: it has been building for over a century. Lord Kelvin claimed (around 1900) that there was nothing new to be learned in physics. Relativity and quantum mechanics shushed the Lord Kelvins for a few decades, but soon they were at it again. The Big Brag hit what one might call a new crescendo in 1988 with the release of Stephen Hawking's book *A Brief History of Time*. There Hawking claimed that we would achieve physical omniscience within a decade, and physics would be finished. Now, over two decades later, we are no nearer omniscience; we are only nearer a perfect hubris. As I showed in my analysis of a recent NASA video on Hulu.com[1], most science releases meant for public consumption still lead with this claim of near-omniscience. We are told that we are close to complete understanding of physics, and that we need only a couple of small pieces to complete the puzzle.

I have compiled my website mainly to counter this very disgusting (and unscientific) attitude. Now I am writing this paper to compile some of the biggest cheats and fudges I have uncovered, so that you may have them all in one place to refer to whenever you come face to face with one of these promoters of the "near-perfect" knowledge of modern physics.

I say "standard model" in my title because although the standard model usually refers only to the *status quo* in particle physics, there is a standard model of physics in every sub-field. This standard model has ossified into dogma, into a set of beliefs one is not allowed to question. Anyone in academia who questions the standard model can expect to be set upon by the institutional jackals and marginalized into oblivion. He will find his papers refused for publication and his funding cut off. Those outside academia will simply be dismissed as cranks and crackpots.

As a fair debater myself, I will tell you the number one rule of debating, according to the current handbook: always keep your opponent on the defensive. It is not a device I use, since I prefer the more subtle and less used method of actually knowing what I am talking about. But the mainstream preferentially follows the number one rule, since in most cases it is so effective. They know that with most audiences, facts and truth mean almost nothing. Everything is judged on form, and if your opponent can be made to look awkward, you will have won more points than could ever be won by being right. For this reason, you are taught

[1] http://milesmathis.com/peg.html

always to ask questions; never to answer them. Yes, this is the technique of the mainstream in dealing with any resistance. Always attack. Always go for blood. If there is a threat, do not address the substance of it. Attack the person.

Therefore, if you get into a debate with anyone over physics (or anything else), I suggest you remember what your opponent is up to at all times. Do not allow him or her to put you on the defensive. If your opponent is part of the *status quo* in physics, he or she should be able to answer questions. He is claiming near-omniscience, not you, so he should be able to answer all questions with ease, like the god he claims to be. The standard model is the one making the money and getting the attention and taking all the jobs, so they are the ones that should be answering questions, not you. They are the ones getting all the magazine and journal articles, all the book publishing, and all the government funding, so they are the ones that should be answering questions, not you. You are on the fringe, an independent researcher, a person just trying to help for free, so it is no surprise if your ideas are incomplete. No one should find that out of the ordinary. But what IS extraordinary is that mainstream physics, which has been gathered and culled by thousands of geniuses over centuries, and is defended by all the top people now, is full of huge awful holes and embarrassing fudges. Even more extraordinary is that these self-styled geniuses and top-of-the-field people do not have the intellectual honesty or the scientific acumen to see these holes and fudges for what they are, and to want to correct them. Remember that always.

None of that is to say that those of us in the margins should not try to answer questions, or that we have a free pass in proposing theories without putting them to tests. I answer questions gladly via email when they are proposed in a spirit of scientific goodwill. What bothers me is emails from mainstream people who skim my papers for about five minutes and then attack me for saying things that they don't understand. As a lead-in to my eleven questions you should have for the mainstream, I will share with you one of these recent emails. I do this so that you can see that the questions put to me are not nearly as interesting as the questions I put to the mainstream. The mainstream sicks these people on me, thinking to show me how superior they are, but all they end up doing is confirming my original thesis: the mainstream is built on little but bluster and propaganda, and the people who defend it are small people posing as large people.

> Dear Mr. Mathis:
>
> I found your website and have been looking over your writings. It's highly commendable and admirable the time and thought that have been put into this impressive quantity of work.
>
> I have three questions if you don't mind:
>
> 1. In your article "A New Definition of Gravity Part 7,"[2] you write, "If I were more rigid, I would weigh more." So if you were dipped into liquid nitrogen, or just frozen solid in a way where no atoms of molecules left or entered your body, would that alone cause you to weigh more? For that matter, why do 10cc's of rigid ice melt to produce the same measured weight of liquid water (10 grams in both cases)? Can't an experiment be designed proving that structural rigidity creates weight, and if so, why aren't you performing it?
>
> 2. Regarding expansion theory of gravity: If two bowling balls, one 50% hollowed out, were placed 1 meter apart in space, surrounded by a frame of rulers, would they gravitationally meet at the midpoint (as measured by the rulers), or somewhere else? If at the midpoint, I would think that as a scientist you'd want to perform a version of this experiment and blow the roof off general relativity. And if not at the midpoint, how is this possible through expansion if both balls remain the same size?
>
> 3. Regarding the stacked-spin theory[3] of wave/particle duality: In my experience, objects seem to only spin freely about their center of mass. Try as I might, I can't think of a way to get a ball to spin about an axis that does not pass through its center of mass (instead, intersecting its surface or a point outside its surface). Wouldn't a pitcher be interested in getting a baseball to spin that way, so that the batter is swinging at a wave? To put it another way, if QM is all about real-world mechanics, why can an electron move this way but not a baseball?

I won't give the name of this person, since I believe it was signed with a pseudonym anyway. But hopefully you can see how pathetic these questions are. Out of the 1,500 pages I have on my site, this is the best he could do? Let me answer the questions very quickly, to show how shallow they are. Concerning question

[2] http://milesmathis.com/third7.html
[3] http://milesmathis.com/super.html

1, my claim that rigidity tied into weight was made concerning E/M rigidity, and I made that very clear in the paper. The rigidity is a rigidity of atomic and molecular bonds, caused by various E/M interactions. I never said that a frozen man would weigh more than a warm man, so this person has just created a frozen strawman to hit. Furthermore, I said that more quanta would create more bonds, so that my explanation is just a subtle variation of common knowledge. I was not stating anything extraordinary. If this person wished to truly debate me on this topic, he should have addressed the idea I actually had, instead of debating me about frozen men. Freezing doesn't strengthen any atomic bonds, or create more, so it couldn't be what I was talking about. I say that to weigh more, you would have to strengthen or increase these bonds; but you couldn't do that with a man without changing what he was made out of. You would have to make him out of lead or something, in which case I hardly think I need to create a man of lead in order to to prove my point.

Concerning question 2, I answer that in depth in my paper on weight[4]. The answer is that if we had the balls in a solo gravity field, with no E/M component, they would meet in the middle. If we had them in a current gravity field, which is really composed of both fields, they wouldn't meet in the middle. I even do the full math to solve a problem Newton and Einstein couldn't and didn't solve. It burns me up when people email me and ask me tongue-in-cheek to explain something they think I can't explain, when I do explain it in papers they haven't bothered to read. It really makes them look stupid, because they don't bother to pose the same question to Newton or Einstein, or to do the experiment. I don't do the experiment because no one is funding me to do any experiments, and I am not a rich guy. Why aren't they doing the experiments? They have had centuries to do these experiments, and they have spent trillions of dollars doing experiments. They are currently spending many billions seeking gravitons and many more billions on a hadron experiment that can't even start up. It is clear why a poor guy working alone might not have new experiments to back up every equation. Why doesn't the standard model ever do any basic experiments on gravity? I can tell you why. The experiments they have already done in the past have shown they are wrong (see below), and they don't want to do any more in that line.

[4] http://milesmathis.com/weight.html

Concerning question 3, it amazes me how fertile a person's imagination can be when reading mainstream articles or accepting mainstream claims, but how quickly that imagination dries up when they read anything by me. "Try as he might," this self-assured person cannot think of a way to create a wave motion with real matter. Interesting, since we know that real matter does show wave motions. It is not just light that shows wave motions, either. He should know that all matter shows wave motions. He seems to have some problem with my insistence that quanta must obey material rules and have size, so maybe he thinks that protons, like photons, are also point particles that show wave characteristics only by mathematical magic. Apparently he prefers non-physical solutions to physics rather than physical solutions, since he can hardly veil his contempt for my attempt at mechanics. Beyond that, I never said quanta were strictly equivalent to baseballs. In the paper he is talking about, I compare them to gyroscopes. I would love to do some experiments with gyroscopes, since my imagination, or ability to visualize, is much better than his. If he will just recommend funding for me, I will get right on that. I can tell him, for now, that his baseball example fails simply because the pitcher can apply a force only at the beginning. The pitcher cannot run along with the ball and apply a continuous spin to it, or try to stack spins on it. With quanta, we assume that the first spin is continuous, and will maintain itself as we apply secondary spins. This is not the case with a baseball in flight. For example, suppose we let two spinning baseballs hit eachother midair, and hit on edge. No wave will be created because the original spins will be damped or stopped by the collision. But with quanta this is not the case, because quanta are receiving a continuous source of spin from a field. An on-edge hit like this would not stop a quanta from spinning, because you can't stop a quanta from spinning. It is not spinning like a baseball, from an initial force. It is spinning from a continuous force. Therefore the spin of the hit would have to stack on top of it. It is quite possible we could show this with internally powered gyroscopes moving down through heavy air or water. We create on-edge collisions and see if wave motions are caused. The number of basic and fundamental experiments we have failed to do is near-infinite, and yet current physics is satisfied with magic point particles and statistical dodges. Again, fund me and I will do these experiments. I can think them up five a day. Beyond that, we already have trick balls that move or roll in a wave motion, as he should know. Weighted balls will move back and forth, as will gyroscopes. So his pretense that none of this can be imagined, much less shown, is just posturing for an audience that isn't nearly as stupid as he thinks it is.

Now let us look at the questions I have had for the mainstream. I have tried to answer their questions, even when these questions are clearly hostile and poorly chosen. But they don't ever address my questions, or anyone else's. They just dodge and misdirect. They do this because there is no possible answer to my best questions. My best questions are immediately fatal, and I like to think they can see that. These eleven questions are among the most embarrassing and fatal questions in my papers, and you will never see the mainstream address them. These are the questions that have been in the dark, are in the dark, and will remain in the dark, if the mainstream has anything to say about the matter.

1. In the case of a gravitational resonance, as in the resonance with Jupiter and Saturn[5], what causes the bodies to begin moving apart after the closest pass in the resonance? Gravity is stronger at closer distances, so what makes the resonance "turn"?

2. Roche limits[6] are an outcome of gravity, so why don't the inner moons of Jupiter and Saturn obey gravitational laws? They not only go below the Roche limit, and avoid break-up despite having low densities, they also survive large impacts (as we see from large cratering). Finally, they accrete. How can bodies that should be dissolving accrete?

3. We are told that atmospheric muons[7] are experiencing time dilation in order to reach sea level detection. But special relativity tells us that all objects in relative motion experience both time dilation and length contraction. The length contraction in SR is derived from the x or distance contraction, and they are proportional. Meaning, the whole x-dimension must be contracting, not just the "length" of the muon. Which means that a time-dilated particle must seem to be going a shorter distance than expected, not a longer distance. How can current theory ignore the length contraction?

[5] http://milesmathis.com/laplace.html
[6] http://milesmathis.com/roche.html
[7] http://milesmathis.com/muon.html

4. The orbit is currently explained by only two motions: gravity and the velocity of the orbiter. But according to Kepler's[8] and Newton's equations[9], which still stand, this velocity is the tangential velocity. It is not the orbital velocity, since the orbital velocity is the *result* of the two motions, not the cause of them. In other words, the orbital velocity curves, and it curves because it is composed of the centripetal acceleration. If the orbital velocity is the result of the two motions, it cannot be one of the two motions. According to Newton, the tangential velocity is the "innate motion" of the orbiter. But this innate motion cannot curve by itself. Given these two motions, why is the orbit stable? Current physicists just sum to show the stability, but summing hides the variations in the differentials. The problem is that if we study the differentials[10], we find the tangential velocity varying to create the stability. How can the "innate motion" of an orbiter vary? Are we to imagine that orbiting bodies are self-propelled, or that they can change their motions to suit summed orbits?

5. Perturbations are an important part of solar system mechanics. These perturbations often take the form of torques or tangential forces from one body to another. Given that neither Newton's nor Einstein's fields allow for forces at the tangent caused by the gravitational field, how do physicists justify these torques?

6. Symmetry breaking is a common tool of modern particle physics. Since symmetry breaking[11] requires borrowing from the vacuum, how is this physically justified? What are the rules for borrowing? That is, why can particle physicists borrow from the vacuum in order to fill holes in electroweak theory, but I cannot borrow from the vacuum to fill all the holes in my theories? Is it something to do with institutional credits? Is Goldman Sachs involved in this borrowing?

7. After more than a century of silence, the standard model finally assigned the "mechanics" of charge to the messenger photon, a single virtual photon that can either tell quanta to move away or move nearer. What is the

[8] http://milesmathis.com/ellip.html
[9] http://milesmathis.com/g.html
[10] http://milesmathis.com/cm.html
[11] http://milesmathis.com/weak2.html

operation of this "telling"? It is some sort of code etched on the virtual face of the virtual photon? Is it a mysterious wave sent across intervening space, a wave that can be inverted at the will of the photon? Or is it a voice message? A Tweet perhaps?

8. Speaking of virtual particles: is there anything a virtual particle cannot do? Are there any rules of virtuality? For instance, if virtual particles can explain charge and color and borrowing from the vacuum, why can they not explain every other problem of modern physics? Where is the imaginary line drawn, and why draw it there? Once you begin cheating, why cheat halfway when you can cheat all the way?

9. If $e = mc^2$, and if the photon has energy, how can it be massless? How can an equation with the speed of light in it not apply to light? Sure, we can say that the photon has no rest mass, since it is never at rest, but how can we say it doesn't have moving mass? Don't energy and field equations, like charge equations, have to be fudged, in order to deny mass to the photon? Energy without mass contradicts both the classical equation and definition of energy ($e = mv^2/2$) and the relativistic equation and definition of energy ($e = mc^2$). Might this be why particle physics now hides out in a renormalized gauge math?

10. If gravity is now defined by curvature[12] rather than by a centripetal force, what impels an object placed at rest in a field to begin moving? General Relativity supplies us with field differentials, which can explain why an object already moving in the field will move as it does. But field differentials, being math, cannot create a force. The math of GR represents motions, it cannot cause them. GR is also not a field of potentials, since it requires a field of forces to create potentials. GR is not a field of forces, so the differentials cannot be interpreted as potentials. Einstein admitted that GR was the bypassing of Newton's inertial field. How can an object that is "feeling no forces" begin moving in such a field? In other words, Einstein inherited and extended the field of Newton, but he did not overwrite Newton's first law. If he had, we would not still be taught it in high school. Newton's first law is that an object at rest will remain at rest unless a force acts upon it. What force acts upon an object placed in Einstein's curved

[12] http://milesmathis.com/gr3.html

field? How does the object know that the field differential just below it is any different than the field differential it inhabits? It can't know, and therefore GR fails to explain motion from rest in a field.

11. The Moon is experiencing tides front and back caused by the Earth. Because the Moon is in synchronous orbit, these tides are always in the same place: they do not travel. All tides are caused[13] by two mechanisms, we are told. They are caused by different levels in the gravity field, and they are caused by unequal centrifugal forces due to the orbital motion. The second effect is half the first, so it is 1/3rd the total: very significant, in other words. If the forward and backward points of the Moon are experiencing strong and constant tides, why are they not shearing strongly sideways? The farthest part of the Moon should shear in the reverse direction of the orbital motion, since there is nothing in the gravitational field to make it orbit faster than the center of the Moon. Just the opposite, in fact. If we assume all parts of the Moon have the same "innate motion", and if we are given that an object at a greater distance has a *smaller* acceleration from the field, then the farthest part of the Moon should be going *slower* than the center of the Moon. As it is, it travels faster than the center of the Moon for no physical reason. The reverse applies to the forward part of the Moon, and it should shear in the direction of orbit. Why is this data so obviously negative? Among other hugely embarrassing data on the Moon is the negative tide on the front. The standard model of tides predicts equal tides front and back, but the Moon's crust is obliterated almost down to its mantle in front, showing an obvious negative tide. The standard model has no explanation for this, while I have a simple and mechanical explanation. The question is, how can piles of obvious data like this continue to be ignored, when there exist straightforward explanations for it?

As you see, I have already "blown the roof off" GR and Newton so many times the molecules won't even cohere into shingles anymore. An honest person would just admit that and ask what's to be done. Instead, the mainstream simply refuses the see the holes I have pointed out. They pretend that I have not asked them a thousand important questions, and they begin scanning my papers for weak points. That is also a clear sign: a real scientist would scan any paper for its

[13] http://milesmathis.com/tide.html

strong points, since those are the most useful to science. Instead, mainstream scientists scan any new ideas, especially those from outsiders, for their weakest points, ignoring the strong points on purpose. This immediately proves that the reading is hostile, and therefore unscientific.

They redirect always: they pretend that this is not about them, because they want it to be about me. Remember their mantra: never answer a direct question, or look directly at a problem; instead, attack the questioner personally and ask him an unbroken line of questions, so that he can never be on the offensive himself. They always say something like, "You are the one claiming to know something we don't, so you should have to prove it." But that is just misdirection. It is true, but it is true on a much smaller scale than my reply to them, which is, "We are *both* claiming to know something, but you are the one whose account has been *accepted*. Therefore, it is even more important that your account be tested than mine. Besides, I admit doubts about both your theories and my own, while you admit no doubt about anything. Since your doubt is 100 times less, your data should be 100 times more secure. But it isn't. You have just unloaded all your negative data into a dark pit, and refused to remember it exists. You claim that physics should be testable, but then dodge all tests except those that you create to confirm yourselves. You look away from huge piles of negative data, and get mad when it is pointed out. That isn't scientific. Science requires criticism, but you refuse to countenance any criticism, blacklisting anyone that doesn't immediately accept your proposals. Your whole method of teaching makes this clear, since it is a method of indoctrination and peer pressure, rather than an open method of free inquiry. You have been defining science as free inquiry for hundreds of years, but the amount of free inquiry that actually gets done in academia is now near zero. Free inquiry in a time of such partial knowledge would spawn great disagreement and debate, and the fact that we have so little of either is clear evidence against free inquiry. Therefore, don't be surprised when I take your hostile questions with an ill grace. I can see them for what they are: suppression of science."

What I have done is to dig deep into the closet and pull that bundle of negative data back out into the open. I have laid all the old problems out on the sidewalk, where passers-by can see them and study them. I have pinned all the old data on the trees in the front yard, where it can air in the wind once more. For this reason, I hardly need new data or experiments of my own. This old data can be used by either the standard model or by me, and since they have no use for it, I am free to use it myself. This was a good move on my part, since this old data has turned out to be my best friend. As in a zero-sum game, every plus for me scores a minus for them, which is a change of two in the game. While they have been jacking themselves off with string theories and backward causality and virtual particles and symmetry breaking, throwing a series of airballs, I have been scoring at least two points with every paper I write. I passed GO some time ago, and they are still rotting in jail or in no parking, looking for the community chest. They no longer even have the gumption to realize that I own all four railroads, that the wheels are off their car, the shoe is off the foot, and the little silver hat is headless.

So print out this list and sew it into your peacoat, like Thoreau did with Carlyle's *Sartor Resartus*. And when some mainstream stuffed shirt starts calling you a crank for not bowing down before him and his false gods, ask him these simple questions. Do not let him dodge them, and do not let him re-direct the argument into some slur upon your *alma mater* or your IQ. Badger him, browbeat him, and always seek the higher ground where you can look down upon him. If you don't, he will do it to you. And if you ever feel the least bit unsure of yourself, return to the question he seems to like the least. Roll it up into a sharp point and metaphorically try to insert it into his ear.

Chapter 4

A REVALUATION OF TIME

(and VELOCITY)

I would like to offer here a definition of time that is as little abstract as possible. What we want, I think, is a definition that describes time as something that we measure. Only that. One might call it an operational definition. This definition is not an explanation of what time means (or has come to mean) philosophically or epistemologically. It is an explanation of what time is in our experimental or everyday use of it.

I maintain that time is simply a measurement of movement. This is its most direct definition. Whenever we measure time, we measure movement. We cannot measure time without measuring movement. The concept of time is dependent upon the concept of movement. Without movement, there is no time. Every clock measures movement: the vibration of a cesium atom, the swing of pendulum, the movement of a second hand.

In this way time can be thought of as a distance measurement. When we measure distance, we measure movement. We measure the change in position. When we measure time, we measure the same thing, but give it another name. Why would we do this? Why give two names and two concepts to the same thing? Distance and Time. I say, in order to compare one to the other. Time is just a second, comparative, measurement of distance.

*

* *

The measurement of time is necessary to the measurement of velocity. It may be that time was not even "invented," in the modern sense, until someone first thought of the idea of velocity. Velocity is the measurement of the change in position of one thing (the object in question) relative to the change in position of another thing (the cesium atom, or the pendulum, etc.). Once you have conceived of the idea of velocity in this way, you realize that it can be measured in only one way: Compare the unknown movement to a known movement. That is, find something in your world that moves as uniformly as possible, and let that be your clock. Then compare your unknown movement to the movement of your clock. That is what velocity is.

You may say, how can I know that something moves "as uniformly as possible" without already having an idea of time? You cannot. But I maintain that this idea of time – as simply a commonsense idea of uniformity of movement – is the only operational idea of time we have ever had. The initial idea of time, historically, or instinctively, is the idea of uniform movement. The first clock must have been chosen on this basis, just as the very latest atomic clock is chosen on this basis.

Also notice that there has never been any way to test the uniformity of a clock, except relative to another clock. The first clock must have been chosen based mainly on instinct. The ancient who chose the swinging pendulum because it swung the same number of times per day was comparing it to another clock – the sun. If he was smart he counted his pendulum swings from sunup to sunup, rather than sunup to sundown, and so avoided the variation in length of daylight. And if he was very smart, he continued to look for even better natural clocks to fine-tune his measurements by. But notice that as long as the sun was his standard, he had to assume that the sun was a good clock – he took for granted that one day was the same length as the next.

In judging the uniformity of natural clocks, like the sun or the stars, our ancient would resort to comparing them to his pendulum clock. How did he know that the sidereal clock was more accurate than the solar clock? By comparing it to his pendulum. He corrected his pendulum by the sun and corrected the sun by his pendulum.

In this way you can see that there never was an idea of "absolute time." Time was always a relative measurement. It had to be. It was relative to a given clock, a clock chosen mostly by instinct. For there was never any way to prove that the given clock was absolutely uniform. It was only more uniform relative to clocks that were already relative to other clocks.

So time is not a measurement of "time." Time is a measurement of the movement in or on a given clock. And this given clock is uniform only by definition. It is uniform relative to a standard clock. One that has been *defined* as uniform. This standard clock cannot be proven to be uniform. It is only believed to be more uniform, based on previous definitions and previous clocks.

In this sense, time is not absolute. There is not, and cannot be, a clock that is known to be absolutely uniform. This is a statement of logic. A clock known to be absolutely uniform is a *reductio ad absurdum*. For us to know the clock was absolutely uniform would require us to have a previous clock by which to measure it. A clock may be defined as absolutely uniform. That is, we may decide, quite freely, to define some vibration of the background radiation of the big bang to be absolutely uniform. But we cannot know the truth of that definition.

Every measurement of time is a relative measurement, in this sense. It is relative to a standard clock, defined as standard. Time is also a relative measurement in the sense that it is dependent upon a measurement of distance. The time concept is relative to the distance concept.

*
* *

Now that we have an operational definition of time, we may proceed to an operational description of the calculation of velocity. As I said above, velocity is a relative measurement. It is the change in position of an object **relative to** the change in position of (the internal workings of) a clock. We usually write this as distance-over-time. d/t. I maintain that this is exactly the same as distance-over-distance. If we had written miles per hour, we might have written miles per miles. For we might have remembered that our clock is a little something in movement, and the movement inside the clock might be expressed in our denominator just as easily as the "time" on the clock. A pendulum travels some distance each second, and so does a cesium atom or a pulse of light. In calling the distance traveled a "second" instead of a mile or a foot or an angstrom, we are simply choosing terminology that suits us. But the fact remains: in terms of measurement, what is being measured by a clock is distance.

In the calculation of velocity, one makes one basic assumption. One must assume that there is indeed a relationship between the measurement of the object in question and the measurement of the clock. If I am comparing two things, I must assume that the two things are comparable. I must assume that the distance I am measuring with my object is the same sort of distance I am measuring with my clock. In my velocity equation, what I have is really distance-over-distance. For the equation to make any sense at all, I must assume that the concept in the numerator is equivalent to the concept in the denominator. That is, I must assume continuity. I must assume that the measuring rod of the object-distance is the same measuring rod of the clock-distance. I must assume that the background is the same for the clock and the object. In mathematical terms, I must assume that the clock and the object are in the same co-ordinate system. If they are not, then it would be foolish to compare them. It would be foolish to put one over the other in an equation.

Think of it this way. A velocity equation states that the object (of the numerator) moves a certain distance relative to the movement of another object – the workings of a clock (the denominator). "Relative to" means that the first thing is related to the second thing. If they are in different co-ordinate systems, they are not related to eachother, and it would be senseless to put them in the same equation.

So the basic assumption of a velocity equation is that the object and the clock are related. They are in the same co-ordinate system. Or, to put it another way, space is continuous from the object to the clock. If it were not, there could be no velocity equation.

If time is actually a measurement of distance, then wherever space is continuous, time is also continuous. This being true, it follows that wherever there is an attempt to measure velocity, there is an assumption that time and space are continuous. There is an assumption that all local measurements are equivalent. Without this assumption, no equations are possible.

In this sense, time is absolute. Time is assumed to be invariable from point to point, throughout space. This assumption is what allows for the measurement of velocity.[1]

*
*   *

It is said that Einstein did not make this assumption – of absolute time – when he began his calculations in Special Relativity. It is said he did not make the Newtonian assumption of absolute and continuous space and time (one big co-ordinate system); nor did he make the assumption in a more limited sense, as

[1]This says nothing about measuring moving clocks. As I have shown in another place, the findings of Einstein's Special Relativity are valid, in the main. But in order to calculate the slowing of moving clocks, from a distance, one must assume they are not slow, locally.

I have above. He did not assume the equivalence of local time. It is said that he proceeded without this assumption, and by proceeding without it proved that local time, in my sense, is meaningless. According to the canon, one may now speak of ones own local time. But speaking of the local time in another place is a *faux pas*.

I show in other papers that Einstein hid his assumption very well, but it was there nonetheless. What is the only assumption that most people will admit that Einstein carried into Special Relativity? What was his "only" given? The constancy of the speed of light. But if the speed of light is the same in every co-ordinate system, then that, *by itself*, assures that the local time of every co-ordinate system is equal to that of every other. If light goes 300,000 km/s in every system, then the ratio of kilometers to seconds in every system must be equal. Either that, or the statement "light has a constant speed" has no meaning.

If you say, "Yes, light has a constant speed, but the time in another system may be different than ours," then I don't see what light has a constant speed means. It does not matter that their time is "different than ours." When they measure the speed of light, they will not be using our watches. What their watches are relative to ours will not enter into the velocity equation they use at all. When they measure the speed of light, they will divide the distance light goes in their system by the distance their little cesium atom wobbles. The relationship of light to a cesium atom in their system is the same as in ours, so they will not only see the light go the same speed, they will see it go the same distance we do. Notice this has nothing really to do with cesium atoms. It has to do with the relationship between distance and time in their system. You say "their time is different." But what does that mean? If their time is slow relative to ours, it surely doesn't mean that they will measure it differently. What I mean is, Einstein said they will get the number 300,000 km/s, just like us. You say, perhaps their second is slower, so that the distance must be shorter than 300,000 kilometers in order to equal the same speed. But this is not looking at it from their perspective. They are not going to divide the distance they see light travel by one and a half pendulum swings, for instance, or by 1.5 seconds, or by some extra number of cesium wobbles. They are going to divide the distance by one second, just like we do. And they are going to call it one second, no matter what you or I think of the matter – no matter how long or short that second looks to us. Einstein says that according to them, light will be going 300,000 km/s. They define one second as being one tick of their own clock, just like we do. Therefore, they will see light travel 300,000 kms during that tick.

It is true that if we could see the light in their system from our system (which we can't – by the time we see it, it is in our system) it would appear to have traveled a shorter (or longer) distance – since those clocks over there are slow (or fast). But that is not the question. The question is what do they see. They see the same thing we do. This is not of the nature of a guess. It is a deduction. If the speed of light is given as a constant in every system, then every system must have equivalent local time.

The smartest scientists have understood this, even when they were a bit unclear about Relativity as a whole. Richard Feynman, for instance, who many would call the smartest physicist since Einstein, explicitly believed in what I am calling local time and distance. On page 94 of *Feynman Lectures on Gravitation*, he talks of "absolute time separation" and "proper time". This was his admission not only of local measurement, but of the universal equivalence of local measurement. He understood that you cannot link various systems with any transforms whatsoever unless you assume the equivalence of all local time.

Four-dimensional Space

Minkowski is known as the father of four-dimensional space. In his theory, time becomes a fourth dimension, mathematically equivalent to x, y, and z. In fact, by setting his quadratic equation equal to 1, instead of to zero, Minkowski implied that time travels at a right angle to all three of the other dimensions. It was therefore equivalent to a spatial vector, travelling orthogonally. It so doing, it created what mathematicians call symmetry. The t variable could then be incorporated into matrices as an absolute equal to the other distance variables.

This theory was appealing to those who are attracted to mathematical esoterica, but unfortunately it is completely false. As I have shown, time is a measurement of movement. Without movement there is no time. But this movement already has a direction, determined by x, y, z: it cannot be given a secondary vector. All motion is a vector, and that vector must coincide to some distance vector within the 3-d continuum x, y, z. So to state that time has a vector outside this continuum is false. If time is a measurement of motion and all motion is contained in x, y, z, then time cannot be outside of or external or superadded to x, y, z.

Nor can it be thought of as mathematically symmetrical to the three distance variables. It is a second measurement of distance, as I have shown, so it can certainly be thought of as a distance variable. But it is not the same sort of variable, theoretically. It is different because it is not really a variable at all. It is a postulate. You may not include it with the others simply because the others rely on it. Meaning that you may not have all four variables as variables at the same time. If time is unknown at the same time that x, y, and z are unknown, then all four are unknowable. If x, y and z are thought of as fields, then t is a subfield. If x, y and z are thought of as axes, then t is a defining axis or "axiom axis". It is not strictly equivalent to the other three. Including it in matrices in the way that is now done is therefore dangerous. Theory is lost, postulates are hidden from view, and mathematical errors are the consequence.

If that critique of Minkowski was a bit abstract for some, think of it this way: Velocity is distance over time, right? Distance and time are both vectors. They have direction. Well, you can't put orthogonal vectors in a ratio or a fraction and expect to get a value for your velocity vector. If you have one vector over another, and the vector in the denominator is at a right angle to the vector in the numerator, you have a serious problem. One of the first rules of vector algegra tells us that you can't just divide one number by the other; but this is what happens every time we find a velocity. We simply divide the distance by the time. Which means one of two things must be the case. Either all our historical velocities are wrong, or Minkowski is wrong. The time vector is not at a right angle to any possible distance vector.

Conclusion

I was asked by a reader of another paper whether I ultimately thought time was absolute or not. You can see that this is not such a simple question. I had to ask, "absolute in what sense?"

As I have shown, time is assumed to be absolute in the sense of being equivalent from one system to another. We must make this assumption in order to calculate velocities, among other things. This does not mean that it *is* absolute, of course. It means that we must *define* it as having continuity from our immediate vicinity to any vicinity we want information about. If we do not assume time and space continuity, we cannot hope to build meaningful equations. A universe without continuity is a universe without equations, without mathematics, and without science.

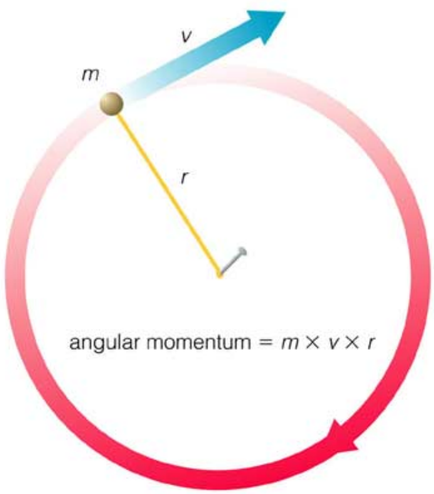
But time is not absolute in the sense of absolutely precise, or absolutely known. It is a concept based on the idea of uniform movement, but the concept allows of only relative measurement. A movement can be known to be more or less uniform, but not absolutely uniform.

Likewise, time is not an absolute in the sense that many "classicists" appear to mean when they mean by it that Special Relativity is wrong. Objects moving at a distance, including of course clocks, look different than objects at hand. And velocity and acceleration influence the appearance of distant objects in quantifiable and dramatic ways. Time dilation is a fact. A poorly interpreted fact – up to now – but a fact nonetheless.

Time is also dependent upon, and therefore relative to, movement. In a sense, time is nothing. Or it is nothing but a second measurement of movement. Displacement is movement. Time is movement. Time is displacement. Time is the displacement of the reference body.

Chapter 5

ANGULAR VELOCITY AND ANGULAR MOMENTUM



One of the greatest mistakes in the history of physics is the continuing use of the current angular velocity and momentum equations. These equations come directly from Newton and have never been corrected. They underlie all basic mechanics, of course, but they also underlie quantum physics. This error in the angular equations is one of the foundational errors of QM and QED, and it is one of the major causes of the need for renormalization. Meaning, the equations of QED are abnormal due in large part to basic mathematical errors like this. Because they have not been corrected, they must be pushed later with more bad math.

Any high school physics book will have a section on angular motion, and it will contain the equations I will correct here. So there is nothing esoteric or mysterious about this problem. It has been sitting right out in the open for centuries.

To begin with, we are given an angular velocity ω, which is a velocity expressed in radians by the equation

$$\omega = \frac{2\pi}{t}$$

Then, we want an equation to go from linear velocity v to angular velocity ω. Since $v = 2\pi r/t$, the equation must be

$$v = r\omega$$

Seems very simple, but it is wrong. In the equation $v = 2\pi r/t$, the velocity is not a linear velocity. Linear velocity is linear, by the equation x/t. It is a straight-line vector. But $2\pi r/t$ curves; it is not linear. The value $2\pi r$ is the circumference of the circle, which is a curve. You cannot have a curve over a time, and then claim that the velocity is linear. The value $2\pi r/t$ is an orbital velocity, not a linear velocity.

I show elsewhere that you cannot express any kind of velocity with a curve over a time. A curve is an acceleration, by definition. An orbital velocity is not a velocity at all. It cannot be created by a single vector. It is an acceleration.

But we don't even need to get that far into the problem here. All we have to do is notice that when we go from $2\pi/t$ to $2\pi r/t$, we are not going from an angular velocity to a linear velocity. No, we are going from an angular velocity expressed in radians to an angular velocity expressed in meters. There is no linear element in that transform.

What does this mean for mechanics? It means you cannot assign $2\pi r/t$ to the tangential velocity. This is what all textbooks try to do. They draw the tangential velocity, and then tell us that

$$v_t = r\omega$$

But that equation is quite simply false. The value $r\omega$ is the orbital velocity, and the orbital velocity is not equal to the tangential velocity.

I will be sent to the *Principia*, where Newton derives the equation $a = v^2/r$. There we find the velocity assigned to the arc.[1] True, but a page earlier, he assigned the straight line AB to the tangential velocity: "let the body by its innate force describe the right line AB".[2] A right line is a straight line, and if Newton's motion is circular, it is at a tangent to the circle. So Newton has assigned two different velocities: a tangential velocity and an orbital velocity. According to Newton's own equations, we are given a tangential velocity, and then we seek an orbital velocity. So the two cannot be the same. We are GIVEN the tangential velocity. If the tangential velocity is already the orbital velocity, then we don't need a derivation: we have nothing to seek! If you study Newton's derivation, you will see that the orbital velocity is always smaller than the tangential velocity. One number is smaller than the other. So they can't be the same.

The problem is that those who came after Newton notated them the same. He himself understood the difference between tangential velocity and orbital velocity, but he did not express this clearly with his variables. *The Principia* is notorious for its lack of numbers and variables. He did not create subscripts to differentiate the two, so history has conflated them. Physicists now think that v in the equation $v = 2\pi r/t$ is the tangential velocity. And they think that they are going from a linear expression to an angular expression when they go from v to ω. But they aren't.

[1] Newton, Principia, Section II, Prop. IV, Theorem IV, Cor. 1.

[2] Newton, Principia, Section II, Prop. I, Theorem I.

This problem has nothing to do with calculus or going to a limit. Yes, we now use calculus to derive the orbital velocity and the centripetal acceleration equation from the tangential velocity. But Newton used a versine solution in the *Principia*. And going to a limit does not make the orbital velocity equal to the tangential velocity. They have different values in Newton's own equations, and different values in the modern calculus derivation. They must have different values, or the derivation would be circular. As I said before, if the tangential velocity is the orbital velocity, there is no need for a derivation. You already have the number you seek. They aren't the same over any interval, including an infinitesimal interval or the ultimate interval.

This false equation $v_t = r\omega$ then infects angular momentum, and this is where it has done the most damage in QED. We use it to derive a moment of inertia and an angular momentum, but both are compromised.

To start with, look again at the basic equations

$$\begin{aligned} p &= mv \\ L &= rmv \end{aligned}$$

Where L is the angular momentum. This equation tells us we can multiply a linear momentum by a radius and achieve an angular momentum. Is that sensible? No. It implies a big problem of scaling, for example. If r is greater than 1, the effective angular velocity is greater than the effective linear velocity. If r is less than 1, the effective angular velocity is less than the effective linear velocity. How is that logical?

To gloss over this mathematical error, the history of physics has created a moment of inertia. It develops it this way. We compare linear and angular energy, with these equations:

$$K = \frac{mv^2}{2} = \frac{m(r\omega)^2}{2} = \frac{(mr^2)\omega^2}{2} = \frac{I\omega^2}{2}$$

The variable "I" is the moment of inertia, and is called "rotational mass." It "plays the role of mass in the equation."

All of this is false, because $v_t = r\omega$ is false. That first substitution is not allowed. Everything after that substitution is compromised. Once again, the substitution is compromised because the v in $K = (1/2)mv^2$ is linear. But if we allow the substitution, it is because we think $v = 2\pi r/t$. The v in $K = (1/2)mv^2$ CANNOT be $2\pi r/t$, because K is linear and $2\pi r/t$ is curved. You cannot put an orbital velocity into a linear kinetic energy equation. If you have an orbit and want to use the linear kinetic energy equation, you must use a tangential velocity.

The derivation of angular momentum does the same thing

$$L = I\omega = (mr^2)(v/r) = rmv$$

Same substitution of v for $r\omega$. Because $v = r\omega$ is false, $L = rmv$ is false.

But this angular momentum equation is used all over the place. I have shown that Bohr uses it very famously in the derivation of the Bohr radius[3]. This compromises all his equations.

Because Bohr's math is compromised, Schrodinger's is too. This simple error infects all of QED. It also infects general relativity. It is one of the causes of the failure of unification. It is one of the root causes of the need for renormalization. It is a universal virus.

The correction for all this is fairly simple, although it required me to study the *Principia* very closely. We need a new equation to go from tangential or linear velocity to ω. Newton does not give us that equation, and no one else has supplied it since then. We can find it by following Newton to his ultimate interval, which is the same as going to the limit. We use the Pythagorean Theorem. As $t \to 0$,

$$\omega^2 \to v^2 - \Delta v^2$$

[3] http://milesmathis.com/magneton.html

and,

$$v^2 + r^2 = (\Delta v + r)^2$$

So, by substitution,

$$\omega^2 + \Delta v^2 + r^2 = \Delta v^2 + 2\Delta v r + r^2$$

$$\Delta v = \sqrt{v^2 + r^2} - r = \frac{\omega^2}{2r}$$

$$\omega = \sqrt{2r\sqrt{v^2 + r^2} - 2r^2}$$

$$r = \sqrt{\frac{\omega^4}{4v^2 - 4\omega^2}}$$

Not as simple as the current equation, but much more logical. Instead of strange scaling, we get a logical progression. As r gets larger, the angular velocity approaches the tangential velocity. This is because with larger objects, the curve loses curvature, becoming more like the straight line. With smaller objects, the curvature increases, and the angular velocity may become a small fraction of the tangential velocity. And if v and ω diverge greatly, as with very small particles, this equation can be simplified to

$$v = \frac{\omega}{r}$$

Yes, it is just the inverse of the current equation.

This means that the whole moment of inertia idea was just a fudge, used to make $v = r\omega$. Historically, mathematicians started with Newton's equations, mainly $v = 2\pi r/t$, which they wanted to keep. To keep it, they had to fudge these angular equations. In order to maintain the equation $v = r\omega$, the moment of inertia was created. But using my simple corrections, we see that the angular momentum is not $L = mvr = I\omega$. The angular momentum equation is just $L = m\omega$. We didn't need a moment of inertia, we just needed to correct the earlier equations of Newton, which were wrong.

Addendum: August 2010.

Many have not understood my variables here, even after all this. They have replied that my new equation $v = \omega/r$ cannot be correct simply due to units. They say that my v has the dimensions of an angle over a time over a length, which is not a velocity. But my ω is no longer an angular velocity measured in radians, you see. My angular velocity is the same as the orbital velocity, since they are basically equivalent. An angular velocity was always a curve, so it was always *an acceleration*. Therefore it was always a cheat or mistake to express angular velocity in radians/s. Since an angular velocity must be a curve, it must be expressed as an acceleration. Well, if ω is an acceleration, then v is a velocity, and the units do resolve. You will say, "What do you mean, the units resolve? They don't, since if we let ω be an acceleration, we get $v = 1/s^2$. That still isn't a velocity!" Ah, but it is, as long as we remember that time and length are inverse parameters in all such equations. If you visit my paper on time[4], you will be reminded that $L = 1/T$. In other words, as a matter of operation, length and time are really equivalent entities; we just put time in the denominator to create a ratio. For this reason, we can either multiply an acceleration by a time or divide it by a length: either way we will get a velocity.

In fact, it is the current equation that is senseless regarding units. In the equation $v = r\omega$, v is a velocity only if we give an angle no units or dimensions. But of course an angle is not really dimensionless. An angular velocity is a displacement just as much as a linear velocity, so we have motion. If we have motion,

[4] Chapter 4

we must have units. An angular velocity is not "nothing per second," is it? The current equation acts as if the radians can just be dropped, but what we really have, as you now see, is radians x meters/seconds. Is that a velocity? I don't think so. Once we do the full analysis, it is my equation that makes sense and theirs that does not.

Others have complained that if L now equals $m\omega$, and if $\omega = vr$, then the equation $L = mvr$ is saved. My argument appears circular. But it isn't, because my v is different from their v. My v is the tangential velocity, and their v is the orbital velocity. They will say that their v is labelled vt, which is tangential velocity, but that labelling is false. Yes, they label it that way, but they do not use it that way. They substitute $v = 2\pi r/t$ into that equation, and $2\pi r/t$ is not a tangential velocity. Their v is v_0, not v_t. The working equation is either $L = mrv_t$ or $L = m\omega = mv_0$, but $L \neq mrv_0$. The last equation is the current one, so it is false.

You will say that if my ω is not measured in radians/s, I shouldn't label it ω; but since measuring angular velocity as radians/s is a fudge, there will be no use for that in the future. I am free to capture that variable and use it as I will.

For more on this, see my long paper on Newton[5].

You may also see my new paper on the electron radius[6] for an interesting use of these new equations.

[5] Chapter 20
[6] http://milesmathis.com/elec3.html

Chapter 6

UNIFIED FIELDS IN DISGUISE

Abstract: I will show that we have had not one but two correct and successful unified field equations for centuries.

Both Newton's and Coulomb's famous equations are unified field equations in disguise. This was not understood until I pulled them apart, showing what the constant is in each equation and how it works mechanically.

A unified field equation does not need to unify all four of the presently postulated fields. To qualify for unification, it only has to unify two of them. The unified field equations that will be unmasked in this paper both unify the gravitational field with the electromagnetic field. This unification of gravity and E/M was the great project of Einstein and is now the great project of string theory. But neither Einstein nor string theory has presented a simple unified field equation. As time has passed this has seemed more and more difficult to achieve, and more and more difficult math has been brought in to attack the problem. But it turns out the answer was always out of reach because the question was wrong. We were seeking to unify fields when we should have been seeking to un-unify them. We already had two unified field equations: which is why they couldn't be unified. We were trying to rejoin a couple that was already happily married.

Yes, both Newton and Coulomb discovered unified field equations. That is why their two equations look so much alike. But the two equations unify in different ways. Newton was unaware of the E/M field, as we know it now, so he did not realize that his heuristic equation contained both fields. And Coulomb was working on electrostatics, and likewise did not realize that his equation included gravity. So the E/M field is hidden inside Newton's equation, and the gravitational field is hidden inside Coulomb's equation.

Let's look at Newton's equation first.

$$F = \frac{GMm}{r^2}$$

We have had this lovely unified field equation since 1687. But how can we get two fields when we only have mass involved? Well, we remember that Newton invented the modern idea of mass with this equation. That is to say, he pretty much invented that variable on his own. He let that variable stand for what we now call mass, but it turns out he compressed the equation a bit too much. He wanted the simplest equation possible, but in this form it is so simple it hides the mechanics of the field. It would have been better if Newton had written the equation like this:

$$F = \frac{G(DV)(dv)}{r^2}$$

He should have written each mass as a density and a volume. Mass is not a fundamental characteristic, like density or volume is. To know a mass, you have to know *both* a density and a volume. But to know a volume, you only need to know lengths. Likewise with density. Density, like volume, can be measured only with a yardstick. You will say that if density and volume can be measured with a yardstick, so can mass, since mass is defined by density and volume. True. But mass is a step more abstract, since it requires *both* measurements. Mass requires density *and* volume. But density and volume do not require mass.

Once we have density and volume in Newton's equation, we can assign density to one field and volume to the other. We let volume define the gravitational field and we let density define the E/M field. Both fields then fall off with the square of the radius, simply because each field is spherical. There is nothing mysterious about a spherical field diminishing by the inverse square law: just look at the equation for the surface area of the sphere:

$$S = 4\pi r^2$$

Double the radius, quadruple the surface area. Or, to say the same thing, double the radius, divide the field density by 4. If a field is caused by spherical emission, then it will diminish by the inverse square law. Quite simple.

The biggest pill to swallow is the necessary implication that gravity is now dependent only on radius. If gravity is a function of volume, and no longer of density, then gravity is not a function of mass. We have separated the variables and given density to the E/M field, so gravity is no longer a function of density. If gravity is a function of volume alone, then with a sphere gravity is a function of radius, and nothing else.

It is only the compound or unified field that is a function of mass. Yes, Newton's equation still works like it always did, and in that equation the total force field is a function of mass. But in my separated field[1], gravity is not a function of mass. It is a function of radius and radius alone.

Now we only need to assign density mechanically. I have given it to E/M, but what part of the E/M field does it apply to? Well, it must apply to the emission. Newton's equation is not telling us the density of the bodies in the field, it is telling us the density of the emitted field. Of course one is a function of the other. If you have a denser moon, it will emit a denser E/M field. But, as a matter of mechanics, the variable D applies to the density of the emitted field. It is the density of photons emitted by the matter creating the unified field.

Finally, what is G, in this analysis? G is the transform between the two fields[2]. It is a sort of scaling constant. As we have seen, one field – gravity – is determined by the radius of a macro-object, like a moon or planet or a marble. The other field is determined by the density of emitted photons. But these two fields are not operating on the same scale. To put both fields into the same equation, we must scale one field to the other. We are using both fields to find a unified force, so we must discover how force is transmitted in each field. In the E/M field, force is transmitted by the direct contact of the photons. That is, the force is felt at that level. It can be measured from any level of size, but it is being transmitted at the level of the photon. But since gravity is now a function of volume alone, it is not a function of photon size or energy. It is a function of matter itself, that is, of the atoms that make up matter. Therefore, G is a scaling constant between atoms and photons. To say it another way, G is taking the volume down to the level of size of the density, so that they may be multiplied together to find a force. Without that scaling constant, the volume would be way too large to combine directly to the density, and we would get the wrong force. By this analysis, we may assume that the photon involved in E/M transmission is about G times the atom, in size.

Now we continue on to Coulomb's equation:

$$F = \frac{kq_1q_2}{r^2}$$

[1] http://milesmathis.com/uft.html
[2] http://milesmathis.com/g.html

One hundred years after Newton, we got another unified field equation. Here we have charges instead of masses, and the constant is different, but otherwise the equation looks the same as Newton's. Physicists have always wondered why the equations are so similar, but until now, no one really knew. No one understood that they are both the same equation, in a different disguise.

I unveiled this equation using a different trick. With Newton's equation, I pulled the veil off by writing the masses as densities and volumes. With Coulomb's equation, it was the constant that got me in. In fact, if it weren't for Bohr, I would never have unveiled Coulomb's equation.

It happened like this: I noticed that the angular velocity equation in textbooks didn't make any sense, so I went back to Newton to see how it was derived. I discovered that Newton had given us different values for tangential velocity and orbital velocity, but that the two numbers had gotten conflated since then. Meaning, the two numbers had become one. Modern physicists now think tangential velocity and orbital velocity are the same thing, but they aren't. In correcting this muddle[3], I found that the angular momentum equation had to change. By my analysis, $L = rmv$ was no longer true. After I corrected it, I went to Bohr's equations for hydrogen, finding that they had to be redone. Once I fixed them[4], it turned out that the value for the Bohr radius was exactly the same as Coulomb's constant (in reverse). The new Bohr radius is 9×10^{-9} meters. Coulomb's constant is 9×10^{9}.

I could immediately see that Coulomb's constant is another scaling constant, like G. Instead of scaling smaller, like G, k scales larger. Coulomb's constant takes us up from the Bohr radius to the radius of macro-objects like Coulomb's spheres. It turns the single electron charge into a field charge.

But where is the gravitational field in Coulomb's equation? If we study charge, we find that it has the same fundamental dimensions as mass. The statcoulomb has dimensions of $M^{\frac{1}{2}} L^{\frac{3}{2}} T^{-1}$. This gives the total charge of two particles the cgs dimension ML^3/T^2 . But mass has the dimensions L^3/T^2, which makes the total charge M^2. So we can treat Coulomb's charges just like Newton's masses.

[3]Chapter 5

[4]http://milesmathis.com/magneton.html

We write the equation like this:

$$F = \frac{k(DV)(dv)}{r^2}$$

Once again, the volume is the gravitational field and the density is the E/M field. The single electron is in the emitted field of the nucleus, and *D* gives us the density of that field. But this time the expressed field is the E/M field and the hidden field is gravity. So we have to scale the electromagnetic field UP to the unified field we are measuring with our instruments.

If *k* and *G* had been the same number, all this would have been seen earlier. It would have then been easy to see that Coulomb's equation was just the inverse of Newton's equation. But because the constants were not the same number, the problem was hidden.

