his own classes, which was most instructive and suggestive to the teachers present. Mr. H. G. Forder, M.A., senior mathematical master at the college, gave a paper on " The Infinite in Mathematics." The Branch is largely indebted to the hospitality of the headmaster for an interesting and enjoyable meeting.

### LONDON BRANCH.

#### PROGRAMME FOR 1922-23.

1922.

Oct. 14th—(Saturday)—Meeting at The London Day Training College, at 3 p.m. Paper on " The Final Stage in the Teaching of School Geometry," by Professor T. P. NUNN, M.A., D.Sc., London Day Training College.

Nov. 18th—(Saturday)—Meeting at The London Day Training College, at 3 p.m. Discussion on " The Use of Symmetry in Geometrical Teaching," to be opened by Professor C. GODFREY, M.V.O., M.A., Royal Naval College, Greenwich.

Dec. 2nd—(Saturday)—Meeting at The London Day Training College, at 3 p.m. Paper on " Knowledge, Mathematic and Mythologic," by BENCHARA BRANFORD, M.A.

1923.

Feb. 3rd—(Saturday)—Annual Meeting at The London Day Training College, at 3 p.m. Presidential Address by Sir GEORGE GREENHILL, M.A., F.R.S.

Feb. 24th—(Saturday)—Meeting at The London Day Training College, at 3 p.m. Paper on " The Teaching of Algebra," by Miss K. REEVE, Fulham Secondary School.

Mar. 24th—(Wednesday)—An Informal Dinner at 7 p.m., to be followed by Papers on "The Teaching of Mechanics," by Prof. W. M. ROBERTS, M.A., and G. GOODWILL, B.Sc., at The London Day Training College.

# Obituary.

## T. G. CREAK, M.A.

WE greatly regret to record the death, in his sixty-second year, of Thomas Gasquoine Creak, honorary secretary of the North Wales Branch of the Mathematical Association.

Having graduated, at Emmanuel College, Cambridge, as 27th Wrangler in 1883, Creak joined the staff of the Newcastle-on-Tyne Grammar School. Reasons of health compelled him to resign this appointment before reaching the age of thirty, and for many years he led an invalid's life near Manchester. His health improved during the last fifteen years, and since 1903 he lived near Llanberis at the foot of Snowdon.

Throughout his life Creak maintained his interest in mathematics. Several workers found in him a most painstaking and willing collaborator. He gave useful assistance to Sir George Greenhill in troublesome algebra which arises in the division of the period in elliptic functions, to Prof. G. H. Bryan in the evaluation of the coefficients in some Fourier expansions, to the late Dr. G. B. Mathews in calculating polynomials which occur in lemniscate-function theory and to the present writer in the complex multiplication of elliptic functions.

The greater part of Creak's mathematical work, however, was done in association with Lt.-Col. Cunningham. He obtained, by direct calculation, the $n$ solutions of the congruence

$$x^n - 1 \equiv 0 \ (\text{mod } p),$$

for a large range of values of $n$ and $p$ ($p$ being a prime number and $n$ a factor of $p-1$). From these tables, some of which are already in print, the prime factors (within the limits of the table) of $a^n - 1$ can be taken by inspection.

Another table, prepared jointly by Lt.-Col. Cunningham and Messrs. H. J. Woodall and T. G. Creak, gives the least *primitive root* of the congruence

$$x^{p-1} - 1 \equiv 0 \pmod{p}$$

for the 2800 odd primes less than 25410. The primitive roots are values of $x$ such that the remainders, when $x, x^2, \ldots x^{p-1}$ are divided by $p$, are all different. When $p = 7$, $x = 2$, the remainders in order are 2, 4, 1, 2, 4, 1, so that 2 is not a primitive root of $x^6 - 1 \equiv 0 \pmod 7$. But when $x = 3$ they are in order

$$3, \ 2, \ 6, \ 4, \ 5, \ 1,$$

and 3 is the least primitive root for $p = 7$.

Creak was chosen to be secretary of the North Wales Branch of the Association (the first of the local branches) when it was founded in 1907, and retained this office until his death. The members of the branch are scattered over a wide area and much of the success attained in getting them together for the meetings has been due to Creak's energy. On more than one occasion it was the privilege of members to be entertained by his mother, Mrs. Creak, at Llanberis.

With his improved health of late years he made himself thoroughly familiar with the Snowdon district and frequently acted as guide to friends desiring his services. He ascended Snowdon on foot more than 250 times, and was also at home among the Glyders, the Carnedds and other mountains in the range.    W. E. H. BERWICK.

# THE LIBRARY.

THE Library has now been removed to 29 Gordon Square, London, W.C. 1, and Mr. W. E. Paterson has taken over the duties of Honorary Librarian.

The Librarian will gladly receive and acknowledge in the *Gazette* any donation of ancient or modern works on mathematical subjects.

### REGULATIONS FOR THE USE OF THE LIBRARY BY MEMBERS.

1. Any member of the Association is entitled to borrow books from the Library (except those marked in the catalogue with an asterisk).

2. Not more than three volumes at a time may be borrowed, and any book borrowed must be returned within one calendar month.

3. The borrower must pay carriage both ways, and will be held responsible for any loss or damage.

4. Requests for the loan of books, or for permission to consult the books in the shelves, must be made to Mr. G. D. Dunkerley, at 29 Gordon Square, London, W.C. 1.

### SCARCE BACK NUMBERS.

Reserves are kept of A.I.G.T. Reports and Gazettes, and, from time to time, orders come for sets of these. We are now unable to fulfil such orders for want of certain back numbers, which the Librarian will be glad to buy from any member who can spare them, or to exchange other back numbers for them :

Gazette No. 8 (very important).
A.I.G.T. Report No. 11 (very important).
A.I.G.T. Reports, Nos. 10, 12.