the mathematics teacher

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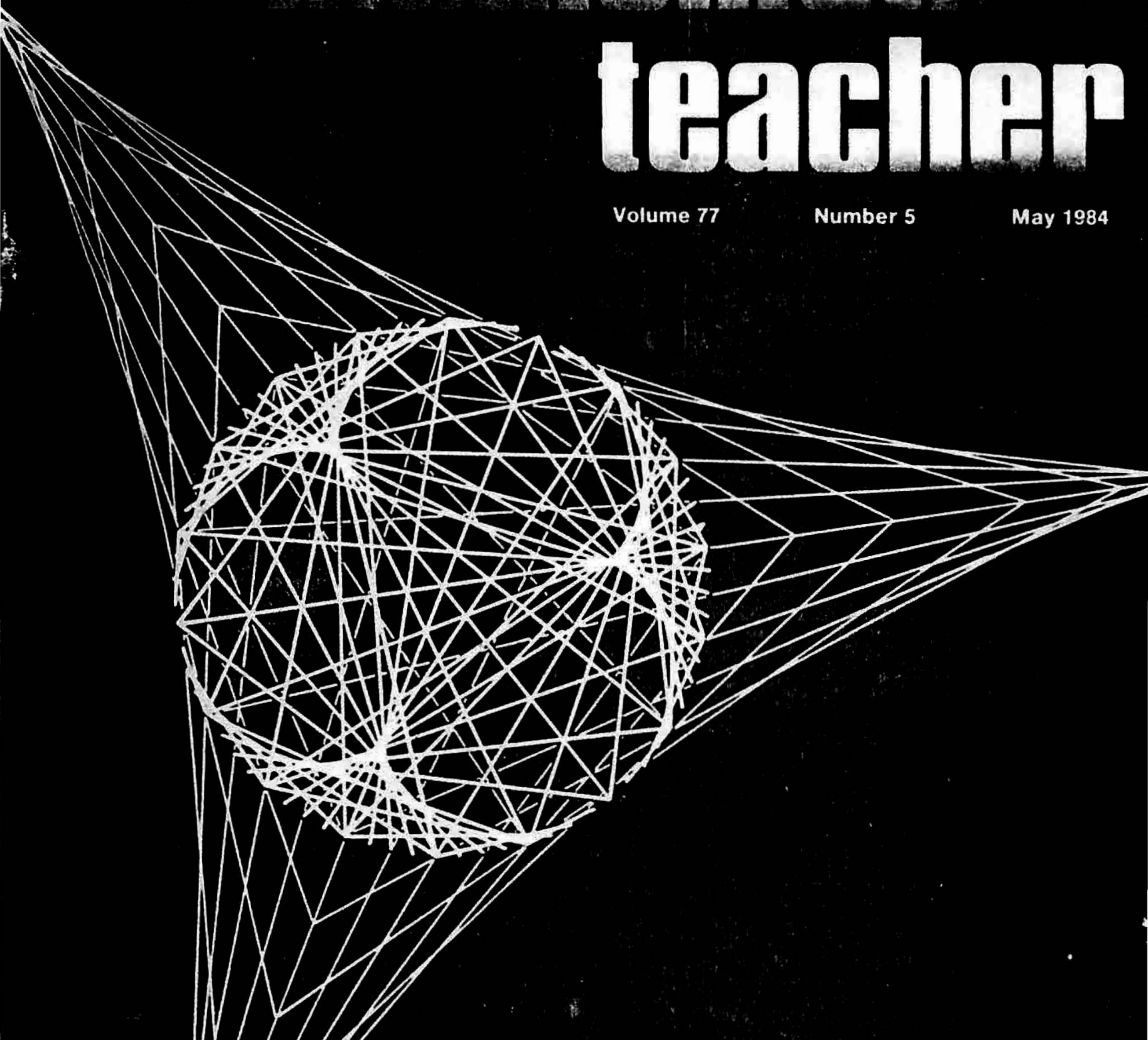

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reader reflections Reactions to articles and points of view on teaching mathematics

Notes on notation II

In his letter, "Notes on notation" (October 1983, p. 468), Hardy Reyerson states that the square root symbol once stood for positive and negative values. In fact, the symbol $\sqrt{\ }$ has always stood for the positive root only. To indicate the negative root, the symbol must be prefaced by a negative sign. Furthermore, $-4^2 = -16$, not 16 as stated in his letter. Hence, there is no contradiction between $-x^2$ and -16^2. Both are negative.

