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SATANIC MATH

What strikes me at the outset, and prompts the title, is that nothing exhibits more clearly than mathematics the complicity between man, God and Satan. That man should have knowledge so luminous, so absolute, would seem impossible did he not share, under whatever doubt or qualification, in the divine. On the other hand, the arrogation of that knowledge, its over-reaching distortion and delimitation of mind and world, hints how far it reenacts the revolt of Lucifer.

Of course, mathematics in this is like every deployment of energy in the real world—like the verbal assault of this essay, which risks as it aims to reveal. Yet in mathematics, more perhaps than in philosophy, poetry, even politics, the satanic fable stands stripped and hard—one of those anatomical nudes rising from the dead in the Judgement by Signorelli.

This may seem strange to those who have thought of mathematics not as the maddest, but as the sanest of our enterprises—so reasonable that, as Descartes says: "Whether I am awake or dreaming it remains true that two and three makes five, and that a square has but four sides;" so practical in use that it appears what locomotives and the stock market (not to mention the starry spheres) run on. But it is just the rift between our subtlest intuitions and the skeletal abstraction mathematics stamps within and without with formal verity which apprises us of the visionary character of our experience, the phantasmagoria of reality itself, most of all as seized on by the lunatic genius of systematized quantity. As Stevenson wrote in a beautiful, if somewhat romantic

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and now neglected essay (*Pulvis et Umbra*): "There seems no substance to the solid globe on which we stand—nothing but symbols and ratios."

To take the globe as so constituted has been from Pythagoras to Eddington the necessary drift of the mathematical mind, most diabolically fulfilled in the act of mathematical science. Where so crippling an arrogation lies at the heart of an enterprise the image of Lucifer is fit—though for the Greeks we might better have invoked Prometheus. As light-bearers, both should make clear that the intention is not to condemn either mathematics or science. Though in the end the question must be asked, as with any Faustian thrust, within what context it may be fruitfully contained.

Surely, if I imagine myself, a spark of spirit flung from the divine, burning in space "when the morning stars sang together," and I ask, "What am I supposed to *do*, how exemplify the I AM of my created godhead?"—I get no answer, no clear distinction that will save me from the temptation of Lucifer. It is true, I can imagine that some other timid or cautious spirits might crook the servile knee in tedious orthodoxy and dim their in-light droning "All is God." But I can hardly imagine God as being satisfied with that, or as not waiting impatiently for the brightest of all to blaze the "God-in-me," to overween and be thrown down, plucking creative history from the forbidden tree.

As Whitehead says: "Importance is the immanence of infinitude in the finite." There is no secure road, even of obedience. We do not release the power of anything until we elevate it beyond what is safe and right. To perfect paradigms and treat them as verities is a feature not only of mathematics, but of all our operations. Take the moral realm. Its dilemma is easily stated; what is it but that moral judgements wear the externality of the relative, but have the inner necessity of the absolute. So phrased, the antithesis is the same as that which Einstein made between mathematics and nature: "As far as the propositions of mathematics refer to reality they are not certain, and insofar as they are certain they do not refer to reality."

In ordering its world, thought has no choice but (as with the old Aristotelian genus and species) simultaneously to merge likes into wholes, and to distinguish wholes into parts. We have seemed to melt all action into one Faustian venture; in what peculiar way does mathematics exhibit the satanic compact?

Begin with what is almost too obvious to remark: that two limiting modes of discourse have evolved—though as always it may be hard to define and keep them apart—the poetic and the mathematical. These, with all other modes variously mingling those poles—religion, philosophy, history, the sciences, not to mention modes with other centers, as music and the arts—must spring from some common core of perceptive ordering and representation, though they leave that watershed necessarily in the channels which private genius, with the whole evolution of thought and expression, has deepened for them. By way of illustration, think of two contrasting cases: Newton in mathematical science and Yeats in poetry.

