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, and Kepler did not have our concept of logarithms as powers of a base. In 1624 appeared the great work containing $\log N$ for $N = [1(1)20\,000$ and $90\,000(1)\,101\,000$; 14D]; only some copies of these tables have the Chiliad for $N > 100\,000$. His remarkable Canon of Sines, and other material (published posthumously, 1633) has been already described. Note *MTAC*, p. 100.

R. C. A.

9. Cayley and Tabulation.—Except for a brief first paragraph which has nothing to do with the sequel, the following is a letter (in my possession) written to J. W. L. Glaisher (1848–1928) by Arthur Cayley (1821–1895):

"Dear Mr. Glaisher,

. . . .

"Apropos of tabulation—in many arithmetical operations you are sure of your last figure—i.e., the result as directly obtained to a given number of figures, say three, is accurate as far as it goes but always in defect e.g., .246. To correct the last figure you have to go *one* figure further; if the next figure is 0, 1, 2, 3 or 4, you leave the last figure unaltered—if it is 5, 6, 7, 8 or 9, you increase it: of course the maximum error is $\pm.0005$.

"Now suppose you were not to correct the last figure at all, but tabulate always in defect—*and in using the tables* supply in every case a last figure 5. e.g. read your tabular number .246 as .2465 the maximum error would be as before $\pm.0005$ you would have saved yourself the calculation of the additional figure (the 4th figure) in making the table.

"To counterbalance this you have to work with 4 instead of 3 figures.

"Which is best? It seems to me the accuracy is *absolutely* the same. In favor of the ordinary plan it may be said, that the table is a thing made once for all and that the labour of the calculation *does not signify*—(a view for me rather than for *you*).

"In favor of the other plan; it would be perhaps hundreds or thousands of years before all the tabular numbers come into use—so that even admitting that in each single case the labour of using the final figure 5 is equal to what would have been the labour of correcting the figure (and it is certainly much less). There would be on the whole (i.e., considering together the labor of computing the table and of using it) a saving of labour.

Believe me, yours very sincerely,

Cambridge, 9th July 1874. A. Cayley"

R. C. A.

QUERY

3. A Shortrede Table.—In *Catalogue of the Library of the Royal Astronomical Society*, London, 1886, is the following entry: "Table of $\log \frac{\text{vers } P}{\sin 1''}$ to every second of time as far as 1^h00^m4to. Poona, 1842." There is no suggestion as to the author of the table. Mrs. Grace O. Savage, librarian of the U. S. Naval Observatory, kindly drew my attention to the fact that in R. Astron. So., *Mo. Notices*, v. 8, 1848, p. 160, there is a reference to a memoir "On a formula for reducing observations in azimuth of circumpolar stars near elongation, to the azimuth at the greatest elongation" by Robert Shortrede (1800–1868), who spent a number of years in India; see also *MTAC*, p. 42. The report concludes with the statement that a table of "$\log \frac{\text{ver. sin}}{\sin 1''}$" [sic] "for all arcs up to 1^h is added to the memoir." This is evidently the Poona table. Where may a copy be seen in America?

R. C. A.