

PROGRESS REPORT ON THE MATHEMATICS REVOLUTION

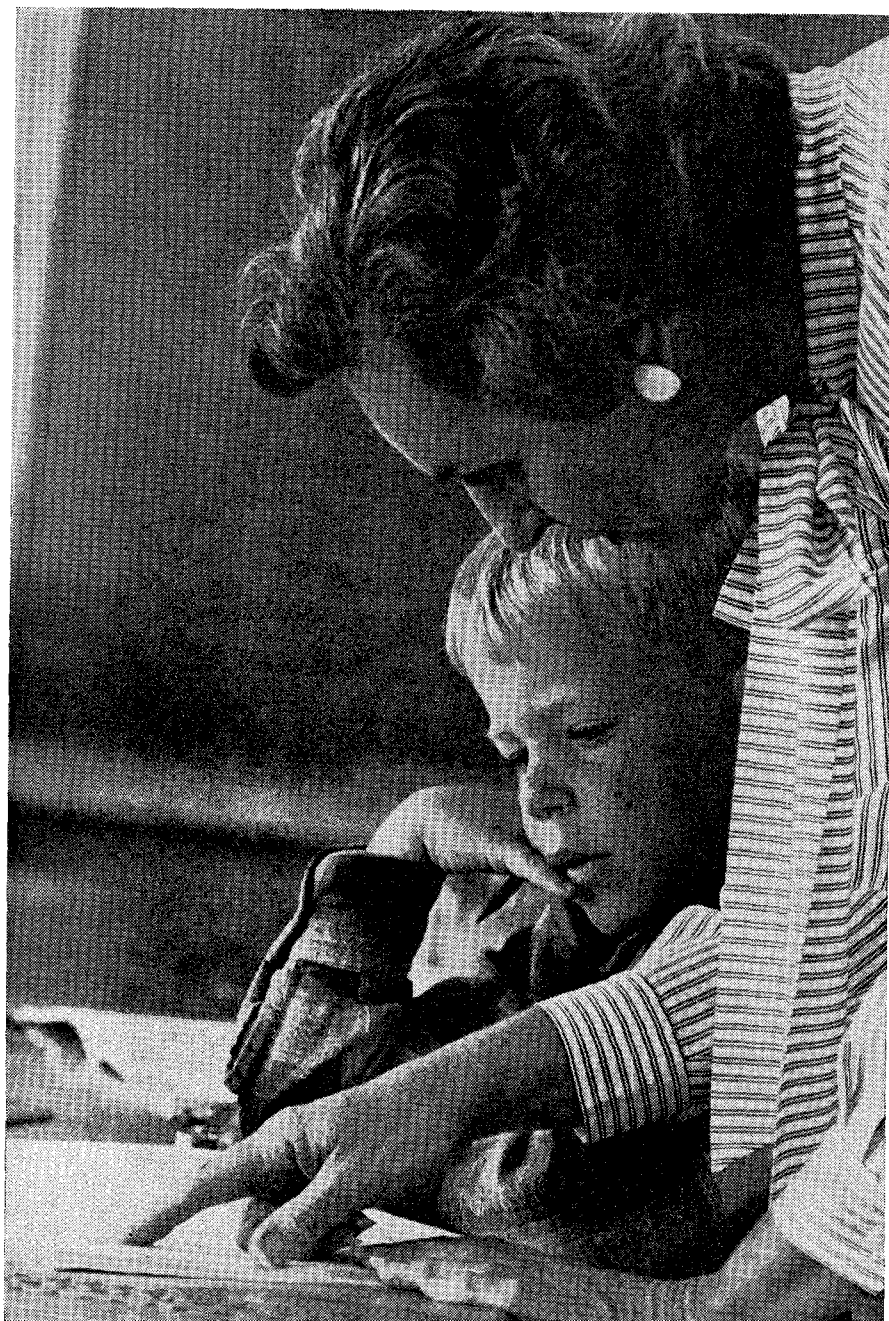
By EVELYN SHARP, *mathematics teacher, Holland Hall High School, Tulsa, Oklahoma, and author of the recently published "A Parent's Guide to the New Mathematics."*

THIS SUMMER the National Science Foundation will again pay some 25,000 secondary and elementary school teachers to become students. These grants are neither awards for scholarship nor rewards for merit, but are designed to raise the level of instruction in the nation's mathematics and science classrooms. In some cases it is the eighth time that a college has offered such a summer institute.

In these courses mathematics teachers are familiarized with the subject matter of the new curriculums, which according to some estimates now reach 30,000,000 pupils. Specifically, the courses are often built around the material of the School Mathematics Study Group (SMSG), the most widely used of the new programs. It, too, received financial support from the National Science Foundation.

