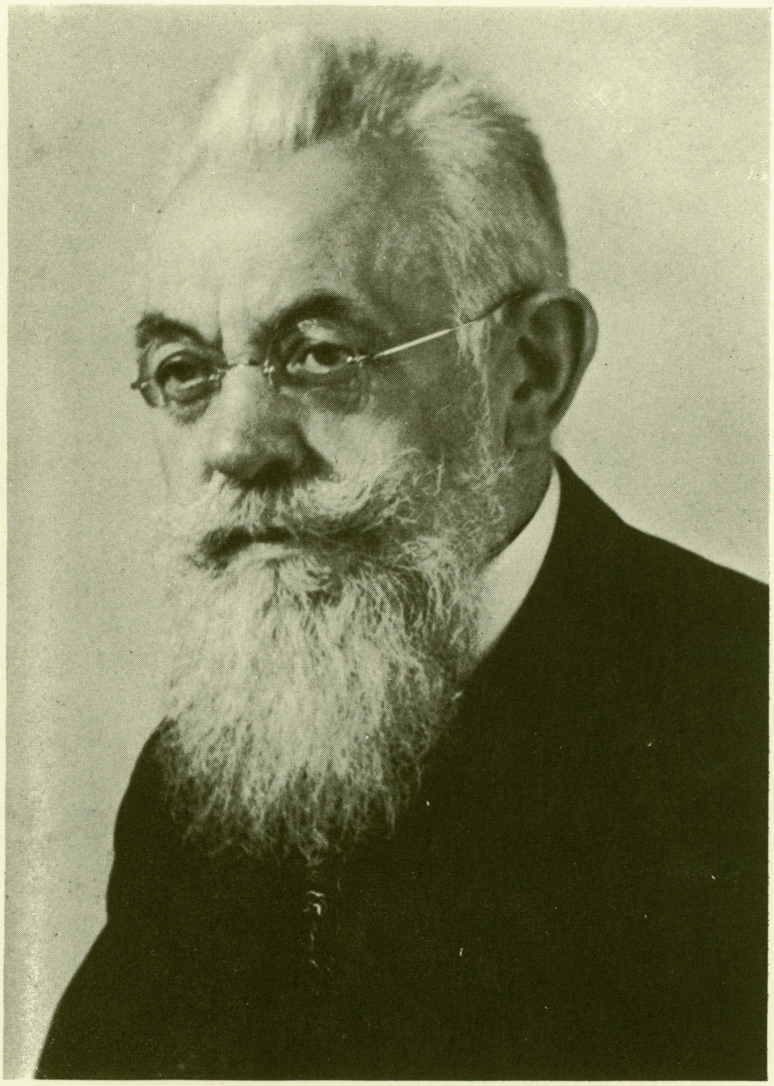

FRITZ EMDE 1938

The BAASMTC now RSMTC

EDITORIAL NOTES:—Dr. MILLER has kindly furnished us with a copy of the final report of the BAASMTC, which has now been replaced by a Mathematical Tables Committee of the Royal Society. He has given us permission to print it almost simultaneously with its appearance in *The Advancement of Science*, the quarterly journal of the BAAS. The long and very interesting report of the late BAASMTC, covering the nine years 1939–1947, was published in this journal, v. 5, Apr. 1948, p. 67–72. From this report we make the following notes:

It is expected that early in 1949 the Committee will publish *Bessel Functions*, Part 2, and at the same time a second edition of Part 1. Part 2, edited by Prof. BICKLEY, will contain 8D or S tables of $J_n(x)$, $Y_n(x)$ or $x^n Y_n(x)$, $e^{-x} I_n(x)$ or $x^{-n} I_n(x)$, $e^x K_n(x)$ or $x^n K_n(x)$, for $n = 2(1)20$ and x not greater than 25 or 20; also 10S tables of $J_n(x)$, $Y_n(x)$, $I_n(x)$, $K_n(x)$ for $n = 0(1)20$, and x not greater than 25.

It is planned that *Bessel Functions*, Part 3, shall include tables of: $(2/\pi)K_n(x)$ and $I_n(x)$ for $n = \frac{1}{2}, \frac{3}{4}$; an extension of MEISSEL'S table $J_n(x)$ for $x = 1(1)24$, and $n = 1(1)N$, where N is such that $J_{N+1}(x)$ is less than half a unit in the 18th decimal, values to 18D; a similar table of $Y_n(x)$ for the same values of x, and for n up to 30 or more. BESSEL function zeros of $J_n(x)$ and $Y_n(x)$ are planned for Part 4.