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Reyerson raised the question about the interpretation of $12 \div 3a$ as compared to $12 \div 3 \times 2$. Of course we treat $3a$ as a quantity. The assumption is, as many books do show, that $3a$ is the divisor, that is, $12 \div (3a)$. These problems do not look the same to experienced teachers. The first one is $4 \div a$ in disguise.

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In response to Hardy Reyerson's letter (October 1983), -4^2 is in fact equal to -16, not 16. In the order of arithmetic operations, exponentiation precedes taking an opposite, since the latter is essentially a multiplication by -1. It is true, however, that $(-4)^2 = 16$.

The disparate ways of evaluating $12 \div 3a$ when $a = 2$ would also have struck me as a paradox before I taught FORTRAN. Therein, however, the order of operations given above is extended to include functions, and function evaluation catapults to the top of the list (second only to simplifying inside parentheses). I think it is natural for someone to look at "$3a$" and consider it a function of a, even if subconsciously, and thus it seems reasonable to conclude that the value of the algebraic expression $12 \div 3a$ when $a = 2$ is 2, whereas the value of the arithmetic expression $12 \div 3 \times 2$ is 8.

Brian Hayes
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Hardy Reyerson responds: I have sent some reprints of textbooks which show some of the confusion regarding the use of the square root symbol to C. Diane Bishop. On the other issue, I do teach that $-4^2 = -16$, even though I am not totally satisifed with the symbolism. I believe the difficulty begins when students and others read "-4^2" as "negative four squared" because it is unclear whether "(negative four) squared" or "negative (four squared)" is intended. It would be better if "-4^2" were read "the negative (or opposite) of four squared." Likewise, "$(-4)^2$" should be read "the square of negative four." Since the earlier curriculum stresses that each number has a sign, it is difficult for students to separate the negative sign from the number.

Editor's note: The following readers also raised the same issues: Pansy W. Brunson, Western Kentucky University, Bowling Green, KY 42101; Allen P. Keith, P. O. Box 382, New Hampton, NH 03256; Steven Schwartzman, Austin Community College, Austin, TX 78734; and Louise Sterett, Lyons Township High School, Western Springs, IL 60558.

Because of space limitations, letters may be subject to abridgment. Although we are unable to acknowledge those letters that cannot be published, we appreciate the interest and value the views of those who take the time to send us their comments. Readers who are commenting on articles are encouraged to send copies of their correspondence to the authors. Please double space all letters that are to be considered for publication.

What do we teach?

In the September 1983 issue Gene Maier sounded a call to all who teach mathematics. I wish to emphasize one particular aspect of Maier's message: that microcomputers will change *what* we teach. I hope the shift will be in the direction of mathematics as it really is—not only problem solving but also the understanding of underlying relationships among numbers, functions, geometric figures, and other mathematical concepts. Such understanding is necessary for successful problem solving.

We are experiencing a crucial moment in the history of mathematics education. The big question is this: will the time formerly spent on computation and the manipulation of symbols be spent doing mathematics, or will that time (i.e., whole courses) be spent doing something else? The answer rests heavily on the kind of software available to fill the freed-up time. *Mathematics teachers must beware that software whose primary aim is problem solving in areas outside mathematics does not replace basic mathematical coursework and truly mathematics-oriented software.* As Gene Maier said, "we have a choice."

Different teachers will have different notions about what makes good mathematical software. Nonetheless, I hope that the section "Microcomputer-assisted Discoveries" in this journal can begin to serve as a forum for exchanging ideas. I hope that readers will submit materials for review to this section.

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How do we teach?

Gerald Rising's "Separate Computer Science from Mathematics" (November 1983) contains some provocative ideas. I would like to expand on one of them by saying that if we take the computer out of the mathematics offerings, then we lose the most magnificent motivational device mathematics has ever found. Many students are studying mathematics with more determination in order to better program the computer. Every program a student writes involves logic, manipulation of symbols, modeling, problem solving, reading word descriptions, interpretation of results, recognition of assumptions and constraints, and the formulation of algebraically related expressions that form the problem.