We can see Newton sitting in his orchard watching the fall of the apple, as his niece later reported to Voltaire. At that moment whatever vision comes to him is at once poetic, philosophic, mathematical, scientific; it is a total vision—that the force which accelerates the apple down is the same which holds the moon in its orbit, the same which draws the earth to the sun and which gives order to the solar system and to the universe of stars. A poet could have used such an insight, as Yeats did one from history, that civilizations move in interfolded spirals of subjective and objective, alternating like the beat of a butterfly's wings or the electromagnetic waves formulated by Maxwell. Yeats' art turned that generalization into a series of sacramental poems, "odor of blood where Christ was slain;" where Newton with no qualms about the loss of poetic radiance in what imagination had given him, began to calculate how far from the tangent the moon would have to fall and whether the force required would be that of gravity at the earth's surface reduced by the square of the distance, and, as he said "found it to agree pretty nearly." The mathematical problem was to formulate unchanging truth in terms of exact quantity; whatever the poetic requirement, it would have been something else.

The mathematical aspect (like the poetic) must arise wherever nature, through mind, receives the power to reflect on itself, since every act of nature (or every reflection of it in thought) turns out to be deeply rooted in the quantitatively formulable.

If I move my paired arms outward or inward in the mirrored spirals their elasticity suggests, I feel in my muscles as in my mind that the motion is mathemable. Though it might take all of history to articulate the study, we sense it equally in the flow and undulation of liquids, the swirl and grouping of clouds, the flight of a bird, the calculated leap of a cat, the coursing of a deer. All revert to that tensile play of energized bodies on themselves, the nexus from which mathematics, a formulable reflection of that play, precipitates. Every motion, every perception of motion, every intuition of thought is instinct with mathematical latencies requiring that they be drawn out. What Newton formulated was "the love which moves the sun and the other stars."

I do not assume, with these few words, that I have taken care of the relationship of *a priori* mathematics to the empirical world, though it became clear a hundred years ago that Kant's way of deriving the regularity of nature from the inescapable frame of our cognizance, while it offered a kind of metaphysical solution, did so at the continuing Cartesian cost of cleaving the mind-matter nexus down the middle, leaving no way to account for organism, for the actual embodied interplay between perceptor and perceived. The more deeply dialectical direction which evolution in the life-sciences, quantum mechanics and probability in the physical, has made inescapable for us, is hinted at by Maxwell at the close of his essay on Analogies in Nature: "...the only laws of matter are those which our minds must fabricate, and the only laws of mind are fabricated for it by matter."

In short, the occurrences in us which have become carriers of psychic purpose have to fit hand in glove with the events of the nature we call physical. Even the numbers, those God-given integers of the Greeks, must have hatched from physical quantity long before we appeared on the scene to call them by names; so that we must introduce them in every account of actions involving resonance or period, in the Pythagorean tones, crystallography, genetic chemistry, atomic structure and emission spectra. And our mathematics could never unlock nature's doors if our heads were not full of such models, not pendulums exactly, but neuro-physical systems continually emanating ideals of periodicity, equality and ratio. Since nature from top to bottom finds itself in such congruences, all that we study outwardly is built, in the smallest parts, into our experimentally selected structure.

And no doubt the Satanic flaw we began with could be traced back to the beginning of things, when primal energy, falling into the habits we call natural law, took up that reductive mode of action which in society is stigmatized as "the inhuman use of human beings"—to strip off and abstract from collections and wholes such merely operant quantities as mass, momentum, pressure and potential. Since nature, like man, is always hardening into a relation not of whole to whole or essence to essence but of habitual surfaces, as if gravity and colliding bodies had accepted "the unnatural use of the natural." It is in this fallen nature that fallen math pursues its risky road.

The first crevasse it encounters is between numbers and the continuum—not so much the dilemma Plato toys with in the *Phaedo*, and Ionesco picks up in *The Pupil*, how *one* and *one* can ever turn into *two* (the One necessarily coming to rest again over the dual, as over any multiple, to make it a nameable number); but the plain irreconcilability of what slides with what is counted.

The one-many is the root antinomy of our experience, an ambivalence on which awareness, like its world-objects, seats itself, proliferating everywhere polarities of part and whole, atoms and substance, time and moment, soul and states of consciousness. And it is of course the drive of every opposition to assert itself once and for all as paradox. Thus the number-line continuously stretched over incommensurate points of number.

