

# ► “Behind Every Jewel Are Three Thousand Sweating Horses”: Meditations on the Ontology of Mathematics and Mathematics Education

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## Preamble

[What if mathematics, or poetry, or the taxonomies of biology, or any other of the pieces of the world entrusted to us as teachers] no longer has the character of an object that stands over and against us? We are no longer able to approach this like an object of knowledge, grasping, measuring and controlling. Rather than meeting us in our world, it is much more a world into which we ourselves are drawn. [It] possesses its own worldliness and, thus, the centre of its own Being so long as it is not placed into the object-world of producing and marketing. The Being of this thing cannot be accessed by objectively measuring and estimating; rather, the totality of a lived context has entered into and is present in the thing. And we belong to it as well. Our orientation to it is always something like our orientation to an inheritance that this thing belongs to, be it from a stranger's life or from our own.

—Hans-Georg Gadamer, *Heidegger's Ways*

What possible good could come from a meditation on the *ontology* of mathematics and mathematics education?

Our answer to this question is simple to state, even though its practical educational consequences are enormous. Currently, the only discourses available in mathematics education are those of consumption or production. Becoming involved in mathematics, therefore, means becoming either a producer or a consumer. Mathematics, therefore, is

something produced or consumed. Either one “makes meaning” of it oneself, or the meaning made by another is imposed “from outside” and simply “swallowed” because of the “authority” (which always means “power”) of the maker.

Or, we “socially construct.” That is, we are *all* producers and consumers of knowledge, and the whole known world is at the formative disposal of our knowing. Thus a thread of European history and the collapse of epistemology into the market begins:

[Immanuel] Kant’s dictum “the mind makes the object” were the words of blessing spoken at the wedding of knowing and production, and should be remembered when we contemplate what is common throughout the world. (Grant, 1998, p. 1)

Accordingly, the spontaneity of understanding becomes the formative principle of receptive matter, and in one stroke we have the old mythology of an intellect which glues and rigs together the world’s matter with its own forms. (Heidegger, 1985, p. 73)

And, accordingly, the Earth becomes a passive, malleable (and eventually disposable) “resource” for our consumptive and productive manipulation, and the term “math manipulatives” carries no irony or hesitation.

And children become “our greatest natural resource” with little thought given to what we’ve done to the rest of those things we’ve considered merely sources for our consumption and satisfaction, with no Being of their own, no reserve or character beyond our desire, our “wanting and doing” (Gadamer, 1989, p. xxviii).

But what if this is not the way that mathematics *exists*, as an object either produced or consumed, either individually or collectively? What if it somehow *is* different from what the economies of production and consumption, either individual or collective, can handle? What if the options of production and consumption (along with their consort images of ownership and the commodified exchange of objects between “individuals” whose only “world” is now “the market” [Jardine, Clifford, & Friesen, 2000] turn upon the same ontological ground and are therefore not especially options at all? What if, therefore, the epistemological quarrels over “production versus consumption” (and those over “individual versus collective”), which have been exhausting

us, instead conceal a deeper, more dangerous debate that has been thus far successfully avoided?

What if mathematics is much more a world into which we ourselves are drawn, a world which we do not and cannot "own," but must rather somehow "inhabit" in order to understand it? What if we cannot own mathematics (either individually or collectively), not because it is some object independent of us and our (individual or collective) ownerships, but because *it is not an object at all*? What if, instead of production and consumption, the *world* of mathematics (as a *living, breathing, contested human discipline* that has been handed to us) needs our memory, our care, our intelligence, our work, the "continuity of [our] attention and devotion" (Berry, 1977, p. 32) and understanding if it is to remain hale and healthy and whole?

## I

[Images] announce themselves, bear witness to their presence: "Look, here we are." They regard us beyond how we may regard them, our perspectives, what we intend with them, and how we dispose of them. (Hillman, 1982, p. 77)

Catch only what you've thrown yourself, all is mere skill and little gain. (From a poem by Rainer Maria Rilke, quoted as the epigraph in Gadamer, 1989)

Images have a most peculiar sense of arrival. They seem to *arrive*, out of nowhere, often unexpectedly, with a clear feeling of agency, of portent, of demand and deliberateness. This is phenomenologically undeniable. During the act of writing, of composing, of setting forth an idea in the already-imaginal (not simply signifying and signing [Gadamer, 1989, pp. 405, 412–418]) realm of words, images can, sometimes, become catalytic moments of experience, finally, it feels, saying what was silent, gathering what was dispersed, drawing us into the ways of a world of relations that has the center of its own Being beyond our "wanting and doing" (Gadamer 1989, p. xxviii).

