

Mathematics and the Character of Tragedy
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There is a tension between mathematics and the narrative arts. I am speaking here of an uneasiness that goes much deeper than the hatred of math so often confessed to (even with a perverse sort of pride) by literary types, or the symmetrical inclination among a good many mathematical types to dismiss storytelling as so much fluff. I am alluding rather to an *argued* strain between mathematics and the narrative arts that comes with the finest intellectual pedigree, reaching back to the fifth-century B.C.E. Its first and finest expression occurred in Greece, not so surprising since this is the location for the first and the finest expression of a dismaying number of fundamental ideas and themes and preoccupations of Western culture. It was Plato who best expressed— who veritably embodied—the tension between the narrative arts and mathematics.

Of course, there were no novelists in Plato's day. The closest thing to novelists were the dramatists and epic poets. Mastery of the poetic legacy was largely what counted as wisdom. Sprinkling one's oratory with passages from Homer and Hesiod yielded an authority almost tantamount to proof. Though Plato certainly rejected the probative value of poetic quotations, he nevertheless continually availed himself of them throughout his writings, though always in the way of illustrative flourishes, never as substantive elements of argument.

Plato clearly loved them both, both mathematics and poetry. But he *approved* of mathematics, and heartily, if conflictedly, disapproved of poetry. Engraved above the entrance to his Academy, the first European university, was the admonition: ***Oudeis ageometretos eisetō.*** Let none ignorant of geometry enter. This is an expression of high approval indeed, and the symbolism could not have been more perfect, since mathematics was, for Plato, the very gateway for all future knowledge. Mathematics ushers one into the realm of abstraction and universality, grasped only through pure reason. Mathematics is the threshold we cross to pass into the ideal, the truly real.

In the Allegory of the Cave—the best piece of storytelling in all of Western philosophy—he presents us with a sort of epistemological Pilgrim's Progress, deliberately setting up an alternative myth as a rival to the poet's tales of the immortal gods. His new myth is presented in a few paragraphs of the *Republic* but its scope is as large as any myth offered up in the millennia since. It presents not only a vision of the nature of reality, but of our cognitive relationship to reality. Plato is attempting to tell us what knowledge is and how it is possible for the likes of us. Even more largely, it is a view about how we can save ourselves by coming to know the real. All reference to the

gods is stricken in his narrative; whether we happen to find favor with that capricious mob is not the contingency that makes the difference between a life well-lived or not. We need never stand passive before them, nor anything else, again. Instead the difference between a life worth living and one that is not is a difference that we ourselves make, relying only on our capacity to reason out objective truth. Reason gives us the world as it really is and arriving at the world is the one activity worth doing, bringing us the only solace that we can honestly attain.

The allegory presents a prisoner chained with others so that he, like them, stares only at the back wall of the Cave, over which plays flickering configurations of shadows that he and the other prisoners regard as the sum total of reality. They study the shadows, keen on discerning any underlying patterns. Some among them, shadow-scientists, seem to excel at predicting events in the random sequence and they are honored as thinkers. This level of confusion is called by Plato *eikrasia*, the lowest rung of consciousness.

One prisoner is freed and sees that the shadows are only shadows, cast by puppets being toted on sticks by men. Only then does he understand the nature of the entities studied in the pseudo-science of his former colleagues, knows the shadows for what they are by ascending to the next level where he can see their explanation.

The light that creates the shadows comes from a small fire burning within the Cave. The fire stands for the personal ego in Plato's allegory. (I am engaging in some interpretation here. An allegory obviously calls for such a response.) A chained prisoner staring at the flickering shadows is looking at how the world would be if he were really as important in it as he unreflectively feels himself to be—as we all unreflectively feel ourselves to be, which is why Plato solemnly intones that this strange situation, being

chained so that one's scope of vision is restricted to shadows that one cannot identify as shadows, is one that universally holds: "It is a strange picture, he said, and a strange sort of prisoner. Like us, I replied" (vii. 514).

In the *Timeus*, Plato's creation myth, he has the Demiurge delegating to a lesser god the doling out of human emotions. This lesser god, in his inexperienced zeal, infuses too much of the "necessary and dreadful" emotions needed for survival. It is necessary that each person confer special significance on himself, be interested in himself as he is in nothing else. But we do tend to go overboard in this direction, Plato is telling us, and to objectify into false metaphysical schemes what is merely a contingent fact: that one happens to be who one happens to be, and, being that thing, one wants very much that that thing that one is to particularly and objectively matter: to matter largely, on a scale to flatter one's own sense of one's importance. To be imprisoned in such a viewpoint (many people's personal religiosity comes to mind) is to be at level of the chained prisoner.

