THE FIRST NATIONAL LIFE TABLES FOR EGYPT

BY

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NÉCROLOGIE

YEHIA IBRAHIM PACHA

C'est avec une profonde douleur partagée par toutes les classes de la population que l'Egypte apprit le matin du 23 mars la mort d'un de ses enfants les plus illustres et les plus aimés, YEHYA IBRAHIM PACHA, plusieurs fois président du Conseil des Ministres, ancien président du Sénat, titulaire des plus Hautes distinctions égyptiennes et étrangères.

Sa longue carrière de magistrat—dans laquelle il débuta en 1888 et dont il atteignit le plus haut grade, celui de président de la Cour d'Appel indigène qu'il occupa pendant treize ans—développa à l'extrême les qualités d'un humanisme exquis dont la nature l'avait généreusement doté.

Sa parfaite connaissance des hommes et des choses de son pays qu'il aimait ardemment, et avec une claire vision de ses possibilités et des intérêts réels, son profond sentiment du devoir, sa droiture absolue, son désir de servir, sa bonté sans bornes, sa fidélité envers ses amis et son indulgence à l'égard de ses adversaires, la modestie et la simplicité dont il ne s'est jamais départi même lorsqu'il atteignit le faîte des grandeurs et des honneurs, avaient fait de lui une des plus belles, des plus attachantes figures de l'Egypte contemporaine dont il fut un des meilleurs artisans.

Ces qualités lui valurent la confiance absolue du Souverain qui, connaissant son désintéressement et sa loyauté indéfectibles, recherchait ses conseils et ses services aux heures les plus difficiles que le pays a traversées depuis l'année 1922.

C'est, en effet, au lendemain de la déclaration de l'Indépendance de l'Egypte, en 1922, que Yéhia Ibrahim Pacha, par pur patriotisme et non par ambition, entra dans la politique où il joua d'emblée un rôle de premier plan grâce à son esprit de conciliation, de modération et de clair-voyance et au fait qu'il a toujours mis son pouvoir au service de la justice.

Son rôle terminé, il rentrait silencieusement et avec joie dans sa famille très unie dont il avait le culte et qui était la source où il puisait ses plus grandes satisfactions.

La Société Royale d'Economie Politique, de Statistique et de Législation, dont il était le vice-président depuis le 19 avril 1917, a perdu en la personne révérée de YEHIA IBRAHIM PACHA, un de ses membres de la toute première heure, un ami fidèle, un précieux conseiller et collaborateur.

Nous nous inclinons respectueusement devant sa tombe. Que sa famille éplorée veuille trouver ici l'expression de notre sympathie émue et de notre fidèle et reconnaissant souvenir.

LA RÉDACTION

PREFATORY NOTE

M. R. El-Shanawany Effendi has asked me to write an introduc tion to his study of the first mortality table for Egypt, and I gladly comply, in view of the importance of the subject.

He has drawn attention to two short-comings of Egyptian vital statistics: (1) the existence of actual errors in the recorded figures of births and deaths and (2) the errors in the statement of age in death registration and in Census returns. I can confirm his remarks. Shortly after the figures of the 1927 Census became available I began, together with Badie Effendi Hanna, to attack the problem which El-Shanawany Effendi has solved, namely the investigation of life-tables for male and female lives. It was soon evident that the usual method was not applicable, namely that of referring the deaths at each age, which have occurred over an interval extending equally in each direction from the Census date, to the population of that age enumerated in the Census, because no reliance could be placed on the recorded deaths. I have since then gone more fully into the errors of registration, and hope to publish my results soon, but my conclusions are, in brief,

1. that records of deaths in the towns have been fairly reliable ; but

2. that such records in the country districts have been much less so, and have been quite unreliable as regards deaths of females.

These conclusions were the result of several converging lines of argument, none of which depended at all on Census figures, and I think there is no escaping the facts. The figures bear in themselves evidence of their own inaccuracy. Incidentally, this conclusion disposes of a criticism of the Census figures, that they were "obviously untrustworthy because they do not accord with the vital statistics."

The usual method of compiling a life-table not being applicable, I was forced to adopt that employed by El-Shanawany Effendi, which is to compare age-groups in the 1927 Census with the corresponding age-groups (very closely 10 years younger) in the 1917 Census. But my procedure differed from his in that I smoothed the very rugged age-distributions by a graphical process, combined with an arithmetical adjustment of the differences, whereas El-Shanawany Effendi has smoothed by the use of one of Professor Karl Pearson's frequency curves.

His justification for the use of a frequency curve must lie in its *ex post facto* success in representing the statistics, rather than on any *a priori* grounds. Actually I was engaged in the attempt to fit to the crude age-groups an expression consisting of the sum of exponential terms of the form $\Sigma A_k \exp.(\alpha_k x)$, where x was the age, and the coefficients A_k and a_k might be real or complex. I hoped that the complex parts would be found to arise from the periodicity of the age mis-statements, and that, by ignoring their imaginary parts, there would result a smoothed expression of the age, from which the mis-statements had been eliminated. A technique was elaborated, and the arithmetical work, which was heavy, carried out, but the result was so absurd that it was clear that some error had crept into the arithmetic. Pending its investigation, the work was stopped and not even the graphical figures were used.

So to El-Shanawany Effendi belongs the credit of having carried through the very heavy calculations that such a research necessitates and of having produced the first life-tables for the population of Egypt, Of the importance of such work there can be no question and he is to be congratulated on what he has done.

J. I. Craig.

Cairo, March 15, 1936.

P.S.—I have judged it advisable to leave the letterpress exactly. as written by the author.

I.—Introductory

No attempt has yet been made in Egypt to investigate the age – distribution and the rates of mortality of the male and female populations, as disclosed by the various General Censuses carried out in the country since 1882.

This may be attributed to the scantiness of the raw material necessary for the investigation and the unreliability of the returns in the earlier censuses.

Since a comparison of the duration of successive generations in Egypt and other countries will throw much light on the physical condition of the population, and suggest to scientific and philanthropic individuals —and to the Government— many ways of diminishing the sufferings and ameliorating the health and condition of the people, I felt it very desirable to try to investigate the age –distributions and the rates of mortality of the male and female populations of Egypt as a whole, as recorded by the censuses of 1917 and 1927. I hope —in another paper— to be able to pursue this subject further and to exhibit the difference which prevails in each of the fourteen provinces which constitute the Kingdom.

Before proceeding to the theme of the present paper it may be useful to give a brief review of the previous censuses and to state the maiu difficulties which I have faced in my investigation of the 1917 aod 1927 figures.

The first systematic attempt to ascertain the population of Egypt was made in 1882, but it was beset with the usual difficulties attending a pioneer census, and the population of 6,804,021 shown by the returns was considerably less than the actual oumber, and therefore it is impossible to regard the results as sufficiently accurate to furnish a basis for comparison. In 1897 the first reliable census was carried out and there was an increase of 2,910,504 persons, a substantial share of which was fictitious and due to improved enumeration. Between the Census of 1897 and that of the ensiuing Census of 1907, the recorded population increased by 16·2 per cent, a fact which shows a progressive improvement n the organisation of the census operations.

In the last two Censuses of 1917 and 1927, which are the fundamental basis of the present research, no trace of systematic resistance to inquiry has been found, and as far as the number of living is concerned, there was no serious omission in the returns of the two censuses. The general arrangements in the two censuses were nearly identical. The census taking was divided into two periods so far as the illiterate population was concerned: a preliminary census was taken by the enumerators, nearly two weeks before its final revision. The literate portion of the population themselves filled in details of the composition of the household at midnight between the day of the final revision and that preceeding it. Therefore, there is no prior reason to suspect any omissions from the returns; and we may confidently assert that the standard of accuracy in the enumeration was exceptionally high, for the various steps in the organisation are now familiar to the people and accepted by them, usually without resentment and often with considerable interest. In spite of this, there still remains a fundamental difficulty arising in connection with the Census records, namely the mis-statement of age. This difficulty will be dealt with fully later on, and the method which has been adopted for adjusting these age records illustrated. Unfortunately another serious difficulty arises in respect of defective registration of births and deaths and the inaccuracies in the statement of ages of the deceased. These deficiencies of the birth and death registration records, as will be seen later, are the main difficulties which cannot be avoided; facing them I thought I should have to depart entirely from the usual method of calculating National Life-Table, *i.e.* dealing with the figures of two successive decennial ensuses, together with the number of births and deaths for each of the intervening ten years.

II.—The Deficiencies of Births and Deaths Registration

Although the registers of births and deaths in Egypt showed great improvement since the last amendment to the Registration Law of Births and Deaths of 1912, yet they still contain many inaccuracies and are still incomplete.

This may be fully grasped by comparing the populations ascertained at the Censuses with those calculated on the basis of the returns of births and deaths and published in the Official Publications of the Statistical

Department, Cairo. Table I. shows the populations of Egypt as disclosed by the five Censuses, together with the mid-year estimated population of the last three Censuses according to Vital Statistics. The mid-year estimated population of the two earliest Censuses of 1882 and 1897 were carried out by the Public Health Department, but no Official records for these two estimations seem to exist.

TABLE I.

Date of Census	Population according to Census	Population according to Vital Statistics	Difference
May 3, 1882	6,804,021	—	—
June 1, 1897	9,714,525	—	—
April 29, 1907	11,287,359	11,150,559	136,800
March 7, 1917	12,750,918	12,338,000	412,918
Febr. 19, 1927	14,217,864	14,688,700	—470,836

It can be easily seen from the Table that there is a notable difference between the two populations. According to the Vital Statistics, the births exceeded the deaths during the last decade by 1,937,782 persons, while the census disclosed an increase of 1,466,946 persons; in other words, the census returns showed about half a million less than the estimated population of 1927. It seems probable that a number larger than half a million deaths escaped registration. On the other hand, the Vital Statistics estimations of the population in 1917 and 1907, were less than the corresponding figures disclosed by the Censuses of 1917 and 1907. A fact which indicates that before the amendment to the Registration Law of Births and Deaths of 1912, the reporting of births was less complete than that of deaths, —a condition similar to that prevailing now in India. In 1917, the Vital Statistics estimation exceeded the Census figure by about half a million persons, while in 1907 it exceeded the Censns figure by about one-fifth of a million persons. Therefore, it is clear that little reliance can be placed on the birth and death returns and it is impossible in the present state of Vital Statistics, which have only recently attained a fair degree of accuracy, to take its scanty data as a basis for calculating Life-Tables. In addition to this incomplete registration of births and deaths, the statement of age at

death is extremely rough and crude and in the majority of cases is a matter of guess work, which may differ by 10 or 20 years —or even more— from the true age of the deceased, a matter which gives rise to hesitation and diffidence. Facing the difficulties mentioned above, it seemed essential to depart entirely from the general rule of calculating a Life-Table ; it was necessary to find some other way quite independent of the birth and death returns. It is to be hoped that, in the future, efforts will be concentrated on insuring accurate registration of births and deaths and securing more reliable information of age at death in order that Life-Tables may be deduced with greater reliability.

III.—The Data required for the Construction of the Present Life-Tables

The Census of 1917 disclosed a population of 12,750,918, as compared with 14,217,864 at the Census taken on February 19, 1927. The increase in the population is almost entirely the result of its natural growth during a period free from destructive epidemics—except in 1918—when an influenza epidemic spread all over the country and caused the natural increase, (births-deaths) to be a small negative quantity, in other words, deaths slightly exceeded births. Also it was a period of considerable agricultural prosperity. Although we have no means, at present, of gauging the net result of migration, it is likely to be very small. Emigration of the natives is almost non-existent, while the net result of migration among the foreigners is practically nil, since the number of foreigners disclosed by the two Censuses of 1917 and 1927 was almost the same and amounted to about 225,000 persons. Therefore, during the decade 1917–1927, the Egyptian population may be regarded as a community which had been undisturbed by emigration or immigration. Moreover, it can be seen from the minority of foreigners, that the Egyptian population, on which the present investigation is made, included an overwhelming proportion of native lives and may be considered, for all practical purposes, as consisting entirely of native Egyptians. Bearing this in mind I decided to construct the present Life-Tables,using only data from Censuses of 1917 and 1927 and to abandon entirely the use of any other data concerning births and deaths or the age-distribution of deaths in the intervening years. Thus, the following data only will be used for calculating the present Life-Tables.

(1) The age-distribution according to Census Returns of 1927 for each sex.

(2) The age-distribution according to Census Returns of 1917 for each sex.

The summary figures of these two Censuses are given in Table 2. The enumerated populations with discrimination of sex, in 1917 and 1927, are given in rows (1) and (2); while the actual and percentage variations of the populations are given in rows (3) and (4).

TABLE 2.

	Total	Males	Females
(1) Population 1927 ...	14,177,867	7,058,073	7,119,794
(2) Population 1917 ...	12,718,255	6,369,517	6,348,738
(3) Actual Variation ...	1,459,612	688,556	771,056
(4) Per cent	11·5	10·8	12·1

It should be noted that these figures do not include the Bedouins, while those in Table 1, contain an estimated number of them. I have excluded them from my data because any information as to their number is wholly inaccurate, while their age-distribution is not given at all.

The age-distribution for the males and the females as published for the 1927 Census is given by annual age-periods up to 5, and then for quinquennial periods up to 100, the last group being 100 and over; while for the 1917 Census the distributions are given for each year of life up to 5, for quinquennial periods up to 30, and then for decennial periods up to 100, the last group again being 100 and over. The unstated-age population in 1917 amounted to 40, 417, out of whom 14,990 were females and the remainder 25,427 were males. In 1927 Census, the number of persons who did not state their age amounted to 39,397; out of whom 18,325 were males, and 21, 072 were females.

One of the fundamental difficulties arising in connection with the two Census figures is the inaccuracy of the statement of age. These entries are most unreliable, partly owing to ignorance, partly to carelessness and partly to deliberate mis-statement. It is impossible to determine

with any accuracy to what extent these different factors contributed to the irregularities in the age-distribution ; but we may confidently say — owing to the fact that the great bulk of the population is illiterate — that ignorance is the prominent factor responsible for a great deal of the irregularities, while deliberate mis-statement of age occurs only in certain age-group which differ according to sex. In the female distribution the age-group 10–20, as will be seen from the graduated age-distribution given below, seems to be the favourite group for the misstatement of age ; while the age-group 20–30 is the favourite for males. An explanation of this, which I believe may be sound, will be given later when the misstatement of age is dealt with.

In order to give a clear idea of the extent of the irregularities and anomalies in the age-distribution, I have, fortunately, at my disposal the male and female age-distribution for each year, as disclosed by the Census of 1927. These two distributions have not yet been published anywhere, but I have made use of them in an Official Report upon some other investigation. They are shown in Table 3, and to convey the general idea of the great fluctuation in both age-distributions, the figures are presented in graphic form in Diagrams (1) and (2).

I do not propose, at this stage, to comment on this Table, beyond pointing out the tendency of individuals to choose ages ending with 0 or 5, and a glance, even at the Table shows the great irregularities of the distribution and indicates that it is entirely unreliable, and that such distribution, as it stands, tells us virtually nothing. It would be of great interest to compare the age-distribution of the population by individual years, as stated in the 1927 Census, with that given in 1917 to see the degree of progress and improvement in the statement of age, but unfortunately in 1917 such a distribution was not published and cannot even be traced.

In spite of the awkward irregularities of the distribution, a fair approximation of the actual facts can be deduced from it by grouping the date in quinquennial or preferably in decennial age-groups, for when we deal with large numbers, the errors due to under and over statement of age tend to cancel one another, while the effects of choosing favourite numbers can be eliminated by a careful process of smoothing.