In general, the schools are now moving into the phase of the mathematics revolution that involves shifting from experimental programs and books to those designed and published by commercial textbook companies, and on these the influence of SMSG has been enormous. Materials developed in other projects—such as the Greater Cleveland Mathematics Program—which were not government financed and therefore were free to enter the competitive market, are now available in their entirety from commercial publishers.

The states, as well as the federal government, are taking part in the new mathematics movement. California has spent a reported \$10,000,000 for new math textbooks, even making the innovation of augmenting basic texts with supplementary books in the ratio of one for every four children. Series like



—Stanford University.

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Exploring Mathematics on Your Own let seventh and eighth graders read for themselves about such things as vectors and computers.

South Carolina, through the medium of closed circuit television extending to every county in the state, is attempting to retrain in one year a whole generation of mathematics teachers. Idaho has a plan for using high school teachers who have previously attended summer institutes to organize in-service programs for elementary school teachers in their own towns or districts.

Such has been the impact of this top-to-bottom overhauling of school mathematics that parents, on a nationwide scale, have been willing to spend one evening a week and five to ten dollars in fees (plus baby sitters) for night

classes in order to keep in touch with their children's homework.

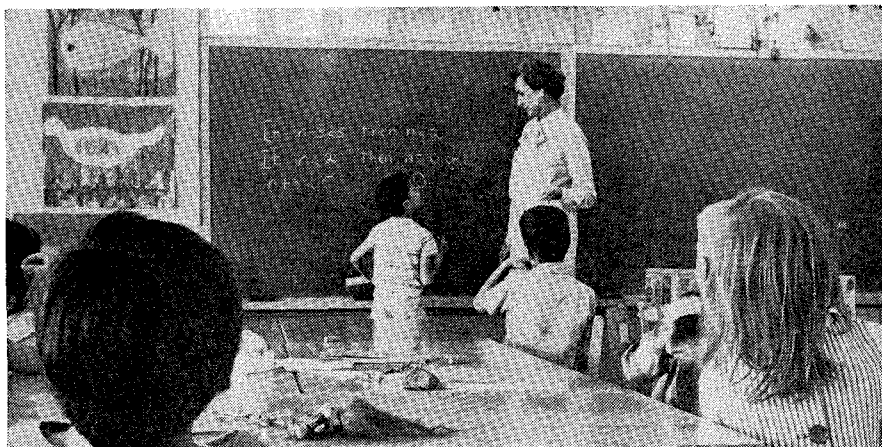
The new math has cropped up in unexpected places. *Esquire* ran an article on the subject. CBS's *Camera Three*, a program usually devoted to such cultural matters as the sculpture of Alexander Calder, and Brecht on Shakespeare, televised a discussion of new math. Montgomery Ward's catalogue, which carries few books, this spring listed one explaining the new math to parents.

Such a major upheaval in the school curriculum has not taken place without dissent. As the wave of mathematical reforms swept through the educational system, from the high schools downward, a spray of criticism has been thrown up, usually at the point of im-

pact. A few years ago it was the new seventh and eighth grade courses that were viewed with concern, now it is those for the second and third grade. Here, of course, the problem is compounded by the fact that arithmetic is usually taught by the same person who also teaches reading and writing. Furthermore, it is a safe bet that in the majority of cases, mathematics was never her favorite subject. A suggested solution is to have grade school arithmetic taught by arithmetic specialists, as music and art often are.

The most common criticism is that the new math is too abstract and that it does not teach computational skills. It is true that if, in reaction against the old system of rote learning and undiluted drill, the pendulum swings too far in the other direction, a class might turn out like a football team that spent all its time in skull practice, learning to understand the plays, but never actually played a game. On the other hand, it is also true that there were a great number of children who couldn't compute satisfactorily under the old system of math, either, as any experienced teacher can tell you.

What works best is a change-over that is gradual, sound, and thorough. Crash programs run into difficulties in any line. A middle of the road approach, fusing the old math with the new, gives the best results. Of course, the middle keeps



—Stanford University.

"Simple mathematical concepts can be understood by the beginner provided these are presented precisely, with the help of a consistent notion."

moving over—in some quarters SMSG is now regarded as conservative.

Although the decisions about the new curriculums in math have not been unanimous, there is no gainsaying the improvement in the quality of the math programs which are now being offered. As concrete evidence, there are the new achievement tests in mathematics which the College Entrance Examination Board inaugurated this year.

THE College Board bases its examinations on the courses currently being taught on a nationwide scale—not on some hypothetical future program. It has stepped up its requirements to the point where the content coverage of *both* the former tests—the Intermediate and the Advanced—is now combined in the new Level I (Standard) test. This means that a student who knows only the mathematics necessary for the old Intermediate Test is not now prepared to take a college board in math *at all*.

