ON THE
MORTALITY OF THE MEMBERS
OF
THE AMICABLE AND EQUITABLE
ASSURANCE SOCIETIES.

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THE question of the influence of age on the mortality of mankind is one of modern origin. Until the end of the seventeenth century the existence of such influence does not appear to have been suspected. The general opinion previously entertained by the most civilised classes of mankind apparently was, that the rate of mortality at all ages was constant. Life they regarded as uncertain, and equally uncertain at all ages. This opinion, however erroneous it may now appear, was not merely speculative, for at the commencement of the eighteenth century, when institutions for the assurance of lives first began to exist, it was the common practice to charge one rate of premium (about 5 per cent. per annum) for all lives, without distinction of age. The "Amicable," which is the oldest existing life-assurance office, was established in 1707, and then offered the same benefit at death to all persons without distinction of age, in consideration of the same annual premium payable during life. This society subsequently limited the admission of its members to ages between 12 and 45 years. With this limitation the Amicable continued to receive members on its original erroneous plan, down to a period so recent as the year 1808.

The establishment of the "Equitable" in the year 1762, with rates of assurance graduated according to age, was the first remarkable event in the progress of the principle that human mortality is influenced by age in a specific degree, or according to a fixed and determinate law. The first of all tables of mortality having been published by Dr. Halley, in 1692, there had thus intervened a period of seventy years from the theoretical establishment of a new principle to its adoption in practice. So limited, however, had been the progress of the new principle in the minds of the public during the seventy years, that the new scheme of the Equitable was pronounced visionary and unsafe by the law-officers of the Crown, and the application of the society for a charter was refused, although their rates of premium at the outset were twice as high as they are at the present day.

During the seventy years following the establishment of the Equitable many additional observations were made, by which was established, beyond the possibility of dispute, the fact of the influence of age on the mortality of mankind. But nothing resulted from these observations beyond the conclusion, that in a certain population, at

certain ages, the same or similar degrees of mortality recurred. No attempt, or no successful attempt, at least, had been made to connect together, by any law or principle, the rates of mortality at successive ages in the same or in different populations. All these observations, however they might differ in the classes of life observed, agreed in showing that in all populations the rate of mortality, which is very high immediately after birth, rapidly diminishes thence until the age of about 9 years; that it then slowly increases until the age of about 55 years; and that after the last age the mortality rapidly increases until the extinction of life. The fact now stated as common to all tables of mortality was announced by Dr. Price more than sixty years ago, yet the hint thus conveyed of an important truth was followed by no practical result. Until the year 1832 no person had published a table of mortality founded upon observation, in which there was any apparent or expressed bond of connection between the mortality at one age and the mortality at any other age.

In the year 1832 I published a complete set of life-assurance and annuity tables, all of which rested for their basis on mortality tables, constructed on one common principle, which is, that there are there well-marked periods of human life over which preside three specific constants which I had determined. From birth to the age of about 8 years, the constant is $32\frac{1}{2}$ per cent., being the rate at which the mortality decreases for each advance of one year in age; from 12 to about 55 years of age the constant rate of increase in the mortality is 3 per cent. for each year of age; after 55 years the constant rate of increase is 8 per cent. for each year of age. At the time of publishing these tables I produced evidence of the universal applicability of these constants to all tables of mortality whose credit was established. I made also a special selection of one particular observation, that by Dr. Heysham, at Carlisle, which then enjoyed a higher reputation than any other, and from this observation I constructed a table (village mortality) in agreement with my theory. I then compared the results of this theoretical table with the results from the table of Mr. Milne, founded upon the same observation; and from their coincidence, almost exact throughout, was enabled to show that so far as regarded the Carlisle observation my theory was true, if Mr. Milne's table was a true representation of that observation.