The Committee has accepted for publication under the CUNNINGHAM bequest (see *MTAC*, v. 3, p. 144) a compilation by Professor NEVILLE of the FAREY series of order 1025; this series has 319765 terms, and is arranged to occupy 420 pages. The series exhibits solutions of the linear Diophantine equation $bx - ay = 1$ for all values of a and b not exceeding 1025, and furnishes the closest rational approximations within the same order to any number, rational or irrational, between 0 and 1. The introduction shows how by a process of local self-packing the series can be used efficiently to solve linear equations with coefficients of any magnitude and to find rational approximations of any order.

* * *

FINAL REPORT of COMMITTEE on Calculation of Mathematical Tables, Summer, 1948. Dr. A. J. THOMPSON, *Chairman;* Dr. J. WISHART, *Vice-Chairman;* Dr. J. C. P. MILLER, *Secretary;* Prof. W. G. BICKLEY, Dr. R. O. CASHEN, Prof. R. A. FISHER, F. R. S., Dr. E. T. GOODWIN, Dr. J. HENDERSON, Dr. J. O. IRWIN, Dr. C. W. JONES, Prof. L. M. MILNE-THOMSON, Prof. E. H. NEVILLE, Mr. D. H. SADLER, Mr. F. SANDON, Mr. W. L. STEVENS, Mr. JOHN TODD, Dr. M. V. WILKES, and Mr. J. R. WOMERSLEY.

During the past two years, negotiations have been in progress for transferring the responsibility for the work undertaken by the Committee from the British Association to the Royal Society. The Royal Society now has set up a Committee on Mathematical Tables, of which Prof. Bickley, Prof. Fisher, Dr. Miller, Prof. Neville, Mr. Sadler, Dr. Thompson, Dr. Wishart and Mr. Womersley are members. This Committee has set up a General Sub-Committee to advise on and carry out the making and publishing of mathematical tables; an invitation to serve on this Sub-Committee has been extended to other members of the B.A. Committee, who are prepared to play an active part in its work.

The assets and liabilities of the B.A. that are associated with the Committee, including the Cunningham Bequest for new tables in the Theory of Numbers, were transferred to the Royal Society on June 30, 1948, and the B.A. Committee held its final meeting on June 23, 1948.

Seven meetings were held in the past year, during which plans were made for continuing the production of tables under the new conditions; the present status of the various projects in hand is given in the list below. Three volumes, I, VI and IX are to be reprinted shortly, while volume X has been passed for press. Volume X, Bessel Functions, Part II, will be the final volume in the series of B.A. Mathematical Tables.

Of the grant of £150 available this year, £100 has been spent, on Bessel Function checking and calculations, and on the tables of $\tan^{-1} m/n$, etc. The work of volunteers—in

particular of Mr. D. F. FERGUSON, of Mr. C. E. GWYTHER, of Dr. H. GUPTA and of the Mathematics Division of the National Physical Laboratory, through Mr. Womersley and Dr. Goodwin—made it unnecessary to spend the full grant this year.

It seems appropriate to include in this final report a short history of the Committee and of its forerunners, with a list of Chairmen and Secretaries. Following this is a list of publications in book form; mathematical tables given in the Committee's reports are listed in *MTAC*, v. 1, p. 69–75, 1943. The report ends with a list of projects at present in hand; the previous report of the Committee, for the period 1939–47, should be consulted for further details of most of these projects.

SHORT HISTORY OF THE BRITISH ASSOCIATION MATHEMATICAL TABLES COMMITTEE

In 1871, at a meeting of the Association in Edinburgh, a Committee was set up, with A. CAYLEY (served 1871–95) as Chairman (1871–89), J. W. L. GLAISHER (1871–1901) as Secretary (1871–89), and H. J. S. SMITH (1871–83), G. G. STOKES (1871–84), and Sir W. THOMSON, later Lord KELVIN (1871–1901; Chairman, 1897–1901) for its members. The Committee was formed 'for the purpose of reporting on Mathematical Tables, which it may be desirable to compute or reprint.' The first report of the Committee appeared in 1873 where the aims of the Committee were defined more precisely. 'The purposes for which the Committee was appointed were twofold, viz.: (1) to form as complete a catalogue as possible of existing mathematical tables, and (2) to reprint or calculate tables which were necessary for the progress of the mathematical sciences.'