The prisoner, once he is free of his chains, can turn his head and take in others. This is progress, but still the whole inside of the Cave is limited to the view from the distinctly human perspective. It is still dark with subjectivity—even if the viewpoint is broadened beyond that of the single individual. Plato has in mind at this stage the sort of undergraduate-beloved specious enlightenment that comes with recognizing that one's own point of view is but one's own, others having others, and therefore—here comes the specious part—there is nothing at all that makes one point of view superior to any other. This sort of relativism, despite its postmodern tone, is as old as philosophy itself,

represented in Plato's own day by such sophists as Protagoras. Plato deplored relativism. It is only one step above *eikrasia*, closer to it than to the next stage of the ascension.

Now the prisoner is taken to the opening of the Cave. He steps out, with difficulty, into the sunlight. He doesn't look yet at the sun; he can't. He must get to the sight of it by degrees. With this motion outside of the Cave he takes the big step, going from the dark and narrow confines of points of view thrown up by the fire of human subjectivity that casts its weak and illusion-making light within the Cave, into the broad and bright Out There of the objectively real. One can only get Out There through the exercise of reason, the only means one has of overcoming ego-induced illusions. Reason acquaints one, according to Plato, with a new level of reality—the objects of pure abstraction—existing precisely as reason deduces them to be, unobscured by the emotional smoke of the ego-fueled perspective, seeing the world as it wishes it to be for such purposes as meet its own narrow needs.

The prisoner is at first too stunned by the dazzle of light to take in the objects around him and instead looks at their reflections in water. These reflections, Plato tells us, represent mathematics. Mathematics is the training ground for the faculty of reason. Mathematics is the first encounter with rigorous rationality, the first acquaintance with the objects we know to exist because we deduce that they *must* exist. The self's desires—the major source of illusions—have no role to play in the deductions of pure reason. The world to which one ascends is perfectly objective, appearing to all as it appears to each.

For Plato, there are objects of abstraction beyond the mathematical, but mathematics is our entry into the realm of abstraction. For those who have no head for mathematics, there is simply no hope of attaining the sights of true reality. They will

never make their way further into the bright and broad reality beyond the Cave. No wonder that he inscribed that warning to the ageometretos above the entrance to his Academy.

Mathematics, then, plays a special role in Plato's epistemological myth. Interestingly enough, to the extent that a Platonic metaphysics—a commitment to the real existence of abstract entities—still survives in contemporary thinking it is almost exclusively restricted to mathematical Platonism, the view to which many mathematicians appear to subscribe. For example, G.H. Hardy, in *A Mathematician's Apology*, unapologetically confesses his core Platonism:

I believe that mathematical reality lies outside of us, that our function is to discover or *observe* it, and that the theorems which we prove, and which we describe grandiloquently as our "creations," are simply our notes of our observations. This view has been held, in one form or another, by many philosophers of high reputation from Plato onwards, and I shall use the language which is natural to a man who holds it . . .

This realistic view is much more plausible of mathematical than of physical reality, because mathematical objects are so much more what they seem. A chair or a star is not in the least what it seems to be; the more we think of it, the fuzzier its outlines become in the haze of sensation which surrounds it; but "2" or "317" has nothing to do with sensation, and its properties stand out the more closely we scrutinize it. It may be that modern physics fits best into some framework of idealistic philosopher—I do not believe it, but there are eminent physicists who say so. Pure mathematics, on the other hand, seems to me a rock on which all idealism founders. 317 is a prime, not because we think so, or because our minds are shaped in one way or another, but *because it is so*. Because mathematical reality is built that way.

In any case, whether or not mathematicians are disposed to think well of Platonism, Plato was certainly disposed to think well of mathematics. Mathematics presents us with the model of objective reason, of thought processes that have been purified of all the smoky soot of subjectivity, of how things merely appear to us, these

appearances conditioned by our own particular place in the world, and transports us out into the wide impersonal open of the truly real, the necessarily existent, the pure and perfect and certain.

So math is good, according to Plato. Very very good. What of the narrative arts? Not so good, according to Plato.