Every word [-as-image, not -as-sign (Gadamer, 1989, pp. 405, 412–418)] breaks forth *as if* from a center. Every word causes the whole of the language to which it belongs to resonate and the whole world-view that underlies it to appear. (Gadamer, 1989, p. 458, our emphasis)

As signs, words re-present. They are mere stand-ins for the real thing, pointers to somewhere else.

As images, the real thing presents itself "in" words.

The title of this chapter is taken from Jane Hirshfield's wonderful work *Nine Gates: Entering the Mind of Poetry* (1997, p. 43). When we happened upon it, the first question was how to take care of it. This is because its arrival is first and foremost experienced as a claim made upon each of us (Gadamer, 1989, pp. 126–127, 297), an address spoken to us and for us (Gadamer, 1989, pp. 290, 295, 299).

This image we simply stumbled upon seemed to *require something of us*, seemed to require our attention and devotion and love and care and cultivation.

"Look. Here I am" (Hillman, 1982, p. 77).

The trouble always is, of course, that *the image itself* contains many, most, maybe all of the answers to the questions its demand provokes.

It pulls us into *its* question, *its* repose, *its* regard.

Therefore, first the question is posed not *by us* but *to us*. Good questions must be first *posed* (Gadamer, 1989, p. 363) and the writing that follows necessarily belies the writer's own emerging composure (an "exaggerated" [Gadamer, 1989, p. 115] reading of Gadamer's reading of *Bildung* [p. 9ff]) in the face of such questions.

And, too, if things go well, the writers and the readers might get a wee glimpse of the composure of the thing written about, its "repose" (Gadamer, 1977, p. 227) its "*Da*," (Gadamer, 1994, pp. 22–25) its "standing-in-itself" (Gadamer, 1977, p. 226), again, over and above our "wanting and doing" (Gadamer, 1989, p. xxviii).

## II

"Behind each jewel are three thousand sweating horses." This is an image from Zen Buddhism that invokes the tale of Indra's Jeweled Net from the *Avataska Sutra*:

Far away in the heavenly abode of the great god Indra, there is a wonderful net that has been hung by some cunning artificer in such a manner that it stretches out infinitely in all directions. In accordance with the extravagant tastes of deities, the artificer has hung a single glittering jewel in each "eye" of the net, and since the net itself is infinite in all dimensions, the jewels are infinite in

number. There hang the jewels, glittering like stars of the first magnitude, a wonderful sight to behold. If we now arbitrarily select one of these jewels for inspection and look closely at it, we will discover that in its polished surface there are reflected all the other jewels in the net, infinite in number, not only that, but each of the jewels reflected in this one jewel is also reflecting all the other jewels, so that there is an infinite reflecting process occurring. (Quoted in Loy, 1993, p. 481)

This image of Indra's Net invokes an ontological claim: that things *are* their interdependencies with all things, and, therefore, to deeply understand any thing, we must understand it as *being itself* only in the midst of all its relations. Each thing, therefore, must be understood and experienced, not as some self-contained, self-existing substance ("a substance is that which requires nothing except itself in order to exist" [Descartes, 1640/1955, p. 255]), but as empty (*sunya*) of any self-existence (*svabhava*) apart from such living relatedness.

Each thing thus *is*, so to speak, what it *is not* while still remaining itself (Nishitani, 1982). This is a thing's reposing "in itself." It *is* the long and twisted entrails of all the interdependencies that gave rise to its being manifest just here, just now.

It *is* all the rains, all the breaths, that passed it along.

Each thing thus *is* all the codependent arisings that brought it here, and to understand this particular thing is to understand its standing in an "inheritance that it belongs to" (Gadamer, 1994, p. 192). Each thing, therefore, is not simply its own, isolated, subsequently-in-relation self, but is itself as center of a "totality of a lived context" (Gadamer, 1994, p. 191). This totality has "entered into and is present in the thing" (Gadamer, 1994, p. 192).

"And we belong to it as well" (Gadamer, 1994, p. 192).

"Thus in each dust mote is vast abundance" (Hongzhi, 1991, p. 14).