The reason so many mathematics teachers have started teaching programming skills is that they recognize the motivational and mathematics skills fostered by programming. It is a grass roots movement—one of Nesbitt's megatrends.

Perhaps those professors calling for an end to computer mathematics offerings are disturbed that so many computer classes do not emphasize problem-solving skills. The solution to this situation is not to dismiss computer programming out of hand but to work with high school mathematics teachers to use the computer as the vehicle that enhances these skills. I would even argue that writing algorithms for random disk access and other less obvious mathematics is still pure mathematics.

Students should be counseled so that computer mathematics is a concurrent offering with the more normal mathematics curriculum. Students often take two humanities courses. Why not take two mathematics courses? A student who is heading for a major in engineering should never be counseled to preempt trigonometry for computer or vice versa.

This micro-megatrend cannot be stopped. Those who are describing a different position must join us in the battle lines and see what we see—a method of motivating our students to be more thorough in all aspects of their approach to a problem. We need the dissenters to help us use this tool more effectively, not to take it away altogether. The culture gap between the theorists and the implementors must be closed.

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Whom do we teach?

Much has been written in the media about the success of Saxon's algebra series. There is little doubt in the public's mind that his texts bring results where other texts have failed. I, too, have found that my students comprehend more and "do better" when using his text; however, I find nothing revolutionary about the text.

It will take the Saxon student almost 225 days of instruction to cover the same material that other texts cover in one academic year (160 teaching days). If one were to allow another 65 days to provide review and practice in any first-year algebra course, one could expect similar results.

Improved SAT scores will no doubt come about using Saxon's text or any program that devotes such time to first-year algebra. However, have we ever wondered how far the student who requires a Saxon approach is going to go in his or her study of mathematics? Perhaps our goal should not be to improve SAT scores but rather to offer a mathematics education that is appropriate and meaningful for the "Saxon student." For improved scores, use Saxon's texts. For mathematics education for the "Saxon student," change your curriculum.

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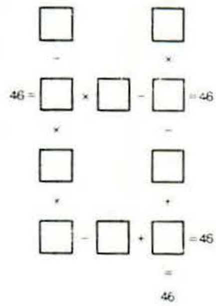
problems of the month

These problems were selected for publication at the "Best Problems Contest" session sponsored by the Editorial Panel of the *Mathematics Teacher* at the 61st Annual Meeting of the National Council of Teachers of Mathematics in Detroit.

1. Fill in the boxes with numbers that make the sentences true.



—Tonja Colwell (grade seven), Washington Junior High School, Hamilton, OH 45015.

2. *Ordinary dice are numbered so that the opposite faces sum to seven. An icosahedron is a solid figure consisting of twenty triangular faces. If an icosahedron was numbered in the same manner as a die, with opposite faces summing to a constant, what would this constand be? = SP5 Bruce D. Beckett, Company A, USAARMC #17, Fort Know, KY 40121.*

3. Find one convex hexagon that possesses all the following properties:

(1) Its sides are all of integral length.
(2) Its diagonals are all of integral length.
(3) The segments into which the diagonals divide each other are all of integral length.

—Zalman Usiskin, University of Chicago, Chicago, IL 60637.

(Answers appear on page 381.)

Valuable homework

A recent issue of the *NEA Journal* had an excellent overview of the trends in mathematics. It implies that problem-solving skills rather than mechanical skills will be stressed in algebra. It was a little strange to see John Saxon's name mentioned as one of the innovators in mathematics education, since he views algebra as a series of skills to be mastered.

He is an engineer by training and views mathematics as a tool. This past spring I attended a lecture given by Saxon. Before he spoke, several teachers described their experiences using his books and their impression of them. Then Saxon talked about his philosophy.

I can buy his philosophy, but in these days of tight funding I can't afford to buy his book. Actually, his philosophy can be implemented without his book. It is his thesis that the present method employed by authors does not lead to easy acquisition of algebraic skills. At present, a new topic is introduced, twenty to thirty problems are given on that topic, then something new is introduced in the next section. Saxon does introduce new topics each section, but his homework