outward physical circumstances, but also of principles of human nature, even morality and social habits, the progress even of medical science, the laws of inheritance and evolution, and the like. And, consequently, from the nature of the case, whatever partial uniformities of operation we may discover of the force, death, we cannot express the action in a general mathematical formula.

Not merely, therefore, do I believe that no law of mortality has been discovered which is capable of being exhibited in a mathematical shape, but I also think, from the nature of the subject, that it is futile to expect that such a result will ever be obtained.

In modifying series, accordingly, I am content, in our ignorance, whenever I desire to introduce an element into facts which they do not naturally present, to adopt some distributive process, like the excellent formula of Mr Woolhouse (which is *not* the mathematical expression of an assumed mortality law), or the old method of differences. To employ either of the formulas I have referred to, on the ground of being a representation of a law of mortality, which the facts, when altered, are then imagined to reveal, would be, I consider, to assume a non-existent rule, and to make an unjustified interpretation.

It is, I admit, difficult at first to accept this view; for all our terms connected with the alteration of mortality tables involve the preconceived notion that a law exists, and is known: and the association of ideas is consequently strong. For example, the word "adjustment", from its derivation, carries with it the assumption that adjusting a series of numbers is really fitting them into accordance with a law; and the term "graduation", too,—meaning a progression by regular degrees,—involves again the affirmation of a standard or law.

Yours faithfully,

Commercial Union Assurance Co.,
Cornhill, London, E.C.
Dec. 1879.

T. E. YOUNG.

DEATH RATES AMONG INFANTS IN SCOTLAND.

To the Editor of the Journal of the Institute of Actuaries.

DEAR SIR,—I have been much interested by Professor Pell's communication in the *Journal of the Institute of Actuaries* for January 1879, on "The Rates of Mortality in New South Wales", and more especially by the very clear account which he gives at pages 262-5 of the method which he prefers for deducing, by means of registered births and deaths, and without reference to the notoriously incorrect enumerations of persons of each age furnished by census, the probabilities of living for a year at each of the ages 0, 1, 2, 3, and 4.

The births and deaths that take place in Scotland are as perfectly registered as those of any country; and I have accordingly thought it worth while to prepare the accompanying tables, by means of which the numbers and probabilities furnished by recent experience in this country during a series of years may be compared with the similar details for New South Wales which Professor Pell has given.

My tables D and E are strictly in the form of those at pages 263-4 of his paper; and, in the calculation of the values of q_x, are treated without adjustment, and exactly according to my understanding of his original formulas.

It is perhaps doubtful whether the annual number of deaths *at unspecified ages* is in New South Wales so considerable as to justify any addition to the deaths recorded for each of the first five years of life. And positive assurance is lacking that any such number of births escape registration in the colony as would render an addition to the annual official statement of births desirable. It may, however, be gathered from Professor Pell's paper that he deems no adjustment of his Tables D and E either necessary or practicable; and, most certainly, to make any such adjustments on the Scottish Tables would involve an illusory show of accuracy, and be an abuse of arithmetic.

The record of births in the Scottish Table D is, I believe, as accurate as a good Registration Act can make it. In the Scottish Table E there will be found, both in its Male and in its Female portion, additional columns, showing how many deaths *at unspecified ages* occurred in all Scotland during each of sixteen years. Hence sticklers for accuracy have it in their power to repeat my calculation, after distributing among the first five years of life such rateable proportion of the deaths occurring at unspecified ages as they may think proper.

I have only to add that, although the values attributed to q_x and to p_x are, in *my* statement, carried to seven decimal places, I am perfectly aware that *five* places would have been amply sufficient, and that the only purpose really served by the higher decimal places is to attest the honesty of the arithmetical work.

When working with the aid of the Arithmometer it is sometimes easier to retain than to discard superfluous figures. I make no pretension to extreme accuracy in stating the values of q_x and p_x.

Yours very truly,

WILLIAM ROBERTSON, M.D.

