

## MATHEMATICS

# New Mathematics in School

To keep pace with our complex technological society, mathematicians and educators are cooperating to revise the teaching of school mathematics, Marilyn Ferster reports.

► CONTRARY to what confused parents may think, the so-called new mathematics is not a radical departure from the old. One and one still make two.

In fact, all of the traditional mathematics the parents themselves learned in school is still correct. The reason they are finding it difficult now to help their children with homework is that the emphasis has shifted to different aspects of the traditional subjects.

Trigonometry, for example, has been a part of the school curriculum for 300 years. It was introduced because, at that time, educated men became either sea captains, ministers or surveyors.

Knowledge of trigonometry, and particularly the solution of triangles, was essential for these professions. The sea captain used the principles involved in the solution of triangles to navigate; the minister, to compute the date of Easter; and the surveyor, to stake out new land.

Today, the solution of triangles is no longer an important application of trigonometry. Radar and radio beams assist in navigation; observatories compute the date of Easter; and the land has been staked out.

## Emphasis Shifted

What is important, however, is understanding the properties of trigonometric functions. These properties have important applications in electrical engineering, for example, and are also basic for understanding more advanced mathematics.

With logarithms, too, the emphasis has shifted. Formerly, they were taught as a tool for calculations. With the introduction of desk calculators, this use for logarithms became obsolete. But the properties of logarithmic functions must still be taught, because they are fundamental for understanding higher mathematics.

Another reason the new mathematics appears so radical is that traditional course material is being taught to much younger students nowadays. In many experimental programs, for example, elementary school children are learning to make geometric constructions.

Instead of Euclidean geometry in tenth grade, a combination of plane, solid and analytic geometry is presented. High school students are also introduced to vectors, and they work with coordinate systems on a line, in a plane and in space.

The attention directed to the sciences in the colleges today must be extended to include mathematics as well. Mathematics is, after all, the foundation for science. Consequently, course material in mathematics once reserved for college is now being proposed for high school.

One problem arises in extending instruc-

tion in physics, which many educators recommend. Traditionally, college students study calculus concurrently with introductory physics, for which a knowledge of calculus is essential.

Many educators argue that education in physics is retarded by lack of mathematical preparation.

They believe that calculus rightly belongs in the high school curriculum, since its concepts are simple enough for high school students to understand. With a background in calculus, college students could then absorb more advanced training in physics.

On the other hand, many mathematicians are opposed to introducing calculus in the high schools, and other more advanced courses, such as matrix algebra, because of the lack of adequately trained high school teachers.

The teacher, then, seems to hold the key to success of the revolution in mathematics. And the shortage of well-qualified teachers of mathematics is critical.

Many of the instructors of mathematics in high schools have had little advanced mathematics beyond calculus, and it has been many years since they have used this.

In the elementary schools, the situation is even more acute. Large numbers of elementary school teachers have always disliked mathematics, and have had no formal training in mathematics beyond high school.

Yet, they are forced to teach this subject, as well as reading and spelling.

In 1960, the Mathematical Association of America prepared a set of recommendations of minimum standards for the training of teachers of mathematics.

High school teachers, for example, should have three courses in analysis, two courses in abstract algebra, two courses in geometry besides analytic geometry and two such other elective courses as introduction to real variables, number theory or topology.