Not only do the arts in general belong to the ego-warped, emotionally clouded, narrowly particular, shifting quasi-reality of mere subjectivity, presenting the world as it appears to be from the merely human point of view, or worse, from the point of view of particular idiosyncratic “artistic” human beings, rarely the most stable or virtuous among us. Plato emphasized the cognitively empty status of the arts by identifying them with the flickering shadows dancing their meaningless dance on the back wall of the Cave. The arts, of all the modes of thinking, are the furthest removed from salubrious objectivity. All the flaws from which the sooty world within the Cave suffer are accentuated in art. To take the world as it is given to us in art is to remove oneself even further from knowledge of the real. Art, as beautiful as it may be, in the end has nothing to teach us.

Yes, as beautiful as it may be. The beauty of art is worth remarking on, since Plato does not undervalue beauty, as any mathematically inclined metaphysician would not. Beauty, he believes, is vital to us in helping us see our way clear to objectivity. Without our susceptibility to beauty there would be no hope for us at all. It is only because we fall in love with beautiful things, including truth, that our attention can be wrested away from our default object of fascination: ourselves. Beauty then is part of our cognitive salvation. So there is a bit of a mystery as to why the arts, dedicated as they are to ideal beauty, are dismissed as inhabiting the absolute lowest sphere of human thought.

And of all the arts he singles out the narrative arts for special abuse. In that very same dialogue, the *Republic*, in which the Allegory of the Cave is presented, he—regretfully and with many terms of affection—gives the poets the boot. The outrage occurs toward the end of Book X. Socrates, in an attempt to answer the large question of what justice consists in, has been constructing a utopian state, down to the smallest detail, even prescribing who shall mate with whom, and how it shall be brought about, and how the issue of those matings shall be educated, according to their innate cognitive abilities. In his micro-management he must, of course, consider the issue of the arts, which in ancient days, as in ours, formed such a substantive part of shared communal sensibility. He allows for certain kinds of music, mainly martial, to stir up the right sort of stuff for battle, and for simple forms of visual art—small and uninspired art, not the sort to make us swoon with aesthetic bliss. It sounds as if, for Plato, safe art is pretty bad art.

But there is to be no place at all for the narrative poets. Were one of these gifted fellows to wander into the reason-sanctioned city he would be told that there are none at all like him in residence—ambiguous words of praise. The poet will be anointed with myrrh, his head wreathed in laurel, and then he will be respectfully but firmly accompanied to the nearest border and bidden farewell.

Why did Plato feel he had to go to such lengths to de-poetize his rational city? Is there no safe narrative art at all? No, there isn't, not according to Plato. The better, the narrative artist is, the more he moves us, the more he undermines the rational life that Plato espouses.

The answer as to why Plato took such drastic measures is not straightforward at all, and I am doing a good deal of extrapolation and reconstruction—not to speak of

condensation—here. There are various answers, though they interweave with one another in a reinforcing sort of way.

The simplest answer as to why Plato, poet-lover though he was, felt compelled to take such drastic measures in his imaginative city, is to concentrate on Plato's reality-chauvinism, so to speak, which inclined him to harbor little respect for the products of imagination. Reality, for him, consists in the abstractions of pure reason, the world outside the Cave. Art, though it may reflect abstractions and universal, is made up out of particulars, and particulars were of no particular interest to Plato. Even worse, art does not present real particulars but imitations of particulars, placing art at an even further remove from the real.

But this observation, often presented as the sum and substance of Plato's argument against the artists, does not begin to do justice to the complexity of Plato's conflicted attitude toward art. And it does not explain why the narrative arts, of all the mimetic arts, were singled out for specially abusive treatment.

Another possible answer centers on Plato's view of beauty. Beauty is just too potent a power for Plato to allow it to be utilized by any but the rigorously rational, those who put truth above all. Artists will go after a beautiful effect whether it is edifying or not, and this is dangerous because we are helpless before beauty, ready to believe anything, or anyone, if it, or he, stirs our aesthetic sense. It is true that were we not disposed to love the beautiful we would all remain staring at the shadows of the back wall of the Cave, enchanted by our own personal vision of the way the world would look if we were the most important thing in it. Our love of beauty breaks the heavy daze of our self-enchantment, turns the vectors of our attention around so that they are pointing away

from us and we can take in something of the world beside ourselves. But because it is so potent, our love of beauty can be misused, making us fall in love with what is neither true nor good. The philosopher alone knows how—like the mathematician that he must also be—to use beauty responsibly, as a guide for the truth.