In scaling up and scaling down, we don't simply reverse the scale. It is a bit more complex than that, as you have seen. In scaling down, we go from atomic size to photon size. In scaling up, we go from atomic size to our own size.

Unifying the two major fields of physics like this must have huge mathematical and theoretical consequences. Because Coulomb's equation is a unified field equation, gravity must have a much larger part to play in quantum mechanics and quantum electrodynamics. Gravity must also move into the field of the strong force, and require a complete overhaul there.

By the same token, the E/M field must invade general relativity, requiring a complete reassessment of the compound forces. At all levels of size, we will find both fields at work, creating a compound field in which each field is in opposition to the other.

Yes, according to my new equations, the two fields are always in vector opposition. And since gravity, by itself, is a function of radius alone, it must be much larger at small scales than we thought–and somewhat smaller at large scales.

Chapter 7

THE KINETIC ENERGY EQUATION

another hole in your physics book

Abstract: I will show that the kinetic energy equation is derived by bad math in contemporary textbooks, and that it is never derived by good math. I will derive the equation by more logical means, showing the mechanical reason that we have a square velocity in the equation.

Here's a question not many ask: why is the velocity squared in the kinetic energy equation, $E = \frac{1}{2}mv^2$. Why should the energy depend on the square of the velocity? We have the same question with the equation $E = mc^2$. Einstein was nice enough to provide us with this simple equation, but not nice enough to tell us why the energy depends on the square of the speed of light.

To find out, let us look at how the first equation is derived in textbooks. We start with the constant acceleration equation,

$$2ad = v_f^2 - v_i^2$$

Then substitute $a = F/m$ into that

$$\frac{2Fd}{m} = v_f^2 - v_i^2$$

If we let the initial velocity equal zero, and define work as force through a distance, we get

$$W = E = Fd = \frac{mv_f^2}{2}$$

Work is then defined as the change in kinetic energy, in the famous work-energy theorem.

The hole here couldn't be bigger, though we never see comment on it. Lots of things have kinetic energy that don't have accelerations. A photon is a prime example, but there are millions of other easy examples. The equation itself makes this clear, since it doesn't have an acceleration in it. You can plug any particle with any constant velocity into it, and achieve a kinetic energy. So this derivation is misdirection. It implies that we need an acceleration in order to have a force or kinetic energy, but we don't. Any object with any velocity will have a force. A car hitting you will apply a force, whether or not it is accelerating.

But can we derive the kinetic energy equation without a force? Can we achieve a square velocity without assuming an acceleration? Not according to classical mechanics. Classical mechanics answers this question by ignoring it completely. QED and string theory do not address it either: they are busy ignoring all sorts of new questions, and would not dream of addressing old ignorance.

Some quarters try to dodge this problem as Wikipedia does when it says, "Having gained this energy during its acceleration, the body maintains this kinetic energy unless its speed changes." But this is absurd. The equation is developed *from* the acceleration, as I just showed. The work-energy theorem requires a change in velocity, which is an acceleration. You cannot get work without a force and you cannot get a force without an acceleration. But the current kinetic energy equation has no change in velocity. A particle has kinetic energy with a constant velocity. If the kinetic energy equation is developed from an acceleration, it means the energy *depends* on the acceleration. The particle should have kinetic energy only while it is being accelerated.

Wikipedia actually leads its page on kinetic energy with the assertion above, wanting to misdirect from the first utterance, proving once again that it is the primary playground of contemporary propaganda. Whereas most textbooks ignore the question completely, hoping to keep it in the dark, Wikipedia takes a more proactive approach in mind control. It sees the question coming and deflects you in a positive way from asking it.

But this is question begging of the first order, and it is amazing that 15 generations of students have failed to ask it.

Let me put it another way. If $v_f = v_i$, then the postulate equation becomes

$$\begin{aligned} 2ad &= v_f^2 - v_I^2 = 0 \\ \frac{2Fd}{m} &= 0 \\ E = Fd &= 0 \end{aligned}$$

You cannot postulate an acceleration in order to develop an equation, and then dump the acceleration. The equations that come after the first equation depend on the first equation. You cannot have different assumptions in the postulate equation and the derived equations. You cannot have variable motion in the first equation, and then derive constant motion from it! We see once again how our textbooks are riddled with gloriously negligent math.

In another paper[1], I showed that we can develop the equation $E = \frac{1}{2}mv^2$ from the equation $E = mc^2$, by reworking Einstein's equations and making a few corrections. But this brings us back to explaining $E = mc^2$. Einstein develops this equation mainly by assuming that E/c is the momentum of the photon. Then, by the equation $E/c = mv$, and substituting c for v, he gets his new equation. But E/c was found by experiment, not by theory, so the theory becomes circular at this point. We keep returning to the question, why c^2? Einstein gives us the number but not the mechanical explanation. Why square the speed of light? Why should the energy depend on c^2? Or, to extend the question, why should the energy of any moving particle, moving with a constant velocity, depend on the square of that velocity?

This reason this is all hidden is that the standard model has no answer for it. If it could derive the kinetic energy equation with good math, it wouldn't need to derive it with bad math. If anyone could tell you why the kinetic energy is a function of the square velocity, they wouldn't need to pin the equation to acceleration.

Even if I didn't have an answer for this question, I think it would be important to show the hole. These holes should not be covered up, they should be put on the front page: that is the only hope of an answer. But I do have an answer. I can tell you why the kinetic energy is dependent on the square velocity.

In my paper on photon motion[2], I showed that the measured wavelength and the real wavelength of the photon differ by a factor of c^2. This is because the linear motion of the photon stretches the spin wavelength. The linear velocity is c, of course, and the circular velocity approaches $1/c$. The difference between the two is c^2. Energy, like velocity, is a relative measurement. A quantum with a certain

[1] http://milesmathis.com/emc.html

[2] http://milesmathis.com/photon2.html

energy has that energy only relative to us, since it has its velocity only relative to us. If the wavelength has to be multiplied by c^2 in order to match it to our measurements, then the mass or mass equivalence will also. Hence the equation $E = mc^2$. In this way, c^2 is not a velocity or a velocity squared, it is a velocity transform. It tells us how much the wavelength is stretched, and therefore how much the mass and energy are stretched, due to the motion of the object.

The same analysis can be applied to any object. The energy of any object is determined by summing the energies of its constituent atomic and quantum particles, and all these particles also have spins. The quanta will impart this spin energy in collision, so this spin energy must be included in the total kinetic energy.

You will say, "The object as a whole would have to be spinning to impart spin energy. The quanta cannot transmit this energy, since most of the quanta will be away from the surface of collision. How can quanta deep inside an object transmit their spin energy in collision?"

And I answer, how could they not? The quanta have this energy – no matter where they exist in the object – and the macro-object made up of these quanta is nothing but the summation of these quanta and their energies and interactions. A collision is not just an interaction of surfaces, it is an interaction of objects, *through* a surface. If a car hits you, you don't just feel the forces from mass on the front bumper, you feel forces from the entire mass of the car. Any energy the car has, whether it is linear energy or spin energy or energy from mass, will sum to create the total effect upon you. If quanta are spinning, this spin must affect all energies and forces, at all levels. And this must apply to nucleons and electrons as well as photons.

So the short answer is that the kinetic energy equation, like the equation $E = mc^2$, always included the spin energy; but no one recognized that. Just as with the photon, all matter has a wavelength (see de Broglie), and the wavelength is determined by spin. The spin has a radius, and this radius is the local wavelength. Any linear velocity of the spinning particle will stretch our measurement of this wavelength, in a simple mechanical manner, as I showed in the photon paper. As the linear velocity increases, the spin velocity relative to the linear velocity decreases, by a factor of $1/v$. This makes the *difference* between the linear velocity and the spin velocity v^2. The term v^2 *transforms* the local wavelength into the measured wavelength. This is why we find the term in the energy equation.

The only question remaining is why we have the term $\frac{1}{2}$ in the kinetic energy equation. The reason is simple: we are basically multiplying a wavelength transform by a mass, in order to calculate an energy. So we have to look at how the mass and the wavelength interact. I have shown that the wavelength is caused by stacking several spins (at least two spins), so what we have is a material particle spinning end-over-end. If we look at this spin over any extended time interval, we find that half the time the material particle is moving in the reverse direction of the linear motion. Circular motion cannot follow linear motion, of course, and if we average the circular motion over time, only half the circular motion will match the linear vector. This means that half the effective mass will be lost, hence the equation we have.

This does not apply to the photon, or to the equation $E = mc^2$, due only to the fact that c^2 is so large. The photon has the same mechanics, but $\frac{1}{2}$ is so small relative to c^2 that it can be ignored. The equation $E = mc^2$ can be applied to the photon, to find a kinetic energy (since the photon is almost all kinetic energy), so the equation is analogous in all ways to $E = \frac{1}{2}mv^2$. But since the mass is negligible compared to c^2 , we can ignore the $\frac{1}{2}$. It does not matter that the mass is moving opposite to the linear motion, since $\frac{1}{2}$ of almost nothing is still almost nothing.

Chapter 8

THE EQUATION $V = V_0 + AT$ IS FALSE

as a field equation

In a recent paper on the muon[1], I showed that this equation doesn't work when v_0 is equal to c. It doesn't work when we have a particle with a very high velocity being accelerated by a gravity field. In that case the equation is $v_f = v_0 + 2v_0^2 t$. Why?

[1] http://milesmathis.com/muon.html

I will show that the reason is because the equation in the title is false as a field equation. It only works when the acceleration is not a field. It works only when the acceleration is an internal acceleration, as with a car.

In textbooks, the equation in my title is derived like this:

$$\begin{aligned} a &= \frac{v}{t} \\ v &= at \end{aligned}$$

Then we add the initial velocity. That's it. The equation is basically a definition of acceleration. But in a recent paper on the calculus and variable acceleration[2], I showed that the equation can actually be calculated from the time derivative.

$$v = \frac{a\,\mathrm{d}(t^2)}{2} = at$$

The 2 in the denominator comes from the halved first interval, which we must take into account in any acceleration.

So we have confirmed that part of the equation. The problem must be with the way the initial velocity and the acceleration stack up in a field. Apparently we can't just add the final velocity from the acceleration to the original velocity. Again, why?

Put simply, the reason is because if we have an initial velocity meeting an acceleration field, we have three velocities. Let us start with just the acceleration field, and no initial velocity. Let us say you have a gravity field, or any other acceleration field that creates a normal or squared acceleration. If you place an object in the field, the object will be given two simultaneous velocities. That is what an acceleration is, after all. If the object has one velocity, it has no acceleration. If it has an acceleration, it must have more than one velocity over each interval or differential. A squared acceleration, or an acceleration to the power of 2, is

[2] Chapter 15

composed of two velocities. Therefore an object placed in any acceleration field will be given two velocities.

OK, but now we take an object that already has a velocity of its own, and we fly it into that acceleration field. It must then have three velocities over each interval. Or, to say it another way, it now has a cubed acceleration. It has three t's in the denominator.

For this *not* to be the case, we would have to break Newton's first law. If we don't include the initial velocity in each differential of acceleration, that means the acceleration field has somehow negated that velocity during the time of acceleration. The field would have to stop the object, then accelerate it, then give it its original velocity back at the end. Of course all that is impossible and absurd. No, the field would have to keep the initial velocity in every differential of acceleration, meaning that it would be accelerating the velocity, not the object.

Now maybe you see the problem with the equation in the title. It does not include a cubed acceleration. The "*a*" variable stands for a squared acceleration. The equation includes three velocities, but the first velocity has not been integrated into the acceleration. It is only added, as a separate term. But that is not the way the real field would work. The real field would accelerate the initial velocity, not just the object. As it is, the initial velocity is not summed in every differential, as it should be; it is only summed *outside* the acceleration. That cannot work, either as a matter of calculus or as a matter of physics. The equation is wrong, in any and all cases where a field is involved.

Now, some have had difficulty understanding this. They know the equation works in a simple case like a car. Why would it not work in a field? How is a car accelerating different than a field? Well, the car is accelerating itself, internally, with its own engines, and the car has no velocity relative to itself. The car and its engines have no way of knowing the car is moving at all, since velocity is relative. The car cannot be its own field, by the definition of field. Relative to itself, the car always has a velocity of zero. Therefore the acceleration is not a field acceleration. The engines really are accelerating the car, not the velocity of the car. But if we have an external field, the field must be accelerating the velocity itself.

The other problem many people have is that my new equations show huge final velocities. And yet we know that falling objects and objects like meteors entering the atmosphere do not reach velocities like that. How can I answer that? I answer it with terminal velocity. Most objects will have an appreciable size and mass, so that they are affected strongly by the atmosphere. They can't reach those velocities simply due to drag. However, I do believe that objects entering our gravity field reach terminal velocity much quicker than previously supposed, and they do so because of my new equations. In addition, when we consider very small objects like muons, we have objects that are not affected by atmospheric drag. They aren't slowed by the atmosphere at all. They are either absorbed or deflected by it, or they are not. If we detect them at sea level, then it is because they have avoided collision with molecules in the atmosphere. If they avoided collision, then they avoided "drag". Therefore they *can* cover these very long distances predicted by my field equations.

Now, I have developed a simple equation for cubed acceleration in another paper[3]:

$$v = \frac{a\,\mathrm{d}^2(t^3)}{2} = 3at$$

But the "*a*" variable there is the cubed acceleration. We need to be given that acceleration in order to find velocities and distances. And that equation does not integrate an initial velocity either. In the muon problem, we were given only the initial velocity and the squared acceleration. That is why we have to use these equations:

$$s = v_0 t$$

That is the distance the object would travel with only the initial velocity.

$$\Delta s = v_0 t + \frac{at^2}{2}$$

[3]Chapter 15

That is the additional distance it would travel during each interval, due to the acceleration.

$$2s\Delta s = 2v_0t\left(vt + \frac{at^2}{2}\right) = 2v_0^2t^2 + av_0t^3$$

That is integrating the three velocities.

$$\begin{aligned} v_f &= v_0 + \frac{2s\Delta s}{t} = v_0 + 2v_0^2t + av_0t^2 \\ v_f &= v_0(1 + 2v_0t + at^2) \end{aligned}$$

If the time is very small and the initial velocity very large, as in our muon problem, we can ignore the acceleration and estimate the final distance with this equation:

$$s = v_0^2t^2$$

Which gave us a distance of about 435,000 m in the muon problem.

A reader has pointed out to me that the dimensions appear to be off in that final equation. What causes it is that I am multiplying a distance by a distance, which appears to give us a distance squared. Go back two steps and you will see what I mean. But a distance times a distance is not a distance squared, if they are in line. A distance times a distance is a distance squared only in the case that the two distances are orthogonal, so that we have a square or something. A distance times a distance in line cannot be a distance squared anymore than a distance plus a distance can be a distance squared. This is another mainstream misunderstanding.

I have used algebra here to solve, but notice that if we use integration, we get the same problem: $\int(2x+y)\,\mathrm{d}x = x(x+y)$. We integrate a sum but get meters squared.

This problem ties into the historical problem of velocity squared versus acceleration. Physics has never been clear about the mechanical difference. One has meters squared in the numerator and one does not, but are they really different? No. A square velocity IS an acceleration, by definition, so if we are getting different dimensions it is by ignoring some mechanics. We see that in this problem very clearly: if we multiply a velocity times a velocity in a field, we should get an acceleration. Therefore the extra length in the numerator is just that: extra. [You can now read more about this in a separate paper[4].]

Critics have said I can't be right, because if we use c for v_0, we get a final velocity way above c. But I have shown that this does not break any rules of Relativity, since v_f doesn' really apply to the object (as with a muon). The final velocity in the equation is a field result, not a real velocity of any one object. The field acts like a second object in the math. Relativity does not forbid a result over c, or a calculation over c, it forbids a measurement over c. It tells us we will never discover a value over c in our data, and I do not disagree with that. However, we already know from accepted data that fields create results over c all the time. We know this from blueshifts. Blueshifts are impossible without motion relative to light. Some still think Relativity forbids motion relative to light, but it doesn't. It only forbids *measurement* of motion relative to light. It cannot forbid calculations relative to light, and we calculate motion relative to light every time we calculate a blueshift (or a redshift).

Conclusion: Historically, the equations have failed to properly integrate the initial velocity, but I have corrected that. I have claimed that physics books were wrong from the first chapters, and I have shown yet another shocking example of that. Physics has not realized that this basic equation has a very limited use, and that it does not apply to fields.

I have claimed that physicists and mathematicians were hiding away in esoteric equations and arcane problems while they couldn't do basic math and physics, and I have shown yet another shocking proof of that. The highschool physics books are full of false equations, while the top physicists are getting Nobel Prizes for modeling the first split seconds of the Big Bang[5]. Ask yourself this: is it

[4] http://milesmathis.com/accel.html
[5] http://milesmathis.com/inflat.html

likely they are getting the right answer for that, when they have the wrong answer for this?

Part II

CALCULUS

Chapter 9

A REDEFINITION OF THE DERIVATIVE

(Why the calculus works – and why it doesn't)

For briefer, less technical analyses of contemporary calculus, you may now go to Chapter 11, Chapter 16 and Chapter 15.

Introduction

In this paper I will prove that the invention of the calculus using infinite series and its subsequent interpretation using limits were both errors in analyzing the given problems. In fact, as I will show, they were both based on the same conceptual error: that of applying diminishing differentials to a mathematical curve (a curve as drawn on a graph). In this way I will bypass and ultimately falsify both standard and nonstandard analysis.

The nest of historical errors I will roust out here is not just a nest of semantics, metaphysics, or failed definitions or methods. It is also an error in finding solutions. I have now used my corrections to theory to show that (Chapter 13) various proofs are wrong. Furthermore, my better understanding of the calculus has allowed me to show that the calculus is misused in simple physical problems[1], getting the wrong answer.

By re-defining the derivative I will also undercut the basic assumptions of all current topologies, including symplectic topology – which depends on the traditional definition in its use of points in phase space. Likewise, linear and vector algebra and the tensor calculus will be affected foundationally by my re-definition, since the current mathematics will be shown to be inaccurate representations of the various spaces or fields they hope to express. All representations of vector spaces, whether they are abstract or physical, real or complex, composed of whatever combination of scalars, vectors, quaternions, or tensors will be influenced, since I will show that all mathematical spaces based on Euclid, Newton, Cauchy, and the current definition of the point, line, and derivative are necessarily at least one dimension away from physical space. That is to say that the variables or functions in all current mathematics are interacting in spaces that are mathematical spaces, and these mathematical spaces (all of them) do not represent physical space.

[1] Chapter 15

This is not a philosophical contention on my part. My thesis is not that there is some metaphysical disconnection between mathematics and reality. My thesis, proved mathematically below, is that the historical and currently accepted definitions of mathematical points, lines, and derivatives are all false for the same basic reason, and that this falsifies every mathematical space. I correct the definitions, however, which allows for a correction of calculus, topology, linear and vector algebra, and the tensor (among many other things). In this way the problem is solved once and for all, and there need be no talk of metaphysics, formalisms or other esoterica.

In fact, I solve the problem by the simplest method possible, without recourse to any of the mathematical systems I critique. I will not require any math beyond elementary number analysis, basic geometry and simple logic. I do so pointedly, since the fundamental nature of the problem, and its status as the oldest standing problem in mathematics, has made it clearly unresponsive to other more abstract analysis. The problem has not only defied solution; it has defied detection. Therefore an analysis of the foundation must be done at ground level: any use of higher mathematics would be begging the question. This has the added benefit of making this paper comprehensible to any patient reader. Anyone who has ever taken calculus (even those who may have failed it) will be able to follow my arguments. Professional mathematicians may find this annoying for various reasons, but they are asked to be gracious. For they too may find that a different analysis at a different pace in a different "language" will yield new and useful mathematical results.

The end product of my proof will be a re-derivation of the core equation of the differential calculus, by a method that uses no infinite series and no limit concept. I will not re-derive the integral in this paper, but the new algorithm I provide here makes it easy to do so, and no one will be in doubt that the entire calculus has been re-established on firmer ground.

It may also be of interest to many that my method allows me to show, in the simplest possible manner, why umbral calculus has always worked. Much formal work has been done on the umbral calculus since 1970; but, although the various equations and techniques of the umbral calculus have been connected and extended, they have never yet been fully grounded. My re-invention and re-interpretation of the Calculus of Finite Differences allows me to show – by lifting a single curtain – why subscripts act exactly like exponents in many situations.

Finally, and perhaps most importantly, my reinvention and re-interpretation of the Calculus of Finite Differences allows me to solve many of the point-particle problems of QED without renormalization. I will show that the equations of QED required renormalization only because they had first been de-normalized by the current maths, all of which are based upon what I call the Infinite Calculus. The current interpretation of calculus allows for the calculation of instantaneous velocities and accelerations, and this is caused both by allowing functions to apply to points and by using infinite series to approach points in analyzing the curve. By returning to the Finite Calculus – and by jettisoning the point from applied math – I have pointed the way in this paper to cleaning up QED. By making every variable or function a defined interval, we redefine every field and space, and in doing so dispense with the need for most or all renormalization. We also dispense with the primary *raison d'être* of string theory.

Newton's calculus evolved from charts he made himself from his power series, based on the binomial expansion. The binomial expansion was an infinite series expansion of a complex differential, using a fixed method. In trying to express the curve as an infinite series, he was following the main line of reasoning in the pre-calculus algorithms, all the way back to the ancient Greeks. More recently Descartes and Wallis had attacked the two main problems of the calculus – the tangent to the curve and the area of the quadrature – in an analogous way, and Newton's method was a direct consequence of his readings of their papers. All these mathematicians were following the example of Archimedes, who had solved many of the problems of the calculus 1900 years earlier with a similar method based on summing or exhausting infinite series. However, Archimedes never derived either of the core equations of the calculus proper, the main one being in this paper, $y' = nx^{n-1}$.

This equation was derived by Leibniz and Newton almost simultaneously, if we are to believe their own accounts. Their methods, though slightly different in form, were nearly equivalent in theory, both being based on infinite series and differentials that approached zero. Leibniz tells us himself that the solution to the calculus dawned upon him while studying Pascal's differential triangle. To solve the problem of the tangent this triangle must be made smaller and smaller.

Both Newton and Leibniz knew the answer to the problem of the tangent before they started, since the problem had been solved long before by Archimedes using the parallelogram of velocities. From this parallelogram came the idea of instantaneous velocity, and the 17^{th} century mathematicians, especially Torricelli and Roberval, certainly took their belief in the instantaneous velocity from the Greeks. The Greeks, starting with the Peripatetics, had assumed that a point on a curve might act like a point in space. It could therefore be imagined to have a velocity. When the calculus was used almost two millennia later by Newton to find an instantaneous velocity – by assigning the derivative to it – he was simply following the example of the Greeks.

However, the Greeks had seemed to understand that their analytical devices were inferior to their synthetic methods, and they were even believed by many later mathematicians (like Wallis and Torricelli) to have concealed these devices. Whether or not this is true, it is certain that the Greeks never systematized any methods based on infinite series, infinitesimals, or limits. As this paper proves, they were right not to. The assumption that the point on the curve may be treated as a point in space is not correct, and the application of any infinite series to a curve is thereby an impossibility. Properly derived and analyzed, the derivative equation cannot yield an instantaneous velocity, since the curve always presupposes a subinterval that cannot approach zero; a subinterval that is, ultimately, always one.

9.1 *The Groundwork*

To prove this I must first provide the groundwork for my theory by analyzing at some length a number of simple concepts that have not received much attention in mathematical circles in recent years. Some of these concepts have not been discussed for centuries, perhaps because they are no longer considered sufficiently abstract or esoteric. One of these concepts is the cardinal number. Another is the cardinal (or natural) number line. A third is the assignment of variables to a curve. A fourth is the act of drawing a curve, and assigning an equation to it. Were these concepts still taught in school, they would be taught very early on, since they are quite elementary. As it is, they have mostly been taken for granted – one might say they have not been deemed worthy of serious consideration since the fall of Athens. Perhaps even then they were not taken seriously, since the Greeks also failed to understand the curve – as their use of an instantaneous velocity makes clear.

The most elementary concept that I must analyze here is the concept of the point. In the Dover edition of Euclid's *Elements*, we are told, "a point is that which has no part." The Dover edition supplies notes on every possible variation of this definition, both ancient and modern, but it fails to answer the question that is central to my paper here: that being, "Does the definition apply to a mathematical point or a physical point" Or, to be even more blunt and vivid, "Are we talking about a point in space, or are we talking about a point on a piece of paper?" This question has never been asked much less answered (until now).

Most will see no point to my question, I know. How is a point on a piece of paper not the same as a point in space? A point on a piece of paper is physical – paper and ink are physical things. So what can I possibly mean?

Let me first be clear on what I do *not* mean. Some readers will be familiar with the historical arguments on the point, and I must be clear that my question is a completely new one. The historical question, as argued for more than two millennia now, concerns the difference between a monad and a point. According to the ancient definitions a monad was indivisible, but a point was indivisible and had position. The natural question was "position where?" The only answer was thought to be "in space, or in the real world." A thing can have position nowhere else. A point is therefore an indivisible position in the physical world. A monad is a generalized "any-point", or the idea of a point. A point is a specific monad, or the position of a specific monad.

But my distinction between a mathematical point and a physical point is not this historical distinction between a monad and a point. I am not concerned with classifications or with existence. It does not matter to me here, when distinguishing between a physical point and mathematical point, whether one, both, or neither are ideas or objects. What is important is that they are not equivalent. A point in a diagram is neither a physical point nor a monad. A point in a diagram is a specific point; it has (or represents) a definite position. So it is not a monad. But a diagrammed or mathematical point is an abstraction of a physical point; it is not the physical point itself. Its position is different, for one thing. More importantly, whether idea or object, it is one level removed from the physical point, as I will show in some detail below.

The historical question has concerned one sort of abstraction – from the specific to the general. My question concerns a completely different sort of abstraction – the representation of one specific thing by another specific thing. The Dover edition calls its question ontological. My question is operational. A mathematical point represents a physical point, but it is not equivalent to a physical point since the operation of diagramming creates fields that are not directly transmutable into physical fields.

Applied mathematics must be applied to something. Mathematics is abstract, but applied mathematics cannot be fully abstract or it would be applicable to nothing. Applied mathematics applies to diagrams, or their equivalent. It cannot apply directly to the physical world. And this is why I call a diagrammed point a mathematical point. Applied geometry and algebra are applied to mathematical points, which are diagrammed points.

A point on a piece of paper is a diagram, or the beginning of a diagram. It is a representation of a physical point, not the point itself. When we apply mathematics, we do so by assigning numbers to points or lengths (or velocities, etc.). Physics is applied mathematics. It is meant to apply to the physical world. But the mathematical numbers may not be applied to physical points directly. Mathematics is an abstraction, as everybody knows, and part of what makes it abstract even when it is applied to physics is that the numbers are assigned to diagrams. These diagrams are abstractions. A Cartesian graph is one such abstraction. The graph represents space, but it is not space itself. A drawing of a circle or a square or a vector or any other physical representation is also an abstraction. The vector represents a velocity, it is not the velocity itself. A circle may represent an orbit, but it is not the orbit itself, and so on. But it not just that the drawing is simplified or scaled up or down that makes it abstract. The basic abstraction is due to the fact that the math applied to the problem, whatever it is, applies to the diagram, not to the space. The numbers are assigned to points on the piece of paper or in the Cartesian graph, not to points in space.

All this is true even when there is no paper or pixel diagram used to solve the problem. Whenever math is applied to physics, there is some spatial representation somewhere, even if it is just floating lines in someone's head. The numbers are applied to these mental diagrams in one way or another, since numbers cannot logically be applied directly to physical spaces.

The easiest way to prove the inequivalence of the physical point and the mathematical point is to show that you cannot assign a number to a physical point. We assign numbers to mathematical points all the time. This assignment is the primary operational fact of applied mathematics. Therefore, if you cannot assign a number to a physical point, then a physical point cannot be equivalent to a mathematical point.

Pick a physical point. I will assume you can do this, although metaphysicians would say that this is impossible. They would give some variation of Kant's argument that whatever point you choose is already a mental construct in your head, not the point itself. You will have chosen a *phenomenon*, but a physical point is a *noumenon*. But I am not interested in metaphysics here; I am interested in a precise definition, one that has the mathematically required content to do the job. A definition of "point" that does not tell us whether we are dealing with a physical point or a mathematical point cannot fully do its job, and it will lead to purely mathematical problems.

So, you have picked a point. I am not even going to be rigorous and make you worry about whether that point is truly dimensionless or indivisible, since, again, that is just quibbling as far as this paper is concerned. Let us say you have picked the corner of a table as your point. The only thing I am going to disallow you to do is to think of that point in relation to an origin. You may not put the corner of your table into a graph, not even in your head. The point you have chosen is just what it is, a physical point in space. There are no axes or origins in your room or your world. OK, now try to assign a number to that point. If you are stubborn you can do it. You can assign the number 5 to it, say, just to vex me. But now try to give that number some mathematical meaning. What about the corner of that table is "5"? Clearly, nothing. If you say it is 5 inches from the center of the table or from your foot, then you have assigned an origin. The center of the table or your foot becomes the origin. I have disallowed any origins, since origins are mathematical abstractions, not physical things.

The only way to assign a number to your point is to assign the origin to another point, and to set up axes, so that your room becomes a diagram, either in your head or on a piece of paper. But then the number 5 applies to the diagram, not to the corner of the table.

What does this prove? Euclid's geometry is a form of mathematics. I don't think anyone will argue that geometry is not mathematics. Geometry becomes useful only when we can begin to assign numbers to points, and thereby find lengths, velocities and accelerations. If we assign numbers to points, then those points must be mathematical points. They are not physical points. Euclid's definitions apply to points on pieces of paper, to diagrams. They do not apply directly to physical points.

I am not going to argue that you cannot translate your mathematical findings to the physical world. That would be nihilistic and idiotic, not to say counter-intuitive. But I *am* going to argue here that you must take proper care in doing so. You must differentiate between mathematical points and physical points, because if you do not you will misunderstand all higher math. You will misinterpret the calculus, to begin with, and this will throw off all your other maths, including topology, linear and vector algebra, and the tensor calculus.

To show how all this applies to the calculus, I will start with a close analysis of the curve. Let us say we are given a curve, but are not given the corresponding curve equation. To find this equation, we must import the curve into a graph. This is the traditional way to "measure" it, using axes and an origin and all the tools we are familiar with. Each axis acts as a sort of ruler, and the graph as a whole may be thought of simply as a two-dimensional yardstsick. This analysis may seem self-evident, but already I have enumerated several concepts that deserve special attention. Firstly, the curve is defined by the graph. When we discover a curve equation by our measurement of the curve, the equation will depend entirely on the graph. That is, the graph generates the equation. Secondly, if we use a Cartesian graph, with two perpendicular axes, then we have two and only two variables. Which means that we have two and only two dimensions. Thirdly, **every point on the graph will likewise have two dimensions**. Let me repeat: every POINT on the graph will have <u>TWO DIMENSIONS</u> (let that sink in for a while). Using the most common variables, it will have an x dimension and a y dimension. This means that any equation with two variables implies two dimensions, which implies two dimensions at every point on the graph and every point on the curve.

If you are mathematician who is chafing under all this "philosophy talk" – or anyone else who is the least bit lost among all these words, for whatever reason – let me explain very directly why I have bolded the words above. For it might be called the central mathematical assertion of this whole paper: the primary thesis of my analysis. A point on a graph has two dimensions. But of course a physical point does *not* have two dimensions. A mathematician who defined a point as a quantity having two dimensions would be an oddity, to say the least. No one in history has proposed that a point has two dimensions. A point is generally understood to have *no* dimensions. And yet we have no qualms calling a point on a graph a point. This imprecision in terminology has caused terrible problems historically, and it is one of these problems that I am unwinding here. The historical and current proof of the derivative both treat a point on a graph and on a curve as a zero-dimensional variable. It is not a zero dimension variable; it is a two dimensional variable. A point in space can have no dimensions, but a point on a piece of paper can have as many dimensions as we want to give it. However, we must keep track of those dimensions at all times. We cannot be sloppy in our language or our assignments. The proof of the calculus has been imprecise in its language and assignments.

Let me clarify this with an example. Say a bug crawls by on the wall. You mark off its trail. Now you try to apply a curve equation to the trail, without axes. Say the curve just happens to match a curve you are familiar with. Say it looks just like the curve $y = x^2$. OK, try to assign variables to the bug's motion. You can't do it. The reason why you can't is that a curve drawn on the wall, whether by a bug or by Michelangelo, needs three axes to define it. You need x, y and t. The curve may look the same, but it is not the same. A curve on the wall and a curve on the graph are two different things.

As a second example, say your little brother jumps into his new car and peals off down the street. You run out after him and look at the black marks trailing off behind his car. He's accelerating still, so you should see those marks curve, right? A curve describes an acceleration, right? Not necessarily. The car is going in only one direction, so you can plot x against t. There is no third variable y. But it still doesn't mark off a curve. The car is going in a straight line. Mystifying.

<u>The curve for an equation looks like it does only on a graph</u>. **Its curve is dependent on the graph**. That is, its rate of change is defined by the graph. All those

illustrations and diagrams you have seen in books with curves drawn without graphs are incomplete. Years ago – nobody knows how many years – books stopped drawing the lines, since they got in the way. Even Descartes, who invented the lines, probably let them evaporate as an artistic nuisance. And so we have ended up forgetting that every mathematical curve implies its own graph.

A PHYSICAL CURVE AND A MATHEMATICAL CURVE ARE NOT EQUIVALENT. THEY ARE NOT **MATHEMATICALLY** EQUIVALENT.

This is of utmost importance for several reasons. The most critical reason is that once you draw a graph, you must assign variables to the axes. Let us say you assign the axes the variables x and y, as is most common. Now, you must define your variables. What do they mean? In physics, such a variable can mean either a distance or a point. What do your variables mean? No doubt you will answer, "my variables are points." You will say that x stands for a point x-distance from the origin. You will go on to say that distances are specified in mathematics by Δx (or some such notation) and that if x were a Δx you would have labeled it as such.

I know that this has been the interpretation for all of history. But it turns out that it is wrong. You build a graph so that you can assign numbers to your variables at each point on the graph. But the very act of assigning a number to a variable makes it a distance. **You cannot assign a counting number to a point**. I know that this will seem metaphysical at first to many people. It will seem like philosophical mush. But if you consider the situation for a moment, I think you will see that it is no more than common sense. There is nothing at all esoteric about it.

Let us say that at a certain point on the graph, $y = 5$. What does that mean? You will say it means that y is at the point 5 on the graph. But I will repeat, what does that mean? If y is a point, then 5 can't belong to it. What is it about y that has the characteristic "5"? Nothing. A point can have no magnitudes. The number belongs to the graph. The "5" is counting the little boxes. Those boxes are not attributes of y, they are attributes of the graph.

You might answer, "That is just pettifoggery. I maintain that what I meant is clear: y is at the fifth box, that is all. It doesn't need an explanation."

But the number "5" is not an ordinal. By saying "y is at the fifth box" you imply that 5 is an ordinal. We have always assumed that the numbers in these equations are cardinal numbers numbers [I use "cardinal" here in the traditional sense of cardinal versus ordinal. This is not to be confused with Cantor's use of the term cardinal]. The equations could hardly work if we defined the variables as ordinals. The numbers come from the number line, and the number line is made up of cardinals. The equation $y = x^2$ @ $x = 4$, doesn't read "the sixteenth thing equals the fourth thing squared." It reads "sixteen things equals four things squared." Four points don't equal anything. You can't add points, just like you can't add ordinals. The fifth thing plus the fourth thing is not the ninth thing. It is just two things with no magnitudes.

The truth is that variables in mathematical equations graphed on axes are cardinal numbers. Furthermore, they are delta variables, by every possible implication. That is, x should be labeled Δx. The equation should read $\Delta y = \Delta x^2$. All the variables are distances. They are distances from the origin. $x = 5$ means that the point on the curve is fives little boxes from the origin. **That is a distance**. It is also a differential: $x = (5–0)$.

Think of it this way. Each axis is a ruler. The numbers on a ruler are distances. They are distances from the end of the ruler. Go to the number "1" on a ruler. Now, what does that tell us? What informational content does that number have? Is it telling us that the line on the ruler is in the first place? No, of course not. It is telling us that that line at the number "1" is one inch from the end of the ruler. We are being told a distance.

You may say, "Well, but even if it is a distance, your number "5" still applies to the boxes, not to the variable. So your argument fails, too."

No, it doesn't. Let's look at the two possible variable assignments:

$$x = \text{five little boxes}$$

or

$$\Delta x = \text{five little boxes}$$

The first variable assignment is absurd. How can a point equal five little boxes? A point has no magnitude. But the second variable assignment makes perfect sense. It is a logical statement. Change in x equals five little boxes. A distance is five little boxes in length. If we are physicists, we can then make those boxes meters or seconds or whatever we like. If we are mathematicians, those boxes are just integers.

You can see that this changes everything, regarding a rate of change problem. If each variable is a delta variable, then each point on a curve is defined by two delta variables. The point on the curve does not represent a physical point. Neither variable is a point in space, and the point on the graph is also not a point in space. This is bound to affect applying the calculus to problems in physics. But it also affects the mathematical derivation. Notice that you cannot find the slope or the velocity at some point (x, y) by analyzing the curve equation or the curve on the graph, since neither one has a point x on it or in it. I have shown that the whole idea is foreign to the preparation of a graph. No point on the graph stands for a point in space or an instant in time. No point on any possible graph can stand for a point in space or an instant in time. A point graphed on two axes stands for two distances from the origin. To graph a line in space, you would need one axis. To graph a point in space, you would need zero axes. **You cannot graph a point in space**. Likewise, you cannot graph an instant in time.

Therefore, all the machinations of calculus, all the dx's and dy's and limits, are not applicable. You cannot let x go to zero on a graph, because that would mean you were really taking Δx to zero, which is either meaningless or pointless. It either means you are taking Δx to the origin, which is pointless; or it means you are taking Δx to the point x, which is meaningless (point x does not exist on the graph–you are postulating making the graph disappear, which would also make the curve disappear).

In its own way, the historical derivation of the derivative sometimes understands and admits this. Readers of my papers like to send me to the epsilon/delta definition, as an explanation of the limit concept. The epsilon/delta definition is just this: For all $\varepsilon > 0$ there is a $\delta > 0$ such that whenever $|x - x0| < \delta$ then $|f(x) - y0| < \varepsilon$. What I want to point out is that $|x - x0|$ is not a point, it is a differential. The epsilon/delta definition is sometimes simplified as "Whatever number you can choose, I can choose a smaller one." Which might be modified as "You can choose a point as near to zero as you like; but I can choose a point even nearer." But this is not what the formal epsilon/delta proof states, as you see. The formal proof defines both epsilon and delta as differentials. In physics or applied math, that would be a length. Stated in words, the formal epsilon/delta definition would say, "Whatever *length* you choose, I can choose a shorter one." Epsilon/delta is dealing with lengths, not points. If you define your numbers or variables or functions as lengths, as here, then you cannot later claim to find solutions at points. If you are taking differentials or lengths to limits, then all your equations and solutions must be based on lengths. You cannot take a length to a limit and then find a number that applies to a point. Currently, the calculus uses a proof of the derivative that takes lengths to a limit, as with epsilon/delta. But if you take lengths to a limit, then your solution must also be a length. If you take differentials to a limit, your solution must be a differential. Which is all to say that the calculus contains no points. It contains differentials only. That is why it is called the differential calculus. All variables and functions in equations are differentials and all solutions are differentials. The only possible point in calculus is at zero, and if that limit is reached then your solution is zero. You cannot find numerical solutions at zero, since the only number at zero is zero.

If this is all true, how is it possible to solve a calculus problem? The calculus has to do with instants and instantaneous things and infinitesimals and limits and near-zero quantities, right? No, the calculus initially had to do with solving areas under curves and tangents to curves, as I said above. I have shown that a curve on a graph has no instants or points on it, therefore if we are going to solve without leaving the graph, we will have to solve without instants or infinitesimals or limits.

It is also worth noting that finding an instantaneous velocity appears to be impossible. A curve on a graph has no instantaneous velocities on it anywhere – therefore it would be foolish to pursue them mathematically by analyzing a curve on a graph.

To sum up: You cannot analyze a curve on a graph to find an instantaneous value, since there are no instantaneous values on the graph. You cannot analyze a curve off a graph to find an instantaneous value, since a curve off a graph has a different shape than the same curve on the graph. It is a different curve. The given curve equation will not apply to it.

Some will say here, "There is a simple third alternative to the two in this summation. Take a curve off the graph, a physical curve – like that bug crawling or your brother in his car – and assign the curve equation to it directly. Do not import some curve equation from a graph. Just get the right curve equation to start with."

First of all, I hope it is clear that we can't use the car as a real-life curve equation, since it is not curving. How about the bug? Again, three variables where we need two. Won't work. To my dissenters I say, find me a physical curve that has two variables and I will use the calculus to analyze it with you without a graph. They simply cannot do it. It is logically impossible.

One of the dissenters may see a way out: "Take the bug's curve and apply an equation to it, with three variables, x, y and t. The t variable is not a constant, but its rate of change is a constant. Time always goes at the same rate! Therefore we can cancel it and we are back to the calculus. What is happening is that the calculus curve is just a simplification of this curve on three axes."

To this I answer, yes, we can use three axes, but I don't see how you are going to apply variables to the curve without putting it on the graph. Calculus is worked upon the curve equation. You must have a curve equation in order to find a derivative. To discover a curve equation that applies to a given curve, you must graph it and plot it.

The dissenter says, "No, no. Let us say we have the equation first. We are given a three-variable curve equation, and we just draw it on the wall, like the bug did. Nothing mysterious about that."

I answer, where is the t axis, in that case? How are you or the bug drawing the t component on the wall? You are not drawing it, you are ignoring it. In that case the given curve equation does not apply to the curve you have drawn on the wall, it applies to some three-variable curve on three axes.

The dissenter says, "Maybe, but the curvature is the same anyway, since t is not changing."

I say, is the curve the same? You may have to plot some "points" on a three dimensional graph to see it, but the curve is not the same. Plot any curve, or even a straight line on an (x, y) graph. Now push that graph along a t axis. The slope of the straight line decreases, as does the curvature of any curve. Even a circle is stretched. This has to affect the calculus. If you change the curve you change the areas under the curve and the slope of the tangent at each point.

The dissenter answers, "It does not matter, since we are getting rid of the t-axis. We are going to just ignore that. What we are interested in is just the relationship of x to y, or y to x. It is called a function, my friend. If it is a simplification or abstraction, so what? That is what mathematics is."

To that I can only answer, fine, but you still haven't explained two things.

1. If you are talking of functions, you are back on the two-variable graph, and your curve looks the way it does only there. To build that graph you must assign an origin to the movement of your little bug, in which case your two variables become delta variables. In which case you have no points or instants to work on. The calculus is useless.

2. Even if you somehow find values for your curve, they will not apply to the bug, since his curve is not your curve. His acceleration is determined by his movement in the continuum x, y, t. You have analyzed his movement in the continuum x, y which is not equivalent.

The dissenter will say, "Whatever. Apply my curve to your brother's car, if you want. It does not matter what his tire tracks look like. What matters is the curve given by the curve equation. An x, t graph will then be an abstraction of his motion, and the values generated by the calculus on that graph will be perfectly applicable to him."

I answer that we are back to square one. You either apply the calculus to the real-life curve, where there are points in space, or you apply it to the curve on the graph, where there are not. In real life, where there are points, there is no curvature. On the graph, where there is curvature, there are no points. If my dissenter does not see this as a problem, he is seriously deluded.

9.2 *Historical Interlude & A Critique of The Current Derivation*

Let us take a short break from this groundwork and return to the history of the calculus for just a moment. Two mathematicians in history came nearest to recognizing the difference between the mathematical point and the physical point. You will think that Descartes must be one, since he invented the graph. But he is not. Although he did much important work in the field, his graph turned out to be the greatest obstruction in history to a true understanding of the problem I have related here. Had he seen the operational significance of all diagrams, he would have discovered something truly basic. But he never analyzed the fields created by diagrams, his or any others. No, the first to flirt with the solution was Simon Stevin, the great Flemish mathematician from the late 16$^{\text{th}}$ century. He is the person most responsible for the modern definition of number, having boldly redefined the Greek definitions that had come to the "modern" age via Diophantus and Vieta.[2] He showed the error in assigning the point to the "unit" or the number one; the point must be assigned to its analogous magnitude, which was zero. He proved that the point was indivisible precisely because it was zero. This correction to both geometry and arithmetic pointed Stevin in the direction of my solution here, but he never realized the operational import of the diagram in geometry. In refining the concepts of number and point, he did not see that both the Greeks and the moderns were in possession of two separate concepts of the point: the point in space and the point in diagrammatica.

John Wallis came even nearer this recognition. Following Stevin, he wrote extensively of the importance of the point as analogue to the nought. He also did very important work on the calculus, being perhaps the greatest influence on Newton. He was therefore in the best position historically to have discovered the disjunction of the two concepts of point. Unfortunately he continued to follow the strong current of the 17$^{\text{th}}$ century, which was dominated by the infinite series and the infinitesimal. After his student Newton created the current form of the calculus, mathematicians were no longer interested in the rigorous definitions of the Greeks. The increasing abstraction of mathematics made the ontological niceties of the ancients seem quaint, if not passé. The mathematical current since

[2]See for example, Jacob Klein, Greek Mathematical Thought and the Origin of Algebra.

the 18th century has been strongly progressive. Many new fields have arisen, and studying foundations has not been in vogue. It therefore became less and less likely that anyone would notice the conceptual errors at the roots of the calculus. Mathematical outsiders like Bishop Berkeley in the early 18th century failed to find the basic errors (he found the effects but not the causes), and the successes of the new mathematics made further argument unpopular.

I have so far critiqued the ability of the calculus to find instantaneous values. But we must remember that Newton invented it for that very purpose. In *De Methodis*, he proposes two problems to be solved.

1. "Given a length of the space continuously, to find the speed of motion at any time."

2. "Given the speed of motion continuously, to find the length of space described at any time."

Obviously, the first is solved by what we now call differentiation and the second by integration. Over the last 350 years, the foundation of the calculus has evolved somewhat, but the questions it proposes to solve and the solutions have not. That is, we still think that these two questions make sense, and that it is sensible that we have found an answer for them.

Question 1 concerns finding an instantaneous velocity, which is a velocity over a zero time interval. This is done all the time, up to this day. Question 2 is the mathematical inverse of question 1. Given the velocity, find the distance traveled over a zero time interval. This is no longer done, since the absurdity of it is clear. On the graph, or even in real life, a zero time interval is equal to a zero distance. There can be no distance traveled over a zero time interval, even less over a zero distance, and most people seem to understand this. Rather than take this as a problem, though, mathematicians and physicists have buried it. It is not even paraded about as a glorious paradox, like the paradoxes of Einstein. No, it is left in the closet, if it is remembered to exist al all.

As should already be clear from my exposition of the curve equation, Newton's two problems are not in proper mathematical or logical form, and are thereby insoluble. This implies that any method that provides a solution must also be in improper form. If you find a method for deriving a number that does not exist, then your method is faulty. A method that yields an instantaneous velocity must be a suspect method. An equation derived from this method cannot be trusted until it is given a logical foundation. There is no distance over a zero distance; and, equally, there is no velocity over a zero interval.

Bishop Berkeley commented on the illogical qualities of Newton's proofs soon after they were published (*The Analyst*, 1734). Ironically, Berkeley's critiques of Newton mirrored Newton's own critiques of Leibniz's method. Newton said of Leibniz, "We have no idea of infinitely little quantities & therefore I introduced fluxions into my method that it might proceed by finite quantities as much as possible." And, "The summing up of indivisibles to compose an area or solid was never yet admitted into Geometry."[3]

This "using finite quantities as *much as possible*" is very nearly an admission of failure. Berkeley called Newton's fluxions "ghosts of departed quantities" that were sometimes tiny increments, sometimes zeros. He complained that Newton's method proceeded by a compensation of errors, and he was far from alone in this analysis. Many mathematicians of the time took Berkeley's criticisms seriously. Later mathematicians who were much less vehement in their criticism, including Euler, Lagrange and Carnot, made use of the idea of a compensation of errors in attempting to correct the foundation of the calculus. So it would be unfair to dismiss Berkeley simply because he has ended up on the wrong side of history. However, Berkeley could not explain why the derived equation worked, and the usefulness of the equation ultimately outweighed any qualms that philosophers might have. Had Berkeley been able to derive the equation by clearly more logical means, his comments would undoubtedly have been treated with more respect by history. As it is, we have reached a time when quoting philosophers, and especially philosophers who were also bishops, is far from being a convincing method, and I will not do more of it. Physicists and mathematicians weaned on the witticisms of Richard Feynman are unlikely to find Berkeley's witticisms quite up-to-date.

I will take this opportunity to point out, however, that my critique of Newton is of a categorically different kind than that of Berkeley, and of all philosophers

[3] Newton, Isaac, Mathematical Papers, 8: 597.

who have complained of infinities in derivations. I have not so far critiqued the calculus on philosophical grounds, nor will I. The infinite series has its place in mathematics, as does the limit. My argument is not that one cannot conceive of infinities, infinitesimals, or the like. My argument has been and will continue to be that the curve, whether it is a physical concept or a mathematical abstraction, cannot logically admit of the application of an infinite series, in the way of the calculus. In glossing the modern reaction to Berkeley's views, Carl Boyer said, "Since mathematics deals with relations rather than with physical existence, its criterion of truth is inner consistency rather than plausibility in the light of sense perception or intuition."[4] I agree, and I stress that my main point already advanced is that there is no inner consistency in letting a differential $[f(x+i)–f(x)]$ approach a point when that point is already expressed by two differentials $[(x-0)$ and $(y-0)]$.

Boyer gives the opinion of the mathematical majority when he defends the instantaneous velocity in this way: "[Berkeley's] argument is of course absolutely valid as showing that the instantaneous velocity has no physical reality, but this is no reason why, if properly defined or taken or taken as an undefined notion, it should not be admitted as a mathematical abstraction."[5] My answer to this is that physics has treated the instantaneous velocity as a physical reality ever since Newton did so. Beyond that, it has been accepted by mathematicians as an undefined notion, not as a properly defined notion, as Boyer seems to admit. He would not have needed to include the proviso "or taken as an undefined notion" if all notions were required to be properly defined before they were accepted as "mathematical abstractions." The notion of instantaneous velocity cannot be properly defined mathematically since it is derived from an equation that cannot be properly defined mathematically. Unless Boyer wants to argue that all heuristics should be accepted as good mathematics (which position contemporary physics has accepted, and contemporary mathematics is closing in on), his argument is a non-starter.

Many mathematicians and physicists will maintain that the foundation of the calculus has been a closed question since Cauchy in the 1820's, and that my entire thesis can therefore only appear Quixotic. However, as recently as the 1960's

[4] Boyer, Carl. B., The History of the Calculus and its Conceptual Development, p. 227.
[5] Ibid.

