Shortage of Mathematics Teachers: Seeking Status for the Non-Ph.D.

While demand for college teachers in nearly all fields has been rising, the demand for mathematics teachers has grown dramatically. Increasingly, students are taking courses in mathematics, statistics, and computer science, as they recognize the theoretical and practical importance of these subjects. Between 1955 and 1965 college enrollments approximately doubled, but the number of bachelor's degrees awarded annually in mathematics increased by nearly fivefold—compared to less than a twofold increase in the number of degrees awarded in engineering and the physical sciences. The enormous growth in the demand for mathematics courses, together with the recent modernization of the undergraduate mathematics curriculum, has created a shortage of adequately trained mathematics teachers.

The shortage is most marked in the 4-year liberal arts and teachers colleges, and in the junior colleges. In fact, while such institutions employ more than half of all of the mathematics teachers in higher education, they have less than a third of the 5000 Ph.D.'s who are teaching mathematics. For most of the Ph.D.'s, the appeal of the universities, with their research environment and generally higher salaries, is irresistible.

Contributing to the shortage of mathematics teachers in the colleges is the fact that, unless exceptionally able, the student who aspires to a teaching career in mathematics has little chance of obtaining a Ph.D., without which he may never attain full academic respectability. By tradition, requirements for a Ph.D. degree in mathematics include an original contribution to the subject; by this is meant a creation of new mathematics and not, as in some fields, largely an analysis or synthesis of the work of others. A few years ago, Mina S. Rees, professor of mathematics and now graduate dean of the City University of New York, commented: "Why is it that so few mathematics majors go on to the Ph.D.? Must a student be a genius to receive a Ph.D. in mathematics? Some of our students seriously think the answer to this question is 'yes.' In physics, a B student at college can do a very good job in his Ph.D. research; but a B student in mathematics will rarely be accepted as a candidate for a doctorate in mathematics. [Yet] we shall certainly need some of our B students as teachers [especially in community and junior colleges] . . ."

One who stops short of a Ph.D., but tries nevertheless to make a career in teaching, may be setting forth on a discouraging journey. Tenure may be denied him. Or, receiving tenure, he may (indeed, probably will) see promotions and higher pay go to colleagues who hold the doctorate. Thus, the mathematics teacher who lacks a Ph.D. will often find the opportunities in industry or elsewhere inviting and abandon teaching, even though his qualifications for undergraduate instruction are strong.

The Committee on the Undergraduate Program in Mathematics (CUPM) of the Mathematical Association of America hopes to encourage college administrators and other academicians to adopt a new attitude toward the well-qualified college teacher who lacks a Ph.D. Last summer CUPM issued a report prepared by its *ad hoc* committee on the Qualifications of College Teacher of Mathematics. The *ad hoc* group, chaired by Lowell J. Paige of U.C.L.A., specified the amount of preparation necessary for effective teaching at various levels of the undergraduate program, and said that rank and salary should "correspond to professional competence and achievement, as indicated by all professional activities and by teaching effectiveness, as well as by earned degrees."

While the research demanded for a Ph.D. dissertation was described as perhaps the best guarantee of "mathematical maturity," the report made clear that the Ph.D. was by no means necessary for college teaching. The three lower levels of preparation regarded as adequate for teaching various courses in the "General Curriculum in Mathematics for Colleges," described in a 1965 CUPM report by that title, follow.

1) Completion of a Strong Undergraduate Mathematics Major with distinction—qualifying the graduate student who has a definite interest in teaching to assist more mature teachers in teaching elementary college-level courses.

2) Completion of the First Graduate Component, which, building on the Strong Major, includes graduate studies in modern algebraic theory, analysis, general and algebraic topology, plus one or two semesters of teaching an undergraduate class under supervision of an experienced teacher. Such preparation is deemed sufficient for teaching some upper division courses in the General Curriculum.

3) Completion of the Advanced Graduate Component, which is to say, completion of all the requirements for a Ph.D. except the dissertation. This level of preparation, demanding at least 2 or 3 years of full-time graduate study, is held sufficient for teaching all General Curriculum courses.

According to CUPM, the teacher who has completed the Advanced Graduate Component should be accepted as a member of a college faculty and treated accordingly. "Unfortunately," the CUPM report says, however, "the relevance of the doctoral degree in the qualification of a college teacher is often misunderstood, and the resulting confusion has, in many cases, led to serious abuses. We have in mind such abuses as the preferential treatment frequently assured the holder of a doctoral degree over an otherwise well-qualified teacher who lacks a Ph.D.; or unrealistic emphasis at some institutions on the number of doctoral degrees, regardless of origin, held by members of the faculty."

In the judgment of many who have studied it, the problem of overcoming the shortage of college mathematics teachers has no simple solution and will require a variety of measures. Major universities with strong mathematics programs are sure to be called on to help—for example, by sending out distinguished mathematicians as lecturers or for a year's service as "missionaries" to the smaller institutions. Another suggestion is to establish a program of "indentured" fellowships for gifted students who have agreed that, after their graduate studies, they will teach for a few years at an "underdeveloped" institution. Still another idea is to set up regional teaching centers for the devel-

opment and exchange of undergraduate mathematics courses and improved teaching methods.