This is all true, though it is also true that all the arts—music and painting and sculpture, as well as the narrative arts— are guilty of slavishly worshiping beauty, detached from its truth-seeking rationale. No answer has yet been offered as to why Plato singles out the narrative artists alone for banishment. Why can't the poets of his day, and by extension the novelists of today, undergo Platonic rehabilitation so that the wares of their creativity can pass muster in the rational city?

Can't we novelists be good for the soul?

No, we can't, not according to Plato, even though we too have the power of pulling an individual out of his little ego-warped worldview, by making him participate in other points of view, inhabit them as if they were his own. But the subjective point of view is not a good thing in itself, so pulling people out of their own, so that they see the world from others' viewpoints, is not much progress. Multiplying what has no value in itself doesn't amount too much.

But more seriously still, the narrative arts are profoundly and irreconcilably at odds with the Platonic project of rational salvation, of saving ourselves by becoming rational. Saving ourselves from what? From being human, with all of the dreadful and necessary emotions—and tragedy—that this entails. The project of rationality as Plato conceived of it was to be nothing less than delivering us from the tragic dimension altogether, by bringing us to that glaring sunlit world where not a shadow of the personal

perspective can survive. Within this brave sunlit world there can be no storytelling—deep participation in the narrative of people’s lives. These narratives all conjure up the emotions of subjective attachments that get blessedly burned away in the sun’s bright glare.

In order for narrative art to move us, to yank out us out of the own enchained personal visions by awakening us to a deep emotional participation in other narratives, making us momentarily forgetful of who precisely we are, we must take it for granted that the individual matters in incalculably significant proportions, that his diminishments are diminishments of the world itself. And, too, good literature makes us feel what a pitiful thing it is to be human—all of our terrible longings and the indifference with which the world treats them, not least our longing to live forever. We are infinite only in our longings—which means that we long to be gods.

Good art offers no false consolations. From Plato’s day to ours, art tells us not only that we are not gods, but that it is a tragic shame that we are not, and that there is nothing that we can do to make it better. As the literary critic George Steiner beautifully put it:

Tragic drama tells us that the spheres of reason, order, and justice are terribly limited and that no progress in our science or technical resources will enlarge their relevance. Outside and within man is l'autre, the "otherness" of the world. Call it what you will: a hidden or malevolent God, blind fate, the solicitations of hell, or the brute fury of our animal blood. It waits for us in ambush at the crossroads. It mocks us and destroys us. In certain rare instances, it leads us after destruction to some incomprehensible repose.

Our essential pitifulness is impressed on us most intensely when the protagonists of a tragedy are cast in the heroic mold, with strengths that make them stand out in vivid bas relief from hoi polloi. Their very giftedness, and the ambition for transcendence that

these gifts engender, is what typically brings them down. It is not that were they to have stayed nearer to the earth, crouching on its surface, they would have been able to avoid tempting tragedy altogether; after all, none of us can. But what they could have avoided were the spectacular tragedies that make their stories worth the telling—stories like that of Icarus, who soared and plunged, or of Marsyas, the musical mortal who dared to challenge Apollo to sing music more beautiful than his. Marsyas lost to the god, of course, and was flayed alive for his hubris, crying out to the god in his agony: “Why do you pull myself from myself?” This is a particularly apt cry of agony for a tragic hero; the heroic attempt is, after all, an attempt to pull one’s self from one’s self, and to fail, and to suffer the consequences.

This whole tragic way of looking at things is what Plato is keen to deny. And this is why literature, from his day to ours, is at odds with his ambitious project of rationality, and why he was compelled to send the laurel-wreathed poets packing. Plato would like to save us from our fragility, which means that he would like to save us from being ourselves—infinite only in our longings to be other than what we necessarily are, to pull ourselves from our selves. Plato, too, is asking us to be heroic, to pull ourselves from ourselves, but he is asking that we complete the job, *become* the impersonal point of view, submerge our own particularity into the fullness of objectivity. The more our own identity merges with the impersonal world of pure abstraction into which our love of beauty carries us, entering it through the portal of mathematics, the more indifferent we are to the vicissitudes of our own personal fortune, which is the only salvation that we can know. We render our particular selves invulnerable by ceasing to be, or at least caring particularly about, those particular selves.