Abraham Robinson was still trying to solve perceived problems in the foundation of the calculus. His nonstandard analysis was invented for just this purpose, and it generated quite a bit of attention in the world of math. The mathematical majority has not accepted it, but its existence is proof of widespread unease. Even at the highest levels (one might say especially at the highest levels) there continue to be unanswered questions about the calculus. My thesis answers these questions by showing the flaws underlying both standard and nonstandard analysis.

Newton's original problems should have been stated like this:

1. Given a distance that varies over any number of equal intervals, find the velocity over any proposed interval.
2. Given a variable velocity over an interval, find the distance traveled over any proposed subinterval.

These are the questions that the calculus really solves, as I will prove below. The numbers generated by the calculus apply to subintervals, not to instants or points. Newton's use of infinite series, like the power series, misled him to believe that curves drawn on graphs could be expressed as infinite series of (vanishing) differentials. All the other founders of the calculus made the same mistake. But, due to the way that the curve is generated, it cannot be so expressed. Each point on the graph already stands for a pair of differentials; therefore it is both pointless and meaningless to let a proposed differential approach a point on the graph.

To show precisely what I mean, let us now look to the current derivation of the derivative equation. Take a functional equation, for example

$$y = x^2$$

Increase it by δy and δx to obtain

$$y + \delta y = (x + \delta x)^2$$

subtract the first equation from the second:

$$\delta y = (x + \delta x)^2 - x^2 = 2x\delta x + (\delta x)^2$$

divide by δx

$$\frac{\delta y}{\delta x} = 2x + \delta x$$

Let δx go to zero (only on the right side, of course)

$$\frac{\delta y}{\delta x} = 2x$$

$$y' = 2x$$

Most will expect that my only criticism is that δx should not go to zero on the left side, since that would imply to ratio going to infinity. But that is not my primary criticism at all. My primary criticism is this:

In the first equation, the variables stand for either "all possible points on the curve" or "any possible point on the curve." The equation is true for all points and any point. Let us take the latter definition, since the former doesn't allow us any room to play. So, in the first equation, we are at "any point on the curve". In the second equation, are we still at any point on the same curve? Some will think that $(y + \delta y)$ and $(x + \delta x)$ are the co-ordinates of another any-point on the curve – this any-point being some distance further along the curve than the first any-point. But a closer examination will show that the second curve equation is not the same as the first. The any-point expressed by the second equation is not on the curve $y = x^2$. In fact, it must be exactly δy *off* that first curve. Since this is true, we must ask why we would want to subtract the first equation from the second equation. Why do we want to subtract an any-point on a curve from an any-point off that curve?

Furthermore, in going from equation 1 to equation 2, we have added different amounts to each side. This is not normally allowed. Notice that we have added δy to the left side and $2x\delta x + (\delta x)^2$ to the right side. This might have been justified by some argument if it gave us two any-points on the same curve, but it doesn't. We have completed an illegal operation for no apparent reason.

Now we subtract the first any-point from the second any-point. What do we get? Well, we should get a third any-point. What is the co-ordinate of this third any-point? It is impossible to say, since we got rid of the variable y. A co-ordinate is in the form (x, y) but we just subtracted away y. You must see that δy is not the same as y, so who knows if we are off the curve or on it. Since we subtracted a point on the first curve from a point off that curve, we would be very lucky to have landed back on the first curve, I think. But it doesn't matter, since we are subtracting points from points. Subtracting points from points is illegal. If you want to get a length or a differential you must subtract a length from a length or a differential from a differential. Subtracting a point from a point will only give you some sort of zero – another point. But we want δy to stand for a length or differential in the third equation, so that we can divide it by δx. As the derivation now stands, δy must be a point in the third equation.

Yes, δy is now a point. It is not a change-in-y in the sense that the calculus wants it to be. It is no longer the difference in two points on the curve. It is not a differential! Nor is it an increment or interval of any kind. It is not a length, it is a point. What can it possibly mean for an any-point to approach zero? The truth is it doesn't mean anything. A point can't approach a zero length since a point is already a zero length.

Look at the second equation again. The variable y stands for a point, but the variable δy stands for a length or an interval. But if y is a point in the second equation, then δy must be a point in the third equation. This makes dividing by δx in the next step a logical and mathematical impossibility. You cannot divide a point by any quantity whatsoever, since a point is indivisible by definition. The final step – letting δx go to zero – cannot be defended whether you are taking only taking the denominator on the left side to zero or whether you are taking the whole fraction toward zero (which has been the claim of most). The ratio $\delta y/\delta x$ was already compromised in the previous step. The problem is not that the denominator is zero; the problem is that the numerator is a point. The numerator is zero.

To my knowledge the calculus derivation has never been critiqued in this way. From Berkeley on the main criticism concerned explaining why the ratio $\delta y/\delta x$ was not precisely zero, and why letting δx go to zero did not make the fraction go to infinity. Newton tried to explain it by the use of prime and ultimate ratios, and Cauchy is believed to have solved it by having the ratio approach a limit. But according to my analysis the ratio already had a numerator of zero in the previous step, so that taking it to a limit is moot.

Nonstandard analysis has no answer to this either. Abraham Robinson's "rigorously" defining the infinitesimal has done nothing to solve my critique here. Adding new terminology does not clarify the problem, since it is beside the point whether one part of these equations is called "standard" or "nonstandard." If δy is a point on the curve in the third equation, then it is no longer an infinitesimal. At that point it doesn't matter what we call it, how we define it, or how we axiomatize our logic. It isn't a distance and cannot yield what we want it to yield, not with infinitesimals, limits, diminishing series or anything else.

I have gotten several emails over the years from angry mathematicians, saying or implying that my mentioning this derivation is some sort of strawman. They tell me they don't prove the derivative that way and then launch into some longwinded torture of both mediums (math and the English language) to show me how to do it. Unfortunately, this derivation above is much more than a strawman. It is the way I was taught the calculus in high school in the early 80's, and it is posted all over the internet to this day. If it is a strawman, it is the mainstream's own strawman, and they had best stop propping it up. These mathematicians are just angry I am using their own equations against them. They reference Newton and Leibniz when it suits them, but when someone else references them, it is a strawman. These mathematicians are slippery than eels. If you mention one derivation, they misdirect you into another, claiming that one has been superceded. If you then destroy the new one, they find a third one to hide behind. And you won't ever finding them address the main points of your papers. For instance, I have never had a single mathematician respond to the central points of this paper. They ignore those and look for tangential arguments they can waste my time with indefinitely. This, by itself, is a sign of the times.

9.3 *The Rest of the Groundwork*

Now let us return to the groundwork. The next stone I must lay concerns rate of change, and the way the concept of change applies to the cardinal number line. Rate of change is a concept that is very difficult to divorce from the physical world. This is because the concept of change is closely related to the concept of time. This is not the place to enter a discussion about time; suffice it to say that rate of change is at its most abstract and most mathematical when we apply it to the number line, rather than to a physical line or a physical space. But the concept of rate of change cannot be left undefined, nor can it be taken for granted. The concept is at the heart of the problem of the calculus, and therefore we must spend some time analyzing it.

I have already shown that the variables in a curve equation are cardinal numbers, and as such they must be understood as delta variables. In mathematical terms, they are differentials; in physical terms, they are lengths or distances. This is because a curve is defined by a graph and a graph is defined by axes. The numbers on these axes signify distances from zero or differentials: $(x–0)$ or $(y–0)$. In the same way the cardinal number line is also a compendium of distances or differentials. In fact, each axis on a graph may be thought of as a separate cardinal number line. The Cartesian graph is then just two number lines set zero to zero at a 90° angle.

This being true, a subtraction of one number from another – when these numbers are taken from Cartesian graphs or from the cardinal number line – is the subtraction of one distance from another distance, or one differential from another. Written out in full, it would look like this:

$$\Delta\Delta x = \Delta x_f - \Delta x_i$$

Where Δx_f is the final cardinal number and Δx_i is the initial cardinal number. This is of course rigorous in the extreme, and may seem pointless. But be patient, for we are rediscovering things that were best not forgotten. This equation shows that a cardinal number stands for a change from zero, and that the difference of two cardinal numbers is the change of a change. All we have done is subtract one number from another and we already have a second-degree change.

Following this strict method, we find that any integer subtracted from the next is equal to 1, which must be written $\Delta\Delta x = 1$. On a graph each little box is 1 box wide, which makes the differential from one box to the next 1. To go from one end of a box to the other, you have gone 1. This distance may be a physical distance or an abstract distance, but in either case it is the change of a change and must be understood as $\Delta\Delta x = 1$.

Someone might interrupt at this point to say, "You just have one more delta at each point than common usage. Why not simplify and get back to common usage by canceling a delta in all places?" We cannot do that because then we would have no standard representation for a point. If we let a naked variable stand for a cardinal number, which I have shown is not a point, then we have nothing to let stand for a point. To clear up the problem like I believe is necessary, we must let x and y and t stand for points or instants or ordinals, and only point or instants or ordinals. We must not conflate ordinals and cardinals, and we must not conflate points with distances. We must remain scrupulous in our assignments.

Next, it might be argued that we can put any numbers into curve equations and make them work, not just integers. True, but the lines of the graph are commonly integers. Each box is one box wide, not $\frac{1}{2}a$ box or e box or π box. This is important because the lines define the graph and the graph defines the curve. It means that the x-axis itself has a rate of change of one, and the y or t-axis also. The number line itself has a rate of change of one, by definition. None of my number theory here would work if it did not.

For instance, the sequence 1, 1, 1, 1, 1, 1.... describes a point. If you remain at one you don't move. A point has no RoC (rate of change). Its change is zero, therefore its RoC is zero. The sequence of cardinal integers 1, 2, 3, 4, 5.... describes motion, in the sense that you are at a different number as you go down the sequence. First you are at 1, then at 2. You have moved, in an abstract sense. Since you change 1 number each time, your RoC is steady. You have a constant RoC of 1. A length is a first-degree change of x. Every value of Δx we have on a graph or in an equation is a change of this sort. If x is a point in space or an ordinal number, and Δx is a cardinal number, then $\Delta\Delta x$ is a RoC.

I must also stress that the cardinal number line has a RoC of 1 no matter what numbers you are looking at. Rationals, irrationals, whatever. Some may argue that the number line has a RoC of 1 only if you are talking about the integers. In that case it has a sort of “cadence,” as it has been suggested to me. Others have said that the number line must have a RoC of zero, even by my way of thinking, since it has an infinite number of points, or numbers. There are an infinite number of points from zero to 1, even. Therefore, if you “hop” from one to the other, in either a physical or an abstract way, then it will take you forever to get from zero to one. But that is simply not true. As it turns out, in this problem, operationally, the possible values for Δx have a RoC of 1, no matter which ones you choose. If you choose numbers from the number line to start with (and how could you not) then you cannot ever separate those numbers from the number line. They are always connected to it, by definition and operation. The number line always “moves” at a RoC of 1, so the gap between any numbers you get for x and y from any equation will also move with a RoC of 1.

If this is not clear, let us take the case where I let you choose values for $x1$ and $x2$ arbitrarily, say $x1 = .0000000001$ and $x2 = .0000000002$. If you disagree with my theory, you might say, "My gap is only .0000000001. Therefore my RoC must be much slower than one. A sequence of gaps of .0000000001 would be very very slow indeed." But it wouldn’t be slow. It would have a RoC of 1. You must assume that your .0000000001 and .0000000002 are on the number line. If so, then your gap is ten billion times smaller than the gap from zero to 1. Therefore, if you relate your gap to the number line – in order to measure it – then the number line, galloping by, would traverse your gap ten billion times faster than the gap from zero to one. The truth is that your tiny gap would have a tiny RoC only if it were its own yardstick. But in that case, the basic unit of the yardstick would no longer be 1. It would be .0000000001. A yardstick, or number line, whose basic unit is defined as 1, must have a RoC of 1, at all points, by definition.

From all this you can see that I have defined rate of change so that it is not strictly equivalent to velocity. A velocity is a ratio, but it is one that has already been established. A rate of change, by my usage here, is a ratio waiting to be calculated. It is a numerator waiting for a denominator. I have called one delta a change and two deltas a rate of change. Three deltas would be a second-degree rate of change (or 2RoC), and so on.

9.4 *The Algorithm*

With this established I am finally ready to unveil my algorithm. We have a tight definition of a rate of change, we have our variable assignments clearly and unambiguously set, and we have the necessary understanding of the number line and the graph. Using this information we can solve a calculus problem without infinite series or limits. All we need is this beautiful table that I made up just for this purpose. I have scanned the math books of history to see if this table turned up somewhere. I could not find it. It may be buried out there in some library, but if so it is unknown to me. I wish I had had it when I learned calculus in high school. It would have cleared up a lot of things.

Δx	1	2	3	4	5	6	7	8
$\Delta 2x$	2	4	6	8	10	12	14	16
Δx^2	1	4	9	16	25	36	49	64
Δx^3	1	8	27	64	125	216	343	512
Δx^4	1	16	81	256	625	1296	2401	4096
Δx^5	1	32	243	1024	3125	7776	16807	32768
$\Delta\Delta x$	1	1	1	1	1	1	1	
$\Delta\Delta 2x$	2	2	2	2	2	2	2	
$\Delta\Delta x^2$	1	3	5	7	9	11	13	
$\Delta\Delta x^3$	1	7	19	37	61	91	127	
$\Delta\Delta x^4$	1	15	65	175	369	671	1105	
$\Delta\Delta x^5$	1	31	211	781	2101	4651	9031	
$\Delta\Delta\Delta x^2$	2	2	2	2	2	2		
$\Delta\Delta\Delta x^3$	6	12	18	24	30	36		
$\Delta\Delta\Delta x^4$	14	50	110	194	302	434		
$\Delta\Delta\Delta x^5$	30	180	570	1320	2550	4380		
$\Delta\Delta\Delta\Delta x^3$	6	6	6	6	6			
$\Delta\Delta\Delta\Delta x^4$	36	60	84	108	132			
$\Delta\Delta\Delta\Delta x^5$	150	390	750	1230	1830			

$\Delta\Delta\Delta\Delta x^4$	24	24	24	24
$\Delta\Delta\Delta\Delta x^5$	240	360	480	600
$\Delta\Delta\Delta\Delta\Delta x^5$	120	120	120	

from this, one can predict that $\Delta\Delta\Delta\Delta\Delta\Delta x^6 = 720, 720, 720, 720, 720$ and so on.

This is what you call simple number analysis. It is a table of differentials. The first line is a list of the potential integer lengths of an object. It is also a list of the cardinal integers, as you can see. **It is also a list of the possible values for the number of boxes we could count in our graph**. It is therefore both physical and abstract, so that it may be applied in any sense one wants. Line 2 lists the potential lengths or box values of the variable $\Delta 2x$. Line 3 lists the possible box values for Δx^2. Line seven begins the second-degree differentials. It lists the differentials of line 1, as you see. To find differentials, I simply subtract each number from the next. Line eight lists the differentials of line 2, and so on. Line 14 lists the differentials of line 9. I think you can follow the logic of the rest.

Now let's pull out the important lines and relist them in order:

$\Delta\Delta x$	1	1	1	1	1	1	1
$\Delta\Delta\Delta x^2$	2	2	2	2	2	2	2
$\Delta\Delta\Delta\Delta x^3$	6	6	6	6	6	6	6
$\Delta\Delta\Delta\Delta\Delta x^4$	24	24	24	24	24	24	24
$\Delta\Delta\Delta\Delta\Delta\Delta x^5$	120	120	120	120	120	120	120
$\Delta\Delta\Delta\Delta\Delta\Delta\Delta x^6$	720	720	720	720	720	720	720

Do you see it?

$$
\begin{aligned}
2 \times \Delta\Delta x &= \Delta\Delta\Delta x^2 \\
3 \times \Delta\Delta\Delta x^2 &= \Delta\Delta\Delta\Delta x^3 \\
4 \times \Delta\Delta\Delta\Delta x^3 &= \Delta\Delta\Delta\Delta\Delta x^4 \\
5 \times \Delta\Delta\Delta\Delta\Delta x^4 &= \Delta\Delta\Delta\Delta\Delta\Delta x^5 \\
6 \times \Delta\Delta\Delta\Delta\Delta\Delta x^5 &= \Delta\Delta\Delta\Delta\Delta\Delta\Delta x^6
\end{aligned}
$$

and so on.

Voila. We have the current derivative equation, just from a table. All I have to do now is explain what it means. Instead of looking where the differentials approach zero, as the calculus did, I have looked for a place where the differentials are constant – as in the second little table. I have had to look farther and farther up in the rate of change table each time to find it, but it is always there. The calculus solves up from a near-zero differential. I solve down from a constant differential. Their differential is never fully defined or explained (despite their claims); mine will be in the paragraphs that follow.

I will explain in great detail below what is being expressed as I re-derive the derivative equation; but let me first gloss the important aspects of this chart. The chart is generated by basic number theory, as I have already said. That means that it is true for any and all variables. It is an analysis of the number line, and the relationship of integers and all exponents of integers. Therefore we can use the information in the chart to give us more information about any curve equation. The information in the chart is defined by the number line itself. Meaning that it is true by definition. In that way it may be thought of as a cache of pre-existing information or tautological equalities. As you can see, the chart needs no proof, since it is simply a list of givens. It is a direct result of exponential notation, and I have done nothing more than list values.

Lagrange claimed that the Taylor series was the secret engine behind the calculus, but this chart is the secret engine behind both the Taylor series and the calculus. I personally don't believe that the Greeks were concealing any algorithms or other devices, but if they were this is the algorithm they were likely concealing. I don't believe Archimedes was aware of this chart, for if he had been he would not have continued to pursue his solutions with infinite series.

The calculus works only because the equations of the calculus work. The equation $y' = nx^{n-1}$ and the other equations of the calculus are the primary operational facts of the mathematics, not the proofs of Newton or Leibniz or Cauchy. Newton's and Leibniz's most important recognition was that these generalized equations were the most needful things, and that they must be achieved by whatever means necessary. The means available to them in the late 17$^{\text{th}}$ century was a proof using infinitesimals. A slightly finessed proof yielded results that far outweighed any philosophical cavils, and this proof has stood ever since. But what the calculus is really doing when it claims to look at diminishing differentials and limits is take information from this chart. This chart and the number relations it clearly reveals are the foundations of the equations of the calculus, not infinite series or limits.

To put it in even balder terms, the equalities listed above may be used to solve curve equations. By “solve” I mean that the equalities listed in this chart are substituted into curve equations in order to give us information we could not otherwise get. Rate of change problems are thereby solved by a simple substitution, rather than by a complex proof involving infinities and limits. A curve equation tells us that one variable is changing at a rate equal to the rate that another variable (to some exponent) is changing. The chart above tells us the same thing, but in it the same variable is on both sides of the equation. So obviously all we have to do is substitute in the correct way and we have solved our equation. We have taken information from the chart and put it into the curve equation, yielding new information. It is really that simple. The only questions to ask are, "What information does the chart really contain?" And, "What information does it yield after substitution into a curve equation?"

I have defined Δx as a linear distance from zero on the graph, in the x-direction (if the word "distance" has too much physical baggage for you, you may substitute "change from zero"). $\Delta\Delta x$ is then the change of Δx, and so on. Since $\Delta\Delta x/\Delta\Delta t$ is a velocity, $\Delta\Delta\Delta x$ is sort of constant acceleration, waiting to be calculated (given a $\Delta\Delta t$). In that sense, $\Delta\Delta\Delta\Delta x$ is a variable acceleration waiting to be calculated. $\Delta\Delta\Delta\Delta\Delta x$ is a change of a variable acceleration, and $\Delta\Delta\Delta\Delta\Delta\Delta x$ is a change of a change of a variable acceleration. Some may ask, "Do these kinds of accelerations really exist? They boggle the mind. How can things be changing so fast?" High exponent variables tell us that we are dealing with these kinds of accelerations, whether they exist in physical situations or not. The fact is that complex accelerations do exist in real life, but this is not the place to discuss it. Most people can imagine a variable acceleration, but get lost beyond that. Obviously, in strictly mathematical situations, changes can go on changing to infinity.

I said in the previous paragraph that velocity is $\Delta\Delta x/\Delta\Delta t$. By my notation it must be. Current notation has one less delta at each point than I do. Current notation assumes that curve-equation variables are naked variables: x, t. I assume they are delta variables, Δx, Δt. But I agree with current theory that velocity is a change of these variables. Therefore velocity must be $\Delta\Delta x/\Delta\Delta t$.

You will say, "Then you are implying that velocity is not distance over time. You are saying by your notation that velocity is change in distance over change in time." Precisely. Look at it this way: say I am sitting at the number 3 on a big ruler. I have shown that the number three is telling the world that I am three inches from the end. It is giving a distance. Now, can I use that distance to calculate a velocity? How? – I just said I was sitting there. I am not moving. There is no velocity involved, so it would be ridiculous to calculate one. To calculate a velocity, we must have a velocity, in which case I must move from one number mark on the ruler to another one. In which case we have a change in distance, you see.

You may answer, “What if you were at the origin to begin with? Then the distance and the change in distance are the same thing.” They would be the same number, yes. But mathematically the calculation would still involve a subtraction, if you were writing out the whole thing. It would always be implied that $\Delta\Delta x = \Delta x_{\text{final}} - \Delta x_{\text{initial}} = \Delta x_{\text{final}} - 0$. Your final number would be the same number, and the magnitude would be the same, but conceptually it is not the same. Δx and $\Delta\Delta x$ are both measured in meters, say, but they are not the same conceptually.

One way to clear up part of this confusion is to differentiate between length and distance. In physics, they are often used interchangeably. In our rate of change problems, we may create more clarity by assigning one word exclusively to one situation, and the other word to the other situation. Let us assign length to Δx and distance to $\Delta\Delta x$. A cardinal number represents a length from zero. It is the extension between two static points, but no movement is implied. One would certainly have to move to go from one to the other, but a length implies no time variable, no change in time. A length can exist in the absence of time. A distance, however, cannot. A distance implies the presence of another variable, even if that variable is not a physical variable like time. For instance, to actually travel from one point to another requires time. Distance implies movement, or it implies a second-degree change. A length is a static change in x. A distance is a movement from one x to the other.

9.5 *The Derivation*

Now, let's see what the current value for the derivative is telling us, according to my chart. If we have a curve equation, say

$$\Delta t = \Delta x^3$$

Then the derivative is

$$\Delta t' = 3\Delta x^2$$

From my chart we can see that

$$3\Delta\Delta\Delta x^2 = \Delta\Delta\Delta\Delta x^3$$

So, $3\Delta x^2 = \Delta\Delta x^3$. [Deltas may be cancelled across these particular equalities][6]

[6]Why can we cancel deltas here? That is a very important question. Is a delta a variable? Is every delta equal to every other delta? The answer is that a delta is not a variable; and that every delta does not equal every other delta. Therefore the rules of cancellation are a bit tricky. A delta is not a free-standing mathematical symbol. You will never see it by itself. It is connected to the variable it precedes. A variable and all its deltas must therefore be taken as one variable. This would seem to imply that cancelling deltas is forbidden. However a closer analysis shows that in some cases it is allowed. A variable and all its deltas stand for an interval, or a differential. At a particular point on the graph, that would be a particular interval. But in a general equation, that stands for all possible intervals of the variable. As you can see from my table, some delta variables have the same interval value at all points. Most don't. High exponent variables with few deltas have high rates of change. However, all the lines in the table are dependent on the first line. Notice that each line could be read as, "If $\Delta x = 1, 2, 3$ etc, then this line is true." You can see that you put those values for Δx into every other line, in order to get that line. Each line of the table is just reworking the first line. Line three is what happens when you square line one, for instance. So that the underlying variable Δx is the same for every line on the table. Therefore, if you set up equalities between one line and another, the rates of change are relatable to each other. They are all rates of change of Δx. That is why you can cancel deltas here. This all goes to say that if x is on both sides of the equation, you can cancel deltas. Otherwise you cannot.

And,

$$\Delta t' = 3\Delta x^2 = \Delta\Delta x^3$$

$$\Delta t = \Delta x^3$$

Therefore,

$$\Delta t' = \Delta\Delta t$$

The derivative is just the rate of change of our dependent variable Δt. But I repeat, it is the rate of change of a length or period. It is not the rate of change of a point or instant. A point on the graph stands for a value for Δt, not a point in space. The derivative is a rate of change of a length (or a time period).

Now let's do that again without using what we already know from the calculus. Let's prove the derivative equation logically just from the chart without making any assumptions that the historical equation is correct. Again, we are given the curve equation and a curve on a graph. $\Delta t = \Delta x^3$.

We then look at my second little chart to find Δx^3. We see that the differential is constant (6) when the variable is changing at this rate: $\Delta\Delta\Delta\Delta x^3$. You will say, "Wait, explain that. Why did you go there on the chart? Why do we care where the differential is constant?" **We care because when the differential is constant, the curve is no longer curving over that interval. If the curve is no longer curving, then we have a straight line. That straight line is our tangent. That is what we are seeking**.

Now let's show what $2\Delta\Delta x = \Delta\Delta\Delta x^2$ means. The equation is telling us "two times the rate of change of x is equal to the 2RoC of x^2." This is somewhat like saying "twice the velocity of x is equal to the acceleration of x^2." These equalities are just number equalities. They do not imply spatial relationships. For instance, if I say, "My velocity is equal to your acceleration," I am not saying anything about our speeds. I am not saying that we are moving in the same way or covering the same ground. I am simply noticing a number equality. The number I calculate for my velocity just happens to be the number you are calculating for your acceleration. It is a number relation. This number relation is the basis for the calculus. The table above is just a list of some slightly more complex number relations. But they are not very complex, obviously, since all we had to do is subtract one number from the next.

Next let's look again at our given equation, $\Delta t = \Delta x^3$.

What exactly is that equation telling us? Since the graph gives us the curve – defines it, visualizes, everything – we should go there to find out. If we want to draw the curve, what is the first thing we do? We put numbers in for Δx and see what we get for Δt, right? What numbers do we put in for Δx? The integers, of course. You can see that if we put integers in, then Δx is changing at the rate of one. We put in 1 first, and then 2, and so on. So Δx is changing at a rate of one. As I proved above, we don't have to put in integers. Even if we put in fractions or decimals, Δt will be changing at the rate of one. It just won't be so easy to plot the curve. If Δx is changing at the rate of one, then Δt will be changing at the rate of Δx^3. That is all the equation is telling us.

Now that we are clear on what everything stands for, we are ready to solve.

We are given

$$\Delta t = \Delta x^3$$

We find from the table

$$3\Delta\Delta\Delta x^2 = \Delta\Delta\Delta\Delta x^3$$

We simplify

$$3\Delta x^2 = \Delta\Delta x^3$$

We seek $\Delta\Delta t$.

We notice $\Delta\Delta t = \Delta\Delta x^3$ since we can always add a delta to both sides[7]

[7] We were allowed to add deltas to both sides of the equation in this case because we were adding the same deltas. Deltas aren't always equivalent, but we can multiply both sides by deltas that are equivalent. What is happening is that we have an equality to start with. We then give the same rate of change to both sides: so the equality is maintained.

We substitute $\Delta\Delta t = 3\Delta x^2$

$$\Delta\Delta t = \Delta t'$$

So

$$\Delta t' = 3\Delta x^2$$

Now I explain the steps thoroughly. The final equation reads, in full: "When the rate of change of the length Δx is one, the rate of change of the length (or period, in this case) Δt is $3\Delta x^2$." The first part of that sentence is implied from my previous explanations, but it is good for us to see it written out here, in its proper place. For it tells us that when we are finding the derivative, we are finding the rate of change of the first variable (the primed variable) when the other variable is changing at the rate of one. Therefore, we are not letting either variable approach a limit or go to zero. To repeat, $\Delta\Delta x$ is not going to zero. It is the number one.

<u>That</u> is why you can let it evaporate in the denominator of the current calculus proof. In the current proof the fraction $\Delta y/\Delta x$ (this would be $\Delta\Delta y/\Delta\Delta x$ by my notation) is taken to a limit, in which case Δx is taken to zero, we are told. But somehow the fraction does not go to infinity, it goes to Δy. The historical explanation has never been satisfactory. I have shown that it is simply because the denominator is one. A denominator of one can always be ignored.

You may now ask, "OK, but how did you know to seek $\Delta\Delta t$? You have shown above that the current proof seeks that, but you were supposed to be solving without taking any assumptions from the current proof or use of the calculus. Why did you seek it? What does it stand for in your interpretation? What is happening on the graph or in real life that explains $\Delta\Delta t$?"

Good question. By answering that I can pretty much finish off this proof. I have shown that by the very way the equation and the graph are set up, we can show that it must be true that $\Delta\Delta x = 1$. Given that, what are we seeking? The tangent to the curve on the graph. The tangent to the curve on the graph is a straight line intersecting the curve at $(\Delta x, \Delta t)$. Each tangent will hit the curve at only one $(\Delta x, \Delta t)$, otherwise it wouldn't be the tangent and the curve wouldn't be a differentiable curve. Since the tangent is a straight line, its slope will be $\Delta\Delta t/\Delta\Delta x$. So we need an equation that gives us a $\Delta\Delta t/\Delta\Delta x$ for every value of Δt and Δx on our curve. Nothing could be simpler. We know $\Delta\Delta x = 1$, so we just seek $\Delta\Delta t$. $\Delta\Delta t/\Delta\Delta x = \Delta\Delta t/1 = \Delta\Delta t$.

$\Delta\Delta t$ is the slope of the tangent at every point on the curve on the graph.

If $\Delta t = \Delta x^3$

Then $\Delta\Delta t = 3\Delta x^2$.

9.6 *Application to Physics*

We have solved the first part of our problem. We have found the derivative without calculus and have assigned its value to the general equation for the slope of the tangent to the curve. Now we must ask whether we can assign this equation to the velocity at all "points on the curve". This is no longer a math question. It is a physics question. The answer appears to be "yes."

$$\frac{\Delta\Delta t}{\Delta\Delta x} = \Delta\Delta t = (\Delta t)'$$

I made t the dependent variable initially, but this was an arbitrary choice on my part. If I had made x the dependent variable, then we would have had

$$(\Delta x)' = \frac{\Delta\Delta x}{\Delta\Delta t}$$

So the derivative looks like a velocity.

But the velocity at the point on the graph is not the velocity at a point in space, therefore the slope of the tangent does not apply to the instantaneous velocity. It is the velocity during a period of time of acceleration, not the velocity at an instant. You will say, “Yes, but by your own method we may continue to cancel deltas, in which case we will get $\Delta\Delta t/\Delta\Delta x = \Delta t/\Delta x = t/x$. If the Δt’s are equal then the t’s are equal, and so on."

No they’re not. Notice that the equation x/t doesn’t even describe a velocity. It is a point over an instant. That is not a velocity. It is not even a meaningful fraction. As I have shown, t in that case is really an ordinal number. You cannot have an ordinal as a denominator in a fraction. It is absurd. In reducing that last fraction, you are saying that 5 meters/5 seconds would equal the fifth meter mark over the fifth second tick. But the fifth meter mark is equivalent to the first meter mark and the hundredth meter mark. And the fifth tick is the same as every other tick. Therefore, I could say that 5 meters/5 seconds = 5$^{\text{th}}$ mark/5$^{\text{th}}$ tick = 100$^{\text{th}}$ mark/ 7$^{\text{th}}$ tick. Gobbledygook.

Furthermore, your method of cancellation is not allowed. I cancelled deltas across equalities, under strictly analyzed circumstances (x was on both sides of the equation); you are canceling across a fraction. You are simplifying a fraction by canceling a delta in the numerator and denominator. This is not the same as canceling a term on both sides of an equation. Obviously, $\Delta\Delta t/\Delta\Delta x$ cannot equal $\Delta t/\Delta x$, since the derivative is not the same as the values at the point on the graph. The slope of a curve is not just $\Delta y/\Delta x$. A delta does not stand for a number or a variable, therefore it does not cancel in the same ways. It sometimes cancels across an equality, as I have shown. But the delta does not cancel in the fraction $\Delta\Delta t/\Delta\Delta x$, because Δt and Δx are not changing at the same rate. If they changed at the same rate, then we would have no acceleration. The deltas are therefore not equivalent in value and cannot be cancelled.

You will answer, “OK, fine. But if the velocity you have found is not an instantaneous velocity, it must be the velocity over some interval. You have just shown that is not the velocity of the interval $\Delta x_{\text{final}} - \Delta x_{\text{initial}}$. That only applies if the curve is a straight line. So what interval is it?"

It is the velocity over the nth interval of $\Delta\Delta x$, where $\Delta\Delta x = 1$. [If t were the independent variable, then the interval would be $\Delta\Delta t$.] Again, $\Delta\Delta t/\Delta\Delta x$ is the velocity equation, according to our given equation. Therefore the velocity at a given point on the graph $(\Delta x_n, \Delta t_n)$ is the velocity over the n$^{\text{th}}$ interval $\Delta\Delta x$. Very straightforward. The velocity equation tells us that itself: the denominator is the interval. Each interval $\Delta\Delta x$ is one, but the velocity over those intervals is not constant, since we have an acceleration. The velocity we find is the velocity over a particular subinterval of Δx. The subinterval of Δx is $\Delta\Delta x$. The velocity may be written this way:

$$\frac{\Delta t'}{\Delta\Delta x}$$

We have not gone to a limit or to zero; we have gone to a subinterval – the interval directly below the length and the period. What do I mean by this? I mean that our basic intervals or differentials are Δx and Δt. But if we have a curve equation, we have an acceleration or its mathematical equivalent. If we have an acceleration, then while we are measuring distance and period, something is moving underneath us. We have a change of a change. A rate of change. Our basic intervals are undergoing intervals of change. Not that hard to imagine. It happens all the time. While I am walking in the airport (measuring off the ground with my feet and my watch) I step onto a moving sidewalk. The ground has changed over a subinterval. It changes over only one subinterval, so I feel acceleration only over this subinterval. Once I achieve the speed of the sidewalk, my change stops, the subinterval ends, and I am at a new constant velocity. The subinterval is not an instant, it is the time(beginning of change) to the time(end of change). But in constant acceleration, I would be stepping onto faster sidewalks during each subsequent subinterval, and I would continue to accelerate.

All this means that the subinterval is not an instant. It is a definite period of time or distance, and this time or distance is given by the equation and the graph. As I have exhaustively shown, the subinterval in any graph where the box length is one and the independent variable is Δx is simply $\Delta\Delta x = 1$. If we assign the box length to the meter, then $\Delta\Delta x = 1\,\mathrm{m}$. If we find the velocity "at a point," then we must assign that velocity to the interval preceding that point. Not an infinitesimal interval, but the interval 1 meter. If we then assign that velocity to a real object at a point in space, an object we have been plotting with our graph and our curve, then the velocity of the object must also be assigned to the preceding one-meter interval.

You will say, “But a real object does not accelerate by fits and starts. Nor does the curve on the graph. We should be able to find the velocity at any fractional point, in space or on the graph."

Yes, you can, but the value you achieve will apply to the interval, not the instant. You can find the velocity at the value $\Delta x = 5\,\text{m}$ or $\Delta x = 9.000512$ m or at any other value, but any velocity will apply to the metric interval preceding the value.

You will say, "Good God, we need to be more precise than that. Can't I make that interval smaller somehow?"

Of course: just assign your box length to a smaller magnitude. If you let each box equal an angstrom, then the interval preceding your velocity is also an angstrom. However, notice that you cannot arbitrarily assign magnitude. That is, if you are actually measuring your object to the precision of angstroms, fine. You can mirror that precision on your graph. But if you are not being that precise in your operation of measurement, then you can't assign a very small magnitude to your box length just because you want to be closer to an instant or a point. Your graph is a representation of your operation of measurement. You cannot misrepresent that operation without cheating. It would be like using more significant digits than you have a right to.

This means that in physics, the precision of your measurement of your given variables completely determines the precision of your velocity. This is logically just how it should be. We should not be able to find the velocity at an instant or a point, when we cannot measure an instant or a point. An instantaneous velocity would have an infinite precision. We have a margin of error in all measurement of length and time, since we cannot achieve absolute accuracy. But heretofore we expected to find instantaneous velocities and accelerations, which would imply absolute accuracy.

9.7 *The Second Derivative – Acceleration*

As a final step, let me show that the second derivative is also not found at an instant. There is no such thing as an instantaneous acceleration, any more than there is an instantaneous velocity. What we seek for the acceleration at the point on the graph is this equation:

$$\Delta t'' = \frac{\Delta\Delta\Delta t}{\Delta\Delta x}$$

Acceleration is traditionally $\Delta v/\Delta t$. By current notation, that is $(\Delta\Delta x/\Delta t)/\Delta t$. By my notation of extra deltas, that would be $[\Delta(\Delta\Delta x)/\Delta\Delta t]/\Delta\Delta t$. My variables have been upside down this whole paper, meaning I have been finding slope and velocity as t/x instead of x/t. So flip that last equation $[\Delta(\Delta\Delta t)/\Delta\Delta x]/\Delta\Delta x$. As we have found over and over, $\Delta\Delta x = 1$, therefore that equation reduces to $\Delta\Delta\Delta t$. For the acceleration we seek $\Delta\Delta\Delta t$. The denominator is one, as you can plainly see, which means we are still seeking $\Delta\Delta\Delta t$ over a subinterval of one, not an interval diminishing to zero or to a limit.

We are given

$$\Delta t = \Delta x^3$$

We find from the table

$$3\Delta\Delta\Delta x^2 = \Delta\Delta\Delta\Delta x^3$$

We simplify

$$3\Delta\Delta x^2 = \Delta\Delta\Delta x^3$$

We seek $\Delta t''$ or $\Delta\Delta\Delta t$. We notice

$$\Delta\Delta\Delta t = \Delta\Delta\Delta x^3$$

since we can add the same deltas to both sides.

We substitute

$$3\Delta\Delta x^2 = \Delta\Delta\Delta t$$

Back to the table

$$2\Delta\Delta x = \Delta\Delta\Delta x^2$$

Simplify

$$2\Delta x = \Delta\Delta x^2$$

Substitute once more

$$6\Delta x = \Delta\Delta\Delta t$$

At $\Delta x = 5$, $\Delta\Delta\Delta t = 30$

The subinterval for the acceleration is the same as the subinterval for velocity. This subinterval is 1.

Summation

The proof is complete. Newton's analysis was wrong, and so was Leibniz's. No fluxions are involved, no vanishing values, no infinitesimals, no indivisibles (other than zero itself). Nothing is taken to zero. No denominator goes to zero, no ratio goes to zero. Infinite progressions are not involved. Even Archimedes was wrong. Archimedes invented the problem with his analysis, which looked toward zero 2200 years ago. All were guilty of a misapprehension of the problem, and a misunderstanding of rate of change. Euler and Cauchy were also wrong, since there is no sense in giving a foundation to a falsehood. The concept of the limit is historically an *ad hoc* invention regarding the calculus: one which may now be jettisoned. My redefinition of the derivative as simply the rate of change of the dependent variable demands a re-analysis of almost all higher math.

For example, my correction to the calculus changes the definition of the gradient, which changes the definition of the Lagrangian, which changes the definition of the Hamiltonian. Indeed, every mathematical field is affected by my redefinition of the derivative. I have shown that all mathematical fields are representations of intervals, not physical points. It is impossible to graph or represent a physical point on any mathematical field, Cartesian or otherwise. The gradient is therefore the rate of change over a definite interval, not the rate of change at a point.

Symplectic topology also relies upon the assumptions I have overturned in this paper. If points on a Cartesian graph are not points in real space, then quantum mechanical states are not points in a symplectic phase space. Hilbert space also crumbles, since the mathematical formalism cannot apply to the fields in question. Specifically, the sequence of elements, whatever they are, does not converge into the vector space. Therefore the mathematical space is not equivalent to the real space, and the one cannot fully predict the other. This means that the "uncertainty" of quantum mechanics is due (at least in part) to the math and not to the conceptual framework. That is to say, the various difficulties of quantum physics are primarily problems of a misdefined Hilbert space and a misused mathematics (vector algebra), and not problems of probabilities or philosophy.

In fact, all topologies are affected by this paper. Elementary topology makes the same mistake as the calculus in assuming that a line in $\mathbb{R}^2$ represents a one-dimensional subspace. But I have just shown that a line in $\mathbb{R}^2$ represents a velocity, which is not a one-dimensional subspace. I proved in section 1 above that a point in $\mathbb{R}^2$ was already a two-dimensional entity, so a line must be a three-dimensional subspace. In $\mathbb{R}^3$ a line represents an acceleration. In $\mathbb{R}^4$ a line represents a cition (Δa). Since velocity is a three-dimensional quantity – requiring the dimensions y and t, for instance, plus a change (a change always implies an extra dimension) – it follows that a line in $\mathbb{R}^n$ represents an $(n+1)$-dimensional subspace. This means that all linear and vector algebras must be reassessed. Tensors are put on a different footing as well, and that is a generous assessment. Not one mathematical assumption that relies on the traditional assumptions of differential calculus, topology, linear algebra, or measure theory is untouched by this paper.

The entire mess was built on one great error: all these mathematicians thought that the point on the graph or on the mathematical curve represented a point in space or a physical point. There was therefore no way, they thought, to find a subinterval or a differential without going to zero. But the subinterval is just the number one, as I have shown. That was the first given of the graph, and of the number line. The differential $\Delta\Delta x = 1$ defines the entire graph, and every curve on it. That constant differential is the denominator of every possible derivative – first, second or last. The derivative is not the limit as Δx approaches zero of $\Delta f(x)/\Delta x$. It is the value $\Delta f(x)/1$.

And this is precisely why the Umbral Calculus works. The current interpretation and formalism of the Calculus of Finite Differences is so complex and over-signed that it is difficult to tell what is going on. But my simple explanation of it above shows the groundwork clearly, even to those who are not experts in this subfield. Once you limit the Calculus of Finite Differences to the integers, build a simple table, and refuse to countenance things like forward differences and backward differences (which are just baggage), the clouds begin to dissipate. You give the constant differential 1 to the table, not arbitrarily, but because the number line itself has a constant differential of 1. We have defined the number 1 as the constant differential of the world and of every possible space. Mathematicians seem apt to forget it, but it is so. Every time we apply numbers to a problem, we have automatically defined our basic differential as 1. What this means, operationally, is that in many problems, exponents begin to act like subscripts, or the reverse. To see what I mean, go back to the table above. Because the integer 1 defines the table and the constant differentials on it, the exponents could be written as subscripts without any change to the math.

Once we have defined our basic differential as 1, we cannot help but mirror much of the math of subscripts, since subscripts are of course based on the differential 1. Unless you are very iconoclastic, your subscript changes 1 each time, which means your subscript has a constant differential of 1. So does the Calculus of Finite Differences, when it is used to replace the Infinite Calculus and derive the derivative equation like I have done here. Therefore it can be no mystery when other subscripted equations – if they are explicitly or implicitly based on a differential of 1 – are differentiable.

Beyond this, by redefining the problem completely, I have been able to prove that instantaneous values are a myth. They do not exist on the curve or on the graph. Furthermore, they imply absolute accuracy in finding velocities and accelerations, when the variables these motions are made of – distance and time – are not, and cannot be, absolutely accurate. Instantaneous values do not exist even as undefined mathematical concepts in the calculus, since they were arrived at by assigning diminishing differentials to points that were not points. You cannot postulate the existence of a limit at a "point" that is already defined by two differentials, $(x-0)$ and $(y-0)$.

I achieved all this with an algorithm that is simple and easy to understand. Calculus may now be taught without any mystification. No difficult proofs are required; nothing must be taken on faith. Every step of my derivation is capable of being explained in terms of basic number theory, and any high school student will see the logic in substituting values from the chart into curve equations.

[As proof that the calculus does not go to a limit, an infinitesimal, or approach zero, you may consult my second paper on Newton's orbital equation a = v^2/r[8]. There, I use the equation on the Moon, showing that the acceleration of the Moon due to the Earth is not an instantaneous acceleration. In other words, it does not take place at an instant or over an infinitesimal time. I actually calculate the real time that passes during the given acceleration, showing in a specific problem that

[8] Chapter 21

the calculus goes to a subinterval, not a limit or infinitesimal. That subinterval is both finite and calculable in any physical problem. In other words, I find the subinterval that acts as 1 in a real problem. I find the value of the baseline differential.]

[In a new paper[9], I prove my contention here that calculus is fundamentally misunderstood to this day by analyzing a textbook solution of variable acceleration. I show that the first integral is used where the second derivative should be used, proving that scientists don't comprehend the basic manipulations of the calculus. Furthermore, I show that calculus is taught upside-down, by defining the derivative in reverse.]

Addendum

In subsequent papers, I show how my tables may be converted to find integrals, trig functions[10], logarithms[11], and so on. I think it is clear that integrals may be found simply by reading up the table rather than down. But there are several implications of this that must be enumerated in full. And the conversion to trig functions and the rest is somewhat more difficult, although not, I hope, esoteric in any sense. All we have to do to convert the above tables to any function is to consider the way that numbers are generated by the various methods, keeping in mind the provisos I have already covered here.

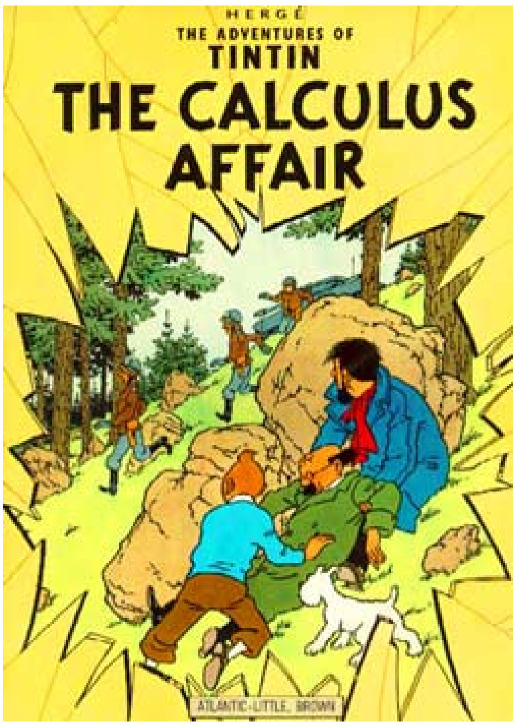
Links: To see how this paper ties into the problems of Quantum Mechanics, see my paper Quantum Mechanics and Idealism[12].

---

[9] Chapter 15
[10] Chapter 17
[11] Chapter 13
[12] http://milesmathis.com/quant.html

Chapter 10

THE CALCULUS IS CORRUPT



The current and historical method for differentiating is a mess. In Lagrange's derivation of the virial[1], we find him differentiating x^2 with respect to t, to find

$$\frac{dx^2}{dt} = 2x\,\frac{dx}{dt}$$

He then lets

$$\frac{dx}{dt} = v$$

so that

$$\frac{dx^2}{dt} = 2xv$$

I found this astonishing, but then was more astonished to find that it is done all the time, to this day. No one calls Lagrange on this cheat because they want to use it themselves. It is the same reason the Democrats never called the Republicans for stealing elections with voting machines. The Democrats wanted their turn with the machines, and got it.

We could continue this cheat of Lagrange to find that $2xv = 2x^2/t$, which would mean that the derivative of x^2 with respect to t is $2x^2/t$.

Does any of this make any sense? Does anyone ever bother to check to see if these equations are physically true? Apparently not.

If the derivative of x^2 with respect to t is $2xv$, then what velocity is that? I will be told it is the velocity at (x,t), but $2x$ is already the velocity at (x,t). Because our power is 2 here, we have a curve equation. The derivative of a curve at a point is a velocity. It is supposed to be the instantaneous velocity at that point on the curve. The derivative is the tangent to the curve, remember, and it is also the velocity at that point. So by this finding of $2xv$, we appear to have two

[1] Mathis, Miles. The Virial Theorem is False. 2010.

simultaneous velocities at a single point, multiplied together. The value $2x$ is the velocity, and v is also the velocity, so we actually have v^2. The derivative of a power 2 curve equation is a velocity squared?

The derivative of x^2 with respect to t cannot be $2xv$, since the derivative is the rate of change. The rate of change of x^2 with respect to t cannot be $2xv$, unless $v = 1$. Historically, Newton used the notation $\mathrm{d}x/\mathrm{d}t$ (or the equivalent) here simply as a reminder of the relationship. It is like a listing of physical dimensions in an equation, not a continuation of variables. For example, if we find the derivative of x^2 with respect to x, we find $2x$, which could be written $2x(\mathrm{d}x/\mathrm{d}x)$. That would be read, "The rate of change of x^2 is $2x(x$ with respect to $x)$." But since it is clear that $\mathrm{d}x/\mathrm{d}x = 1$, we drop the notation.

When we find the derivative of x^2 with respect to t, we are doing the same thing. We can write that as $2x(\mathrm{d}x/\mathrm{d}t)$, but only if we remember that $\mathrm{d}x/\mathrm{d}t$ is just notation. In that equation, $\mathrm{d}x/\mathrm{d}t$ is reducible to 1, so it cannot be written later as a velocity *variable*.

In fact, in this notation, $\mathrm{d}x/\mathrm{d}t$ *is* the dimensional notation. It does not stand for a velocity variable, it stands for meters/second, or something like that. If we find the derivative of x^2 at $x = 4$, the answer is 8, and the $\mathrm{d}x/\mathrm{d}t$ only stands for the dimensions. We need dimensions, since 8 is not a physical answer. Since x^2 is an acceleration, the rate of change of that curve at a given x must be a velocity. The derivative of an acceleration is a velocity. So $\mathrm{d}x/\mathrm{d}t$ is giving us the velocity dimensions of length over time. The ratio $\mathrm{d}x/\mathrm{d}t$ is not a velocity variable, it is dimensional constant.

The ratio $\mathrm{d}x/\mathrm{d}t$ is reducible to 1 simply because, physically, distance and time cannot be changing at different rates, as infinitesimals or at the limit. You will say that if our velocity is 2, our distance is changing at a rate of 2 while our time is changing at a rate of 1, but in the calculus, first order changes like that are ignored. The derivative of 2 is 0 and the derivative of 1 is 0. That is why the ratio in the notation is written $\mathrm{d}x/\mathrm{d}t$. It is not written x/t. The letter d here does not mean delta, it means fluxion or infinitesimal change. At the limit, all first order changes are equal, so $\mathrm{d}x/\mathrm{d}t$ is vanishing in the same sense that 1 is vanishing in equations. It is vanishing in the sense that you can ignore it. You can cross it out of the equation. If you were Newton, you would think of it as a dot over a dot, and let it vanish for that reason. If you are with me, you think of this as $1/1$, which is "vanishing" for a different but mostly equivalent reason.

That notation $\mathrm{d}x/\mathrm{d}t$ here is not a representation of how x and t are changing relative to each other in any *specific* problem, it is a representation of how x and t are changing relative to each other in the physical field or space, absolutely. It is analogous to $\mathrm{d}x/\mathrm{d}y$. If we study space itself, does x change at a different rate than y? Do we measure the width of space differently than we measure the depth of space? Does space itself get wider faster than it gets longer? No. In physics, $\mathrm{d}x/\mathrm{d}y$ always equals 1, just as $\mathrm{d}x/\mathrm{d}x$ always equals 1. For the exact same reason, $\mathrm{d}x/\mathrm{d}t$ always equals 1 *in this sort of notation*. Since time is defined relative to distance, they cannot be changing at different rates. If x is changing at a rate of 1, t must be changing at a rate of 1, and this has nothing to do with the velocity of any real object in any real measurement.