The first task was carried out magnificently in two parts, by Glaisher for general tables in the 1873 report, and by Cayley for tables in the Theory of Numbers in 1875. These reports have only been superseded within the last 10 years and remain bibliographical works of the greatest value.

The second task, the production of new tables, was also commenced immediately and remains in progress. It was at first intended that tables should be published independently of the Annual Reports of the Association, and this was done with Glaisher's table of e^x and e^{-x}, Camb. Phil. Soc., *Trans.*, v. 13, 1883, p. 243–272. The next works prepared and published by the Committee, with JAMES GLAISHER added (served 1877–89), were the *Factor Tables for the Fourth, Fifth and Sixth Millions* (published in 1879, 1880, and 1883), which filled the gap between the tables of BURCKHARDT and of DASE. The publication was financed by grants from the British Association and the Royal Society. The calculations were chiefly the work of James Glaisher, while J. W. L. Glaisher compiled a comparison of the numbers of primes actually counted in various ranges with the numbers given by three different formulae. The Introduction to the *Sixth Million* contains many similar enumerations of great interest. D. N. LEHMER in his *Factor Table for the First Ten Millions*, says of James Glaisher: 'The character of his work should be a matter of the deepest satisfaction to every member of that Association. The sixth million, in particular, is the most remarkable table of the sort ever published. It contains only one slight error in the computation and two insignificant typographical errors!'

In the B. A. Annual Report for 1879 a table of LEGENDRE Polynomials was given, the first of many various functions that appeared in these Reports up to 1929.

Other tables initiated during the period 1871–88 by J. W. L. Glaisher, were a Table of Powers of Integers, Tables in the Theory of Numbers connected with the Divisors of a Number, and Tables of the Elliptic Theta Functions [see *MTAC*, v. 3, p. 92, 245]. All three reached the stage of printer's proofs, and much mystery is attached to the reasons for not completing the publication at this time. Proof copies of the first two tables were found, and publication, with additions, has recently (1940) been completed in Volumes IX and VIII respectively of the *B.A. Mathematical Tables*. No proof copy of the Elliptic Function tables has come to light and it now seems unlikely that Glaisher's tables will ever be published, since they are not in a form that now seems appropriate and have largely been superseded by the *Smithsonian Elliptic Functions Tables*, by G. W. and R. M. SPENCELEY [see *MTAC*, v. 3, p. 89f].

In 1888 a fresh Committee was set up with Lord RAYLEIGH as Chairman (1888–97) and A. LODGE (served 1888–1937) as Secretary (1888–96), other new members being A. G. GREENHILL (1888–1901, 1910–21), W. M. HICKS (1888–1901), and B. PRICE (1888–99). The terms of reference were to consider 'The possibility of Calculating Tables of Certain Mathematical Functions, and, if necessary, of taking steps to carry out the calculations, and to publish the results in an accessible form.' This, broadly, has been the task of the Committee ever since, apart from a period of inactivity from 1901 to 1906. At first the attention of the Committee was directed to the tabulation of Bessel functions, and tables of $I_n(x)$ were given in the report of 1889, $I_1(x)$ in 1893 and $I_0(x)$ in 1896. These were the first of a long series of tables of Bessel functions, culminating in *B.A. Mathematical Tables*, volume VI, Bessel Functions, Part I, published in 1937, and volume X, Bessel Functions, Part II, now in the press, which will terminate the series of *B.A. Mathematical Tables*.

Once again, in 1896, with A. J. C. CUNNINGHAM (served 1895–1901) as Secretary (1896–1901), and with P. A. MACMAHON (1895–1901) added to the Committee's membership, attention was drawn to a table in the Theory of Numbers, and in 1900 the *Binary Canon*, a new *Canon Arithmeticus*, by A. J. C. Cunningham, was published.

