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Platonism and All That...

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Humanists, I take it, value people, and are willing to weigh their suggestions and beliefs, giving some potential credence to any, as yet unfamiliar, belief, just from the fact that some people hold to it.

So, as a humanist, I may consider Platonism, formalism and constructivism, all views of mathematics which are held by thoughtful and scholarly people. My mathematical instinct to mark these views correct or mistaken should perhaps be held in check, since I am looking not at mathematical propositions, but at perspectives, views and beliefs. These perspectives may be valid at different times of the day!

My day begins with teaching. In the classroom there are pupils and myself. Here I am a constructivist. My pupils have come to learn mathematics. I am here to speak, to question, to write and act in such a way that as much mathematical thinking and knowing goes on as possible. I may exaggerate, tell jokes, deviate from a deductive sequence, perform a drama or an experiment, whatever, so long as these contribute to the pupils' construction of mathematics. Whatever mistakes they make afterwards are in some degree my responsibility, reflecting the emphasis or lack of emphasis I have generated.

When the lesson is over I return to my office and try reading about the history of the mathematics I have just taught. I would like to be a constructivist in this mode too, but the secondary history texts tend to focus on the achievements of past mathematicians, not upon the process by which those achievements were attained, and I am regularly frustrated.

I turn then to my research on when a binary operation has the left inverse property that $ab = 1 \Rightarrow a(bc) = c$, a weak form of the associative law. I look through a catalogue of loops of order 6. Very few of these objects relate to other parts of mathematics. For the most part I seem to be indulging in a "meaningless game played with meaningless marks on paper" (Hilbert) and confirming the formalist stance. The theorems that

emerge *may* become useful at some time in the future, but the satisfaction I have now does not depend on that. But I am a geometer and owe so much to Hilbert. His replacement of "points, lines and planes" by "tables, chairs and beer mats" was the psychological device that let him identify unstated assumptions in our geometrical language and produce his *Foundations of Geometry* (1899). Formalism can be both useful and functional.

Now I am a grandparent, and watch grandchildren acquiring language. I see the beginnings of counting not with the comparison of sets, but with the recitation of an almost senseless rhyme:

*One, two, three four five,
Once I caught a fish alive.
Six, seven, eight nine ten,
Then I let it go again.*

Just getting used to this sequence of sounds provides the equipment for future mathematics. Formalism seems to be part of the story from a very early age!

I wonder sometimes what is going on when I subtract, say, two 4-digit numbers. There is a routine, which has become second nature, a process which I apply. If the process is to be effective it is best not to relapse into thinking what it means.

After the research interval I go to the coffee room and meet non-mathematical colleagues. The post-modernists are curious about mathematics. I tell them it is fashionable to knock Platonism these days, and they respond by asking whether there are historically or anthropologically inconsistent versions of mathematics available. I tell them that each of the versions of mathematics I am aware of can be understood as containing or being contained in some other version, and they return to their work having convinced themselves that the subject is absolute. Then I reflect back to my

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Lensmire and John Pryor." *Harvard Educational Review* 65, (1995), 670-677.

¹⁷ Ole Skovsmose, "Mathematical Education vs. Critical Education." *Educational Studies in Mathematics* 16 (1985), 337-354.

¹⁸ McNair, "Context and Autonomy."

¹⁹ See Tate, "Mathematizing and the Democracy," 187-190. Tate gives an example that makes the need for this shift clear.

²⁰ Robert Thomas, "Proto-mathematics and/or real mathematics." *For the Learning of Mathematics* 16 (Number 2, 1996), 11-18.

²¹ See Robert P. Moses, Mieko Kamii, Susan McAllister Swap & Jeffrey Howard, "The Algebra Project: Organizing in the Spirit of Ella." *Harvard Educational Review* 59 (Number 4, 1989), 423-443. The authors offer a fine example of using the experience of riding the subway to help students develop deep understandings of the abstract concept of negative numbers.

²² See Anna Sfard, "On the Dual Nature of Mathematical Conceptions: Reflections on Processes and Objects as Different Sides of the Same Coin." *Educational Studies in Mathematics* 22 (1991), 1-36. Here Sfard gives short descriptions of the development of both the number and function concepts.

²³ Skovsmose, "Mathematical Education and Democracy," and Bill Rosenthal, "No More Sadistics, No More Sadists, No More Victims." *UMAP Journal* 13 (Number 4, 1990), 281-290.

²⁴ Christine Keitel, "What Are the Goals of Mathematics for All?" *Journal of Curriculum Studies* 19 (Number 5, 1987), 393-407.

²⁵ National Council of Teachers of Mathematics, *Curriculum and Evaluation Standards for School Mathematics*. (Reston VA: Author, 1989).

²⁶ Henry A. Giroux & Roger Simon, "Popular Culture and Critical Pedagogy: Everyday Life as a Basis for Curricular Knowledge." In Henry A. Giroux & Peter L McClaren (Eds.) *Critical Pedagogy, the State, and Cultural Struggle*. (Albany NY: State University of

New York Press, 1989), 236-252.

²⁷ In "Mathematical Education and Democracy," Skovsmose discusses the seeming contradiction between teaching based on students' interests and teaching based on the democratic imperative.

²⁸ Tate, "Mathematizing and the Democracy."

²⁹ The statistics unit described was designed in collaboration with Bill Rosenthal. The collaboration was part of our ongoing efforts to understand how to best bridge the divide between critically-oriented university academics and progressive classroom teachers.

³⁰ Bill Rosenthal, "No More Sadistics, No More Sadists, No More Victims." *UMAP Journal* 13 (Number 4, 1990), 281-290.

³¹ National Council of Teachers of Mathematics, *Curriculum and Evaluation Standards for School Mathematics*.

³² See, for example, P. J. Davis & R. Hersh, *Descartes' Dream: The World According to Mathematics*. (New York: Harcourt, Brace Jovanovich, 1987), cited in Putnam, Lampert, & Peterson, "Alternative Perspectives on Knowing Mathematics in Elementary Schools."

³³ Stephen J. Gould, *The Mismeasure of Man*. (New York: W. W. Norton, 198 1), cited in Tate, "Mathematizing and the Democracy."

³⁴ Terezinha Nunes, Analucia Dias Schliemann, & David William Carraher, *Street Mathematics and School Mathematics*. (Cambridge: Cambridge University Press, 1993).

³⁵ Hans Freudenthal, *IOWO- Mathematik Fur alle und Jedermann. Neue Sammlung* 20 (Number 6, 1980) 634-635, cited in Keitel, "What Are the Goals of Mathematics for All?"

³⁶ Michael W. Apple, "Do the Standards Go Far Enough? Power, Policy, and Practice in Mathematics Education." *Journal for Research in Mathematics Education* 23 (Number 5, 1992), 412-431.

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own research: yes, proofs I have invented, but the patterns which the proofs legitimate seem to have been there, waiting to be found. I have no idea what absolute reality is like, but I can tell you what it felt like to find these things.

And, so, back to Plato and his cave; the firelight casting shadows on the wall. We face the wall, and guess, if we will, what makes the shadows. Sometimes mathematics seems firm, unshadowlike. But sometimes the

shadows waver. In *Proofs and Refutations*, Lakatos (1976) documents the wavering which may take place. He says we never know whether our proofs are right, but he believes we can be sure of their improvement. And what of Gödel? Undecidability promises that we will never come to the end of our search, because the choice amongst the undecidables will remain, and the absence of a consistency proof is the guarantee that shadows, not ultimates, are what we see. I think I am a Platonist at night.