Mandelbrot Set "explorations" possible with "lowest-cost true computer ever marketed"

To the editor:

The cover of the January Computer was a delight, as were the illustrations on page 13; and the list of equipment used to produce them was truly impressive. But it would be a pity if readers were left with the impression that this level of expensive equipment is really necessary to enjoy exploration of the Mandelbrot Set.

The enclosed photographs [reproduced below] were made with, to paraphrase the boxed text on page 13, "a TI 99/4A computer with 15K memory, using a PHP2700 portable tape recorder for intermediate storage. The images were displayed on a 10-year-old Sears-Roe-buck TV model 562.40270301, connected via a TI model UM 1381-1 modulator, and photographed with a Minolta XG/M camera."

The pictures all show the same tiny region of the complex plane, from (-.106838, .922621) at the lower left to (-.106688, .922707) at the upper right, with differing allocations of the 13 available colors to the iteration number ranges in which each pixel removed itself from the set. The black areas are those which were still indeterminate after 199 iterations, and are thus presumed to be in the set.

I note that there is a statement in the box on page 13 that the black ("colorless") areas are in the set. Can you prove this? The fact that z is still bounded after 999 iterations (or 999 billion) may be a very strong indication, but it is not a proof unless the consecutive z values form a closed sequence which repeats indefinitely.

Obviously my pictures cannot begin to compete in elegance with those of H.W. Smith, but the pleasure of the exercise alone justified the $55 cost of the TI 99/4A and modulator. There was one casualty: each diagram took about four hours to calculate, and the tape recorder eventually seized up after being repeatedly held in "record" mode for this length of time, most of which is simply waiting for the next point to be calculated. So I was out of pocket $35.

My real point is that, even with the lowest-cost true computer ever marketed (I understand it fell below $50 at some New York discount houses), one can still make enjoyable explorations, starting from the Scientific American article [A.K. Dewdney, “Computer Recreations,” Aug. 1985, p. 16] and using only a simple form of Basic.

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J.R.M. Vaughan is correct. Under finite iteration, there will always be some black area near the fringe that is not in the set. Only under infinite iteration would the black area exactly represent the Mandelbrot Set.

—Homer W. Smith