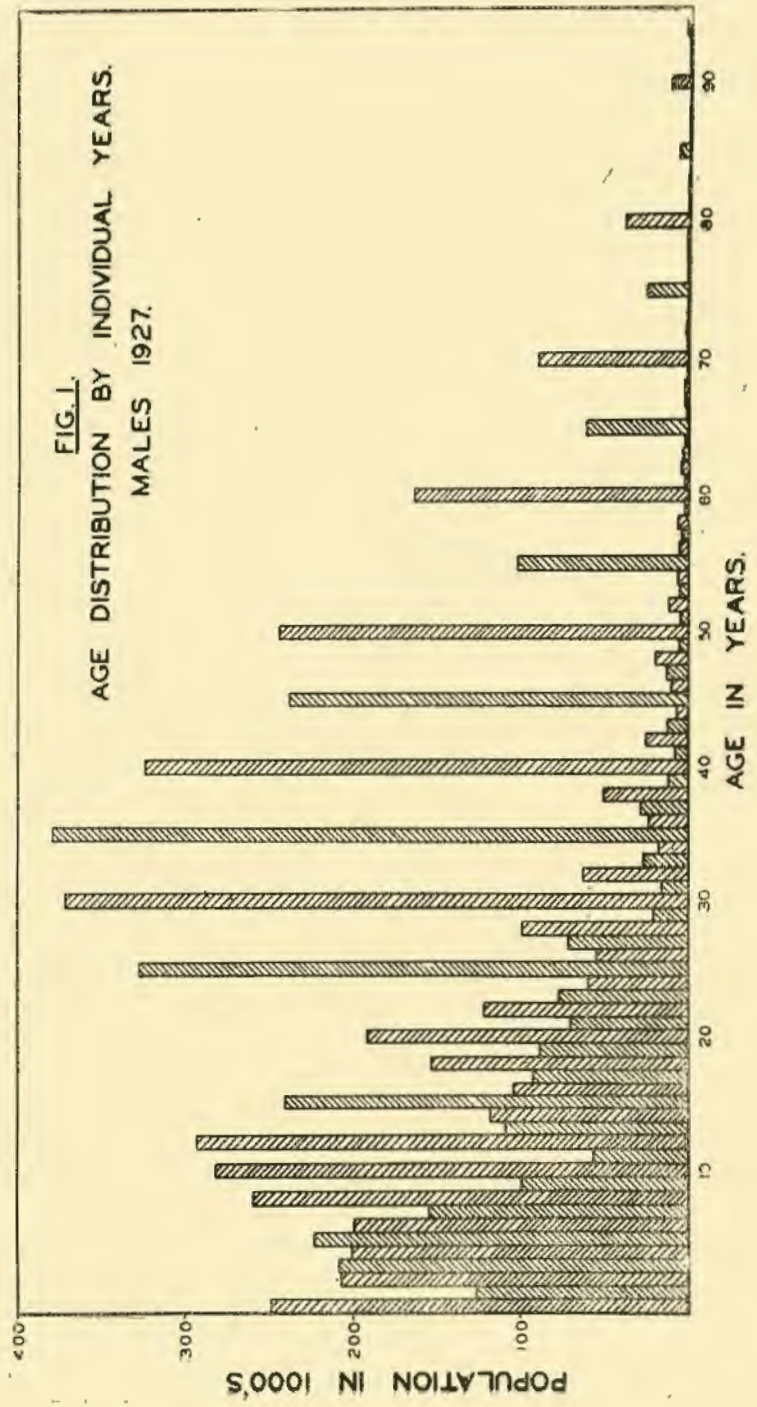


FIG. 1.
AGE DISTRIBUTION BY INDIVIDUAL YEARS.
MALES 1927.
POPULATION IN 1000'S
400
300
200
100
0
10
20
30
40
50
60
70
80
90
AGE IN YEARS.

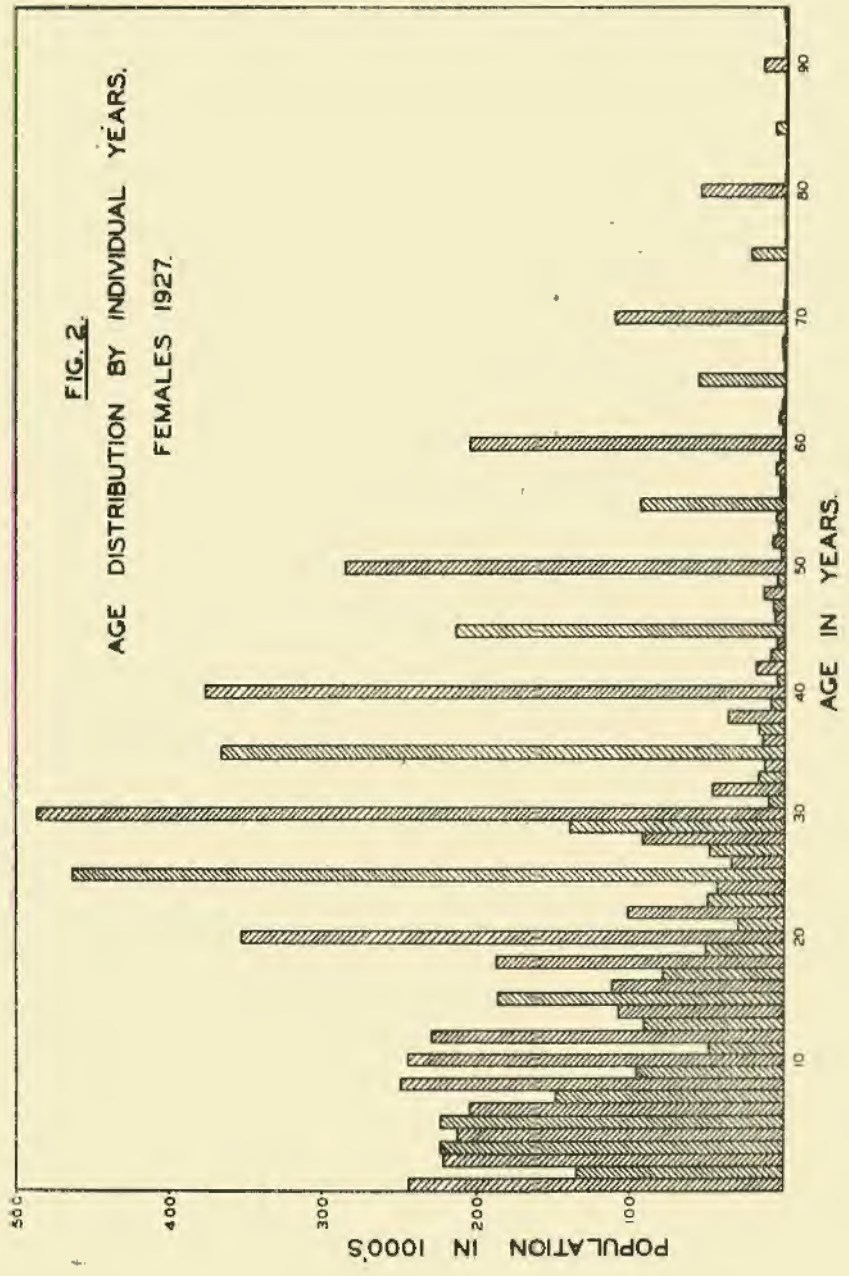


FIG. 2.
AGE DISTRIBUTION BY INDIVIDUAL YEARS.
FEMALES 1927.
POPULATION IN 1000'S
100
200
300
400
500
AGE IN YEARS.
10
20
30
40
50
60
70
80
90

TABLE 3.—MALE AND FEMALE POPULATIONS, AS ENUMERATED AT EACH AGE FROM 1927 CENSUS SCHEDULES.

Age	Males	Females	Age	Males	Females	Age	Males	Females	Age	Males	Males
0	249,166	243,785	24	59,365	43,824	48	19,704	13,754	72	1,784	1,539
1	127,462	135,141	25	327,921	463,728	49	5,395	4,184	73	827	675
2	207,314	211,127	26	54,506	34,572	50	243,172	285,369	74	493	360
3	208,750	223,729	27	71,969	48,980	51	4,058	2,685	75	24,829	22,972
4	201,769	212,452	28	98,688	91,362	52	11,167	7,403	76	522	403
5	223,041	223,627	29	20,461	13,983	53	5,738	3,611	77	475	357
6	199,518	204,155	30	372,407	486,263	54	6,433	4,008	78	655	565
7	155,490	149,360	31	15,990	9,444	55	101,446	93,666	79	305	305
8	260,167	249,240	32	62,083	46,657	56	5,015	2,915	80	38,228	55,668
9	99,217	95,576	33	26,074	16,169	57	4,989	2,972	81	282	315
10	282,276	244,564	34	17,775	12,528	58	6,930	5,038	82	502	494
11	56,475	48,550	35	379,499	366,906	59	2,183	1,821	83	241	200
12	293,741	228,600	36	23,270	13,789	60	165,007	204,810	84	195	157
13	109,367	90,310	37	28,721	16,967	61	1,954	1,354	85	6,872	7,042
14	118,624	107,371	38	50,196	36,685	62	4,912	3,474	86	163	124
15	240,093	186,107	39	11,686	8,114	63	3,373	2,128	87	222	189
16	104,937	111,940	40	324,856	376,340	64	2,091	1,332	88	136	142
17	92,400	78,390	41	7,561	4,750	65	60,661	56,268	89	93	101
18	154,598	187,412	42	25,825	17,552	66	1,436	854	90	11,662	15,427
19	88,085	50,879	43	12,950	8,872	67	2,118	1,428	91	81	87
20	192,208	353,290	44	6,773	4,065	68	2,333	1,969	92	128	126
21	70,882	29,100	45	237,009	213,491	69	762	716	93	61	67
22	122,554	101,452	46	9,930	5,020	70	89,766	110,158	94	42	29
23	77,748	49,600	47	11,931	6,423	71	754	699	95	2,281	2,192

IV.—Graduation of Male and Female Age-Distributions of 1917 and 1927 Census Figures

It would occupy too much space to state in details the whole process and calculation involved in fitting the four appropriate Pearsonian Curves to the male and female populations of 1917 and 1927. The main steps of graduation are presented in the Appendix, and it will suffice here to give a brief summary of the situation. The male and female figures of 1927 have been grouped in quinquennial age-groups 0–4, 5–10, ... etc. ; and then the nonstated number of each sex has been distributed proportionally over the several periods of life. Having adjusted the age groups according to the appropriate number of individuals whose ages are not stated, the first four moments, ν_1, ν_2, ν_3, and ν_4, about a working origin are calculated and corrected for abruptness, and consequently the values of β_1 and β_2. It has been found that the appropriate frequency curves of the male and female distributions of 1927 are Pearsonian Type IX–Curves.

$$y=y_0\,(a-x)^{\lambda}$$

where y and λ are constants to be determined from the data ; and the age at which all individuals vanish is x=ka, where k is the unit of grouping, and equal to 5 years in the case of 1927 data. Unfortunately the figures of 1917 cannot be grouped in quinquennial age-groups, for, as mentioned before, the official figures of these two distributions are not given in quinquennial age-groups up to the end of the life. Therefore the only alternative is to adopt decennial age-groups in this case. Moreover, in dealing with these data I faced another difficulty owing to the lack of information concerning the five sub-groups of the first age-group 0–10, *i.e.* the number of lives whose ages lie between 0–2, 2–4, 4–6, 6–8, and 8–10 ; the result of this is that we cannot apply the Abruptness or even Shepherd's Corrections to the moments, for in such a case, instead of improving the result, they make it worse. The two frequency curves which have been fitted to the distributions are still Type IX.

It is rather interesting to see the effect of decennial grouping and non-corrected moments, on the final results given by the curve. To illustrate this point, the male distribution of 1927 has been grouped in decennial age-groups ; no correction has been applied to the first four moments and thus I obtained the following curve which represents the distribution,

$$y=y_0\,(10{\cdot}557{,}839-x)^{2{\cdot}349{\cdot}106} \qquad \ldots\ldots\ldots\ldots \text{(A)}$$

FIG. 3.

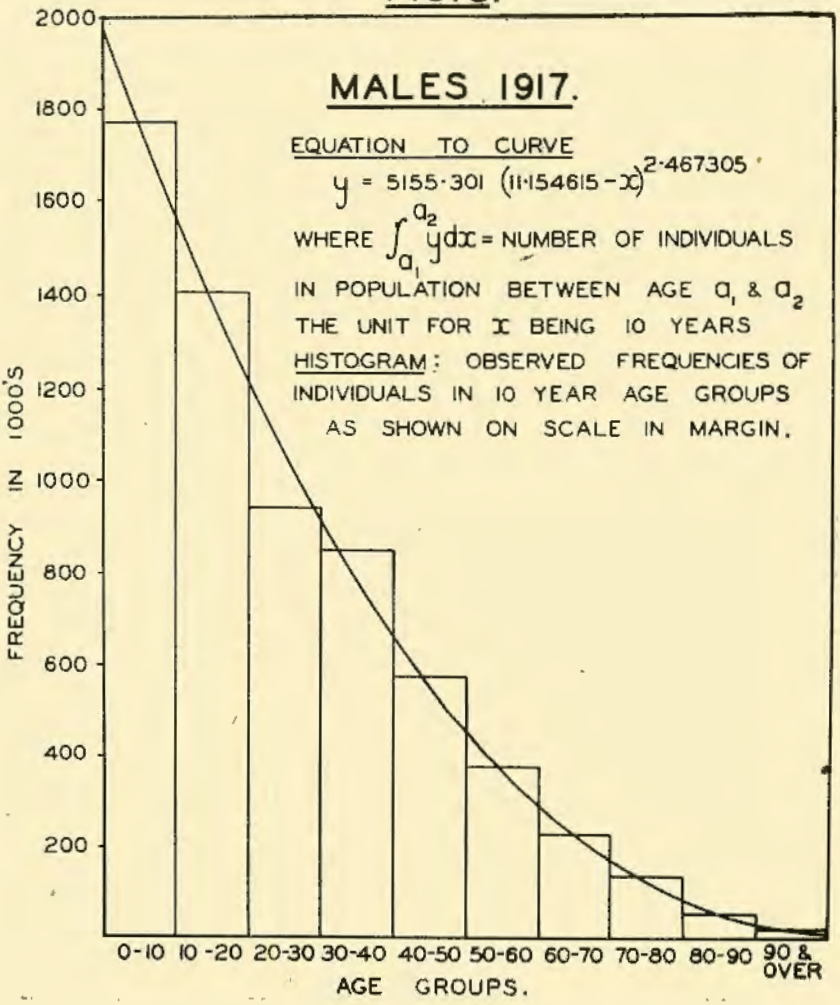
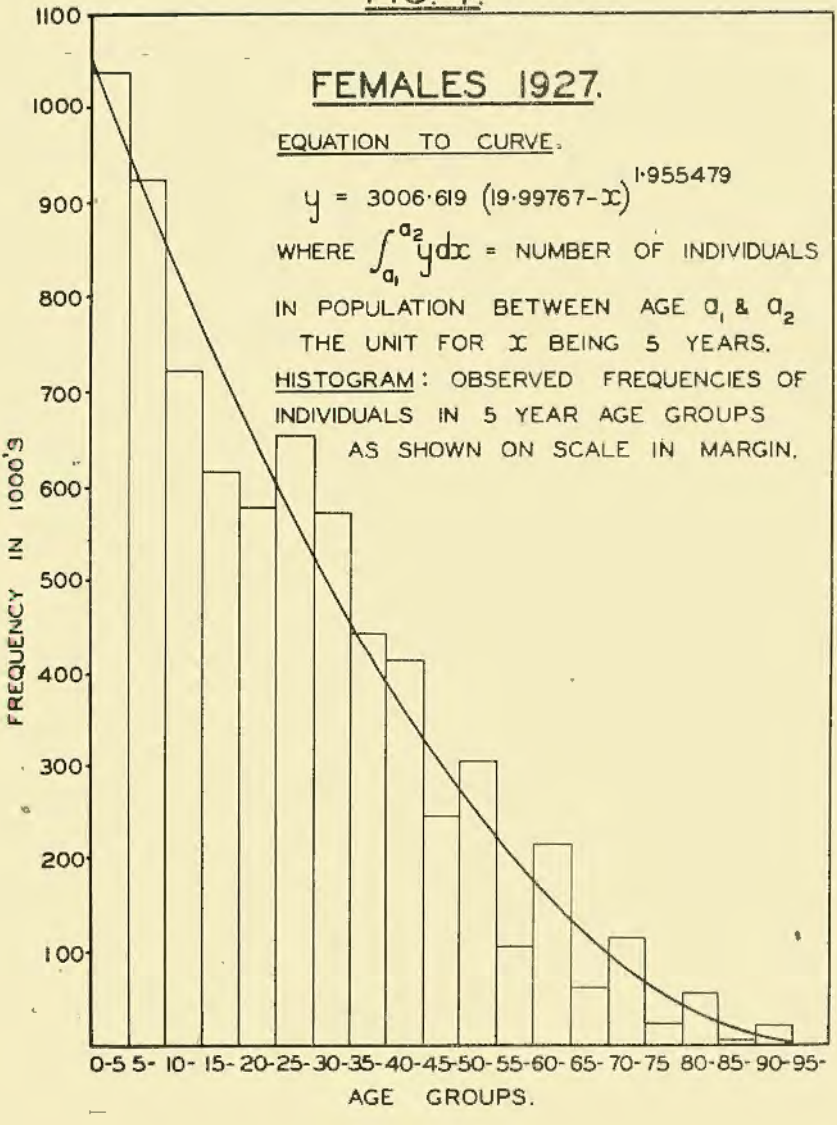