It is just with regard to this rift that the Promethean drama of mathematics seems to have separated itself into two phases: the Greek, traditionally concerned with the fixed; and the Western, driven to invent a calculus of motion.

The Greek task was to precipitate eternal clarity, at the cost of whatever abandonment of the transient and vital. As if understanding could exist only in an empyrean of frozen forms.

But it cannot be that the root intuition of geometry is of Euclidean space, or other systems, as of spherical, hyperbolic, multidimensional, saddle space, and the rest, could not be made reasonable. The root of geometry must be a set of emergent correspondences which can be idealized into a spatial order. If that order is imperative enough within the range of some experience, it will, like any order we seize on and apply, take upon itself, for axiomatic fulfillment, the certification of the absolute.

Neither can it be that the root intuition of numbers is of One, Two, Three; but of the sliding continuum adaptively jelling into tellable recurrence—as by feedback approximations and corrections, narrowing toward a limit, we close in on a position reached for. It is in that amorphous space, where the formalized array of like intervals is always refining itself, that the commutative and other laws of arithmetic are comprised, with the whole atomic structure of calculation. Nor is it merely the willful distortion of some Faustian modern, to stretch out the clear logic and calm beauty of Euclid and Greek number on the rack of so adaptive a fable.

We might get a clue to the inadequacy of the Greek perfection by asking where it is in nature that the undergirding of pure number comes to the surface, crops out, like crystal rocks from the softer mottlings of earth and vegetation. It was here that the ancients seated gods and angelic intelligences, in the divine regularity of the stars. Here too mathematical physics contrived the triumphs of equation which have lured all sciences in that wake, and which the naive are always taking (as Plato did the Pythagorean proof) as a paradigm of knowledge—while the universe of the Bible and war and tragedy and flesh and marriage eddies around and in us—imagine—a paradigm of knowledge.

Of course the stars to primitive man looked like divine things sailing through aether, each with its angelic mover carrying it in harmonious circles, But for us that beautiful regularity exemplifies the billiard ball determinism into which the lowest and most unorganized aggregates of material nature fall.

If we ask why the planets, why any mass fulfills so perfectly the Newtonian laws, the modern answer is that in such inert aggregates, primary or quantum indeterminacies cancel out; a statistical law (or high-order probability) emerges—but only on the condition that the matter, as unorganized, doesn't go into cahoots about its action.

A simple example: Take a stand at some high window in New York and look down, in the noon rush, at the intersection. Count the number of people coming and going in each direction. You will be able to write a law, having the general form of a current function, and find that for each branch of the circuit it fulfills itself rather well from day to day. As in the flow of electricity along a wire, we have no notion which route individual particles will take: with the crowd we assume that depends on will; each man proceeds (as Lucretius said about his atoms) *sponte sua.* It is that very fact—the lack of relation of each to any other—which has made prediction possible. For suppose one day an army comes along marching behind a leader. He turns, the organized army follows; our predictive laws are broken.

We cannot escape the antinomy this involves. The determined order of the whole arose from the disordered randomness of the parts; when the parts on the other hand are ordered into one, the result is the law-breaking indeterminacy of the whole. We seem here almost in touch with a complementarity shared by nature and mind; as if the clarity of form and number were drawn from the sliding and amorphous at the cost of separating out some dark and formless Other—an act which can only be the first step of knowledge, since richer techniques must always be sought for whipping that Alien back into the substance of the known—the full act of reason deploying light, dark and penumbra.

So the Greek separation of mathematics from the paradox of motions was in one sense the proudest dare—to rear a temple of Parian marble above the swampy flux. On the other hand, since mind is stretched willy-nilly between the Forms and the shifting actual, that axiomatic perfection became a withdrawal and timid incapacity. Even "the whole is equal to the sum of its parts" has suspended validity with respect to the actual, to a man, a poem, a marriage, a society, a body of organized stuff—where all stuff is organized—since not even some assumed quantity of mass or of energy can ever be brought back after an action to what it was before; therefore the axiom defines a realm of self-established eternals where substances and qualities do not change, where time is not a transforming force but an indifferent dimension, where the moment, in Kierkegaard's terms, is never decisive—the moment, as it turns out, being at the crux of the matter.