28 *Albany St., Edinburgh,*
December 1879.

TABLE D.—*Births registered in Scotland during* 15 *years*, 1859-73.

Years.		Males.	Females.	Years.	
1	1859	54,628	51,915	1859	1
2	1860	54,409	51,220	1860	2
3	1861	54,606	52,403	1861	3
4	1862	55,257	51,812	1862	4
5	1863	56,226	53,115	1863	5
6	1864	57,374	54,959	1864	6
7	1865	58,220	54,850	1865	7
8	1866	58,360	55,307	1866	8
9	1867	58,517	55,527	1867	9
10	1868	59,222	56,292	1868	10
11	1869	58,321	55,033	1869	11
12	1870	58,959	56,431	1870	12
13	1871	60,029	56,099	1871	13
14	1872	61,293	57,472	1872	14
15	1873	61,467	58,233	1873	15

TABLE E.—*Deaths under Five Years of Age registered in Scotland during* 16 *Years, namely*, 1859-74.

MALES.								FEMALES.							
Years.		0–1	1–2	2–3	3–4	4–5	Additional at Unspecified Ages.	0–1	1–2	2–3	3–4	4–5	Additional at Unspecified Ages.	Years.	
1	1859	6,461	2,843	1,508	976	700	84	5,062	2,714	1,503	1,005	723	51	1859	1
2	1860	7,366	3,252	1,544	1,007	711	77	6,047	3,028	1,473	1,024	741	46	1860	2
3	1861	6,653	2,859	1,396	871	611	67	5,216	2,683	1,347	865	600	32	1861	3
4	1862	6,982	3,210	1,567	932	649	52	5,574	3,005	1,587	1,029	662	41	1862	4
5	1863	7,275	3,835	2,017	1,374	880	67	5,850	3,550	1,958	1,377	935	42	1863	5
6	1864	7,786	3,355	1,761	1,283	898	38	6,394	3,176	1,705	1,195	822	50	1864	6
7	1865	7,808	3,150	1,432	960	699	58	6,291	2,995	1,369	945	679	36	1865	7
8	1866	7,673	3,069	1,474	967	640	36	6,242	2,895	1,394	891	697	38	1866	8
9	1867	7,544	3,002	1,468	902	620	41	5,977	2,728	1,350	900	628	37	1867	9
10	1868	7,527	3,158	1,549	1,036	779	38	6,073	2,971	1,472	1,048	742	24	1868	10
11	1869	8,120	3,477	1,774	1,214	862	39	6,534	3,236	1,699	1,216	909	30	1869	11
12	1870	7,894	3,029	1,508	1,053	784	26	6,272	2,783	1,500	1,056	784	20	1870	12
13	1871	8,352	3,160	1,549	1,022	712	38	6,782	3,067	1,551	1,011	729	20	1871	13
14	1872	8,180	3,073	1,468	975	677	29	6,540	2,924	1,417	941	767	24	1872	14
15	1873	8,322	3,320	1,450	951	695	27	6,628	2,981	1,415	902	677	16	1873	15
16	1874	8,692	3,388	1,831	1,297	982	43	6,755	3,014	1,710	1,236	918	18	1874	16

Calculation, by Pell's Method, of q *for the first Five Years of Life in Scotland.*

	Males.	Females.
B_0	866,888	820,668
B_1	805,421	762,435
B_2	744,128	704,963
B_3	684,099	648,864
B_4	625,140	592,433
χ_0	115,060	92,329
χ_1	45,017	42,015
χ_2	20,631	19,946
χ_3	12,852	12,615
χ_4	8,297	8,361
q_0	·1327265	·1125047
q_1	·0644462	·0620919
q_2	·0341702	·0339909
q_3	·0239732	·0241783
q_4	·0173523	·0179863

NOTE.—The above calculations were made by the Arithmometer, without any attempt to shorten the arithmetical process by means of logarithms.

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