Since the year 1832 there have been received by the public three new and valuable statements or observations of mortality in England,—all of which accord well with my theory of mortality and my published tables. The first was a statement of the number of registered deaths in England and Wales, with distinction of ages, for 18 years, to the 31st December, 1830. This statement of the

dying and their ages, in combination with a previous statement or enumeration of the living population and their ages made in the year 1821, constituted the first complete observation which had ever been made of the mortality of the total (or any large portion of) population of England. The result of this observation was first published in *THE LANCET*, Nos. 640, 641 (Dec. 1835). The resulting mortality of the English population was not found materially to differ from the mortality long previously observed of the population of Sweden and Finland, except in one remarkable particular, regarding that of children. The mortality under 5 years of age was found to be in England more than one-third part less than it had been supposed to be, or than it had ever before been observed in any population. This reduction in the relative mortality of children, the mortality of adults remaining stationary, or nearly so, was anticipated by me; and I had previously published tables which for ages under 10 years differed materially from all preceding tables and observations of mortality. The difference between my new table and previous tables did not consist merely in a proportionate reduction of the mortality at all ages under 10 years; for, in order to make the diminution in infancy accord with my theory, it became necessary to reduce the mortality from birth to 5 years of age, in a much greater proportion than the mortality from 5 to 10 years of age, and thus to change the usual relative proportions between the mortalities at these two intervals of age. The reduction made in the manner indicated has been found to be in agreement with the observation of the mortality of the population of England, and its correctness, as well as that of the theory on which it was founded, has thus received the strongest confirmation. The discrepancy also at ages under 10 years, between the English and all other observations of mortality, was thus explained before the existence of such discrepancy could have been known.

The second of the observations alluded to, and which appeared nearly simultaneously with the preceding, is that made on the mortality of the members of the Equitable Assurance Society, from its commencement in 1762, to the 1st January, 1829. At the time of its publication this was by far the most valuable observation which had been until then made on the mortality of any class of people. In the case of ordinary observations on the mixed population of a district or territory, the information obtained rests generally upon the unsupported statements of their ages made by a multitude of individuals. Although the approach to truth of these statements in the aggregate will hardly be denied, yet their accuracy may fairly be questioned when it is considered that there is little or no check on any wilful misrepresentation. The value of these general ob-

servations on mortality rests principally upon the probability that the errors with which they abound being in different directions, will reciprocally destroy or neutralise one another, leaving a result nearly as correct as it would have been if there had been no error in the individual facts. This remark is also applicable to errors of enumeration of the living, or of registration of the dying, which may also be presumed to balance one another. These defects, to which observations on the mortality of general populations are liable, do not exist in observations on their members made by life-assurance offices, for the ages of all members are certified, and any error or false statement subjects the member to the forfeiture of his policy, together with all the premiums which have been paid. Any defect also in the registration of deaths, or in the enumeration of the living, is highly improbable, and next to impossible; for the death of a member, or the fact of his continuance as a member, living in any year, cannot fail to be recorded in the office-books. If a member dies, there will be entered at that time payment of the claim under his policy; if he continued to be a member during any year, that fact will be shown by his having paid his premium during that year to the office: for these reasons the observations on the mortality experienced in life-assurance offices (to which life-annuity offices may be added) are much more valuable, as correct registries of facts, than observations on the mortality of general populations can be expected to be; in the one case the alleged facts being supported by evidence, in the other case such support being wanting.

There is, however, one defect to which most observations on the members of assurance or annuity societies are liable, which consists in the members not being average lives, but having been at their admission selected as better than average lives of the same age and station. The effect of this selection is to depress below the average the mortality at every age of newly-admitted members. This diminution of the mortality at any age, which is proportional to the recency of admission, renders useless any observation on the mortality of the total of members indiscriminately: for the mortality at any age will be dependent on the proportions of newly and anciently-selected lives entering into the formation of the aggregate. It is only within a very recent period that any account has been taken of the disturbing effect of selection on the laws of mortality. It was formerly supposed that a good law or table of mortality must be true under all circumstances, and be independent of any agency of man. It is now becoming extensively known that it is by no means difficult to distinguish good from bad lives, and by collecting the good lives, or those better than average lives, thus to reduce at any age the mortality of the selected class below that of

the larger class of people from which the selection has been made.