To show what I meant when I said that this notation is equivalent to dimensional notation, we can look at some common equation in physics. Say,

$$G = 6.67\,10^{-11}\,\mathrm{m}^3/\mathrm{kg.s}^2$$

You can't rewrite that as

$$G = 6.67\,10^{-11} v^2\,\mathrm{m}/\mathrm{kg}$$

And then start inserting different values for v into that equation. That second equation is true only in the case that $v = 1$. v is not a variable there, it is just a dimensional analysis.

It is the same with the notation $\mathrm{d}x/\mathrm{d}t$. The ratio $\mathrm{d}x/\mathrm{d}t$ can be written as a velocity only if you remember that $v = 1$. In that case, v is not a variable, it is just a constant dimension, reminding us of a prior relationship. In Newton's and Leibniz's notation, they used $\mathrm{d}x/\mathrm{d}t$ (or its equivalent) only in this way.

Therefore, Lagrange's math is just a cheat. Any time you see $\mathrm{d}x/\mathrm{d}t$ written as a velocity, in a situation like this, a big red flag should pop up.

You will say, "C'mon, we all know that $\mathrm{d}x/\mathrm{d}t$ is a velocity. What are you talking about? Velocity is *defined* as $\mathrm{d}x/\mathrm{d}t$, for heaven's sake!" Yes, in many situations, it is. I am not denying that $\mathrm{d}x/\mathrm{d}t$ is a velocity, as long as it is used correctly. What I am denying is that $\mathrm{d}x/\mathrm{d}t$ *in this particular case* is equivalent to the definitional notation of velocity. I am pointing out something fundamental and of great importance, and you better open your eyes to it. The notation of calculus has always been convoluted and sloppy, and this sloppiness had already reached epidemic proportions by the time of Lagrange. If you differentiate x^2, finding $2x\,\mathrm{d}x/\mathrm{d}t$, the $\mathrm{d}x/\mathrm{d}t$ in that notation is not a velocity. The notation is telling us that we are finding the rate of change of x^2 with respect to the given rate of change of time. Since the given rate of change of time is always 1, $\mathrm{d}x/\mathrm{d}t$ must also be one.

Let me put it another way. I try to explain this in as many ways as possible. In physics, does time ever change at any other rate than 1? Can time itself be accelerated or dilated? No. Not even in Relativity. In Relativity, *measurements* of time can be dilated or compressed, but time itself is invariable. We never find time to any power. We never find time going at any rate above 1 or below 1. Time is always ticking at a rate of 1, by definition. The rate of change of time is and must be 1. Therefore, if we are given the ratio $\mathrm{d}x/\mathrm{d}t$, and we know that $\mathrm{d}x$ is 1, then $\mathrm{d}x/\mathrm{d}t$ must be 1. Well, if we differentiate some power of x with respect to t, then $\mathrm{d}x$ can hardly be anything but 1, can it? Given x^2, we assume $\mathrm{d}x = 1$. If we differentiate x^2 with respect to x, we assume $\mathrm{d}x = 1$, don't we? If we didn't, then we couldn't find that $\mathrm{d}x^2/\mathrm{d}x = 2x$. The denominator $\mathrm{d}x$ has to equal 1 or the equality is ruined. In the same way, when we differentiate with respect to t, $\mathrm{d}x$ is still changing at a rate of 1. Therefore, $\mathrm{d}x/\mathrm{d}t = 1$. It can be dropped.

If we differentiate x^2 with respect to t, the answer is $2x$, not $2x\,\mathrm{d}x/\mathrm{d}t$. This sloppy and confusing notation should be abandoned. The ratio $\mathrm{d}x/\mathrm{d}t$ should mean one thing in calculus and one thing only. It should not be used differently in different places, since that only encourages this sort of cheating.

I have also seen x^2 differentiated with respect to t to get $2xx'$. That is unnecessary for the same reason. It just gives cheaters another variable to play with, to fudge later if they want. The term x' just means the derivative of x, and of course the derivative of x is just 1. So there is no reason to write it. The only reason to write it is so that you can use the Lagrange fudge later, claiming that $x' = v$, and push your equations that way. I have seen "real" mathematicians defending this manipulation, claiming that whenever you differentiate a length, you get a velocity. But that is the upside-down calculus I have talked about elsewhere[2]. Many mathematicians and physicists actually believe they can differentiate any length they like into a velocity. But they can't, as I have shown with Lagrange and his virial proof. They have to be given an acceleration, and every length is not part of an acceleration. Because they have misunderstood calculus from day one in high-school, they think that when they differentiate some power like x^2, they are differentiating a length. But they aren't. When you differentiate x^2, you are differentiating a curve, which is an acceleration. The term x^2 is *already* an acceleration, even without a ratio, a denominator, or a "with respect to." The term x^2 stands for this accelerating series of numbers:

x^2 : 1, 4, 9, 16, 25, 36, 49, 64, 81.

Therefore, you differentiate an acceleration into a velocity. You do not differentiate a length into a velocity. You differentiate down, not up.

But as it is, mathematicians think they can differentiate both up and down. They can differentiate x^2 into a velocity, because x^2 is a velocity at the point x; and they can also differentiate x into a velocity, since $x' = v$. But their second manipulation here is illegal, since they have just differentiated *up*, with no given acceleration or curve. If you are given x, you are not given a curve or any variable change. You are given this series of numbers:

x : 1, 2, 3, 4, 5, 6, 7, 8.

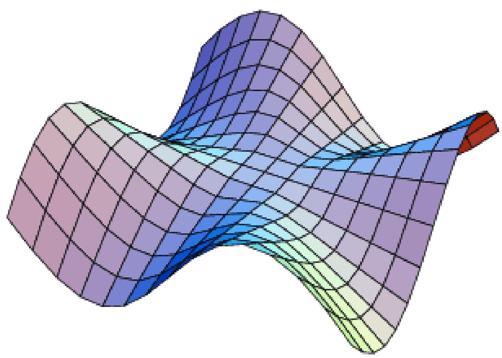
The derivative of that series of numbers is 1, because the rate of change of that line is 1. There is a difference of 1 between each and every term. If you assign a velocity to that series, it is also 1. You cannot differentiate x into a velocity *variable*. You can only differentiate x into the velocity 1.

Therefore, the calculus has been corrupt and almost infinitely fudgable, at least since the time of Lagrange.

[2] Mathis, Miles. A Study of Variable Acceleration. 2009.

Chapter 11

THE PROOF FOR THE CURRENT DERIVATIVE FOR POWERS IS FALSE



Yes, I will show that the proof of $y' = \mathrm{n}x^{\mathrm{n}\text{-}1}$ is false. Not only unnecessary, but false. I will re-prove it by a simpler and more transparent method.

Many readers don't understand why I would attack the calculus, so I try to begin all these papers by reminding them that physics has hit several major walls in the past century. Pure mathematicians may not be aware of that, so they may not be aware that we have empirical evidence that their maths are failing. I get emails telling me that the calculus is the greatest thing ever invented and that I am either an ingrate or a monster for looking closely at it. But I am looking closely at it for a reason. The two pillars of 20$^{\text{th}}$ century physics, Quantum Mechanics and General Relativity, both hit similar walls. Many people know that they have failed to be unified, but most people don't know that both have to be renormalized. Renormalization is a big part of QED, as is admitted, and GR also requires a sort of renormalization, a push that is hidden in the tensor calculus and in the field definitions. Renormalization was perfected by a famous physicist named Richard Feynman, and he is notorious for calling his own creation "hocus-pocus" that was "not mathematically legitimate." He also called it a shell-game. What does renormalization do? It removes zeroes and infinities from equations that are imploding or exploding. Why are these equations imploding and exploding? No one knows. Richard Feynman was the top mathematical physicist of his time, and Edward Witten is the top mathematical physicist now. Witten has posed just this question at Claymath, as one of the Millennium prizes. He wants to know why the point maths of QED and QCD are failing. I have no intention of submitting for this prize, since I know they will not like my answer. But my answer is that the maths are failing because they are based on the calculus, and that the calculus is failing in QED because it is based on the point and on a move to zero. This has also affected the search for unification, since the mainstream is trying to unify by quantizing gravity. But since they have misdefined the photon and other particles as point particles, based on a misunderstanding of the calculus, this effort is wasted.

Therefore, my work on the calculus is neither capricious nor insolent. It may seem to overreach at times, but it is always focused. It is focused on re-defining the derivative and on jettisoning the point from all equations.

The next complaint I hear is that I seem to have an aversion for limits and infinities. In fact, I don't[1]. I believe some problems are best solved with limits: I just don't think the calculus is one of them. The calculus can be solved by simple number relations, because that is what creates the equalities. As it turns out, proving the calculus with limits is not only unnecessary and inefficient, it is

[1] http://milesmathis.com/zeno.html

false. It breaks rules and finds fake numbers. It also warps fields and allows for particles and motions that cannot exist. The problems embedded in the calculus are what have caused many of the physical problems in the past century.

Currently, modern mathematicians use the calculus to find a derivative and a slope of the tangent by taking Δx to zero. I have shown[2] many reasons they can't do that (and don't need to do that), but the main reason is the one I will concentrate on in this paper: it changes the given curve. If you go below 1 for the change of your independent variable, you will have changed the curve. This is important, because unless you also monitor that change, you will get the wrong answer for your curve at x. I will show you what I mean straight from the tables for x^2 and x^3.

Let $\Delta x = 1$:

x	1	2	3	4	5	6	7	8	9
x^2	1	4	9	16	25	36	49	64	81
x^3	1	8	27	64	125	216	343	512	729
Δx	1	1	1	1	1	1	1	1	1
Δx^2	3	5	7	9	11	13	15	17	19
Δx^3	7	19	37	61	91	127	169	217	271
$\Delta\Delta x^2$	2	2	2	2	2	2	2	2	2
$\Delta\Delta x^3$	6	12	18	24	30	36	42	48	54
$\Delta\Delta\Delta x^3$	6	6	6	6	6	6	6	6	6

Let $\Delta x = 0.5$:

x	0.5000	1.0000	1.5000	2.0000	2.5000	3.0000
x^2	0.2500	1.0000	2.2500	4.0000	6.2500	9.0000
x^3	0.1250	1.0000	3.3750	8.0000	15.6250	27.0000

Let $\Delta x = 0.25$:

[2] Chapter 9

x	0.2500	0.5000	0.7500	1.0000	1.2500	1.5000
x^2	0.6250	0.2500	0.5625	1.0000	1.5625	2.2500
x^3	0.0156	0.1250	0.4219	1.0000	1.9531	3.3750

If $\Delta x = 0.5$, then $y = x^2$ no longer has its original rate of change or curvature, as you see. It has exactly $\frac{1}{4}$ the curvature it originally had. The curve $y = x^3$ loses much of its original curvature, too: it retains only $\frac{1}{8}$ of its curvature. If we continue taking Δx toward zero, by making $\Delta x = 0.25$, this outcome is magnified. $y = x^2$ has $\frac{1}{16}$ of its curvature, and $y = x^3$ has $\frac{1}{64}$ of its curvature.

This shouldn't be happening, and is not usually known to happen. You will not see the curves analyzed in this way.

A critic will say, "Of course the curve is straightening out. That is the whole point. We are going to zero to magnify the curve. When you magnify a curve, its loses its curvature at a given rate, depending upon the magnification. Your curve x^2 at $\Delta x = 0.5$ IS the same curve, it is just four times smaller. "

True, but the curve should lose its curve at the same rate you magnify it. If all the calculus were doing is magnifying the curve, then if you magnified 2 times, the curve would lose half its curve. If you are approaching zero in a defined and rigorous manner, your magnification and curvature should change together. But here, you magnify by 2 by halving your Δx, but your curvature has shrunk to $\frac{1}{4}$ with x^2 and to $\frac{1}{8}$ with x^3. That is not a quibble, that is a major problem. If you change your curve, you change your tangent.

My will critic will answer, "It doesn't matter how much the curve changes as we go in. We are going into a point, and the tangent only hits at a point. Therefore the curvature won't change at that point."

Wow, that sounds like pettifogging to me. By that argument you can make the slope anything you want to at any point on any curve. If changing the curvature doesn't really change the curvature, then curvature has no meaning.

Currently, the calculus just ignores this problem, or dodges it with oily answers like that last one. To approach a limit in this way while your given curve is changing would require a very tight proof to convince me it is legal, and I have never seen one. If you dig, you find that it requires an infinite line of proofs to "prove" the legality of the first move to zero. For example, if you go to Wikipedia, you will see the first in this line of proofs. Wiki starts by telling us that the difference quotient

> has the intuitive interpretation that the tangent line to f at a gives the best linear approximation to f near a (i.e., for small h). This interpretation is the easiest to generalize to other settings.

But to tighten this up a bit, they next let the slope of the secant $Q(h)$ go to zero, and tell us

> If the limit exists, meaning that there is a way of choosing a value for $Q(0)$ which makes the graph of Q a continuous function, then the function f is differentiable at the point a, and its derivative at a equals $Q(0)$.

They still have not proved anything there, they have just juggled some terms. Notice they say, "IF the limit exists." In fact, they admit in the next sentence that the quotient is undefined at $h = 0$, which means the limit they have just created does not exist. You cannot choose the value $h = 0$, so their function is nullified.

Some will say that is an unnecessarily harsh judgment, but it is no more than the truth. Every point on every curve becomes a limit with the modern calculus, since whenever you approach a value of x, you are approaching a limit to find the derivative at that point. $Q(0)$ exists not at the limit of some given curve, it exists at *every* point on that curve. Any point you desire to find a derivative for becomes your limit of zero. So a curve is just a compendium of limits. A curve becomes a sum of zeroes. Zeno knew[3] that was a paradox 2500 years ago, but the modern calculus still boldly embraces it.

Wiki admits that taking Δx (their h) to zero is a problem:

> The last expression shows that the difference quotient equals $6 + h$ when h is not zero and is undefined when h is zero. (Remember that because

[3] http://milesmathis.com/zeno.html

> of the definition of the difference quotient, the difference quotient is never defined when h is zero.) However, there is a natural way of filling in a value for the difference quotient at zero, namely 6. Hence the slope of the graph of the squaring function at the point $(3,9)$ is 6, and so its derivative at $x = 3$ is $f'(3) = 6$.
>
> More generally, a similar computation shows that the derivative of the squaring function at $x = a$ is $f'(a) = 2a$.

Do you see what they just said? After 300 hundred years, this is the rigor we get. Wiki tells us there is "a natural way of filling in a value for the difference quotient at zero." That just means that we already know what the derivative is by looking at differentials. We know the answer, so we push the difference quotient to match it. That is the "natural way" of solving this.

True, there are other more complex methods for proving the move to zero. In fact, there are three centuries worth of proofs, in hundreds of thousands of pages, from Newton and Leibniz and Euler and Lagrange and Cauchy and Riemann so on, all different and all in different notations. But if the answer were clear, don't you think it could have been presented a bit more quickly and easily than that? One would think that if the move to zero were legal, it could have been shown immediately. In my experience, only things that *aren't* true require proofs of a million pages over many centuries.

I think that just from what I have said, it is clear that the move to zero is illegal. You cannot go to a limit to analyze a curve when your curve is changing at a different rate than your approach to the limit.

To solve, modern mathematicians simply shrink Δx to suit themselves, never noticing or caring that it must change the curve of the given curve. In other words, they take a graph like the one below, draw the forward and backward slopes (or secants, as the case may be), then begin making them smaller and closer to their chosen point. Because it all looks perfectly legal on the graph, no one ever questions the legality of it. But I have just shown it is strictly illegal. If you go below $\Delta x = 1$, you will change your curve. If you have made your Δx twice as small and at the same time your curve is 4 times smaller, then your absolute curvature has changed. There is no way around it.

But even if one or all of the millions of pages of proofs are correct, it doesn't matter. Why should we choose to solve this problem with a million pages of difficult proofs, when we can solve it by looking at a few tables of simple differentials? Why do teachers and textbooks and Wiki reference all these complex proofs and never show us the simple tables?

Regardless of the status of all these proofs, going to zero wasn't necessary to begin with. We can find specific slopes as well as general slope equations by several other methods, and none of them use limits. We don't need to go below $\Delta x = 1$, because the forward slopes and backward slopes will give us the slope at x by a simple average. Since x is changing at a constant rate on the graph, the forward slopes and backward slopes are the same size differentials, by definition. The constancy of change in x assures us that our given value of x is at the midpoint between forward and backward slopes. Just look at the graphs: the change in x is always the same.

My critic will say, "What you say is true of squared acceleration, but you clearly don't understand cubed acceleration. You can't find distances from cubed accelerations by averaging, since the distance in the second period is much greater than the distance in the first." Well, that is also true of squared acceleration. With a squared acceleration, the distance in the second period is much greater than the distance in the first. So that isn't the reason we can't (at first) seem to average. The reason we can't seem to average with powers above 2 is that the power 2 changes at a constant rate of 2, but higher powers don't.

Let me show you exactly what I mean. We can find a slope for x^2 very simply and accurately by averaging forward and backward slopes, as you see from this graph. However, another similar graph tells us we cannot get the current value of the slope that way for x^3. Why? It is because the curve x^2 is changing 3, 5, 7, 9. You can get that either from the table or the graph. It is changing 2 each time. The curve x^2 has a fundamental acceleration of 2. Therefore we can average in one step. The average of 5 and 7 is 6, which is the slope at $x = 3$. But the curve x^3 is changing 7, 19, 37. It appears we can't average.

The modern calculus tells us this is why we have to go to zero. We can't average forward and backward slopes with most functions, therefore we have to solve by going to zero. But that is false. With x^3 we don't have to go to zero any more than we did with x^2. We can find a derivative with a simple average. Like in figure 11.1 on the facing page.

Since x^3 is changing 7, 19, 37, it has a fundamental acceleration of $6n$ (where $n = 1,2,3$). You can see that in the last two lines in the table above. That being the case, our acceleration could be written as this series:

$$1, \quad 1+6, \quad 1+12, \quad 1+18, \quad 1+36\ldots$$

That is where the numbers 1, 7, 19, 37 come from. So, if we want to find the slope at 3, say, that will be between the numbers 19 and 37. Just consult the graph. I have shown that we cannot average 19 and 37 directly, because that would give us the number 28, which is not the current slope. But since the curve is is achieved by a 1+ series, we can subtract the one away from each term. If we do that, then our forward and backward slopes at $x = 3$ will be 18 and 36, in which case we can find the current slope by averaging. $(18+36)/2 = 27$. That is the current slope at 3. So we *could* find a slope just by averaging, even with an acceleration of $6n$.

You will say, "Wait, you just changed your curve by doing that. You just proved that changing the curve was forbidden, then you did it. You subtracted 1 away from your series, and you now have this series:

$$\Delta x^3 = 6,\ 18,\ 36,\ 60,\ 90$$

Those are the rates of change for 0, 6, 24, 60, 120, 210, not x^3 =1,8,27,64,125,216."

True, but the curve 0, 6, 24, 60, 120, 210 is still an acceleration of $6n$, therefore it is an acceleration above x^2, therefore you CAN find an average acceleration for powers above 2. You can't find it just by adding two numbers and dividing by 2, but you can find it. In this case, it is the forward slope minus 1 plus the backward

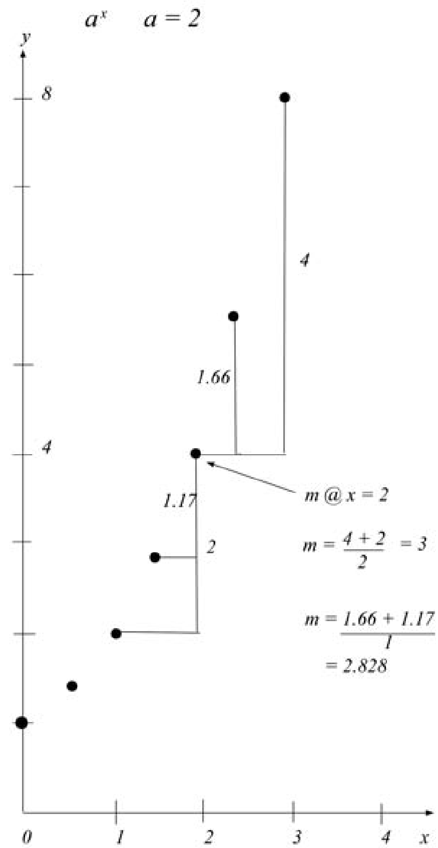


Figure 11.1: Simple Average

slope minus 1, over 2. It is still an average, it is still very simple, and it doesn't require using a limit.

$$\mathrm{m}@(x,y) = \frac{\{[\Delta y@(x+1)]-1\}+\{[\Delta y@(x)]-1\}}{2}$$

The same analysis applies to x^4:

$$\mathrm{m}@(x,y) = \frac{\{[\Delta y@(x+1)]-12\}+\{[\Delta y@(x)]-12\}}{2}$$

Because we can average forward and backward slopes like this with a general equation, it means the process is not an accident or push.

$$\Delta x^5 = 1, 31, 211, 781, 2101, 4651, 9031$$

$$\text{m}@(x,y) = \frac{\{[\Delta y@(x+1)]–(10\text{x}2+1)\} + \{[\Delta y@(x)]–(10\text{x}2+1)}{2}$$

We can average powers above 2 because they are constant. They are constant not as the power 2 is constant: the power 2 is constant at the first rate of change. But all simple powers are constant in that they increase in a consistent manner, by a process that can be broken down. We can see that right from the tables. If we take enough changes of any power, we see that it is constant at a fundamental level. That is what 6, 6, 6, 6 is telling us about x^3. Two rates down, it is constant. Therefore it is constant. That was my point in a recent paper on "variable" acceleration. Cubed acceleration is not really variable. It is constant. It can be averaged, if you do it in the right way. It is a consistent increase, therefore it can be analyzed in a straightforward manner, as we are doing here. We don't need limits, we can just use simple number relations.

Although I have shown we can average forward and backward slopes with all powers, the slope equations get very complicated as we advance into the higher powers. We also encounter a problem with finding slopes for values of x near 1, since we are subtracting large numbers from our Δy's. This means we need a better way to generalize our slope equation. I have already shown how to do that in my long paper on the derivative. I will gloss it again here.

We will pull the general equation straight from the tables. We will start with the smaller powers. Since x^3 is changing 7, 19, 37, it has a fundamental acceleration of $6n$ (where $n = 1, 2, 3$). You can see that in the last two lines in the table above. Since x^2 has a fundamental acceleration of 2, the fundamental acceleration of x^3 is 3 times that of x^2 over each interval. Six is three times two. We can write that as $f\,x^3 = 3x^2$, where f means fundamental acceleration.

If we are physicists, or logical people of any stripe, that proof of the derivative of x^3 is much preferable to the current one. We don't go to zero, we don't talk of limits or functions or infinitesimals or any of that. We pull the general derivative equation straight from a table of differentials, and in doing so we see right where all the numbers are coming from. Now we just need to generalize that equation. We can do that by analyzing other powers. By studying the simple tables[4], we find that all other powers obey the same relationship we just found between x^2 and x^3.

$$f\,x^{\mathrm{n}} = \mathrm{n}\,x^{\mathrm{n}-1}$$

The differentials themselves give us the derivative equation for powers. This means we don't need any other proof of it. A table of differentials is all the proof we need. It is a proof by "show me." You want me to prove that a dog is white, so I show you the white dog. You want me to prove that the derivative equation for powers is $f\,x^{\mathrm{n}} = \mathrm{n}\,x^{\mathrm{n}-1}$, so I show you the tables, with the numbers sitting right next to each other. If you require a proof beyond that, we must call you a confused and meddlesome person, and we recommend you go into set theory, where you can write thousand-page books proving tautologies (while ignoring much greater real problems sitting on your desk).

I will answer one more question here before I move on to the other more important questions on *my* desk. A close reader will ask, "We can write the series 0, 6, 24, 60, 120, 210... as $x^3 - x$, and you have shown that both the curve $x^3 - x$ and the curve x^3 can be written as accelerations of $6n$. By your abbreviated and direct proof, both curves should have a derivative of $3x^2$. But they don't. The derivative of $x^3 - x$ is $3x^2 - 1$. How do you explain that?"

Once again, I am not here to show that the current derivatives for powers are wrong. I am here to show that the proofs are wrong. I admit the derivatives are different for $x^3 - x$ and x^3, but that difference can be shown and generalized without using limits. In this case, the difference is caused by the first term in the series. The first term in one series is 1 different from the other, and so is the derivative. So the difference in equations can be shown by simple demonstration, or by pointing to a table. It doesn't require limits or difficult proofs. I have not exhausted all the demonstrations, or answered all questions. I am only here

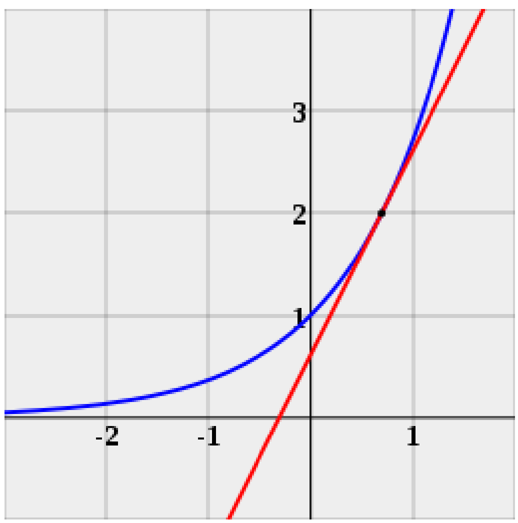
[4] Chapter 9

to suggest that every question has a simpler answer than the one we have so far been shown, one that can be achieved without limits. All calculus questions can be answered by studying the tables, since the tables supply the actual number relations that generate the calculus. Fundamentally, calculus is about these number relations, not about limits or approaches to zero.

Because the calculus is not about limits and can be proved without limits, it cannot find solutions at points or instants. My method differs from the modern calculus not only in its simplified proofs, but in its definitions. Because Δx is always 1 and cannot go below one, our derivatives and solutions are always found over a defined interval of 1. Instantaneous velocities and accelerations are impossible, as are point particles and all other solutions at points. This solves many of the problems of QED and General Relativity. It solves renormalization directly, since the equations are never allowed to become abnormal to begin with. And it disallows "mass points" in the field equations. If you cannot have math at a point, you cannot have mass at a point. Modern physicists have been fooled by the calculus into thinking they can or should be able to do things they simply cannot do. My correction to the calculus disabuses them of this mistaken notion. They have had problems with points in their math and their fields because points do not exist, in either math or fields. Only intervals exist. Only intervals can be studied mathematically. This is why they call it the differential calculus. It is a calculus of differentials, and differentials are always intervals. Just check the epsilon/delta proof. It is defined by differentials, not points. Mathematicians at all levels and in all centuries always seem to forget that whenever it is convenient.

Chapter 12

MY CALCULUS APPLIED TO EXPONENTIAL FUNCTIONS



IN PROGRESS

Abstract: I will show that the current derivative for exponents a^x is not correct. I will correct it. I will also show that the derivative for e^x, though correct in some ways, is proved in a faulty manner. The proof from $\ln(x)$ is completely compromised, and I save the derivative of e^x only by showing it is a subset of a^x. This is opposite the current method, which proves a^x from e^x. I will also show that the slopes of these functions are not the current values, and not the values of their derivatives (defined in a certain way). I will then show that the calculus is taught upside down.

After a short period of indecision and revision, I have begun to close in on a solid correction to the calculus. I am certain the current calculus is compromised, but I cannot always see how to correct it. My newest solution in this paper to the exponential functions is my best so far, but if you have ideas how to continue to perfect it, please drop me an email. There is always more left to do. If, on the other hand, you are certain the current methods are completely satisfactory and correct, do not bother telling me I am sociopath and a math monster. That kind of blockage has never stopped me. If you love the living calculus, stay married to it: it won't bother me. We all have different needs, with math as with wives, and who am I to deprive you of your pleasure.

Because I am an independent researcher, I am free to speculate, and sometimes speculate wildly. This kind of speculation with abandon is needed in science and math as well as the more sober sort of congregating, and so I will not stop doing it. If I do not solve what I mean to solve here, I may trip over something else important. I am just thankful for the freedom I have to do so.

Yes, this paper stood for a few days before Christmas in an incomplete state. It is still incomplete after major extensions yesterday, as I just admitted. But since the calculus has stood in an incomplete state for centuries, perhaps millennia, I don't feel especially pressed to apologize.

Many will not understand why I would want or dare to attack the calculus. Isn't is near perfect? Doesn't it get the right answer? Well, sometimes it does pretty well. As you will see, the derivatives, though false, are numerically pretty accurate most of the time. But, no, the calculus is far from perfect, and that has always been known. It is known just by looking at the current manipulations, which are a jungle of ill-defined pushes and pulls. But, more importantly, it is known by the big failures of the calculus in the 20th century. I come to this problem from physics, and it is my belief that unification has been hampered by just this problem I am attempting to unwind. As I have said in many other papers, it is my belief that the need for renormalization is caused by this problem with the calculus. All or most of the point problems in QED and General Relativity are caused by the sloppy definitions and manipulations of the modern calculus. So I am not on this page just to be contrary or revolutionary. I am trying to solve a problem that most top scientists admit exists. They may not admit that the calculus has anything to do with it, but they admit that these problems exist in QED and GR.

So when I get emails telling me I am on a fool's quest, I have to laugh. They told me the same thing about Relativity. Relativity is perfect, we are told. Yes, it is perfect except for the pile of Lorentz violations that now stack to the Moon, and except for the million Pioneer anomalies and Saturn anomalies and so on, and except for the failure to unify GR with QED, and except for the complete lack of a mechanism for gravity, and except for the solutions at zero in Black Holes, and except for everything else to do with the theory. I am told the same thing about QED: it is the most successful theory of all time, the crown jewel of physics. That is true, if you overlook all pertinent facts: that the math is a jumble of renormalization that its inventor Feynman called hocus-pocus, that it has failed to be unified, that it has failed to be mechanical, that it has failed to explain mass or charge, that it requires borrowing from the vacuum with magical incantations, that it requires symmetry-breaking to correct its gauge fields, and that it has required a ridiculous string theory to bypass it.

I have shown good, albeit circumstantial, evidence that the calculus is the root cause of many of these problems, and I intend to continue pursuing proof of that in these papers. A real lover of truth would wish me luck.

*

*   *

I continue to get letters complaining that my correction to the calculus[1], by reinventing and reinterpreting the calculus of finite differences, can only apply to the integers. I regard to real numbers, so that my correction and simple proof is just an anomaly or a curiosity.

The mathematicians who say this have not understood my papers or my proofs. They claim that the current equation for the derivative is generalized, when I have shown[2] that it is simply garbled and false:

$$f'(a) = \lim_{h \to 0} \frac{f(a+h) - f(a)}{h}$$

The variable h can neither be zero nor go to zero. Even current mathematicians admit the first part of this. At Wikipedia, it says,

> Substituting 0 for h in the difference quotient causes division by zero, so the slope of the tangent line cannot be found directly. Instead, define $Q(h)$ to be the difference quotient as a function of h:
>
> $$Q(h) = \lim_{h \to 0} \frac{[f(a+h) - f(a)]}{h}$$
>
> $Q(h)$is the slope of the secant line between $(a, f(a))$ and $(a+h, f(a+h))$. If f is a continuous function, meaning that its graph is an unbroken curve with no gaps, then Q is a continuous function away from the point $h = 0$. If the limit $\lim_{h \to 0} Q(h)$ exists, meaning that there is a way of choosing a value for $Q(0)$ which makes the graph of Q a continuous function, then the function f is differentiable at the point a, and its derivative at a equals $Q(0)$.

This is amazing, because it means that in these equations, you have to go to zero twice. First, you go to zero to find the first equation. Then, because you *can't* go to zero, you create a second function you can push in the gap. You fudge your fudge. You push your push.

[1] Chapter 9
[2] Ibid.

All of this is very ugly, as I think most people can see. We are told that we cannot find the tangent directly, even 300 years after Newton. This must be ridiculous after the publication of my long paper[3], because there I am able to find the derivative directly and precisely. I am able to derive the basic derivative equation straight from a table of differentials, and my generalized equation is exact and complete. It is not an estimate or an approximation, since we never go to zero or to an infinitesimal. Readers complain that I don't prove the equation for all numbers, only integers, but I don't need to prove it for all numbers. All numbers are defined by integers, so any extension of the basic equation is true by definition. Yes, I prove my basic and general equation from a table of integers, but the solution is not limited to integers, and this should be clear to anyone awake. Any such proof that is proved for integers is proved for all numbers, since the number line is defined by integers. Exponential notation is defined by integers. Likewise, logarithms are defined by integers and by exponential notation, so that anything proved for integers must be proved for exponents and logarithms. There is no such thing as an exponent or integer or log that is not defined by the number line, and since the number line is defined by the integers, my proof is generalized automatically. All we have to do is make a simple table of differentials, using the same method I used for integers (as I will do again below).

To be a bit more rigorous, my proof in the long paper is not just a proof for integers, it is a proof of cardinal numbers and the cardinal number line. Since all derivatives are defined by the cardinal number line, a proof for the cardinal number line is a proof for all derivatives, by definition. In this way, extending the proof is just busywork, which is why I have avoided it for so long. I showed briefly how to extend my proof to trig functions[4] a few years ago, but even that did not convince my detractors. It failed to convince them because they still haven't fathomed my method. Perhaps this proof that the current derivative for exponents is false will wake them from their slumbers.

[For those who think verbal explanations are just "hand waving", I have put a formal proof from integers to reals in a footnote[5]. Thanks to my reader Diego

[3] Chapter 9

[4] Chapter 17

[5] "Since it is always possible to introduce into the function $f(x)$ a new variable whose increment is equal to one, we shall generally do so. For instance if $y = f(x)$ and the increment of x is

Herrera for the reference.]

To say it again, I have ditched the entire differential notation of Newton and Leibniz and the moderns because that notation uses the wrong differentials.

In my solution, the variable h never goes to zero because it is simply the number 1. The analog of h in my solution is $\Delta\Delta x$, and $\Delta\Delta x$ is just 1. The derivative is not found at a diminishing or near-zero differential, it is found at a sub-differential which is constant and which may be defined as one. In other words, the derivative is not found at an instant, and in physical problems we can even find the time that passes and the length traveled during the derivative. Using my corrections to Newton, I have found the time[6] that passes *during* a centripetal acceleration, which is supposed to be instantaneous, proving in a specific problem that going to zero was not only unnecessary, it was physically and mathematically false.

For this reason, I have refused to create new equations to take the place of Newton's difference quotients or to replace the equations above. I have shown that they simply aren't necessary. The generalized derivative equation is

$$y' = nx^{n-1}$$

and since that equation is taken straight from a table of integers, it is much preferable to show the simple table than to show a generalized difference quotient. In fact, the kind of difference quotient taught today is impossible to correct, since in the true derivation there is and can be no ratio. The derivative equation we use today, proved correctly, is not proved by pushing a ratio toward zero, it is found by simple substitution. In other words, we take this equation directly from a table of differentials[7].

---

h, then we put $x = a + h\xi$; from this it follows that $\Delta\xi = 1$; that is, ξ will increase by one if x increases by h. Therefore, starting from $f(x)$ we find $f(x) = f(a+\xi h) = F(\xi)$ and operate on $F(\xi)$; putting finally into the results obtained $(x-a)/h$ instead of ξ." – Jordan, Charles. "Calculus of Finite Differences". Second Edition. New York: 1950. [Note: I personally don't find this sort of "functional" speech useful, but if you do, you can have it. – Miles]

[6] Chapter 21

[7] Chapter 9

$$2x = \Delta x^2$$

Then generalize it to $nx^{n-1} = \Delta x^n$

And then define Δx^n as the derivative. We can call it y' or $\mathrm{d}y/\mathrm{d}x$ or whatever is convenient, but there is no ratio involved, no approach to zero, and no difference quotient. This can be seen simply by looking at the table in my long paper or at a similar table below.

Newton's difference quotient and the current ratio of changes come from analyzing curves on a graph, but I have shown that this analysis has been faulty in many ways. It is both unnecessary and logically flawed. It is unnecessary because there is a much simpler way to derive the equation, as I have proved by doing it; and it is flawed because Newton's method implies that we can find solutions at a point, when we cannot. The points on the graph are not defined rigorously enough, so that the solution has remained unclear for centuries. This is not a quibble, since it is precisely what causes all the point problems of QED and General Relativity.

Let me show you why there is no ratio. You can see for yourself that there is no ratio in the final equation $y' = nx^{n-1}$. So where does the ratio in the difference quotient still used today come from? It comes from Newton's derivation, still taught today.

$$\begin{aligned} y &= x^2 \\ y + \delta y &= (x + \delta x)^2 \\ \delta y &= (x + \delta x)^2 - x^2 \\ &= 2x\delta x + \delta x^2 \end{aligned}$$

divide by δx :

$$\frac{\delta y}{\delta x} = 2x + \delta x$$

Let δx go to zero (only on the right side, of course) :

$$\frac{\delta y}{\delta x} = 2x$$

$$y' = 2x$$

Dividing by δx is just a trick that Newton uses to get the equation at the end. It doesn't come from any graph or table of differentials; it is just a manipulation. Dividing by δx creates the ratio of changes, and it creates the approach to zero, since δx is the h in the equations way above. The manipulation was chosen because it worked, but Newton was never able to justify it. Bishop Berkeley showed in Newton's own time that the manipulation was a fudge, and Wikipedia admits today that the manipulation is still not fully understood. Even today the equation has to be pushed with a further fudge, using the $Q(h)$ trick above. [To read more about this, go to my first paper on the derivative[8].]

And this brings us to one last thing to discuss before we find the derivative for exponents. The standard model of calculus now tells us that the calculus of finite differences (which my table is a variation of) has a margin of error relative to the regular calculus. After a long period of study, I have been able to prove this is absolutely false. In fact, it is the opposite of the truth. It is propaganda. Or, no, it is a lie, told right to your face. What the standard model tells you, to convince you of this lie, is that the calculus of finite differences cannot find solutions at an instant or point. The calculus of finite differences can only find a solution over a defined differential, which is a length. The standard model then calls this solution a margin of error. They tell us the regular calculus can find solutions at an instant, so it must be superior.

But the defined solution of the calculus of finite differences is not a margin of error, it is simply an outcome of any math or measurement. *No* mathematical solution can be at a point or instant, by definition, so the failure of the calculus of finite differences to find solutions at a point is not a failure of math. It is not

[8] Chapter 9

really a failure at all. It is a logical *achievement*. It is an achievement because it shows that the math has remained true to the postulates of all math and measure.

Conversely, the regular calculus, in claiming to find a solution at a point or instant, is not showing its superiority over the calculus of finite differences, it is parading a logical contradiction. It is highlighting a failure to match its own postulates and axioms. The regular calculus has claimed to be able to do something that is impossible, therefore it must be flawed.

We can see this just by looking at Wikipedia again. We are told that

> the tangent line to f at a gives the best linear approximation to f near a, (i.e. for small h).

Approximation, notice. Then we are told

> In practice, the existence of a continuous extension of the difference quotient $Q(h)$ to $h = 0$ is shown by modifying the numerator to cancel h in the denominator. This process can be long and tedious for complicated functions, and many shortcuts are commonly used to simplify the process.

Then we are shown more tricks for bettering the approximation by taking h to zero in other ways. All this must mean that it is the regular calculus that has a margin of error, and that error is NOT caused by defining all numbers as lengths or differences, as with the calculus of finite differences. It is caused by not being able to logically take the denominator of a ratio to zero. A "long and tedious process" is used to force the solution to that point or zero, but that process must be illogical and illegal, since there can be no solution at zero anyway.

This means that it is the regular calculus that has the margin of error, caused by an approximating method. The calculus of finite differences has NO ERROR, since the rate of change is precise. The number equality we take from the table of differentials is a precise number equality. The differentials equal eachother exactly, with no error and no approximation. The only "imprecision" of the calculus of finite differences is that the solution must be over a defined differential, not a point. But this is not a mathematical error, it is a mathematical triumph.

What was necessary was not a lot of separate difference quotients for all the various types of functions; no, what always has been necessary is a clear proof for integers and exponents, since a clear proof for integers and exponents would supply us with methods and equations for all other functions. As Kronecker said, "God gave us the integers, all else is the work of man." Once the fundamental derivative is proved, the definition of integer and exponent will automatically give us the proof for all other numbers and functions, since all other numbers and functions are defined relative to integers. The integers are based on the number 1, and all other numbers are based on the number 1. Even e is based on the number 1, since if the number 1 loses or changes its character, e must also lose or change its character: $e = 2.718$ only if $1 = 1$. Logarithms may have different bases, but the number line always has a base of 1. Therefore, if we prove a derivative for the constant differential of 1, we will have proved the derivative for all numbers on the cardinal number line.

To show what I mean once again, let us look more closely at the derivative for exponents. The generalized difference quotient for exponents currently is

$$\frac{\mathrm{d}a^x}{\mathrm{d}x} = \lim_{h \to 0} \frac{(a^{x+h} - a^x)}{h}$$

But, as before, that is both unnecessary and false. We don't go to a limit, because h is neither zero nor approaching zero. Instead, we make a simple table of differentials.

1	$a=1$	1	1	1	1	1	1	1
2	$a=2$	2	4	8	16	32	64	128
3	e	2.718	7.389	20.086	54.6	148.4	403.4	1097
4	$a=3$	3	9	27	81	243	729	2187
5	$a=4$	4	16	64	256	1024	4096	16384
6	$a=5$	5	25	125	625	3125	15625	78125
7	$a=6$	6	36	216	1296	7776	46656	279936
8	Δa_1	0	0	0	0	0	0	0
9	Δa_2	2	4	8	16	32	64	
10	Δe	4.67	12.7	34.5	93.8	255	693.6	
11	Δa_3	6	18	54	162	486	1458	
12	Δa_4	12	48	192	768	3072	12288	
13	Δa_5	20	100	500	2500	12500	62500	
14	Δa_6	30	180	1080	6480	38880	233280	
15	$\Delta\Delta a_2$	2	4	8	16	32		
16	$\Delta\Delta e$	8.03	21.8	59.3	161.2	438.6		
17	$\Delta\Delta a_3$	12	36	108	324	972		
18	$\Delta\Delta a_4$	36	144	576	2304	9216		
19	$\Delta\Delta a_5$	80	400	2000	10000	50000		
20	$\Delta\Delta a_6$	150	900	5400	32400	194400		
21	$\Delta\Delta\Delta e$	13.77	37.5	101.9	277.4			
22	$\Delta\Delta\Delta a_3$	24	72	216	648			
23	$\Delta\Delta\Delta a_4$	108	432	1728	6912			
24	$\Delta\Delta\Delta a_5$	320	1600	8000	40000			
25	$\Delta\Delta\Delta a_6$	750	4500	27000	162000			

What can we tell already? Well, we can tell that the current derivative for $y = a^x$ is probably wrong. The current derivative is

$$\frac{\mathrm{d}a^x}{\mathrm{d}x} = a^x \ln(a)$$

But a cursory glance at the table tells us that might be wrong. We can see from the table that if $a = 2$, we have a rather special situation. The rate of change of the first curve $y = 2^x$ (line 2 in the table above) is 2^n. The rate of that change (line 9) is 2^n, and the change of that change (line 15) is also 2^n. Therefore, the derivative of a^x when $a = 2$ appears to be a^x. This means that for the current derivative to be correct, the value $\ln(a)$ for $a = 2$ needs to be 1. But it isn't. The natural log of 2 is about .693.

What I will now do is derive the proper derivative, straight from the table. Since I showed in my power tables[9] and natural log tables[10] that the derviative is actually the *second* rate of change of our given curve, we have to study line 15 in relation to line 2.

2	$a = 2$	2	4	8	16	32	64	128
15	$\Delta\Delta a_2$	2	4	8	16	32	64	128

Then we find one line directly from the other, using the basic differential equations:

$$\begin{aligned}
\Delta a^x &= a^{x+1} - a^x \\
\Delta a^{x+1} &= a^{x+2} - a^{x+1} \\
\Delta\Delta a^x &= [a^{x+2} - a^{x+1}] - [a^{x+1} - a^x] \\
\Delta\Delta a^x &= a^{x+2} - 2a^{x+1} + a^x
\end{aligned}$$

But we aren't finished. Let us compare line 17 to line 4. The first term in line 4 is 3, and the first term in line 17 is 12. To compare the rates of change, we have to mesh the two series of numbers, which means we have to multiply line 17 by $\frac{1}{4}$. But that can't be our general transform, since it doesn't work on lines 5 and 18, or on lines 6 and 19. The general transform is $1/(a-1)^2$. Which makes our derivative

$$\frac{\mathrm{d}a^x}{\mathrm{d}x} = [1/(a-1)^2][a^{x+2} - 2a^{x+1} + a^x]$$

[9] Chapter 9

[10] Chapter 13

This means that our snap analysis of $a = 2$ was correct. The transform reduces to 1, and so $\ln(a)$ cannot apply. This new derivative equation also gives us a good number for e. If we let $x = 2$, the derivative equals 7.39, which is the present value of $e^2 = 7.39$. Let us look at some other numbers

The slope at e, $x = 1$ is 2.71828, which confirms the current number.
The slope at e, $x = 2$ is 7.393, which confirms the current number.
The slope at e, $x = 3$ is 20.086, which confirms the current number.

However, if we calculate the slopes for other values of a, we find a large mismatch with current values:

The slope at $a = 2$, $x = 2$ is 4, not 2.77.
The slope at $a = 3$, $x = 2$ is 9, not 9.9.
The slope at $a = 4$, $x = 4$ is 256, not 355.

It appears that the derivative equation reduces to a^x, which was our first guess from the table.

$$\frac{\mathrm{d}a^x}{\mathrm{d}x} = a^x$$

But the slope is either not the derivative here, or we need an extra manipulation to get the slope from the derivative. The slopes just calculated for values of "a" other than e cannot be right.

So let us seek the tangent and slope, damn the derivative and the rate of change of the curve. My critics have told me that the calculus has long since moved past graphs and tables of differentials, but in the case of the slope and the tangent, that cannot be true. The slope and tangent are defined relative to the graph. These curve equations represent accelerations, but unless x and y are orthogonal on a graph, we won't get a curve. In real life, you can accelerate in a straight line, remember. So these accelerations were put on a graph, with x and y at right angles, specifically in order to create a curve we could analyze.

The slope is defined as $\Delta y/\Delta x$. Currently, the analysis takes Δx to zero to find a solution, but have shown that is both impossible and unnecessary (and I will show it again right now, in a novel and damning way). The current method allows the calculus to find solutions at an instant and point, which is impossible. It is unnecessary, since we can find the slope without doing that. Once again, we can pull them straight from the table, without going to zero or any limit. But we will also consult a graph as we go, to see what this means there (figure 11.1 on page 147).

If we let $\Delta x = 1$, then we can find a slope by the first method I have written on the graph. $(4+2)/2 = 3$. The slope at $x = 2$ is 3. You can see that is just averaging the forward slope and the backward slope. But the historical calculus was never satisfied with that answer. Mathematicians thought, "Why not take Δx below 1, and get a more exact answer?" So they did what I have begun to do on the graph. They looked at a smaller sub-slope, where $\Delta x = .5$. Using that smaller interval, they found a slope of 2.828. Then, by going to zero, they found a limit for that slope at 2.77. Since 2.77 is $4\ln(2)$, they thought they had found the slope.

The problem there is that if $a = 2$ is your base, your denominator in your slope cannot be less than 2. To see why, you have to go back to line 1 in our table above. If the base is $a = 1$, then you get a constant differential of 1, as you see. But you want a smaller differential, so you think, "I will just use smaller values for x. I won't use 1, 2, 3. I will use .00001, .00002, .00003." Try it, and see what happens. No matter how small you make your x's, you still get 1, 1, 1, 1, 1. Since $a = 2$ is defined relative to $a = 1$, what you cannot do with $a = 1$, you cannot do with $a = 2$.

Or, reverse this logic. Say you demand that you be able to find smaller values for $a = 2$ in line 2. So you ignore me and just do it. Instead of 1, 2, 3, you start with .5, 1, 1.5. This gives you smaller differentials, and this allows you to take the equation $1.66 + 1.17 = 2.828$ straight from the table, confirming the first step toward zero as shown on the graph. OK, but now you will have to do the same for all the values of a on the table. You say, fine. But if you do that, you will have a very strange-looking table:

$a = 0.5$	0.707	0.500	0.354	0.250	0.177	0.125	0.088	0.063
$a = 1$	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
$a = 2$	1.410	2.000	2.830	4.000	5.660	8.000	11.300	16.000
$a = 3$	1.730	3.000	5.200	9.000	15.600	27.000	46.800	81.000

Do you see the problem? You have made your Δx smaller, but it has skewed your entire solution. The rate of change of the line $a = 2$ is not what it was before. **You have changed your original curve**! These two curves are not equivalent:

$a = 2$	2.00	4.00	8.00	16.00	32.00	64.00	128.00	256.00
$a = 2$	1.41	2.00	2.83	4.00	5.66	8.00	11.30	16.00

One curve is not double the other one, as you want it and need it to be. The first curve is the second curve *squared*. To say it another way: when you lowered your value for Δx, what you wanted was to put your curve under a magnifying glass. You wanted to look closer at it, moving in closer to that value of x. This is how the history of calculus is taught. This is precisely what the inventors and masters tell us they were doing. They were magnifying parts of the curve to study it. What they thought they were doing is this: when they halved their Δx, they thought they had magnified the curve by 2. In other words, in going from $\Delta x = 1$ to $\Delta x = .5$, they thought they were twice as close to zero, and therefore twice as close to the limit and the answer. But I have just proved that this assumption was wrong. They were not twice as close. They were not in any proper approach to a limit. In going from $\Delta x = 1$ to $\Delta x = .5$, they had not halved the curvature, they had actually gone to the square root of the curvature, so their magnification was not working like they thought it was.

Going to zero historically looked like a great idea, since it seemed to promise a more exact slope. But in going below $\Delta x = 1$, the calculus has actually falsified its solution. It has found what appears to be a more exact solution only by changing its original curve. You cannot legally go below $\Delta x = 1$, because that differential is what defined the curve to begin with. A smaller differential will give you a different curve and a different rate of change.

What this means for our solution is that the slope at $x = 2$ on our graph is not 4 or 2.77. It is simply 3. Our differential Δx cannot be taken below 1, due to our definitions and givens. If you go below 1, you are cheating and you are getting the wrong answer. If you desire precision in your answer, you do not take Δx to zero, your make your 1 smaller. Meaning, you set up your graph where $x = 1$ angstrom instead of 1 meter.

Our derivative method above therefore does not yield a slope. To find a slope, you use differentials from the table, but you solve in this way:

$$\text{slope @ } (x,y) = \frac{[y \text{ @ } (x+1) - y \text{ @ } (x-1)]}{2}$$

This new slope equation skews the solution for e^x. If we find a slope at $x = 2$, the slope is 8.68, not $e^2 = 7.39$. The slope of e^x is not e^x.