Poetry's beauty is then particularly dangerous, according to Plato, for it points us precisely where we should not go, toward deep participation in the heartbreaking poignancy of our frail and mortal lives. And, too, the plight of the hero, singled out for suffering precisely because he is heroic, could not go further against what Plato is urging of us, viz. to be heroically rational—his tale of the Cave is precisely such an exhortation, and one for which, too, he foresees, in some sense, a tragic end: The epistemological pilgrim having emerged into the glorious refulgence of reality will feel compelled to go back and try to enlighten the others. But back down in the darkness of the Cave, his eyes still filled with the sunlight of impersonal Truth, he will appear the fool, and the others are almost guaranteed not to understand him, and to mock him, and if he still insists on these truths that they cannot begin to guess at he will begin to seriously annoy them. Helpless down in their darkness, precisely because he is enlightened, he will be vulnerable to their low cunning and “if they catch him they will kill him” (vii. 517).

A tragic denouement, in a certain, sense, but not in Plato's sense. What Plato is trying to do is change our frame of reference so that these are no longer seen as tragic tales, all these stories that seek to move us by recounting the demise of one particular person, no matter how poignantly heroic. Who is he, who is anyone, compared with the truth? Plato's project of rationality rests in excising the tragic dimension altogether from our conception. And this is why he says in the *Phaedo* that to philosophize is to prepare to die.

Plato then loves and approves of mathematics, but he only loves— and against his better reason—the narrative arts. He doesn't approve of serious—that is, tragic—storytelling. He can't approve of it, since it is designed to make us feel what a pitiful

thing it is to be human—even for the greatest among us, the heroes, who can seem, in their audacious powers, to transcend the limits of finitude, but who, in the end, don't, because none of us can.

But still Plato—how I love his conflicted soul—can't help loving poetry. He betrays his better philosophical instinct by sneaking poetry in wherever he can. And of course he is the greatest literary artist among the philosophers, wielding the tools of the literary trade—dialogue, metaphor, allegory—with enviable artistry.

Even after he gets through banishing the poets he confesses his love for their art and holds out the hope that someone will convince him that his anti-poetical stance isn't necessary:

But in case we are charged with a certain harshness and lack of sophistication, let's also tell poetry that there is an ancient argument between it and philosophy Nonetheless, if . . . poetry has any argument to bring forward that proves it ought to have a place in a well-governed city, we at least would be glad admit it, for we are ourselves very susceptible to its charms. (Book X 607)

What I am going to offer is nothing like the sort of poetry-justifying argument that Plato is looking for. In fact, if anything what I will have to say will only strengthen Plato's claim that the narrative arts stand irreconcilably opposed to the project of rationality, as Plato conceives of it. I wouldn't want to read novels if they didn't. I wouldn't want to write them.

Still, I confess I take Plato's argument seriously. I feel his banishment of those of my ilk with a certain admiring sense of justification. I always hear Plato's voice in my head and I'm always trying to answer him. Plato's right that narrative art must be poignant. It must pierce us through and through. It must devastate us with the terrible knowledge of our fragility—even the most god-gifted among us. If the project of

rationality is to make ourselves immune from devastation, then Plato's logic is flawless: fiction is no damn good for us. I'm not going to try to answer him here on that score. Mostly, I try to answer him by writing fiction.

And often this fiction that I write features mathematicians as major characters, which is ironic, given whom I'm trying to answer here. Why is this? What draws me, again and again to mathematicians as characters?

There is something about being a mathematician that crystallizes, at least for me, some of the very features of the human predicament—the ways in which we partake of the infinite and the ways in which we don't, the ways in which we are caught between the gods and our mortality— from which Plato sought to rescue us by way of mathematical reasoning itself. That is to say, there is something that I find essentially tragic—in the noblest and most moving sense of that word—about being a mathematician. If to be a tragic figure is to be a finite mortal who strains toward the infinite, who resists the mortal limitations and tries to gain entry into the sphere of the limitless and eternal, the necessary and ideal, well then, isn't that the job description of the mathematician? Only the mathematician can lay claim to intimacy with the infinite, proving theorems about its true nature, revealing that there are infinities beyond infinity, an ascending order of uncountable domains containing more things than could have been dreamed of in any Horatian philosophy.

“I wish I could describe it to you, could capture it in words. But I never could, not even if I had the verbal facility which I lack. I wish I were able to describe the beauty and excitement when it's working, when I'm seeing it.

“Like the past few hours?”

“Like the past few hours. It's not always like that, of course. Sometimes I wonder round and round in circles, going over the same ground, getting lost, sometimes for hours, or days, or even weeks. But I know that if I immerse myself in it long enough, things will clarify, simplify. I can count on that. When it happens, it

happens fast. Boom ba boom ba boom! One thing after the other, taking the breath away. And then you know I feel like I'm walking out in some remote corner of space, where no mortal's ever been, all alone with something beautiful."

