Editorial

Vincent J. Glennon

Balanced Progress in School Mathematics

ABOUT eight years ago we saw the first issue of the new journal, *The Arithmetic Teacher*. The lead article by Brownell [1] was concerned with the revolution in arithmetic. A few days ago, as of the time of this writing, we saw the most recent publication of the National Council of Teachers of Mathematics—its title, *The Revolution in School Mathematics: A Challenge for Administrators and Teachers.*[2] During the time between the appearances of these two publications we have seen many articles, experimental texts and films, as well as speeches, panel discussions and demonstration lessons devoted to the same theme—the revolution in school mathematics.

To the professional worker in mathematics education whose background includes an acquaintance with the major developments in the long history of mathematics education, this recent activity is welcome but not unique. That mathematics in general and school mathematics in particular are now and have been for the past five thousand years a "living" thing characterized by change and growth is readily apparent. To be sure there were times when the rate of each was hardly perceptible, seemingly dormant; but at other times it was significant and substantial. Illustrative of this latter point would be the total and radical shift from a deductive to an inductive approach in the organization of arithmetic programs brought about by Charles Colburn in 1821.

But to the professional worker whose background and interest are not concentrated in mathematics education the present scene can be ambiguous and frustrating, even anxiety-inducing. He typically asks: What is this all about? and, What, if anything, should it mean to me and my school program?

Revolution or Evolution?

Whether we are truly undergoing a revolution, or whether the term is merely a convenient one to connote the need for urgency (and the need is real) in the task of speeding the rate of evolution, may be a matter of definition. If one accepts Webster's definition of a revolution as "a total or radical" change, the present activity is not a revolution in the sense that the change is of the same order of magnitude as, say, the Copernican shift from geocentrism to heliocentrism, or, in medicine, the shift from a demonic theory of disease to a germ theory. But, revolution or not, the present activity is most certainly characterized by an ac-

[1] William A. Brownell. "The Revolution in Arithmetic." *The Arithmetic Teacher* 1:1-5; February 1954.

[2] *The Revolution in School Mathematics: A Challenge for Administrators and Teachers*, Washington, D. C.: The National Council of Teachers of Mathematics, 1961. 90 p.

celeration in the *rate of evolution* the like of which we have not seen in this century.

In a very real sense, however, the present activity is not a discrete endeavor but is a continuation of the efforts of many persons (Brownell, Buckingham, Buswell, Clark, Judd, McConnell, Sueltz, Thiele, Thorndike, Wheat, as well as the team of McLellan and Dewey, and others), who during this century have sought to make school mathematics more meaningful and less manipulative, more a science of numbers and less a set of skills. Indeed, there is perhaps no person writing today who has sensed and stated the problem as brilliantly as did Brownell in the Tenth Yearbook of the National Council of Teachers of Mathematics—a statement as good now as then (1935).

Causes of Present Concern

Prior to this century two curriculum theories determined the content of the school mathematics program. The first, the need of society for mathematical training on the part of its citizenry (the sociological approach); the second, the need for the subject to be taught as a system of related ideas (the logical approach).

In the Roman civilization a clear-cut separation of these two approaches was made. The plebeian was taught the practical uses of arithmetic, *logistica;* the patrician studied arithmetic as a science of numbers, *numerorum scientia.*

With the creation in this century of vast amounts of knowledge about the conditions of effective learning, the nature of human growth and development, and the nature of mental health and its relationship to classroom learning, a third curriculum theory was developed and must be considered when we try to determine what mathematics we *ought* to teach in school. This third theory is usually referred to as the "needs of the child" theory (the psychological approach). We emphasized "ought" above in order to distinguish between the mathematical content that we ought to teach and that which we *can* teach. "Oughtness" is essentially a curriculum problem; "can-ness" is essentially a psychological problem.

All too often, unfortunately, we see programs being proposed with no curriculum rationale other than the fact that the material *can* be taught and *can* be learned. Since we know that children can learn much more content than we have time to teach, the task of the curriculum worker becomes that of selecting out of all that can be learned that which is of greatest importance. The three curriculum theories enable us to make judgments in selecting that content.

These three theories have influenced the mathematics curriculum variously, from time to time, and from one school to another. Each theory has its limitations.