What does all this mean? It means that the calculus has been very sloppy in its math and definitions. The calculus needs to be more rigorous in defining what it wants to find from the curve. In physical situations, what the calculus wants from a curve is a velocity, but I will show below that these curves won't give them that. Velocity is defined in a rigorous manner, and you can't get a velocity from these curves. In pure math, the calculus claims to want to find a rate of change at a point, but since there is no such thing, we won't be able to find that either. We have just found a slope, but what does that apply to, if not to a rate of change at a point or to a velocity? Well, it applies to a rate of change at (x,y), which is the rate of change at two number values, which is a rate of change at two distances from the origin. In other words, it is a rate of change at the end of two defined intervals. As such, it is not the rate of change at a point in space. It may loosely be defined as a rate of change at a "position" in space, but that position is defined relative to other positions, and is always represented by differentials, as in distances from the origin.

But why did we find different values for the slope and the derivative here? Aren't they the same? Not really. Again, it is a lack of rigor that has doomed us throughout history. With $a = 2$, $x = 2$, we found a value of 4 for the derivative and of 3 for the slope. Which is correct? Both are correct, and either can be used in math or physics. The number 4 is the change in y between $x = 2$ and $x = 3$. The number 3 is the average change in y midway between $x = 1$ and $x = 3$, and since x is changing at a constant rate, that gives us the correct value at $x = 2$. Remember, the curvature here comes from y accelerating, not x. We put in consistent values for x, so x by itself is acting like a velocity or the pure math equivalent. No matter how big or small you make change in x, you always insert steadily increasing values, remember, as in 1, 2, 3. We never study curve equations by putting in accelerating values for x, as in 1, 4, 9, 16.

So, if we define the derivative as the rate of change *after* a given time, rather than the rate of change at a given time, the derivative will equal the slope. In that case we can just use my simplified slope equation. By saying "after a given time," I am not implying that we are calculating a total change from zero or the origin, I am just reminding you that we are finding a time at specific x, and that x is telling us a distance from the origin. You will say, "If we signify a time or position 'after some time,' haven't we signified an instant or a point? Isn't the endpoint of any interval a point?" No, the end"point" of any interval is a position in time or space, but not an instant in time or a point in space. The position "after 6 seconds" is not at an instant, since after 6 seconds your clock does not stop running. A second is defined as an interval between ticks, but not even ticks happen at an instant. Just as you can't measure a second with complete accuracy, you can't have an event at a instant or point. In physics and math, there are only intervals, measured with more or less accuracy.

Then you will say, "But when we actually draw a tangent to a curve on a graph, we can measure a slope more accurately than you have allowed here. Are you saying we have cheated in that also?" Yes, that is what I am saying. For instance, let us study the graph I just posted. The distance 1 is about $5/8$ of an inch there. That size differential therefore defines the graph and the curve on it. You say you can tell the difference between a slope of 2.773 and 3 on that graph. First of all, accurate slopes and tangents are very difficult to find by hand, especially to curves that are curving so slightly. I doubt you or anyone else can find that accurate a slope by hand. That is why these equations were developed in the first place: you can't do it by hand or eye. But even if you could, you would find a slope of 3 at $x = 2$, not a slope of 2.773. You are sure you would find a slope of 2.773, but you simply trust the calculus too much.

Now you say, "But you can't be right. You are averaging two lengths of curve that aren't even close to the same. The curve above that point is about twice as long as the curve below. Therefore your average has to be just a wild approximation. And yet you claim it is more accurate than the calculus which goes to zero to find precision. You must be mad!" No, you must be blind not to see that the averaging here will give us precisely the right answer without any approach to zero, since the interval above and the interval below are exactly the same size, by definition. In saying they aren't, you give me the length of the curve or of y, but that is not what defines the intervals above and below. What defines them is x, and x is the same size in both places. For instance, if x were t instead, then the horizontal axis would be time. In that case, the time during the interval above and the time during the interval below would be equal. Because the intervals are equal in this way, we can average without any qualms. And that average will give us the right answer, without any approximating or error. Since x has no acceleration, all the acceleration is with y, which means we have a constant acceleration, which means we can average like this without any problem. Going to zero is not only unnecessary, it gets the wrong answer.

*
* *

I have now joined the proofs for a^x and e^x. I have shown that e^x is a subset of a^x. I have shown that neither are linked to $\ln(x)$, and the proofs do not rely on $\ln(x)$ or $1/x$. The derivatives can be proved straight from the tables.

How does the current proof find that the derivative of a^x is $\ln(a)\,a^x$? Well, the derivative of a^x is proved from the derivative of e^x, and e^x is proved from the derivative of $\ln(x)$. But I have already proved that the derivative of ln(x)[11] is fudged and false, so all three proofs fall with that proof.

Of course this means that the current derivative proof of e^x is fudged as well. The proof starts with (given) $\mathrm{d}(\ln(x))/\mathrm{d}x = 1/x$. Since that is false, we know the proof is finessed. I will show you how it is finessed:

$$
\begin{aligned}
\frac{\mathrm{d}\big(\ln(e^x)\big)}{\mathrm{d}x} &= \frac{\mathrm{d}(x)}{\mathrm{d}x} = 1 \\
\frac{\mathrm{d}\big(\ln(e^x)\big)}{\mathrm{d}x} &= \frac{\mathrm{d}\big(\ln(u)\big)}{\mathrm{d}u}\,\frac{\mathrm{d}(e^x)}{\mathrm{d}x} \qquad (\text{Set } u = e^x) \\
&= \frac{1}{u}\,\frac{\mathrm{d}(e^x)}{\mathrm{d}x}
\end{aligned}
$$

[11] Chapter 13

$$
\begin{aligned}
&= \frac{1}{e^x}\frac{\mathrm{d}(e^x)}{\mathrm{d}x} \\
&= 1 \quad \text{(equation 1)} \\
\frac{\mathrm{d}(e^x)}{\mathrm{d}x} &= e^x
\end{aligned}
$$

That is even uglier than the $\ln(x)$ proof. Concentrate on this line:

$$\frac{\mathrm{d}\big(\ln(e^x)\big)}{\mathrm{d}x} = \frac{\mathrm{d}\big(\ln(u)\big)}{\mathrm{d}u}\frac{\mathrm{d}(e^x)}{\mathrm{d}x} \quad (\text{Set } u = e^x)$$

but work backwards. Set $u = e^x$ on its own line, like this:

$$\frac{\mathrm{d}\big(\ln(e^x)\big)}{\mathrm{d}x} = \frac{\mathrm{d}\big(\ln(e^x)\big)}{\mathrm{d}u}\frac{\mathrm{d}(e^x)}{\mathrm{d}x}$$

Do you see the problem now? That cannot be equal, unless $\mathrm{d}(e^x)/\mathrm{d}x = 1$. But the derivative of e^x is not equal to one. Another way to look at it is that you cannot differentiate $\ln(e^x)$ with respect to u, when there is no u in the term. Or, if you substitute in the reverse way, $e^x = u$, and create this equation

$$\frac{\mathrm{d}\big(\ln(e^x)\big)}{\mathrm{d}x} = \frac{\mathrm{d}\big(\ln(u)\big)}{\mathrm{d}u}\frac{\mathrm{d}(u)}{\mathrm{d}x}$$

you cannot differentiate u with respect to x, when there is no x in the term. This proof is trying to rush by that manipulation, making you think that u and x have somehow been defined relative to one another in a way that allows this, when they haven't. This is just a clever juggle. If $u = e^x$, then u and x have an *exponential* relationship themselves. Which means that you cannot go back and forth from $\mathrm{d}x$ to $\mathrm{d}u$ so nonchalantly. Since u and x are changing at such totally different rates, differentiating with respect to u and differentiating with respect to x are not capable of substitution, not even for a moment.

A final way of understanding this is that the chain rule doesn't apply to u and x when u and x are exponential to one another. I have proved that in this very paper, showing that exponential functions aren't differentiable in the common way. If they were differentiable, then the differentials would flatten. Not only do the differentials not flatten, or move toward a straight line, they don't change at all. This is the fundamental reason that the proof of the derivative of e^x fails. You will say that no one is aware of that, but they should have been if they weren't. It shouldn't have required this paper to show or prove that exponents and normal variables change in fundamentally different ways. My table is a beautiful visualization of it, but every schoolboy knows the difference between integers and exponents.

We can see this very same error by looking at the difference quotients.

$$f'(a) = \lim_{h \to 0} \frac{[f(a+h) - f(a)]}{h}$$

$$\frac{\mathrm{d}a^x}{\mathrm{d}x} = \lim_{h \to 0} \frac{(a^{x+h} - a^x)}{h}$$

Those two equations aren't analogous in form or theory. In the first equation, h is not in an exponent; but in the second equation, it is. That can't work. And it can't work for another fundamental reason. Look again: in the second formulation, h is exponential in the numerator, and not exponential in the denominator! So how can h be approaching zero at the same rate in both places? Exponents don't change at the same rate as normal variables. The rates aren't even close, and every high school kid knows that.

This is another blunder of titanic proportions. If this basic derivative is wrong, then we must assume that the bulk of the differential equations in the standard math tables are also wrong. And if the bulk of the differential equations are wrong, then the bulk of the integrals are also wrong. As you can now see, my correction to the calculus requires that we recheck every single derivative and integral known to man.

How in the name of all that is holy could the entire world neglect to check the derivative against a simple list of differentials like this? I can see why mathematicians would prefer to generalize their derivative equations without making a table every time, but you would think they would make the table the first time they calculated a basic type of derivative, like this fundamental exponential derivative, just to be sure they weren't doing their chain rules wrong or something. This is just more proof that the history of math is a cesspool of false equations.

Some will try to squirm out of this by telling me that the calculus can't be pulled from these tables I am making, but if this is the case, they will have to explain to everyone how and why my first table in my long paper so successfully and easily proved the equation $y' = nx^{n-1}$. I think it is clear that my method of finding differentials and rates of change is both fundamental and straightforward. This method shows that the most used equation of calculus, $y' = nx^{n-1}$ is correct. But it also shows that modern proofs are using a different method when finding that equation and when finding the equation $\mathrm{d}a^x/\mathrm{d}x = a^x \ln(a)$. I have just shown that the two methods for deriving the equations can't be the same, since the differentials from the tables confirm the first equation and refute the second.

All those mathematicians who have, since 1820, moved into sexier fields because there was nothing left to do in calculus are looking more and more foolish. I have shown that "pool ball mechanics" is a house of cards, and now I have shown that calculus is another house of cards. There appears to be plenty of work to do, and I can't do it all myself.

*

* *

I have found new and correct derivatives and slopes for a^x and e^x, but I still deny that my derivative or slope is an instantaneous velocity, or any velocity. It isn't an instantaneous velocity at the point x for two reasons:

1. x isn't a point; x signifies a certain interval on my derivative curve, an interval defined by the *ordered pair* (x, y). Since all derivatives in the

tables above are still curves, they must be curving over all intervals. The curve isn't made up of either points or straight lines, so trying to assign points is impossible.

2. Power curves can be straightened out by going to subintervals, but exponential curves can't, as I just proved from the table. For instance, the derivative of x^2 is $2x$, which is a straight line. The second derivative of x^3 is $6x$, which is a straight line. But the derivative of a^x never straightens out. Therefore, finding a velocity from a derivative with exponential functions is mathematically impossible, by the current methods. And if you do find a tangent by other more clever means, that tangent won't be the velocity at x.

In the end, it doesn't really matter one way or the other what the slope of the drawn tangent is, with exponential functions, since the slope isn't the instantaneous velocity. Exponential functions aren't differentiable, in that way, as I will show below when I show how to get an acceleration in meters and seconds from a curve equation. In other words, no real acceleration, no matter how variable, can be represented by an exponential function. Therefore we will never have to differentiate it in physics.

*
*   *

Something else is strange about the calculus. Notice that the derivative of a curve is a tangent, which is a straight line. But (we are told) the derivative of a velocity with respect to time is an acceleration. In one instance, we get a straight line from a curve; in the other, we get a curve from a straight line. We are told we can differentiate a line into a curve and differentiate a curve into a line. This paradox is caused by another imprecision in language. Acceleration is said to be the derivative of the velocity, but it isn't. The derivative is the rate of change of the curve, and a velocity isn't a curve. The derivative of any straight line is a constant, since the rate of change of any straight line is a constant. You can't really differentiate a velocity, since there isn't any variation. If you differentiate a velocity in the differential tables, you only get a line of numbers like 6, 6, 6, 6, 6. That can tell you a distance, but it can't tell you an acceleration. Therefore, when we "differentiate" dv, we aren't differentiating a velocity. This is because dv is calculus shorthand for Δv, and Δv isn't a velocity; Δv is already an acceleration, by definition. An acceleration is defined as a change in velocity. When we find an acceleration "by going to zero," what we are really finding is an "instantaneous" acceleration from an average acceleration. But, unless the acceleration is variable, the acceleration at any instant will BE the average acceleration. Instantaneous acceleration = average acceleration. This means that the equation

$$a = \frac{\mathrm{d}v}{\mathrm{d}t} = \lim_{t \to 0} \frac{\Delta v}{\Delta t}$$

is meaningless if the acceleration is constant. No differentiating is going on, and we aren't finding a derivative. The time is not going to zero. That equation gives us exactly the same number solution as the equation $a = \Delta v / \Delta t$, which means that we aren't going to zero or a limit. That equation is just putting the equation into calculus-speak, but no calculus is going on.

Wikipedia tells us that "the derivative of velocity with respect to time is the acceleration," but that is simply false. In fact, it is upside down. You can't differentiate a velocity into an acceleration, since a velocity has a constant rate of change. Conversely, if you differentiated an acceleration, you MIGHT get a velocity. Or, as I have shown with the curve caused by the exponential function, if you differentiate an acceleration you will get another acceleration. In no case can you differentiate a straight line into a curve, or a velocity into an acceleration.

You cannot differentiate in both directions at once. You cannot differentiate a straight line (velocity) to get a curve (acceleration), and differentiate a curve to get a straight line (the tangent). One would have thought this was clear regardless.

The same applies to the equation $v = \mathrm{d}x/\mathrm{d}t$. No limit is being approached there and no derivative is being found. You can't differentiate a distance, since there is no rate of change. That equation is just the absurd attempt to put non-calculus equations into the language of calculus. It is just a fancy and confusing way of writing $v = x/t$.

If we apply $v = \mathrm{d}x/\mathrm{d}t$ to a curve to find an "instantaneous" velocity, then we are not finding the derivative of a distance, we are finding the derivative of the curve, and the curve is an acceleration. You are GIVEN an acceleration, and you differentiate the acceleration to find the velocity. So when Wikipedia tells us that "the derivative of the displacement of a moving body with respect to time is the velocity of the body," the truth is on its head again. The velocity is the rate of change of the acceleration or of the curve, not of the displacement. We are differentiating the curve, not the displacement. You cannot find a derivative of the displacement.

Modern terminology is utterly reversed and topsy-turvy. Modern mathematicians appear to believe that you differentiate up from a velocity to an acceleration, when the reverse is true. The derivative is the rate of change of the curve, and the derivative flattens out the curve. When you differentiate, you go from a curve to a velocity, not from a velocity to a curve. Just look at the derivative of x^2. The derivative of x^2 is $2x$. x^2 is a curve; $2x$ is a straight line. The derivative straightens out the curve. And yet we are told that we differentiate a distance to find a velocity, and differentiate a velocity to find an acceleration. No wonder physics and math are completely compromised.

This means that if we differentiate a variable acceleration, we should expect to find a constant acceleration as the first derivative. With power functions, taking the derivative always straightens out the curve. Is this what we find? No. When physicists use the calculus on variable accelerations, they suddenly switch to integrals. They put v on the vertical axis and t on the horizontal axis, and use integration. This is perverse, but it is understandable. They misdefined differentiation with regard to velocity and constant acceleration, getting it upside down, so now when they come to second-degree acceleration, where they really do have to minimize their Δt in order to solve by their own method, they reverse the math. They actually integrate an acceleration to find a displacement. To do this, you have to utterly ignore the history of the calculus and the definition of "integrate." An integration is a sum, remember, and so you integrate up from distances to velocities, and up from velocities to accelerations. You cannot integrate down. [To read more about this, see my paper on variable acceleration[12], where I show the modern analysis is a complete hash.]

[12] Chapter 15

*
* *

I said I would show that the velocity for exponential functions cannot really be found, and I will do that now. From studying my table above, it is easy to see that no rate of change can be found, or at least no rate can be found that differs from the rate of the given equation. For $a = 2$, the millionth derivative would have the same rate of change as the first derivative and of the curve equation itself, so differentiation, defined as straightening out the curve, is impossible. This means that the derivative listed in mathematical tables for the exponential function is just a ghost. It was a ghost even before I showed it was false. My own derivative is mainly a ghost as well, though it is a correct ghost. It gives us the slope of the drawn tangent on the graph, yes, but that slope is not a velocity we can apply to a physical problem. Mathematicians have differentiated something that cannot be differentiated, and they don't seem to understand that. I will now show you why.

Calculus was invented as a study of power series. That is fairly well understood, since we still use power series a lot, as well as Maclaurin Series and Taylor Series, and so on. I have shown that you can also apply calculus to trig functions, simply because trig functions can be written as power functions. But many of the functions we have claimed to have differentiated are undifferentiable, and the exponential function is the prime example of this. The exponential function can't be differentiated because differentiation is a method used on powers, not exponents. I have shown you the fundamental reason we can't differentiate: the table shows that the differences don't change or flatten. The physical reason we can't differentiate is that the rate of change of the exponential equation itself is greater than any variable acceleration expressed by powers. The power x^2 is a constant acceleration and the power x^3 is a "variable" acceleration. All higher powers are higher accelerations. But a^x, even when $a = 2$, has a greater rate of change than any power acceleration. As a function, it is tidy only very near the origin; but at relatively low numbers for x, the function already has a gigantic slope. In fact, the slope of a^x will pass the slope of any power, given a relatively short time. For this reason, we might say that, compared to the power functions, the function $y = a^x$ is infinitely variable. That is why it cannot be differentiated. As a matter of physics, the slope of a^x is so near infinite, at all positive numbers except those closest to zero, that the function can be treated as a vertical line on the graph. You cannot differentiate a vertical line.

Because the function $y = a^x$ does not fail to converge in the normal ways, it is thought to be differentiable, but it is clear just from studying the tables of differentials that the function fails to converge. If it converged in the right way, the differentials would change. Since they don't, the function cannot converge and cannot be differentiated. The differentials of exponential functions don't ever flatten, they just shift.

From this, we can see that the definition of convergence for a function is incomplete. Convergence should define our ability to differentiate, which means it should define our ability to straighten out a curve by differentiation. But because the definition of convergence has been incomplete, we think we can differentiate $y = a^x$ when we cannot. We can pretend to differentiate, by finding a tangent at x, but we cannot have differentiated because the differentials themselves will not allow it.

This doesn't matter in physics because higher power accelerations there are always in the form m/s^n. We do not see accelerations in the form m/n^t. Time, as the independent variable in physics and life, cannot change exponentially. Time acts like a constant velocity in physics, and it is expressed to powers only to indicate multiple motions over a single interval. Therefore, we don't care whether a^x can be differentiated or not, which is probably why the problems I am uncovering have gone unnoticed.

Since velocity is defined as distance over time, and since time cannot be written as an exponential function, a real acceleration cannot be written as an exponential function. And that means that if you graph $y = a^x$ and then find a tangent at x, you cannot claim that tangent is a velocity of any kind, instantaneous or otherwise. Not only is it not the derivative of the drawn curve, it isn't a velocity. It can't be a velocity by definition of velocity and time. Modern mathematicians have simply forgotten most of the definitions of words, so they have wasted a lot of time differentiating things that can't be differentiated and velocitizing things things that can't be velocitized.

You will say that any straight line on a graph can be a velocity, by definition, but the problem is not in the tangent itself, it is in applying it to the curve. To call the straight line a velocity, you have to assign t to the horizontal axis. Which makes your equation $y = a^t$. That makes the relationship between distance and time exponential. But the relationship of distance and time cannot be exponential. The relationship between distance and time is always some power relationship. This is because time is operationally[13] just a second measure of one of the distance dimensions. There can't be an exponential relationship between y and t any more than there can be an exponential relationship between length and width. In space, the x-dimension and y-dimension, as dimensions, change at the same rate, so you will never find an exponential relationship between them. Since time is operationally hooked to the measure of length, the same applies to time.

*

* *

Conclusion: this means that the calculus is not fully understood. The fact that modern mathematicians think they can integrate down from an acceleration to a distance, and think they can define the derivative up, means that history has been turned on its head. Calculus is taught upside down, nothing less. In addition, we have seen that various modern derivatives are not even correct. They are derived from compromised proofs and they get the wrong numbers. The modern calculus thinks it can take Δx to zero, not realizing that this move to a limit is changing their curve. This must mean that all of physics and math is utterly compromised. Many have wondered if they can trust newer maths like gauge maths and tensor maths and so on, and the answer is, "NO." You can't even trust the calculus, since physicists and mathematicians don't know how to use it. If scientists can't do algebra and basic calculus, you can be sure they can't do "higher" maths. Not only are higher maths completely foundationless and often false, the standard math tables of simple functions are also false (in many cases). The textbooks and standard tables cannot be trusted, even in the simplest of cases. Basic physics textbooks cover velocity and acceleration in chapter one or two, and get it wrong. This is why physics has hit a wall. It has not hit a wall because there are dimensions we don't know about or because Nature is illogical or chaotic or because the future is ruining our equations and experiments via backward causality. Physics has hit a wall because the simple math and

[13] http://milesmathis.com/time.html

mechanics is wrong. The basic algegra, basic calculus, and basic mechanics is full of very big holes and very big errors.

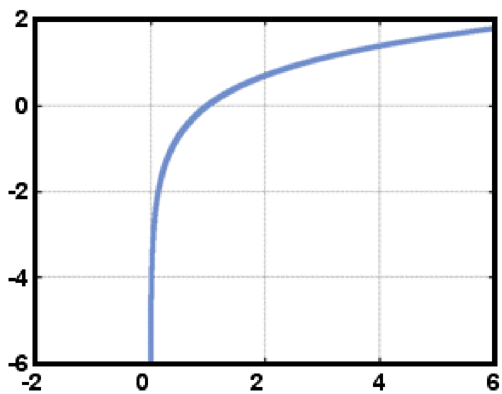
That said, I admit this paper is still not satisfactory. We know that averaging forward and backward slopes works for some curves like x^2, but it is not clear that it is working here. It gets very close to the current numbers, but we need a method that can be derived right from the tables, as I was trying to do with the differentials. I remain convinced that going to zero is both illegal and a fudge, and I am convinced the current proofs are finessed, but I cannot see a clear way around them. If you can see a way to get from the rate of change equation here to the slope equation, drop me an email. That is what I am working on right now.

To read more about upside-down calculus and the basic mistakes in textbooks, go to my paper on variable acceleration[14].

[14] Chapter 15

Chapter 13

THE DERIVATIVES OF THE NATURAL LOG AND OF 1/X ARE WRONG



Abstract: I will show that the current derivative of the natural log and the current derivative of $1/x$ are both wrong. In doing so, I will show the magnificent cheat in the current derivation of $d\ln(x)/dx$, embarrassing every living mathematician.

I have been prodded by recent events to add an introductory paragraph here, explaining why I would want to attack the calculus. These papers have only been up about a week, but I can already see the firestorm ahead.

I come to this problem from physics. In my theoretical research over the last decade, I have come to the conclusion that many of the problems in QED and GR are caused by fundamental and long-standing disclarities in the calculus. These problems include the cause of the need for renormalization, the cause of the failure of unification, and the cause of all the point problems in both QED and GR. All the modern maths are based on the calculus, and a problem with the calculus would infect every manipulation that depends upon it. For this reason, these latest papers are not proof that I am contrary and crazed, they are just one more indication that I have the courage to go where my nose leads me, the consequences be damned. My corrections to the calculus are incomplete and will remain incomplete for many months or years, no doubt. But since the calculus has been incomplete for centuries, perhaps millennia, I do not feel especially pressed to apologize. I will continue to put up what I have as I discover it, and if some of turns out to be wrong, well, so what. No one gets everything right.

*

* *

The derivative for the natural log is currently found by this method:

$$
\begin{aligned}
\frac{\mathrm{d}\ln(x)}{\mathrm{d}x} &= \lim_{d\to 0}\frac{\left[\ln(x+d)-\ln(x)\right]}{d}\\
&= \lim_{d\to 0}\frac{\ln\left[(x+d)/x\right]}{d}\\
&= \lim_{d\to 0}\frac{1}{d}\ln(1+\frac{d}{x})\\
&= \lim_{d\to 0}\left[\ln(1+\frac{d}{x})^{\frac{1}{d}}\right]
\end{aligned}
$$

Set $u = d/x$ and substitute :

$$\begin{aligned}
&= \lim_{u\to 0}\left[\ln(1+u)^{\frac{1}{ux}}\right] \\
&= \frac{1}{x}\ln\left[\lim_{u\to 0}(1+u)^{\frac{1}{u}}\right] \\
&= \frac{1}{x}\ln(e) \\
&= \frac{1}{x}
\end{aligned}$$

That derivation is false. It is false because it contains huge errors, errors I can point out very easily. I will lead with the biggest error.

Look closely at this manipulation:

$$\lim_{u\to 0}[\ln(1+u)^{\frac{1}{ux}}] = \frac{1}{x}\ln[\lim_{u\to 0}(1+u)^{\frac{1}{u}}]$$

As they pull the $1/x$ down from the exponent and put it in front of the ln (which is legal) they also shift the $\lim_{u\to 0}$ forward, so that it is now in front of the ln (which is not legal). It is gloriously illegal. You cannot separate the ln from its number. This is important, because as confirmation of the last step, we are sent to the "definition" of e:

$$e = \lim_{n\to 0}(1+n)^{\frac{1}{n}}$$

Notice that does not read

$$e = \lim_{n\to 0}\ln(1+n)^{\frac{1}{n}}$$

Nor are the two equations equivalent. Because they are not equivalent, we can see that shifting the $\lim_{u\to 0}$ is not just a matter of preference. With the term

$\lim_{u\to 0}[\ln(1+u)^{1/ux}]$, we are monitoring the natural log as we approach the limit. With the term $\lim_{u\to 0}(1+u)^{1/u}$ we are monitoring only the sum and exponent as we approach the limit. Not at all the same. In fact, this is what the brackets mean in the term

$$\lim_{u\to 0}\left[\ln(1+u)^{\frac{1}{ux}}\right]$$

The mathematicians write down the brackets and then ignore them, transferring the limit inside them to suit themselves.

So the final substitution of e for $\lim_{u\to 0}(1+u)^{1/u}$ is illegal. The $\lim_{u\to 0}$ has no reason or right to be there. The correct derivation should go like this:

$$\lim_{u\to 0}\left[\ln(1+u)^{\frac{1}{ux}}\right] = \lim_{u\to 0}\left[\frac{1}{x}\ln(1+u)^{\frac{1}{u}}\right]$$

If they can shift the lim inside the brackets, why not shift it anywhere? Why not

$$\left[\ln(1+\lim_{u\to 0} u)^{\frac{1}{ux}}\right]$$

They don't do that, obviously, because they don't want to destroy their e substitution. By the same token, you can't shift $1/x$ outside the limit. $1/x$ is a curve, which will change the way the limit is approached once again. Remember, this is a curve equation, which means that it is not only u that is changing: x is also changing. Go back a step and you will see that more clearly. Before we brought $1/x$ down, it was with u in the exponent like this: $1/ux$. That means that the rate of change of u and the rate of change of x are affecting one another. They are tied together. Which means that the change of u cannot be considered separately. In other words, the exponent $1/ux$ isn't approaching infinity like $1/u$ is in the definition of e.

Again, that is why the limit sign must stay outside the brackets.

That is not really an error. It is a fudge. A big cheat. In other words, it was not done by accident. This proof has very heavy prints of finessing on it, and it is amazing that no one catches these mathematicians in their pawing and gnawing.

The gods of math grimace and gnash their teeth.

But there are other problems: even the first equation

$$\frac{\mathrm{d}\ln(x)}{\mathrm{d}x} = \lim_{d\to 0} \frac{\left[\ln(x+d) - \ln(x)\right]}{d}$$

is false. As I will prove again below, the variable d must be equal to 1; so we have no ratio. The rate of change of the independent variable must be defined as one, to get the differentiation tables to work. It must also be defined as one so that we can apply these differentials to the number line, where the rate of change of the integers is one, by definition. You can't push the differential of your independent variable to zero without pushing the dependent variable to zero as well, and this just makes the graph smaller: it doesn't change the relationships of the numbers. If it doesn't change the relationships, it can't give you a solution.

You will say that d isn't the independent variable, but it is. It was originally $\mathrm{d}x$ or Δx that was going to zero, and the moderns have just relabeled it as d or h or whatever in order to hide this fact.

How do we begin to correct such deep-seated problems? If the calculus were healthy, we would not see such brazen and long-lived cheats in full view, so we must assume it is a total mess. In my long paper on the derivative[1], I started over from the beginning, but here I will gloss and simplify, limiting myself to the solutions of these two specific derivatives: $\ln(x)$ and $1/x$.

The derivative is currently defined in several ways. At Wikipedia, in the second sentence on the page, the derivative is defined as

> Loosely speaking, a derivative can be thought of as how much a quantity is changing at a given point.

[1] Chapter 9

I think we have had enough of loose speech, and a quantity cannot change at a point, by definition. What this author means is, "how much a drawn curve is changing at a point on a graph." But since a point on a graph is an ordered pair like (x,y), a "point" on a graph is not really a point. It is not a point in space and it is not a dimensionless entity. An ordered pair has two dimensions, by definition of the word "pair."

Somewhat less loosely, the derivative is defined as the rate of change of the given curve, and it is defined as the slope of the tangent at x. To begin our analysis, let us look at the table of the actual differentials of $\ln(x)$:

$\ln(x)$	0	.6931	1.099	1.386	1.609	1.792	1.946	2.079
$\Delta\ln(x)$	.6931	.4055	.2877	.2231	.1823	.1542	.1335	.1178
$\Delta\Delta\ln(x)$	.2876	.1178	.0646	.0408	.0281	.0207	.0157	
$\Delta\Delta\Delta\ln(x)$	.1698	.0532	.0238	.0127	.0074	.0050		
$\Delta\Delta\Delta\Delta\ln(x)$	.1166	.0294	.0111	.0053	.0024			
$\Delta\Delta\Delta\Delta\Delta\ln(x)$	.0872	.0183	.0058	.0029				

The derivative, if defined as the general rate of change of the function, is the second line. The problem, as you can clearly see, is that we aren't straightening out our curve, as we were with the power functions. We can find a derivative of $\ln(x)$, of a sort, since we can certainly find a rate of change of the curve. But that rate of change is increasing as we look further and further down the chart. Therefore, no derivative of $\ln(x)$ will ever give us a straight line or a velocity. Every derivative of $\ln(x)$ is a greater curve than $\ln(x)$ itself.

There is another problem. The current derivative of $\ln(x)$ is said to be $1/x$. But you can see immediately that isn't true. The rate of change of line two is not $1/x$. Nor is there any constant we can use to make the rate of change $1/x$, since there is no value for z that will make the rate of change of line two z/x.

But let us be more rigorous. The calculus was invented for the power functions, and with power functions, the derivative is not really the general rate of change of the curve. The derivative, as currently used, is the rate of change at x. To say it again, it is the rate of change at a specific interval, not the rate of change of the whole curve.

To be even more rigorous, the derivative equation is an equality between two rates of change: the rate on the left side of the equality and the second rate on the right side. For example, if we go to the differential tables for powers to analyze the function $y' = x^3$, we find that it is really an equality like this

$$3\Delta x^2 = \Delta\Delta x^3$$

I have shown that can be read as "the rate of change of the curve x^2 times 3 is equal to the second rate of change of the curve x^3". The derivative is not simply the rate of change of the curve on the right side. The derivative is a relationship of two curves. The derivative is telling us a number equality between two different curves. That being so, as we study this problem, we have to compare the tables for $\ln(x)$ to the tables for $1/x$, to see if the rates of change ever equal eachother.

x	1	2	3	4	5	6	7
$1/x$	1.0000	0.5000	0.3333	0.2500	0.2000	0.1667	0.1429
$\Delta 1/x$	0.5000	0.1667	0.0833	0.0500	0.0333	0.0238	0.0179
$\Delta\Delta 1/x$	0.3333	0.0833	0.0333	0.0167	0.0095	0.0059	
$\Delta\Delta\Delta 1/x$	0.2500	0.0500	0.0167	0.0071	0.0036		
$\Delta\Delta\Delta\Delta 1/x$	0.2000	0.0333	0.0095	0.0035			

To find the right lines to analyze, we can follow the method we used in the tables for powers and analyze the current derivative of $\ln(x)$ from its table. We are told:

$$\frac{\mathrm{d}\ln(x)}{\mathrm{d}x} = 1/x$$

Which means the rate of change of the curve $1/x$ is equal to the second rate of change of the curve $\ln(x)$.

$$\Delta 1/x = \Delta\Delta\ln(x)$$

Is that true? Let us take a look:

$\Delta 1/x$	0.5000	0.1667	0.0833	0.0500	0.0333	0.0238
$\Delta\Delta \ln(x)$	0.2876	0.1178	0.0646	0.0408	0.0281	0.0207

Well, the two curves are very close, which explains the relative success of the current derivative; but the rates are not a match. But we can check in a few other places, to be sure. The equality may not be at the first rate of change. In the power tables, the equalities are sometimes further down the chart, as with higher powers.

$\Delta\Delta 1/x$	0.3333	0.0833	0.0333	0.0167	0.0095	0.0059
$\Delta\Delta\Delta \ln(x)$	0.1698	0.0532	0.0238	0.0127	0.0074	0.0050

Again, close, but we appear to be diverging. Let's try another:

$\Delta\Delta\Delta 1/x$	0.2500	0.0500	0.0167	0.0071	0.0036
$\Delta\Delta\Delta\Delta \ln(x)$	0.1166	0.0294	0.0111	0.0053	0.0024

Definitely diverging. The best match was with $\Delta 1/x$.

I have shown that the derivative $1/x$ is a good approximation, but it is not a match. This tends to confirm my critique of the proof, since if the e substitution were allowed, this derivative should be perfect or close to perfect. The definition of e using the limit is not an approximation, since it allows you to be as exact as you want to be. It would not cause the kind of error we see here in the differentials.

The current derivative was found by looking at the curve on the graph and actually drawing some tangents. After long years of this, it was decided that the slopes seemed to follow $1/x$. Then the math was simply pushed to create a proof of that educated guess. But instead of guessing and then pushing equations, let us calculate the equation right from the numbers in the table. We want an equation that gives us those numbers above. It looks kind of difficult at first, but we just remember the definition of a differential. We remember how the table was made, and what it means. We remember that we can always write $\Delta\Delta \ln(x)$ as $\Delta \ln(x)$-$\Delta \ln(x+1)$, since that is the definition of a rate of change, and it comes right out of the table, as you see. The numbers in that line are found by that method.

By the same method, we can write $\Delta\ln(x)$ as $\ln(x+1)-\ln(x)$. Again, that comes right out of the table, and the order is reversed since $\ln(x)$ is getting larger while $\Delta\ln(x)$ is getting smaller. And we can rewrite $\Delta\ln(x+1)$ as $\ln(x+2)-\ln(x+1)$. Combining all that gives us

$$\begin{aligned}
\Delta\Delta\ln(x) &= \big[\ln(x+1)-\ln(x)\big]-\big[\ln(x+2)-\ln(x+1)\big] \\
&= \ln\frac{(x+1)}{x}-\ln\frac{(x+2)}{(x+1)} \\
&= \ln\left[\frac{(x+1)/x}{(x+2)/(x+1)}\right] \\
&= \ln\left[\frac{(x+1)^2}{(x^2+2x)}\right]
\end{aligned}$$

With these lines of differentials, each line is a factor of 2 separated from the previous line. What I mean is, the first real differential in line 1 is the natural log of 2. So we are starting with 2. If we want a rate of change, we have to shift the entire table by a factor of 2. Since we are finding line 3 from line 1, we must multiply by 22=4.

$$\text{rate of change} = 4\ln\left[\frac{(x+1)^2}{(x^2+2x)}\right]$$

But is that the slope? No. As with the exponential functions, to find a slope we just find an average of the forward slope and the backward slope, like this:

$$\text{slope @ }(x,y)=\frac{\big[y\text{ @ }(x+1)-y\text{ @ }(x-1)\big]}{2}$$

The slope at x=2 is .5495, not .5.
The slope at x=3 is .3464, not .3333.

The slope at x=4 is .255, not .25.
The slope at x=5 is .203, not .2.
The slope at x=6 is .1685, not .1667.
The slope at x=7 is .1435, not .1429.

You can see that these new slopes are very close to the current ones. To see a full argument for why averaging forward slope and backward slope is actually better than going to zero, you will have to read the full analysis in my paper on the exponential functions[2].

Once I made these tables, I could see that $\ln(x)$ wasn't acting like a power curve. It wasn't straightening out as we differentiated. The first solution I considered was integrating. Because our curve is increasing instead of decreasing, we can try integrating instead of differentiating. To find a velocity, you need to straighten out the curve, and differentiating is further curving this curve, you see. So reversing the process might have helped us. We can seek an integral or anti-derivative of $\ln(x)$ just by reversing our chart, like this:

$\Delta \ln(x)$	0.6931	0.4055	0.2877	0.2231	0.1823	0.1542	0.1335
$\ln(x)$	0.0000	0.6931	1.0990	1.3860	1.6090	1.7920	1.9460
$\int \ln(x)$	0.6931	1.7920	3.1780	4.7870	6.5790	8.5250	10.6000
$\iint \ln(x)$	0.6931	2.4800	5.6630	10.4500	17.0300	25.5500	36.1600

All I have done is turn the table upside down, then try to find more lines of differentials. But since we are going the opposite direction of what has historically been called differentiation, I call these lines integrals. They are found by adding instead of subtracting, and that is what integration originally meant.

But, as you now see, we find the same problem in this direction in the table. Our curve is again increasing. It switched directions, and then immediately began increasing again. So we can't find a straight line, or what has been called the velocity, by either the old-fashioned differentiation or integration. Calculus was invented in relation to the power functions, and $\ln(x)$ is not a power function. The power functions could be related to one another, because the rate of change of a higher power was equal to the rate of change of a lower power. As we found the

[2] Chapter 12

derivative, we took higher powers to lower powers, thereby straightening them out. Here, we can't do that. Both up and down the table, we get more curvature.

It is also very important to notice that with this function, differentiating never lowers the rate of change. With power series, finding a derivative always meant decreasing the curve of the function, which means the rate of change of the curve was decreasing. But with $\ln(x)$, neither differentiating nor integrating decrease the curvature. Both increase it. In problem solving, this must be important.

The current calculus has solved this dilemma by

1. Ignoring it. They pretend these simple tables don't exist;
2. Fudging the equations to match the slope they know exists, from studying the lines on real graphs. If the slope looks like the slope of $1/x$, they assume that it is, and they push their math to find $1/x$, using chain rules and finessed limits and fake substitutions and whatever else they need to hammer the solution down.

The current method has found a fair approximation with $1/x$, but my method finds the right answer with no approximation. I never go to zero and don't use infinitesimals. My rates of change are absolutely correct relative to one another, and there is no margin of error. My method is vastly superior to the current method in both operation and answer. My operation is simple and transparent, with no fudgy manipulations. My notation is much simpler than the current method. And my answer is correct, whereas the current answer is simply incorrect. The current answer is nothing but a poor estimate of my answer, and I have explained why in my long paper on the derivative and its history.

*

* *

Now let us look at the derivative of $1/x$. The current calculus treats this function as equivalent to x^{-1}, and uses the power equation nx^{n-1}:

$$\frac{\mathrm{d}x^{-1}}{\mathrm{d}x} = -1x^{-2} = -\frac{1}{x^2}$$

But we can't apply the power equation to $1/x$ to find a derivative. If we did, then the anti-derivative, which is supposed to be $\ln(x)$, would be $x^0/0$. But the biggest problem is that the differentials themselves tell us the rate of change of $1/x$ is not $1/x^2$. The only reason mathematicians chose that derivative is because it looked right on the graph. But if they had made this table, they would have seen it doesn't look right, even at a first glance.

$1/x$	1.0000	0.5000	0.3333	0.2500	0.2000	0.1667	0.1429
$\Delta 1/x$	0.5000	0.1667	0.0833	0.0500	0.0333	0.0238	0.0179
$\Delta\Delta 1/x$	0.3333	0.0833	0.0333	0.0166	0.0095	0.0059	
$\Delta\Delta\Delta 1/x$	0.2500	0.0500	0.0167	0.0071	0.0036		
$\Delta\Delta\Delta\Delta 1/x$	0.2000	0.0333	0.0095	0.0035			

Defined as it is, the derivative is the third line, and the third line is not changing as $1/x^2$. It is not changing like 1, 4, 9, 16, 25; it is changing 1, 4, 10, 20, 35. We can write the line as 1/3, 1/12, 1/30, 1/60, 1/105. Dividing each denominator by 3 gives us the series 1, 4, 10, 20, 35. So we just need to write an equation for that series. That is the famous pyramid series, and the equation is known to be $x(x+1)(x+2)/6$.

But can we derive that equation without knowing the pyramid equation? Yes, we can take it straight from the table again, using the differentials themselves.

$$\begin{aligned}
\Delta\Delta\frac{1}{x} &= \Delta\frac{1}{x+1} - \Delta\frac{1}{x} \\
\Delta\frac{1}{x+1} &= \frac{1}{x} - \frac{1}{x+1} \\
\Delta\frac{1}{x} &= \frac{1}{x+1} - \frac{1}{x+2}
\end{aligned}$$

$$\begin{aligned}
\Delta\Delta\frac{1}{x} &= \frac{1}{x}\text{-}\frac{1}{x+1}\text{-}\frac{1}{x+1}+\frac{1}{x+2} \\
&= \frac{1}{x}+\frac{1}{x+2}\text{-}\frac{2}{x+1} \\
&= \frac{x^2+3x+2-2x^2-4x+x+x^2}{x(x+1)(x+2)} \\
&= \frac{2}{x(x+1)(x+2)}
\end{aligned}$$

Because the first term in the line $\Delta\Delta 1/x$ is .3333, we have to multiply by 3 to get our first term up to 1. So,

$$\frac{\mathrm{d}\frac{1}{x}}{\mathrm{d}x} = \frac{6}{x^3+3x^2+2x}$$

But is that the slope? No, it is the rate of change. The slope is found by the equation

$$\text{slope @ } (x,y) = \frac{y \text{ @ } (x+1) - y \text{ @ } (x-1)}{2}$$

For x=3, the slope is -.125, not -.1111.
For x=4, the slope is -.0666, not -.0625.
For x=5, the slope is -.0416, not -.04.
For x=6, the slope is -.0285, not -.0278.
For x=7, the slope is -.0208, not -.0204.
For x=8, the slope is -.0159, not -.01563.
For x=10, the slope is -.0101, not -.01.

Those values are astonishingly close, and I think even my biggest critics must be sweating a little.

I have found a new rate of change and a new slope, both of which give us values that are very close to the current derivative. The new slope gives us values that are closer, but that doesn't mean it is the one to choose as the replacement for the derivative. I have some work left to do in showing why this averaged slope equation either can or cannot apply to $1/x$. We know it can be used on x^2 without any problem, but that does not mean it applies here.

*

* *

As with the exponential functions, these two functions behave in strange ways. I remind you, for example, that $\ln(x)$ increases its curvature with both differentiation and integration. I said that this must affect solutions in physics, and what I meant is that in physics we find a velocity from a curve by straightening out the curve. By the modern interpretation, the velocity is always equal to the tangent, which is always equal to the derivative, but that isn't true even with power functions. It is true only with the power 2. I showed in a recent paper on http://milesmathis.com/expon.html[3] that the velocity is found from the second derivative, not the first. This is because to find the velocity, we straighten out the curve. For higher powers, it takes more derivatives to do that. But with $\ln(x)$, you can't straighten out the curve, no matter how many derivatives you take. You can find a tangent and a derivative, as I just showed, but you can't assign either one to a velocity. To find a velocity for $\ln(x)$, you have to go off the table and outside the normal equations of differentiation and integration. I will show how to do that in an upcoming paper, but for now I simply point out that if the curves increase in both directions on the table, they must have a turn-around point. This means that there must be a straight line hidden between two lines on the table, and with $\ln(x)$, that straight line must be found near $\ln(x)$. The same can be said for $1/x$. The derivative cannot be the velocity, because the all the derivatives are still a curves. The velocity must have a constant rate of change, by definition, and our derivative equation does not. Of course, the slope may give us the velocity directly, but it may not. I will have to study the problem more before I come to a final decision.

[3] Chapter 15

*
* *

Conclusion: By ignoring the differential tables themselves, the calculus has vastly overcomplicated the methods and proofs. In doing so, they have actually gotten the wrong answer for many derivatives, as with these two. Moreover, they have been forced to fudge many proofs. The fudge above with $\ln(x)$ is not what one would call subtle, and the modern calculus is full of fudges like that. For another, see my explosion of the proof of the derivation of the exponential[4].

Of course, Newton and Leibniz started all this by cheating in their own proofs. Like the modern derivative proofs, the original proofs were written from the end backwards. Both men knew the answer they wanted, and they forced their proofs to show it. I have already shown this with Newton's proof[5], and the same can be said for that of Leibniz.

I still haven't figured out the exact history of this mistake. Was it done because no one has been in possession of these simple tables I am making; or were the tables suppressed because they did not allow for solutions at an instant and point, and everyone desired solutions at an instant and point? I suspect the latter. The tables are so simple they could not have been overlooked or misread. My first paper on the derivative[6] was probably refused for publication for the same reason this problem has been buried from the beginning. Mathematicians don't want to clarify any of the proofs or manipulations or definitions of the calculus, because that would require that they give up their instantaneous solutions. It would also require that they admit being wrong for 300 hundred years, and admit that they have been pushing proofs for the same amount of time.

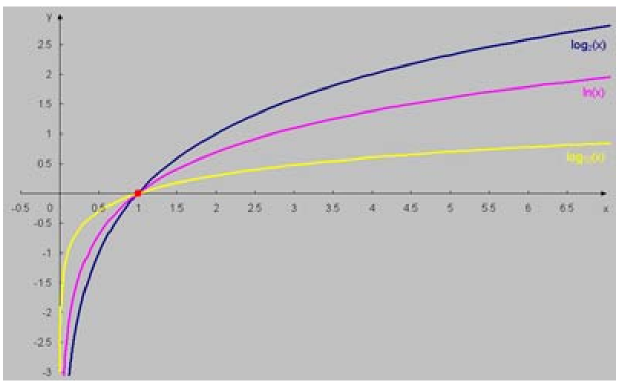
Unfortunately, no one else seems to have made the connection between this historical choice to look away, and the historical problems with the point in QED and General Relativity. I have shown that renormalization is the price physics is paying for the math department's refusal to face facts. Equations are exploding

[4] Chapter 12
[5] Ibid.
[6] Chapter 9

and imploding in many fields, and mathematicians pretend not to know why. Edward Witten, supposedly a master of mathematics, asks in the Millennium Prize why the math of QED is such a mess. He should know that the calculus itself is the main cause of the mess.

Chapter 14

THE DERIVATIVE OF LOG(x) IS ALSO WRONG



Abstract: Following the simple method of previous papers, I will show that the current derivative of $\log(x)$ is wrong. I will correct it.

Like the other papers I have put up in the last week, this one has also had to be extended and corrected. My problems with a^x forced me to continue studying these solutions, until they all matched one another and matched the correction to the calculus that I knew was needed. It took a bit of work over the holidays, but I believe it has paid off.

Not only have I not backed off, I have found a way to advance even further. In my next paper[1], I will show that even the derivative equation for powers is proved in a faulty way. Yes, although I have confirmed the equation $y' = nx^{n-1}$ in my long paper, it turns out even that proof will fall. It gets the correct slope and velocity and so on, but it is not absolutely correct as a matter of math or physics.

This is a table of the actual differentials of log(x):

$\log(x)$	0.000	0.301	0.477	0.602	0.699	0.778	0.845	0.903
$\Delta\log(x)$	0.301	0.176	0.125	0.097	0.079	0.067	0.051	
$\Delta\Delta\log(x)$	0.125	0.051	0.028	0.018	0.012	0.016		
$\Delta\Delta\Delta\log(x)$	0.074	0.023	0.010	0.006	0.004			
$\Delta\Delta\Delta\Delta\log(x)$	0.051	0.013	0.004	0.002				

The following are the real differential equations for $\log(x)$, finding line 3 from line 1. According the current definition of the derivative, line 3 is the derivative of line 1. Line 2 is the general rate of change of the curve $\log(x)$, and line 3 is the rate of change at a given interval x.

$$
\begin{aligned}
\Delta\Delta\log(x) &= \Delta\log(x) - \Delta\log(x+1) \\
\Delta\log(x) &= \log(x+1)\text{-}\log(x) \\
\Delta\log(x+1) &= \log(x+2) - \log(x+1) \\
\Delta\Delta\log(x) &= \log(x+1) - \log(x) - \log(x+2) + \log(x+1) \\
\frac{\log(x)}{\mathrm{d}x} &= 2\log(x+1) - \log(x) - \log(x+2)
\end{aligned}
$$

In the differential table, each line is a factor of 2 separated from the previous line. What I mean is, the first real differential in line 1 is the log of 2. So we are starting with 2. If we want a slope, we have to shift the entire table by a factor of 2. Since we are finding line 3 from line 1, we must shift or multiply by $2^2 = 4$.

[1] Chapter 11

rate of change = 4 $\left[2\log(x+1)\text{-}\log(x)-\log(x+2)\right]$

But, as before, that isn't the slope. The slope is found most easily and perfectly by this equation, as I discovered today while chewing for the third day in a row on the derivative of a^x.

$$\text{slope @ } (x,y) = \frac{\left[y \text{ @ } (x+1) - y \text{ @ } (x-1)\right]}{2}$$

slope x=3 is .1505, not .145
slope x=4 is .111, not .109
slope x=5 is .088, not .087
slope x=6 is .073, not .0725
slope x=7 is .0625, not .0621
slope x=8 is .0545, not .0543
slope x=10 is .0437, not .0435

Once again, my critics have to be sweating. Those numbers are astonishing, and there is no way around it. To see a full explanation of why averaging forward slope and backward slope is actually better than going to zero, you will have to read the extended analysis and question answering in my earlier paper on the derivative for exponents[2].

Now let us look at the current proof for $\log(x)/dx$. This log is proved straight from the natural log using the change of base rule.

Assume $(\ln x)' = 1/x$

$$(\log x)' = \frac{\mathrm{d}(\ln x)}{\mathrm{d}x(\ln b)} = \frac{1}{x(\ln b)} = \frac{1}{2.3x}$$

The problem there is that the assumption is false. I have proven[3] that $1/x$ is not the derivative of $\ln(x)$. Therefore this proof falls with several others.