Two other Committees, existing at the same time as the major Committee, may also be considered in some respects as forerunners of the Committee now reporting. When the new Committee was set up in 1888, the old one continued for one year and was then reconstituted for the period (1889–93) with A. Cayley as Chairman, A. Lodge as Secretary, and J. J. SYLVESTER and A. R. FORSYTH as members. Its purpose was to carry on 'the Tables connected with the Pellian Equation from the point where the work was left by DEGEN in 1817'; the resulting tables appeared in the Report for 1893. The other Committee (1894–99) was set up 'To co-operate with Prof. KARL PEARSON in the Calculation of Certain Integrals.' It had Rev. R. HARLEY as Chairman, A. R. Forsyth as Secretary, and J. W. L. Glaisher, A. Lodge and K. Pearson as members. Tables connected with the $G(r, \nu)$ or Pearson Integrals, computed under the supervision of this Committee, appeared in 1896 and 1899.

After a lull in activity, the Committee was again set up in 1906, with M. J. M. HILL as Chairman (1906–19), L. N. G. FILON (1906–29) as Secretary (1906–10), and A. Lodge as the only member, and the sole link, at that time, with the old Committees. Its purpose was 'The further tabulation of Bessel Functions'; this was altered in 1913 to the 'Calculation of Mathematical Tables,' which has remained the purpose of the Committee since then without a break. A report, dealing with the asymptotic series for $J_n(x)$ and including short tables, was given in 1907. In 1909, the Committee, with the addition of J. W. NICHOLSON (served 1908–31, Secretary 1910–20, Chairman 1920–31) made a second report, and stated that 'they are also considering the advisability of collecting all existing tables of Bessel Functions and publishing them as a single set of tables in a form easily accessible to all students,' and the following year it was reported that a list of Bessel functions tables had been completed. In 1911 the report dealt with the further tabulation of Bessel and other functions; A. G. Greenhill, who had rejoined the Committee, also brought forward a scheme for the rearrangement of tables of elliptic functions. In the same report tables of $G_n(x)$ and $Y_n(x)$ by J. R. AIREY (1911–37, Secretary 1920–29) were published. During the next few years tables of Bessel functions of various types, and of elliptic functions occupied the attention of the Committee. By 1915 the Committee had become much larger with the addition of A. G. WEBSTER (1912–25), E. W. HOBSON (1913–29), A. E. H. LOVE (1913–31), H. M. MACDONALD (1913–30), T. W. CHAUNDY (1914–28), A. T. DOODSON (1915–17 and 1925–31), and H. G. SAVIDGE (1915–16); several of the new members had made contributions to the tables of Bessel functions. In the report of this year it was stated, 'the order of calculation is being arranged in accordance with the real urgency of the tables, and the stage is now coming in sight at which the Committee will be able, as authorised already by the Association, to publish a volume of fairly complete tables of the more important transcendental functions.'

In 1916 G. KENNEDY (1916–25) and G. B. MATHEWS (1916–22) joined the Committee, and the report contained tables of sines and cosines of angles in radians (J. R. Airey),

logarithmic Gamma function and derivative (G. N. WATSON, served 1916–25), Bessel and NEUMANN functions, etc. (J. R. Airey, A. T. Doodson). Elliptic functions were dealt with in the Report of 1919, and a table, by R. L. HIPPISLEY (1919–23), was given. In 1920 Nicholson became Chairman and Airey Secretary. During the period to 1929 the reports contained tables connected with Bessel functions, LOMMEL-WEBER functions, confluent hypergeometric functions, FRESNEL's integrals, hyperbolic sines and cosines, exponential, sine and cosine integrals. During this period, new members of the Committee were R. A. Fisher (1925–48), J. Henderson (1927–48), Miss D. M. WRINCH (1923–29).