MALES 1917.
EQUATION TO CURVE
$y = 5155 \cdot 301 \ (11 \cdot 154615 - x)^{2 \cdot 467305}$
WHERE $\int_{a_1}^{a_2} y\,dx$ = NUMBER OF INDIVIDUALS IN POPULATION BETWEEN AGE a_1 & a_2 THE UNIT FOR x BEING 10 YEARS
HISTOGRAM: OBSERVED FREQUENCIES OF INDIVIDUALS IN 10 YEAR AGE GROUPS AS SHOWN ON SCALE IN MARGIN.
FREQUENCY IN 1000'S
2000
1800
1600
1400
1200
1000
800
600
400
200
0-10 10-20 20-30 30-40 40-50 50-60 60-70 70-80 80-90 90 & OVER
AGE GROUPS.

FIG. 4.


FEMALES 1927.
EQUATION TO CURVE.
$y = 3006{\cdot}619\ (19{\cdot}99767 - x)^{1{\cdot}955479}$
WHERE $\int_{a_1}^{a_2} y\,dx$ = NUMBER OF INDIVIDUALS IN POPULATION BETWEEN AGE a_1 & a_2
THE UNIT FOR x BEING 5 YEARS.
HISTOGRAM: OBSERVED FREQUENCIES OF INDIVIDUALS IN 5 YEAR AGE GROUPS AS SHOWN ON SCALE IN MARGIN.
FREQUENCY IN 1000's
1100
1000
900
800
700
600
500
400
300
200
100
0-5 5-10-15-20-25-30-35-40-45-50-55-60-65-70-75 80-85-90-95-
AGE GROUPS.

This curve should be compared with that fitting the distribution when it is grouped in quinquennial age-groups, having its first three moments corrected and equal to those of the distribution. This curve is represented by

$$y = y_0 \, (19{\cdot}984{,}04 - x)^{2{\cdot}094{,}194} \quad \ldots\ldots\ldots\ldots \text{(B)}.$$

It should be noted that the unit of grouping of the age " x " is 10 years for the first curve, and 5 years for the second curve.

Table 4 gives the number of males in decennial age-groups according to the 1927 Census, after distributing the number whose ages are not stated; also the graduated figures for each group deduced by the two curves mentioned above.

TABLE 4.—SHOWING AGE-DISTRIBUTION OF MALE POPULATION FOR THE CENSUS OF 1927 AND THE GRADUATED FIGURES BY CURVES A AND B.

Ages	Census Numbers	Graduated Numbers: Curve A.	Graduated Numbers: Curve B.
0- 9	1,936,923	2,000,371	1,964,946
10-19	1,544,606	1,564,603	1,556,741
20-29	1,099,106	1,189,158	1,197,930
30-39	990,272	871,611	887,923
40-49	663,657	609,342	626,077
50-59	392,349	399,464	411,625
60-69	245,284	238,765	243,673
70-79	120,724	123,575	121,114
80-89	47,056	49,561	42,488
90-upwards	18,096	11,623	5,556
TOTAL	7,058,073	7,058,073	7,058,073

Diagram 5 helps in showing the difference between the two curves; the data are represented by the histograms, Curve A is shown by a dotted line and Curve B by a continuous line. Thus, it can be seen that the difference between the two curves is so small that it will hardly affect the final results. In other words, the Life-Tables calculated on the basis

FIG. 5.

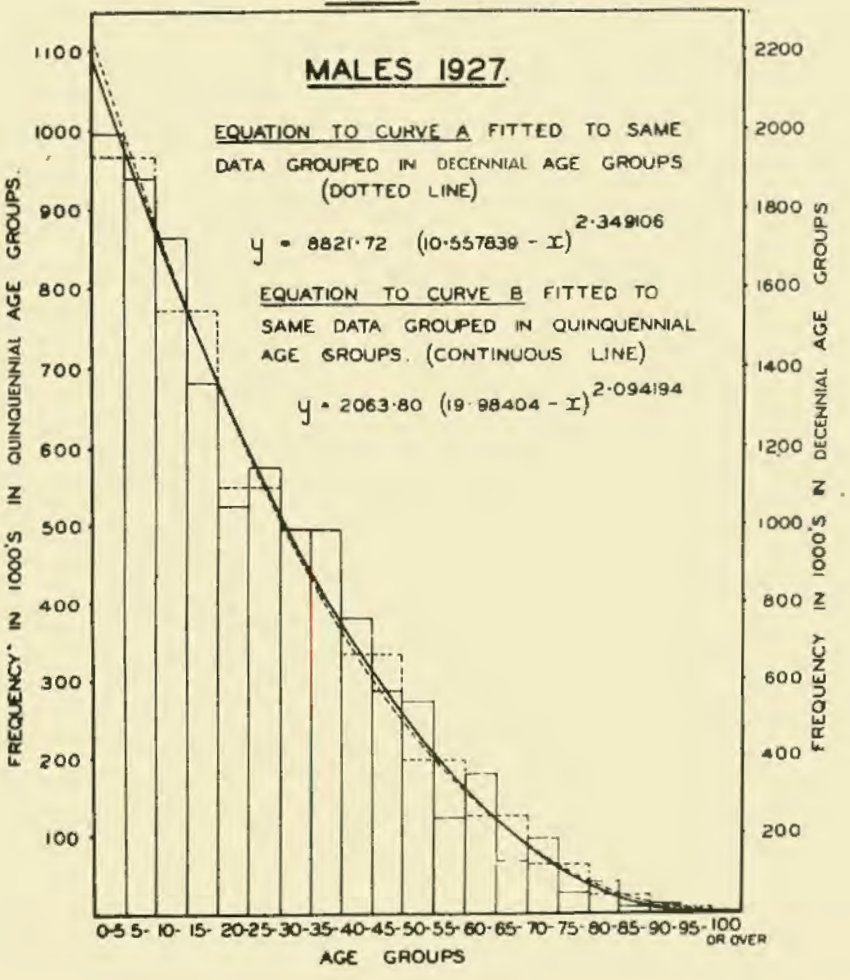
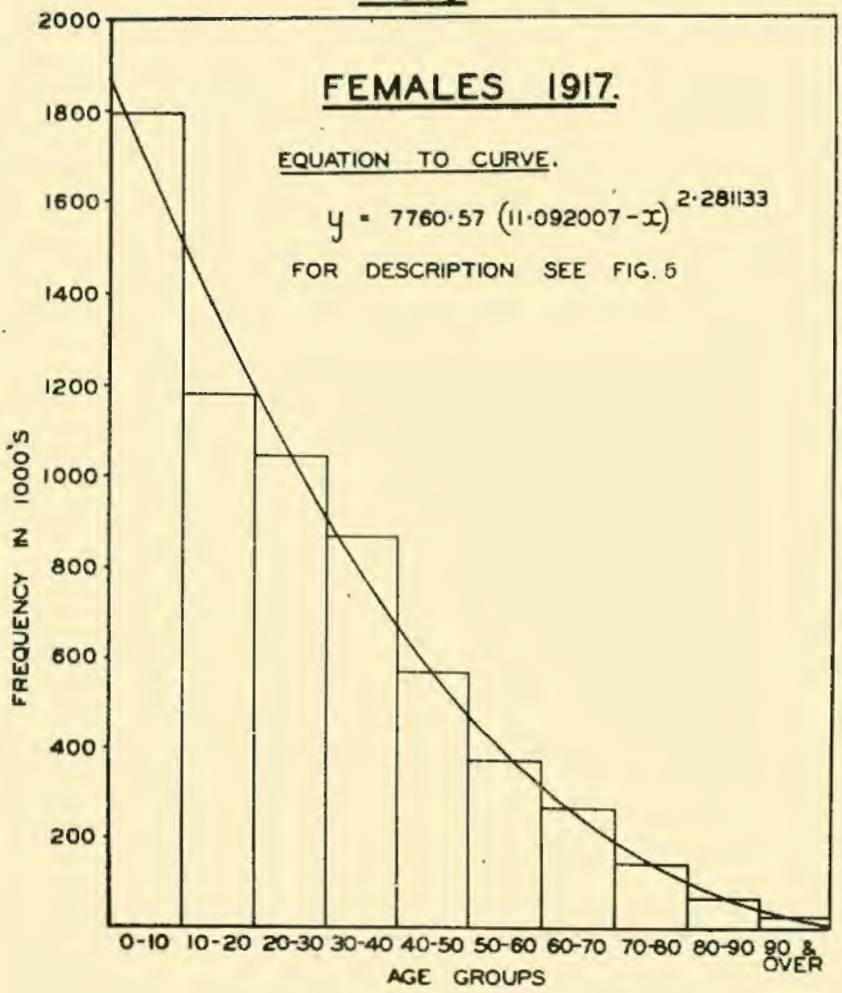

MALES 1927.
EQUATION TO CURVE A FITTED TO SAME DATA GROUPED IN DECENNIAL AGE GROUPS (DOTTED LINE)
y = 8821·72 (10·557839 - x)^2·349106
EQUATION TO CURVE B FITTED TO SAME DATA GROUPED IN QUINQUENNIAL AGE GROUPS. (CONTINUOUS LINE)
y = 2063·80 (19·98404 - x)^2·094194
FREQUENCY IN 1000'S IN QUINQUENNIAL AGE GROUPS.
FREQUENCY IN 1000'S IN DECENNIAL AGE GROUPS
AGE GROUPS
0-5 5- 10- 15- 20-25-30-35-40-45-50-55-60-65-70-75-80-85-90-95-100 OR OVER

FIG. 6.


FEMALES 1917.
EQUATION TO CURVE.
$y = 7760{\cdot}57\,(11{\cdot}092007 - x)^{2{\cdot}281133}$
FOR DESCRIPTION SEE FIG. 5
FREQUENCY IN 1000'S
2000
1800
1600
1400
1200
1000
800
600
400
200
0-10 10-20 20-30 30-40 40-50 50-60 60-70 70-80 80-90 90 & OVER
AGE GROUPS

of the curve, as will be explained later, will hardly be affected, especially if we bear in mind that it is by no means certain that the true curves would be quite the same as those mathematically deduced and that no pretence is made for absolute accuracy. However, I believe that the curves give a nearer approximation to the truth than the obvious erroneous numbers of the Census enumerations. With these considerations in mind, I believe that such a graduation adopted and explained in the Appendix to this paper seems to be the safest guide through the enormous anomalies and irregularities presented in the distribution.

V.—Mis-statement of Age in the Returns of the Census

It is possible to make use of the graduated curves to analyse the irregularities in the age-distribution which are so marked in figure (1) and (2). I shall use the 1927 figures and follow the method adopted by Dr. James Craufurd Dunlop, then Registrar-General for Scotland, in connection with his study of the amount of error in the returns of the Scottish Census of 1921*. I shall consider, for each sex and age, the differences between my graduated frequencies and the recorded frequencies. These differences are so remarkable that they suggest a systematic mis-statement of age associated with definite preferences for certain digits.

Unfortunately because of the destruction of the 1927 Census Schedules, I am not able to study the ages of children separately, but I hope to do this after the census of 1937, and will then submit another paper. In the present paper, ages of children will be studied together with those of the rest of the population, without any discrimination, although the method is not quite adequate in the case of children. The method consists of "assuming that all differences between the numbers given by the graduated population curve and the reported numbers are errors in excess, or plus errors, when the reported numbers are greater than the graduated numbers, and errors in deficit, or minus errors, when the reported numbers are less than the graduated numbers."

In Tables (5) and (6) the enumerated numbers in 1927 and 1917, for each sex, are given together with the corresponding graduated figures, to show how far these figures indicate an inadmissible degree of discrepancy. It may be well to state certain salient facts as to the distribution of errors in Table (5). In looking at the Table, we note, firstly, after age 55,

* Journal of the Royal Statistical Society, Vol. LXXXVI, year 1923, p. 547 *et seq.*

the percentage of errors, either plus or minus is very high. It is, on the whole, similar in both sexes but of greater magnitude in females. Moreover, it seems quite probable that the older people are apt to exaggerate their ages unintentionally. Secondly, the reported ages of the male population of 7,058,073, contain errors in excess and therefore errors in deficit, amounting to 329,633, while the reported ages of the females population of 7,119, 794 contain errors amounting to 499,956. The maximum error for males, amounting to 116,682 in deficit, occurs in the age period 20–24. This deficiency may be attributed to the fact that the official conscription age occurs in that particular age-group and individuals may mis-state their age, lest they may be forced to recruit. This indicates that although there has undoubtedly been a progressive improvement in the organisation and administration of the Census operations and the population is more accustomed to the idea of it, yet its true object is not yet fully appreciated. With females, the maximum error, 105,966 females in deficit, occurs in the age-period 15–20. This may be due to the fact that unmarried girls unconsciously minimise their ages. It may plausibly be argued that this apparent deficiency may be due to concealment of girls at that age. But this is an extreme view to take of the matter, for we have no justification whatsoever to suspect the concealment of women in any period of life, especially if we remember that nothing of the kind was detected in the course of testing the work of the enumerators.

Thirdly and finally, the error in the middle-life period is in excess *i.e.* the reported numbers in these age-groups are greater than the graduated numbers. This may be caused by individuals having favourite ages which lie almost within the range of the middle-life period ; in case of males, these favourite ages are 35, 30, 40, 50 and 45 respectively, while the female ages are 30, 40, 35, 50, 45 respectively.

Comparison of Tables (5) and (6), seems to show that in 1927, males and females tended to give 40, 50, 60 or 70 as their age ; alternately in excess and deficit. In 1917, with ten years grouping, these errors are much less.