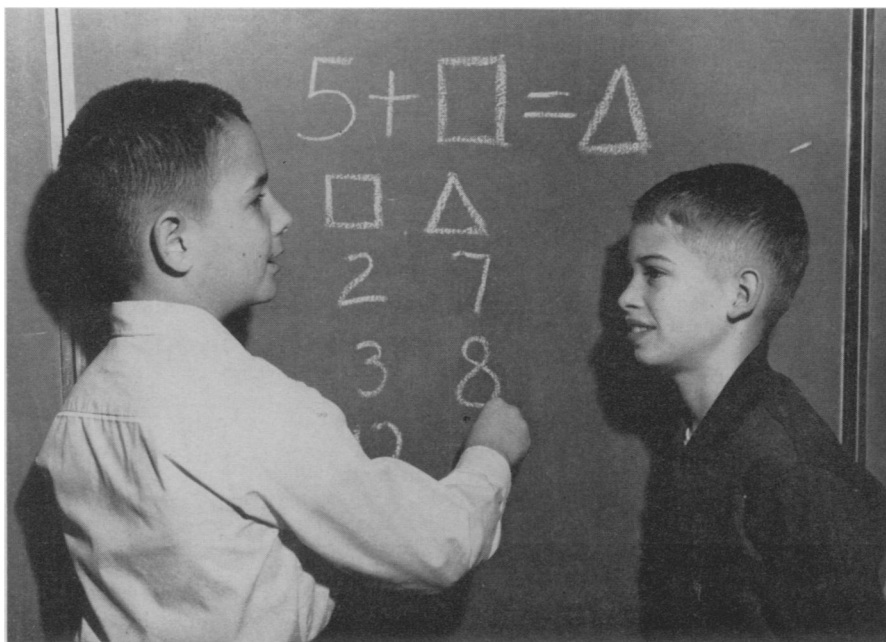
## Inservice Classes

Many schools participating in experimental programs have initiated inservice classes to help the teachers. Taking these courses demands much extra time and dedication. Nevertheless, many of the teachers who have been trained and are working with the new methods are most enthusiastic about the results, and say they would not like to return to the more traditional ways of teaching mathematics.

There are many varieties of experimental programs in the new mathematics. Investigations are underway, reflecting a national attitude that school mathematics programs must be revised to meet present-day needs. The National Science Foundation has supported a number of these programs.

The School Mathematics Study Group is exploring new ways to present mathematics to junior high and senior high school students.

Dr. Patrick Suppes of Stanford University and his associates have introduced kindergarten and first-grade children to the notion of a set. A set is defined as any collection



Fremont Davis

**TRUTH IN FIGURES**—Mathematics is taught by use of "truth sets" which these two boys are working out.

or family of objects. Dr. Suppes believes that set theory is a superior way to begin arithmetic, because sets of objects are more concrete than numbers and can therefore be manipulated more easily.

Furthermore, set notation facilitates a more exact mathematical concept than the vague relationship between groups of objects and arabic numbers. Young students learn that numbers are properties of sets, and that addition of numbers is simply a way to combine sets of objects without specifying the objects themselves.

Although Dr. Suppes cannot yet evaluate the results of his experiments, he does believe that very young children can handle significantly more complex material than they are given in the conventional curriculum, as well as the technical vocabulary.

Another very exciting program is the so-called Madison Plan, directed by Dr. Robert Davis of Syracuse University, in which university professors teach the teachers, who in turn teach mathematical concepts to their students. Fourth-grade children learn fundamental concepts of algebra through games and situations arising in the classroom, rather than from standard textbook examples.

The children are given "truth sets," such as the equation on the blackboard in the

picture, ( $5 + \text{square} = \text{triangle}$ ) and pairs of numbers to be substituted, as (2, 7), (3, 8) and (12, 17). By placing the first number of each pair in the square and the second number in the triangle, the young students find they have produced a true statement.

One advantage of this method is that it is graphic rather than verbal. In fact, Dr. Davis tried it first with delinquent children who were nonverbal except on the playground, and found they were able to learn mathematics with a minimum of words.

Since 1946, Dr. Max Beberman of the University of Illinois has conducted his "discovery method," designed to lead elementary school children to discover basic laws of algebra by themselves. For example, students try to find whether it is true that  $\text{---} + 23 = 23 + 49$ .

After working with several similar problems, they discover that in adding numbers, varying the order does not change the sum.

Dr. Beberman believes that conventional ways of teaching mathematics produce rigid "computers," when, in fact, young students could grasp abstract mathematical relationships. His students, too, are very much excited about his method, which is now supported by several foundations and taught in many schools.

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#### ENTOMOLOGY

## Anti-Locust Campaign

► THE DESERT LOCUST, which threatens the destruction of enough crops to feed one-eighth of the world's population, will soon be under attack by an international team of locust experts.