So the true Lucifer of mathematic formulation did not emerge, blazing among the sons of morning, until the ordering power of Greek reason, revived in the post-Gothic West, and celebrating the paradox of that daring, seized on the horned angle (between the tangent and the curve) which Euclid had avoided as irrational, and determined to give it a measure. The measure of the horned angle, however, must lie at the point, or instant, of tangency, where, if it is not to be zero, the point itself must be transformed, functionally smeared from Euclid's dimensionless locus to one of those infinitesimal carriers everyone from Galileo down was in pursuit of—to diminish an area without limit and by such a method exhibit its vanishing vectors and derivatives of vectors: tangent, curvature, force and rate of change of force, Maxwell's flux and curl, whatever other properties and ultimate tensors of the field may lurk in that minute Leibnitzean point—a whole world, as Pascal saw it, contained in the barest atom. And not only to isolate and formulate these, but to add them up, infinite series after series, and so to write the law of the entire field. It was at the outset of that mathematical venture, which would make the Greek look rather tame, that Galileo cried out in the *Two New Sciences*: "What a sea we are falling into...with vacua and infinities and indivisibles...shall we ever be able to reach dry land?"

At the heart of that arrogation lay one weird little Arabian devil, one of those Divs that lurk in Persian manuscripts—the algebraic notation which slipped into Europe under cover of the Middle Ages and enflamed the Renaissance: as Vieta says (1591) in the book Descartes took off from: "For there is no problem which cannot be solved." The div that told him that, sent no doubt by Ariman, power of darkness, is easily described: it is the will to write a sliding function as if it were a Greek quantity and to operate with it under that fiction—an act of daring, since to use x as a number is to plant the paradox in the ground of reason. It is this, more than anything else, which has sustained the satanic truth and illusion that mathematics is the key to knowledge and power...

> *Here begins a technical interlude, an illustration drawn from the calculus in common use in today's physics. The reader who is put off by the nature of the demonstration may go directly on to page 42, at the close of the brackets.*

The sequence chosen is easy enough for us to deal with, yet advanced enough to generate the required excitement. As for ease, physics works in our favor, since no science could be more chuckle-headedly simple in its use of models, and that is a feature of the divide-and-conquer reductionism we have called satanic. Most of the physics of energy, magnetism and electricity up to

Maxwell's laws and the derivation of electromagnatic waves, springs from two related models, one of masses accelerating under force, and the other of the flow of some ideal liquid. Under these assumptions, our common notions, turned into axiomatic math, naively apply.

Take electricity. It has to be a quantity. Call it *charge.* The fluid model fits; let there be so much liquid—of two kinds, it turns out, plus and minus. Here gravitation enters, since much of physics (entropy for example) is read over from the experience of living in a gravitational field. Our electric liquid can be piled against a dam, say, and then there is energy stored in it, a power to get moving and do work, which from the parallel, depends on the height. Call that *potential.* In either case, the containers can have different *capacities,* the less the capacity the more any quantity of liquid runs up the height. Out of these containers we can bring a flow; call it *current,* and let it have all the properties of a material flow. Of course, one has to be tricky about mathematizing it, formulating what happens at one of those smeared points and then integrating back to the continuous; but that sort of juggling can be a sport—apart from what it promises.

Though nature sometimes comes up with surprises. If you run that current down a wire, it's not surprising that there is resistance, because every conduit offers resistance to a flow, some more, some less: we know water will rise less high in the suburbs than in the city's center, because of the resistance in the pipes. But that a current flowing down a wire should beget around itself another kind of field, a magnetic field, when we had thought of magnetism as an independent property of some iron ore we called lodestone—that the magnetic power to move and align lodestone should arise now around a wire in which a current is flowing—that came as a surprise. In fact, you could say a *discovery.*

Though it can be taken at once into the quantitative system, varying with the amount of current flowing in the wire. At that point another wonder appears, though the principle of symmetry might have suggested it from the former; that when a magnetic field comes into being or collapses, as from current turned on and off in the first wire, and if the changing magnetic flux is cut by another wire, a current also will flow in that wire. The two are reciprocally intergenerant, so that already if we would think of space alone without the wires as being able to hold shifting

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magnetic and electric fields—the electric as it shifts generating a magnetic around it, and that as it comes into being producing another electric surge—and if one has followed that, either with the intuition or with motions of the hands, we have already arrived at something which looks like wave propagation.

