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BACKGROUND

Mathematics teaching is in a state of transition in all parts of the world. Numerous experiments aimed at modernizing the mathematics curriculum have been undertaken.

The Comprehensive School Mathematics Program (CSMP) was envisioned in 1963 as a response to a research impetus in mathematics education manifested in the reports of several prominent committees of mathematicians and mathematics educators from the United States and abroad.

CSMP, located in Carbondale, Illinois, U.S.A., is a major effort to modernize both the content of the pre-college mathematics curriculum and the methods of teaching.

In 1966, CSMP was established and became affiliated with Southern Illinois University. A proposal for a long-range curriculum development project was written during this year. The proposal was presented to the Central Midwestern Regional Educational Laboratory (CEMREL), and CSMP was incorporated as one of its major programs in the spring of 1967.

The Central Midwestern Regional Educational Laboratory was established under Title IV of the Elementary and Secondary Education Act of 1965, and began operation in June, 1966. One of 15 educational laboratories in the United States, whose purpose is to improve education for the children of the nation, CEMREL's mission is the development, CEMREL has set as its mission the development of individualized curricula in mathematics and the arts and humanities for all students in kindergarten through twelfth grade; it is also concerned with the development of effective instructional techniques and materials for children who have learning disabilities. Foremost authorities from across the nation compose the advisory committees to these programs. CEMREL is also concerned with developing instructional management systems, making use of the latest technology, to be used in conjunction with the curriculum development programs. Various related projects as well are a part of CEMREL's activities.

CEMREL is governed by a Board of Directors made up of outstanding educators, civic leaders, businessmen and labor officials from Illinois, Kentucky, Missouri and Tennessee. Headquarters for the laboratory are located in St. Ann, Missouri at 10646 St. Charles Rock Road, and programs offices are maintained in Carbondale, Illinois, Bowling Green, Kentucky, and in

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Chattanooga and Nashville, Tennessee. Wade M. Robinson is the executive director.

CEMREL works cooperatively with the State Departments of Education in the four states, as well as with colleges, universities and, of course, the elementary and secondary schools.

The primary goal of CSMP is the development of individualized mathematics curricula for students of ages 5–18 which provide for each student a program sound in content, enjoyable, and most appropriate for his needs and abilities. Each activity package will provide a teaching program which may involve individual study, teacher instruction, small group interaction, reading a text, watching a demonstration film, listening to a tape, playing mathematical games, or a combination of these and other procedures.

In considering strategies to achieve this ultimate goal, namely the development of mathematics curricula that are sound in content and appropriate for the needs of future adults in a changing society, the developers of CSMP decided the program must be discipline-oriented. By this is meant that, while all pedagogical aspects of mathematics education are of deep concern, priority is given to the selection of *mathematical content* that is sound, relevant, and enjoyable. The implications of this decision are that the mathematical community must be deeply involved in the program, that there be mathematicians physically in residence, and that mathematicians must guide the program. To date, this has been the case, and it is a principle of CSMP procedure that every phase of future development of the program will continue to enjoy the strong involvement of mathematicians.

The major role of mathematicians in CSMP is the selection and analysis of content. The CSMP attitude is that content selection should, as far as is possible, be unfettered by traditional notions of "what children can do" or "what teachers can teach"; it should instead be guided by what is important in mathematics, by what the outcomes of mathematics instruction should be, and by what students actually demonstrate they can do. For these reasons, content selection within CSMP is based on empirical data gathered from probes made with students in the trying-out of ideas generated by mathematicians. Serious content suggestions are accepted or rejected only after adequate trials in the classroom.

To have a truly individualized curriculum, one must take into account the different views of mathematics held by various people. The creative research mathematicians view it in various ways, depending on their fields of research. There are various users of mathematics (scientists, engineers, social scientists, businessmen, etc.) who view mathematics in other ways; mathematics educators are concerned with curriculum and methods, while school administrators, parents, students, and the man in the street view it in terms of the exigencies of their situations and in terms consistent with their backgrounds. Each has needs that some form of mathematics can fulfill. Each can enhance his services to society by bringing to his vocation an "appropriate" background in mathematics.