With a view to obviate the defects just pointed out, the observation on the mortality of the members of the Equitable, from its commencement in 1762 to Jan. 18, 1829, was made according to a new plan, the object of which was to afford the means of separating at every age the mortality of members admitted at one year of age from the mortality of those admitted at any other year of age. By this new plan, a statement was made in detail of the mortality at each year of age as suffered by each class of members admitted in any of the preceding years of age. For example, in the 50th year of age, not only was the total mortality of all the members in that year of age stated, but the mortality in that year was separately stated of those who had been admitted in their 49th, 48th, 47th, or any lower year of age. Materials were thus supplied for the first time, whereby might be appreciated the disturbing effect of selection at different ages. These materials were not, however, applied by Mr. Morgan, the actuary of the Equitable, to the purpose for which they were appropriate; he confined himself to drawing conclusions from the aggregate mortality at different years of age, in the same manner as he would have done if the new distinction of years from admission had not been introduced. Excepting myself, I am not aware that any person has made any attempt to apply the new materials supplied by the Equitable to the purpose to which they are specially adapted. In THE LANCET of October and November of 1837, I have given the results of the observation, distinguishing at the same ages the mortality of those who had been members less than 5 years from that of those who had been members from 5 to 10 years, or from 10 to 15, or from 15 to 20 years, &c. &c. From these results it appeared that the mortality at any given age was greatly dependent on the time elapsed since admission, and that it increased, as that time increased. As the form in which I have given these results has since appeared to me capable of some improvement, I have availed myself of the present opportunity to recast my observations and calculations on the materials supplied by the Equitable; and I now present the reader with a new series of results founded upon the published experience of that society. Although the present results are derived from a new investigation, they will be found to be the same in substance with the results already published. The chief difference is in the classification made of the facts, the present being thought more suited for comparison with other observations of the same nature.

We come now to the third of the important observations on human mortality which have been made during the last ten years, which is, the observation published a few months

ago by the AMICABLE Life-Assurance Society, of the mortality experienced by its members during thirty-three years, from the 5th April, 1808, to the 5th April, 1841. The chief value of this observation, like that of the Equitable, consists in the mortality of the members admitted at each year of age being separately stated, from their entrance to their departure or death. The actuary of the society, Mr. Galloway, has not, however, attempted to make any use of the ample details collected, with the view of ascertaining in what degree selection might have affected the mortality at different ages. Indeed, Mr. Galloway follows the example of Mr. Morgan in this respect; both contenting themselves with laying before the public the rude materials of what may be valuable information, but leaving to others the task of finding it out. However much the materials published by Mr. Morgan and Mr. Galloway may excel in value all previously published, the results published by them differ in no respect from the results of materials of the most ordinary description.

Before proceeding to describe the results of the present observations of the Amicable and Equitable, it may be well, as a preliminary step, to say a few words as to the mode in which observations of this kind are made. All such observations consist of aggregations of lifetime and correspondent deaths, both distinguished according to age. The elements of the observation in each individual case are (1), the age at admission; (2) the duration of membership (and, consequently, the age at departure); and (3), the mode of departure from observation, whether by death, by voluntary secession, or by having been a living member at the termination of the period of observation. When these three things are known, nothing more is requisite in each individual case. What remains is, to collect together for each year of age all who have lived through that year, all who have died in that year, all who have discontinued their assurances in that year, and all who were living in that year when the observation terminated. If it is desired to distinguish at any age the mortality of members who were admitted in different years of age, it will be necessary to divide the foregoing aggregates into two or more parts, separating, for instance, the observed mortalities of those who had been members less than five years, and those who had been members more than five years, which separation can always be made in observations detailed like those of the Amicable or Equitable. From these materials so collected the mortality for each year of age may be accurately determined, which is the object of the observation.