Promising as such ideas may be, however, gaining proper faculty status for the college teacher who, despite his lack of a Ph.D., is nevertheless well qualified to teach undergraduate courses is regarded as essential if the shortage of college mathematics teachers is to be met. According to the Conference Board of Mathematical Sciences, some 800 Ph.D.'s in mathematics are being produced annually—far too few to fill teaching vacancies. Perhaps 120 graduate students drop out each year as Ph.D. candidates after completing all requirements except the dissertation. Some mathematicians speculate that the number attaining this Advanced Graduate Component level might reach between 200 and 300 a year if the students knew that, by thus preparing themselves, they would receive greater professional recognition as teachers and mathematicians. As the CUPM report noted, a few institutions confer an interim degree—such as the "candidate in mathematics" degree awarded by the University of California at Berkeley—as formal recognition of this level of achievement.

One suggestion is to award an "associate Ph.D." for completion of the "advanced graduate component." Yet many college administrators doubt that anything short of a full doctoral degree —though not necessarily a Ph.D.—will ever be accepted as the mark of a fully qualified faculty member.

If, however, by somehow offering greater status and incentives for the non-Ph.D., the annual output of persons qualified for college teaching is increased by even 25 percent, the gain will be significant. For if, say, only two of the six members of a small mathematics department have been trained to the Advanced Graduate Component level, the department may be competent to offer the full range of General Curriculum courses.

As part of its effort to enhance the status of the well-qualified teacher who lacks the Ph.D., CUPM is holding a series of regional conferences with college administrators and mathematics professors. Thus far, two such conferences have been held: the first was conducted last fall in Denver, with 26 institutions from Colorado and several other states represented; at the second, held 2 weeks ago at Columbia, S.C., 20 South Carolina institutions were represented.

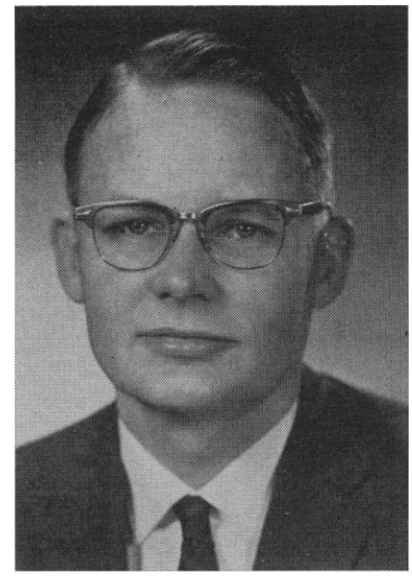
According to Malcolm W. Pownall, executive director of CUPM, which is based in Berkeley, CUPM's recommendations as to the appropriate qualifications for college mathematics teachers drew an interested response from those attending the Colorado and South Carolina meetings. He adds, however, that some of the deans questioned the idea of according the non-Ph.D. who is a competent teacher full status as a faculty member.

Indeed, a number of administrators who have considered the matter feel strongly that CUPM is unrealistic in proposing equal status for such teachers. The point of view expressed by John H. Crabtree, Jr., associate dean for academic affairs of Furman University (a liberal arts college at Greenville, S.C.) and a participant in the recent CUPM conference, appears to be widely held. "They fail to take certain facts of life into account," he says. "As long as the Ph.D. exists, regardless of how many bright young men we certify to teach mathematics, if they lack the Ph.D., the promotions will go to others who have the degree." Furman, he says, grants tenure to the non-Ph.D. who is a good teacher but none is promoted higher than associate professor and most "have to sit it out at the assistant professor level."

Before issuing its report last summer CUPM brought together a group of college presidents and deans to seek their reaction to its recommendations. Among these officials was Everett Derryberry, president of Tennessee Technological University, Cookeville, Tenn., and a member of the Commission on Colleges of the Southern Association of Colleges and Schools (SACS), which is one of the six regional accrediting bodies in the United States. In Derryberry's view, his faculty would never accept the idea that a mathematics teacher who has completed the Advanced Graduate Component (or who

Sproull To Head Defense Science Board

Robert L. Sproull, vice president for academic affairs at Cornell University, has been appointed chairman of the Defense Science Board (DSB), which is the highest-ranking scientific and technical advisory body in the Department of Defense. Sproull succeeds Frederick Seitz, president of the National Academy of Sciences, who on 1 March completed a second 2-year term as DSB chairman. Under John S. Foster, Jr., Defense Director of Research and Engineering, the DSB has lately been given increased responsibility, and, at a time when many academic institutions are experiencing antimilitary sentiments, the Board serves as an important source of guidance for the Department in its relations with the academic world. Sproull formerly headed the Laboratory of Atomic and Solid State Physics and the Materials Science Center at Cornell, and was director of the Defense Department's Advanced Research Projects Agency from 1963 to 1965. Newly appointed as vice chairman of the DSB is Thomas L. Phillips, president of the Raytheon Company, who succeeds Patrick E. Haggerty, chairman of the Board of Directors of Texas Instruments.