This is a character, Noam Himmel, speaking from my first novel *The Mind-Body Problem*, trying to explain to his wife of a few weeks, whom he has largely ignored on their honeymoon, the exhilaration of his work. There is something heroic about such ascents into infinity, ascents impossible for all but a handful of people (Noam, when he was twelve, had discovered numbers he dubbed the "supernaturals"). Noam's wife listens to his passionate description of his solitary work, and feels chastened for having resented being left so completely on her own on their ostensible honeymoon. "You're a god," she gushes to him. He has the modesty of knowing the history of mathematics, and demurs:

"Some are gods. Archimedes, Newton, Gauss, they were gods."

"A minor deity, then?"

"No, not that either. Euclid, Descartes, Fermat, Euler, Lagrange, Riemann, Cantor, Poincaré, Hilbert, and Gödel—they're the minor deities."

"A demigod, then, the offspring of a god and mortal?"

"Okay." He laughed. "Maybe I'm a demigod in the pantheon of math."

There is no tragic hero without intimations of divinity, and, too, there is no tragic hero without those intimations bringing him to his ruin. Mathematicians, despite their pilgrimages to the infinite, are finite. In fact, they are typically all too finite, often extravagantly flawed as human beings, vulnerable not only in the ordinary ways that plague us all, but subject to their own extraordinary afflictions and mortifications. In almost all narrative art—including not only novels but plays and movies as well—which feature mathematical characters, these special vulnerabilities enter prominently into the plot, making ultimately for a tragic tale.

There are three particular vulnerabilities to which mathematicians, at least in their fictional appearances, are portrayed as being peculiarly vulnerable, rendering them tragic figures.

The first of these is the classic hubris of the hero. Plato placed mathematics at the very portals of the extreme objectivity which would cure us of the “dreadful and necessary emotions” required for survival. To emerge, by way of pure reason, into the Out There was to be on one’s way to saving one’s self by transcending the self. But just because you have transcendent mathematical talent doesn’t mean that you’ve signed on for the whole Platonic project of transcendence.

Mathematicians, just like artists, just like novelists, are often astonishing in their single-mindedly commitment to the personal *I*, intent not only on knowing the truth for its own sake, but on being known as the one who first knows the truth. Someone else may get there first, and then all—all!— will be lost. Pure mathematicians tend not to be so pure. Plato’s project of rationality was to save us from being hostages to fate; the only thing that we can truly control is the progress of our own understanding, but that is the only thing that we need to control in order to live a life worth living. But a mathematician’s personal ambition in regard to impersonal truth makes him more hostage than most. The difference between winning and losing is not entirely within one’s control and this can produce extraordinary agony, worthy of the narrative artist.

So for example, in *Uncle Petros and Goldbach’s Conjecture*, the eponymous Uncle Petros does not mention to anyone when he has derived an important result which he regards as valuable primarily as a stepping stone to the big one, proving Goldbach’s

Conjecture. He's afraid that someone else will use his result and get to the proof that all even numbers are the sum of two primes before him. So he keeps mum and is punished on the grand tragic scale, for someone else of course proves the intermediate step, an important result in its own right, and Uncle Petros, his obsession with glory now laced with the bitter poison of feeling himself the victim of misfortune, descends into further tragedy, following the path of the classical hero, made to suffer for his wanton hubris:

Reminiscing for my benefit, Uncle Petros marked this decision as a turning point in his life. From then onwards, he said, difficulties began to pile upon difficulties.

By withholding publication of his first truly important contribution to mathematics, he had placed himself under double time-pressure. In addition to the constant gnawing anxiety of days and weeks and months and years passing without his having achieved the desired final goal, he now also had to worry that someone might arrive at his discovery independently and steal his glory.

William Boyd's *Brazzaville Beach* also has a tragic mathematician, John Clearwater, whom, as in *The Mind-Body Problem*, we see through the eyes of his non-mathematical wife:

"Do you remember," he said, "when you came to see me, after I'd moved out?"

"A Sunday?"

"Yes. And I said that the work was going well, that I was very close to a breaking through? I had worked out this set?"

"The Clearwater set."

His laugh was dry. "Well, I was beaten to it. Someone got there first."

He wrote a formula in the condensation of the car window.

"Unreal," he said. "Dazzling. But someone else thought it up."

"You know it means nothing to me."

