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ANGLETERRE

The Training of Mathematics Teachers in England.¹

I. — GENERAL PREPARATION OF CANDIDATES.

TEACHERS of Mathematics will normally have spent their early years in a Public Elementary School, the Preparatory Department of a Secondary School, or a private Preparatory School. From either of the first two transference to a Secondary School takes place at about 11 +, but the private Preparatory School generally sends pupils on to the Public Schools (Secondary) at about 13 +. Transfer from the school to the University generally takes place at eighteen to nineteen years of age.

At the Secondary School a general course is followed up to the age of about sixteen, when the First Examination is taken. The curriculum includes the study of English, Scripture, Geography, History; one, two or three foreign languages; Mathematics always, and Science generally. Of the foreign languages French is the first choice in most cases, Latin the second, and Greek or German the third. The number of pupils taking German is now tending to increase.

From the passing of the First Examination until entrance to a University a more specialized course is followed. Those who will ultimately be taking a degree in Mathematics will commonly have spent most of their time during these years in reading as their principal subjects Mathematics and Physics, or Mathematics, Physics and Chemistry, or less frequently Pure Mathematics; as subsidiary subjects they generally devote some time to English and to a modern foreign language. In the older universities of Oxford and Cambridge some Latin is required from candidates for a mathematical degree, but the Latin done in preparation for the First Examination at sixteen years of age meets the requirements. In the more recently established universities Latin is not required from those who are taking a mathematical degree.

Of the Secondary teachers in England who are trained, the great majority have spent four years in one of the universities and have taken the University Diploma in Education. The first three years are occupied in taking the University degree, which may be an

¹ Ce texte est conforme à celui que la Délégation anglaise, présidée par M. H. NEVILLE, a publié dans la *Mathematical Gazette*, Vol. XVI, N° 221, p. 331-336.

ordinary or pass degree in a group of subjects or an Honours degree in a much more limited number of subjects, and often only one subject. The fourth year is given up wholly to the professional training, which is entirely divorced from the academic or scientific training, and may, indeed, be taken at a different university.

It should be made clear that while opportunities for training exist, there are no regulations laying down that training, or indeed a University degree, is necessary for teachers of Secondary schools. The following figures may, however, be interesting. In 1913, of the men teaching in Secondary schools, 71.6 per cent. were graduates, 37.5 per cent. were trained and 27.9 per cent. were trained graduates; the corresponding figures for the women being 52.3 per cent., 47.4 per cent. and 29.7 per cent. In 1931, of the men, 83.6 per cent. were graduates, 49 per cent. were trained and 44 per cent. were trained and graduates; corresponding figures for the women being 65.5 per cent., 46 per cent. and 39 per cent. It will be seen that nowadays the great majority of the teachers are graduates. The Honours graduates in Mathematics will usually have a good knowledge of Applied Mathematics, Mechanics, and Physics, but not necessarily of Philosophy, History or foreign languages. Of the pass graduates the majority—those who hold a Science degree—will have some knowledge of the same subjects, but the others, with an Arts degree, may have combined Pure Mathematics with literary subjects.

Four Year students, *i.e.* those who are taking a three-year degree course of academic study, followed by a year of professional training in a University Training Department, are eligible for grants towards their tuition and maintenance from the Board of Education provided that they intend on the completion of their course to teach in state-aided schools. The tuition grant for the degree course varies with the fees charged and is, as a rule, sufficient to meet the whole of the fees. The tuition grant for the postgraduate training is £35; at some University Training Departments this covers the charges, at others the students pay a fee. The maintenance grant in each of the four years is £43 for a man and £34 for a woman, if resident in a college or recognised hostel; £26 for a man and £20 for a woman if not so resident.

II. — THEORETICAL SCIENTIFIC TEACHING, *i.e.* THE DEGREE COURSE.

The preparation for the degree in the case of Mathematics (pure, applied, and mechanics) is carried out almost entirely by means of lectures, exercises, and preparation. The number of lectures in these subjects would vary considerably, but in many cases would be about ten to twelve per week. The time given to exercises and preparation

would depend entirely on the student. Usually in the degree course little or no attention is given to the Foundations of Mathematics, the History of Mathematics, or practical work in Mathematics.

Students taking the ordinary or pass degree commonly take Physics, and sometimes Physics and Chemistry, as well as Mathematics, though certain other subjects could be chosen in place of them. In these branches of Science the teaching is by means of lectures, exercises, preparation, combined with a considerable amount of experimental work in the laboratories.

This theoretical preparation is tested by the University degree examinations. There is no Government examination.

III. — PROFESSIONAL TRAINING.

The professional training may vary in details in the different University departments, but normally students will have had courses in: The Principles of Education. — General Methods of Teaching. — Educational Psychology. — Educational Hygiene. — The History of Education.

In addition the course must include practice in teaching under supervision in a school, and students who have not had previous teaching experience must spend at least twelve weeks in such practice.

The actual amount of instruction in the methods of mathematical teaching given by the University Training Department varies very considerably. The lessons may be given by a member of the university staff, or by someone who is teaching or has taught in schools and is specially engaged for this purpose. The extent of such courses may vary from very little to a thorough discussion of methods, applicable to pupils to the age of sixteen.

The period of practical training may be made up of three separate months at difference points of the year of training, and these three months may be spent at different schools. On the other hand, the period of training may be one of three months taken consecutively in one school. During the period of practical training the student commonly is treated in the same way as a junior member of the teaching staff, with similar privileges, etc. The student who intends to teach Mathematics will be under the immediate direction of the Head Master (if he is a mathematician) or of the Chief Mathematical Master, and will spend his time in hearing lessons, giving lessons in the presence of the regular teacher, and, later on, taking complete charge of classes. In a large school where there may be four or five Mathematical teachers there will be plenty of opportunity for him to see how different parts of the subject are presented, and,

in the case of Applied Mathematics, of seeing to what extent practical work is encouraged.