The comparison between the errors found at the Census of 1927 and those found, by the same method, in the returns of the Census of 1917, indicated in Table 6, does not show any marked improvement in the returns. It is rather curious that the deficiency in the age-period 10–20 for females and 20–30 for males is also markedly noted on 1917 Census ; and what is more, it is in accordance with the results obtained from investigating the ages of the Indian population. The

TABLE 5.—GRADUATED AND REPORTED NUMBERS IN EACH QUINQUENNIAL AGE-GROUP : MALES AND FEMALES, 1927.

Age-Groups	Males				Females			
	Census	Graduated	Errors	%	Census	Graduated	Errors	%
0– 4	997,050	1,036,610	—39,560	—3·8	1,039,310	1,001,614	37,696	3·7
5– 9	939,873	928,336	11,537	1·2	924,695	903,642	21,053	2·3
10–14	862,723	826,299	36,424	4·4	721,530	810,604	—89,074	—11·0
15–19	681,883	730,442	—48,559	—6·6	616,553	722,519	—105,966	—14·7
20–24	524,068	640,750	—116,682	—18·2	578,980	639,381	—60,401	—9·4
25–29	275,038	557,180	17,858	3·2	654,562	561,220	93,342	16·6
30–34	495,616	479,687	15,929	3·3	572,756	488,046	84,710	17·4
35–39	494,656	408,236	86,420	21·1	443,774	419,876	23,898	5·7
40–44	378,949	342,789	36,160	10·5	412,801	356,725	56,076	15·7
45–49	284,708	283,288	1,420	5	243,593	298,615	—55,022	—18·4
50–54	271,272	229,690	41,582	18·1	303,976	245,563	58,413	23·8
55–59	121,077	181,935	—60,858	—33·5	106,728	197,594	—90,866	—46·0
60–64	177,799	139,965	37,834	27·0	213,731	154,732	58,999	38·1
65–69	67,485	103,708	—36,223	—34·9	61,417	117,006	—55,589	—47·5
70–74	93,868	73,091	20,777	28·4	113,768	84,449	29,319	34·7
75–79	26,856	48,023	—21,167	—44·1	24,675	57,103	—32,428	—56·8
80–84	39,551	28,399	11,152	39·3	57,003	35,009	21,994	62·8
85–89	7,505	14,089	—6,584	—21·4	7,621	18,232	—10,611	—58·2
90 &c.	18,096	5,556	12,540	225·7	22,320	7,864	14,456	183·8
TOTAL ...	7,058,073	7,058,073	±329,633		7,119,794	7,119,794	±499,956	

TABLE 6.—GRADUATED AND REPORTED NUMBERS IN EACH DECENNIAL AGE-GROUP: MALES AND FEMALES 1917.

Age-Groups	Males				Females			
	Census	Graduated	Errors	%	Census	Graduated	Errors	%
0– 9	1,770,508	1,770,432	76	0·0	1,797,114	1,692,303	104,811	6·2
10–19	1,407,500	1,388,668	18,832	1·4	1,181,580	1,350,001	—168,421	—12·5
20–29	924,410	1,060,727	—118,317	—11·2	1,042,901	1,050,514	—7,613	—0·7
30–39	852,913	783,933	68,980	8·8	875,225	792,542	82,683	10·4
40–49	574,765	555,426	19,339	3·4	571,017	574,639	—3,622	—0·6
50–59	376,586	372,140	4,446	1·2	377,780	395,261	—17,481	—4·4
60–69	229,552	230,749	—1,197	—0·5	262,985	252,645	10,340	4·1
70–79	139,072	127,594	11,478	9·0	141,775	144,800	—3,025	—2·1
80–89	55,212	58,559	—3,347	—5·7	71,840	69,383	2,457	3·5
90 & c.	20,999	21,289	—290	—1·4	26,521	26,648	—127	—0·5
TOTAL ...	6,369,517	6,369,517	+123,151 —123,151		6,348,738	6,348,736	+200,291 —200,289	

following note, extracted from the Census of India 1911, Volume I, illustrates the situation in India.

"Intentional mistatement exists chiefly in connection with unmarried girls who have attained the age of puberty, who are almost invariably returned as younger than they really are. Men approaching the meridian of life, especially if they are widowers, also commonly understate their age. Unintentional error in a particular direction occurs chiefly in the case of older people, who are prone to exaggerate their age, and of young wives with children, who also are nearly always entered as older than they are."

There remains then as the subject of inquiry, the determination of the favourite unit digits of age and the order of each unit in respect to the other ten digits. Such an investigation can only be carried out for the male and female populations of 1927, where the numbers of each sex, for individual years of age, are obtainable, but owing to the lack of such data for 1917, we cannot carry out the same investigation.

In Table (9), the reported numbers of males and females for individual years are compared with the corresponding graduated numbers. It can be seen from the table that after age 20, errors in excess are only associated with ages, the unit digits of which are 0 and 5, while all ages ending with any one of the remaining digits contain always errors in deficit.

In Tables (10) and (11), the graduated numbers of males and females are given, to show the true proportions of the individuals whose ages end with each of the ten unit digits ; while Tables (12) and (13) are given to demonstrate the amounts of errors in ages ending with each of these unit digit. Moreover, the percentages of the above-mentioned errors are set out in Tables (14) and (15).

It can be seen from the tables, that although all digits of ages, with the exception of those ending in 0 and 5, show errors in deficit, yet the degree of the repulsion of the individuals from these digits is not the same and therefore, we can still arrange these digits in their order of preference. It is rather interesting to compare the ranks of the different digits as shown from the Egyptian population, with those obtained from the Indian* and Scottish† population.

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* Mr, Thomas G, Ackland's report submitted to the Indian Government and published in Journal of the Institute of Actuaries, Vol. XLVII, part IV, July 1913, p. 315 *et seq.*

† *See* previous note page 17,

Table 7 shows the rank of each digit of age of the Egyptian and Scottish populations of 1927 and 1921 respectively, together with that of the male population obtained from six provinces in India : Bengal, Bombay, Burma, Madras, Punjab and United Provinces. The rank of each digit of age for the Indian female population is not given in Mr. Ackland's paper.

TABLE 7.—SHOWING THE RANK OF EACH DIGIT OF AGE FOR THE EGYPTIAN MALE AND FEMALE POPULATIONS, FOR SCOTTISH MALES AND FEMALES AND FOR THE INDIAN MALE POPULATION.

Country		Digit of Age									
		0	1	2	3	4	5	6	7	8	9
Egypt ...	Males	1	10	3	5	7	2	6	8	4	9
	Females	1	9	4	7	6	2	5	8	3	10
India ...	Males	1	9	3	7	6	2	5	8	4	10
Scotland ...	Males	1	10	3	8	6	4	5	9	2	7
	Females	1	10	5	8	6	4	3	9	2	7

The above figures indicate that there is a remarkable preference for the even digits in the three countries. In Egypt and India they can be arranged in the following order : 2, 8, 6, and 4 ; whilst the odd digits may be arranged as follows : 3, 7, 1 and 9 ; but in Scotland the digit 9 replaces the digit 3, and the digit 8 replaces the digit 2.

VI.—Graduated Life-Tables

The graduated figures for individual ages for the male and female populations of 1927 and 1917, deduced by the mathematical formulæ mentioned in the Appendix, would serve as a basis for calculating the probability of living 10 years at age x ($_{10}p_x$) for each sex. To illustrate the method, let us confine ourselves to male Life-Tables. The female Life-Tables can be constructed by a method exactly similar.

The number of males in 1917, n, whose age is exactly x can be easily calculated from the formula :—

$$n_x = \int_{(x-\frac{1}{2})\,h}^{(x+\frac{1}{2})\,h} y_0\,(11{\cdot}154615-x)^{2{\cdot}467305}\,dx \quad \ldots\ldots\ldots\ldots (1)$$

where h=·1

Then we may argue that, during the interval between the Census of 1917 and that of 1927, some of these individuals died and those who lived should have returned their age, in the Census of 1927, as $(x+\delta)$ years, where δ is the interval between the two Censuses amounting to 9·96164 years. If the interval δ between the two Censuses was exactly ten years, we could easily have calculated the numbers of individuals whose age was exactly (x+10) in 1927 from the following equation—

$$n'_{x+10} = \int_{(x+10-\frac{1}{2})\,h}^{(x+10+\frac{1}{2})\,h} y_0\,(19{\cdot}98404-x)^{2{\cdot}094194}\,dx \quad \ldots\ldots\ldots\ldots (2)$$

where h=·2,

and eventually obtained two sets of numbers ; (n_x and n'_{x+10}), from which we could have deduced the probability of surviving ten years ($_{10}p_x$) at each age of life. These values of $_{10}p_x$ could have been obtained from the simple formula :—

$$_{10}p_x = \frac{n'_{x+10}}{n_x} \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

But owing to the fact that the Census of 1917 was carried on March 7, 1917 and that the last Census was taken on February 19, 1927, the interval between the two Censuses is 16 days less than 10 years, so the number of the individuals who should return their ages as (x+10) had the Census of 1927 been taken on March 7, will be less than the value of n'_{x+10} obtained from equation (2), *i.e.* n_{x+10} instead of $n'_{x+\delta}$. An approximation to the true value of n_{x+10} can be obtained from $n'_{x+\delta}$ by subtracting from it. ·03836 $\delta n'_{x+10}$; where $\delta n'_{x+10} = n'_{x+10} - n'_{x+11}$. It should be noted that because the interval between the two Censuses is less than the 10 years by 16 days only, such an approximation may be reasonable.

Having obtained the two series of ${}_{10}p_x$ for both sexes, it remains to determine the probability of living one year (p_x) at each age: Before discussing the process of obtaining the values of p_x, it should be noted, that the aim of this paper is to construct the Egyptian Life-Tables from age 10 to the end of life only because I feel that the data and even the curves concerning the ages of infancy and childhood are not quite reliable and therefore it is not worth the trouble to make any elaborate and detailed investigation at these early ages. It can be easily seen that, since we got the series of the values of ${}_{10}p_x$ for males and females for each age, from x=10 to the end of life, than all we need is a method to provide us with the first ten values of $l_{11}, l_{12}, l_{13}, \ldots\ldots l_{20}$, *i.e.* the number of survivors, at age x, from the arbitrary radix l_{10} of 100,000; for once we get these ten values, we can automatically get the next ten, namely $l_{21}, l_{22}, \ldots\ldots l_{30}$ by simply multiplying l_{11} by ${}_{10}p_{11}$; l_{12} by ${}_{10}p_{12}$ ...;...and l_{20} by ${}_{10}p_{20}$.

To get the first set of l_x, we simply calculate the number of survivors at age 20, 30 and 40, on the assumption that the radix $l_{10}=100{,}000$, and then we fit these four points by means of Makeham's first modification of Gompertz's formula. In the case of males, this formula becomes:

$$\log l_x = 5{\cdot}0740096 - {\cdot}0408639x - {\cdot}0212053\ (1{\cdot}5630864)^x \ldots\ldots\ldots (4)$$

while that for females becomes:—

$$\log l_x = 5{\cdot}0616564 - {\cdot}0281468x - {\cdot}0216594\ (1{\cdot}5471158)^x \ldots\ldots\ldots (5)$$

From equation (4) and (5) we can calculate the first set of l_x, namely $l_{11}, l_{12} \ldots\ldots l_{20}$ for males and females respectively, and therefore all values, of l_x from age 10 to the end of life can be obtained, for both sexes, as explained above.

It is interesting to see the degree of accuracy of the first ten values of l_x deduced by Makeham's modification of Gompertz's Law. For this pupose the values of ${}_{10}p_x$, deduced by dividing l_{x+10} by l_x, have been compared with the corresponding values of ${}_{10}p_x$ deduced by the graduated frequency curves, as illustrated above. The results are remarkably surprising for all the intermediate values for ages between 10 and 30 *i.e.* throughout the whole range of the part of the survivors-curve fitted by Makeham's Law. The degree of closeness of the approximation can be shown by the fact that the maximum absolute difference between any corresponding values of these two sets of ${}_{10}p_x$ amounts to 7 in the fifth decimal place.

For the purpose of illustration these 21 values of ${}_{10}p_x$ for females x=10 to x=30 as deduced by Makeham's Law, together with the corresponding values obtained from the graduated frequency curves are set out in Table (8).

TABLE 8.—SHOWING THE PROBABILITY OF LIVING TEN YEARS (${}_{10}p_x$) AT AGE x, FOR FEMALE LIVES, AS DEDUCED BY MAKEHAM'S MODIFICATION OF GOMPERTZ' LAW, AND BY THE GRADUATED FREQUENCY CURVES.

Age x	${}_{10}p_x$ Frequency Curves	${}_{10}p_x$ Makeham's Law	Difference	Age x	${}_{10}p_x$ Frequency Curves	${}_{10}p_x$ Makeham's Law	Difference
10	·89850	·89850	·00000	21	·87541	·87543	·00002
11	·89680	·89681	·00001	22	·87280	·97277	·00003
12	·89504	·89505	·00001	23	·86997	·87001	·00004
13	·89320	·89321	·00001	24	·86709	·86712	·00003
14	·89127	·89130	·00003	25	·86411	·86411	·00000
15	·88929	·88930	·00001	26	·86097	·86099	·00002
16	·88716	·88722	·00006	27	·85769	·85774	·00005
17	·88506	·88505	·00001	28	·85435	·85435	·00000
18	·88273	·88280	·00007	29	·85086	·85083	·00003
19	·88039	·88044	·00005	30	·84717	·84716	·00001
20	·87799	·87800	·00001				

VII.—Comparison of Rates of Mortality

Having calculated all the values of l_x, we can easily calculate the values of p_x —the probability of surviving one year at age x—from age ten to the end of life. For purpose of comparison, I have set out in Table (16), the values of 100 ($q_x=1-p_x$) is the probability that a person of precise age x will die within one year for Egypt together with the corresponding values for India, England and Lagos. The values of 100 q for India are those deduced by Mr. Ackland for male and female lives of all India (1901–1911); while the English figures have been taken from the English Life-Table No. 9.

I am indebted to Dr. E. S. Pearson for referring me to the work of Mr S. M. Jacob, the Government Statistician for Nigeria, to compare the results obtained for Egypt with other African results. Mr. Jacob did not calculate a Life-Table for all Nigeria, the population of which in 1931 was reported to be 19,928,171 persons, but he confined himself to the male population of Lagos, the seat of Government, and the population of which is 126,108 persons. But because Lagos, being the Capital and situated on the sea coast, is much healthier than the rest of Nigeria, its rates of mortality are much lower, and therefore not representative of the whole country. It is of interest, in this connection to cite the following passage from Mr. Jacob's report, Census of Nigeria, 1931, Vol. 1.

" On the other hand, though Lagos, with 85 per cent of that tribe, is predominately a Yoruba town, it offers, both on account of its position as a sea-port, through which three-fifths of the import and half of the export trade of Nigeria passes, and as the seat of Government, an unrepresentative sample even of Yorubaland. Still less is it representative of Southern Nigeria. "

Bearing this in mind, it is not surprising to see that the rates of mortality in Lagos, as given in Table XLI, " Life-Table for decade 1921-1930." Census of Nigeria 1931, Vol. 1., are slightly lower than those of Egypt as a whole.