In the school program that places a disproportionately heavy emphasis on the importance of having the curriculum emerge out of the immediate needs of the children, the mathematics program tends to be unsystematic and somewhat less than the child can learn and will need in life.

In the school program that places too heavy an emphasis on the needs of adult society as the sole determiner of the scope and sequence of the child's program, the content selected for study tends to be unsystematically developed and somewhat removed from the learner's present needs.

Finally, in the school program that places an undue emphasis on arithmetic as a science of numbers, or pure game, unrelated to life, the program will quickly lose the apparent initial interest in abstract mathematics and become a sterile subject.

Of these three theories, however, the one that is having the greatest impact on the school mathematics program today is the science of numbers, or pure game, point of view.

This impact has its origin in two sources. The first source can be viewed as a continuation of the efforts of the men named above in this century to make the school mathematics program more meaningful. The second source can be found in the advances made in the creation of new mathematical knowledge and the application of this knowledge to technology. Reliable estimates indicate that more mathematics has been created during the twentieth century than during all the past history. Surely some of this new knowledge must be integrated into the present program if mathematics is to continue as a living and growing thing, and if the program of the school is to continue as a balanced program—balanced in both content (*what* we teach) and in method (*how* we teach).

The New Balance in Content

When all three theories mentioned above are influencing the school mathematics program in equitable, but perhaps not equal, amounts, we say the curriculum is balanced. That balance in any school program is desirable can hardly be denied. The need for balance is the theme of ASCD's 1961 yearbook, *Balance in the Curriculum*.

Yet, that balance is difficult to define, obtain and maintain can be attested to by any person who has given serious thought to the problem. Of course, it is easy to change a mathematics program, but a changed program is not necessarily a balanced one, or a better one. As Foshay stated in the yearbook, "sometimes, despite the best efforts of wise men, the result (of curriculum change) has been only to substitute one distortion for another." [3]

We can do no less, however, than continue to work earnestly and honestly at the problem. It may be of some consolation to know that the problem is not unique to curriculum workers in America. In the recent *Proceedings of the Southampton (England) Mathematical Conference*, Thwaites writes, "There is an urgent need for textbooks which present the subject from a modern point of view and no member of the Conference was able to name a single British school textbook which does so. Such books *must* be written as soon as possible." [4]

In this country, several experimental textbook programs have been planned and written by teams of authors, and others are being written. In some instances, materials have been written by individuals. The advantage of a team approach is that the mathematical content in the end-product tends to be better balanced, less biased.

There is a clear and present danger that a school system can, in a rush to get on the bandwagon, produce a distorted program. In fact, the danger is so great that some of the country's leading mathematics educators have found it necessary to sound warnings. Typical of these warnings against extremism in our at-

[3] Arthur W. Foshay. "From the Association." *Balance in the Curriculum*, Yearbook 1961. Washington, D. C.: The Association for Supervision and Curriculum Development, 1961. p. iii.

[4] Bryan Thwaites. "On Teaching Mathematics." *Proceedings of the Southampton Mathematical Conference*. New York: The Pergamon Press, 1961. p. 30. (116 p.)

tempts to make our programs more mathematical is that of Phillip S. Jones, President of the National Council of Teachers of Mathematics:

> As I read and listen to the expositions of the denunciators and the innovators I feel, happily, that with thought, discussion and experimental teaching, we are progressing toward a substantially improved mathematics program which will, however, be less changed and less radically modified than some of the loudest of the outcries seemed to demand.[5]

And Howard F. Fehr, a recent past President of the National Council, expressed a similar deep concern:

> Another note of caution is to be found in the desires of some mathematicians to make mathematicians out of all children who can become mathematicians, and as far as the rest are concerned, that is a problem for those interested in the less capable. . . . I also believe that learning arithmetic as a (pure) game will turn as many children away from learning and liking arithmetic as the meaningless rote teaching that is still being widely practiced.[6]

Many more similar cautions and warnings against unbalanced programs could be cited if space permitted.

The New Balance in Method

Many mathematics educators are of the opinion that modernizing a school mathematics program is as much a problem of changing the methods by which we teach the present content as it is of changing the content.