From 1928–31 the Committee was reorganised, E. H. Neville (served 1929–48) becoming Chairman (1931–47), and L. J. COMRIE (served 1928–37) becoming Secretary (1929–37). Other new members were J. O. IRWIN (1928–48), A. J. Thompson (1928–48), J. F. TOCHER (1928–45), T. WHITWELL (1928–31), J. Wishart (1928–48, Secretary, 1937–46), E. S. PEARSON (1930–33) and FRANK ROBBINS (1930–45). In 1928 the decision was made to discontinue the publication of tables in the B.A. Annual Reports, and to give in book form a number of the tables that had appeared in the reports; gaps were to be filled by new calculations, while provision was to be made for interpolation. The first result of this policy was volume I in the series of Mathematical Tables, which appeared in 1931. It was edited by J. Henderson and includes circular and hyperbolic functions, with material from the Reports of 1916, 1923, 1924, and 1928 by Doodson and Airey, collated and completed by Comrie; Exponential, Sine, and Cosine Integrals with tables by Airey (from reports of 1927 and 1928) and Fisher, collated by Henderson; Factorial and Polygamma Functions, with tables by Watson (from the 1916 Report), Lodge (1929 Report) and Fisher, collated and completed by Lodge and Wishart; *Hh* functions, or integrals and derivatives of the probability integral, with tables by Airey from the 1928 Report, slightly extended, collated by Irwin, with an account of properties and applications by Fisher. This initiated the period of greatest activity in the Committee's history. The Committee has always owed a great deal to its secretaries. The influence of Glaisher and of Airey, in particular, is well exhibited in the progress of the Committee during their periods of office, while Comrie, by the successful application of commercial machines to the construction of mathematical tables, combined with drive and opportunity to push projects to completion, contributed largely to the rapidity with which the Committee's volumes were produced from 1931 onwards. This together with particular attention on the part of the Committee to the special typographical problems connected with the printing of numerical tables, and with the emphasis on the needs of the user who may be consulting such tables continuously for long periods, has resulted in standards of accuracy and presentation that have not been surpassed and rarely equalled.

Volume II, EMDEN Functions, was prepared by D. H. Sadler (served 1932–48), who edited it, and J. C. P. Miller (1933–48, Secretary 1946–48), at the suggestion of Sir ARTHUR EDDINGTON, and financed jointly by the British Association and the International Astronomical Union. Comrie and Airey were responsible for planning the initial stages of the project, and for devising methods of computation. The resulting volume was published in 1932.

Lt.-Col. A. J. C. Cunningham, who died in 1928, left to Section A of the British Association a legacy for producing new tables in the Theory of Numbers. The duty of making use of this bequest was entrusted to the Committee in 1929, and five volumes coming within its terms have so far been produced. Volume III, published in 1933, gives a table of Minimum Decompositions into Fifth Powers, computed by L. E. DICKSON and accepted for publication by the Committee; this is the only volume not produced by printing from type—it was in fact reproduced by photography from typescript—and the results have discouraged a repetition of the experiment, and have reinforced the firm opinion of the Committee that first-class results can be obtained only by printing from type. Volume IV, published in 1934, gives Cycles of Reduced Ideals in Quadratic Fields; this was suggested by W. E. H. BERWICK and computed for the Committee by E. L. INCE (served 1932–41). Volume V, published in 1935, is a Factor Table, prepared independently in triplicate by J. PETERS, by A. Lodge

and Miss E. J. TERNOUTH, and by Mrs. E. GIFFORD; the part played by Comrie in collating the three calculations, and in supervising the reading of proofs and the comparisons with published tables was considerable. All three volumes contain the results of new calculations.

The Cunningham Bequest also financed the publication of Volumes VIII, Number-Divisor Tables, and IX, Table of Powers, both of which originate, as remarked above, in tables computed under the direction of J. W. L. Glaisher on behalf of the first Committee about 70 years ago. With proof copies as basis, the tables were checked and extended—volume VIII, by Prof. D. H. LEHMER (who attended meetings of the Committee by invitation in 1939) and J. Wishart (Editor), and volume IX by W. G. Bickley, C. E. Gwyther, J. C. P. Miller (Editor), and Miss E. J. Ternouth. Both volumes were published in 1940.

The production of these volumes has not exhausted the bequest, and further projects connected with the Theory of Numbers have been described in the Committee's previous report. It is intended that these should be completed within the next few years.

In 1929, the decision was taken to separate consideration of Bessel functions from that of other functions, and Bessel functions were made the special business of a sub-committee, whose reports and recommendations have formed the basis of the Committee's subsequent discussions and decisions. The original members of the Sub-Committee were J. Henderson and J. O. Irwin; later members were J. C. P. Miller, D. H. Sadler, A. J. Thompson and W. G. Bickley (served 1934–48), Henderson being Chairman. L. J. Comrie, while Secretary of the main Committee, kept in closest touch with the Sub-Committee and attended many of its meetings. In 1937, volume VI was published; this is Bessel Functions, Part I, (Functions of Order Zero and Unity), and, although consisting largely of new calculations, is a result of the continued interest of the Committee since 1888 in Bessel functions. The volume was dedicated to Prof. Alfred Lodge, secretary of the 1888 Committee, whose record of continuous service is unequalled; Lodge died just before publication, in ignorance of this token of the Committee's appreciation of his work.