[2] Chapter 12
[3] Chapter 13

Conclusion: As with my other recent papers, this solution remains incomplete. I am satisfied neither by the current proofs nor by my own. This averaging of forward and backward slopes works very well here, but I have not proved it is correct while the current numbers are not. I need to connect my two solutions here, the rate of change taken from the table and the slope taken from the graph. All derivatives and slopes should be provable without going to zero.

Chapter 15

A STUDY OF VARIABLE ACCELERATION

Abstract: I will analyze a textbook solution of variable acceleration, showing that it is incorrect in both method and answer. It is incorrect because it is solved improperly with integration when it would be easier and more transparent to solve with the second and third derivatives. Once again, I will show that the calculus is taught upside down.

Apparently many readers have been mystified by this paper. They do not comprehend my method, and assume I wrote it standing on my head. But I stand by *it. In my opinion, it is far easier and far more transparent to solve for distance using the third derivative here than by integrating. I honestly believe that if you penetrate this paper, some important scales will fall from your eyes.*

In previous papers[1] I have shown many problems with the modern calculus. In this paper I will show problems in applying the calculus to variable acceleration. To do this, I will follow a physics textbook solution line for line.

To start, we must ask what we mean by a variable acceleration. It could mean two things. One, it could mean that we were speeding up and slowing down, so that our change in velocity was not constant. That is not what I mean here. What I mean is an acceleration represented by a power of 3 or more, as in the curve equation $x = t^3$. That means that you take a constant acceleration and then accelerate it. For example, you take your car out on the highway and press down on the gas at a constant rate. If your foot and engine work like they should, you will have created a constant acceleration. Now, take that whole stretch of highway, suck it up into a huge alien spacecraft, and accelerate the spacecraft out of orbit, in the same direction the car is going. The motion of the car relative to the earth or to space is now the compound of two separate accelerations, both of which are represented by t^2. So the total acceleration would be constant, not variable, but it would be represented by t^4. This is what I am calling a "variable acceleration" here. It is not really variable, it is just a higher order of change.

The acceleration would be represented by t^3 if the alien spacecraft had a constant velocity instead of a constant acceleration. An acceleration is two velocities over one interval, so t^3 is three velocities over one interval. Or, it is three changes in x over one defined interval, say one second. We can write that as either three x's or three t's, but it is common usage to use three t's in the denominator instead of three x's in the numerator.

The cubed acceleration can also be created in a car, by increasing your pressure on the gas pedal at a constant rate of increase. This will cause a cubed acceleration in the first few seconds.

In engineering, a higher order acceleration like this is called a "jerk" (though it is usually applied to a negative acceleration, as in a jerk to a stop). I call the positive

[1] Chapter 9

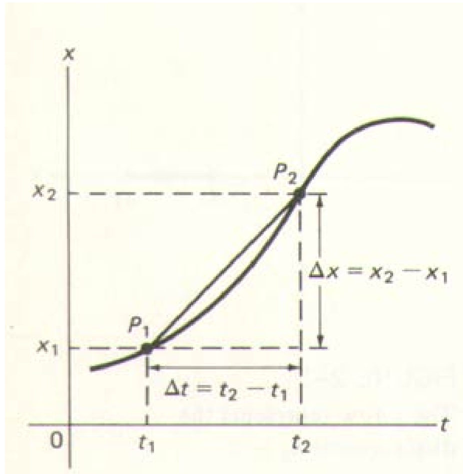
acceleration a *cition* in my first paper on the derivative, from the Latin “citius”. As in the Olympics motto “citius, altius, fortius”: faster, higher, stronger.

Because this sort of acceleration is often called a variable acceleration in physics textbooks, most people seem to think it isn’t constant, and therefore can’t be averaged like the squared variable. But higher powers can be constant, if they are created by a constant process like the one I proposed above with the car and the spacecraft. If the car and spacecraft are both accelerating at a constant rate, the higher power total acceleration will also be constant. Just because an acceleration has a power greater than two does not mean it isn’t constant. We will see how important this is below.

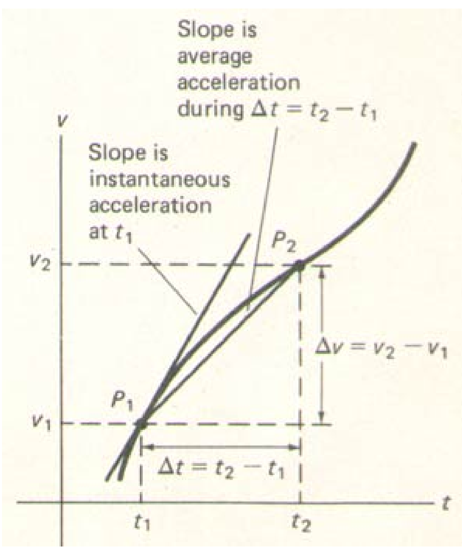
When I say that the acceleration is constant, I do not mean that we can average the velocity. Yes, the velocity is accelerating itself, so we cannot find the velocity at a given time by averaging. We have to take the second derivative, not the first. When I say the acceleration is constant, I mean that it increases at a consistent rate. It is not fluctuating.

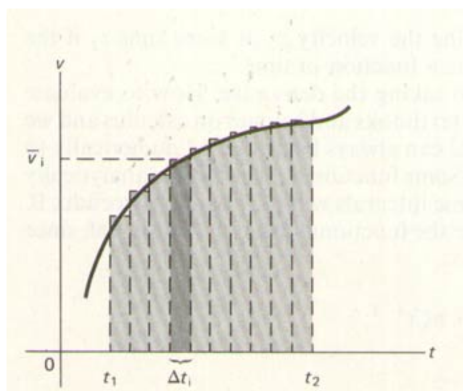
Now let us look at all the problems encountered by modern mathematicians in trying to analyze this situation. In physics textbooks, the chapter on velocity and acceleration normally comes very early. In my textbook[2], it comes in chapter 2. You don’t need calculus for constant velocity, but for “instantaneous velocity” you do, so we get an entire subsection for that. To begin, we get a graph plotting x against t and are given a curve (but no curve equation).

[2] General Physics, Douglas C. Giancoli, 1984.



In the next section, constant acceleration is covered, and we are given a graph that plots v against t, with a similar curve. And in the section after that, we find "variable" acceleration. We are given a graph that again plots v against t, with a curve.





We should already have several questions. Since we are measuring the curvature of these curves with the graph, and finding tangents and areas beneath them, shouldn't our methods be analogous as we go from velocity to acceleration to variable acceleration? In other words, if we plot x against t in the first graph, shouldn't we plot x against t in all the graphs? Or, by another method, we would plot x against t in the first graph, v against t in the second, and a against t in the third. That would keep our method even and unchanged as we moved from one rate of change to the next.

Instead, we find the textbook plotting v against t when solving for a variable acceleration. This is not a quibble: it must be important, because the curve determines the tangent and the area under the curve. If you have a different curve, the tangent and the area are different, too. Well, plotting x against t will not give you the same curvature as plotting v against t or "instantaneous a" against t, will it? If we are going to differentiate or integrate, shouldn't we be careful to get the right curve?

Another problem. All textbooks I have seen solve problems of variable acceleration with integration. But that is upside down. You should differentiate down and integrate up. In other words, if you are given an acceleration and you want to find a velocity, you differentiate. The derivative of x^2 is $2x$, where x^2 is the acceleration and $2x$ is the velocity. Conversely, to go from a velocity to an acceleration, you integrate. The integral of $2x$ is x^2. But in textbooks, they integrate from a velocity graph, and find a velocity from a variable acceleration by integrating only once. Since a velocity is two steps from a variable acceleration, they should be seeking the second derivative, not the first integral.

To be even more specific, let me quote from the textbook:

> If x is given by $x = At^3 + Bt$, then $v = \mathrm{d}x/\mathrm{d}t = 3At^2 + B$ . . . Then, since $a = \mathrm{d}v/\mathrm{d}t$, $a = 6At$.

What the authors are doing here is preparing you to integrate. They are showing you how differentiating works, and then preparing you to reverse it in the upcoming problem. You probably don't see anything wrong there, but as I pointed out in my paper on the exponential derivative, modern calculus is a jumble. What the textbook has done is take the first derivative and then the second, as you see, but they have called the first derivative of a variable acceleration a velocity and the second derivative a constant acceleration. That is backward. Just look at the equations: $v = 3At^2 + B$? Since when can you write a velocity as a squared variable? Or, $a = 6At$? Isn't $6t$ a straight line on a graph? That isn't an acceleration.

My initial reaction was that this textbook author is just a nut, but by looking around me I have found that all of calculus now "works" this way. According to current wisdom, velocity is supposed to be the derivative of distance, and acceleration the derivative of velocity, and that is what causes this horrible confusion. As I showed in previous papers, Wikipedia and most modern sources define the derivative like this, which is enough to raise Newton from the grave. He would tell you that velocity is the derivative of acceleration, not the reverse. You differentiate down and integrate up.

Some will not see my point. They will think I am the nut. They will say, "What in the devil are you talking about? The first equation $x = At^3B + t$ *is* the distance. That is what the book means by 'x is given by'. That is what 'x equals' means, you dope!" But no, I am not the dope, so pay attention here. This is where it all comes out in the wash. The standard model and standard reply is wrong again, since the equation $x = At^3 + Bt$ is the curve equation on the graph, and it *represents* a variable acceleration. That equation is not x, that equation is the variable acceleration. You have been fooled by the "$x =$".

Bear with me, please. Look closely at the equation $x = At^3 + Bt$. The physical displacement x is not given by that equation. That equation applies to the graph only. It is telling you an x-distance from the y-axis at time t. The x in that equation tells you what x you are at, at the given value of t, but it does not tell you the distance traveled on the curve, since the curve is curving. To say it another way, x in a curve equation does not equal x in a physics equation. So$x = At^3 + Bt$ will not tell you a value for total distance traveled after t. If it did, we wouldn't need calculus at all, we could just read the value for x right off the graph, for any and all curves. But no, to find x you have to use physics equations, not curve equations. The equation $x = At^3 + Bt$ is a curve equation, and because it has a t^3 in it, it must stand for a variable acceleration.

The entire modern interpretation of the calculus is upside down! To show this, let us look at the textbook solution of a specific problem:

> Given $a = 7\,\mathrm{m/s^3}$ and $2s$, find v final from rest.
>
> $v = \int (7\,\mathrm{m/s^3})\,t\,\mathrm{d}t = (7\,\mathrm{m/s^3})\,t^2/2 = (3.5\,\mathrm{m/s^3})\,t^2 = 14\,\mathrm{m/s}.$

That solution looks like a fudge to me, from the start. If the moderns don't understand the foundations of the calculus, or how it works, it is unlikely they will be able to apply it in a logical and correct manner. In fact, the solution can't be right, because in the math they have taken one integral of time, to convert a variable acceleration to a velocity. Since the velocity is two steps of differentiation away from the variable acceleration, in the differential table[3] or in real life, that solution can work only by some sort of accident or push or other miracle. But I will show that it doesn't work. That solution is not correct.

But first let us see why the textbook is integrating. We only have to look at its own explanation [this follows the quote above, explaining differentiation]:

> The reverse process is also possible. If we are given the acceleration as a function of time, we can determine v as a function of time; and given v as a function of time, we can obtain the displacement, x.

The textbook integrates because it believes it is reversing the above process. But because I have just shown their first process was upside down, this can't work. They thought they were going $x \to v \to a$ with differentiation, so now they think they are going $a \to v \to x$ with integration. But differentiation is the process $a \to v \to x$. Differentiation goes down, and integration goes up. They are trying to differentiate up and integrate down. Honestly, it is beyond belief that I need to be here telling anyone this.

One more time, for good measure. We are given a curve equation, say $y = x^3$. That is a **curve equation**, so it must stand for a curve. It does not stand for the point y or the distance y, since a point or distance y cannot curve. The only "y" it gives us is some vertical distance from the horizontal axis at some value of x. But that is not the solution for the distance traveled along the curve. Therefore it is not the solution to any physics problem. The equation $y = x^3$ is not telling us a displacement, given an acceleration. It is telling us the acceleration.

Now let us solve the problem, without using integrals. We will start with the velocity. As I said, we need to find the second derivative, since velocity is the second derivative of a variable acceleration. The second derivative of t^3 is $6t$, so

[3] Chapter 9

while the time is changing by the cube, the velocity will be changing by 6's. You can see this clearly by taking the lines out of my differential tables:

Δx^3	=	1	8	27	64	125	216	343
$\Delta\Delta x^3$	=	1	7	19	37	61	91	127
$\Delta\Delta\Delta x^3$	=	6	12	18	24	30	36	42
$\Delta\Delta\Delta\Delta x^3$	=	6	6	6	6	6	6	6

The first line is the cubed acceleration, the second is the first rate of change of that acceleration, and the third is the second rate. The second line is (a sort of) first derivative of the first line, and the third line is (a sort of) second derivative. **We are straightening out the curve**. So the third line gives us a velocity. You can see that it is changing the same amount in between numbers. The differential is constant. That is the definition of a velocity. You can see that the velocity is changing by 6's. Its rate of change is 6. In our current problem, its rate of change is $6t$, and t is 2, so at $t = 2$, its rate is 12. Again, you can see that right from the table. The second entry is 12. But we have an acceleration of 7, not 1, so we multiply by 7 and divide by 2 (to take into account the first halved interval). This gives us $v = 42\,\text{m/s}$.

$$v = a\,\frac{\mathrm{d}^2(t^3)}{2} = 3\,at$$

That is the new equation for velocity, given a cubed acceleration. This is logical since we can derive the current equation for normal (squared) acceleration in the same way. The current equation is $v = at$. Current textbooks don't derive that equation with calculus, they just take it as given or derive it from the classical equation $a = v/t$. But we can now expand it showing the derivative:

$$v = a\,\frac{\mathrm{d}(t^2)}{2} = at$$

Since the derivative of t^2 is $2t$, we get the current equation. This means we can intuit the velocity equation for an acceleration of t^4 as

$$v = a\frac{d^3(t^4)}{2} = 24a\frac{t}{2} = 12at$$

And

$$v = a\frac{d^4(t^5)}{2} = 120a\frac{t}{2} = 60at$$

I have shown a simple method for taking higher order acceleration equations straight from my table of differentials. No one has ever done this before, that I know of. It is certainly not done presently, because, as I showed you, current textbooks solve with integration.

Let us look at the textbook's solution. They found $v = 14\,\text{m/s}$, remember? I found $42\,\text{m/s}$. I bet you think they are right and I am wrong, but I can prove they are wrong very easily. An acceleration of $7\,\text{m/s}^3$ must be greater than an acceleration of $7\,\text{m/s}^2$, right? A cubed acceleration is the motion of an acceleration, so the distance traveled has to be greater. So let us solve the same problem for $a = 7\,\text{m/s}^2$ instead of $7\,\text{m/s}^3$. Using current equations for constant acceleration, we find

$$v = at = 14\,\text{m/s}$$

They found the same final velocity for $7\,\text{m/s}^3$ and $7\,\text{m/s}^2$. That is impossible. An object accelerated to a cube must be going faster at all t's than an object accelerated to a square. That much is clear to anyone, I hope. So the textbook solution is a blatant fudge, one that doesn't even get the right answer.

We can also use the differential table to find the distance here. But first let use my velocity $42\,\text{m/s}$ to find a solution. Because our acceleration is constant (or consistent), we can tweek the old equations.

$$x = \frac{v_f t}{2} = (3at)\frac{t}{2} = 3a\frac{t^2}{2} = 42\,\text{m}$$

Going to the table, we see that the object is moving 6 during each interval of 1. That is what 6, 6, 6, 6 means. Since our acceleration is 7, we just multiply. In doing this, we are using the third derivative, like so:

$$x = a\,(\mathrm{d}^3 t^3)\,\frac{t^2}{4} = 42\,\mathrm{m}$$

To find a distance from a cubed acceleration, we take the third derivative. We differentiate *down* three times.

Let me clarify that. Some have not understood what I am doing here. They have complained that I am treating the acceleration as a motion constant and thereby trying to average the velocity or distance over the elapsed time. That is not what is happening. When I say that the object is moving 6 during each interval, I should say subinterval. I do not mean that the object is traveling 6 during each 1/7 of a second or something, the same distance over each equal time. No, my third derivative is telling us that the object is moving 6 for each constituent velocity, and a cubed acceleration is made up of three of those. You really have to study the tables to see what I am doing, and no one has done that in centuries. The calculus hasn't been taught like that, so my simple manipulations seem mysterious. Yes, you could integrate to find the same thing, but you have to integrate correctly. This textbook is not integrating correctly, and I have seen many other textbooks get it wrong as well. My belief is that a good understanding of the third derivative gives us a quicker and clearer solution, but if you have been brought up on integration, perhaps it is too late to teach an old dog new tricks. You can integrate to find a total distance if you like, but I find integral notation to be an ugly mess, and personally I would teach students to solve simple problems like this with derivatives. And I would do it from tables, where the source of values can be made clear.

Let us see what the textbook got:

> To get the displacement, we use $x_2 = \int v(t)\,\mathrm{d}t$ with $v_1 = 0$, $v_2 = 14\,\mathrm{m/s}$, and $t_2 = 2s$.
>
> $x_2 = \int (3.5\,\mathrm{m/s^3})\,t^2\,\mathrm{d}t = (3.5\,\mathrm{m/s^3})\,t^3/3 = 9.33\,\mathrm{m}$

Again, let us check that by comparing it to the solution for the distance traveled after 2 seconds at $7\,\mathrm{m/s^2}$. Everyone agrees that the equation $x = at^2/2$ works for constant acceleration, so we find $14\,\mathrm{m}$. The textbook found a number less than that, therefore the textbook cannot possibly be correct. A cubed acceleration must give us more displacement after any amount of time than a squared acceleration.

I have just proven that the textbook solution is a fudge, in both method and answer.

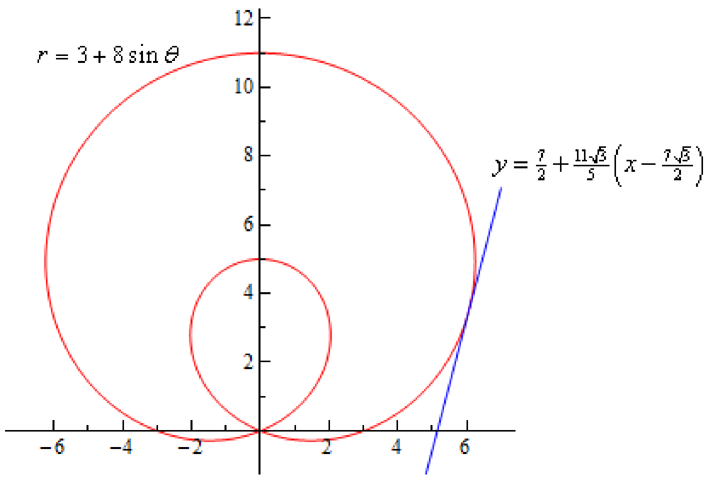
Conclusion: I have shown in a direct manner that modern physicists and mathematicians do not know how to use the calculus. Anytime you see a scientist integrating down from accelerations to distances in this way, you know that madness is afoot. In other papers[4] I have shown that the calculus is misdefined, and now I have shown that it is misused, even in simple problems. Nor is this an isolated incident, since I have shown that Wikpedia, as the mouthpiece of common wisdom, defines the derivative up instead of down. Students are currently taught to differentiate a distance to get a velocity and differentiate a velocity to get an acceleration, when that is upside down.

Given this fundamental misunderstanding, we can now see why scientists and mathematicians hide away in esoteric problems and esoteric maths. They can't do simple math, either algebra or basic calculus, so they must take cover under slippery operators in slippery fields. If you had thought that the math in places like Physical Review Letters was a big con game, you are right. Most math is a con game, and that includes the simple maths you were taught in high school and college. If the math in chapter 1 and 2 is false, you know the math in chapter 30 is false.

[4] Chapter 9

Chapter 16

CALCULUS SIMPLIFIED



Several years ago I wrote a long paper on the foundation of the calculus[1]. The paper was not really dense or difficult – as these things usually go – since I made a concentrated effort to keep both the language and the math fairly simple. But because I was tackling a large number of problems that had accumulated over hundreds of years, and because calculus is considered a bit scary to start with,

[1] Chapter 9

the paper was still hard to absorb. I found it necessary to talk a lot about history and theory and to bring up very old and outdated ideas, like those of Archimedes and Euclid. This ended up confusing most of my readers, I think, and very few made it through to the end.

For this reason I have now returned to the subject, hoping to further shorten and simplify my findings. What I plan to do here is try to sell my idea to a hypothetical reader. I will imagine I am talking to a high school student just entering first-semester calculus. I will explain to him or her why my explanation is necessary, why it is better, and why he or she should prefer to take a course based on my explanation rather than a course based on current theory. In doing this, I will show that current notation and the current method of teaching calculus is a gigantic mess. In a hundred years, all educated people will look back and wonder how calculus could exist, and be taught, in such a confusing manner. They will wonder how such basic math, so easily understood, could have remained in a halfway state for so many centuries. The current notation and derivation for the equations of calculus will look to them like the leeches that doctors used to put on patients, as an all-round cure, or like the holes they drilled in the head to cure headache. Many students have felt that learning calculus is like having holes drilled in their heads, and I will show that they were right to feel that way.

What some of you students have no doubt already felt is that the further along in math you get, the more math starts to seem like a trick. When you first start out, math is pretty easy, since it makes sense. You don't just learn an equation. No, you learn an equation and you learn why the equation makes sense. You don't just acquire a fact, you acquire understanding. For example, when you learn addition, you don't just learn how to use a plus sign. You also learn why the sign works. You are shown the two apples and the one apple, and then you put them together to get three apples. You see the apples and you go, "Aha, now I see!" Addition makes sense to you. It doesn't just work. You fully understand why it works.

Geometry is also understood by most students, since geometry is a physical math. You have pictures you can look at and line segments you can measure and so on, so it never feels like some kind of magic. If your trig teacher was a good teacher, you may have felt this way about trig as well. The sine and cosine stuff seems a bit abstract at first, but sooner or later, by looking at triangles and circles, it may dawn on you that everything makes absolute sense.

Algebra is the next step, and many people get lost there. But if you can get your head around the idea of a variable, you are halfway home.

But when we get to calculus, everyone gets swamped. Notice that I did not say, "almost everyone." No, I said everyone. Even the biggest nerd with the thickest glasses who gets A's on every paper is completely confused. Those who do well in their first calculus courses are the ones that just memorize the equations and don't ask any questions. One reason for this is that with calculus you will be given some new signs, and these signs will not really make sense in the old ways. You will be given an arrow pointing at zero, and this little arrow and zero will be underneath variables or next to big squiggly lines. This arrow and zero are supposed to mean, "let the variable or function approach zero," but your teacher probably won't have time to really make you understand what a function is or why anyone wanted it to approach zero in the first place. Your teacher would answer such a question by saying, "Well, we just let it go toward zero and then see what happens. What happens is that we get a solution. We want a solution, don't we? If going to zero gives us a solution, then we are done. You can't ask questions in math beyond that."

Well, if you teacher says that to you, you can tell your teacher he or she is wrong. Math is not just memorizing equations, it is understanding equations. All math, no matter how difficult, is capable of being understood in the same way that $2+2=4$ can be understood; and if your teacher cannot explain it to you, then he or she does not understand it.

What is happening with calculus is that you are taking your first step into a new kind of math and science. It is a kind of faith-based math. Almost everything you will learn from now on is math of this sort. You will not have time to understand it, therefore you must accept it and move on. Unless you plan to become a professor of the history of math, you will not have time to get to the roots of the thing and really make sense of it in your head. What no high school or college student is supposed to know is that even the history-of-math professors don't understand calculus. No one understands or ever understood calculus, not Einstein, not Cauchy, not Cantor, not Russell, not Bohr, not Feynman, no one. Not even Leibniz or Newton understood it. That is a big statement, I know, but

I have already proved it and I will prove it again below. The short proof is to point out that if they had really understood it, they would have corrected it like I am about to. If any of these people had understood calculus, they would have reconstructed the whole thing so that you could understand it, too. There is no reason to teach you a math that can't be explained simply. There is no conspiracy. You are taught calculus as a big mystery simply because, until now, it was a big mystery.

Now, when I say that math after calculus is faith-based, I am offending a lot of important people. Mathematicians are very proud of their field, as you would expect, and they don't want some cowboy coming in and comparing it to religion. But I am not just saying things to be novel or to get attention. I can give you famous examples of how math has become faith-based. Many of you will have heard of Richard Feynman, and not just because I mentioned him ten sentences ago. He is probably the most famous physicist after Einstein, and he got a lot of attention in the second half of the 20$^{\text{th}}$ century – as one of the fathers of QED, among other things. One of his most quoted quotes is, "Shut up and calculate!" Meaning, "Don't ask questions. Don't try to understand it. Accept that the equation works and memorize it. The equation works because it matches experiment. There is no understanding beyond that."

All of quantum dynamics is based on this same idea, which started with Heisenberg and Bohr back in the early 1900's. "The physics and math are not understandable, in the normal way, so don't ask stupid questions like that any more." This last sentence is basically the short form of what is called the Copenhagen Interpretation of quantum dynamics. The Copenhagen Interpretation applies to just about everything now, not just QED. It also applies to Relativity, in which the paradoxes must simply be accepted, whether they make sense or not. And you might say that it also applies to calculus. Historically, your professors have accepted the Copenhagen Interpretation of calculus, and this interpretation states that students' questions cannot be answered. You will be taught to understand calculus like your teacher understands it, and if your teacher is very smart he understands it like Newton understood it. He will have memorized Newton's or Cauchy's derivation and will be able to put it on the blackboard for you. But this derivation will not make sense like $2+2=4$ makes sense, and so you will still be confused. If you continue to ask questions, you will be read the Copenhagen Interpretation, or some variation of it. You will be told to shut up and calculate.

The first semester of calculus you will learn differential calculus. The amazing thing is that you will probably make it to the end of the semester without ever being told what a differential is. Most mathematicians learn that differential calculus is about solving certain sorts of problems using a derivative, and later courses called "differential equations" are about solving more difficult problems in the same basic way. But most never think about what a differential is, outside of calculus. I didn't ever think about what a differential was until later, and I am not alone. I know this because when I tell people that my new calculus is based on a constant differential instead of a diminishing differential, they look at me like I just started speaking Japanese with a Dutch accent. For them, a differential is a calculus term, and in calculus the differentials are always getting smaller. So talking about a differential that does not get smaller is like talking about a politician that does not lie. It fails to register.

A differential is one number subtracted from another number: $(2-1)$ is a differential. So is $(x-y)$. A "differential" is just a fancier term for a "difference". A differential is written as two terms and a minus sign, but as a whole, a differential stands for one number. The differential $(2-1)$ is obviously just 1, for example. So you can see that a differential is a useful expansion. It is one number written in a longer form. You can write any number as a differential. The number five can be written as $(8-3)$, or in a multitude of other ways. We may want to write a single number as a differential because it allows us to define that differential as some useful physical parameter. For instance, a differential is most often a length. Say you have a ruler. Go to the 2-inch mark. Now go to the 1-inch mark. What is the difference between the two marks? It is one inch, which is a length. $(2-1)$ may be a length. $(x-y)$ may also be a length. In pure math, we have no lengths, of course, but in math applied to physics, a differential is very often a length.

The problem is that modern mathematicians do not like to teach you math by drawing you pictures. They do not like to help you understand concepts by having you imagine rulers or lengths or other physical things. They want you to get used to the idea of math as completely pure. They tell you that it is for your own good. They make you feel like physical ideas are equivalent to pacifiers: you must grow up and get rid of them. But the real reason is that, starting with calculus, they can no longer draw you meaningful pictures. They are not able to make you understand, so they tell you to shut up and calculate. It is kind of like the wave/particle duality, another famous concept you have probably already heard of. Light is supposed to act like a particle sometimes and like a wave at other times. No one has been able to draw a picture of light that makes sense of this, so we are told that it cannot be done. But in another one of my papers I have drawn a picture of light that makes sense of this, and in this paper I will show you a pretty little graph that makes perfect sense of the calculus. You will be able to look at the graph with your own eyes and you will see where the numbers are coming from, and you will say, "Aha, I understand. That was easy!"

There is basically only one equation that you learn in your first semester of calculus. All the other equations are just variations and expansions of the one equation. This one equation is also the basic equation of what you will learn next semester in integral calculus. All you have to do is turn it upside down, in a way. This equation is

$$y' = nx^{n-1}$$

This is the magic equation. What you won't be told is that this magic equation was not invented by either Newton or Leibniz. All they did is invent two similar derivations of it. Both of them knew the equation worked, and they wanted to put a foundation under it. They wanted to understand where it came from and why it worked. But they failed and everyone else since has failed. The reason they failed is that the equation was used historically to find tangents to curves, and everyone all the way back to the ancient Greeks had tried to solve this problem by using a magnifying glass. What I mean by that is that for millennia, the accepted way to approach the problem and the math was to try to straighten out the curve at a point. If you could straighten out the curve at that point you would have the tangent at that point. The ancient Greeks had the novel idea of looking at smaller and smaller segments of the curve, closer and closer to the point in question. The smaller the segment, the less it curved. Rather than use a real curve and a real magnifying glass, the Greeks just imagined the segment shrinking down. This is where we come to the diminishing differential. Remember that I said the differential was a length. Well, the Greeks assigned that differential to the length of the segment, and then imagined it getting smaller and smaller.

Two thousand years later, nothing had changed. Newton and Leibniz were still thinking the same way. Instead of saying the segment was "getting smaller" they said it was "approaching zero". That is why we now use the little arrow and the zero. Newton even made tables, kind of like I will make below. He made tables of diminishing differentials and was able to pull the magic equation from these tables.

The problem is that he and everyone else has used the wrong tables. You can pull the magic equation from a huge number of possible tables, and in each case the equation will be true and in each case the table will "prove" or support the equation. But in only one table will it be clear why the equation is true. Only one table will be simple enough and direct enough to show a 16-year-old where the magic equation comes from. Only one table will cause everyone to gasp and say, "Aha, now I understand." Newton and Leibniz never discovered that table, and no one since has discovered it. All their tables were too complex by far. Their tables required you to make very complex operations on the numbers or variables or functions. In fact, these operations were so complex that even Newton and Leibniz got lost in them. As I will show after I unveil my table, Newton and Leibniz were forced to perform operations on their variables that were actually false. Getting the magic equation from a table of diminishing differentials is so complex and difficult that no one has ever been able to do it without making a hash of it. It can be done, but it isn't worth doing. If you can pull the magic equation from a simple table of integers, why try to pull it from a complex table of functions with strange and confusing scripts? Why teach calculus as a big hazy mystery, invoking infinite series or approaches to 0's or infinitesimals, when you can teach it at a level that is no more complex than $1 + 1 = 2$?

So here is the lesson. I will teach you differential calculus in one day, in one paper. If you have reached this level of math, the only thing that should look strange to you in the magic equation is the *y*'. You know what an exponent is, and you should know that you can write an exponent as $(n-1)$ if you want to. That is just an expansion of a single number into a differential, as I taught you above. If $n = 2$, for instance, then the exponent just equals 1, in that case. Beyond that, "*n*" is just another variable. It could be "*z*" or "*a*" or anything else. That variable just generalizes the equation for us, so that it applies to all possible exponents.

All that is just simple algebra. But you don't normally have primed variables in high school algebra. What does the prime signify? That prime is telling you that

y is a different sort of variable than x. When you apply this magic equation to physics, x is usually a distance and y is a velocity. A variable could also be an acceleration, or it could be a point, or it could be just about anything. But we need a way to remind ourselves that some variables are one kind of parameter and some variables are another. So we use primes or double primes and so on.

This is important, because it means that mathematically, a velocity is not a distance, and an acceleration is not a velocity. They have to be kept separate. A calculus equation takes you from one sort of variable to another sort. You cannot have a distance on both sides of the magic equation, or a velocity on both sides. If x is a distance, y' cannot be a distance, too.

Some people will try to convince you later that calculus can be completely divorced from physics, or from the real world. They will stress that calculus is pure math, and that you don't need to think of distances or velocities or physical parameters. But if this were true, we wouldn't need to keep our variables separate. We wouldn't need to keep track of primed variables, or later double-primed variables and so on. Variables in calculus don't just stand for numbers, they stand for different sorts of numbers, as you see. In pure math, there are not different sorts of numbers, beyond ordinal and cardinal, or rational and irrational, or things like that. In pure math, a counting integer is a counting integer and that is all there is to it. But in calculus, our variables are counting different things and we have to keep track of this. That is what the primes are for.

What, you may ask, is the difference between a length and a velocity? Well, I think you can probably answer that without the calculus, and probably without much help from me. To measure a length you don't need a watch. To measure velocity, you do. Velocity has a "t" in the denominator, which makes it a rate of change. A rate is just a ratio, and a ratio is just one number over another number, with a slash in between. Basically, you hold one variable steady and see how the other variable changes relative to it. With velocity, you hold time steady (all the ticks are the same length) and see how distance changes during that time. You put the variable you know more about (it is steady) in the denominator and the variable you are seeking information about (you are measuring it) in the numerator. Or, you put the defined variable in the denominator (time is defined as steady) and the undefined variable in the numerator (distance is not known until it is measured).

All this can also be applied to velocity and acceleration. The magic equation can be applied to velocity and acceleration, too. If x is a velocity, then y' is an acceleration. This is because acceleration is the rate of change of the velocity. Acceleration is v/t. So you can see that y' is always the rate of change of x. Or, y' is always x/t. This is another reason that calculus can't really be divorced completely from physics. Time is a physical thing. A pure mathematician can say, "Well, we can say that y' is always x/z, where z is not time but just a pure variable." But in that case, x/z is still a rate of change. You can refuse to call "z" a time variable, but you still have the concept of change. A pure number changing still implies time passing, since nothing can change without time passing. Mathematicians want "change" without "time", but change is time. If a mathematician can imagine or propose change without time, then he is cleverer than the gods by half, since he has just separated a word from its definition.

At any rate, I think you are already in a better position to understand the calculus than any math student in history. Whether you like that little diversion into time and change is really beside the point, since even if you believe in pure math it doesn't effect my argument.

All the famous mathematicians in history have studied the curve in order to study rate of change. To develop the calculus, they have taken some length of some curve and then let that length diminish. They have studied the diminishing differential, the differential approaching zero. This approach to zero gives them an infinite series of differentials, and they apply a method to the series in order to understand its regression.

But it is much more useful to notice that curves always concern exponents. Curves are all about exponents, and so is the calculus. So what I did is study integers and exponents, in the simplest situations. I started by letting z equal some point. If I let a variable stand for a point, then I have to have a different sort of variable stand for a length, so that I don't confuse a point and a length. The normal way to do this is to let a length be Δz (read "change in z"). I want lengths instead of points, since points cannot be differentials. Lengths can. You cannot think of a point as $(x-y)$. But if x and y are both points, then $(x-y)$ will be a length, you see.

In the first line of my table, I list the possible integer values of Δz. You can see that this is just a list of the integers, of course. Next I list some integer values for other exponents of Δz. This is also straightforward. At line 7, I begin to look at the differentials of the previous six lines. In line 7, I am studying line 1, and I am just subtracting each number from the next. Another way of saying it is that I am looking at the rate of change along line 1. Line 9 lists the differentials of line 3. Line 14 lists the differentials of line 9. I think you can follow my logic on this, so meet me down below.

1	Δz	1	2	3	4	5	6	7	8
2	$\Delta 2z$	2	4	6	8	10	12	14	16
3	Δz^2	1	4	9	16	25	36	49	64
4	Δz^3	1	8	27	64	125	216	343	512
5	Δz^4	1	16	81	256	625	1296	2401	4096
6	Δz^5	1	32	243	1024	3125	7776	16807	32768
7	$\Delta\Delta z$	1	1	1	1	1	1	1	1
8	$\Delta\Delta 2z$	2	2	2	2	2	2	2	2
9	$\Delta\Delta z^2$	1	3	5	7	9	11	13	15
10	$\Delta\Delta z^3$	1	7	19	37	61	91	169	217
11	$\Delta\Delta z^4$	1	15	65	175	369	671	1105	1695
12	$\Delta\Delta z^5$	1	31	211	781	2101	4651	9031	15961
13	$\Delta\Delta\Delta z$	0	0	0	0	0	0	0	
14	$\Delta\Delta\Delta z^2$	2	2	2	2	2	2	2	
15	$\Delta\Delta\Delta z^3$	6	12	18	24	30	36	42	
16	$\Delta\Delta\Delta z^4$	14	50	110	194	302	434	590	
17	$\Delta\Delta\Delta z^5$	30	180	570	1320	2550	4380	6930	
18	$\Delta\Delta\Delta\Delta z^3$	6	6	6	6	6	6		
19	$\Delta\Delta\Delta\Delta z^4$	36	60	84	108	132	156		
20	$\Delta\Delta\Delta\Delta z^5$	150	390	750	1230	1830	2550		
21	$\Delta\Delta\Delta\Delta\Delta z^4$	24	24	24	24	24			
22	$\Delta\Delta\Delta\Delta\Delta z^5$	240	360	480	600	720			
23	$\Delta\Delta\Delta\Delta\Delta\Delta z^5$	120	120	120	120				

from this, one can predict that

24	$\Delta\Delta\Delta\Delta\Delta\Delta\Delta z^6$	720	720	720	720

And so on.

Again, this is what you call simple number analysis. It is a table of differentials. The first line is a list of the potential integer lengths of an object, and a length is a differential. It is also a list of the integers, as I said. After that it is easy to follow my method. It is easy until you get to line 24, where I say, "One can predict that. . . ." Do you see how I came to that conclusion? I did it by pulling out the lines where the differential became constant.

7	$\Delta\Delta z$	1	1	1	1	1	1
14	$\Delta\Delta\Delta z^2$	2	2	2	2	2	2
18	$\Delta\Delta\Delta\Delta z^3$	6	6	6	6	6	6
21	$\Delta\Delta\Delta\Delta\Delta z^4$	24	24	24	24	24	
23	$\Delta\Delta\Delta\Delta\Delta\Delta z^5$	120	120	120	120		
24	$\Delta\Delta\Delta\Delta\Delta\Delta\Delta z^6$	720	720	720	720		

Do you see it now?

$$\begin{aligned}
2 \times \Delta\Delta \mathrm{z} &= \Delta\Delta\Delta z^2 \\
3 \times \Delta\Delta\Delta z^2 &= \Delta\Delta\Delta\Delta z^3 \\
4 \times \Delta\Delta\Delta\Delta z^3 &= \Delta\Delta\Delta\Delta\Delta z^4 \\
5 \times \Delta\Delta\Delta\Delta\Delta z^4 &= \Delta\Delta\Delta\Delta\Delta\Delta z^5 \\
6 \times \Delta\Delta\Delta\Delta\Delta\Delta z^5 &= \Delta\Delta\Delta\Delta\Delta\Delta\Delta z^6
\end{aligned}$$

All these equations are equivalent to the magic equation, $y' = nx^{n-1}$. In any of those equations, all we have to do is let x equal the right side and y' equal the left side. No matter what exponents we use, the equation will always resolve into our magic equation.

If I know anything about teenagers, I will expect this reaction: "Well, sir, that may be a great simplification of Newton, for all we know, but it is not exactly $1 + 1 = 2$." Fair enough. It may take a bit of sorting through. But I assure you that compared to the derivation you will learn in school, my table is a miracle of simplicity and transparence. Not only that, but I will continue to simplify and explain. Since in those last equations we have z on both sides, we can cancel a lot of those deltas and get down to this:

$$
\begin{aligned}
2z &= \Delta z^2 \\
3z^2 &= \Delta z^3 \\
4z^3 &= \Delta z^4 \\
5z^4 &= \Delta z^5 \\
6z^5 &= \Delta z^6
\end{aligned}
$$

Now, if we reverse it, we can read that first equation as, "the rate of change of z squared is two times z." That is information that we just got from a table, and that table just listed numbers. Simple differentials. One number subtracted from the next.

This is useful to us because it is precisely what we were looking for when we wanted to learn calculus. We use the calculus to tell us what the rate of change is for any given variable and exponent. Given an x, we seek a y', where y' is the rate of change of x. And that is what we just found. Currently, calculus calls y' the derivative, but that is just fancy terminology that does not really mean anything. It just confuses people for no reason. The fact is, y' is a rate of change, and it is better to remember that at all times.

You may still have one very important question. You will say, "I see where the numbers are coming from, but what does it *mean*? Why are we selecting the lines in the table where the numbers are constant?" We are going to those lines, because in those lines we have flattened out the curve. If the numbers are all the same, then we are dealing with a straight line. A constant differential describes a straight line instead of a curve. We have dug down to that level of change that is constant, beneath all our other changes. As you can see, in the equations with a lot of deltas, we have a change of a change of a change. . . . We just keep going down to sub-changes until we find one that is constant. That one will be the tangent to the curve. If we want to find the rate of change of the exponent 6, for instance, we only have to dig down 7 sub-changes. We don't have to approach zero at all.

In a way we have done the same thing that the Greeks were doing and that Newton was doing. We have flattened out the curve. But we did not use a magnifying glass to do it. We did not go to a point, or get smaller and smaller. We went to sub-changes, which are a bit smaller, but they aren't anywhere near zero. In fact, to get to zero, you would have to have an infinite number of deltas, or sub-changes. And this means that your exponent would have to be infinity itself. Calculus never deals with infinite exponents, so there is never any conceivable reason to go to zero. We don't need to concern ourselves with points at all. Nor do we need to talk of infinitesimals or limits. *We don't have an infinite series, and we don't have any vanishing terms*. We have a definite and limited series, one that is 7 terms long with the exponent 6 and only 3 terms long with the exponent 2.

I hope you can see that the magic equation is just a generalization of all the constant differential equations we pulled from the table. To "invent" the calculus, we don't have to derive the magic equation at all. All we have to do is generalize a bunch of specific equations that are given us by the table. By that I mean that the magic equation is just an equation that applies to all similar situations, whereas the specific equations only apply to specific situations (as when the exponent is 2 or 3, for example). By using the further variable "n", we are able to apply the equation to all exponents. Like this:

$$n z^{n-1} = \Delta z^n$$

And we don't have to prove or derive the table either. The table is true by definition. Given the definition of integer and exponent, the table follows. The table is axiomatic number analysis of the simplest kind. In this way I have shown that the basic equation of differential calculus falls out of simple number relationships like an apple falls from a tree.

Even pure mathematicians can have nothing to say against my table, since it has no necessary physical content. I call my initial differentials lengths, but that is to suit myself. You can subtract all the physical content out of my table and it is still the same table and still completely valid.

We don't need to consider any infinite series, we don't need to analyze differentials approaching zero in any strange way, we don't need to think about infinitesimals, we don't need to concern ourselves with functions, we don't need to learn weird notations with arrows pointing to zeros underneath functions, and we don't need to notate functions with parentheses and little "f's", as in $f(x)$. But the most important thing we can ditch is the current derivation of the magic equation, since we have no need of it. I will show you that this is important, because the current derivation is gobblydegook.

I am once again making a very big claim, but once again I can prove it, in very simple language. Let's look at the current derivation of the magic equation. This derivation is a simplified form of Newton's derivation, but conceptually it is exactly the same. Nothing important has changed in 350 years. This is the derivation you will be taught this semester. The figure δ stands for "a very small change". It is the small-case Greek "d", which is called delta. The large-case is Δ, remember, which is a capital delta. Sometimes the two are used interchangeably, and you may see the derivation below with Δ instead of δ. You may even see it with the letter "d". I will not get into which is better and why, since in my opinion the question is moot. After today we can ditch all three.

Anyway, we start by taking any functional equation. "Functional" just means that y depends upon x in some way. Think of how a velocity depends on a distance. To measure a velocity you need to know a distance, so that velocity is a function of distance. But distance is not a function of velocity, since you can measure a distance without being concerned at all about velocity. So, we take any functional equation, say

$$y = x^2$$

Increase it by δy and δx to obtain

$$y + \delta y = (x + \delta x)^2$$

subtract the first equation from the second:

$$\delta y = (x + \delta x)^2 - x^2 = 2x\delta x + \delta x^2$$

divide by δx

$$\frac{\delta y}{\delta x} = 2x + \delta x$$

Let δx go to zero (only on the right side, of course)

$$\frac{\delta y}{\delta x} = 2x$$

$$y' = 2x$$

That is how they currently derive the magic equation. Any teenager, or any honest person, will look at that series of operations and go, "What the. . . ?" How can we justify all those seemingly arbitrary operations? The answer is, we can't. As it turns out, precisely none of them are legal. But Newton used them, he was a very smart guy, and we get the equation we want at the end. So we still teach that derivation. We haven't discovered anything better, so we just keep teaching that.

Let me run through the operations quickly, to show you what is going on. We only have four operations, so it isn't that difficult, really. Historically, only the last operation has caused people to have major headaches. Newton was called on the carpet for it soon after he published it, by a clever bishop named Berkeley. Berkeley didn't like the fact that δx went to zero only on the right side. But no one could sort through it one way or the other and in a few decades everyone just decided to move on. They accepted the final equation because it worked and swept the rest under the rug.

But what I will show you is that the derivation is lost long before the last operation. That last operation is indeed a big cheat, but mathematicians have put so many coats of pretty paint on it that it is impossible to make them look at it clearly anymore. They answer that δx is part of a ratio on the left side, and because of that it is sort of glued to the δy above it. They say that $\delta y/\delta x$ must be considered as one entity, and they say that this means it is somehow unaffected by taking δx to zero on the right side. That is math by wishful thinking, but what are you going to do?

To get them to stand up and take notice, I have been forced to show them the even bigger cheats in the previous steps. Amazingly, no one in all of history has noticed these bigger cheats, not even that clever bishop. So let us go through all the steps.

In the first equation, the variables stand for either "all possible points on the curve" or "any possible point on the curve." The equation is true for all points and any point. Let us take the latter definition, since the former doesn't allow us any room to play. So, in the first equation, we are at "any point on the curve". In the second equation, are we still at any point on the same curve? Some will think that $(y+\delta y)$ and $(x+\delta x)$ are the co-ordinates of another any-point on the curve – this any-point being some distance further along the curve than the first any-point. But a closer examination will show that the second curve equation is not the same as the first. The any-point expressed by the second equation is not on the curve $y = x^2$. In fact, it must be exactly δy *off* that first curve. Since this is true, we must ask why we would want to subtract the first equation from the second equation. Why do we want to subtract an any-point on a curve from an any-point off that curve?

Furthermore, in going from equation 1 to equation 2, we have added different amounts to each side. This is not normally allowed. Notice that we have added δy to the left side and $2x\delta x + \delta x^2$ to the right side. This might have been justified by some argument if it gave us two any-points on the same curve, but it doesn't. We have completed an illegal operation for no apparent reason.

Now we subtract the first any-point from the second any-point. What do we get? Well, we should get a third any-point. What is the co-ordinate of this third any-point? It is impossible to say, since we got rid of the variable y. A co-ordinate is in the form (x, y) but we just subtracted away y. You must see that δy is not the same as y, so who knows if we are off the curve or on it. Since we subtracted a point on the first curve from a point off that curve, we would be very lucky to have landed back on the first curve, I think. But it doesn't matter, since we are subtracting points from points. Subtracting points from points is illegal anyway. If you want to get a length or a differential you must subtract a length from a length or a differential from a differential. Subtracting a point from a point will only give you some sort of zero – another point. But we want δy to stand for a length or differential in the third equation, so that we can divide it by δx. As the derivation now stands, δy must be a point in the third equation.

Yes, δy is now a point. It is not a change-in-y in the sense that the calculus wants it to be. It is no longer the difference in two points on the curve. It is not a differential! Nor is it an increment or interval of any kind. It is not a length, it is a point. What can it possibly mean for an any-point to approach zero? The truth is it doesn't mean anything. A point can't approach a zero length since a point is already a zero length.

Look at the second equation again. The variable y stands for a point, but the variable δy stands for a length or an interval. But if y is a point in the second equation, then δy must be a point in the third equation. This makes dividing by δx in the next step a logical and mathematical impossibility. You cannot divide a point by any quantity whatsoever, since a point is indivisible by definition. The final step – letting δx go to zero – cannot be defended whether you are taking only taking the denominator on the left side to zero or whether you are taking the whole fraction toward zero (which has been the claim of most). The ratio $\delta y/\delta x$ was already compromised in the previous step. The problem is not that the denominator is zero; the problem is that the numerator is a point. *The numerator is zero*.

My new method drives right around this mess by dispensing with points altogether. You can see that the big problem in the current derivation is in trying to subtract one point from another. But you cannot subtract one point from another, since each point acts like a zero. Every point has zero extension in every direction. If you subtract zero from zero you can only get zero.

You will say that I subtracted one point from another above $(x-y)$ and got a length, but that is only because I treated each variable as a length to start with. Each "point" on a ruler or curve is actually a length from zero, or from the end of the ruler. Go to the “point” 5 on the ruler. Is that number 5 really a point? No, it is a length. The number 5 is telling you that you are five inches from the end of the ruler. The number 5 belongs to the length, not the point. Which means that the variable x, that may stand for 5 or any other number on the ruler, actually stands for a length, not a point. This is true for curves as well as straight lines or rulers. Every curve is like a curved ruler, so that all the numbers at “points” on the curve are actually lengths.

You may say, “Well, don’t current mathematicians know that? Doesn’t the calculus take that into account? Can’t you just go back into the derivation above and say that y is a length from zero instead of a point, which means that in the third equation δy is a length, which means that the derivation is saved?” Unfortunately, no. You can’t say any of those things, since none of them are true. The calculus currently believes that y’ is an instantaneous velocity, which is a velocity at a point and at an instant. You will be taught that the point y is really a point in space, with no time extension or length. Mathematicians believe that the calculus curve is made up of spatial points, and physicists of all kinds believe it, too. That is why my criticism is so important, and why it cannot be squirmed out of. The variable y is not a length in the first equation of the derivation, and this forces δy to be a point in the third equation.

A differential stands for a length only if the two terms in the differential are already lengths. They must both have extension. Five inches minus four inches is one inch. Everything in that sentence is a length. But the fifth-inch mark minus the fourth-inch mark is not the one inch-mark, nor is it the length one inch. A point minus a point is a meaningless operation. It is like 0-0.

This is the reason I was careful to build my table only with lengths. I don’t use points. This is because I discovered that you can’t assign numbers to points. If you can’t assign numbers to points, then you can’t assign variables or functions to points. When I was building my table above, I kind of blew past this fact, since I didn’t want to confuse you with too much theory. My table is all lengths, but I didn’t really tell you why it had to be like that. Now, however, I think you are ready to notice that points can’t really enter equations or tables at all. Only ordinal numbers can be applied to points. These are ordinal numbers: 1^{st}, 2^{nd}, 3^{rd}. The fifth point, the eighth point, and so on. But math equations apply to cardinal or counting numbers, 1, 2, 3. You can’t apply a counting number to a point. As I showed with the ruler, any time you apply a counting number to a "point" on the ruler, that number attaches to the length, not the point. The number 5 means five inches, and that is a length from zero or from the end of the ruler. It is the same with all lines and curves. And this applies to pure math as well as to applied math. Even if your lines and curves are abstract, everything I say here still applies in full force. The only difference is that you no longer call differentials lengths; you call them intervals or differentials or something.