[5] Phillip S. Jones. "The Mathematics Teacher's Dilemma." *The University of Michigan School of Education Bulletin* 30:65-72; January 1959.

[6] Howard F. Fehr. "Trends in the Teaching of Arithmetic." *Frontiers of Elementary Education VII.* Vincent J. Glennon, Editor. Proceedings of a Conference on Elementary Education. Syracuse, N. Y.: The Syracuse University Press, 1960. Chapter III. p. 29-37.

As with content, the attempt to build a new concept of balance in methodology is not new in our time. However, we are witnessing, fortunately, a renewed effort to make fuller use of the 2500-year-old Socratic method, now more often referred to as the heuristic or discovery method.

In a word, balance in method is the problem of finding a more judicious mixture of unguided discovery, guided discovery, and telling methods of teaching, and of using each when it is the most appropriate method for the type of cognitive material being taught.

Making decisions on which is the best method to use with a given child or group of children and with a given type of subject matter material is the high art of teaching, and has much to do with arousing and maintaining interest.

As Bruner recently wrote: "Somewhere between apathy and wild excitement, there is an optimum level of aroused attention that is ideal for classroom activity. What is that level?"[7]

Much has yet to be learned before this question can be answered.

A Skillful Integration

The new concept of balance in content does not mean a wholesale abandonment of all, nor even of much, of the content presently found in our better textbook programs. Quite the opposite. Rather the new program that will emerge in this decade will be a skillful integration of some of the modern mathematics with much of the present content.

As stated in the foreword of the School Mathematics Study Group experimental textbook, *Mathematics for the Elemen-*

[7] Jerome S. Bruner. *The Process of Education.* Cambridge: Harvard University Press, 1960, p. 72. (97 p.)

tary School: "[This book] should be thought of as a sample of the kind of improved curriculum that we need and as a source of suggestions for the authors of commercial textbooks." [8]

Until such commercial textbooks are available, which, incidentally, will be soon, we must continue to make progress, but balanced progress, in developing our school mathematics programs.

And after the textbooks are available, it will be quite a few years before we have enough good quality research on the effectiveness of the modern programs to allow us to make any strong claims. Such research must be carried out and must be reported in the professional literature even though, on occasion, the results may be quite the opposite of the earlier claims.

On this point Keppel, in this country, and Wall, in England, expressed the same concern. Dean Keppel said:

> The eager desire for results—fast, dramatic, tangible results . . . has led to the temptation to engage in a variety of loose practices under the rubric of "research," and to advance premature claims for the results. There is the haunting danger that too hasty action may result in short-changing the next generation. Just as serious is the danger that irresponsible or misleading claims may lead to public and professional disillusionment and resistance to further change and experimentation.[9]

And Wall:

> I would go further and say that we should try a pilot run on a limited scale and under carefully controlled conditions before we attempt to persuade our colleagues in schools to adopt new ideas on a large scale. We have no right to ask society and the teachers to accept the new simply because it has been proved moderately successful. However, they can be encouraged to accept and try that which has been tested on a sufficient scale and has been found successful and more desirable.[10]

This entire issue of *Educational Leadership* is devoted to the theme, "Mathematics in the School," and is an effort to bring to the reader the perceptions of several professional educators looking at several aspects of this complex problem from as many points of view. All sides must be heard. No informed person should hesitate to speak out.

This decade will witness many more such efforts out of which will eventuate a new concept of balance in the school mathematics program, and this in turn will result in a reduced rate of evolution.

It is the purpose of this all-too-brief guest editorial to provide the reader with one person's perception of a curriculum model for reading and interpreting these papers in order that they may contribute to progress, balanced progress, in school mathematics programs.

—Vincent J. Glennon, *Professor of Education, and Director, Arithmetic Studies Center, School of Education, Syracuse University, Syracuse, New York.*

[8] *Mathematics for the Elementary School.* School Mathematics Study Group. New Haven, Conn.: Yale University Press, 1961.

[9] Francis Keppel. *Dean's Report of the Harvard Graduate School of Education 1959-60.* Cambridge, Mass.: Harvard University Press, 20 p.

[10] W. D. Wall. *New Thinking in School Mathematics.* Organization for European Economic Co-operation. Washington, D. C.: O.E.E.C. Mission, Publications Office, p. 101.