A Spanish firm armed with four aircraft and tons of Dieldrin insecticide is under a year's contract by the Food and Agriculture Organization of the United Nations. Dieldrin is a widely used chlorinated anti-insect poison that kills by direct contact with the insect and has a residual effect as a stomach poison on plants which the locusts eat.

The base of operation is Beirut, Lebanon, where crews will be able to launch full-scale sorties against the locusts in locations from New Delhi to Tanganyika. This area, twice the size of the United States, is subject to overnight crop devastation which could bring famine to 310 million persons.

Before the international team was sent to battle against the locusts, a series of tests were made on an area of 22 square miles of the Indo-Pakistan frontiers, resulting in 99 per cent eradication of the pests. With this proof of success the FAO launched its international offensive operation against the locusts.

Two methods of insect eradication will be used. An attack by air will be made on insects in the adult stage that form swarms dense enough to block out sunlight. Planes will spray the swarm from above with Dieldrin solution atomized in droplets too tiny for the insect to brush away with its head.

Plant life on which the insect feeds will be sprayed with the chemical to kill the

locusts in the pre-adult stages before they can fly.

The desert locust belongs to the grasshopper family and is related to such North American pests as the Rocky Mountain locust and the clear-winged grasshopper. The common "17-year locust" in the U. S. is actually a member of another family of insects, the cicadas.

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#### PUBLIC HEALTH

## Cigarette Machines Out At Cancer Study Center

► ALL CIGARETTE vending machines have been removed from the premises of Roswell Park Memorial Institute, Buffalo, one of the leading cancer research centers in the United States.

In keeping with the findings of the research and medical staff relating cigarette smoking to lung cancer, Dr. George E. Moore, director of the Institute, which is under the New York State Department of Health, and Dr. Morton L. Levin, chairman of the Institute's Cigarette Cancer Committee, ordered removal of the machines.

In place of the machines, signs have been put up saying that research at the Institute "has proved conclusively that cigarette smoking is a major cause of lung cancer. It also increases diseases of the heart and blood vessels, chronic bronchitis and gastrointestinal disorders."

The American Cancer Society removed its cigarette vending machines at the headquarters office in New York more than a

year ago, but a spokesman told SCIENCE SERVICE the Society is not aware of any other cancer institute following the example of Roswell Park.

Cigarette machines remain in buildings of the U.S. Public Health Service, including the National Cancer Institute, pending results of a study begun by ten scientists on the Surgeon General's Advisory Committee on Smoking and Health.

The ten scientists expect to complete the first phase of their activities by summer of 1963. After reviewing all available data on smoking and other factors in the environment that may affect health, they will begin the second phase, which will concern recommendations for action.

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#### PUBLIC HEALTH

## No Flu Reported Yet But Winter Is Young

► IT IS TOO EARLY to say there will be no flu epidemic this winter, although so far no outbreak has been reported either in the U. S. or in other countries.

Booster shots for persons who have had previous inoculations for flu can still do some good, but the Public Health Service is not urging those who have never had any shots to start now inasmuch as two initial vaccinations are recommended two months apart, beginning in the fall.

More colds and respiratory diseases occur in the winter months, with a peak of deaths in January and February, regardless of flu epidemics, the Public Health Service Mortality Analysis Division said.

Dr. Carl C. Dauer, medical adviser for the PHS National Center for Health Statistics, said in an interview that scientists do not know why there should be more colds in the winter and more measles in spring.

"Cold temperature, unless it is extreme, apparently does not effect the health," Dr. Dauer said. "People have deliberately exposed themselves in scant clothing during freezing weather without taking cold. Some say people take cold because they are 'inside more' but this does not hold water either. Local and widespread epidemics have been reported in the fall at times."

The Public Health Service does not require physicians to report isolated cases of flu, so it is possible that there have been a few cases in the country already this winter.

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#### NUTRITION

## Exploding Populations Will Eat Soybean Hams

► SOYBEAN HAMS, flaked steaks, and other treated foods promise a means of feeding the world's exploding population. Modifying tough meats and low-quality foods such as soybeans can expand the food supply to help fulfill future requirements, according to Dr. Virgil O. Wodicka, technical director at Hunt Foods and Industries, Inc., Fullerton, Calif.

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