An example will render this more clear. Let us suppose the year of age under observation to be the 46th, and let us also suppose that it has been observed that exactly 1015

members had completed their 45th year of age, and that exactly 973 members had completed their 46th year of age whilst belonging to the society. There will thus be a decrement of 42 in the 46th year of age, which decrement we may suppose made up of 12 deaths, 14 voluntary departures, and 16 living in that year of age when the period of observation terminated. These 42 who have departed or passed from observation in their 46th year of age, will upon an average each of them have belonged to the society one-half of that year, it being equally probable that as many will have departed in one month as in another month of that year, or that as many will have lived more than half of the year in the society as will have lived less than half of the year. The departed members will have lived together (in the society) the half of 42 years or 21 years, which last number is to be added to 973, or the number of entire years of life which had been observed in the 46th year of age. In that year of age there will thus have been observed a total of $(973 + 21 =) 994$ years of life, and a correspondent number of 12 deaths. The proportion of 994 to 12 just arrived at, expresses the relation between the constantly living and the dying of the supposed population between the ages of 45 and 46 complete years, and is, in fact, the simplest and most correct form of stating the result of the observation for that or any year of age. For the purpose of framing tables of mortality, however, the most common and advantageous mode of expressing the mortality observed in any year of age is by a comparison of the number dying during any year of age, with the number alive at the beginning of that year of age. Taking the example before cited, 973 having been alive throughout, and at the end of the 46th year of age there will have to be added thereto 12, the total number of deaths, together with 15, being the half of those who passed from observation alive during the 46th year of their age, and there will be found 1000 as the number completing the age of 45 years, out of whom 12 deaths occur before the completion of their 46th year, yielding a percentage of 1.20 or $1\frac{1}{5}$ for the year. The result just arrived at differs in form only from the result before arrived at, expressing the relation between the constantly living and the dying in the same year of age. The advantage of the latter mode of expressing the result, consists in the facility which it affords for the tabulation of the results; the proportions surviving from any given year of age, at successive yearly or quinquennial intervals, being hence most easily deducible. When from any observation the proportions surviving from year to year of age have been successively obtained, and when from these proportions have been deduced the similar proportions for periods of five years of age, there will have been obtained all the informa-

tion which the observed facts are capable of yielding.

The published observations of the Amicable and Equitable are the same in form, although there exists some difference in the mode of adjustment of the mortality for fractional years of age. Since the admissions into a society do not take place exactly at the completion of any year of age, but occur, taking one with another, at the middle of the year of age, it was necessary to contrive some method whereby these fractions of years might be made to disappear. Mr. Galloway's plan of proceeding has been to assume that all who entered in any year of age during each year of the observation, entered at the middle of that year of age. Having completed his observation for successive ages, reckoned from the middle of one year to the middle of the next, he regains the usual division of age by taking the mean of each two successive fractional years of age. For example, the mortality of the 47th year of age, or from 46 complete years to 47 complete years, is derived by adding together the mortalities of the years of age from $45\frac{1}{2}$ to $46\frac{1}{2}$, and from $46\frac{1}{2}$ to $47\frac{1}{2}$, and dividing the sum by two. Mr. Morgan has adopted a different plan from that just described. He assumes that all who have been admitted during any year of the observation, in any specific year of age, will have completed that year of age at the end of such year of the observation. Having made this assumption, he disregards any mortality occurring in the fractional part of the first year of admission, and commences the observation from the beginning of the ensuing year when the age is expressible without fractions of a year. For example, if a member had been admitted in the 45th year of age in any part of the year 1821, he will have been regarded as having completed his 45th year, or as being exactly 45 years old on the 31st December, 1821, and for the purposes of the observation no account will have been taken of this member before the 1st January, 1822. Although, as I have learned from inquiries, this is the mode of proceeding adopted by Mr. Morgan, yet there is no statement to this effect published by him. In the absence of such statement I had concluded that his plan was the same as that since adopted by Mr. Galloway, and that the ages given in the marginal columns were the office ages, and not the true or corrected ages; and in consequence the results which I have given in *THE LANCET*, October and November, 1837, correspond to ages half a year greater than the marginal ages of the tables there given. With this correction, the tables which I then gave of the Equitable experience, are in agreement with the tables which I now give.