Here the question arises, how can we deal with it mathematically? We could start with a text by Oresme about quantities and the rate at which they change, where it is first stressed that the rate at which a thing changes can change also, and that rate in turn, and so on as far as one needs to go.

Stand where your shadow falls on a wall and move your hand in a steady circle. The shadow also makes a circle—Euclidean, though its being a trajectory is not. Turn now, so that the plane of your hand's motion is at right angles to the wall. You will see the shadow rise, stop at the top, gain speed as it goes down, reaching a maximum at the center, then slow down and stop at the bottom and so go up again. That's obviously a regular motion of some kind, because it's the projection of circular motion. Call it simple harmonic motion—simple because it's from one circle and not compounded, as from epicycles or whatever. Also we recognize, both with the eye and with the reason, that it's rather like the oscillation of a weight on a spring, or (if that could be straightened a bit) the motion of a pendulum.

Now while your hand is moving edgewise as before, walk along uniformly in front of the wall. The shadow will produce a wave; you can call it a sine wave, or a cosine wave, depending on where you start. Note in passing a curious thing about a wave, this one, or another, no matter how complex: the same pattern of displacements up and down can be experienced either in space or time. You can stand still in space and let them come to you, as a cork does in water; or you can stop time, as in a flash photo, and there is the same pattern stretched out in space. Clear too that to make spatial pattern give you the experience of the time one, you would have to invoke the velocity—get the thing moving again.

Therefore the rate of displacement in time should bear to that in space the ratio of the velocity. In a kind of shorthand that can be written $\frac{dv}{dt} = v\frac{dv}{dy}$. But what we need is less a shorthand than a clear and distinct notion of "rate of displacement."

Crank your hand again, at right angles to the wall. From the circle you are making, it will be evident that when the flattened motion gets furthest up or down, it is at a distance from the center which the Greeks called the radius, r. If I ask how that displacement in space, s, is changing with respect to time at any instant (and I can write that in various ways, $\frac{ds}{dt}$, or I can just put a dot over the s—in any case we all know what it is, because we drive cars, it's velocity), the circle suggests some things, that up here at the top, where the displacement is r, your hand seems to stop for an instant, since it's only moving toward you, and the up and down velocity must be zero. On the other hand, the center, where displacement is zero (say your hand is moving in the circle at one radius length—radian—per second) the velocity must be r. They're alternating, push-me-pull-you.

But it is not only position in space which can change with time. We know equally well from driving, that velocity also can change—you just step on what they call the accelerator. So a is the rate at which v is changing in t. Again you can write it different ways, as $\frac{d^2s}{dt^2}$, which means the second derivative of space with respect to time; or you can write that s again, this time with two dots over it, $\ddot{s}$. That's the rate at which change-in-space is changing. We could go on, because we know you can accelerate at different rates; but we don't have to. Because a curious thing now emerges.

Call the space at the top r and at the bottom minus r, because the signs have to show up and down. Then the velocity at the center going down must be minus because it's going toward minus. So it's $-r$. If we ask about acceleration, some people get confused. They say, how can it be accelerating at the top or bottom where it's standing still? That same difficulty is voiced in Galileo by the guy called Simple. Whereas we can see from the circle that here at the center where displacement is zero and velocity is either plus or minus r, you are seeing for that instant the original circular motion, broadside, undistorted by any acceleration. So where s is zero, s or a is zero also. But at the top, where the displacement is plus r, the velocity has to be changing all the way from plus to minus; the acceleration is at a maximum—or minimum, since here it has to be minus; it turns out to be minus r. And at the bottom where s is minus r, there has to be the same acceleration, but upward, that is plus r.

