to be of an order of magnitude faster than desk calculators for this type of work. The time required to work Example 1 is given as 44 minutes of which only 2 were spent in adjusting the x's. This compares favorably with the 5-hour estimate given for desk machine work.

In problems where more accuracy is required, as in certain statistical work for example, it is possible to use first the computer and then to improve the solution thus obtained by using a desk calculator. In this way the electrical computer should be quite useful in any one of the host of problems which can be reduced to systems of linear equations.

D. H. L.

27[Z].—G. S. MERRILL, "Slide-disk calculator," *General Electric Rev.*, v. 49, no. 6, June 1946, p. 30–33. 22.3 × 29.5 cm.

This note is a well illustrated description of an ingenious combination of a sliding rule and a rotating disk for the computation of the standard deviation

$$\sigma = [x_1^2 + x_2^2 + \cdots + x_n^2]^{\frac{1}{2}} n^{-\frac{1}{2}}$$

of the set of deviates $x_1, x_2, \cdots, x_n$ from the arithmetic mean of n values. The quantities

$$x_1, (x_1^2 + x_2^2)^{\frac{1}{2}}, (x_1^2 + x_2^2 + x_3^2)^{\frac{1}{2}}, \cdots$$

are built up in succession geometrically by successive applications of the Pythagorean theorem. An alignment chart is then used to multiply the final square root by $n^{-\frac{1}{2}}$. The sliding rule permits one to set the device with the origin at the arithmetic mean of the values concerned so that one need not really calculate the deviates themselves. No statement is made as to the accuracy obtainable. This depends somewhat on the order in which the n values are introduced. In general the accuracy should be comparable with that obtained from an ordinary slide rule. Even a much cruder device would be useful for class room demonstration purposes.

D. H. L.

NOTES

63. EARLY TABLES OF FACTORIALS.—While tables of $N!$, by various authors, 1926 to 1936, $N = 20$ to 30, are reported in FMR, *Index*, p. 34, the following three very much earlier appearances of such tables may be recorded:

(a) G. G. LEIBNIZ, *Dissertatio de Arte Combinatoria*. Leipzig, 1666, p. 57. Table of $N!$ for $N = 1(1)24$ (erratum $N = 15$, *for* 1307*8*74368000, *read* 1307*6*74368000). Also, with the same erratum, in *Leibnizens mathematische Schriften*, ed. by C. I. GERHARDT, part 2, v. 1, Halle, 1858, p. 61.

(b) JOHN WALLIS, *A Treatise of Algebra*. . . . London, 1685, Part IV, p. 116. Table, without error, up to $N = 24$.

(c) JAMES DODSON, *The Calculator: being, correct and necessary Tables for Computation. Adapted to Science, Business and Pleasure*. London, 1747. P. 44, Table XXIII, up to $N = 30$.

S. A. J.

64. ERRATUM:—May I call attention to a rather amusing type of error made by J. R. WOMERSLEY in his article "Scientific computing in Great Britain," *MTAC*, v. 2, p. 114? In illustrating the very great power of the h^2-process in deferred approach to the limit, he states that its application to the determination of π from the perimeters of the inscribed square and

hexagon leads to the value of 3.18 "which is astonishingly accurate when we consider the crudeness of the two original approximations, namely 2.83 and 3.00."

As a matter of fact, its application does not give 3.18 but 3.14, which is even more remarkable! For if we assume that the error is inversely proportional to the square of the number of sides (a) $\pi - 2.83 = \frac{1}{16}K$, (b) $\pi - 3.00 = \frac{1}{36}K$. Elimination of K leads to (b) $9\pi/4 - 3.00 \times 9/4 = K/16$. Thus with (a), $\pi - 2.83 = 9\pi/4 - 6.75$, or $5\pi/4 = 3.92$, $\pi = 3.136$ or 3.14.

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NBSMTP

65. *Guide* (*MTAC*, No. 7), SUPPL. 5 (for Suppl. 1–4, see v. 1, p. 403, v. 2, p. 59, 92, 190f).—J. B. ROSENBACH, E. A. WHITMAN & D. MOSKOVITZ, *Mathematical Tables*, 1937 (see RMT **355**) contains the following three tables involving $J_n(x)$:

T. XXXIX (p. 202), $J_n(x)$, $n = 0, 1$, $x = [0(.1)15; 4D]$;
T. XL (p. 203), $J_n(x)$, $n = 2(1)10$, $x = [1(1)24; 4D]$;
T. XLI (p. 203), zeros of $J_n(x)$, $j_{n,s}$, for $n = 0(1)5$, $s = [1(1)9; 3D]$.

These tables were compared with the corresponding tables of E. JAHNKE & F. EMDE, *Tables of Functions*. New York, 1943. The entries of T. XXXIX agree completely with those of J. & E., p. 156–163. In T. XL there is agreement with J. & E., p. 171–177, except for two entries: R. W. & M. shows $J_9(3) = 0.0000$, while J. & E. shows $J_9(3) = 0.00008440$; R. W. & M. has the corrected value (-0.0318, see *MTAC*, v. 1, p. 109) of $J_9(21)$. Since T. XLI agrees completely with J. & E., p. 168, there are 27 errors in each of the tables (*MTAC*, v. 1, p. 160, 282, 396, 398). These 27 errors are corrected in the 1945 edition of J. & E.