In its principal feature, the arrangement which I now make of the facts observed in the Amicable and Equitable, is the same as that which I adopted for the Equitable in

the year 1837. I allude now to the separation from each other of the mortality suffered by members of less than five years from that of members of more than five years' standing. The result of the observation now made on the members of the Amicable fully confirms the propriety of such distinction being drawn. For in the Amicable, as in the Equitable, it is found that among members of more than 5 years' standing, the mortality has been as high and as regular as it is in tables of mortality highest in repute; whilst for members of less than 5 years' standing, the mortality has been lower and more irregular than that indicated by any table of mortality.

The results deduced from the present observation of the members of the Amicable and Equitable Assurance Societies will be found exhibited in a concise and complete form in the four tables subjoined. In tables (1) and (2) are presented the principal results, together with the facts on which they are based, without regard to any theory or peculiar medium of view. In tables (3) and (4) are presented for comparison results of combinations of the same facts, and results flowing from the adoption of a specific theory of mortality; the object of the comparison being to show that the two series of results, actual and theoretical, are almost coincident at all ages, and that they do not differ so much from one another as do generally the series of actual results, and the series of adjusted results of calculators of mortality tables from observation. In all these four tables the divisions of age observed upon are the same; the intervals of age are quinquennial; and the commencement or termination of any interval is at one of the ages 30, 35, 40, &c. &c., or 90 complete years. In all the four tables, also, the results express exact or determined relations between the numbers living at the beginning of any quinquennial period of age, and the number, as reduced by death, at the end of that period. In the first three tables it is stated how many died in passing through each quinquennial interval of age out of an assumed number of 100 alive at the beginning of the same interval. In table (4) a constant number living is assumed at a given age, which number is successively reduced at each quinquennial stage, in proportions previously indicated. In the first three tables the proportionate mortality in each quinquennial interval of age is stated independently of the mortality at preceding or succeeding intervals of age; in the fourth table, the numbers expressing the survivors (and indirectly the mortality) at successive intervals of five years of age, form a connected series, of which any two terms, distant from each other two or more intervals, express by their difference the total mortality suffered at all the intermediate intervals of age.

On inspection of tables (1) and (2), it will

be immediately seen that in the Amicable, as in the Equitable, the mortality at any age increases with the duration of membership; that the mortality of persons of a given age who had been members from 5 to 15 years, was considerably greater than the mortality of those who had been members less than 5 years; whilst the mortality of those who had been members more than 15 years, was greater than that of those who had been members from 5 to 15 years. In the Amicable, the difference between the mortality of the first 5 years of membership, and the mortality of membership exceeding 5 years, is considerably greater than it is in the Equitable. In the Amicable the proportion of the former to the latter is that of 2 to 3 nearly at all ages; in the Equitable, the proportion generally is that of 3 to 4 nearly; that is to say, in the Amicable, at given ages, the mortality of the older members exceeds that of new members by 50 per cent.; in the Equitable this excess is about 34 per cent. It will be observed that in the two tables the successive numbers in column (1) (applicable to members of less than 5 years' standing) do not increase regularly with the age (as they do in the other columns), and that at one period they decrease instead of increasing with the age. In column (1) of both tables the mortality is at a maximum between the ages of 35 and 40 years; from which quinquennial period it decreases slowly, or is almost stationary until the age of 50 years is reached. From this it may be inferred that the effect of selection in reducing the mortality, increases from 35 to 50 years of age; or that it is more easy to distinguish good from bad lives between 45 and 50, than it is between 35 and 40 years of age.