The new Level II (Intensive) test is designed to give those students who have taken enriched or accelerated mathematics courses an opportunity to demonstrate their knowledge and ability. There is some talk of lifting, for this test, the present CEEB score ceiling of 800 so that exceptional candidates can show the full extent of their achievements.

Thus, seven years after the appearance of the report of the College Entrance Examination Board's Commission on Mathematics (approximately coincident with the launching of the first Sputnik) the recommended escalation of the school mathematics curriculum shows results.

There is today under discussion in the mathematical community another report—that of the Cambridge Conference—which some say marks the beginning of a *second* revolution in mathematics. It was drawn up in the summer of 1963 at Cambridge, Massachusetts, by a group of twenty-nine of the country's leading

mathematicians and mathematics users, including not only representatives from such institutions of higher learning as Harvard, MIT, Stanford, and Cal Tech, but also from IBM and the Bell Telephone Laboratories. Present were "pure mathematicians" of various kinds, applied mathematicians, statisticians, several physicists, and a chemist.

They called their report *Goals for School Mathematics*, pointing out that the natural province of research scholars is exploratory thinking with a view to the long range future. Cautioning that their proposals are not to be taken as a prescription to be put into effect immediately, they made no suggestions as to how their recommended curriculum for kindergarten through twelfth grade is to be implemented. They simply stated their belief that if a teachable program were developed, teachers would be trained to handle it.

In a foreword to the published report, Francis Keppel, the U.S. Commissioner of Education, wrote "These are the curricula toward which the schools should be aiming. If teachers cannot achieve them today, they must set their courses so that they may begin to achieve them in ten years, or twenty years, or thirty."

Members of the Cambridge Conference based their mathematics curriculum for the first six grades on the parallel development of arithmetic and geometry, which is what many new programs already do. However, some of their proposed topics are not merely eye-opening, they are eye-popping—Cartesian coordinates, vectors, the use of the slide rule, interpolation, logic, and the elements of flow charting.

Their overall plan is a spiral curriculum in which concepts are introduced first at the pre-mathematics level, then returned to again and again, each time at a higher and higher level of mathematical sophistication until formal study of the subject is reached in high school. To the Cambridge Conference, "pre-

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—Stanford University.

"How much and what kind of mathematics is the mind of a child able to absorb?"



—George Zimbel (Monkneyer).

COLLEGE STUDENTS—THE NEW BREED

By JAMES L. JARRETT, *Professor of Education at Berkeley, former President of the Great Books Foundation and college president.*

EIGHT AND TEN YEARS AGO the worry of faculty groups, especially those who had come of age in the tumultuous Thirties, was student apathy. Over and over the complaint was heard: The students don't care, not about anything—except a good job, a good marriage, a nice home. War and peace, poverty and affluence, oppression and equality, rights and duties: these were *words* and they didn't want to be bothered. It seems a long time ago, for now they care. Yet, one should not say "they," for college students, especially now that going to college has become so overwhelmingly popular, are a very diverse lot. For instance, on the Berkeley campus of the University of California, where massive student demonstrations erupted last fall, with its more than 27,000 students there are of course many who are politically apa-

thetic. There are many whose genteel traditions require them to avert their glance from beards, uncombed hair, and raucous harangues. There are still those exclusively interested in conformity and security. There are nearly all types—except the stupid.

That a great many students do care, Berkeley may now be said to have demonstrated, for what began as a small movement last September spread with considerable speed to a sizable portion of the student body, and those who were brought along were not just along for the ride. They carried banners, they picketed, they sat down in public places, they got themselves arrested and taken off to jail. Furthermore, the letters and telegrams poured in from all over the nation, from student groups expressing sympathy and from faculty groups saying Bravo! Also from enterprising recruiters asking Berkeley faculty if perhaps they were ready for a move to quieter quarters.

The question to ask is: How much longer will the other quarters remain all that quiet? Or, as the student in another

state university recently put it in a forum: "The Berkeley Fallout: Will It Contaminate Other Campuses?" The answer is yes, although the lead shield of apathy is still thick in some places.

But change is afoot: in student concern, in willingness to employ the devices of protest—petitions, resolutions, mass meetings, pickets, massive mailings, sit-ins, litigation. The particular cause is and will be highly variable. If now racial issues and restrictions on student freedoms are prominent, tomorrow the sky's the limit, including not only all the political and social controversies that agitate community, state, nation, and the wide world, but also the whole range of problems hitherto thought to be the exclusive prerogative of faculty and administrations: budget, curriculum, grades, degrees, library, dormitory hours—yes, and the hiring, advancement, and firing of members of the faculty.

Curiously, the *in loco parentis* idea even managed to survive, with only minor scrapes, the onslaught of student veterans after the war, but in recent years the paternalistic functions of col-