"It's so simple. And that's why it's beautiful. If you knew, if you just knew what you could achieve with that. If you knew what it implied."

She looked at the innocuous figures, bleeding now, mysterious and unknowable. For the first time in ages she felt that old envy of him.

“You see how much better I am,” he laughed, not quite so calm.

“I can look at that,” he rubbed it out with a swipe of his fist, “and not burst into tears.”

Brazzaville Beach's John Clearwater, as well as Uncle Petros, bring me to the second affliction to which the tragic mathematicians of fiction are presented as being painfully susceptible. It is a delicate subject to touch upon: madness. Why do you pull myself from myself, Marsyas had cried out, in the name of all heroes, to the god. Madness is perhaps the cruelest way in which this agony can be realized.

The current play—and now movie—“Proof,” not to speak of the academy-award-winning movie “A Beautiful Mind” also dwelled on the madness of mathematicians. “A Beautiful Mind, loosely based on the biography of that same title by Sylvia Nasser, features Russell Crowe playing John Nash—of course a real mathematician, one of the original developers of game theory, who lost decades of his life to schizophrenia. There are others—already mentioned in the roll call of the pantheon of mathematics that my character Noam Himmel recited—who similarly lost themselves to madness. There is Georg Cantor, who more than any other mathematician could be described as achieving intimacy with infinity, and who died in an insane asylum, and there is Kurt Gödel who ended up starving himself to death under the paranoid delusion that he was being poisoned. One of Gödel's mathematics professors, Phillip Fürtwangler, once remarked in regard to Gödel's paranoia: “Is his illness a consequence of proving the non-provability or is his illness necessary for such an occupation?”

In *Uncle Petros*, the narrator nephew catches a glimpse of Gödel and decides to forswear his own mathematical ambitions:

Yet, hopeful as I still was in my ignorance about my abilities, it wasn't professional failure that I feared. It all started with the sorry sight of the father of the Incompleteness Theorem padded with layers of warm clothing, of the great Kurt Gödel as a pathetic, deranged old man sipping his hot water in total isolation in the lounge of the Institute for Advanced Study.

A few paragraphs later he remarks:

Sammy's theory of hubris had haunted me ever since I'd heard it, and after my brief review of mathematical history I embraced it wholeheartedly. His words about the dangers of coming too close to Truth in its absolute form kept echoing in my mind. The proverbial 'mad mathematician' was more fact than fancy. I came increasingly to view the great practitioners of the Queen of Sciences as moths drawn towards an inhuman kind of light, brilliant but scorching and harsh.

There have been spectacular specimens of the mad mathematician—I mean in real life, not only in literature—the very prominence of the individuals in question tending to exaggerate perhaps the appearance of a strong correlation between the two mental anomalies, mathematical talent and insanity. We don't really know what the precise statistics are correlating the continuous variable mathematical talent with the many forms of madness, which must also be distinguished from one another if empirical hypotheses are to be tested. (The British psychologist, Simon Barrett-Cohen, who studies autism, has theorized that the mathematically inclined have an increased inclination toward the mental problems that fall in the continuum spreading from mild Asperger Syndrome to full-fledged autism, and has set up a longitudinal study to test whether offspring of two mathematical parents are at an increased risk of falling within the autism spectrum.)

But no matter what the true statistical situation should prove to be correlating mathematicians and madness, the mathematicians of narrative art tend to be seriously

unhinged. Why is it that when narrative artists create mathematicians they so often create them going mad? True, to outsiders the mental life of the mathematician is so inaccessible and weird, that it can suggest, in and of itself, the idea of madness . (The inaccessibility is also what keeps many narrative artists from even thinking of creating mathematical characters, or sometimes, when they do, causes them to get the inner life risibly wrong.) That fixed concentration on questions of no practical applicability that can't be communicated to regular people can in itself seem like lunacy. (When the play "Proof" moved from Off-Broadway to Broadway, the producers held a day of panel discussions on matters mathematical at the Courant Institute for purposes of publicity. I was on a panel with David Auburn, the author of "Proof," which revolves around the theme of mathematics and madness. Auburn, at one point in the panel discussion, burst out, partly in jest but with some sincerity as well, with the remark that the day at Courant had convinced him that *all* mathematicians are howlingly mad.)