An assumption accepted by CSMP is that all these views of mathematics are viable and valid. One goal for the content of CSMP is a curriculum so designed that none of these views is excluded; students at each stage of their schooling have, therefore, a maximum number of avenues open for their adult uses of mathematics.

In order to obtain such a curriculum, several alternative approaches to one and the same topic will need to be developed. It is, therefore, essential that a detailed analysis of the content selected for the CSMP curriculum be made by the mathematicians involved. CSMP has to be open to any suggestion which might affect its goals, its choices of content, its techniques of presentation. This means that the program should have channels of information about trends in mathematics as a developing science, as well as about research in mathematics education, both here and abroad.

One such useful channel has been opened with the launching, by CEMREL, of a series of CSMP international conferences on the teaching of mathematics at the pre-college level. The first conference, which attracted scholars from every continent, was held in Carbondale, Illinois, from March 18 to March 27, 1969, and dealt with the teaching of probability and statistics.*

This book is a report of the second international conference held in Carbondale, March 19–28, 1970, to investigate the teaching of geometry in the schools. Future conferences will examine the teaching of algebra, of logic and foundations, and of analysis.

The last century has witnessed a burgeoning of geometrical thinking. The fields of projective and affine geometry have taken their place alongside classical Euclidean geometry, and their interrelations have been studied through the ideas of transformation geometry. Historically, modern axiomatic theory was first exemplified in the context of geometry. With the development of the theory of metric spaces, of topology and of linear algebra, geometrical structures could be viewed as part of a wider and more general system, while geometrical ideas and terminology penetrated to a great advantage into general theories and their applications.

Since the turn of the century many scholars and educators have urged the incorporation of such ideas and terminology in the secondary school curricula. Under Felix Klein's influence, the use of transformations and vectors

* *The Teaching of Probability and Statistics: Proceedings of the First CSMP International Conference on the Teaching of Mathematics at the Pre-College Level*, Almqvist & Wiksell, Stockholm, 1970; John Wiley & Sons, Inc., New York.

became a significant aspect of German school reform. Many countries are now engaged in similar reform programs. The treatment of geometry totally within the framework of linear algebra was strongly advocated in several recent conferences, and at the 1960 Aarhus Conference, in particular.*

When long-range objectives are to be set for a K-12 program the problems are numerous indeed. That is why, in the original invitation letter to the prospective Geometry Conference participants, we were forced to draw up a rather lengthy list of topics for lectures and for discussion:

(1) Introduction of geometry in the early grades: topological aspects; spacial geometry before plane geometry; experimental attitude towards geometry; motion geometry; symmetries.

(2) Geometry for the intermediate grades: role of affine geometry; transition from an experimental to a theoretical-deductive attitude; the role of mathematization; order and orientation; concept of angle; geometry and numbers (algebraization); group theoretical aspects of geometry; congruence; similarity; geometrical constructions; measures, such as length, angle measure, area, volume.

(3) Geometry for the upper grades: geometry and axiomatics; linear algebra approach; coordinate geometry; linear mappings; bilinear forms and conics; orthogonal group; the place of trigonometry; projective geometry, non-euclidean geometry; convex sets; combinatorial geometry; topological aspects of geometry; applications of geometry and the use of geometrical language in other fields.

The papers presented at the Conference could not be expected to cover the entire field of problems in need of attention. Several topics of interest were brought up and clarified during the discussion periods and at several working sessions.

We believe that these proceedings do offer a broad background for future curriculum decisions.

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* Aarhus Universitet Matematisk Institut: Elementaer Afdeling No. 7, *Lectures on Modern Teaching of Geometry and Related Topics*, ICMI Seminar, 1960.