There is no study of Educational Legislation except in so far as it may be dealt with under the History of Education.

The professional training may be tested by a definite written examination or by essays. The diploma may be awarded partly on the mark given for these examinations or essays and partly on the mark given on the student's ability to teach as shown during the three months' practice. On the other hand there may be written examination, in which case the award may be in part on the student's written work throughout the year's training or on a thesis presented by the student.

As to the current opinion on the value of these courses, there is no doubt that a quarter of a century ago they were not regarded with particular favour. The figures previously quoted as to the proportion of trained teachers now in the schools gives some idea of the changed position in this respect.

The method of training referred to hitherto has been that of the University Training Departments. There are, however, two or three other methods that should be mentioned.

(i) The Training Colleges, of which there are a great many, aim primarily at the training of teachers for the Elementary Schools, but a number of these obtain posts in Secondary schools either at the close of training or, later on, by transfer. The general lines of the training are similar to those described except that there may be no special attention given to Mathematics.

(ii) The Board of Education may recognize arrangements for the training of persons who have University Degrees in courses of not less than a year in Secondary schools. Any such arrangements must provide for a systematic study of the practice and principles of teaching, and the school must satisfy the Board that it can provide a course suited to the needs and capacity of the particular student concerned. Few schools carry on this form of training, and in no school would there be more than one or two students.

IV. — SUBSEQUENT IMPROVEMENT.

Courses in Mathematics for Secondary school teachers are held in the summer vacation. There is no compulsion to attend, but there is considerable demand. In 1931, for example, something like 200 teachers applied, and of these 80 were selected for the courses.

It is not usual to grant a term or terms leave, even after some years teaching, in order to keep in touch with developments in the subject; there is, however, a Mathematical Association with numerous

branches all over the country, and with a periodical (see § VI below), which help in this direction.

Arrangements may be made by which a teacher may pay an observation visit to other schools where the subject is unusually well organised or taught.

It is quite common for teachers to produce text-books on the subject, for teaching purposes. It is unusual for them to occupy themselves in research or to contribute to any great extent to the sum total of knowledge of the subject. Nor is it common for teachers in Secondary schools to advance to University posts. One or two well-known mathematicians, however, have spent some part of their career in school teaching, as, for example, F. S. Macaulay and W. P. Milne.

V. — DUTIES AND RESPONSIBILITIES.

A teacher whose main subject is Mathematics may spend part of his time in teaching any other subjects. If he is not fully occupied with his own subject he most commonly helps with the Physics.

Mechanics of an elementary kind may be taught either by teachers of Science as an experimental subject in the early part of the Science course or, from the age of sixteen to eighteen, as a branch of Mathematics by the Mathematical teachers.

A preliminary course in descriptive geometry usually precedes the deductive course. It is taken by the same teacher and does not, as a rule, amount to a great deal.

The chief Mathematical teacher in any school is responsible for formulation of programmes of study and for co-operating with the heads of the Science and other departments. Such programmes, etc. will be always subject to the approval of the Head Master or Mistress.

Teachers of Secondary schools are not required by law to have any qualifications, though they are in most cases graduates and are recruited by the methods already indicated.

The great majority of teachers are paid salaries in accordance with the Burnham Scale, and are eligible for the Government pension.

VI. — BIBLIOGRAPHY.

Of the very few books dealing with the teaching of Mathematics, or of particular branches of Mathematics, at the stage with which this report is concerned, the best known are:

B. BRANFORD. *A Study of Mathematical Education*, xii, 432; 1921.

C. V. DURELL. *The Teaching of Elementary Algebra*, viii, 136; 1931.

C. GODFREY and A. W. SIDDONS. *The Teaching of Elementary Mathematics*, xii, 332; 1931.

T. P. NUNN. *The Teaching of Algebra (including Trigonometry)*, xvi, 616; 1914. (A running commentary on two volumes of *Exercises in Algebra (including Trigonometry)* compiled by the same author.)

F. W. WESTAWAY. *Craftsmanship in the Teaching of Elementary Mathematics*, xvi, 666; 1931.

At meetings of the British Association for the Advancement of Science, discussions were opened by J. Perry on the Teaching of Mathematics (1901) and the Teaching of Elementary Mechanics (1905); the verbatim reports of these discussions are still of interest.

The Mathematical Association, a society devoted to the improvement of the teaching of Mathematics in schools, issues from time to time special reports drawn up by committees which often include inspectors and university teachers in addition to school teachers. The longest of these reports hitherto published are:

The Teaching of Geometry in Schools, iv, 74; 1923 (3rd ed. 1929)

The Teaching of Mechanics in Schools, 84; 1930.

The Teaching of Arithmetic in Schools, 82; 1932.

The Mathematical Association publishes also *The Mathematical Gazette* (Editor: T. A. A. Broadbent, 2 Buxton Avenue, Reading), which includes articles of interest to school teachers, and reviews not only of school and university text-books but also of the most advanced mathematical treatises, foreign as well as native; five numbers compose an annual volume of about 400 pages. This is the only periodical designed for the mathematical teacher, but relevant articles and reviews appear occasionally in two weeklies, *Nature* and *The Times Educational Supplement*. The contact with Physics brings Mechanics on the experimental side into *The School Science Review*, the journal of the Science Masters' Association.

E. H. NEVILLE.