The students will now say, "Can't you go back yourself and redefine all the points as lengths, in the existing derivation? Can't you fix it somehow?"

The answer is no. I can't. I have showed you that Newton cheated on all four steps, not just the last one. You can't "derive" his last equation from his first by applying a series of mathematical operations to them like this, and what is more you don't need to. I have showed with my table that you don't need to derive the magic equation since it just drops out of the definition of exponent fully formed. The equation is axiomatic. What I mean by that is that it really is precisely like the equation $1+1=2$. You don't need to derive the equation $1+1=2$, or prove it. You can just pull it from a table of apples or oranges and generalize it. It is definitional. It is part of the definition of number and equality. In the same way, the magic equation is a direct definitional outcome of number, equality, and exponent. Build a simple table and the equation drops out of it without any work at all.

If you must have a derivation, the simplest possible one is this one:

We are given a functional equation of the general sort

$$y = x^n$$

and we seek y', where, by definition

$$y\text{'} = \Delta x^n$$

Then we go to our generalized equation from the table, which is

$$nx^{n-1} = \Delta x^n$$

By substitution, we get

$$y' = nx^{n-1}$$

That's all we need. But I will give you one other piece of information that will come in handy later. Remember how we cancelled all those deltas, to simplify the first equations coming out of the table? Well, we did that just to make things look tidier, and to make the equations look like the current calculus equations. But those deltas are really always there. You can cancel them if you want to clean up your math, but when you want to know what is going on physically, you have to put them back in. What they tell you is that when you are dealing with big exponents, you are dealing with very complex accelerations. Once you get past the exponent two, you aren't dealing with lengths or velocities anymore. The variable x to the exponent 6 will have 7 deltas in front of it, as you can see by going back to the table. That is a very high degree of acceleration. Three deltas is a velocity. Four is an acceleration. Five is a variable acceleration. Six is a change of a variable acceleration. And so on. Most people can't really visualize anything beyond a variable acceleration, but high exponent variables do exist in nature, which means that you can go on changing changes for quite a while. If you go into physics or engineering, this knowledge may be useful to you. A lot of physicists appear to have forgotten that accelerations are often variable to high degrees. They assume that every acceleration in nature is a simple acceleration.

In my long paper I covered a lot of other interesting topics, but I will only mention one more of them here. I have told you a bit about quantum mechanics above, so I will give you a clue about the end of that story, too. QED hit a wall about 20 years ago, and that is why all the big names are now working on string theory. String theory is a horrible mess, one that makes the mess of calculus look like spilled milk. But one of the main reasons it was invented was to save QED from the point. This problem I have solved for you about the point is exactly the same one that cold-cocked QED. All of physics is dependent on calculus and its offshoots, and using calculus with points in the equations has ended up driving everyone a little mad. The only way that physicists could make the equations of QED keep working is by performing silly operations on them, like the ones that Newton performed in his derivation. These operations in QED are called "renormalization". That is a big word for fudging. The inventor of renormalization was the same Richard Feynman who I told you about above. His students are still finding new ways to renormalize equations that won't work in normal ways. Mr. Feynman was a big mess maker, but he did have the honesty to at least admit it, regarding renormalization. He himself called it "hocus pocus" and a "dippy process" that was "not mathematically legitimate." It would have been nice if Newton or Leibniz or Cauchy had had the intellectual honesty to say the same about the calculus derivation.

The reason this should be interesting to you is that my correction to the calculus solves all the problems of QED at one blow, although they haven't figured that out yet.[2] Just by reading this paper you are now smarter than all the "geniuses" fudging giant equations. With your new knowledge, you can go to college, wade briskly through all the muck, and start putting the house in order. Your understanding of calculus and the point will allow you to climb ladders that no one even knew existed. So please remember me when you get to the top. And don't dump any more garbage that might land on my head.

[2]The "uncertainty" of quantum mechanics is due (at least in part) to the math and not to the conceptual framework. That is to say, the various difficulties of quantum physics are primarily problems of a misdefined Hilbert space and a misused mathematics (vector algebra), and not problems of probabilities or philosophy. My correction to the calculus allows for a fix of all higher maths, spaces, and theories.

Chapter 17

TRIG DERIVATIVES FOUND WITHOUT THE OLD CALCULUS

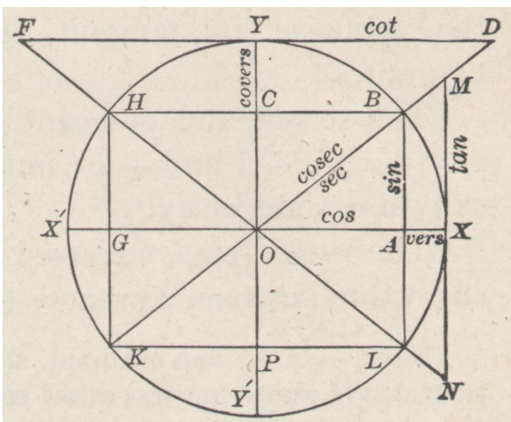


FIG. 31.

Since I first published my paper on the calculus several years ago, I have gotten many angry emails like this one:

> You are wrong! Mathematics is a science about numbers. Graphs, plots are for illustration – you can prove nothing from them. $y = \sin x$, $y' = \cos x$. How do you prove that by your method? – Yuri

Even my mother, who is a professional mathematician, has failed to see how I can incorporate my table into an analysis of all functions. She never got angry, but she has used my silence as proof that my method has limited use.

Now, I said in a footnote to that paper that my method applied to all of calculus and all functions, not just differentials or polynomials. It applies to trig functions, logarithms, integrals, and so on. I assumed that anyone who understood my argument would see that immediately. I didn't even bother to write a follow-up paper on integration, it seemed so clear to me that anyone could just read up the tables instead of down. I was busy with other important problems and decided to let that paper hang, along with any paper that specifically addressed trig functions. Frankly I had hoped that someone might come along and see my point, and that they would do the dirty work of advancing my theory into these other alleys. Once I have solved a problem, I tend to get bored, and stating the obvious does not really inspire me to write.

However, I now see, years later, that I was mistaken in assuming that my initial paper would penetrate into the mathematical community. It has been turned down for publication in all the top forums, for what I think are political reasons. So I have recently gone back and simplified my argument, self-publishing a shorter and simpler paper[1], argued in what I consider to be an extremely transparent manner and language. I hope that this paper may eventually make some headway in the mainstream, even if I continue to be blocked by the higher-ups.

Beyond that, I have decided to publicly solve Yuri's trig problem for him, knowing full well that it won't be the further miracle anyone needs. No matter what I do or how I do it, I now expect most of the status quo to find a way to dismiss it out of hand. They weren't bothered by the fact that the current equation has been hanging from skyhooks for 350 years, and so they won't be impressed to see the equation finally grounded. Anyone who studies my table and doesn't undergo an epiphany is someone who is pretty much unreachable, and solving this trig problem with the table won't reach them either. But here goes.

[1] Chapter 16

So, Yuri, watch closely, my friend. I will do it so quickly and so easily, you will no doubt think it is nothing. I will show you how to do it without limits, without going to zero, without infinite series, and without the current derivation of the calculus. I will do it using only my table of exponents and the constant differential.

$$y = \sin x = \pm\sqrt{(1 - \cos^2 x)}$$

Notice that we are still dealing here with exponents. The cosine is squared and that is the important fact here, not the fact that we are dealing with trig functions. From a rate of change perspective, the trig function is meaningless. A sine or cosine is just a number, like any other. It is written as function of an angle, but that does not affect the rate-of-change math at all. The cosine of x is a single variable, and we could rewrite it as b if we wanted to, to simplify the variable for the rate of change math. Likewise, we could rewrite $\sin x$ as a, if we desire. All we have to do is make sure we don't confuse sine and cosine, since they vary in different ways, but we can mark them anyway we want.

Let

$$a = \sin x$$

$$b = \cos x$$

Therefore, we could rewrite the equation as

$$y = a = \pm\sqrt{(1 - b^2)}$$

Square both sides

$$y^2 = 1 - b^2$$

Since sine and cosine are co-dependent, we can differentiate either side, or both sides, starting with either side we like.

Let $z = 1 - b^2$

$$z = y^2$$

From my table of integer exponents:

$$\Delta z = z' = 2y$$

$$\Delta(1 - b^2) = 2y$$

Now switch sides and differentiate again

$$2y = \Delta(1 - b^2)$$

Once again, straight from the table of exponents:

$$2\Delta y = 2y' = 2b$$

$$y' = b = \cos x$$

You will say that I just followed normal procedure, but I didn't, since whenever I use the equation $nz^{n-1} = \Delta z^n$ I pull it from my table of exponents and constant differentials, not from current sources, which I have shown are all faulty. I prove this equation using a constant differential, not a diminishing differential or a method using limits. My table shows that with the exponent 2, you only have to go to a third sub-change in the rate of change chart in order to find a straight line, or a constant rate of change. This means that you aren't anywhere near zero, and aren't anywhere near an infinite series of any kind. You are two steps below the given rate of change for this problem (which is an acceleration or its pure math equivalent) and two steps is two steps, not an infinite number of steps. In any rate of change problem, we simply aren't dealing with infinite series, points, or limits. We are dealing with subchanges, and we are seeking a line of constant differentials. Not a point, a line. This is why my method is so important.

It does not matter in this problem that the curve was created by sine or cosine. The way the curve was created does not concern us in calculus. All we need is at least one dependence. If we have that dependence then we can use the definition of exponent and integer to create the table, and that table will straighten our curve out in a definite and finite number of steps – the number of steps being absolutely determined by the exponent itself.

An infinite series is only created by an infinite exponent. But an exponent signifies a change, and a change requires time, so that an infinite exponent would imply infinite time. We do not need to solve equations concerning infinite time, not in physics and not in mathematics. Therefore we have no need of infinite series in rate of change problems.

My analysis of the Cartesian graph (in my long paper) was necessary to discover the problem with calculus, and therefore this analysis certainly transcends "illustration", especially since that word has been thrown at me in a pejorative sense. I never claimed that calculus was all about graphs, or implied that the graph was the central feature of either calculus or of my argument. But I would never have discovered what I did without an in-depth analysis of the graph and the way the curve is created there, and I could never fully explain my method without using the graph to make it clear.

Chapter 18

ANOTHER FATAL FLAW IN THE HISTORICAL DERIVATION OF THE CALCULUS

The historical proof of the calculus bids us imagine some infinite series of shrinking numbers. It lets this series approach a limit. This limit is usually conceived of as a point. As an example let us imagine a sphere. Let the radius of the sphere be our given number. Now, let our sphere begin shrinking. The given number will get smaller, of course. The calculus supposes that as the given number gets smaller it gets closer to zero. It *approaches* zero. This implies that our shrinking sphere will physically approach a limit or a zero – that it will approach being a point. But it won't. A shrinking sphere will **not** approach a point, not physically, metaphysically, mathematically, conceptually, really, or abstractly. This is why:

Size is a relative term. It is relative to other things and other times. You may be smaller than another thing, or smaller than you were yesterday, but other than that "small" has no meaning. A shrinking balloon has a limit. You can only let so much air out. It can't get smaller than a deflated balloon. But if you take a sphere in physical or mathematical space and treat it only as structure, then there is no upper or lower limit on size. You can make it infinitely large *or* infinitely small. Large and small are opposite directions in extension, but they are the same conceptually. Just as a thing can go on expanding forever it can go on shrinking forever. *Zero is precisely as far away as infinity*. An infinite regression "toward" zero is exactly the same mathematically as an infinite progression toward infinity.

Most people have a somewhat easier time imagining a large infinity than a small infinity. Especially since I am not talking about a negative infinity. I am not talking about negative numbers here at all, you must realize. I am talking about a regress toward zero. Smaller and smaller fractions, or the like. Just as a large number does not really ever approach infinity, a small positive number does not really approach zero. Any infinite progression or regression does not approach ending. It does not end, therefore it cannot logically approach ending.

Everything I have said here applies to "size" in general, not just to material or physical size. Let us subtract out all the physical content from the discussion above. Let the numbers be numbers alone, and not refer to any physical parameter like length. We still have an inherent concept of size that we cannot subtract out. Numbers have size no matter how abstract we make them. Two is bigger than one in pure math as well as in applied math. If so, then let us ask, "If we move from 2 to 1, have we approached zero?" An exact analogy is the question, "If we move from 2 to 3, have we approached infinity?"

Of course, if we are talking about integers then we have no exact analogy: the answer to the first question is yes and the second no, since obviously the next smallest integer after 1 is 0. But in the second question, we are infinitely far away from infinity at 2, and we are infinitely far away from infinity at 3. We have not approached infinity. At the highest number we can imagine, we are still infinitely far away from the end of the series of integers, by definition. In fact, if we *have* approached the end of the series, then the series is not infinite.

Next, let us leave integers, since some will invoke Cantor to start inserting doubts into my reasoning so far. Let us move to real numbers, which have a higher order of infinity, for those who believe in such things. Let us ask the two questions again. "If we start at 1 and move down, have we approached zero?" And, "If we start at 1 and move up, have we approached infinity?" I think that it is clear that both questions are basically equivalent. We are dealing with an infinite series in either case. Neither series can possibly end, by definition. In fact, the proof of the calculus depends on using an infinite series. If a Cantorian or anyone else proved that a series actually had an end, then it would not be an infinite series, and it would not be the series the calculus is talking about. The calculus applies, axiomatically, to infinite series.

If this is so, then an infinite series of progressively smaller numbers does not in fact approach zero. The smallest number you can think of is still infinitely far away from zero. Therefore it is no closer to zero than 1 is, or a million billion.

All this is hard to imagine for some, since zero is not just like infinity in other ways. Zero has a slot on the number line. We reach it all the time in normal calculations. But we never reach infinity in normal calculations, and it has no slot on the number line. Zero is a limit we can point to on a ruler; infinity is not a limit we can point to on a ruler. For this reason, most people, or perhaps all people, have not yet seen that an infinite regression does not approach zero. Zero is not logically approachable by an infinite series of diminishing numbers. A diminishing series either approaches zero, or it is infinite. It cannot be both.

Therefore, the first postulate of the calculus is a contradiction. Not a paradox, a contradiction. Meaning that it is false. The calculus begins, "Given an infinite series that approaches zero…." But you cannot be given an infinite series that approaches zero.

Some pre-calculus problems get around this problem by summing the series. The ancient Greeks solved problems with infinite series, such as the paradoxes of Zeno (e.g. Achilles and the Tortoise), by summing the series. This has been seen as a sort of pre-calculus, and rightly so, since it deals with both infinite series and limits. But when a series is summed, it no longer matters whether or not the series "approaches" the limit or not. It is beside the point. It simply does not matter whether the series actually reaches or approaches the limit, not in a physical sense nor a mathematical sense. All that is necessary is to show that the **sum** cannot exceed the limit. Since this is so, it may logically be assumed that the **sum** does indeed approach the limit; and what is more, that the **sum** reaches it. However, the terms in the series do not. The terms in the series do not approach or reach the limit.

In post-Newtonian math, it has been the custom to give a foundation to the derivative, and thereby to the differential calculus, by first assuming an infinite series and then letting it approach a limit. The wording is normally something like that with which I started off this paper. But this proof is not a proof of any integral or of the integral calculus. That is to say, we are not dealing with any summations at this point in the historical proof. Rather, the proof is a proof that determines the derivative. Only later do we use the derivative to define the integral and give a foundation to the integral calculus.

Therefore, when the proof of the derivative lets the series approach a limit, it is quite simply wrong to do so. The **terms** in the series do not approach the limit; only the sum of the series approaches the limit. In differential calculus, we are not dealing with sums. We are dealing with differentials, which are simply numbers gotten from differences (gotten by subtraction).

To be even more specific, the proof of the derivative, and of the differential calculus – as taught in contemporary courses – starts with a given differential. We are usually given a curve. We take a differential from the curve, x_2–x_1 for instance. We then let that differential diminish by choosing further x's that are closer and closer to x_2. We then mathematically monitor what is happening to y differentials as the x differentials diminish. We want to know what happens when the x differential hits the limit at the point x_2. So it is clear that summations or sums have absolutely nothing to do with differential calculus. We are not summing any series of x's. We are following diminishing x's, which are individual terms in the series. I have shown above that these terms do not in fact approach the limit. Therefore the proof fails. In my long paper on the calculus, I show many other ways the proof fails, and some of these are more critical than the one I have related here. However, this one is also worthy of notice, since it leads us into other interesting arguments that I will take up in subsequent papers.

A member of the status quo will argue that I am just caviling – inventing problems. He will say, “It is clear that a diminishing series, AND the terms in that series, do approach the limit, or zero in the case you have given. To show this, all I have to do is point at the curve. If we are taking smaller and smaller differentials, then **of course** those differentials are getting closer to x_2. Look at the line itself. The distance is getting shorter, so x_1 must be getting closer to x_2. That is all the proof is claiming.”

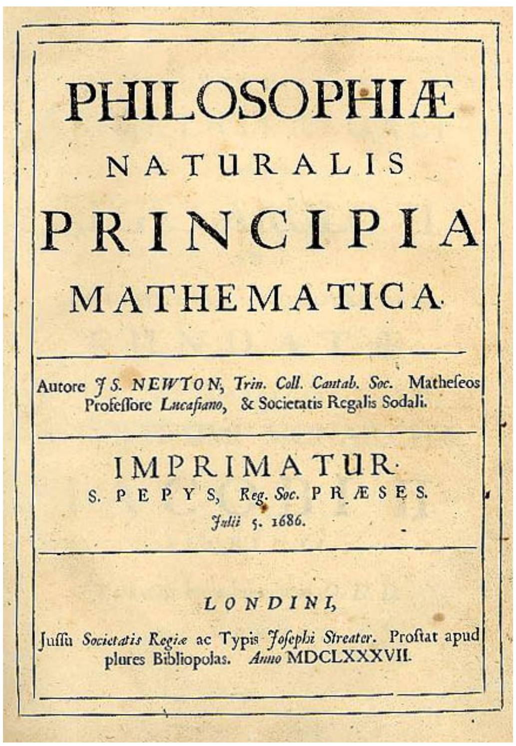
But notice that my antagonist is now using a physical definition of distance. When I attack it on physical grounds, the status quo claims that calculus is pure math, unsullied by physics. When I attack it on logical grounds, the status quo hides behind physical statements. It points to the line, showing me that the line is shorter. But it is showing me a length, and a length is a parameter. A length is not pure math.

My answer is this. Yes, the segment of the curve gets shorter as the differential diminishes. But what is this segment of the curve? Over any interval, the drawn curve or mathematical curve *is a summation*. The complete curve is an overlay of all possible variables in the problem. A segment of this curve is an overlay of all possible variables over the given interval. The curve, and its length, has nothing to do with the individual terms in the series of differentials. What we are concerned with in the differential calculus, and in the proof in question, are the individual terms in the infinite series, not the summation of these terms. So that showing that the length of the curve gets shorter is not to the point. It is a misdirection in argument.

The important point – the one that really matters – is the one I have set forth above. The terms in the infinite series do not approach zero or the limit or the point. The terms in the series in the question at hand are differentials, and they do not approach the limit. They are always infinitely far away from it, as long as “far” is understood in mathematical terms. Therefore it is meaningless to let a differential approach a limit. Differentials do not approach limits, by definition and all the rules of logic.

Chapter 19

A DISPROOF OF NEWTON'S FUNDAMENTAL LEMMAE



PHILOSOPHIÆ
NATURALIS
PRINCIPIA
MATHEMATICA.

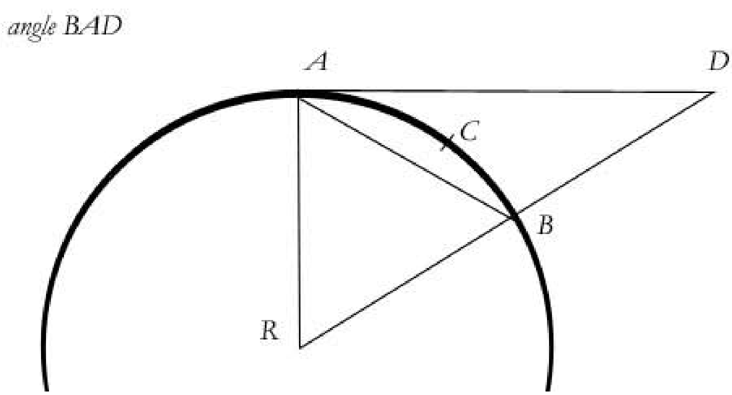
Autore *J S. NEWTON*, *Trin. Coll. Cantab. Soc.* Matheseos Professore *Lucasiano*, & Societatis Regalis Sodali.

IMPRIMATUR.
S. PEPYS, *Reg. Soc.* PRÆSES.
Julii 5. 1686.

LONDINI,
Jussu *Societatis Regiæ* ac Typis *Josephi Streater*. Prostat apud plures Bibliopolas. *Anno* MDCLXXXVII.

Newton published his *Principia* in 1687. Except for Einstein's Relativity corrections, the bulk of the text has remained uncontested since then. It has been the backbone of trigonometry, calculus, and classical physics and, for the most part, still is. It is the fundamental text of kinematics, gravity, and many other subjects.

In this paper I will show a simple and straightforward disproof of one of Newton's first and most fundamental lemmae, a lemma that remains to this day the groundwork for calculus and trigonometry. My correction is important – despite the age of the text I am critiquing – due simply to the continuing importance of that text in modern mathematics and science. My correction clarifies the foundation of the calculus, a foundation that is, to this day, of great interest to pure mathematicians. In the past half-century prominent mathematicians like Abraham Robinson have continued to work on the foundation of the calculus (see Non-standard Analysis). Even at this late a date in history, important mathematical and analytical corrections must remain of interest, and a finding such as is contained in this paper is crucial to our understanding of the mathematics we have inherited. Nor has this correction ever been addressed in the historical modification of the calculus, by Cauchy or anyone else. Redefining the calculus based on limit considerations does nothing to affect the geometric or trigonometric analysis I will offer. The first lemma in question here is Lemma VI, from Book I, section I ("Of the Motion of Bodies"). In that lemma, Newton's provides the diagram below, where AB is the chord, AD is the tangent and ACB is the arc. He tells us that if we let B approach A, the angle BAD must ultimately vanish. In modern language, he is telling us that the angle goes to zero at the limit.



This is false for this reason: If we let B approach A, we must monitor the angle ABD, not the angle BAD. As B approaches A, the angle ABD approaches becoming a right angle. When B actually reaches A, the angle ABD will be a right angle. Therefore, the angle ABD can never be acute. Only if we imagined that B passed A could we imagine that the angle ABD would be acute. And even then the angle would not really be acute, since we would be in a sort of negative time interval. Newton is using A as his zero-point, so that we cannot truly cross that point without arriving in some sort of negative interval, especially since we are talking about the motion of real bodies.

I have added this paragraph after talks with many readers, who cannot visualize the manipulation here. It is very simple: you must slide the entire line RBD toward A, keeping it straight always. This was the visualization of Newton, and I have not changed it here. I am not changing his physical postulates, I am analyzing his geometry with greater rigor than even he achieved.

If we are taking B to A and may not go past A, then the angle ABD has a limit at 90°. When ABD is at 90°, the angle BAD may not be zero. This will be crystal clear in a moment when we look at the length of the tangent at the limit, but for now it is enough to say that if angle BAD were zero, then ADB would also have to be 90°, which is impossible to propose. A triangle may not have two angles of 90°.

In Lemma VII, Newton's uses the previous lemma to show that at the limit the tangent, the arc and the chord are all equal. I have just disproved this by showing that the angle ABD is 90° at the limit. If ABD is 90° at the limit, then the tangent must be greater than the chord. Please notice that if AB and AD are equal, then ABD must be less than 90°. But I have shown that **ABD cannot be less than 90°**. B would have to pass A, which would put us in a negative time interval. If B cannot pass A (A being the limit) then the tangent can never equal the chord, not when approaching the limit and not when at the limit. This verifies my previous assertion that the angle BAD cannot go to zero. If the tangent is longer than the chord at the limit, then this is just one more reason that the angle BAD must be greater than zero, even at the limit. If AD is greater than AB, then DB must be greater than zero. If DB is greater than zero, then the angle BAD is greater than zero.

All this is caused by the fact that the angle ABD goes to 90° *before* the angle BAD goes to zero. The angle ABD reaches the limit first, which keeps the angle

BAD from reaching it. BAD never reaches zero.

Of course this means that B never reaches A. If B actually reached A, then we would no longer have a triangle. The tangent and the chord are equal only when they both equal zero, and they both equal zero when the interval between A and B is zero. But the 90° angle at ABD prevents this from happening. When that angle is at 90°, the tangent must be greater than the chord. Therefore the chord cannot be zero. If the chord is zero, then the tangent and the chord are equal: therefore the chord is not zero. To put it into a more proof-like form:

1. If the chord AB is zero, then the tangent AD is also zero.

2. zero = zero

3. If AB = AD, then the angle ABD must be less than 90°.

4. The angle ABD cannot be less than 90°.

QED: AB does not equal AD; AB does not equal 0.

In fact, this is precisely the reason that we can do calculations in Newton's "ultimate interval", or at the limit. If all the variables were either at zero or at equality, then we could not hope to calculate anything. Newton, very soon after proving these lemma, used a versine equation at the ultimate interval, and he could not have done this if his variables had gone to zero or equality. Likewise, the calculus, no matter how derived or used, could not work at the limit if all the variables or functions were at zero or equality at the limit.

Some will say that my claim that B never reaches A is like the paradoxes of Zeno. Am I claiming that Achilles never reaches the finish line? No, of course not. The diagram above is not equivalent to a simple diagram of motion. B is not moving toward A in the same way that Achilles approaches a finish line, and this has nothing to do with the curvature. It has to do with the implied time variable. If we diagram Achilles approaching a finish line, the time interval does not shrink as he nears the line. The time interval is constant. Plot Achilles' motion on an x/t graph and you will see what I mean. All the little boxes on the t-axis are the same width. Or go out on the track field with Achilles and time him as he approaches the finish line. Your clock continues to go forward and tick at the same rate whether you see him 100 yards from the line or 1 inch from line.

But given the diagram above and the postulate "let B go to A", it is understood that what we are doing is shrinking both the time interval and the arc distance. We are analyzing a shrinking interval, not calculating motion in space. "Let B go to A" does not mean "analyze the motion of point B as it travels along a curve to point A." It means, "let the arc length diminish." As the arc length diminishes, the variable t is also understood to diminish. Therefore, what I am saying when I say that B cannot reach A is that Δt cannot equal zero. You cannot logically analyze the interval all the way to zero, since you are analyzing motion and motion is defined by a non-zero interval.

The circle and the curve are both studies of motion. In this particular analysis, we are studying sub-intervals of motion. That subinterval, whether it is applied to space or time, cannot go to zero. Real space is non-zero space, and real time is non-zero time. We cannot study motion, velocity, force, action, or any other variable that is defined by x and t except by studying non-zero intervals. The ultimate interval is a non-zero interval, the infinitesimal is not zero, and the limit is not at zero. The limit for any calculable variable is always greater than zero. By calculable I mean a true variable. For instance, the angle ABD is not a true variable in the problem above. It is a given. We don't calculate it, since it is axiomatically 90°. It will be 90° in all similar problems, with any circles we could be given seeking a velocity at the tangent. The vector AD, however, will vary with different sized circles, since the curvature of different circles is different. In this way, only the angle ABD can be understood to go all the way to a zero-like limit. The other variables do not. Since they yield different solutions for different similar problems (bigger or smaller circles) they cannot be assumed to be at a zero-like limit. If they had gone all the way to some limit, they could not vary. A function at a limit should be like a constant, since the limit should prevent any further variance. Therefore, if a variable or function continues to vary under a variety of similar circumstances, you can be sure that it is not at its own limit or at zero. It is only dependent on a variable that is.

If AB and AD have real values at the limit, then we should be able to calculate those values. If we can do this we will have put a number on the "infinitesimal." In fact, we do this all the time. Every time we find a number for a derivative, we put a real value on the infinitesimal. When we find an "instantaneous" velocity at any point on the circle, we have given a value to the infinitesimal. Remember that the tangent at any point on the circle stands for the velocity at that point. According to the diagram above, and all diagrams like it, the tangent stands for the velocity. That line is understood to be a vector whose length is the numerical value of the tangential velocity. It is commonly drawn with some recognizable length to make the illustration readable, but if it is an instantaneous velocity, the real length of the vector must be very small. *Very small but not zero*, since we actually find a non-zero solution for the derivative. The derivative expresses the tangent, so if the derivative is non-zero, the tangent must also be non-zero.

Some have said that since we can find sizeable numbers for the tangential velocity, that vector cannot be very small. If we find that the velocity at that point is 5 m/s, for example, then shouldn't the velocity vector have a length of 5? No, since by the way the diagram is drawn and defined, we are letting a length stand for a velocity. We are letting x stand for v. The t variable is not part of the diagram. It is implicit. It is ignored. If we are letting B approach A, then we are letting t get smaller. A velocity of 5 only means that the distance is 5 times larger than the time. If the time is tiny, the distance must be also.

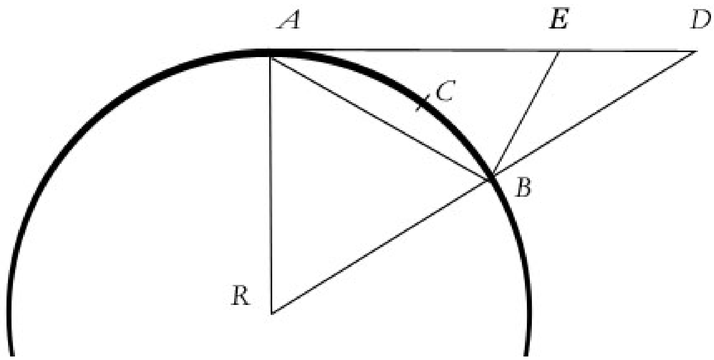
*
* *

There is another way to analyze Newton's problem, and it may be the most interesting of all (for some). In the *Principia*, Newton's actual language in describing this problem (Lemma VI) is this: "if the points A and B approach one another. . ." Two things bear closer attention here. One, A cannot approach B without messing up the geometry. If we start moving the point A, we destroy our right triangle. What he means is what I have said above: Let B approach A. To be rigorous, we should let one point remain stationary and let the other point move. If we let both move, we create unnecessary problems. The other thing to notice is the word "approach". Newton is postulating motion. As confirmation of this, we need only look at his title for this section: "Of Natural Philosophy". Natural philosophy is not pure math, it is physics. Newton is describing a philosophy or study of nature, which we now call physics. Nature is not pure, it is physical.

Therefore this lemma must be a part of what we now call applied mathematics. If this is so, then time must be involved. As I have asserted above, Newton is studying a diminishing interval in order to analyze curved motion. He uses this analysis immediately afterwards to apply to an orbit, for instance. So both motion and time are involved in Newton's analysis. For this reason alone, his angle BAD cannot vanish. That would be taking the problem to a zero time interval, and there is no such thing as a zero time interval in physics. You cannot study motion and then postulate a zero time interval, since motion is defined by a non-zero time interval. If you have a zero time interval, you have no motion, by definition. Simply by using the word "approach", Newton has ruled out a zero time interval. His interval can get smaller and smaller, to any extent he likes, but it cannot vanish. By definition, "approach" and "vanish" are mutually exclusive.

But it gets even more interesting. Using the limit concept alone, this problem cannot be solved at all. Meaning, if we let our angle at R equal θ, then BAD = $\theta/2$ and ABD $= \pi/2 + \theta/2$.

If we let θ go to zero, then BAD and ABD approach the limit in the same way. The limit concept does not support my analysis. No, it supports Newton's analysis, since historically it grew out of his analysis. The limit concept fails to explain why we find non-zero solutions at the limit for both the chord and the tangent, and it fails because its analysis is faulty just as I have shown Newton's analysis is faulty. The limit analysis treats the entire problem as an abstract or pure-math problem, whereas it is a physical problem. Motion and time are both involved here. What that means is that we must have a necessary time separation between A and B. Since we have motion, we cannot have a zero interval. If we do not have a zero interval, then we must have a time separation. Stated that way, we arrive at. . . yes, Relativity. If this is a physical problem, then A and B cannot exist the same time, operationally. An event at B cannot be fully equal to that same event as seen from A. If we think of the measurement of an angle as a physical event instead of an abstract geometric quantity, then angles in a diagram like this must be analyzed from a physical point of view.



Some will think I am overcomplicating this problem, or inventing esoteric solutions, but consider this fact: Newton's gravitational studies and proportionalities came out of this same book, the *Principia*, indeed this same section. Is it not strange that Einstein's Relativity corrections have been applied to gravity but not to the orbit? The diagram above is a preliminary study of the orbit, and underlies $a = v^2/r$, and yet it has never benefitted from a Relativity analysis until now. We think that gravity causes the orbit, and yet we do a Relativity analysis of gravity but not of the orbit. Very strange.

The way that Relativity solves this problem once and for all is that it gives us a way of separating $\theta/2$ at B and $\theta/2$ at A. According to the limit analysis, both angles should diminish in the same way. But because they are spatially separated, they cannot act the same. According to Relativity, we must pick a point and measure everything from there. We must study the problem from A or B, but we cannot study the problem from both places simultaneously. Since we have given the motion to point B, we must let that be our point of measurement. In other words, in this problem, we *exist* at B. The event is at B. Let that event be $\pi/2 + \theta/2$ going to the limit. θ goes to zero, so ABD goes to 90°. Of course BAD is also going to zero, but there is a time lag. As seen or measured from B, information from A must be late, and vice versa. Therefore, as measured from B, the limit at B must be reached before the limit at A. Or, since I have shown that limits are never really reached anyway, especially when those limits are at zero, it would be more rigorous to say that $\theta/2$ is smaller at B, as measured from B, than $\theta/2$ at A. Given time separation, equal angles are not quite equal.

Of course, many people will not like this analysis. Some will find it fascinating and others will find it to be gibberish. Honestly I prefer the simpler explanation myself: we cannot propose a zero time interval, therefore the angles cannot vanish, therefore the lines cannot be equal. No matter how small we go, in order to talk of motion we must have a real time interval. As long as we have a real time interval, we have a triangle. As long as we have a triangle, we have a tangent that is longer than the chord. We "approach" the limit, we do not "reach" the limit. That said, I believe the Relativity analysis is also correct. Either analysis gets the right answer, using ideas that are physically correct and physically real. To be consistent, if we apply time separations to the gravitational field, we must also apply them to the orbit. Gravity cannot physically cause the orbit, Relavity applying to gravity but not to the orbit. Since Newton's whole section in question here is physical, we must either apply Relativity to all of it, or to none of it. Einstein updated Newton's analysis of gravity, and I have just done the same for the orbit.

Conclusion

My finding in this paper affects many things, both in pure mathematics and applied mathematics. I have proven, in a very direct fashion, that when applying the calculus to a curve, the variables or functions do not go to zero or to equality at the limit. This must have consequences both for General Relativity, which is tensor calculus applied to very small areas of curved space, and quantum electrodynamics, which applies the calculus in many ways, including quantum orbits and quantum coupling. QED has met with problems precisely when it tries to take the variables down to zero, requiring renormalization. My analysis implies that the variables do not physically go to zero, so that the assumption of infinite regression is no more than a conceptual error. The mathematical limit for calculable variables – whether in quantum physics or classical physics – is never zero. Only one in a set of variables goes to zero or to a zero-like limit (such as the angle 90°). The other variables are non-zero at the limit. For QED, this means that when the Planck limit is reached, length and time limits are also reached. Neither time nor length variables may go to zero when used in momentum or energy equations of QED. In fact, beyond the logic I have used here, it is a contradiction to assume that values for energy would *not* have an infinite and continuous regression toward zero, but that values for length and time would.

This is not to say that length and time must be quantized; it is only to say that in situations where energy is found empirically to be quantized, the other variables should also be expected to hit a limit above zero. Quantized equations must yield quantized variables. Space and time may well be continuous, but our *findings* – our measurements or calculations – cannot be. Meaning, we can imagine shrinking ourselves down and using tiny measuring rods to mark off sub-areas of quanta. But we cannot *calculate* subareas of quanta when one of our main variables – Energy – hits a limit above these subareas, and when all our data hits this same limit. The only way we could access these subareas with the variables we have is if we found a smaller quantum.

As I said, there has also been confusion on this point in the tensor calculus. In section 8 of Einstein's paper on General Relativity, he gives volume to a set of coordinates that pick out a point or an event. He calls the volume of this point the "natural" volume, although he does not tell us what is "natural" about a point having volume. General Relativity starts [section 4] by postulating a point and time in space given by the coordinates $\mathrm{d}X_1, \mathrm{d}X_2, \mathrm{d}X_3, \mathrm{d}X_4$. This set of coordinates picks out an event, but it is still understood to be a point at an instant. This is clear since directly afterwards another set of functions is given of the form $\mathrm{d}x_1$, $\mathrm{d}x_2$, $\mathrm{d}x_3$, $\mathrm{d}x_4$. These, we are told, are the "definite differentials" between "two infinitely proximate point-events." The volume of these differentials is given in equation 18 as

$$\mathrm{d}\tau = \int \mathrm{d}x_1\,\mathrm{d}x_2\,\mathrm{d}x_3\,\mathrm{d}x_4$$

But we are also given the " natural" volume $\mathrm{d}\tau_0$, which is the "volume $\mathrm{d}X_1$, $\mathrm{d}X_2$, $\mathrm{d}X_3$, $\mathrm{d}X_4$". This natural volume gives us the equation 18a:

$$\mathrm{d}\tau_0 = \sqrt{-g\mathrm{d}\tau}$$

Then Einstein says, "If $\sqrt{-g}$ were to vanish at a point of the four-dimensional continuum, it would mean that at this point an infinitely small 'natural' volume would correspond to a finite volume in the co-ordinates. Let us assume this is never the case. Then g cannot change sign. . . . It always has a finite value."

According to my disproof above, all of this must be a misuse of the calculus, a misuse that is in no way made useful by importing tensors into the problem. In no kind of calculus can a set of functions that pick out an point-event be given a volume – natural, unnatural, or otherwise. If dX_1, dX_2, dX_3, dX_4 is a point-event in space, then it can have no volume, and equation 18a and everything that surrounds it is a ghost.

In the final analysis this is simply due to the definition of "event". An event must be defined by some motion. If there is no motion, there is no event. All motion requires an interval. Even a non-event like a quantum sitting perfectly still implies motion in the four-vector field, since time will be passing. The non-event will have a time interval. Every possible event and non-event, in motion and at rest, requires an interval. Being at rest requires a time interval and motion requires both time and distance intervals. Therefore the event is completely determined by intervals. **Not coordinates, intervals**. The point and instant are not events. They are only event boundaries, boundaries that are impossible to draw with absolute precision. The instant and point are the beginning and end of an interval, but they are abstractions and estimates, not physical entities or precise spatial coordinates.

Some will answer that I have just made an apology for Einstein, saving him from my own critique. After all, he gives a theoretical interval to the point. The function dX is in the form of a differential itself, which would give it a possible extension. He may call it a point, but he dresses it as a differential. True, but he does not allow it to *act* like a differential, as I just showed. He disallows it from corresponding to (part of) a finite volume, since this would ruin his math. He does not allow $\sqrt{-g}$ to vanish, which keeps the "natural" volume from invading curved space.

Newer versions of this same Riemann space have not solved this confusion, which is one of the main reasons why General Relativity still resists being incorporated into QED. Contemporary physics still believes in the point-event, the point as a physical entity (see the singularity) and the reality of the instant. All of these false notions go back to a misunderstanding of the calculus. Cauchy's "more rigorous" foundation of the calculus, using the limit, the function, and the derivative, should have cleared up this confusion, but it only buried it. The problem was assumed solved since it was put more thoroughly out of sight. But it was not solved. The calculus is routinely misused in fundamental ways to this day, even (I might say *especially*) in the highest fields and by the biggest names.

Chapter 20

A CORRECTION TO THE EQUATION $a = v^2/r$

(and a Refutation of Newton's Lemmae VI, VII & VIII)

Introduction

It is assumed by most that Einstein's corrections to Newton's gravitational equations all but completed the necessary analysis of the problem. Einstein fine-tuned an already highly successful mathematics, and almost nothing is left to be done. That is current wisdom.

Of course work continues on the mechanism of gravity, since it is still completely unknown. But the mathematics of gravity is considered to be finished. No one is working on the field equations of General Relativity because they are assumed to be correct.

This paper shows that this assumption cannot be maintained. I have uncovered a basic error of math in one of Newton's fundamental equations. The equation, and Newton's derivation of it, has stood unquestioned for centuries. The equation is used today in many esoteric theories, including the derivation of the Schwarzchild radius, the predicted intensity of a gravity wave, and on and on. It is imported into these derivations as a known fact. Furthermore, the equation is used in General Relativity. It is one of the basic preconditions of several parts of various tensors. I show that all these derivations and computations are fatally compromised by this.

The equation is $a = v^2/r$. We all learned this equation in high school, in regard to uniform circular motion. It states the relationship between an orbiting velocity and centripetal acceleration. The reason the equation is used so often in contemporary physics is that it is also assumed to describe the relationship, in its simplest form, between an orbiting body and the force of gravity felt by that body. It is basic physics, and I would guess that no one has looked hard at the equation in a very long time. Certainly no one has had the perspicuity, or the gumption, to question it in a high school physics class. By the time a student of physics reaches college such equations are not interesting anymore – they are outgrown toys – ones to be used if needed, but never closely examined.

I was led to examine this equation due to problems that have cropped up in several fields. I will not get into theory in this paper: suffice it to say that the fundamental concepts of gravity seemed to me a bit attenuated in several areas.

What was necessary, in my opinion, was not more esoteric math – as in pursuing superstring theories and the like – but rather a closer look at the theories and concepts that supported gravitational mathematics, and especially the simple algebra that lay under most of the higher math. In doing so, I have discovered many errors that can only be called astonishing, I think. This paper relates one of them.

20.1 Newton's Derivation

Newton used the equation $a = v^2/r$ to tie his famous equation of universal gravitation to Kepler's Third Law. That is,

$$F = \frac{Gm_1m_2}{r^2}$$

becomes

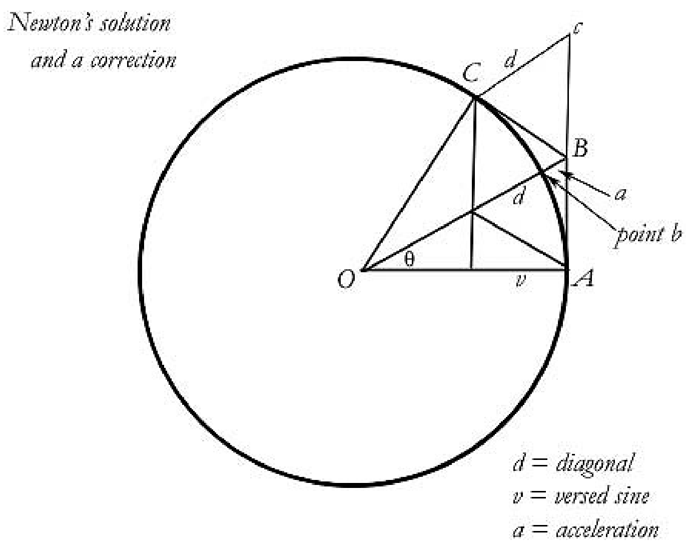
$$\frac{t^2}{r^3} = \frac{4\pi^2}{Gm_2}$$

only by assuming that

$$a = \frac{v^2}{r}$$

The full derivation is in all college textbooks and I will not repeat it here. I only mention it to show that $a = v^2/r$ has been a bedrock equation from the beginning. Newton treated it almost as an axiom himself. He "proved" the equation in a very early part of the *Principia* (Section 2, Proposition 4). I say "proved" because the equation is actually introduced as a corollary, with only the outline of a proof. Corollary 1 is but one sentence embedded in a theorem. This is corollary 1, in full: "Therefore, since those arcs are as the velocities of the bodies, the centripetal forces are in a ratio compounded of the duplicate ratio of the velocities directly, and of the simple ratio of the radii inversely." In modern English, that is, "Since the arc describes the velocity, the acceleration is the square of the velocity over the radius." Newton might justly reply that his sentence contains no implication of exact equality. He simply said that the force was proportional to the inverse of the radius. Therefore, if the equality is not exact the mistake was never his.

In fact, in the previous paragraph, he had said, "These forces tend to the centers of the circles and are one to another as the versed sines of the least arcs described in equal times; that is, as the squares of the same arcs applied to the diameters of the circles." I read this to mean that, according to the trigonometry applied to the problem, it is the diameters that take the proportionality, in the first instance. Newton then elides from diameter to radius simply by saying, "since the diameters are as the radii." To me this proves beyond a doubt that he is talking in this section of proportionalities, not equalities. Both the radius and the diameter are equally proportional, since proportionality does not take into account first-degree magnitudes. If you are proportional to $2x$ then you are proportional to x.



The current derivation of the equation never mentions Newton's method using the versed sine, presumably since knowledge of versed sines is no longer common. Or it may be that the method is not mentioned because it is very difficult to penetrate. I will show that it comes much closer to solving the problem than the current derivation. This should not be too much of a surprise, considering the author. However, by standing on Newton's shoulders modern science should have seen farther eventually, one would have hoped, given the 300 years it has had to perfect his work. Instead it appears that it has only used its time to become myopic, replacing a slightly flawed derivation with one that is a mathematical embarrassment.

Since I prove below that the current derivation fails badly, I feel I must also analyze Newton's original derivation, to show that science does not, at least, have the ignominy of replacing a correct derivation with an incorrect one. Both Newton and the current derivation make fundamental errors in analyzing circular motion.

Newton proposes a body that moves from A to B, is there compelled by a force which turns it, and continues on to C. It had a constant velocity to start with, therefore $AB = Bc = BC$. Newton postulates that c is where the body would have gone without the force. He seeks the size and direction of the force to turn the body from c to C. He assumes that d is the acceleration vector caused by that force, since it is the difference in the two velocities.

In trigonometry, the versed sine is simply the outer section of the radius, when the radius has been cut by a line dropped from the far end of the arc. Newton never draws this line in his *Principia* diagrams, which is interesting. Newton liked to hide his math, for whatever reason. It is assumed that the reason was to keep the competition guessing, but in this case it appears to me to be a bit of obfuscation. Hiding good math may be cleverly cloak-and-dagger for some, but hiding bad math is always something less than that. What Newton is hiding may have been clearer in the 17$^{\text{th}}$ century, but it is very arcane now. The versed sine approaches zero very fast for very small angles, so that it may take on what is called the *sagitta* equation:

$$\text{versine} = \frac{h^2}{2r} \quad (\text{where } h = r\theta)$$

Newton proposes that, at the limit, $h =$ the arc. And, since the versine is proportional to the centripetal force, the acceleration must be proportional to $\text{arc}^2/2r$.

Furthermore, he says, the arc is equal to the velocity, so that a is proportional to $v^2/2r$. But, the versine is only half the force, he says [see Prop. I, Corollary IV], so that the full acceleration becomes $a = v^2/r$. You can see that the *sagitta* equation is the key to understanding Newton's derivation. Newton gives away none of this in the *Principia*, but it is the only way to understand his comments on the versed sine.

This is Newton's hidden math, such as it is. It is finessed in several ways, one of which is his use of Lemma VII. In Lemma VII, Newton states that at the limit (when the interval between two points goes to zero), the arc, the chord and the tangent are all equal. But if this is true, then both his diagonal and the versine must be zero. According to Lemma VII, everything goes to either equality or to zero at the limit, which is not helpful in calculating a solution. Neither the versine equation nor the Pythagorean theorem apply when we go to a limit by Newton's definition. I will show below, with a very simple analysis, that the tangent must be allowed to remain greater than the chord at the limit; only then can the problem be solved without contradiction.

Before I do that, it is interesting to note that Newton nearly achieves the correct answer, despite some faulty lemmae. The versine will give us the correct answer, provided we analyze the correct interval. The versine becomes equal to a only if we are considering the arc length from A to b. Newton has been considering the arc length from A to C. We must drop the perpendicular from b instead of C, in order to achieve the correct versine. If we do this, we do indeed find that versine$= a$ at the limit.

Once we have found a in this way, there is no need to double it though, since in finding the versine we used the angle θ and the arc length from A to b. That must therefore be our interval. You may say that the only difference in Newton's method and my correction is that he finds the force over the interval from A to C, whereas I find the force from A to b. His force is twice mine, and his arc is twice mine, therefore everything should stay the same. But it is not quite that simple.

What we find by Newton's method once we discover d, is the force required to move the body from c to C over the interval B to C. I agree that this force is

$$d = 2a = \frac{v^2}{r}$$

Newton then spreads that force out over the interval from A to C, and we have our current equation. Obviously, the force to take the body from A to C is twice the force to take it from A to b. If I admit that $a = v^2/2r$ then I must admit that $d = v^2/r$. I do admit it. But there remains one very big problem. Newton has gone to the limit to find d. I have gone to the limit to find a. We are both supposed to be at the ultimate ratio. I have just shown, however, that he has found the solution over not one but two intervals. He begins Proposition I with this: "For suppose the time to be divided into equal parts, and in the first part of that time let the body by its innate force describe the right line AB. In the second part of that time, the same would proceed directly to c, along the line Bc equal to AB." So he has postulated two time intervals. You cannot postulate two time intervals and then postulate that you are at the ultimate interval. The ultimate interval is the last interval in the series. It cannot be further subdivided, by a time variable or by anything else. Therefore $d = v^2/r$ must apply to two time intervals. It is the force required to move the body twice the ultimate arc distance, by Newton's own reasoning.

Perhaps you can already see that it is much more logical simply to let Ab be the ultimate interval, so that the arc Ab is compounded of the vectors AB and Bb. Then we can solve for a using either a versine or the Pythagorean theorem – which is what I do below. In either case we find that over the ultimate interval, $a = v^2/2r$.

I want to highlight one thing before I move on. I quoted Newton above as saying that the arc was the velocity, as derived by his method and by his equations (which still stand today). This means that the variable v in all final equations must be understood to be the orbital velocity. It is not the tangential velocity. The tangential velocity is shown by a straight-line vector along the tangent. That means that it moves in that direction. That is what the vector stands for. The tangential velocity does not curve, and it does not follow the curve of the arc. In the diagram above, the tangential velocity over the first interval is AB and the orbital velocity is Ab. Newton gives us the tangential velocity to start with, when he gives us AB; then we seek the orbital velocity. The velocity that follows the curve of the arc is the orbital velocity, and it is the velocity variable in Newton's final equation $a = v^2/r$. Historically, physicists have not kept these two velocity variables separate, but you must learn to do so as you follow the arguments and diagrams in this paper. The two velocities have become conflated, and when we get to modern equations like $v = r\omega$, there is confusion about what v we are talking about. Contemporary textbooks tell us that the v in that equation is tangential velocity, but it isn't. It is orbital velocity.