In England, as might be anticipated, the rates of mortality for both males and females at ages 10 to 70 are much lower than the corresponding rates for Egypt, but after age 60 the Egyptian rates of mortality are slightly lower than the corresponding rates for England and Lagos. It might be argued that this is the effect ofmis-statement of age by older persons in the Census returns ; but we must remember that the rates of mortality in England have not improved during the last half-century and are still notably high ; a similar phenomenon has been observed in connection with the German and Italian populations, namely the Italian Survivors-curve crosses, at a certain age, the German curve, a fact which indicates that although in earlier ages the Italian's rates of mortality are higher than those of Germany, yet after, a certain age, they are lower. Therefore we may come to the conclusion that such a similar phenomenon for Egypt and England is not due to mis-statement of age, but may be regarded as a natural and quite probable phenomenon, in spite of the fact that of mis-statement of age at old ages has undoubtedly a certain effect.

With regard to India, the mortality rates are considerably higher than those of Egypt for both male and female lives. The effect of different rates of mortality operating on different populations can be studied by comparing the numbers of survivors, at each age, out of an arbitrary radix for the different populations. For the purpose of simplifying the comparison, figures (7) and (8) have been drawn The first figure indicates the male Survivors-curves for Egypt, India, England and Lagos, while the second represents the female Survivors-curves for the first three countries only, for, as indicated above, the Female Life-Table for Lagos has not been calculated. The number out of 1,000 persons aged 10, of males (or females) surviving at age x, is represented by the ordinates of the curve corresponding to each race.

VIII.—Comparison of Expectations of Life

Having got the values of l_x, p_x, and q_x, it remains to calculate, firstly, the number living between age x and (x+1), (L_x); secondly, the number living above age x, (T_x), and finally the complete expectation of life, at age x, (e^o_x).

The values of L_x, for ages from 10 to the end of life, have been deduced from the approximate formula

$$L_x = \frac{l_x + l_{x+1}}{2}$$

which is quite applicable to adult ages. The values of T_x can be obtained simply by summing the values of L_x from and including age x upwards, while the complete expectation of life at age x can be deduced by dividing the corresponding value of T_x by the number of survivors at age x. I did not calculate the values of the force of mortality, but they can be easily obtained, if required, by using the formula of approximation

$$\mu_x = \frac{l_{x-1} - l_{x+1}}{2\ l_x}$$

Table 17 shows the expectation of life at ages 10, 15, 20, 25..... and 100, for male and female lives deduced by the above-mentioned

FIG. 7.

LIFE DURATION OF DIFFERENT RACES.

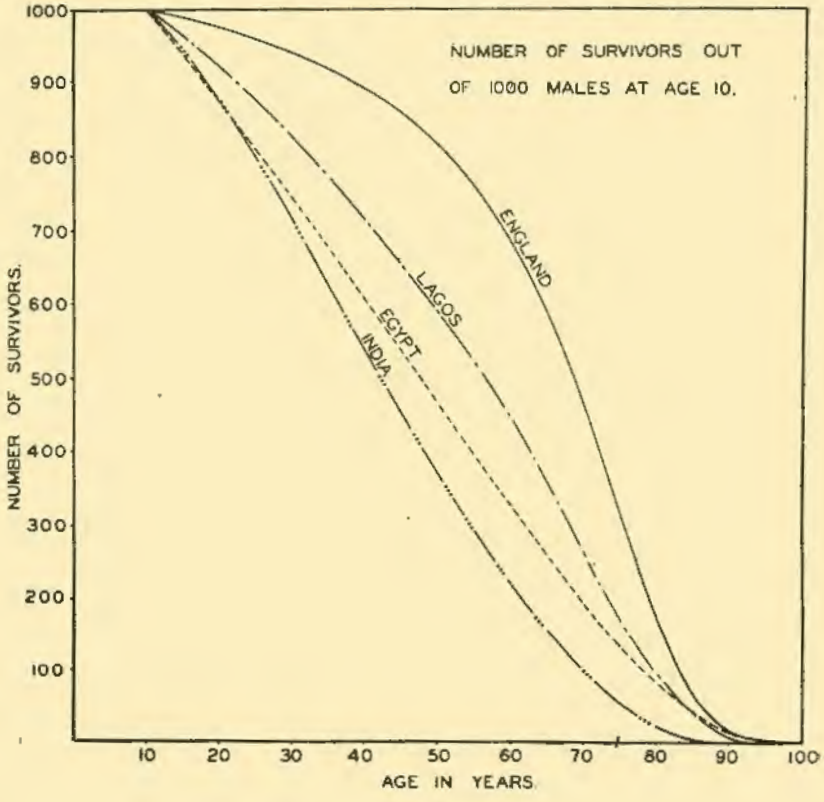
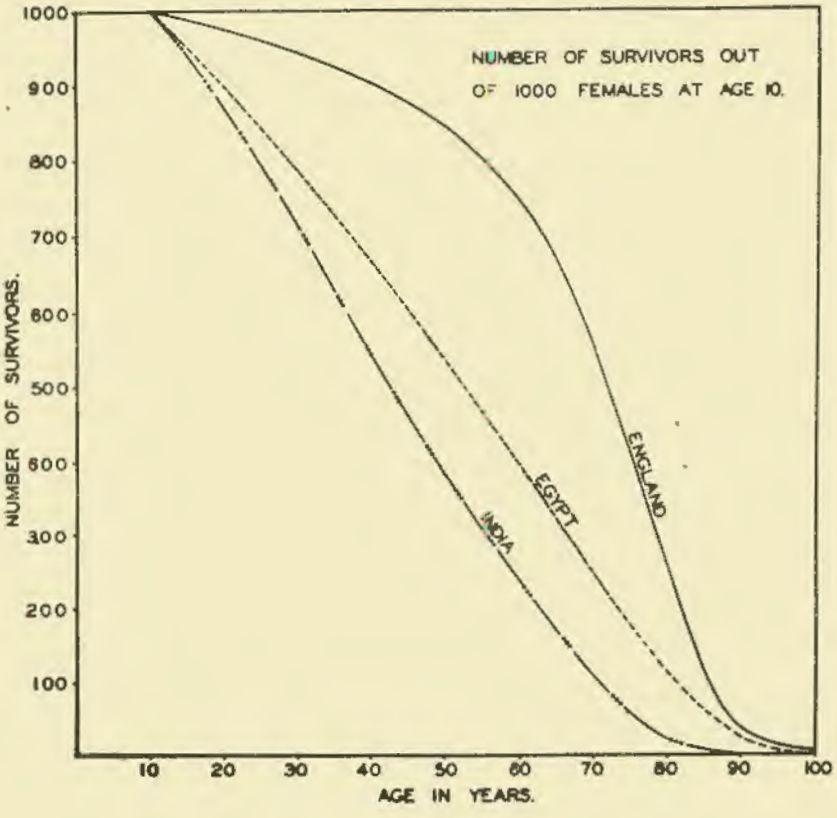


FIG. 8.

LIFE DURATION OF DIFFERENT RACES.



method, together with the corresponding expectations of life for England,* India; and the male expectation of life for Lagos.

At all ages the expectations of life in Egypt, for both males and females, are considerably higher than those of India. Moreover, the two expectation-curves for Egyptian males and females, as represented in Diagrams (9) and (10), are practically parallel to the corresponding Indian males and females expectation-curves, a fact which indicates that Egypt retains a higher vitality than India in all ages by practically the same amount.

A glance at the two above-mentioned diagrams, serves also to show that the highter vitality which the Egyptian females hold over the Indian females, is greater than the higher vitality which the Egyptian males hold over the Indian males. The appropriate explanation of this lies in Mr. Ackland's statement, page 347.

"The expectations for female lives in all India are only slightly higher than for male lives, at all ages, the excess being 0·72 years at birth, diminishing to 0·11 at age 60; whilst in England, the superior expectation of the female lives in 3·98 years at birth, and 1·43 years at age 60." On the other hand, Egypt shows an inferior vitality compared with England and Lagos, throughout the greater part of the curve, and a slightly superior vitality to that of England itself at old ages. The Egyptian male expectation-curve crosses the corresponding curve for Lagos at age 54, and it continues to show a superior vitality over Lagos from this age to the end of life; while it crosses the English expectation-curve at age 64, and then it proceeds to show higher values of expectations up to age 91, where it crosses the English curve again. I believe that the second intersection of the two curves at age 91 may be due to the inaccuracy of the values of expectation for Egypt at very old ages, compared with the accuracy attained for the English values at these ages. Had the same standard of accuracy been attained for both curves, the Egyptian curve should not have crossed the English curve again.

The Egyptian female expectation-curve shows a similar phenomenon. It is practically parallel to that of India, and shows an inferior vitality, compared with England, at ages 0 to 69 and a slightly higher vitality from age 69 to 90, the age where it intersects the English curve again.

* Registrar General. Life-Table No, 9.

See Note Page 23.

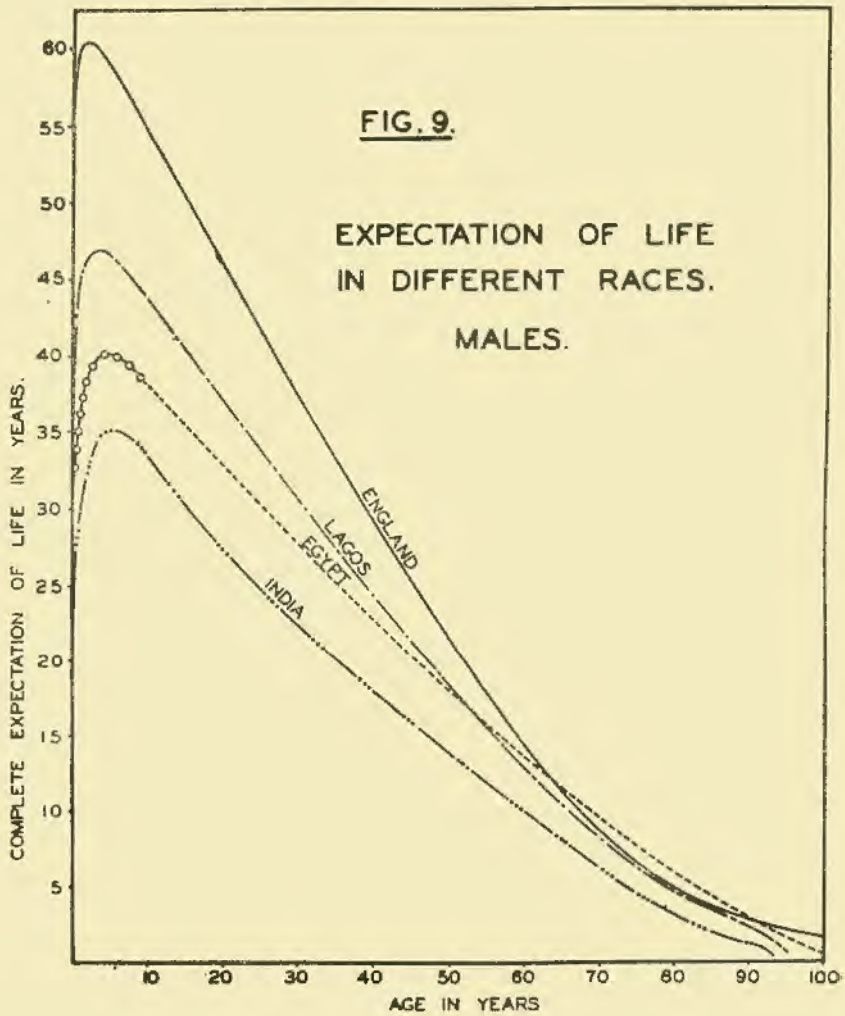


FIG. 9.
EXPECTATION OF LIFE IN DIFFERENT RACES.
MALES.
COMPLETE EXPECTATION OF LIFE IN YEARS.
AGE IN YEARS
ENGLAND
LAGOS
EGYPT
INDIA
60
55
50
45
40
35
30
25
20
15
10
5
10
20
30
40
50
60
70
80
90
100

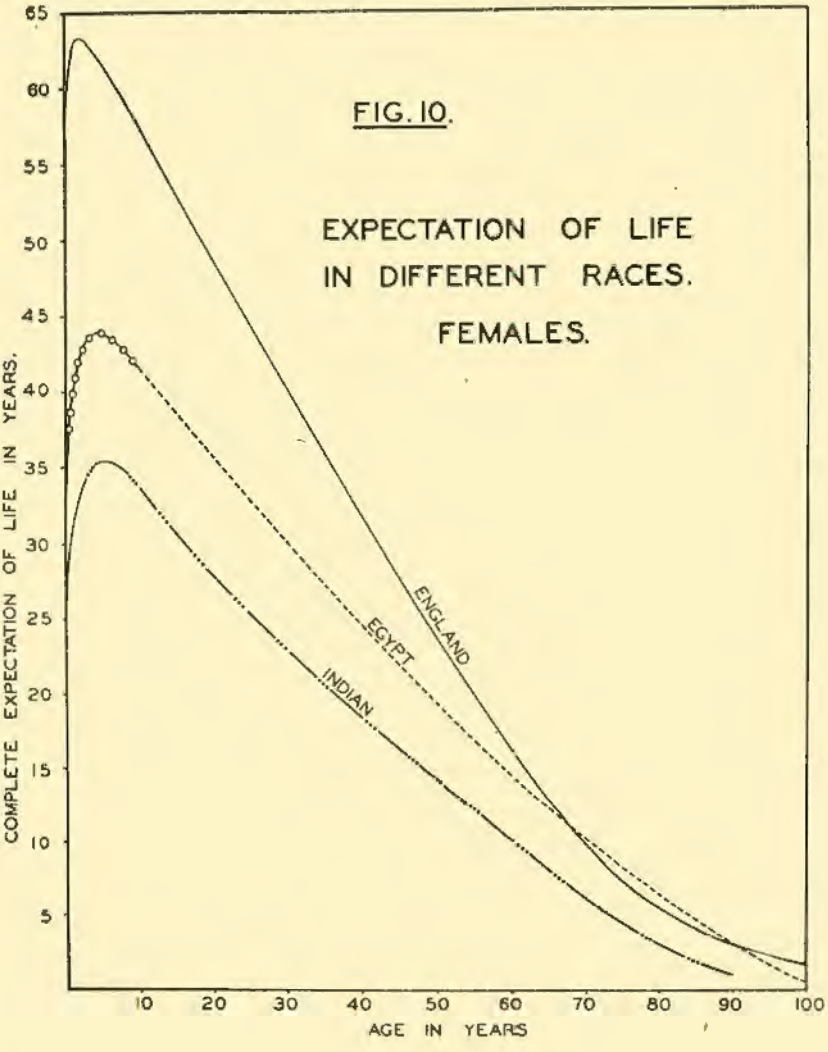


FIG. 10.
EXPECTATION OF LIFE
IN DIFFERENT RACES.
FEMALES.
COMPLETE EXPECTATION OF LIFE IN YEARS.
AGE IN YEARS
ENGLAND
EGYPT
INDIAN
65
60
55
50
45
40
35
30
25
20
15
10
5
10
20
30
40
50
60
70
80
90
100

As I have already mentioned before, I have not tried owing to lack of accuracy at the very early ages, to apply any elaborate and detailed investigation at these ages. I have, however, drawn in on Diagrams (9) and (10) two curves which I suggest as rough approximation to the true expectation-curves between 0 and 10 years. It will be seen that these curves suggest that the expectation at birth is 31 years for males and 36 for females, compared to the English 55·62 years for males and 59·8 for females; and to the Indian 25·59 for males and 23·31 for females. The probable difference in maximum expectations in the different countries can also be seen.

In Egypt it is 40·2 at age 4 for male and 44·0 at age 4 for females; whilst in India the maximum expectation is attained at age 5 for both sexes and amounts to 35·01 years for males and 35·40 years for females; whereas in England the maximum expectation is attained at age 2 for both males and females and amounts to 60·50 years for males and 63·35 for females.

