147. M. Kraitchik, *Recherches sur la Théorie des Nombres*, v. 1, Paris, 1924.

On p. 216–265 of this volume there is a table of the indices of the first 25 primes, modulo N, for all primes $N < 10^4$. The following errata were noted by E. Jacobsthal:[1]

p. 256	$N = 8191$	$q =$ 17	29	31	47	53	89
	for	ind $q =$ 716	4129	6704	6589	2527	3918
	read	ind $q =$ 2693	2152	491	376	550	1941
p. 260	$N = 9137$	$q =$ 17	43	59	71	97	
	for	ind $q =$ 3099	2373	8781	427	2454	
	read	ind $q =$ 3098	2372	8780	428	2453	

Another error on p. 256 may be noted, *for* $N = 5387$, *read* 8387.

D. H. L.

[1] E. Jacobsthal, "Correction de quelques erreurs dans la table d'indices de M. Kraitchik," K. Norske Viden. Selskab, *Fordhandlinger*, Trondhjem, v. 19, 1946, p. 1–2.

148. William Oughtred (1574–1660), *Table of Ln x*. 1618.

Napier's *Mirifici Logarithmorum Canonis Descriptio* was published in 1614 and the first edition of the English translation by Edward Wright (1558?–1615) was published by his son Samuel Wright in 1616. In 1618 there appeared a second edition in which the main text was identical with the first, but a new title-page was supplied, and also a remarkable anonymous 16-page appendix by William Oughtred (1574–1660). This Appendix was completely reprinted by J. W. L. Glaisher in his very notable article "The earliest use of the radix method for calculating logarithms, with historical notices relating to the contributions of Oughtred and others to mathematical notation," *Quart. Jn. Math.*, v. 46, April 1915, p. 125–197.

The reprinted Table on p. 142 gives what is equivalent to $10^6 \ln x$, $x = [1(1)10(10)100(100)1000(1000)10000(10000)100000(100000)900000;\ 6D]$. Glaisher pointed out that there was a misprint of 6 for 8 in the third decimal of ln 3, but the third decimal of ln 50 should be 2, not 1 and the first decimal of ln 20000 should be 9, not 8. Apart from these major misprints for the 54 values of x there are 51 last figure errors of from 1 to 6 units: 3 of 6 units; 8 of 5; 8 of 4; 15 of 3; and 9 of 2. There is also a supplementary table giving $\ln x$ for 18 values $x = 1.1(.1)1.9$ and $1.01(.01)1.09$ each to 6D. These are correct except for 10 unit errors in last decimal places.

Such was the extent of the equivalent of the first table of $\ln x$, although there was at that time no thought of exponents or bases as they were later conceived. Those desiring to understand the exact setting of the table in the mathematical thought of the time will naturally turn to Glaisher's study.

R. C. A.

UNPUBLISHED MATHEMATICAL TABLES

75[K].—Univ. of California, Statistical Laboratory, Berkeley, *Tables of the Bivariate Normal Distribution.*

This Laboratory has just completed work on a table of the Bivariate Normal Distribution. The quantity tabled is

$$L(h,k,r) = \frac{1}{2\pi\sqrt{1-r^2}} \int_h^{+\infty} \int_k^{+\infty} \exp\left\{ -\frac{x^2 - 2rxy + y^2}{2(1-r^2)} \right\} dxdy.$$

A table of this kind was originally computed and published by Karl Pearson in the volume he edited, *Tables for Statisticians and Biometricians*, part II. 1931, p. 78–137, lii–lxxix. In this publication the arguments h and k are tabled for 0(.1)2.6. The argument r is for $-1(.05)+1$. Values are given to 6D.

During World War II the values of $L(h,k,r)$ became necessary in connection with certain work in the Statistical Laboratory under a contract with the Applied Mathematics Panel, N.D.R.C. However, for the most part, the values needed corresponded to h, and k exceeding the range of the table then available. Also, the requisite values of r were extremely close to ± 1 in which region interpolation in Pearson's table is difficult.

The persistent need of values of $L(h,k,r)$ suggested that it might be useful to solve the difficulty once and for all by computing an extension of Pearson's tables. Dr. LEO AROIAN and Dr. MADELINE JOHNSEN (then in the employ of the Statistical Laboratory) were entrusted with calculating the extension of the tables. Their work was interrupted by the cessation of hostilities in September, 1945, and the subsequent discontinuance of the N.D.R.C. project. Thereafter the work on the tables continued sporadically. Some computations were done by Drs. Aroian and Johnsen. Later on a check of the tables was made in the Statistical Laboratory by Dr. EVELYN FIX. This was followed by extensive recalculations by Miss MARY WOO and Miss ESTHER SEIDEN under the direction of Dr. Fix. It is now believed that the errors in the table do not exceed one half unit in the sixth decimal. The combination of the two sets of tables, Karl Pearson's and the new tables, covers the ranges of $h,k = 0(.1)4$; $\pm r = 0(.05).95(.01).99$.

It may be hoped that some way will be found for the combined tables to appear in a single publication.

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AUTOMATIC COMPUTING MACHINERY

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TECHNICAL DEVELOPMENTS

Our contribution under this heading, appearing earlier in this issue, is "Coding of a Laplace boundary value problem for the UNIVAC," by FRANCES E. SNYDER & H. M. LIVINGSTON.

DISCUSSIONS

A Comparison of Various Computing Machines Used in the Reduction of Doppler Observations

Introduction. DOVAP (Doppler Velocity and Position) is a radio-DOPPLER method for the determination of the coordinates of the trajectories of long-range V-2 rockets launched at the Army's White Sands Proving Ground, New Mexico. The method has been in use for the past two years. In this system, continuous-wave radio signals are sent from a transmitter to a transceiver in the missile and to each of several ground station receivers. In the missile-transceiver the signals are modified by a frequency-doubling operation and then are retransmitted to each of the several ground stations. In the ground receivers the frequency of the signals received directly from the transmitter is likewise doubled, and these double-frequency signals are mixed with those received from the missile. The mixed signals are recorded on 35 mm movie film simultaneously for the several receivers at one master receiver station.