In further analyzing this problem, I will also prove that the arc does not describe the velocity – or any true velocity – and that we require a further equation to express a in terms of the tangential velocity. The tangential velocity and the orbital velocity are not the same thing – although by Newton's Lemma VII they have been taken for the same thing throughout history. The tangential velocity is the tangent and the orbital velocity is the arc. Lemma VII says that they are the same length at the limit. I will prove that this is false. Beyond that, I would ask you to consider the very elementary fact that an arc is a curve. A curve cannot describe a velocity, since by definition a velocity cannot curve. A curve describes an acceleration, as we all know. The orbital velocity is a velocity only over the ultimate interval – where it becomes straight. But even there it is not equal to the tangential velocity, as I will prove.

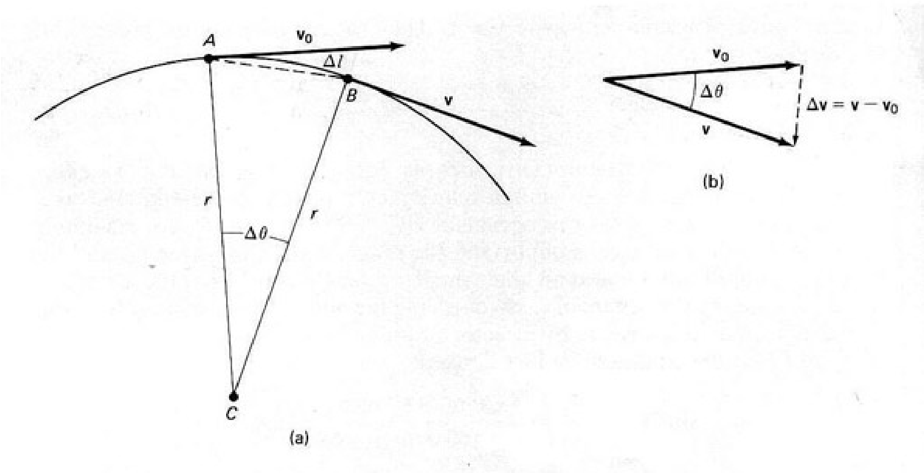
It may also be worth pointing out that the basic linear equation for acceleration is $v^2 = v^2{}_0 + 2ar$. That is in chapter one of most physics books. It took me several years *after* writing this paper to remember that that reduces to

$$\begin{aligned} v^2 &= 2ar \\ \frac{v^2}{2r} &= a \end{aligned}$$

Amazing, really, that no one thought to connect those two equations.

20.2 The Current Solution

Newton provided a mathematical proof that was both slender and dense, but current textbooks offer a slightly more explicit derivation. What I have copied here is the standard mathematical derivation of $a = v^2/r$. I have taken the steps below from a recent college textbook.



This then is the accepted derivation of $a = v^2/r$:

Let v_0 be the initial tangential velocity, as shown in the first illustration.

Since v_0 and v are both perpendicular to r, the two angles θ must be equal; therefore the triangles shown are similar;

therefore as $t \to 0$,

$$
\begin{aligned}
\frac{\Delta v}{v} &= \frac{\Delta l}{r} \\
\Delta v &= \frac{v \Delta l}{r} \\
a &= \lim_{t \to 0} \frac{\Delta v}{\Delta t} \\
&= \lim_{t \to 0} \frac{v \Delta l}{r \Delta t}
\end{aligned}
$$

And since the speed, v, of the object is $\lim_{t \to 0} \Delta l / \Delta t$

$$a = \frac{v^2}{r}$$

The book says, "When Δt is very small, Δl and the angles are also very small, so v will be almost parallel to v_0, and Δv will be essentially perpendicular to them. Thus Δv points toward the center of the circle."

The mistakes here are many. Disregarding the conceptual setup and the calculus for a moment, let me hit the most important problem first. In its derivation the textbook assumes that the variable v in the last equation is the same as the one in the first. But it's not. In the first line of the derivation, the variable v stands for the tangential velocity. Four lines later we are told "the speed of the object, v, is $\lim_{t \to 0} \Delta l/\Delta t$."

But that is the orbital velocity! The variable v has switched. You can see that v in their first diagram is not $\lim \Delta l/\Delta t$, since $\lim \Delta l/\Delta t$ is the curved velocity from A to B: v is only a component of that velocity; v **is a straight line!** But the book substitutes one for the other. That is, $v\Delta l/r\Delta t$ magically becomes v^2/r. But, if $v \neq \lim_{t \to 0} \Delta l/\Delta t$, then the substitution must fail. It does fail, and the derivation falls with it.

A closer analysis of the situation shows that v is the tangential velocity, $\Delta l/\Delta t$ is the orbital velocity, and they will never be equal – not over any interval, including an infinitesimal interval. The book needs subscripts to differentiate the two, like v_t and v_{orb} (for v orbital). $v_{orb} = \Delta l/\Delta t$ but $vt \neq \Delta l/\Delta t$. So the equation $a = v^2/r$ should read $a = v_t v_{orb}/r$, if the book is following its own method very closely.

$$\frac{v_t v_{orb}}{r} \neq \frac{v^2}{r}$$

It is finally unclear whether v in the current equation applies to orbital or tangential velocity, since the derivation makes both assumptions.

For those who are already confused, let me state that in a slightly different manner. This modern derivation is a piece of prestidigitation, or sleight of hand. Like a magician who has crossed over, I will uncover the magic for you. Return to the illustration and notice that they have labelled the two tangential velocities as v_0 and v. Why? The two vectors are both tangential velocities, they are just in different positions. But it is the length or numerical values of the vectors we are interested in, not their positions. The numerical values are the same, so the vectors should both be labelled the same. In *value*, $v_0 = v$, so labelling them differently is just a trick. It is this trick that allows the magicians here to push you from v_0 to v, and to complete this dishonest proof. Look again at the equation

$$\frac{\Delta v}{v} = \frac{\Delta l}{r}$$

Ask yourself, shouldn't that be

$$\frac{\Delta v}{v_0} = \frac{\Delta l}{r}$$

That is where the switch was made. That is where the hand is quicker than the eye. As you see, v_0 has shifted to v, so that when the arc is *also* defined as v, the two will look the same on the page. Then the magicians can substitute one for the other, and achieve the desired result.

Shocking, really, to find such hamhanded cheating in foundational math and physics.

But there are even more problems. Notice that the magicians allow themselves to make substitutions in a limit equation. I am talking about the equation

$$a = \lim_{t \to 0} \frac{\Delta v}{\Delta t}$$

They substitute $v\Delta l/r$ into that. But you can't do that, because those variables are captured by the limit sign. That equation reads, "The limit as t goes to zero of change in v, etc." That is not the same as simply "change in v." The substitution is disallowed. After the substitution, you see, you have Δl going to the limit, whereas before you had Δv. To make the substitution, you have to assume that the two delta variables go to the limit in the same way, but you cannot assume that. The specific reason you cannot assume it is here is because the two deltas are not equivalent. Δl, like Δt, is a simple interval. But Δv is a change in velocity, which is not a simple interval. A change in velocity is already an acceleration, by definition, which means it is not the same sort of variable that Δl is. In the calculus, you must differentiate lengths and velocities and accelerations, usually by primed variables, but here we have none of that. An acceleration looks just like a length here, with no difference in notation.

And the problems continue. The entire (b) part of the illustration is false. $\Delta v \neq v - v_0$, because this math is concerned with values, as I said. The numerical value of v is the same as the numerical value of v_0, so Δv could only be zero here. A body in orbit does not change the numerical value of its velocity. It has a constant velocity. The difference between v and v_0 is only an angle here. So solving in this way can only be called perverse. Even Newton didn't try to subtract one tangent from another. Look back above at his derivation. He analyzes lengths and velocities and acceleration in the *same* interval, not in subsequent intervals. The vector v should be no part of this analysis, and using it to manufacture a proof here is just flamboyantly bad math.

20.3 Feynman's Variation

Some will say that I have simply taken a bad of example of the proof from a poor textbook. To answer this I will provide a different proof from a completely different book. I will critique a proof of the equation by Richard Feynman. Feynman is famous for explaining difficult problems lucidly and concisely, we are told. I take the proof from *Six Not-so-Easy Pieces*.

Feynman varies the problem a bit, for good measure. This will get us out of our rut, perhaps. He postulates any velocity along a curve, not necessarily a circle.

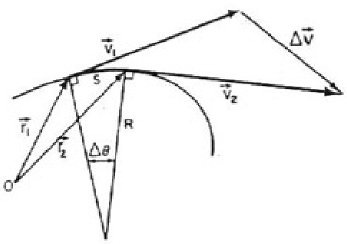


Figure 1-7. A curved trajectory.

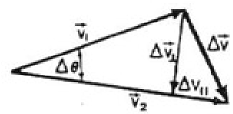


Figure 1-8. Diagram for calculating the acceleration.

As you can see from his diagrams, the tangential velocity varies and this gives us two components to the acceleration. [In the first diagram, you can ignore the little r vectors and the origin o: they do not really come into this problem. And the vector for Δv is drawn in the wrong place on purpose by Feynman. I will not take him to task for it. He "corrects" it in the second diagram. I do take him to task for that correction.]

He says, "The acceleration tangent to the path is of course just the change in length of the vector." I agree. But I point out that in uniform circular motion this component of the acceleration will be zero, since the length of the vector is not changing. He then calculates the other component, the acceleration at right angles to the curve. You can see the break down in his second illustration. This illustration clears up some of the points left vague in the textbook illustrations. You can see, for one thing, that the right angle made by $\Delta v_\perp$ is where it intersects v_2, not v_1. He then says that $\Delta v_\perp = v\Delta\theta$, where "$v$ is the magnitude of the velocity." He does not specify which velocity, but it is clear that he means v_1, since that is the hypotenuse. That is the only way the equation even looks like working, at a glance.

But we already have major problems. $\Delta v_\perp = v\theta$ is a false equation. I hope you can see that it should be $\Delta v_\perp = v\sin\theta$.

There is more. Let us say that the tangential acceleration happens to be zero over this interval of the curve. We are back to circular motion in that case. We keep Feynman's second diagram but lose $\Delta v_{\parallel}$. But you can see that makes v_2 shorter than v_1. Feynman's triangle must be a right triangle for his last equation to work.

But the lengths don't add up. $v_2 - \Delta v_{\|} \neq v_1$. This means that to calculate a perpendicular acceleration, he must have a negative parallel acceleration. Logically impossible.

Feynman gets into even more trouble. In the next step he lets $a_\perp = v_\perp/\Delta t$. That should be $a_\perp = v\,sin\theta/\Delta t$. But to get $\Delta\theta/\Delta t$, he says, if "at any given moment the curve is approximated as a circle of radius r, then in a time Δt the distance s is of course $v\Delta t$ where v is the speed." This would give us

$$\begin{aligned}\Delta\theta &= \frac{v\Delta t}{r}\\ \frac{\Delta\theta}{\Delta t} &= \frac{v}{r}\\ a_\perp &= \frac{v^2}{r}\end{aligned}$$

I hope you can see that he made exactly the same "mistake" in that step as the textbook. You must go back to his first illustration to find s. Once you find it you see that s curves: s is a distance along the arc. He says that

$$s = v\Delta t$$

But this is simply not true. He has already defined v as the magnitude of v_1. Therefore $v\Delta t$ describes a straight line length along that first vector v_1 – not a length along the curve. He has confused tangential velocity and orbital velocity. His variables have shifted in the same way the textbook's did. Nor does he tell us at the end what v stands for in the final equation. A reader has no idea, since he has defined it both ways.

Furthermore, he has hidden a step previous to $\Delta\theta = v\Delta t/r$ above. He needs an equation for the arc length s, which would be

$$\frac{\Delta\theta}{2\pi} = \frac{s}{2\pi r}$$
$$\Delta\theta = \frac{s}{r}$$

Notice that this is not the same as $\sin\theta = s/r$, therefore the substitution fails. Remember that we had $\Delta v_\perp = v\sin\theta$ from above. You can see why Feynman suppressed that step. He didn't want it to suffer any scrutiny. **Besides, the equation $\Delta\theta = s/r$ only works if θ is measured in radians**. But Feynman cannot measure the angle in radians and hope to achieve a solution this way. He wants a velocity measured in m/s, not in radians/s.

Also notice the strange notation for the angle. An angle is usually represented simply by a variable, not by a delta variable. That is, θ not $\Delta\theta$. An angle is already understood to be a change in direction: the delta is superfluous. But in these derivations both Feynman and the textbook use the delta notation. Why? In order that the derivation seem to work. To trick the eye. *Trompe l'oeil*. That delta sign makes the variable seem more than it really is. It is a sort of mystification. You look at that the first time and say to yourself, "What does that mean? $\Delta\theta$? Does it mean something more than θ. I don't know, but maybe Feynman knows. This proof must work, since I already know that $a = v^2/r$, so it is best just to pretend I understand what is going on here." The problem, you now see, is that no one knows what is going on here. The proof is a whitewash.

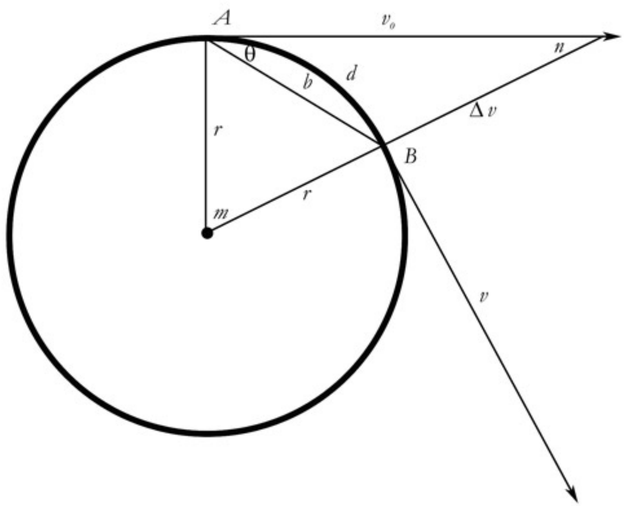
And finally, notice that Feynman has simply done a copy job on the textbook's ridiculous illustration. Specifically, he has drawn v^2 sticking off the far end of the arc. He glibly warns us that vector additions work "only when the tails of the vectors are in the same place" and so he moves the tail of v_2 to that of v_1. What he forgets to warn himself is that vector additions work only when the vectors are in the same interval. Importing a vector willy-nilly from a subsequent interval just because you need it to finesse an equation is no better than drawing open-tailed vectors or three-headed vectors.

Feynman's proof fails. It fails in at least three places in a half-page derivation. I am unsure what to think of this, frankly. I truly do not know whether he and everyone else cannot follow short steps of high school geometry or whether there is a conspiracy to hide these errors. It is beyond belief that the greatest minds of the 20th century cannot see these errors. This sequence of steps in Feynman's book is so obviously finessed that it can only mean that it was done purposefully, I think. You may think the arc length equation was left out because everyone knows it by heart. I think it was left out to help hide the unequal substitution of $\sin\theta$ for $\Delta\theta$. If Feynman and others like him cannot see these mistakes, it is a very bad sign. If they can, it is a very bad sign, since it means that we are the victims of some sort of Jesuitical casuistry – being lied to for our own benefit. We must believe that science is not another house of cards, lest we run screaming into the night. Therefore we must take these absurd derivations on faith. *Credo quia adsurdum*. I suspect that this derivation is used simply because it was used by Newton, and we have never been able to improve on it. It yields the correct experimental numbers, so who cares that it is full of holes?

20.4 My Solution

We have seen three different failed derivations, from the likes of Newton and Feynman, no less (although I should probably not put Newton and Feynman in the same sentence). I will not critique Huygens derivation here, since I consider it equivalent to Newton's. He, like Newton, correctly showed the proportionality of the acceleration, the radius and the "velocity." But he did not incontestably show the equality. I will do so now, by a very transparent method.

In my drawing, a right triangle is formed by the radius, the tangential velocity, and Δv added to another radius. No matter how short or long you make the tangential velocity vector the right triangle pertains. Also notice that in my illustration Δv is always pointing at the center of the circle. It does not point at the center only when t or Δv or arc d is zero. It points at the center if v_0 is very long or if it is infinitesimal. Now all we need is the Pythagorean theorem.



I have drawn v flying off like that only to mirror the textbook illustration, to show how absurd it really is. In my solution, that vector is superfluous.

$$\begin{aligned} v_0^2 + r^2 &= (\Delta v + r)^2 \\ \Delta v^2 &= 2\Delta v r - v_0^2 \\ \Delta v &= \frac{\pm\sqrt{4r^2 + 4v_0^2} - 2r}{2} \end{aligned}$$

If we assume a positive motion around the circle, that reduces to

$$a = \sqrt{v_0^2 + r^2} - r$$

First of all, notice that $\Delta v = a$. That vector is the centripetal acceleration. That vector is the number we are seeking. I followed the example of the book and

Feynman in putting off a full description of what Δv applies to. Until now. But it is clear that Δv is not a velocity vector. It is an acceleration vector. Of course the form alone should tell us the difference. A delta v vector is not the same as a v vector. A delta v vector is an acceleration vector, clearly. Feynman and the textbook imply that it is the difference between one tangential velocity and the next: a difference between velocities is an acceleration. But I have shown that the acceleration vector Δv can be calculated from a single tangential velocity, given the radius. It is the difference between the tangential velocity and the orbital velocity, measured over the same interval. In this way my analysis mirrors that of Newton, who said the same thing. See above where Newton defines the length d as *the difference between the tangential velocity and the orbital velocity, measured over the same interval*. My illustration also mirrors his, as you can see. Just flip his illustration over, and his d is my Δv. The only difference is that I point my vector at the center of the circle.

Some will say, "That won't work. You need to differentiate. You need to find your values at a $\mathrm{d}t$. As it is, you will get a different value for a depending on whether you solve at $\Delta t = 1$, $\Delta t = 5$, or $\Delta t = \mathrm{d}t$. A change in the length of your v_0 vector will change the length of your a vector."

No, it won't: v_0 is a constant in the case you are offering. If you are just varying times to make v_0 change in length, you are talking about a particular given circle. You are not talking about *any* circle. Therefore, if you increase the Δt from one to five, for example, you are also increasing the distance along the vector: therefore the velocity stays the same. A shorter velocity vector in that case is not a different velocity; it is the same velocity measured over a shorter time. If you make the move from $\Delta t = 5$ down towards $\mathrm{d}t$, and the triangle gets smaller, the value for v_0 does not get smaller. Velocity equals x/t, remember. The length of the vector expresses only the x, but the t is always implied.

We don't need to differentiate, because differentiation would yield a change in that vector. It would require us to consider the vector Δv a velocity, and we would be calculating a change in that velocity, a $\Delta\Delta v$, during an infinitesimal interval $\mathrm{d}t$. Not only is that unnecessary, it is absurd. If the vector were a velocity, it would not change over any interval, not a large interval or a tiny interval $\mathrm{d}t$. Therefore $a \neq \mathrm{d}v/\mathrm{d}t$ nor $\mathrm{d}\Delta v/\mathrm{d}t$. Those equations would only yield $a = 0$. Δv is already a differential – it is the difference between two velocities – therefore it would be redundant to differentiate it. The Pythagorean theorem works at any t, even $\mathrm{d}t$. But there is no limit here, since the value for a is the same whether you calculate it at any real interval (a large triangle) or near zero (a tiny triangle).

Think of it this way: the equation $a = \mathrm{d}v/\mathrm{d}t$ describes a ratio of change between v and t. If v does not change as t changes, then v is a constant. The derivative of a constant is zero. Therefore it makes no sense to differentiate a constant velocity, even if it happens to be labeled Δv.

You may say, "OK, but is all that legal? Can you combine different vectors in a vector addition? Isn't there some rule about mixing acceleration vectors and velocity vectors?" Yes, there are rules. The length of the vector stands only for its numerical value: that's why you must keep careful track of angles. But no one has ever had any problem with the way that distance vectors and velocity vectors were combined in this problem, historically. The radius of the circle is obviously not a velocity; it is a distance. But both the textbook and Feynman use the radius and the velocity vectors as values that can be put in the same equation. If you can do that, why not use acceleration vectors as well? The answer is, you can, and Newton, the textbook and Feynman all do that, too. They just don't call attention to it. They solve this problem without ever defining their variables. The trick is, apparently, to fail to define anything: then everyone will accept it without question. But Feynman's vector Δv must also be an acceleration vector, just like mine. Why do you think it is labeled with a delta? A delta v is an acceleration. The vector makes no sense as a velocity, not in his diagram or mine. If Feynman had defined it as a velocity vector, then notice that that vector does not change in length all the way around the circle – if the motion is circular. If there is no change in that velocity vector, then $a_\perp$ must be zero. Neither the orbital velocity nor the tangential velocity (nor the vector Δv) change in magnitude over any interval, so calculating any change in any v, or an a that was a change in v, would only give us the number 0. The number we have always achieved in the equation $a = v^2/r$ for a can only signify the acceleration vector that I have just found.

Feynman says that $a_\perp = \Delta v_\perp/\Delta t$. But $\Delta v_\perp$ is always the same in uniform circular motion, by definition. It is a constant in his diagram and mine. Therefore in his equation, $a = 0$. And we see yet another way that he finessed this proof. For that equation to work, $v_\perp$ would have to be a velocity vector. Otherwise the form of the equation makes no sense. In the vector diagram he labels the tangential velocity v_1. Then he labels the perpendicular velocity $\Delta v_\perp$. One is a variable and one is a delta variable. For what reason? They are equivalent types of vectors according to this equation. If that is so, then $\Delta v_\perp$ should be labeled simply $v_\perp$. He does it to confuse the issue. He needs a number for $\Delta v_\perp$ to put into this equation: $a_\perp = \Delta v_\perp/\Delta t$. And he does gets a number. That seems to imply that the equation will yield a non-zero number for $a_\perp$. But by his notation, what we really need to make the equation a real equation is this $a_\perp = \Delta\Delta v_\perp/\Delta t$. We need a change in his velocity variable – which he labeled $\Delta v_\perp$ for no reason. A change in his perpendicular velocity would then read $\Delta\Delta v_\perp$. But $\Delta\Delta v_\perp = 0$.

If Feynman admitted that $\Delta v_\perp$ is an acceleration vector to start with, then I could answer that his equation does not work that way either. $a_\perp = \Delta v_\perp/\Delta t$ is false, since you would then have $a_\perp = a_\perp/\Delta t$. The rest of his substitutions also get skewed if he defines $\Delta v_\perp$ as an acceleration vector. But it must be one or the other. It is either an acceleration vector or a velocity vector, but I have shown that neither works in his proof.

You may say that my Δv is a constant, too. Yes, it is a constant **acceleration**. But it is not zero, since I never differentiate it.

As a final proof that my analysis of $a = \Delta v$ is correct, go back to the beginning of Feynman's proof. Remember that he said, "The acceleration tangent to the path is of course just the change in length of the vector." Aha! No differentiating or putting the change in length of the vector over Δt there. If you translate his quote into a mathematical equation, it reads, $a_\parallel = \Delta v$. That is all. If the acceleration tangent to the path is figured in that way, why would the acceleration perpendicular be figured in some convoluted way? The answer: it is not. It is figured in exactly the same way.

Besides, with the tangent acceleration in his example, you can differentiate if you want: it doesn't matter as long as you use the correct velocity variable. If you differentiate v_1 in his diagram (not $\Delta v_\parallel$), you get $a_\parallel$. You also get $\Delta v_\parallel$, since $a_\parallel = \Delta v_\parallel$. In other words,

$$a_\parallel = \frac{\mathrm{d}v_1}{\mathrm{d}t} = \Delta v_\parallel \neq \frac{\mathrm{d}\Delta v_\parallel}{\mathrm{d}t}$$

likewise

$$a_\perp \neq \frac{\mathrm{d}\Delta v_\perp}{\mathrm{d}t}$$

You cannot differentiate $\Delta v_\perp$ in order to calculate $a_\perp$, since $\Delta v_\perp$ does not change over time. And you cannot use Feynman's other tricks, since I have shown they are all dirty tricks.

Someone may notice that my equation gives the wrong notation for an acceleration. Yes, that is true. In using the Pythagorean theorem on the lengths of the vectors, I lost their full notation. I only found the length of the acceleration vector, which is to say its number value. However, I will show below that this is not crucial. I will also show that the notation in the current equation is incorrect.

As a final complaint, someone may notice that the vector Δv does not curve: how can it be an acceleration? A vector diagram is a conceptual simplification. The vector's length stands for the Δx and the direction stands for the direction, but nothing can show the change in time. It is understood that the same change in time underlies all the vectors. All the vectors in the diagram exist during the same time interval. But the t-variable is completely ignored. If you put an acceleration vector into a diagram, the same thing holds. The t-variable is ignored. But if you have an acceleration and the t-variable is ignored, then the vector does not curve. It looks just like a velocity vector. An acceleration curves on an x, t graph because you are plotting x against t. In these illustrations we are not plotting against t, we are ignoring t. Therefore, it is possible to have an acceleration vector in an illustration that does not curve. It is not possible to have a curve that is not an acceleration, but it is possible to have an acceleration that is not a curve.

Besides, we have accepted for centuries that the centripetal acceleration points to the center of the circle at every instant. Every time it is drawn in textbooks it is drawn as a straight line vector. If history has drawn it as a straight line vector, then I should not be taken to task for it.

The next thing to notice is that my new equation yields very similar proportions to the current equation between a, r, and v_0. If you think that my equation looks completely different from the current equation, I encourage you to put some numbers into it. Yes, it yields different values in almost all situations, but those values change in almost precisely the same way as the current equation. Meaning that as r and v_0 change, the value for a increases or decreases at the same rate as the current equation. I encourage you to test out the equation before you dismiss it out of hand.

Now let's get back to my proof. My last equation is the relationship between acceleration and tangential velocity. What if we want orbital velocity?

As $t \to 0$, $d \to b$ and the triangle formed by v_0, Δv, and b approaches becoming a right triangle, with the right angle at point B. You can see in my illustration that the angle at B is obtuse. But as the arc d gets shorter, the angle diminishes, reaching a limit at 90°. In that case,

$$b^2 + \Delta v^2 = v_0^2$$

As $t \to 0$, b becomes the orbital velocity vector vorb, which is what we seek.

$$v_{orb}^2 + \Delta v^2 = v_0^2$$

From above, $v_0^2 + r^2 = (\Delta v + r)^2$

So, by substitution, $v_{orb}^2 + \Delta v^2 + r^2 = \Delta v^2 + 2\Delta v r + r^2$

$$\begin{aligned}
2\Delta v r &= v_{orb}^2 \\
\Delta v &= \frac{v_{orb}^2}{2r} \\
a &= \frac{v_{orb}^2}{2r} \\
\Delta v &= \sqrt{v_0^2 + r^2} - r
\end{aligned}$$

$$
\begin{aligned}
&= \frac{v_{orb}^2}{2r} \\
v_{orb} &= \sqrt{2r\sqrt{v_0^2+r^2}-2r^2}
\end{aligned}
$$

As some may be aware, I just solved the problem using Newton's own idea of an ultimate ratio. I have applied the Pythagorean theorem over the last interval of the series – an interval which is not zero. I treat it as a real interval, not as a mystical infinitesimal interval, nor as an "evanescent" (Newton's word) interval. It is a normal interval[1] and there is nothing to keep one from using the Pythagorean theorem over that interval.

I stress again that at the limit, the angle at B (between b and Δv) is 90°, but $v_0 \neq v_{orb}$. For v_0 to equal b, the angle at B would have to go past 90°. It would have to be slightly acute. But that implies a negative time interval. B therefore cannot go past 90°. 90° is the limit. And when the angle is at 90°, $v_0 > v_{orb}$.

You can now see that this solution stands as a refutation of Newton's Lemma VII. Newton states that at the limit, the arc, the tangent and the chord are all equal. I have just shown that at the limit the arc and the chord approach equality, but the tangent remains greater than both. Newton applied his limit to the wrong angle. He applied it to the angle θ in my illustration above, taking that angle to zero. I have shown that the limit must apply first to the angle at B. That angle hits the limit at 90° before θ hits zero. Therefore, θ never goes to zero, and the tangent never equals the arc or the chord. This is why the acceleration never goes to zero (and neither does the versine, for those keeping score). If θ went to zero we could not calculate an acceleration.

Newton's states that BC is compounded of (is the vector addition of) Bc and cC, in the first illustration above. If this is true then the tangential velocity and the orbital velocity cannot be equivalent. That would make BC and Bc equivalent at the limit. That cannot be, since that would completely nullify cC at the limit. But cC is the acceleration vector. You cannot nullify that vector at the limit and then claim to derive it. The arc and the tangent cannot be equal. The orbital velocity and the tangential velocity are never equal.

[1]For further clarification, see Chapter 9

If Lemma VII is false, Lemmae VI and VIII must also be false, since they both concern taking the angle θ to zero. I have shown that θ is not zero at the limit.

It helps me to think of it this way, when I am working in the ultimate interval: we cannot take quantities all the way to zero, since then our variables start to disappear. We do not take B all the way to A or let θ equal zero. We are in the last interval in the series; we are not at zero. Even the last interval must have dimensions, no matter how small they are. Some time must pass; some distance must be crossed. We seek the dimensions at the end of that first interval, not at the beginning of the first interval. The beginning of the first interval is zero. The end of the first interval is not. At the beginning of the first interval, $\sin\theta = 0$. At the end of the first interval, $\sin\theta = \Delta v/v_0 \neq 0$. This is now generally understood, in some form or another. What is not understood, apparently, is that this dooms not only Lemmae VI, VII and VIII but all current derivations of circular motion and $a = v^2/r$. The foundations of the calculus have been rebuilt since the time of Newton, but many of Newton's assumptions have remained standing within the old walls. They have never been thoroughly examined.

Circular motion is, at bottom, a rate of change problem. We have two changes happening at the same time. While the body is moving in a straight line it is also being accelerated toward a central point. But a rate of change problem implies change. Change happens only over definite intervals. If we take our variables to zero we cannot solve, since the changes have gone to zero and therefore the ratios have gone to zero. Forces also cannot act over zero time intervals. There is no such thing as an instantaneous force, by physical definition. A force must act over an interval. The definition of kinetic energy, as related to the force, makes this clear. A force must act through some time or distance interval in order to do work, which work is the transference and equality of the kinetic energy. The same thing applies to acceleration, although this is never made as clear in current definitions. A force must move a body through some time or distance interval in order to impart an acceleration. There is no force at a point or instant. Every force and every acceleration must act through some period of time. This is what Newton did not fully comprehend and what current physics and calculus cannot comprehend.

I have solved this problem using Newton's idea of the ultimate ratio, since it mirrors the current conception of the calculus in most ways. I have corrected

Lemma VII, but this has not affected my ability to use the historical concept of the limit. In my opinion, this concept of the limit is still overly complicated. There is an even easier method to the solution of any curve, without using limits or "infinite" series. However, use of that method requires knowledge of my paper on the foundation of the calculus, knowledge of which I could not take for granted in this paper. I believe that my arguments here are clear enough in the present form, making it unnecessary to include that method in this paper.

20.5 Implications

We have seen that no matter which velocity you assign v to in the final equation – either orbital or tangential – $a \neq v^2/r$.

You may ask, "Well, which is it? Which of your new equations are you proposing as a replacement for $a = v^2/r$?" Notice that one factor in this decision might be supplied by Newton himself, for in the proof I mentioned in the beginning for deriving Kepler's third law from his gravity equation, he uses this step: $v = 2\pi r/t$ where t is the period of the orbit, and $2\pi r$ is the circumference of the orbit. It is clear that this v is the orbital velocity here. For his derivation to work, v in equation $a = v^2/r$ must be the orbital velocity. And according to his math, my correction would not affect his derivation of Kepler's law. It only changes the constant: $t^2/r^3 = 2\pi^2/GM$ instead of $4\pi^2/GM$. However, that leads us into the final embarrassment in this whole ignominious history of blunders. Not only is it now clear that Δv is not a velocity, v_{orb} is also not a velocity. Newton's orbital velocity is not a velocity. This should come as no shock, since a velocity cannot curve. Every calculus curve tells us this. The whole history of circular motion tells us this. A curve is an acceleration. The orbital "velocity" is a complex motion made up of the tangential velocity and the centripetal acceleration. Feynman and the textbook should have already known this, since it is one of the conclusions of the whole problem, but for some reason they kept calling it a velocity and treating it as a velocity in the derivation of a. They differentiated it as a velocity; put it into acceleration equations as a velocity; notated it as a velocity. They acted for some reason as if the orbital velocity was known, and we were deriving the acceleration from it. They acted this way because they had a number for it from the equation above, $v = 2\pi r/t$. It was easy for them to calculate:

orbital "velocities" are the easiest thing in the sky to calculate from visual data. Therefore they thought they understood it. But they didn't, as is clear from these failed derivations.

Newton didn't understand it either, for he substitutes v^2/r for a as if v is a velocity. In the Kepler proof he lets $ma = mv^2/r$. That looks very familiar, in a dangerous way, if you don't know that the v is really an acceleration. That could lead us into kinetic energy problem meltdowns that equal this one. There is no reason why we should still be labeling the orbital velocity as a velocity.

A reader may well ask how this finding can be commensurable with current engineering and applied physics. We have loads of empirical evidence that the historical equation is true. Newton was trying to derive an equation that he already knew was true from data he had on hand. Therefore the historical equation $a = v^2/r$ is deriving for us a relationship between the centripetal acceleration and $2\pi r/t$. We have need of this relationship and can make use of this relationship in physical calculations, despite the fact that the second value is not a velocity. For the sake of convenience, we have labeled it a velocity and gone on with our business. These two equations work together, because they are correct relative to eachother. That is to say, if $a = v^2/r$, then $v = 2\pi r/t$. But the fact is, neither one is true. The orbital acceleration is really $a_{orb} = 2\sqrt{2\pi r/t}$, and the relationship is $a_\perp = a_{orb}^2/2r$.

What this means is that our current equations are just straightforward heuristics. We use them all simply due to the fact that it is easy for us to measure $2\pi r/t$. That is our basic data, data that we like and always have liked, and whether $2\pi r/t$ is a velocity, an acceleration, or none of the above, has never really mattered to us. Newton was trying to develop an equation that contained this data, and he did that. He developed a true equation that relates a and $2\pi r/t$. Unfortunately, he labeled $2\pi r/t$ as the orbital velocity, and it is not the orbital velocity. Nor is it the orbital acceleration. It is just a relation of two variables and a constant. Because Newton derived a true equation, it has not mattered much (in most situations) that his variable assignments were sloppy. As long as we remember that the v variable in the equation $a = v^2/r$ is equal to $2\pi r/t$, we cannot go wrong. But we have not always remembered this, as I will show with Bohr and quantum mechanics.

I have shown that the circle describes not a velocity, but an orbital acceleration. This acceleration is the vector addition of the tangential velocity and the centripetal acceleration. To find it we use the equation $a_\perp = a_{orb}^2/2r$. Using this equation, we find that

$$\begin{aligned}
\frac{(2\pi r/t)^2}{r} &= \frac{a_{orb}^2}{2r} \\
a_{orb} &= \frac{2\sqrt{2}\pi r}{t} \\
a+r &= \sqrt{v_0^2+r^2} \\
a^2+2ar &= v_0^2 \\
v_0 &= a\sqrt{1+\frac{2r}{a}}
\end{aligned}$$

This is another very useful new equation for tangential velocity. It will allow us to calculate velocities and energies that have so far eluded us, such as the energy of a photon emitted by an electron in orbit.

The answer to the question, "which of my equations must replace the current one?" is therefore the first one:

$$a = \sqrt{v_0^2+r^2} - r$$

. If we want an equation that relates the velocity of an orbiting object to its centripetal acceleration, we must use this equation, since it is the only equation with a true velocity variable in it. This works out in other ways, too, since the proportions of the variables in that equation remain the same as the historical equation, while they don't in the equation $a = v_{orb}^2/2r$.

Which brings up another problem. You can see that physics has never had a way to measure tangential velocity. "Orbital velocity" can easily be measured by circumference per time of one revolution. But tangential velocity must be calculated. You can calculate using my new equations, but before this paper there was no equation from orbital to tangential velocity. Neither Feynman nor any of the textbooks were even clear on the difference. I assume this means that no one was clear on the difference. [Notice that Newton also could not calculate from one to the other, since according to lemma VII they were the same thing.]

Both theoretical scientists and engineers should understand that such mistakes as this one ultimately lead to ruin. In the short term they may lead to simple engineering failures, which is bad enough. But in the long term they always lead to theoretical dead-ends, since a sloppy equation is the surest of all possible ways to stop scientific progress. A correct equation is almost infinitely expandable, since its impedance is zero. Future scientists can develop it in all possible directions. But a false or imprecise equation can halt this development indefinitely, as we have ample proof. Mislabelling variables is not a semantic or metaphysical failure. Is it failure of science itself.

All this is very big news, I hope you will agree. What makes it even bigger is that I will show in subsequent papers that this is far from the only basic equation that is fatally flawed. In putting physics under a microscope, I have found that the sloppy algebra and calculus exposed above is the rule, not the exception: one might say it is pandemic. It infects the entire field, including the highest levels. Modern scientists and mathematicians have proven themselves more interested in juggling complex matrices and other higher math than in mastering high-school algebra. Which is precisely why such an error in derivation was left standing for so long.

Much work is left to be done in basic physics, despite the hubristic claims of many that the field is nearly complete. In my opinion, the most important and immediate work to be done is in conceptual analysis – in combing the mass of theoretical and mathematical work already done, and making it consistent. This will be achieved not with so-called higher math, in which the original concepts get lost; nor with the esoteric theories of the scientific avant-garde, in which the production of paradoxes becomes a sign of distinction; but with simple algebra, in which the concepts are kept near the surface at all times. I have led my attack with this short and shocking paper because I know that only a full-frontal assault has any hope of breaching the walls of science. Philosophical subtleties can always be dismissed as arbitrary or subjective or metaphysical, but I hope it is impossible to ignore simple math.

I have now found other mathematical proof that the current equation is wrong, since I have shown in my paper on the virial[2] that the 2 in the equation $2K = -V$ is an outcome of this bad equation. We are told that the potential energy in the virial is twice the kinetic energy, but that has always been illogical. By correcting the equation $a = v^2/r$, I am able to correct the equation $2K = -V$, making it $K = -V$. This not only makes the virial logical, it acts to confirm my correction in this paper. The two corrected equations confirm one another.

For more on this problem, go to my newer paper on pi[3], and my newest paper on a=v²/r[4].

[2] http://milesmathis.com/virial.html
[3] http://milesmathis.com/pi2.html
[4] Chapter 21

Chapter 21

CLARIFICATION OF THE EQUATION $a = v^2/r$

Abstract: I will show the arc and tangent are equal only in one specific place on the circle, and that place is not at zero or the limit. It is at $1/8^{\text{th}}$ of the circle. This being so, we must rework all of Newton's orbital math. Once this is done, I show that we can easily calculate a time for the centripetal acceleration. Yes, the acceleration is not instantaneous, and I can now prove it, by showing you the number for the time.

I was able to continue my analysis of Newton's orbital math by discovering a disclarity between two of my own papers. In my first paper on a = v²/r[1], I show many problems with the historical proofs, and conclude, among other things, that the orbital velocity cannot be equal to the tangential velocity. But in a more recent paper on \pi[2], I show that the tangent is actually equal to the arc. In fact, they are equal not at the limit but at a finite real length. How can these two findings be commensurate?

Well, if we take the orbital velocity as $v = 2\pi r/t$, then the tangential velocity cannot equal the orbital velocity. The tangential velocity cannot be expressed that way. Not only is it in the wrong form, it is the wrong number. However, as I made clear in that first paper, the orbital velocity cannot be expressed that way either. So, NEITHER velocity equals $2\pi r/t$. That expression is simply a heuristic ratio that we like, since it is easy to measure from visual data.

However, what I did not make clear in that first paper is that once we find new correct expressions for both the orbital velocity and the tangential velocity, they MAY equal eachother under certain very specific conditions. The tangent DOES equal the arc, provided the tangent is the same length as the radius. In my "Extinction of π" paper, I let the tangent equal the radius in length, and show that the tangent equals the arc.

This appears to confirm Newton and the standard analysis, but it doesn't. The tangent and arc aren't equal at the limit, they are equal *only* when the tangent equals the radius, in which case the radius, tangent and arc are all equal. Even in this situation, none equals the chord, so my analysis of Newton's lemmae[3] was

[1] Chapter 20
[2] http://milesmathis.com/pi2.html
[3] Chapter 19

not wrong. At the limit, the arc approaches the chord, but at the limit, the arc does not equal the tangent. So at the limit, the orbital velocity and tangential velocity are not equal. Newton's proof fails. The current proof fails. The equality of the tangent and the arc can only be proved by making the tangent equal to the radius. Therefore, the orbital velocity is equal to the tangential velocity only when both velocities are "equal" to the radius.

You will say, How can the tangent equal the radius, when one is a velocity and one is a length? The answer: the numbers must be equal. If the velocity is 30, the radius must be 30. But if we match meters to meters, can we just use one second to create the equality? Good question. Another way of asking it is to ask if the number we are given for any radius can be used as a straight velocity in this way. If we are told that a circle has a radius of 5 m, does that mean that our velocity along it would be 5 m/s? How do the radius and the tangential velocity really relate to one another? I have shown in my π paper that they CAN be related kinematically, but are they NECESSARILY related?

In the case of an orbit, they must be related, since the equation tells us they are. We cannot have an arbitrary velocity at a given radius, we must have a specific velocity. A velocity that is too great will cause escape, and a velocity that is too small will cause a crash. So the answers are yes and yes. The velocity is necessarily related to the radius, and if we get our equations and dimensions right, the velocity should equal the radius. All we have to do is get the time right.

We don't just use 1 second to make the equality, however. Using my new equations, we find that the velocity in orbit is $8r/t$. Therefore, to make the velocity equal the radius, we just let the time period equal 1/8 of the orbit. As I show in the diagrams in the π paper, the radius is 1/8 of the circumference; therefore, in 1/8 of the orbital period, the velocity must equal the radius, numerically.

A critic will say, "That doesn't work in real life, as we know from the Moon. Just look at the numbers from the Moon. The orbital speed of the Moon is 1.022 km/s, and the radius is 384,400 km." Well, it doesn't work because the orbital speed of the Moon is wrong. It is developed from a faulty equation. Let us make all the corrections. If the radius is 384,400 km, then the distance travelled by the Moon in one orbit must be 8 times that, or about 3 million km. The orbital period is 2,360,534 seconds. That is a velocity of about 1.3 km/s.

My critic will now say, "Even if you are right, the velocity still doesn't equal the radius, numerically or otherwise. The number value of the velocity is 1.3, and the number value of the radius is 384,400." No, I meant to point out a number equality between the radius and the distance travelled by the velocity in 1/8$^{\text{th}}$ of an orbit. You see, they ARE the same. The distance travelled at 1.3 km/s in 1/8 of an orbit is $384,400$ km.

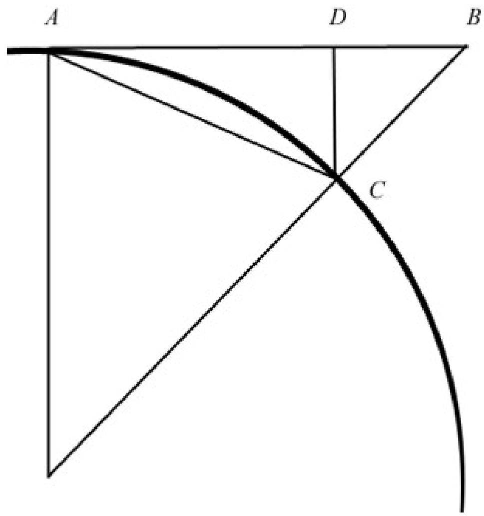
In fact, an onboard satellite speedometer, calibrated to work for straight-line distances, will not work in orbit, and engineers know this. That is precisely what caused the Explorer Anomalies[4]. The thrusts were set for velocities as calibrated here on Earth, in straight-line motions, then transformed into orbital motions by the common equations. Since the common equations were wrong, the orbits established from the thrusts were wrong. The satellites flew too high and were thought to be lost.

Not only is the velocity wrong, the acceleration of gravity is wrong. Using the current equations and the value of π, the acceleration of gravity is calculated from an equation that reduces to $a = 39.5\, r/t^2$. But the correct equation is $32\, r/t^2$. Therefore, the acceleration at the distance of the Moon is not .002725. It is .002208. Which means that using the given numbers for the Moon, in these equations g would not be 9.8, but 7.947. That difference is caused by the fact that we are ignoring the E/M field here. 9.8 is a unified field number, not solo gravity, so we can't scale down just using a radius. We have to monitor both fields. I will not bother with that here: I will look at it in a subsequent paper.

In my other papers, I have continued to use the current numbers, since they are all correct relative to eachother. It is much more convenient to continue to use the posted numbers. But at some point – after all my corrections have been accepted and established – we will have to recalculate all the velocities and accelerations of the planets and satellites and stars and so on. Current numbers are still hiding many secrets, and they cannot be fully uncovered until the equations are corrected and rerun from the beginning.

As just one example of a secret being hidden, we can continue to study the arc and tangent. Let us return to the diagram from my π paper:

[4] http://milesmathis.com/pi4.html



There I proved that $AD + DC = \text{arc}AC$. This means that the tangent equals the arc. This works only when the tangent is equal to the radius, as I said above. The angle at O must be 45°, so that $DC = DB$. If the angle is not 45, then the tangent cannot equal the arc, because $AD + DC$ is not equal to AB.

This is important because if we assign the tangent to the tangential velocity and the arc to the orbital velocity, as Newton did, we find they are equal not at the limit, but only when the tangent equals the radius. In fact, as I have shown[5], the tangent and the arc are NOT equal at the limit. At the limit, the tangent remains longer than the arc. And this means that the tangential velocity and orbital velocity are equal only when the length of the tangent is equal to the radius, or when the time is equal to $1/8^{\text{th}}$ of the orbital period. An orbital velocity found by any other method will get the wrong answer. **This is why $2\pi r/t$ is wrong: $2\pi r/8$ is not equal to r.**

With all this under our belts, we are now in a position to see that we may assign the acceleration a to the line segment BC. Furthermore, if $a = v^2/2r$, and $AB = r$, then $r = v$, and $a = r/2$. Consulting the diagram above again, that is also $2BC = CO$. What this means is that we have a new way to find a centripetal acceleration, currently called gravity. The equation $a = r/2$ gives us a distance of acceleration

[5] Chapter 19

over $1/8^{\text{th}}$ of the orbit, so the total distance of acceleration over the entire orbit is $4r$. Or, we can find the acceleration over any subinterval. Say we want to find the acceleration of the Moon over 1 second. We are given that the period for the Moon is $2,360,534\,\text{s}$. Since the Moon is orbiting at $384,400,000\,\text{m}$, the total distance of acceleration over the orbit is 4 times that, or 1.538 x 109. Dividing gives us $a = 1.538 \times 10^9/2,360,5342 = .000276\,\text{m/s²}$ over 1 second.

For more fun, we can even show that the centripetal acceleration is not found at an instant. If the Moon's acceleration over 1 second is .000276, then an acceleration of .002208 cannot happen over an instant. We can even find the time, with simple math. With the same math, we find that $a = .002208$ when $t = 8\,\text{s}$. That is not an instant or an infinitesimal, since it is a calculable number. You cannot have a real acceleration over an instant: we should have known simply from logic that the centripetal acceleration we have always had could not be an acceleration over an instant or infinitesimal. I have just calculated the real time of orbit during the "instantaneous" acceleration, so I have proved that Newton did not go to a limit or approach zero. As I have said in my paper on the derivative[6], the calculus does not work by going to zero or a limit, it works by going to a subinterval, and I have just shown you the subinterval in a specific problem.

You will say, "But if we can find an acceleration at that small time, we should be able to find an acceleration closer to zero, over an even smaller time." Yes, we can, but that acceleration would not be the centripetal acceleration. In seeking a centripetal acceleration, we are not seeking an acceleration at or near zero time or length. We are seeking the derivative of the orbital velocity, and the derivative of any motion is found by going to a subinterval, as I show in great detail in my calculus paper. We have just gone to that subinterval mathematically, since what I am doing here is calculus without the calculus. I have found the subinterval underneath the orbital motion where that motion becomes uncurved, which is defined as the derivative. And that gives us the acceleration we were seeking. Acceleration is not defined as the change in velocity at or near zero, it is defined as the change in the velocity, period. I showed in my calculus paper that you don't have to go toward zero to find any derivative, and I have shown here in a specific problem that the subchange is always happening over a real interval.

[6]Chapter 9

Now you may ask, "But that number, 8 s, where is that coming from? You just calculated it, but I still don't get it." Normally, the derivative is found at a subinterval of 1, since that is how it is (or should be) defined. The derivative is not found by going to zero or to a limit, it is found by going to a subchange or subinterval where we have a constant differential of 1. So normally, we would be looking for a derivative at 1 second. But in the case of the circle, this logic changes slightly. As you can see from the diagram above, I did my "calculus", or my calculations, over $1/8^{\text{th}}$ of the circle. My solution is therefore over $1/8^{\text{th}}$ of the circle. Therefore, to find a solution for the entire orbit, I have to multiply everything by 8. Even the time of the subchange, or what we call the derivative, must be multiplied by 8. That is why the time here is 8 seconds rather than 1 second.

You can see that it took a complete reworking of Newton's postulates to crack open the orbital math, but once I did it, everything began to make sense. We have always been taught that the centripetal acceleration is the acceleration at an instant, but that is illogical. Acceleration, like velocity, is motion, and you cannot have motion at a instant, by the definition of motion. Acceleration is also defined as a change in velocity, but you cannot have a change at an instant. Change requires an interval of change. Motion can only take place over a differential. This being so, we should have been able to find that differential. If the acceleration is not taking place at an instant, it must be taking place over some real time, and we should have been able to find that real time. Problem is, Newton couldn't solve this one, and no one else since then could either. They were looking in the wrong place. They were looking near zero, and the answer was hiding at $1/8^{\text{th}}$ of the circle. The answer is found only when the tangent equals the radius. Because physicists could not solve this, they decided to hide it. Once again, they hid it in the instant. They buried it in the zero and covered it over with centuries of slippery math and slippery explanations. As you now see, the solution is simple.

If this book was useful to you in any way, please consider donating a dollar (or more) to the SAVE THE ARTISTS FOUNDATION. This will allow me to continue writing these "unpublishable" things. Don't be confused by paying Melisa Smith–that is just one of my many noms de plume. If you are a Paypal user, there is no fee; so it might be worth your while to become one. Otherwise they will rob us 33 cents for each transaction.

Make donations with PayPal - it's fast, free and secure![7]

[7] https://www.paypal.com/us/cgi-bin/webscr?cmd=_flow&SESSION=pYCYMBSyChbte6brvwcb2z6QITUelNmg-LgjcIHyQ8OWH8ME7AGJg_3q7Ga&dispatch=5885d80a13c0db1f8e263663d3faee8d9384d85353843a619606282818e091d0