Robert L. Sproull

Both Seitz and Haggerty will continue to serve as members of the 28-man Board. Also appointed, as members at large, were John L. McLucas, president of the MITRE Corporation; Ithiel de Sola Pool, chairman of the M.I.T. political science department; and Albert D. Wheelon, vice president of the Hughes Aircraft Co.—D.S.G.

holds an interim degree such as an "associate Ph.D.") should be on an equal footing with a Ph.D.

Nor does he believe that a regional accrediting association should make "invidious distinctions" between disciplines by altering its standards to allow a mathematics department to get by with a smaller percentage of doctoral-degree holders than the percentage required for other departments. (In general, the SACS requirement for a 4-year college is that at least 25 percent of the members of each academic department, and at least 30 percent of the total faculty, must hold the doctorate.)

Derryberry is among those who believe that, if the non-Ph.D. who teaches mathematics is at an unfair disadvantage vis-à-vis teachers in other fields where doctoral requirements are less demanding, much of the blame lies with the mathematicians themselves. Some leading mathematicians have been opposed to the idea of conferring the title of "doctor" on anyone who has failed to demonstrate, by a doctoral thesis, competence in mathematical research.

Proposals to award a "doctor of arts" or "doctor of education" degree in mathematics are not new, and some institutions confer such degrees. For example, Pennsylvania State University and the University of Michigan each awards a doctor of education degree in mathematics. Carnegie-Mellon University in Pittsburgh awards a doctor of arts degree in mathematics. One candidate for this Carnegie-Mellon degree satisfied his thesis requirement by preparation of a new course for the undergraduate curriculum.

Derryberry is by no means alone in his belief that mathematicians should agree on an appropriate doctoral degree for the candidate who, by reason of ability or inclination, cannot qualify for or does not seek the traditional Ph.D. degree. One consequence of a failure to do this may be to encourage weaker universities to award Ph.D. degrees for thesis work which stronger institutions would not accept.

The CUPM report includes some cautious language which seems to sanction the idea that a doctorate should be conferred on the candidate who completes the Advanced Graduate Component and prepares an acceptable thesis, even if it is not of the traditional research variety. While the mathematicians deliberate on this question of credentials, the shortage of qualified mathematics teachers in the colleges continues to grow.—LUTHER J. CARTER

Louvain: The University Incubates Belgian Political Crisis

Louvain/Leuven, Belgium. Chronic tensions between Belgium's two linguistic communities provided the gunpowder for the political crisis which exploded in February when the national government resigned, but it was the students of the famous Catholic University of Louvain who lit the fuse. What has not been widely noticed is that Flemish advocates of student power were calling not only for cultural emancipation but for social revolution.

The troubles at Louvain center on insistence by the Flemish activists that the French-speaking or "francophone" section of the university be transplanted into French-speaking territory. Belgium is divided north and south by a linguistic Mason-Dixon line. North of the line, in Flanders, the official language of classroom, court, and street sign is Dutch; south of the line, in Wallonia, it is French.

Belgian political parties have sought to keep the "linguistic question" below the flash point not only in the interest of national unity but also because the major parties have been composed of both Flemish and French-speaking elements. For a century after the founding of the Belgian state in 1830, French culture dominated. French was the language of the middle class, even in the Flemish cities of Ghent, Bruges, and Antwerp. To many a Belgian bourgeois, Flemish was the language of the kitchen. Even today, relatively few francophones seem to learn much Flemish. (The written language is Dutch, the spoken dialect Flemish.)

In recent years Flemish nationalism has been gaining ground steadily in most sectors of Belgian life. It was inevitable that the University of Louvain should become a special objective in the campaign. Louvain is Belgium's oldest and biggest university, and its most distinguished. Erasmus and Vesalius grace its past, and 20th-century Louvain can boast of men like Canon Georges Lemaître, author of the "big bang" theory of the creation of the universe. Louvain is the alma mater of many influential Belgians, both Flemish and French-speaking. And it is in Flemish territory.

Student action in the streets in support of the demand that the French-speaking section of the university be moved attracted increasing Flemish nationalist political support outside the university, and this resulted in mounting pressure for action, on the government and on the church, which in principle administers the university. "Politisation" of the issue diverted attention from the content and style of student demands, which had much in common with the demands of student activists at Berkeley and Berlin. In early February the government of Premier Vanden Boeynants felt compelled to try to reach a decision on the future of the university. Unable to reach agreement, the cabinet resigned. Belgium now appears to be facing new elections in which the parties will be split on linguistic lines. The language question and the future of the university itself will be major issues.

Louvain—or Leuven, in Dutch—lies a few kilometers north of the linguistic frontier, but the university has had special rules which provide that instruction be in both languages. There has been progressive separation, however. A 1966 decree divided the university into Flemish and French sections, each with its own administrative and academic staffs and each charged with its own development.

In demanding the departure of the French section the Flemish do not talk much about cultural humiliation. A main line of argument is that the problem is not linguistic at all, but one of numbers. The town of Louvain has