The actual preparation of the tables was supervised by Comrie, who also provided an account of the various operations performed and of the final checking of the tables.

Further work on Bessel functions has been subdivided, and the preparation of Part II, (Functions of Integer Order), to form volume X (and last) of the B.A. Series, has progressed steadily, although much delayed by the war; the calculations have been performed under the supervision of Bickley, Comrie, Miller, Sadler and Thompson. The Bessel Functions Sub-Committee was reappointed this year with W. G. Bickley as Chairman, E. T. Goodwin (who joined the Committee in 1947) as Secretary, and C. W. Jones (who also joined in 1947), J. C. P. Miller, D. H. Sadler and A. J. Thompson as members. It is hoped that this sub-committee will be able to carry forward its plans for further tables of Bessel functions under the Royal Society Committee.

Volume VII, *The Probability Integral*, by W. F. SHEPPARD, was published in 1939 as a memorial to Sheppard. It originated in a plan by Sheppard that was not quite complete at his death. It was edited by J. O. Irwin.

The work of the Committee during the period 1928–41 was much accelerated by the employment of paid computers, at first by Comrie when Secretary; later the Committee as a whole employed a full-time computer, who worked at the Galton Laboratory, by invitation of R. A. Fisher, under the supervision of W. L. Stevens (served 1936–48) and D. H. Sadler. The three full-time computers were Mr. F. CLEAVER, Dr. H. O. HARTLEY and Mrs. R. St. H. TYSSER; Mrs. TYSSER, on resigning the position of computer soon after the outbreak of war, joined the Committee (as Dr. R. O. Cashen (1941–48)). It is hoped that this very successful experiment of employment of a full-time computer may be repeated by the Royal Society Mathematical Tables Committee.

The appearance of volumes VIII and IX in 1940 was followed by a war-time lull, during which progress was slow, but not negligible. In 1946, a second edition of volume I appeared, and also two 'Part Volumes': A, giving Legendre Polynomials, computed by L. J. Comrie, and edited by A. J. Thompson, and B, giving Tables of the Airy Integral, by J. C. P. Miller, prepared at the suggestion of H. JEFFREYS, the work being initiated by L. J. Comrie.

During the period from 1937 onwards, other new members of the Committee were F. Sandon (1938–48), M. V. Wilkes (1938–48), L. M. Milne-Thomson (1939–48), John Todd (1944–48), J. R. Womersley (1944–48).

During the last two years the Committee has been developing the plans outlined in the previous report (for 1939–47) and adding to the list. This report ends with a list of projects in hand and proposed for future work, with an indication of their present status.

The Committee has worked to produce a series of fundamental tables of high accuracy, taking account of practical needs when these were clear, but largely following the inclinations and enthusiasms of its individual members. Its concern has been as much with the technique of table-making as with the results obtained, and it has felt that it was performing a useful function in developing methods and setting standards. If five of the volumes published since 1931 are connected with the Theory of Numbers, this is because the Cunningham Bequest made them possible; examination of the list of projects in hand will show that the Committee's interests have been wide and that the tables ultimately to be published will combine with earlier ones to form a well-balanced set.

In preparing tables for publication and in seeing them through the press, the main aims of the Committee may be summarised as follows: complete accuracy within stated limits (e.g. within 0.52 of the last digit given), full provision for interpolation wherever feasible and relevant, and the highest standards of typography and arrangement. These have been the occasion of numerous and lengthy discussions in Committee, and the standards attained have not been surpassed. New devices of great power for interpolation have been introduced—in particular, modified differences in volume I, with extended use in Part-Volume B.

Chairmen	*Secretaries*
A. Cayley, 1871–1889.	I. W. L. Glaisher, 1871–1889.
Lord Rayleigh, 1888–1897.	A. Lodge, 1888–1896.
[1] A. Cayley, 1889–1893.	[1] A. Lodge, 1889–1893.
[2] Rev. R. Harley, 1894–1899.	[2] A. R. Forsyth, 1894–1899.
Lord Kelvin, 1897–1901.	A. J. C. Cunningham, 1896–1901.
M. J. M. Hill, 1906–1919.	L. N. G. Filon, 1906–1910.
J. W. Nicholson, 1920–1931.	J. W. Nicholson, 1910–1920.
E. H. Neville, 1931–1947.	J. R. Airey, 1920–1929.
A. J. Thompson, 1947–1948.	L. J. Comrie, 1929–1937.
	J. Wishart, 1937–1946.
	J. C. P. Miller, 1946–1948.
[1] Pellian Equation Committee.	[2] Pearson Integrals Committee.