In Table (20), I have tried to give, for both sexes, the ages for England, India and Lagos, for which the expectations of life are approximately equal to the Egyptian expectations at ages 10, 20, 30..... and 100. In the case of males, out of the three different races, Lagos, India and England, only the African one, namely Lagos, shows the nearest figure to the corresponding Egyptian ages. In the case of females, however, I expect the Lagos result would correspond most nearly to the Egyptian, but, as I have said before, these are not given.

IX.—Conclusion

In conclusion, I should like to express my gratitude to Mr. J. I. Craig, the Financial Secretary of the Ministry of Finance, Cairo, with whom I have been in constant touch, during the course of my investigation. His valuable suggestions and remarks together with his intimate acquaintance with the Census operations and the prominent defects of the Vital Statistics Registration has simplified the task which seemed, at first glance, to be impossible to carry out.

I also wish to express my hearty thanks to Dr. E. S. Pearson, the Professor of Applied Statistics, University College, London, for his useful statistical advice, for reading the paper and for allowing all the diagrams to be drawn in the Department.

TABLE No. 9.—COMPARISON OF THE GRADUATED NUMBERS OF MALES AND FEMALES, DEDUCED FROM THE PEARSONIAN CURVES FOR 1927 CENSUS, WITH THE CORRESPONDING NUMBERS ACTUALLY REPORTED IN EACH INDIVIDUAL YEAR.

Age	Males				Females			
	Numbers		Errors		Numbers		Errors	
	Reported	Graduated	Plus	Minus	Reported	Graduated	Plus	Minus
0– 1	249,166	216,281	32,885	—	243,785	208,396	35,389	—
1– 2	127,462	211,754	—	84,292	135,141	204,309	—	69,168
2– 3	207,314	207,272	42	—	221,127	200,291	20,836	—
3– 4	208,750	202,839	5,911	—	223,729	196,283	27,446	—
4– 5	201,769	198,464	3,305	—	212,452	192,335	20,117	—
5– 6	223,041	194,128	28,913	—	223,627	188,406	35,221	—
6– 7	199,518	189,850	9,668	—	204,155	184,527	19,628	—
7– 8	155,490	185,620	—	30,130	149,360	180,689	—	31,329
8– 9	260,167	181,434	78,733	—	249,240	176,886	72,354	—
9–10	99,217	177,304	—	78,087	95,576	173,134	—	77,558
10–11	282,276	173,227	109,049	—	244,564	169,404	75,160	—
11–12	56,475	169,190	—	112,715	48,550	165,725	—	117,175
12–13	293,741	165,211	128,530	—	228,600	162,080	66,520	—
13–14	109,367	161,277	—	51,910	90,310	158,479	—	68,169
14–15	118,624	157,394	—	38,770	107,371	154,916	—	47,545
15–16	240,093	153,559	86,534	—	186,107	151,393	34,714	—
16–17	104,937	149,773	—	44,836	111,940	147,907	—	35,967
17–18	92,400	146,042	—	53,642	78,390	144,462	—	66,072
18–19	154,598	142,352	12,246	—	187,412	141,058	46,354	—
19–20	88,085	138,716	—	50,631	50,879	137,699	—	86,820
20–21	192,208	135,130	57,078	—	353,290	134,368	218,922	—

21–22	70,832	131,593	—	60,761	29,100	131,079	—	101,979
22–23	122,554	128,099	—	5,545	101,452	127,839	—	26,387
23–24	77,748	124,661	—	46,913	49,600	124,628	—	75,028
24–25	59,365	121,267	—	61,902	43,824	121,468	—	77,644
25–26	327,921	117,926	209,995	—	463,728	118,335	345,393	—
26–27	54,506	114,634	—	60,128	34,572	115,251	—	80,679
27–28	71,969	111,387	—	39,418	48,980	112,205	—	63,225
28–29	98,688	108,191	—	9,503	91,362	109,197	—	17,835
29–30	20,461	105,042	—	84,581	13,983	106,232	—	92,249
30–31	372,407	101,940	270,467	—	486,263	103,299	382,964	—
31–32	15,990	98,892	—	82,902	9,444	100,420	—	90,976
32–33	62,083	95,890	—	33,807	46,657	97,569	—	50,912
33–34	26,074	92,936	—	66,862	16,169	94,762	—	78,593
34–35	17,775	90,029	—	72,254	12,528	91,994	—	79,466
35–36	379,499	87,169	292,330	—	366,906	89,268	277,638	—
36–37	23,270	84,361	—	61,091	13,789	86,582	—	72,793
37–38	28,721	81,601	—	52,880	16,967	83,936	—	66,969
38–39	50,196	78,885	—	28,689	36,685	81,329	—	44,644
39–40	11,686	76,220	—	64,534	8,114	78,762	—	70,648
40–41	324,856	73,599	251,257	—	376,340	76,236	300,104	—
41–42	7,561	71,037	—	63,476	4,750	73,751	—	69,001
42–43	25,825	68,509	—	42,684	17,552	71,305	—	53,753
43–44	12,950	66,035	—	53,085	8,872	68,899	—	60,027
44–45	6,773	63,609	—	56,836	4,065	66,534	—	62,469
45–46	237,009	61,228	175,781	—	213,491	64,210	149,281	—
46–47	9,930	58,896	—	48,966	5,020	61,926	—	56,906
47–48	11,931	56,609	—	44,678	6,423	59,683	—	53,260
48–49	19,704	54,374	—	34,670	13,754	57,479	—	43,725
49–50	5,395	52,181	—	46,786	4,184	55,317	—	51,133
50–51	243,172	50,038	193,134	—	285,369	53,195	232,174	—
51–52	4,058	47,942	—	43,884	2,685	51,113	—	48,428
52–53	11,167	45,891	—	34,724	7,403	49,072	—	41,669
53–54	5,738	43,888	—	38,150	3,611	47,071	—	43,460

TABLE No. 0 (*contd.*).

Age	Males				Females			
	Numbers		Errors		Numbers		Errors	
	Reported	Graduated	Plus	Minus	Reported	Graduated	Plus	Minus
54–55	6,433	41,931	—	35,498	4,008	45,112	—	41,108
55–56	101,446	40,022	61,424	—	93,666	43,194	50,472	—
56–57	5,215	38,158	—	32,943	2,915	41,315	—	38,400
57–58	4,989	36,340	—	31,351	2,973	39,478	—	36,506
58–59	6,930	34,570	—	27,640	5,038	37,681	—	32,643
59–60	2,183	32,845	—	30,662	1,821	35,926	—	34,105
60–61	165,007	31,167	16,840	—	204,810	34,211	170,599	—
61–62	1,954	29,534	—	27,580	1,354	32,538	—	31,184
62–63	4,912	27,947	—	23,035	3,474	30,906	—	27,432
63–64	3,373	26,406	—	23,033	2,128	29,313	—	27,185
64–65	2,091	24,911	—	22,820	1,332	27,764	—	26,432
65–66	60,661	23,461	37,200	—	56,268	26,254	30,014	—
66–67	1,436	22,056	—	20,620	854	24,787	—	23,933
67–68	2,118	20,694	—	18,576	1,428	23,360	—	21,932
68–69	2,333	19,384	—	17,051	1,969	21,974	—	20,005
69–70	762	18,113	—	17,351	716	20,631	—	19,915
70–71	89,766	16,888	72,878	—	110,158	19,328	90,830	—
71–72	754	15,710	—	14,956	699	18,068	—	17,369
72–73	1,784	14,574	—	12,790	1,539	16,848	—	15,309
73–74	827	13,483	—	12,656	675	15,671	—	14,996
74–75	493	12,436	—	11,943	360	14,535	—	14,175
75–76	24,829	11,435	13,394	—	22,972	13,441	9,531	—

76–77	522	10,475	—	9,953	403	12,388	—	11,985
77–78	475	9,561	—	9,086	357	11,379	—	11,022
78–79	655	8,690	—	8,035	565	10,410	—	9,845
79–80	305	7,862	—	7,557	305	9,484	—	9,179
80–81	38,228	7,078	31,150	—	55,668	8,600	47,068	—
81–82	282	6,336	—	6,054	315	7,758	—	7,443
82–83	502	5,637	—	5,135	494	6,960	—	6,466
83–84	241	4,981	—	4,740	200	6,202	—	6,002
84–85	195	4,366	—	4,171	157	5,489	—	5,332
85–86	6,872	3,796	3,076	—	7,042	4,817	2,225	—
86–87	163	3,265	—	3,102	124	4,189	—	4,065
87–88	222	2,777	—	2,555	189	3,603	—	3,414
88–89	136	2,329	—	2,193	142	3,061	—	2,919
89–90	93	1,923	—	1,830	101	2,562	—	2,461
90–91	11,662	1,556	10,106	—	15,427	2,106	13,321	—
91–92	81	1,232	—	1,151	87	1,695	—	1,608
92–93	128	945	—	817	126	1,326	—	1,200
93–94	61	698	—	637	67	1,003	—	936
94–95	42	490	—	448	29	724	—	695
95–96	2,281	—	—	—	2,192	488	1,704	—

TABLE No. 10.—SHOWING THE GRADUATED NUMBERS OF MALES IN 1927, WHOSE AGES END WITH EACH OF THE TEN UNIT DIGITS.

Tens Digit of Age	Units Digit of Age									
	0	1	2	3	4	5	6	7	8	9
0	216,281	211,754	207,272	202,839	198,464	194,128	189,850	185,620	181,434	177,304
10	173,227	169,190	165,211	161,277	154,384	153,559	149,773	146,042	142,352	138,716
20	153,130	131,593	128,099	124,661	121,267	117,926	114,634	111,387	108,191	105,042
30	101,940	98,892	95,890	92,936	90,029	87,169	84,361	81,601	78,885	76,220
40	73,599	71,037	68,509	66,035	63,609	61,228	58,896	56,609	54,374	52,181
50	50,038	47,942	45,891	43,888	41,931	40,022	38,158	36,340	34,570	32,843
60	31,167	29,534	27,947	26,406	24,911	23,461	22,056	20,694	19,384	18,113
70	16,888	15,710	14,574	13,483	12,436	11,435	10,475	9,561	8,690	7,862
80	7,078	6,336	5,637	4,981	4,366	3,796	3,265	2,777	2,329	1,923
90	1,556	1,232	945	698	490	340	231	119	40	4
TOTALS	806,904	783,220	759,975	737,204	714,897	693,064	671,699	650,750	630,249	610,210
Per cent	114	111	108	104	101	98	95	92	89	86

TABLE No. 11.—SHOWING THE GRADUATED NUMBERS OF FEMALES IN 1927, WHOSE AGES END WITH EACH OF THE TEN UNIT DIGITS.

Tens Digit of Age	Units Digit of Age									
	0	1	2	3	4	5	6	7	8	9
0	208,396	204,309	200,291	196,283	192,335	188,406	184,527	180,689	176,886	173,134
10	169,404	165,725	162,080	158,479	154,916	151,393	147,907	144,462	141,058	137,699
20	134,368	131,079	127,839	124,628	121,468	118,335	115,251	112,205	109,197	106,232
30	103,299	100,420	97,567	94,762	91,994	89,268	86,582	83,936	81,329	78,762
40	76,236	73,751	71,305	68,899	66,534	64,210	61,926	59,683	57,479	55,317
50	53,195	51,113	49,072	47,071	45,112	43,194	41,315	39,478	37,681	35,926
60	34,211	32,538	30,906	29,313	27,764	26,254	24,787	23,360	21,974	20,631
70	19,328	18,068	16,848	15,671	14,535	13,441	12,388	11,379	10,410	9,484
80	8,600	7,758	6,960	6,202	5,489	4,817	4,189	3,603	3,061	2,562
90	2,106	1,695	1,326	1,003	724	488	300	155	59	8
TOTALS	809,143	786,456	764,196	742,311	720,871	699,806	679,172	658,950	639,134	619,755
Per cent	114	110	107	104	101	98	95	93	90	87

TABLE No. 12.—SHOWING THE AMOUNT OF ERRORS IN AGES ENDING WITH EACH OF THE TEN UNIT DIGITS (MALES) 1927.

Tens Digit of Age	Units Digit of Age,									
	0	1	2	3	4	5	6	7	8	9
0...	32,885	—84,292	42	5,911	3,305	28,913	9,668	30,130	78,733	—78,087
10...	109,049	—112,715	128,540	—51,910	—38,770	86,534	—44,836	—53,642	12,246	—50,631
20...	57,078	—60,761	— 5,545	—46,913	—61,902	209,995	—60,128	—39,418	— 9,503	—84,581
30...	270,467	—82,902	—33,807	—66,862	—72,254	292,330	—61,091	—52,880	—28,689	—64,534
40...	251,257	—63,476	—42,684	—53,085	—56,836	175,781	—48,966	—44,678	—34,670	—46,786
50...	193,134	—43,884	—34,724	—38,150	—35,498	61,424	—32,943	—31,351	—27,640	—30,662
60...	133,840	—27,580	—23,035	—23,033	—22,820	37,200	—20,620	—18,576	—17,051	—17,351
70...	72,878	—14,956	—12,790	—12,656	—11,943	13,394	— 9,953	— 9,086	— 8,035	— 7,557
80...	31,150	— 6,054	— 5,135	— 4,740	— 4,171	3,076	— 3,102	— 2,555	— 2,193	— 1,830
90...	10,106	— 1,151	— 817	— 637	— 448	1,941	—	—	—	—
TOTALS	1,161,844	—497,771	—29,965	—292,075	—301,337	910,588	—271,971	—282,316	—36,802	—382,019
Per cent	144	—64	—4	—40	—42	131	—41	—43	—6	—63

TABLE No. 13.—SHOWING THE AMOUNT OF ERRORS IN AGES ENDING WITH EACH OF THE TEN UNIT DIGITS (FEMALES) 1927.

Tens Digit of Age	Units Digit of Age									
	0	1	2	3	4	5	6	7	8	9
0...	35,389	69,168	20,836	27,446	20,117	35,221	19,628	— 31,329	72,354	— 77,558
10...	75,160	—117,175	66,520	— 68,169	— 47,545	34,714	— 35,967	— 66,072	46,354	— 86,820
20...	218,922	—101,979	— 26,387	— 75,028	— 77,644	345,393	— 80,679	— 63,225	—17,835	— 92,249
30...	382,964	— 90,976	— 50,912	— 78,593	— 79,466	277,638	— 72,793	— 66,969	—44,644	— 70,648
40...	300,104	— 69,001	— 53,753	— 60,027	— 62,469	149,281	— 56,906	— 53,260	—43,725	— 51,133
50...	232,174	— 48,428	— 41,669	— 43,460	— 41,108	50,472	— 38,400	— 36,506	—32,643	— 34,105
60...	170,599	— 31,184	— 27,432	— 27,185	— 26,432	30,014	— 23,933	— 21,932	—20,005	— 19,915
70...	90,830	— 17,369	— 15,309	— 14,996	— 14,175	9,531	— 11,985	— 11,022	— 9,845	— 9,179
80...	47,068	— 7,443	— 6,466	— 6,002	— 4,332	2,225	— 4,065	— 3,414	— 2,919	— 2,461
90...	13,321	— 1,608	— 1,200	— 939	— 695	1,704	—	—	—	—
TOTALS...	1566,531	—554,331	—135,772	—346,950	—334,749	936,193	—305,100	—353,729	—52,908	—444,268
Per cent ...	194	—70	—18	—47	—45	134	—45	—54	—8	—72

TABLE No. 14.—ERRORS PER CENT IN RETURNS OF AGE—CENSUS 1927—(MALES).