Here we ask a simple question: What is the function whose second derivative is the negative of the function itself? Say the function is s (that's one of those Arab divs that can go through all the values the displacement can assume); when its value is r, a which is $\ddot{s}$ is $-r$; when it's 0, a is 0; when minus r, a is plus r. So we don't need any mysteries of integration to know that when we look at a second derivative of a function which is the negative of the function, that is when $\ddot{s} = -s$, we can only be dealing with a sine wave.

If we had time, we could review the whole theory from a mass on a spring bobbing under restitutional force, to a charge in an electromagnetic oscillator doing the same. We would see the staggering way in which the static and electromagnetic laws led Maxwell to the partial derivative equations of wave propagation, and in those equations, a constant c where we found velocity before, but having now a value given by the ratio of the units of charge in the two systems of electricity, the static and the electromagnetic or current system (as if to get the same effect from a charge racing down a wire at what turns out to be the speed of light, and so stretched out by motion and attenuated to that amount, one would have to pour in a unit or quantity bigger by just that multiple of 3 times 10 to the tenth), we would bring from the equations themselves the universal measurable constant of the speed of light.

But I think for the diversion of the interlude I should proceed with differential equations, starting with another question: What is the function whose *first* derivative is the measure of itself—either equal or proportional? We are asking what sort of function changes in proportion to its own value or size.

Take a shellfish, a nautilus; say each cell divides so often, and it's got so many; suppose it curls that growth around a center and leaves a record in the shell. That should be a logarithmic or growth spiral, which we can also draw geometrically. We have the same thing in a savings account; the interest is based on how much money. If we uncurl the growth from the center, stretch it out above a line (the X-axis), it becomes a curve that always goes up, getting steeper and steeper, growing faster as its value grows. Right in the middle there will be a point where the height is one, and if this is the central curve of the family (the *e* curve) it will go through there with a slope also one, equal to the value, that is at 45 degrees. Whereas far to the left its growth is as small as its value, as in the Biblical proverb. It's a Growth Function—a dream of Capitalism.

Of course we can reverse it. Put a brake on anything, where the friction, say, depends on the speed: the faster you're going the more it will use up of what you've got—and lots of things work that way, too. We don't even have to draw the function in reverse, we just slide back down. The logarithmic function can be of growth or of decay. It is indicative that the place we find these functions going up is in life phenomena, or ar least with semi-organic or chain-reaction interplays, whereas in the laboratory physics of so-called closed systems they are mostly headed down.

So if we ask our question again: What is the function whose change is proportional to its size?—it can be either the one that goes up always steeper, or the other that settles down but, like Zeno's Achilles, never reaches the mark.

Suppose I have an oscillating electrical system with an induction coil which, like a spring or a pendulum, makes a second derivative kickback, and I have in it also a plain resistance, which makes a first derivative drag. Let's not search too hard for a letter-name for the quantity we're oscillating; call it x, that Div we started with. Now I can write $m\ddot{x} + r\dot{x} + kx = 0$ putting in coefficients for the size of the magnetic inductance, resistance and capacitance, and maybe for ease thinking of the kx taken to the right as a minus. Now, if I erase the middle term, I'm saying the second derivative is proportional to the negative of the function itself, so I would have a sine oscillation. But if I take away the first term (letting its coefficient become zero), I'm saying that the first derivative (negative) is measured by the function, and I've got one of those plain old drags.

But with both of them acting together, I don't quite know what to do, because this one says "wave!" and this one says "be damped!" It's true that even my intuition might say, if

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I join them, I should get a damped wave, oscillating, but less and less. But if I go on increasing the resistance, sooner or later the damping ought to take over; since if I put a pendulum or a spring in molasses and make the molasses thicker and thicker and thicker, at first it slows down the oscillation; and then any fool can tell that at a certain point the bob can't oscillate any more because the medium is too thick; it'll just drag to the center. But how can I find that point from the equation?