B. A. Mathematical Tables Committee

Separate Publications

Factor Table for the Fourth Million. By James Glaisher. 1879, 52, [112] p.
Factor Table for the Fifth Million. By James Glaisher. 1880, 12, [112] p.
Factor Table for the Sixth Million. By James Glaisher. 1883, 106, [112] p.
A Binary Canon. By A. J. C. Cunningham. 1900, viii, 172 p.

B. A. Mathematical Tables

V. I. *Circular and Hyperbolic Functions, Exponential, Sine and Cosine Integrals, Factorial (Gamma) and Derived Functions, Integrals of Probability Integral.* London, B. A. Office, 1931, xxvi, 72 p.

V. I. *Circular and Hyperbolic Functions, Exponential, Sine and Cosine Integrals, Factorial Function and Allied Functions, Hermitian Probability Functions.* Second ed. Cambridge University Press, 1946, xii, 72 p.

V. II. *Emden Functions.* By D. H. Sadler and J. C. P. Miller. London, B. A. Office, 1932, viii, 34 p.

V. III. *Minimum Decompositions into Fifth Powers.* By L. E. Dickson. London, B. A. Office, 1933, vi, 370 p.

V. IV. *Cycles of Reduced Ideals in Quadratic Fields.* By E. L. Ince. London, B. A. Office, 1934, xvi, 80 p.

V. V. *Factor Table, giving the Complete Decomposition of all numbers less than 100,000.* By J. Peters, A. Lodge and E. J. Ternouth, E. Gifford; collated and edited by L. J. Comrie. London, B. A. Office, 1935, xvi, 292 p.

V. VI. *Bessel Functions, Pt. I, Functions of Orders Zero and Unity.* Edited by J. Henderson, tables compiled and described by L. J. Comrie. Cambridge University Press, 1937, xx, 288 p.

V. VII. *The Probability Integral.* By W. F. Sheppard. Edited by J. O. Irwin. Cambridge University Press, 1939, xii, 34 p.

V. VIII. *Number-Divisor Tables.* By J. W. L. Glaisher. Completed by D. H. Lehmer and J. Wishart (Editor). Cambridge University Press, 1940, x, 100 p.

V. IX. *Table of Powers,* giving Integral Powers of Integers. By J. W. L. Glaisher, W. G. Bickley, C. E. Gwyther, J. C. P. Miller (Editor), E. J. Ternouth. Cambridge University Press, 1940, xii, 132 p.

Pt.-V. A. *Legendre Polynomials.* By L. J. Comrie. Edited by A. J. Thompson. Cambridge University Press, 1946, 42 p.

Pt.-V. B. *The Airy Integral.* By J. C. P. Miller. Cambridge University Press, 1946, 56 p.

Auxiliary Tables (on card), prepared by J. C. P. Miller.

Number 1. Coefficients in the Modified Everett Interpolation Formula, 1946.

Number 2. Table for Interpolation with Reduced Derivatives, 1946.

In the Press

V. X. Bessel Functions, Part II, Functions of Positive Integer Order 2 to 20. By W. G. Bickley (Editor), L. J. Comrie, J. C. P. Miller, D. H. Sadler, A. J. Thompson. About 300 p.

V. I, VI, IX. Further editions or reprints are in process of preparation.

Projects in Hand, for Future Consideration by the Royal Society Mathematical Tables Committee

Most of these projects have already been described fairly fully in the 1939–47 report of the Committee, and will only be noted briefly below. Numbers 1, 3, 5 and 8 are to be published by means of the Cunningham Bequest and are expected to exhaust it.