Tens Digit of Age	Units Digit of Age									
	0	1	2	3	4	5	6	7	8	9
0	15	—40	0	3	2	14	5	— 6	43	—44
10	63	—66	78	—32	—25	56	30	37	9	— 4
20	42	—45	— 4	—38	—51	178	—52	—35	— 9	—81
30	265	—84	—35	—72	—80	335	—72	—65	—36	—85
40	341	—89	—62	—80	—89	287	—83	—79	—64	—90
50	386	—92	—76	—87	—85	153	—86	—86	—80	—93
60	424	—93	—82	—87	—92	159	—93	—90	—88	—96
70	432	—95	—88	—94	—96	117	—95	—95	—93	—96
80	440	—96	—91	—95	—96	81	—95	—92	—94	—95
90	649	—93	—86	—91	—91	—	—	—	—	—

TABLE No. 15.—ERRORS PER CENT IN RETURNS OF AGE—CENSUS 1927—(FEMALES).

Tens Digit of age	Units Digit of Age									
	0	1	2	3	4	5	6	7	8	9
0	17	—34	10	14	10	19	11	—17	41	—45
10	44	—71	41	—43	—31	23	—24	—46	33	—63
20	163	—78	—21	—60	—64	292	—70	—56	—16	—87
30	371	—91	—52	—83	—86	311	—84	—80	—55	—90
40	394	—94	—75	—87	—94	232	—92	—89	—76	—92
50	436	—95	—85	—92	—91	117	—93	—92	—87	—95
60	499	—96	—89	—93	—95	114	—97	—94	—91	—97
70	470	—96	—91	—96	—98	71	—97	—97	—95	—97
80	547	—96	—93	—97	—97	46	—97	—95	—95	—96
90	633	—95	—90	—93	—96	—	—	—	—	—

TABLE No. 16.—MORTALITY PER CENT "$100\,q_x$" OF EACH SEX IN THE FOLLOWING COUNTRIES.

Age x (1)	Egypt 1927		India 1901–1911		Lagos 1921–1930		England No. 9	
	Males (2)	Females (3)	Males (4)	Females (5)	Males (6)	Females (7)	Males (8)	Females (9)
10	1·281	·987	1·25	1·29	·825		·181	·180
11	1·298	1·003	1·20	1·24	·832		·173	·180
12	1·313	1·018	1·19	1·23	·823		·175	·187
13	1·331	1·035	1·22	1·24	·815		·184	·200
14	1·348	1·052	1·26	1·28	·821		·199	·214
15	1·368	1·070	1·32	1·34	·828		·218	·227
16	1·388	1·089	1·40	1·41	·851		·246	·243
17	1·407	1·109	1·47	1·48	·858		·278	·261
18	1·429	1·130	1·55	1·56	·882		·308	·279
19	1·451	1·151	1·62	1·63	·873		·332	·294
20	1·475	1·174	1·69	1·70	·914		·349	·306
21	1·499	1·197	1·76	1·76	·939	Not Computed.	·363	·316
22	1·525	1·222	1·82	1·82	·964		·374	·325
23	1·552	1·247	1·89	1·88	·990		·383	·333
24	1·580	1·274	1·96	1·94	1·017		·392	·342
25	1·611	1·302	2·03	2·00	1·045		·398	·350
26	1·639	1·331	2·10	2·06	1·073		·401	·358
27	1·671	1·361	2·16	2·12	1·137		·403	·365
28	1·706	1·393	2·23	2·18	1·150		·408	·373
29	1·740	1·426	2·30	2·24	1·199		·418	·382
30	1·776	1·461	2·35	2·31	1·232		·434	·392
31	1·815	1·497	2·44	2·37	1·266		·455	·402
32	1.854	1·535	2·52	2·44	1·300		·476	·414

33	1·898	1·575	2·61	2·51	1·336	Not Computed.	·504	·425
34	1·939	1·616	2·69	2·58	1·374		·529	·438
35	1·986	1·659	2·78	2·66	1·412		·553	·451
36	2·034	1·703	2·87	2·74	1·432		·576	·464
37	2·084	1·751	2·96	2·82	1·473		·600	·478
38	2·135	1·800	3·05	2·90	1·515		·627	·494
39	2·191	1·851	3·14	2·99	1·539		·656	·512
40	2·246	1·903	3·23	3·09	1·604		·688	·532
41	2·306	1·962	3·32	3·18	1·630		·722	·553
42	2·359	2·018	3·42	3·27	1·679		·758	·575
43	2·450	2·082	3·52	3·36	1·730		·797	·602
44	2·497	2·145	3·61	3·45	1·760		·839	·633
45	2·578	2·211	3·72	3·53	1·837		·881	·668
46	2·647	2·281	3·82	3·63	1·897		·922	·706
47	2·735	2·359	3·93	3·72	1·978		·968	·748
48	2·806	2·435	4·04	3·83	2·042		1·024	·796
49	2·910	2·512	4·16	3·94	2·158		1·093	·851
50	2·986	2·599	4·28	4·06	2·281		1·179	·915
51	3·089	2·694	4·40	4·18	2·385		1·280	·987
52	3·179	2·782	4·54	4·31	2·444		1·391	1·064
53	3·309	2·884	4·68	4·44	2·559		1·510	1·147
54	3·402	2·986	4·83	4·58	2·709		1·633	1·234
55	3·522	3·095	4·99	4·74	2·841		1·755	1·319
56	3·648	3·210	5·15	4·91	2·983		1·879	1·403
57	3·786	3·337	5·34	5·09	3·195		2·013	1·495
58	3·912	3·466	5·54	5·30	3·425		2·165	1·603
59	4·078	3·591	5·75	5·52	3·611		2·246	1·736
60	4·209	3·737	5·98	5·78	3·746		2·561	1·897
61	4·381	3·896	6·24	6·06	4·065		2·804	2·081
62	4·542	4·048	6·53	6·35	4·383		3·072	2·287
63	4·751	4·222	6·83	6·68	4·697		3·360	2·510
64	4·918	4·399	7·17	7·04	5·008		3·663	2·747
65	5·131	4·586	7·55	7·44	5·607		3·975	2·992

TABLE No. 10.—MORTALITY PER CENT "100 q_x" OF EACH SEX IN THE FOLLOWING COUNTRIES (*contd.*).

Age x (1)	Egypt 1927		India 1901–1911		Lagos 1921–1930		England No. 9	
	Males (2)	Females (3)	Males (4)	Females (5)	Males (6)	Females (7)	Males (8)	Females (9)
66	5·364	4·793	7·98	7·88	5·674	Not Computed	4·298	3·246
67	5·586	5·017	8·43	8·36	5·874		4·647	3·523
68	5·808	5·242	8·95	8·89	6·141		5·037	3·839
69	6·118	5·478	9·55	9·48	6·383		5·482	4·209
70	6·369	5·747	10·17	10·12	6·050		5·997	4·646
71	6·682	6·033	10·91	10·82	7·273		6·577	5·145
72	7·002	6·319	11·73	11·63	7·843		7·215	5·699
73	7·371	6·657	12·63	12·51	8·511		7·900	6·297
74	7·720	7·001	13·66	13·50	9·302		8·620	6·928
75	8·145	7·370	14·80	14·60	9·402		9·379	7·594
76	8·586	7·780	16·09	15·83	11·321		10·192	8·308
77	9·041	8·226	17·48	17·22	11·702		11·057	9·074
78	9·544	8·711	19·14	18·89	13·252		11·977	9·898
79	10·146	9·220	20·92	20·52	13·889		12·952	10·786
80	10·734	9·792	22·87	22·49	14·516		14·002	11·766
81	11·413	10·422	25·13	24·69	16·981		15·136	12·847
82	12·163	11·109	27·52	27·16	15·909		16·334	14·000
83	13·009	11·881	30·09	29·90	18·919		17·569	15·194
84	13·893	12·743	33·11	32·90	20·000		18·812	16·386
85	14·902	13·693	36·63	36·28	20·833		19·974	17·465
86	16·117	14·738	39·84	39·93	26·316		21·198	18·607
87	17·359	15·984	42·86	44·00	21·429		22·486	19·814
88	18·878	17·374	47·73	48·50	27·273		23·840	21·089

89	20·601	18·998	52·17	53·50	25·000	Not Computed.	25·262	22·434
90	22·643	20·835	54·55	59·07	33·333		26·752	23·852
91	24·922	23·058	60·00	65·30	25·333		28·313	25·343
92	27·921	25·857	50·00	72·39	33·333		29·945	26·910
93	31·564	29·076	100·00	80·34	50·000		31·648	28·554
94	35·849	33·412	—	—	—		33·424	30·277
95	41·503	40·968	—	—	—		35·272	32·078
96	50·280	46·356	—	—	—		37·190	33·959
97	61·798	57·609	—	—	—		39·179	35·918
98	79·412	74·359	—	—	—		41·235	37·955
99 ...	85·714	95·000	—	—	—		43·357	40·068
100	100·000	100·000	—	—	—		45·542	42·254
101	—	—	—	—	—		47·784	44·510
102	—	—	—	—	—		50·079	46·833
103	—	—	—	—	—		52·421	49·216
104	—	—	—	—	—		54·804	51·653
105	—	—	—	—	—		57·220	54·137

TABLE No. 17.—COMPARATIVE EXPECTATION OF LIFE AT QUINQUENNIAL AGES, IN EGYPT, INDIA, LAGOS AND ENGLAND.

Age	Egypt 1917–1927		India 1901·1911		Lagos 1921–1930		England No. 9		Age
	Males	Females	Males	Females	Males	Females	Males	Females	
10	38·06	41·64	33·36	33·74	43·7		54·64	57·53	10
15	35·49	38·69	30·32	30·78	40·5		50·12	53·06	15
20	32·92	35·77	27·46	27·96	37·1		45·78	48·73	20
25	30·35	32·88	24·86	25·40	33·8		41·60	44·48	25
30	27·80	30·04	22·44	22·99	30·7		37·40	40·26	30
35	25·28	27·25	20·16	20·69	27·6		33·25	36·05	35
40	22·82	24·53	18·02	18·49	24·5		29·19	31·86	40
45	20·41	21·90	15·97	16·38	21·4		25·22	27·73	45
50	18·07	19·36	13·97	14·28	18·4		21·36	23·69	50
55	15·81	16·92	11·99	12·20	15·6	Not Computed.	17·73	19·86	55
60	13·65	14·58	10·00	10·11	12·9		14·36	16·22	60
65	11·58	12·37	8·04	8·10	10·5		11·36	12·90	65
70	9·63	10·27	6·17	6·22	8·3		8·75	9·95	70
75	7·78	8·30	4·47	4·52	6·3		6·59	7·49	75
80	6·05	6·45	3·04	3·06	4·6		4·93	5·56	80
85	4·44	4·74	1·94	1·93	3·4		3·72	4·16	85
90	2·93	3·13	1·23	1·10	2·3		2·82	3·13	90
95	1·51	1·62	—	—	·5		2·12	2·33	95
100	·50	·50	—	—	—		1·59	1·73	100.

TABLE No. 18.

Egyptian Life-Table. *Males* (1917–1927).

Age x	l_x	d_x	p_x	q_x	L_x	e_x	Age x
10	100,000	1,281	·98719	·01281	99,360	38.06	10
11	98,719	1,281	·98702	·01298	98,079	37.55	11
12	97,438	1,279	·98687	·01313	96,799	37.03	12
13	96,159	1,280	·98669	·01331	95,519	36.52	13
14	94,879	1,279	·98652	·01348	94,240	36.01	14
15	93,600	1,280	·98632	·01368	92,960	35.49	15
16	92,320	1,281	·98612	·01388	91,680	34.98	16
17	91,039	1,281	·98593	·01407	90,399	34.46	17
18	89,758	1,283	·98751	·01429	89,117	33.95	18
19	88,475	1,284	·98549	·01451	87,833	33.43	19
20	87,191	1,288	·98525	·01475	86,547	32.92	20
21	85,903	1,289	·98501	·01499	85,259	32.40	21
22	84,614	1,287	·98475	·01525	83,971	31.89	22
23	83,327	1,295	·98448	·01552	82,680	31.37	23
24	82,032	1,295	·98420	·01580	81,385	30.86	24
25	80,737	1,298	·98389	·01611	80,088	30.35	25
26	79,439	1,292	·98361	·01639	78,788	29.83	26
27	78,137	1,306	·98329	·01671	77,484	29.32	27
28	76,831	1,301	·98294	·01706	76,176	28.81	28
29	75,520	1,316	·98260	·01740	74,862	28,31	29
30	74,204	1,320	·98224	·01776	73,544	27.80	30
31	72,884	1,322	·98185	·01815	72,223	27.29	31
32	71,562	1,322	·98146	·01854	70,901	26.79	32
33	70,240	1,336	·98102	·01898	69,572	26.28	33

34	68,904	1,336	·98461	·01939	68,236	25·78	34
35	67,568	1,342	·98014	·01986	66,897	25·28	35
36	66,226	1,344	·97966	·02034	65,554	24·78	36
37	64,882	1,355	·97916	·02084	64,070	24·28	37
38	63,527	1,353	·97864	·02136	62,716	23·79	38
39	62,174	1,365	·97809	·02191	61,492	23·31	39
40	60,809	1,366	·97754	·02246	60,126	22·82	40
41	59,443	1,371	·97694	·02306	58,758	22·33	41
42	58,072	1,370	·97641	·02359	57,387	21·85	42
43	56,702	1,389	·97550	·02450	56,008	21·36	43
44	55,313	1,381	·97503	·02497	54,623	20·89	44
45	53,932	1,390	·97422	·02578	53,237	20·41	45
46	52,542	1,391	·97353	·02647	51,847	19·93	46
47	51,151	1,391	·97265	·02735	50,452	19·46	47
48	49,752	1,399	·97194	·02806	49,054	19·00	48
49	48,356	1,407	·97090	·02910	47,653	18·53	49
50	46,919	1,402	·97014	·02986	46,248	18·07	50
51	45,547	1,407	·96911	·03089	44,844	17·61	51
52	44,140	1,403	·96821	·03179	43,439	17·16	52
53	42,737	1,414	·96691	·03309	42,030	16·70	53
54	41,323	1,406	·96598	·03402	40,620	16·26	54
55	39,917	1,406	·96478	·03522	39,214	15·81	55
56	38,511	1,405	·96352	·03648	37,809	15·37	56
57	37,106	1,405	·96214	·03786	36,404	14·94	57
58	35,701	1,393	·96088	·03912	35,005	14·50	58
59	34,308	1,399	·95922	·04078	33,609	14·07	59
60	32,909	1,385	·95791	·04209	32,217	13·65	60
61	31,524	1,381	·95619	·04381	30,834	13·23	61
62	30,143	1,369	·95458	·04542	29,459	12·81	62
63	28,774	1,367	·95249	·04751	28,091	12·40	63
64	27,407	1,348	·95082	·04918	26,733	11·99	64
65	26,059	1,337	·94869	·05131	25,391	11·58	65
66	24,722	1,326	·95941	·05364	24,059	11·18	66

TABLE No. 18 (*contd.*).

Egyptian Life-Table. *Males* (1917–1927).