What has just been stated will serve to explain in a great measure two extraordinary and contradictory statements made by Mr. Galloway and by the "Government calculator," respecting the rate at which the mortality increases below the age of 50 years. Both of these statements are equally at variance with the results of previous observations; but the variation of one statement is in an opposite direction to that of the other statement. According to the Government calculator, the mortality between the ages of 35 and 50 years does not increase with the age, but is stationary. According to the statement now made by Mr. Galloway, the mortality between those ages increases 6 per cent. for each advance of one year in age. The truth lies exactly half way between these two contradictory statements, the true rate of increase between those ages being 3 per cent. for each year of age. The erroneous inference of the Government calculator probably arose from applying generally what is strictly true only of persons who had been members or annuitants less than five years; the proportion of such newly admitted annuitants to the total existing annui-

tables under the age of 50 years, having been so great as to give to the resulting mortality of the total a form nearly resembling that of column (1) in the tables of the Amicable and Equitable. The erroneous inference of Mr. Galloway arises from confounding together the mortalities in columns (1), (2), and (3), in neither of which columns separately does the mortality below 50 years of age increase more than 3 per cent. for each advance of one year in age. The first part of Mr. Galloway's table consists wholly of the facts belonging to column (1); the last part of his table consists wholly of the facts belonging to column (3). It has already been seen that at any given age the mortality in column (3) exceeds that in column (1) by at least 50 per cent. It is hence manifest that Mr. Galloway's table of mortality will express not only the increase due to the increase of age, but will also express the increase consequent on the passage from the mortality of column (1) to that of column (3), being an excess, ultimately, of more than 50 per cent.

The classification of the results of observation on the members of the Amicable and Equitable, as exhibited in columns (1), (2), and (3), of tables (1) and (2), with the view to show the increase of the mortality at any given age, according as the time from admission increases, is new, and, I believe, has never been made by any person but myself. The reader may now learn with some surprise that the information contained in column (4) of the same tables is also new, and not to be found elsewhere; although the numbers given in the column are merely an exact statement of the results of the total observed facts in the Amicable and Equitable, without any distinction of duration of membership. Neither Mr. Morgan nor Mr. Galloway has thought it necessary to present any such statement of actual results where-with the reader might compare his statement of artificial or adjusted results. The more valuable statement has been omitted for the sake of the less valuable; instead of facts, the reader is presented with opinions under the semblance of facts. One example will suffice to show how erroneous may be the conclusions drawn from such statements of opinions and facts intermingled. The example will be drawn from a general comparative table of results from various laws of mortality given by Mr. Galloway in the last page of his pamphlet. This table has a very imposing statistical appearance; it is, nevertheless, true, that out of the multitude of numbers contained, there is not one expressing an observed fact. In this table the mortality (among others) of the Equitable and Amicable are compared. It is there stated that out of 100 alive at the age of 50 years, the numbers dying before the completion of the age 55 years were, 10.07 in the Amicable, and 8.41 in the Equitable; that is to say, the mortality at this age is alleged to have

been 20 per cent. higher in the Amicable than in the Equitable. The truth is, however, that the observed relation at this age was the reverse of that stated; the observed mortality in the Amicable having been 5 per cent. less than the observed mortality in the Equitable. The discrepancy has arisen from a difference of opinion in the framers of the tables compared. To suit his theory of adjustment, Mr. Galloway found it necessary to add 11 per cent. to the number given by observation; whilst, on the other hand, Mr. Morgan, for a similar reason, found it necessary to deduct 11 per cent. from the number observed by him. I may be excused for here remarking in passing, that in order to render my theory of mortality consistent with the facts observed in the Amicable or Equitable, I have in no case found it necessary to deviate so far from observation as Mr. Morgan and Mr. Galloway have done in the instance now cited.