This inexhaustible emptying-out-into-all-their-relations is the deeply Earthly "repose" of things. They "stand-in-themselves," not by standing cut off from all things, but by standing *as* an opening, a portal, a way, an "e-vent," into a world of relations. This seemingly isolated object or word or glance, or even the seemingly most ordinary of classroom events (Jardine, 2000), *is* all of its relations.

As Martin Heidegger (1962) might have put it, even ordinary things sometimes "world," if we care to sit with them and wait a bit. Again, as Hans-Georg Gadamer (1994, p. 192) says in his lovely essays on his

great teacher's thought, "there is a totality of a lived-context [a 'world'] present in the thing."

But this image of "sweating horses" does something more than simply invoke Indra's Net. It plays with the sense of ornateness and visionariness that Indra's Net entails—bright jewels, tapestries, heavenly arcs of space, time, vast, heady infinities, and great, swarming *ideas* of interconnectedness, interdependency, interpenetration, recursiveness, and dependent co-origination (*pratitya-samutpada*).

"Behind every jewel are three thousand sweating horses" disrupts the charming, entrancing composure of such delicious visions of "relatedness." Roaring behind each jewel, now, are not infinite refracted jewel-like visions, but *something coming at us*, something full of piss and blood and sweat, something crashing, stampeding, rough, vigorous, dangerous, full of life and death and the agonies in between, something animate that's spotted us beyond our spotting it, *demanding* attention.

### III

The point to the doctrine of interdependence is that things exist *only* in interdependence, for things do not exist in their own right. In Buddhism, this manner of existence is called "emptiness." Buddhism says that things are empty in the sense that they are absolutely lacking in a self-essence by virtue of which things would have independent existence. (Cook, 1989, p. 225)

Lacking in self-essence resembles social and historical constitution, understands individual things as constituted by their relations to other things and especially to groups, families, species, and kinds. Emptiness resists the autonomy of the individual [which now appears] uniquely European American. (Ross, 1999, pp. 213–214)

We came across the title of this paper in the midst of a series of Grade 7 mathematics conversations, 60 students, two teachers, and a university researcher, over the course of several weeks. This was an ordinary classroom in an ordinary school undergoing what turned out to be, for all of us, an extraordinary experience.

All of us (students, teachers, and researchers) were deeply embroiled in heated talk and the heated display of differing mathematical explorations and differing mathematics solutions gathered around angles and their bisection, compasses and their workings, circles and their arcs

and cords, and all the frustrating beauty of the dropping of perpendiculars. Living in the midst of these conversations day after day, this seemed like real, vigorous, embodied work, and mathematics seemed like a living, breathing discipline that drew us all in to an old, rich, Earthy place, a "topography" (Gadamer, 1989, p. 21): the deeply interrelated, interdependent, fertile (Gadamer, 1989, p. 32) terrains of geometry. Here were the sweating horses: arguments and frustrations and returns, pulling together and pulling apart the long and convoluted work of long-standing relations. And here, too, the sudden condensations of insight, moments of clarity, as they twisted pages sideways with breathtaking yells and smiles, took the pens over from each other, insisting on one more thing, one more thing.

Standing at one table. Four boys pushing a large piece of newsprint between them, given the task, with a straight-edge and compass alone, to drop a perpendicular line from a point to a line below it. We all know this one, and one student pressed ahead of us with moves we all recognized.

*With the compass draw an arc through the line with the point as its centre. From each of the two points where the arc intersects the line, make two marks below the line. Use the straight-edge to connect the original point with the intersection of the two marks. This new line is perpendicular to the original line.*

All of us at the table knew, *beyond a shadow of doubt*, that this solution was correct. But, equally, none of us knew *at all* why it was correct.

One boy insisted, with an insistence that we all recognized in ourselves, "That's just how you *do* it, ok?"

"But how do you know it's not hitting the line at, like, 89 degrees and not 90?" This simple question brought the whole sweaty roil to a halt all over again. We ended up in an odd place, stuck, almost dazzled by our own clarity and assurance, unable, at least initially, to "break open the being of the object" (Gadamer, 1989, p. 382). Many of us in this classroom had, over the year, talked about that odd feeling of having learned, having *memorized* a procedure and knowing how to *do* it beyond question or hesitation, and yet suffering the terrible silence and feeling of being stuck with it, a feeling of cold and deathly immobility (Jardine, Clifford, & Friesen, 2000) if anyone should have the audacity to ask a question about 89 degrees instead of 90.