Age x	l_x	d_x	p_x	q_x	L_x	e_x	Age x
67	23,396	1,307	·94414	·05586	22,743	10.79	67
68	22,089	1,283	·94192	·05808	21,448	10.40	68
69	20,806	1,273	·93882	·06118	20,170	10.01	69
70	19,533	1,244	·93631	·06369	18,911	9.63	70
71	18,289	1,222	·93318	·06682	17,678	9.25	71
72	17,067	1,195	·92998	·07002	16,480	8.87	72
73	15,872	1,170	·92629	·07371	15,287	8.50	73
74	14,702	1,135	·92280	·07720	14,135	8.14	74
75	13,567	1,105	·91855	·08145	13,015	7.78	75
76	12,462	1,070	·91414	·08586	11,927	7.42	76
77	11,392	1,030	·90959	·09041	10,877	7.08	77
78	10,362	989	·90456	·09544	9,868	6.73	78
79	9,373	951	·89854	·10146	8,898	6.39	79
80	8,422	904	·89266	·10734	7,970	6.05	80
81	7,518	858	·88587	·11413	7,089	5.72	81
82	6,660	810	·87837	·12163	6,255	5.39	82
83	5,850	761	·86991	·13009	5,470	5.07	83
84	5,089	707	·86107	·13893	4,736	4.75	84
85	4,383	653	·85098	·14902	4,051	4.44	85
86	3,729	601	·83883	·16117	3,429	4.12	86
87	3,128	543	·82641	·17359	2,857	3.83	87
88	2,585	488	·81122	·18878	2,341	3.52	88
89	2,097	432	·79399	·20601	1,881	3.22	89
90	1,665	377	·77357	·22643	1,477	2.93	90

91	1,288	321	·75078	·24922	1,128	2.64	91
92	966·7	270	·72079	·27921	831·7	2.35	92
93	696·7	219·6	·68436	·31564	586·9	2.07	93
94	477·1	170·8	·64151	·35849	391·7	1.79	94
95	306·3	127·6	·58497	·41503	242·5	1.51	95
96	178·7	89·4	·49720	·50280	134·0	1.24	96
97	89·3	55·4	·38202	·61798	61·6	.97	97
98	33·9	26·8	·20588	·79412	20·5	.74	98
99	7·1	6·1	·14286	·85714	4·1	.65	99
100	1·0	1·0	·00000	1·00000	0·5	.50	100

TABLE No. 19.

Egyptian Life-Table. *Females* (1917–1927).

Age x	l_x	d_x	p_x	q_x	L_x	e_x	Age x
10	100,000	987	·99013	·00937	99,507	41·64	10
11	99,013	993	·98997	·01003	98,517	41·05	11
12	98,020	998	·98982	·01018	97,521	40·46	12
13	97,022	1,005	·98965	·01035	96,520	39·87	13
14	96,017	1,010	·98948	·01052	95,512	39·28	14
15	95,007	1,017	·98930	·01070	94,499	38·69	15
16	93,990	1,024	·98911	·01089	93,478	38·11	16
17	92,966	1,031	·98891	·01109	92,451	37·52	17
18	91,935	1,038	·98870	·01130	91,416	36·94	18
19	90,897	1,047	·98849	·01151	90,374	36·35	19
20	89,850	1,054	·98826	·01171	89,323	35·77	20
21	88,796	1,063	·98803	·01197	88,265	35·19	21
22	87,733	1,072	·98778	·01222	87,197	34·61	32
23	86,661	1,081	·98753	·01247	86,121	34·03	23
24	85,580	1,090	·98726	·01274	85,035	33·46	24
25	84,490	1,100	·98698	·01302	83,940	32·88	25
26	83,390	1,110	·98669	·01331	82,835	32·31	26
27	82,280	1,120	·98639	·01361	81,720	31·74	27
28	81,160	1,131	·98607	·01393	80,595	31·17	28
29	80,029	1,141	·98574	·01426	79,459	30·60	29
30	78,888	1,153	·98539	·01461	78,312	30·04	30
31	77,735	1,164	·98503	·01497	77,153	29·48	31
32	76,571	1,175	·98465	·01535	75,984	28·92	32
33	75,396	1,188	·97425	·01575	74,802	28·36	33

34	74,208	1,199	·98384	·01616	73,609	27·80	34
35	73,009	1,211	·98341	·01659	72,404	27·25	35
36	71,798	1,223	·98297	·01703	71,187	26·70	36
37	70,575	1,236	·98249	·01751	69,957	26·16	37
38	69,339	1,248	·98200	·01800	68,715	25·62	38
39	68,091	1,260	·98149	·01851	67,961	25·08	39
40	66,831	1,272	·98097	·01903	66,195	24·53	40
41	65,559	1,286	·98038	·01962	64,916	24·00	41
42	64,273	1,297	·97982	·02018	63,625	23·47	42
43	62,976	1,311	·97918	·02082	62,321	22·94	43
44	61,665	1,317	·97855	·02145	61,004	22·42	44
45	60,342	1,334	·97789	·02211	59,675	21·90	45
46	59,008	1,346	·97719	·02281	58,335	21·38	46
47	57,662	1,360	·97641	·02359	56,982	20·87	47
48	56,302	1,371	·97565	·02435	55,617	20·36	48
49	54,931	1,380	·97488	·02512	54,241	19·86	49
50	53,551	1,392	·97401	·02599	52,855	19·36	50
51	52,159	1,405	·97306	·02694	51,457	18·86	51
52	50,754	1,412	·97218	·02782	50,048	18·37	52
53	49,342	1,423	·97116	·02884	48,631	17·88	53
54	47,919	1,431	·97014	·02986	47,204	17·40	54
55	46,488	1,439	·96905	·03095	45,769	16·92	55
56	45,049	1,446	·96790	·03210	44,326	16·44	56
57	43,603	1,455	·96663	·03337	42,876	15·97	57
58	42,148	1,461	·96534	·03466	41,418	15·50	58
59	40,687	1,461	·96409	·03591	39,957	15·04	59
60	39,226	1,466	·96263	·03737	38,493	14·58	60
61	37,760	1,471	·96104	·03896	37,025	14·13	61
62	36,289	1,469	·95952	·04048	35,555	13·68	62
63	34,820	1,470	·95778	·04222	34,085	13·24	63
64	33,350	1,467	·95601	·04399	32,617	12·80	64
65	31,883	1,462	·95414	·04586	31,152	12·37	65
66	30,421	1,458	·95207	·04793	29,692	11·94	66

TABLE No. 19 (*contd.*).

Egyptian Life-Table. *Females* (1917–1927).

Age x	l_x	d_x	p_x	q_x	L_x	e_x	Age x
67	28,963	1,453	·94983	·05017	28,237	11·51	67
68	27,510	1,442	·94758	·05242	26,789	11·09	68
69	26,068	1,428	·94522	·05478	25,354	10·68	69
70	24,640	1,416	·94253	·05747	23,932	10·27	70
71	23,223	1,401	·93967	·06033	22,524	9·87	71
72	21,822	1,379	·93681	·06319	21,134	9·47	72
73	20,443	1,361	·93343	·06657	19,764	9·07	73
74	19,083	1,336	·92999	·07001	18,415	8·68	74
75	17,747	1,308	·92630	·07370	17,093	8·30	75
76	16,439	1,279	·92220	·07780	15,800	7·92	76
77	15,160	1,247	·91774	·08226	14,537	7·54	77
78	13,913	1,212	·91289	·08711	13,307	7·18	78
79	12,701	1,171	·90780	·09220	12,116	6·81	79
80	11,530	1,129	·90208	·09792	10,966	6·45	80
81	10,401	1,084	·89578	·10422	9,859	6·10	81
82	9,317	1,035	·88891	·11109	8,800	5·75	82
83	8,282	984	·88119	·11881	7,790	5·41	83
84	7,298	930	·87257	·12743	6,833	5·07	84
85	6,368	972	·86307	·13693	5,932	4·74	85
86	5,496	810	·85262	·14738	5,091	4·41	86
87	4,686	749	·84016	·15984	4,362	3·09	87
88	3,937	684	·82626	·17374	3,595	4·76	88
89	3,253	618	·81002	·18998	2,944	3·44	89
90	2,635	549	·79165	·20835	2,371	3·13	90

91	2,086	481	·76942	.23058	1,846	2.82	91
92	1,605	415	·74143	·25857	1,398	2.51	92
93	1,190	346	·70924	·29076	1,017	2.21	93
94	844	282	·66588	·33412	703	1.91	94
95	562	219	·59032	·40968	453	1.62	95
96	343	159	·53644	·46356	269	1.34	96
97	184	106	·42391	·57609	131	1.04	97
98	78	58	·05641	·74359	49	.77	98
99	20	19	·05000	·95000	10·5	.55	99
100	1	1	·00000	1·00000	·5	.50	100

TABLE No. 20.—SHOWING THE AGES FOR ENGLAND, INDIA AND LAGOS, FOR WHICH THE EXPECTATIONS OF LIFE ARE APPROXIMATELY EQUAL TO THE EGYPTIAN EXPECTATIONS AT THE FOLLOWING AGES.

Males				Females			
Age	India	Lagos	England	Age	India	Lagos	England
10	—	18	29	10	—	Not Computed.	28
20	11	27	36	20	5		35
30	20	35	42	30	16		42
40	29	43	48	40	27		49
50	40	50	55	50	38		56
60	53	58	61	60	49		62
70	61	67	68	70	60		69
80	70	76	76	80	69		77
90	80	88	89 over	90	80		69 over
100	93	95	107	100	93		107

APPENDIX

"Notes on the Graduation of Age-Distribution"

The Census figures for the males and females of 1927 were grouped in quinquennial age-groups; while those of 1917 were grouped in decennial age-groups. The first step is to calculate the first four moments ν_1, ν_2, ν_3, and ν_4, about a working origin. These four moments of the males and females distributions of 1927, have been modified according to the abruptness corrections; while for the distributions of 1917 the moments have not been corrected to abruptness for lack of information. The corrected moments about the start can be obtained from the following formulæ:*

$$\mu'_1 = \nu' + \left\{\frac{1}{12}\left(a'_1 - \frac{1}{60}a'_3 + \frac{1}{2520}a'_5\right) + \frac{1}{12}\left(b'_1 - \frac{1}{60}b'_3 + \frac{1}{2520}b'_5\right)\right\}$$

$$\mu'_2 = \nu'_2 - \frac{h^2}{12} - \frac{h^2}{120}\left(a'_2 - \frac{5}{126}a'_4\right) + b'_5 \text{ terms}$$

$$\mu'_3 = \nu'_3 - \frac{h^2}{4}\nu'_1 - \frac{h^3}{40}\left(a'_1 - \frac{5}{63}a'_3 + \frac{1}{240}a'_5\right) + b_5 \text{ terms}$$

$$\mu'_4 = \nu'_4 - \frac{1}{2}\nu'_2 h^2 + \frac{7}{240}h^4 + \frac{h^4}{126}\left(a'_2 - \frac{7}{80}a'_4\right) + b_5 \text{ terms}$$

where h is the unit of grouping; a_s and b_s, are the abruptness coefficients. In the present case, there is a very steep slope at the beginning of the curve only and a high contract at the other end of the curve, thus the b_s terms vanish from the above equations, while the values of a_s are given by the formulæ:—

$$\text{Na}_1 = -\frac{1}{60}(137\,n'_1 - 163\,n'_2 + 137\,n'_3 - 63\,n'_4 + 12\,n'_5)$$

$$\text{Na}_2 = \frac{1}{12}(45\,n'_1 - 109\,n'_2 + 105\,n'_3 - 51\,n'_4 + 10\,n'_5)$$

$$\text{Na}_3 = -\frac{1}{4}(17\,n'_1 - 54\,n'_2 + 64\,n'_3 - 34\,n'_4 + 7\,n'_5)$$

$$\text{Na}_4 = (3\,n'_1 - 11\,n'_2 + 15\,n'_3 - 9\,n'_4 + 2\,n'_5)$$

$$\text{Na}_5 = -(n'_1 - 4\,n'_2 + 6\,n'_3 - 4\,n'_4 + n'_5)$$

* On Corrections for Moment Coefficients by Eleanor Fairman and Karl Pearson Biometrika, Vol. XII, p. 131-258.

while $a'_s = \frac{a_s}{h}$ where $h = \cdot 2$

N is the size of the population ; n'_1, n'_2, n'_3, n'_4 and n'_5 are the five sub-groups of the first age-group, *i.e.* the number of males or females, in the first, second, third, fourth and fifth year of age respectively, as reported in the Census of 1927 plus the proportionate numbers of the individuals, whose ages are unstated in the Census Returns.

Thus, we get, μ'_1 . μ'_2 . μ'_3 & μ'_4 about the start, then the moments about the mean μ^s can be calculated from the following equations :—

$$\mu_1 = o$$

$$\mu_2 = \mu'_2 - \mu'^2_1 \quad ; \quad \sigma = \sqrt{\mu_2}$$

$$\mu_3 = \mu'_3 - 3\,\mu'_1\,\mu'_2 + 2\,\mu'^3_1$$

$$\mu_4 = \mu'_4 - 4\,\mu'_1\,\mu'_3 - 6\,\mu'^2_1\,\mu'_2 - 3\,\mu'^4_1$$

Consequently, the two fundamental constants β_1 and β_2 determining the shape of the distribution can be easily calculated from :—

$$\beta_1 = \frac{\mu^2_3}{\mu^3_2} \quad ; \quad \beta_2 = \frac{\mu_4}{\mu^2_2}$$

It has been found that the four points (β_1, β_2) s=1, 2, 3, 4 ; representing the male and female distributions of 1927 and 1917, in the (β_1, β_2) plane, lie very close to the lower part of the biquadratic ; a criterion which indicates that the appropriate Pearsonian curve is Type IX. The curve is of the form :—

$$y = y_\sigma\,(a - x)^\lambda$$

where y_σ, a and λ are constants to be determined by the distribution in question.

Now, since the points (β_1, β_2) do not lie exactly on the lower part of the biquadratic, we are unable to find out the values of the constants such as to make the first four moments of the curve equal to those of the distribution ; but owing to the fact that β_2 is subject to a large probable error, we may be justified in fitting the distribution by a curve, the three first moments of which are equal to those of the distribution, while β_2 of the curve is not equal to that of the distribution, but equal to the value

of β_2, obtained from the biquadratic, corresponding to β_1. In this case the value of λ can be obtained from the following cubic :—

$$\lambda^3 (\beta_1 - 4) + \lambda^2 (9\beta_1 - 12) + 24\lambda\beta_1 + 16\beta_1 = 0$$

The real root of λ has been obtained by means of Newton's successive approximations. The other two constants a and y_0 can be calculated from the following equations :—

$$a = \frac{\sigma(2+\lambda)}{\sqrt{(1+\lambda)/(3+\lambda)}} \quad ; \quad y_0 = \frac{N(1+\lambda)}{a^{1+\lambda}}$$

where σ is the standard deviation of the distribution ; N is the number of the individuals composing the population.

The four curves representing the males and females distribution in 1927 and 1917, have been found by the above-mentioned method, and they assume the following equations :—

Males 1927 : $y = 2063{\cdot}80\ (19{\cdot}984040 - x)^{2{\cdot}094194}$ ..... (1)

Females 1927 : $y = 3006{\cdot}62\ (19{\cdot}997670 - x)^{1{\cdot}955479}$ ..... (2)

Males 1917 : $y = 5155{\cdot}30\ (11{\cdot}154615 - x)^{2{\cdot}467305}$ ..... (3)

Females 1917 : $y = 7760{\cdot}57\ (11{\cdot}092007 - x)^{2{\cdot}281133}$ ..... (4)

It should be noted that the unit of x is equal to 5 years in equations (1) and (2) ; while it is equal to 10 years in equations (3) and (4).

These four curves, together with the corresponding histograms of the populations, are represented by the four Diagrams (3), (4), (5) and (6).

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