The complete record, of discoveries, with approximate dates, is as follows:

Pythagoras	1 (540 B.C.)	L. E. Dickson	2 (1911)
Fermat	1 (1636)	T. E. Mason[1]	14 (1921)
Descartes	1 (1638)	P. Poulet[2]	68 (1929)
Euler	59 (1747–50)	A. Gérardin[3]	5 (1929?)
Legendre	1 (1830)	E. B. Escott[4]	235 (1934)
B. N. I. Paganini	1 (1867)	B. H. Brown[5]	1 (1939)
P. Seelhoff	2 (1884)	Total (May 1943)	391

E. B. Escott,
1019 South East Ave., Oak Park, Ill.

[1] T. E. Mason, "On amicable numbers and their generalizations," *Amer. Math. Mo.*, v. 28, 1921, p. 195–200.

[2] P. Poulet, *La Chasse aux Nombres. Fascicule I. Parfait, Amiables et Extensions*, Brussels, 1929, p. 28–51. The 156 pairs of amicable numbers, known at this time, are here classified, and include the 68 new pairs found by Poulet.

[3] All of these pairs are in Poulet's list of 1929. It is possible that their discovery was announced earlier in Gérardin's periodical *Sphinx Oedipe.*

[4] P. Poulet, "De nouveaux amiables," *Sphinx*, v. 4, 1934, p. 134–135, Poulet here states that Mr. Escott had sent him 322 pairs of amicable numbers; he prints 21 pairs discovered by Mr. Escott, and all but one of the 42 numbers are less than 10^9. The other 214 pairs have not yet been published.

[5] B. H. Brown, "A new pair of amicable numbers," *Amer. Math. Mo.* v. 46, 1939, p. 345.

MECHANICAL AIDS TO COMPUTATION

5[X].—R. E. Beard, "The construction of a small-scale differential analyser and its application to the calculation of actuarial functions," Institute of Actuaries, *Jn.*, v. 71, 1942, p. 193–227 + 3 plates.

The author adopts the principles of the differential analyzer as conceived by Kelvin, Bush, and Hartree to construct another small-scale machine for experimental work in finding solutions of differential equations that arise in actuarial science. The article contains a description of its mechanical principles, operation, and application to actuarial functions. At the end is a detailed 16-page abstract of the discussion following the presentation of the author's paper.

The most important unit in the machine is the integrator where $(1/a)\int y\,dx$ is obtained from two mutually perpendicular wheels which touch each other. When the first wheel turns through angle dx, the rim of the second wheel (of radius a) at variable distance y from the center of the first wheel, will turn through distance ydx, corresponding to the angle ydx/a. Use is made of a torque amplifier to increase the friction; this is necessary for proper operation. Adequate description of the adding units, input and output tables and counting devices precedes the discussion of the operation of the machine.

The first stage in the operation consists of the drawing of a diagram showing the required units properly connected. Vannevar Bush's notation is followed. The reader can learn at a glance the notation for the integrator, input and output table, adding unit and right- or left-hand gears, after which he can understand all the diagrams. Initially the author gives a clear description of the set-up for simple integration and its application to the "circle test" of the machine, i.e., the integration of $y'' = -(1/k^2)y$. Finally a description of an elegant device to obtain the integral of a product without getting the product itself, completes the general introduction to the use of the analyzer.

The calculation of interest functions v^n and $(1+i)^n$ is reduced to $e^{-n\delta}$ and $e^{n\delta}$ or an equation of the form $dy = \frac{y}{C}dt$. One immediately obtains $\int f(t)v^t dt$ by integration of a product. For $f(t) = 1$, we get $\bar{a}_{\overline{t|}}$. For mortality calculations the machine solves $\frac{d}{dt}\,{}_tp_x = -\,{}_tp_x\mu_{x+t}$, where ${}_tp_x$ is the probability of survival. A detailed discussion of joint-life functions and whole-life annuities is attended in the latter case with the operation procedure for $\frac{d\bar{a}_{x+t}}{dt} = (\mu_{x+t} + \delta)\bar{a}_{x+t} - 1$. Two methods are mentioned for contingent functions, one of which employs integration of a product and the other of which calculates $|_t\bar{A}'_{xy}$ directly. (The diagram for the latter method contains 10 units). Computation of policy values leads to the solution of

$$-\frac{d}{dt}\,{}_t\bar{V}_x = (\mu_{x+t} + \delta)(1 - {}_t\bar{V}_x) - \frac{1}{\bar{a}_x}$$

which is easily explained by a diagram of 4 units. For some of the simpler of these functions, comparison of the true values with the machine values shows that this analyzer is capable of accuracy to within several units in the third significant figure. In concluding, the author mentions possible extensions in the applications of the machine. He also emphasizes its advantages in that it calculates actuarial functions directly from the "observed functions" μ_x. At the end is a "refutation" of the three main objections to the use of his machine: length of time required, insufficient accuracy, and inconvenient form of μ_x. A few references are cited.

The ensuing discussion contains interesting historical information on similar differential analyzers. The members present furnished elaborate criticisms of the use and limitations of this machine. Most of these comments should be of particular interest to actuaries and also of general interest to anybody concerned with applications of this type of differential analyzer.

H. E. SALZER

NOTES

8. HENRY BRIGGS AND HIS DATES.—We have already referred to this great table-maker, and one of his works (p. 10, 13, 26, 33, 44). Even in the case of first-class authorities there is divergence of statement with regard to the years of his birth and death. D. E. Smith (*History of Mathematics*, v. 1, 1923) gives them correctly, as born February 1560–61 (1561 N. S.), died 26 January 1630/31 (1631, N. S.); the dates are also correctly given by W. W. R. Ball (*Short Account of the History of Mathematics*, 1912). Yet the *Dict. of Nat. Biography* (1886), and its concise one volume edition (1930), give his dates as 1561–1630. From the thirteenth century to 1753, in England and Ireland, the year began on March 25. Hence O. S. the dates of Briggs are 1560–1630, but N. S. 1561–1631. The account of Briggs in J. Ward, *The Lives of the Professors of Gresham College*, London, 1740, makes clear why this work, and such authorities as the following, give the year of Briggs's birth as 1556: J. C. Poggendorff, *Biographisch-Literarisches Handwörterbuch;* M. Cantor, *Vorlesungen über Geschichte d. Math.* v. 2; H. T. Davis, *Tables of the Higher Mathematical Functions*, v. 1, 1933, p. 32; F. Cajori, *A History of Mathematics;* J. Tropfke, *Geschichte der Elementar-Mathematik*, v. 1, 3rd ed., Berlin, 1930, p. 58; *Encyclopædia Britannica* (11th ed. 1910, 14th ed. 1929 and 1936). *DNB* (1886) first produced the authority for 1561.

Briggs was the author of tables for the improvement of navigation, published in the second edition (1610) of Edward Wright's *Certain Errors in Navigation detected and corrected.* Briggs's edition of six books of Euclid's Elements was published anonymously in 1620. His *Logarithmorum Chilias Prima*, "printed for the sake of his friends and hearers at Gresham College" (16 p., 1617) contained log N for N = [1(1)1000; 14D],—the first table of logarithms to the base 10 ever computed or published. But Briggs, Napier,