Tables completely or almost completely planned, and for which considerable work has been done

1. *The Farey Series,* F_{1025}. Compiled and edited by Prof. E. H. Neville. See previous report. Manuscript and preliminaries complete. About 420 p.
2. *Bessel Functions of Orders* $\pm\frac{1}{4}$ and $\pm\frac{3}{4}$. Initiated by Dr. L. J. Comrie, edited by Mr. D. H. Sadler. See previous report. Computations almost completed.
3. *Binomial Coefficients.* The origin of this project is the Table of Binomial Coefficients offered by Mr. W. E. MANSELL and mentioned in the last report. A pagination scheme has been drawn up, and the preparation of new material and of printer's copy is in progress.
4. *Fundamental Tables of Bessel Functions to many decimal places.* This includes the extension of Meissel's table of $J_n(x)$ mentioned in the previous report. Computations by Mr. C. E. Gwyther and Dr. J. C. P. Miller have reached an advanced stage. The N. P. L. Mathematics Division is assisting with final stages in the calculations.

5. *Partition Tables.* By Prof. H. Gupta, with extensions by Mr. C. E. Gwyther and Dr. J. C. P. Miller. See previous report. Prof. Gupta has extended his table for $m \leq 50$ to $n = 400$, and has offered to prepare copy for the printer. A pagination scheme has been prepared.
6. *Cartesian to Polar Conversion Tables.* Supervised by Prof. E. H. Neville. To give, for integral values of x, y, with $y \leq x \leq 105$, values to 12 figures of r with θ in degrees and of $\ln r$ with θ in radians. Values of r not hitherto available are being computed at the Mathematics Division of the N. P. L., and values of θ by Mr. S. JOHNSTON and others; the table incorporates unpublished results by Miss E. J. Ternouth and Mr. S. Johnston.

Tables agreed by the Committee, at least in principle, and for which considerable work has been done

7. *Bessel Function Zeros.* Supervised by Prof. W. G. Bickley, Dr. C. W. Jones and Dr. J. C. P. Miller. See previous report.
8. *Coefficients in Powers of Euler's product.* $F(q) = \prod_{k=1}^{\infty} (1 - q^k)$. See previous report. Computations in progress by Mr. D. F. Ferguson and Dr. J. C. P. Miller. It is also proposed to give coefficients in powers of $F(q)F(q^2)$, of $F(q)F(q^3)$, etc.

Projects on which some work has been done, but which have not reached the stage of formal adoption

9. *Bessel Functions of half-integer order.* Values calculated for I_n and K_n under the supervision of Dr. J. C. P. Miller are offered by Scientific Computing Service. Extension of these tables is in hand under the supervision of Dr. C. W. Jones.
10. *Fundamental Tables for Computers to many figures.* Supervised by Dr. A. J. Thompson. It is proposed to produce a collection giving short tables of functions, mainly elementary, and of constants to a high degree of accuracy. These are intended to meet the occasional needs of computers of mathematical tables who want certain fundamental values to many figures. Members of the Committee have already made contributions; readers who possess suitable material that they are willing to make available are invited to offer them to the Committee.

    Considerable progress has been made with tables of square roots (50 decimals), cube roots (20 decimals), fourth and twelfth roots, by Mr. D. F. Ferguson, Mr. C. E. Gwyther, Mr. S. Johnston and Dr. J. C. P. Miller; with a table of $\log_{10} N$ to 45 decimals and with a table of $\log \Gamma(x)$ to 32 decimals by Dr. A. J. Thompson. A table of $n!$ to $n = 1000$ with 20 figures has also been offered by Mr. S. Johnston.
11. *Confluent Hypergeometric Functions.* Computed by Dr. A. J. Thompson. See previous report.
12. *Struve Functions.* Tables have been prepared by Mr. C. ROBINSON at King's College, London, for an M.Sc. Thesis, under the general supervision of Dr. J. C. P. Miller. These need extension and subtabulation.

Possible Future Projects

13. *Kelvin Functions.* A programme of computation is under consideration by Mr. G. A. GARREAU, Mr. M. BRIDGER and Mr. G. K. VINCENT of Northampton Polytechnic, St. John St., London, E. C. 1.
14. *Integrals of Bessel Functions.* The computation of a number of these is under consideration by Dr. E. T. Goodwin.
15. *Inverse Tangents.* A large number of inverse tangents in radians, have been computed, some in the preparation of the Cartesian to Polar Conversion Table (no. 6) and some for other purposes. The publication of a systematic collection of these tables, as a supplement to no. 6 or otherwise, is under consideration.