All of us at this table did agree, however, that knowing this sort of flat, clear, mindless, unmoving way of understanding a procedure, unsurrounded and unsustained by the heated, tangled movements of relatedness that give it life, was not adequate. Here, in this classroom, we had come to understand that these arcs and lines and points, this compass movement, and the circles it hints at first through and then below the line all belong properly here together, together along with the ghosts of Pythagoras and Euclid and the whole cascade of memory and work that brought all this down to us. This "belonging together" is where this procedure actually *lives* as something sensible, something sane, something understandable in its living movement as a historically, humanly constituted inheritance to which our lives already and inevitably owe unvoiced obligations.

"That's just how you do it" mistakes what that procedure actually *is*. It is an uprising from this terrain of circles and lines and arcs, an uprising and a naming and an ordering and a setting-forth. As such, it is not a *substitute* for that terrain, but an imaginal coming-to-presence of it, a jewel-like condensation of the messy vigor of that terrain. Without this terrain and the risks that are involved in traversing it, the procedure remains merely memorizable. Within this terrain and our travels, it becomes memorable, like an old tale told by those who've been here before and have gathered us around a fire in the darkness to whisper to us. It is not a command, as mathematical procedures might often be experienced. It is a telling of where we have been, places we have witnessed *for ourselves*. We already know the roiling life of which this tale tells.

So one of the boys completed the circle that intersected the line in two places, and completed into circles the criss-crossing arcs below the line, ending, now, with a beautiful figure, reposing, full of the *Vesica Piscis* that we've since discovered (Lawlor, 1982; Friesen, 2000), a wee long-lost geopoetic ancestor caught kicking around in Greek sands.

"OK. I'm 49 years old and it never occurred to me that that crosshatch below the line was part of two circles." What did I think it was? Did I think about it *at all*? I expect the latter is important: I rarely *thought* about mathematics in the way I was witnessing here, in this classroom. I'd only rarely felt this living movement of understanding, this sense, in this case with geometry, of understanding its being what it is.



So over this diagram, one student said, "Oh boy. *Now what?!*" with a wonderful, weary sense of pleasure and exhaustion, but also this lovely, palpable sense of mathematical reality.

#### IV

What man has to learn through suffering is not this or that particular thing, but insights into the limitations of humanity, into the absoluteness of the barrier that separates man from the divine. (Gadamer, 1989, p. 357)

[We] belong to the text [we] are reading. The line of meaning that the text manifests. . . always and necessarily breaks off in an open indeterminacy. [We] can, indeed [we] must accept the fact that future generations will understand differently. (Gadamer, 1989, p. 340)

Mathematics *is*, in some sensible sense, all the actual, human, bodily work which is required if it is to remain hale and healthy, if it is to continue as a living practice which we desire to pass on, in some form, to our children.

"Every experience worthy of the name involves suffering" (Gadamer, 1989, p. 356). Thus, experience is not something we *possess* (like some commodifiable object) but something we *endure*, something we *undergo*. For mathematics to be deeply experienced, it must be drawn back into its suffering, its undergoing, its movement of becoming what it is, its living coming-to-presence, rather than its foreclosing *being* present. It *is* its "passing on." It *is* a fragile and finite and deeply human enterprise. This is the horrible mortality-insight of interdependency, that the seeming self-sufficiency of any seemingly isolated, self-referential object breaks outward into cascading interdependencies with all the ways it has arrived here, seeming so. "Future generations will understand differently." Mathematics *is* its being different in the future.

To understand mathematics free from the stultifying ontology of produced and consumed objects is to enter into the living movement of its "furtherance" (Gadamer, 1989, p. xxiv). Or, differently put, to understand geometry is to help keep it "open for the future" (Gadamer, 1989, p. 340). That is, to understand geometry is to keep it susceptible to being taken up and transformed anew and, it must be emphasized, to keep ourselves open to being transformed in our traversing its terrain and meeting our own ancestors in that terrain. In such a sojourn, we risk

becoming people who bear the marks of having undergone such an adventure. We run the risk of bearing the marks of becoming *experienced* in mathematics in that wonderfully ecological sense that both Martin Heidegger (1962) and Hans-Georg Gadamer (1989) have identified as coming to "know your way around."

Given the dazzling allure of its rules and axioms and procedures, who would have imagined that, right at the heart of what once seemed to be the most cold and unforgiving and punishing of disciplines, is a generative, pedagogic heart? Who would have imagined that geometry *is* all the risk and pleasure and stubborn, sweaty work that brought it safely here to us?

"Behind every jewel are three thousand sweating horses."

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