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EDITORIAL NOTE: In the second edition of the R. W. & M. work, 24 of the 27 errors in T. XLI still persist.

66. HUGE NUMBERS.—Testing with Lucasian sequences (see *MTAC*, v. 1, p. 333, 404; v. 2, p. 94) is extremely monotonous because the answer may not be known for months and the calculations have to be absolutely perfect throughout. So, I became rejuvenated by R. C. A.'s stimulating article on "A Huge Number," *N* **54**. The quoted value 4^{4^4}, namely "13407813 followed by 147 other figures" is too large by five units at least in the last place. In the year 1900 while working on π I used $\tan^{-1} \frac{1}{5}$ and prepared a non-consecutive table of powers of 2 which I later found agreed perfectly with the table given in 1853 by SHANKS (see *MTAC*, v. 2, p. 144). Dr. JOHN WRENCH JR., has recently verified my value of 2^{671}. In fact, therefore, $4^{4^4} = 2^{512} = 13407\ 80792\ 99425\ldots$ to 155S.

Now for CHR. WEISS and $N = 9^{(9^9)}$. His approximation of log N, to 74D, is practically perfect, for his last three figures "700" really come from 699.919. . . . A closer approximation, to 250D, is the following:

3696	93099.	63157	03587	43543	09509	54829	29683	40024	68555	47962
40532	88963	42699	97525	70034	06999	19193	67130	50838	43111	13397
79021	94259	06692	14914	74561	62571	46159	47916	86083	85948	43688
35255	18207	03897	27927	06237	04405	18967	44041	41213	73418	07380
80236	22090	62682	55872	72564	31009	18799	97885.			

I prefer, in general, the base e to the base 10, hence I wrote

$\ln N$ = 8512 49820. 19441 64306 91970 00392 68915 27219 20072 90691
44735 83107 43540 06734 37562 69257 39691 92203 38560 80379 50645
35319 56155 21919 86091 20430 32813 69381 92937 99118 55468 39229
06220 99672 39479 89224 30182 40042 11595 68346 79044 49991 39094
45918 12193 88257 46708 62725 85558 73685 88936 17534 93881 48799
09364 92047 61035 24668 01099 15304 50610 94898 31096 87169 73851
16996.

From this value of $\ln N$ to 320D the calculation of N was made according to formulae (3) and (4) of the Introduction to my 137-place table (see *MTAC*, v. 1, p. 20). My result is N = (4.28124 77317 57470 48036 98711 59305 63521 33905 54822 41443 51417 47537 23053 52388 74717 35048 35319 36652 99432 03337 50604 17533 64763 10007 80326 13904 69104 84) $\times\ 10^{369693099}$. The digit in the 137th decimal place, as obtained from my original work-sheets, is actually 3 followed by 9759, hence I have raised it to 4. The first 59 digits of N calculated earlier by Weiss check exactly with the above result.

I have looked up the article by J. W. MEARES in Br. Astr. Assoc., *Jn.*, v. 31, 1921, p. 277–278, relative to $9!^{(9!^{9!})}$. Towards everything in this note I take emphatic exception. $9!$ is no more one digit than $\Gamma(\frac{1}{2})$ is two digits. Worst of all, his boundaries for $9!^{(9!^{9!})}$ are both wrong. I found $\log 9!^{(9!^{9!})} = (3.58448\ 37219\ 01355\ 569\ldots) \times 10^{2017527}$. Since $10 > (3.58448\ldots) > 1$, $\therefore 10^{(10^{2017528})} > 9!^{(9!^{9!})} > 10^{(10^{2017527})}$. Again, since $10^{3.58448\ldots} = 3841.35\ldots$ roughly, $9!^{(9!^{9!})} = (3841.35\ldots)^{(10^{2017527})}$.

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67. REVERSIBLE PRIME-PAIRS.—A reversible prime-pair is a set of two primes such that one is obtained by reversing the digits of the other, e.g. (3583, 3853). A similar reversible pair is of the type (929, 929), in which both numbers are identical, otherwise it is a dissimilar pair. In a table of such pairs given by GOPAL LAL MATHUR, in "Reversible prime-pairs," *Mathematics Student*, v. 13, 1945, p. 48, are given 65 prime-pairs below 5000, from 11 to 3853, 16 similar pairs and 49 dissimilar. This table is reproduced, in effect, in *Scripta Math.*, v. 11, 1945, p. 274.

QUERIES

20. SANG TABLES.—In what American Libraries may the following works of EDWARD SANG (see *MTAC*, v. 1, p. 368–370) be consulted?

(a) *A New Table of Seven-Place Logarithms of all Numbers from 20 000 to 200 000*, second issues improved. Edinburgh 1878, and London 1883. There are copies of the latter in the British Museum and the Bibliothèque Nationale. Where also may the 1915 reprint be found?

(b) *Life Assurance and Annuity Tables*, v. 2, "for every combination of two lives." London, 1859. In the British Museum there is a copy of both volumes of this work, so highly commended by A. DE MORGAN.

R. C. A.