(I follow Courant here, since his solution is the most divertingly Satanic I know.) Suppose we substitute a growth-decay function for x, some base e to the lambda t ($e^{\lambda t}$), though we know x can't be entirely a power function if it's also an oscillating function; but just for the fun of it, just to see what we get. At least we can differentiate a logarithmic function, as we've just seen; its rate of change is proportional to its value; we just bring the lambda down each time as a coefficient. So when $e^{\lambda t}$ is divided out, the equation reduces to a quadratic in lambda, $m\lambda^2 + r\lambda + k = 0$, which by the quadratic solution will of course have two roots:

$$\lambda_1 = -\frac{r}{2m} + \frac{1}{2m}\sqrt{r^2 - 4mk}$$

$$\lambda_2 = -\frac{r}{2m} - \frac{1}{2m}\sqrt{r^2 - 4mk}$$

What we have to focus on is obviously the plus or minus radical. Since, if $4mk$ is bigger than r^2 that thing under the radical is minus, and the logarithmic solution we attempted becomes imaginary, since the square root of a minus doesn't solve handily. Though even that little i can be got rid of by the amazing detour of Euler's solution, and you find in the process that your x has turned back into a sine-cosine function. Which is the climax of the interlude. It was clear in the first place that diminishing the r (resistance) and weighting the m (magnetic kick-back) would produce an oscillating function; but Courant didn't offer a way directly to that; we had to make the *mistake* of substituting a logarithmic (decay) function, which, to show you that at a certain point you were on the wrong track, popped in an imaginary number; then, when you find another oblique way to eliminate that, it brings you back to the sine function, where you knew from the second derivative term you ought to be all along.

But only if the second derivative term predominated. So that wild detour (what Dante calls "il folle volo") has given us the precise point at which a damped oscillation will become a mere decay (or vice versa). It's when the square of the drag coefficient is greater than four times the product of the other two. And I trust the sliding Divs (their roots deep in nature) who brought us there, that that formulation (who knows, maybe in some primary reaches where matter coalesces out of waves) may suddenly release such powers that the always tempted mind will cry out *Truth.*]

In any case, I have been carried away by the delight of one example. I have now to clarify why (enjoying it as I do) I call this art Satanic—since I am not myself purely Satanical.

So far, we have allowed a confusion which is almost inescapable: we have not distinguished (for are they not one?) between Lucifer and Satan. Yet we must distinguish, even in the single life-drama between the aspiration and the specter.

The mode of Lucifer is the basic mode of spirit. But when in the course of its inescapable and dangerous search for total clarity and efficacy of being, it learns the relative impossibility of its desires, it has two branches of transformation: the Satanic, which seizes, as if it were enough, on what it masters, asserting a tyranny of hardening and desiccating fact; and the sacrificial, which offers itself and its pretentions for a higher life.

As I have written in another place (*Incarnate Fruits*), when the pure Greek reason went down into brute matter and the flux of motion, to incarnate there a logos of the infinite and infinitesimal, that salutary stooping led to the victory of calculus. In such an account, the allusion is not to Lucifer but to Christ. Yet if the sacrificial played a role there, it was of brief duration. As the Calculus rose in splendor like the Prince of this world, it asserted again the old divinity of math, seizing on the universe for its deterministic formulation—in those time-conquering equations where time can run either way. And surely, in no age of history have the sun-bright scales of armored supremacy more sonorously clanged on the logos of number than in this in

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which racked-out nature flames the certification of $E = mc^2$.

As always, however, polar opposites are precipitated together; the incommensurate can only appear where the axiomatic and formal has been sufficiently tightened to catch commensurability. In the oozy flux and relatives of the intuited world, ambiguities are always with us, but indistinct, cloud-shadows of that vegetal. Under Greek reasoning, where the consistencies which some call truth were consolidated (as when a swamp is drained: let the waters gather and dry land appear), the original dim ambiguity also conglobed, revealed by hardening logic as the paradox.