But at a deeper level, there is something in the figure of the brilliant mathematician who is losing his hold on reality that comes close to the heart of tragic poetry. Here is a person with extraordinary powers—in the case of the mathematician, mental powers—being reduced to below the level of the ordinary, powerless in the way that before he was powerful. It is impossible not to think of Lear. The mad mathematician, no matter what extraordinary sights he has glimpsed of the infinite real, is more a chained prisoner than anyone, staring helpless at the shadows thrown up by his own mind. This is the essence of tragedy. It can also be comic, and at the very same time that it is tragic (if the work is only comedy, devoid of the tragedy, then it is merely cruel),

and such a blending is itself a complicated literary device for portraying the human condition. Just because we're absurd doesn't mean we're not also tragic.

There is a third interesting peculiarity of mathematicians that often finds its way into plotlines, yet another susceptibility to remind us of the inescapable finitude of even those among us who have the greatest claims to intimacy with the infinite. I am speaking now about getting older, not pleasant for any of us, but of particular significance to the mathematician. Mathematical talent, while often emerging prodigiously young, also gives out heartbreakingly young. Perhaps only the aging athlete and the fading femme fatale feel the progression of time as devastatingly as the mathematician.

G.H. Hardy's *A Mathematician's Apology* is, in addition to everything else, one of the saddest testaments I have ever read, the very conditions of its composition contributing to the moving quality of the book. Hardy had lost his mathematical powers, had attempted suicide and failed, and was convinced by his friend C. P. Snow, the physicist and novelist, to write a book for non-mathematicians, describing what it is like to be a mathematician. Hardy produced a little book that is eloquent and interesting, and whose almost every line—even when he is speaking of proofs and of Platonism—speaks of loss. This is its opening paragraph:

It is a melancholy experience for a professional mathematician to find himself writing about mathematics. The function of a mathematician is to do something, to prove new theorems, to add to mathematics, and not to talk about what he or other mathematicians have done. Statesmen despise publicists, painters despise art-critics, and physiologists, physicists, or mathematicians have usually similar feelings; there is no scorn more profound, or on the whole more justifiable, than that of the men who make for the men who explain. Exposition, criticism, appreciation is words for second-rate minds.

A few pages later he speaks more directly about again:

I had better say something here about this question of age, since it is particularly important for mathematicians. No mathematician should ever allow himself to forget that mathematics, more than any other art of science, is a young man's game . . . Galois died at twenty-one, Abel at twenty-seven, Ramanujan at thirty-three, Riemann at forty. There have been men who have done great work a good deal later: Gauss's great memoir on differential geometry was published when he was fifty (though he had the fundamental ideas ten years before). I do not know an instance of a major mathematical advance initiated by a man past fifty. If a man of mature age loses interest in and abandons mathematics, the loss is not likely to be very serious either for mathematics or for himself.

It was, by the way, Hardy's elegiac memoir that caused me to become a novelist. I read it while I was a graduate student of philosophy and was so moved by its underlying pathos that, almost despite myself, it suggested the plot of a novel to me, and mathematicians have continued to people my fiction ever since.

But let's not end by speaking of diminution and loss but of power and grandeur. Mathematicians qualify, at least in my book, as tragic heroes not only because they can be tragic but also heroic, not least of all in their susceptibility to beauty. The mathematician and the artist share a well-trained instinct for beauty. The mathematician and the artist can both, in the service of their muses, even manage to subdue their respective raging egos in order to submit themselves to the chastening aesthetic dictates. So it is on this note that I will end, quoting from one of my own short stories, entitled "Strange Attractors":

Suddenly there's a great stamping noise outside of her door, and Oren Glube comes bursting in, his normally pale face flushed as if with fever.

"Come! Now! *This* second, Phoebe!"

Her only thought is of fire, of which she's always been frightened: The Institut des Hautes Etudes Scientifiques is in flames, she thinks.

She rushes to the door, and Oren grabs her hand and is pulling her down the hall with him, stomping loudly in his big black rainboots.

Antoine's taken Phoebe's other hand, and they run for the main door of the building; all of the mathematicians have come from their offices and are running for the door.

Only the secretaries sit calmly at their desks, typing and making their jokes about the "inmates of Bures."

"They're overexciting themselves again," says Suzette. "We'll have our hands full trying to calm them down this evening."

And outside the mathematicians all stand gathered together on the wet lawn, staring up into the western sky, where there's a rare double rainbow stretching itself:

The colors of the primary arc are intense and pure; and beneath is the secondary rainbow, with its paler inversion of the spectrum.

And all of the mathematicians are standing together in silence; on every face the same look of transfixed bliss.