Pre-Socratic discourse must have slipped along, holding common sense and common notions through gulfs of "well yes, and then again no." The Socratic tightening (mathematical in spirit, as all logic, even in language is: "fix what you mean and give it consistency. Is it true or false?") opened under every dialectic the troublesome gulf of contradiction. Plato knew that and turned it into a method, as if axiomatic reasoning must be profoundly valid, especially for reducing opponents, though in the end it could only point beyond itself.

Similarly in Western thought, the method pursued from Descartes to Kant spun a network tight enough to catch and exhibit the antinomies of reason which Pascal had celebrated over a hundred years earlier—somewhat as Heraclitus had played with contradiction a hundred years before it was caught in the sophistic net.

Finally, in modern mathematics, the refinement of symbolic logic with its metamathematic analysis of arithmetic, has sprung the trap on the paradox which since Socrates had lain under every systematic and exact statement. When Gödel, in his proof of unprovability, established (once and for all?) that there are propositions in any formal system which can neither be proved nor disproved on the basis of the system itself, and that therefore no mathematical or arithmetic system can establish its own consistency—at that point (as reason had done in Kant) mathematics seemed on the verge of assuming, or at least of hinting it should assume, the sacrificial role. Though if we hold our wits to the reading of Gödel, our delight will be more in the precision of the rapier, than in any prophetic yielding of the Quixotic knight, pointing beyond himself.

Yet it is beyond mathematics that we must go. Beyond logic, even beyond clarity. That is forced on us by the nature of experience, by the creative originality of space-time, which makes all equation approximate and misleading.

Mathematics is the limit of the exact, as ratio is the limit of analogy. Since all discourse, with one part of its being, must aspire to exactness, we will not gain much by simply drowning thought in the amorphous. What is required is an organism, not a puddle. The world presents us with a *fait accompli* which makes specialized precision as urgent as it is dangerous. In every discipline we must master the proliferated complex of thingy particularity. Philosophy as common denominator is idle if it does not know the facts. However important to philosophize about life, we begin to drone when the discourse of entelechy and the rest cuts loose from the more and more ramified details of biology, evolution, genetics, biochemistry. Even poetry has had to refine itself to an absolute and demanding precision. And poetry, if as in Dante or Goethe it aspired to be architectonic, would have to incorporate as far as possible those disciplines which look up to logic and mathematics as their satanic exemplar. And yet it remains at the other end of the spectrum.

Suppose we close there, with that other way, which has been evolved in ambivalent relation to math, that other fabric of symbols—inexact or exact in some other way—of words—call it the Word—expressing itself ultimately, against the equation, in the poem. The poem, which has never yet, though it springs from the same tensile realm of energy relations as math, been able to incorporate, quote or use mathematical language (not even in Pound) yet which rides on those counted recurrences curiously called numbers. What myth will hint at the way of the word? Already the Word itself will have given the answer.

Where the language of math sets out to grasp and hold, in the end to *be* the truth, the word from the first takes up a sacrificial and sacramental role. It gives itself vicariously for the truth beyond its own formulation. Its strategy as metaphor is to transcend by going under; as Thoreau said "the volatile truth of my words should continually betray the inadequacy of the residual statement;" or as Dante repeats in various ways as he rises toward the culminant vision of God: "how limited words are and how hoarse." It is Lear's madness which speaks beyond sanity. The poetry-lover has faith in that as the Christian has

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in Death and Transfiguration. Even the Greek Word centered on Tragedy, against the geometry of Greek mathematics.

Though as Blake believed, Satan himself must be saved—the specter of formal precision has to be retained and cultivated. But like it or not, the precise can only operate wholesomely within the prevision of the creatively amorphous, and this is as true of reason in the rigorous sense as of mathematics. If philosophy is, as Kant assumed, a rational investigation, then poetry (or religion, if it is available) must be the life-giving mother in which it is contained—nourished by the dark divinity of imagination, which in its highest form has always been recognized as Spirit.

The poetic synthesis this calls for (which might even open itself to equation) must be a new one. But the past can give clues. And what would so perfectly exhibit, not mere philosophy, but the mathematical and rational operating in a poetic whole of inspiration myth and worship—sacramentally pointing beyond itself—as the Platonic dialogue?

But that would be another undertaking...