In tables (3) and (4) are given the final results of the observations on the members of the Amicable and Equitable, founded upon all the facts observed, exclusive of those in the first five years of membership. Collaterally with these results are placed, for comparison, similar results obtained from two theoretical tables; which two series of results are very nearly coincident, one with the other, throughout their whole extent. The two theoretical tables used are those which I have published under the names "Village Mortality" and "Mean Mortality;" the latter being my chief table, and serving as the foundation of an entire series of annuity tables at various rates of interest. The connection between the two tables is of a very simple nature, the mortality of the latter being at every age exactly 20 per cent. greater than that of the former; in both tables the mortality increases at the same rate during the same periods, viz., 3 per cent. for each year from 12 to 55 years of age, and 8 per cent. at all ages above 55 years of age. The village table is identical with what is usually known as the Carlisle table, at least it is so with the allowance made of a most insignificant deviation from the presumed facts observed,—a deviation necessary to render these facts consistent with my theory of mortality. This table represents the lowest mortality ever alleged to have been observed. Believing that, if so low a mortality exists any where, it will be found in a village population and not in a town population, I have thought it right to designate it as village mortality. On inspection of columns (1) and (2) of table (3), it will be seen that the results of this village table closely coincide with the results of the Amicable observation for a period of fifty successive years of age, being the whole extent of the observation when the facts are sufficient in number to serve as a basis, or probably correct index of the truth. The coincidence here

spoken of is in degree twice as close as that of Mr. Galloway's adjusted table with actual observation. The average deviation of Mr. Galloway's table from his observed facts, during the ten quinquennial stages from 40 to 90 years of age, is $5\frac{1}{2}$ (5.80) per cent.; the corresponding average quinquennial deviation of the village table above mentioned from the fact observed is only $2\frac{1}{2}$ (2.63) per cent., being less than one-half of Mr. Galloway's deviation from the facts.

For a period of fifty successive years the village table is coincident with the observation of the Amicable; the coincidence is not, however, age for age, but the age in one case is always three years greater than in the other case. The observed fact in the Amicable at any given age agrees with the mortality indicated by the village table at an age three years greater. The ages 40, 52, and 90 years in the Amicable, correspond with the ages 43, 55, and 93 years in the village table; consequently the mortality in the Amicable at any age above 55 years, is 26 per cent. greater than the mortality indicated by the village table at the same age; this excess being the increase in three years when the increase for one year of age is 8 per cent. according to the theory.

The coincidence of the Amicable observation with the village table, year for year, at ages differing constantly by three years, is a fact deserving special notice, inasmuch as the age of 55 years in the village table is a remarkable epoch, which will render the corresponding age of 52 years equally remarkable, according to the fact observed in the Amicable. In the construction of the village table, and, indeed, of all my theoretical tables, I had assumed the age of 55 years (complete) to be the age at which the rate of increase in the mortality changes from one constant to another, or from 3 per cent. to 8 per cent. for each year of age. The present observation of the Amicable (with which that of the Equitable agrees) shows that instead of 55 the age of 52 complete years is the epoch at which this remarkable change in human life occurs, or rather in the class of life observed. This difference, or a similar difference, had, however, been anticipated by me; for at the time of publishing my "Life Tables," I stated that the age of 55 years was the earliest at which the limit was found in any table of mortality in repute, but that I believed that future observations would show that this limit was receding, and receding in a much greater degree than the infancy limit would be found to be receding. Before the publication of any facts confirmatory of my opinion, I had constructed my principal tables, having the limit of infancy placed one year further back than it had ever been observed. If I had acted further in accordance with my expressed opinion, and removed back the second limit 3 years,

I should then have expressed the fact indicated by the Amicable observation, I do not, however, feel any wish that I had proceeded differently in the construction of my theoretical tables, and placed the limit at 52 instead of 55 years of age. I do not regard the retrocession of the limit as permanent and applicable to all classes of life. Moreover the difference (or defect, as it may be called) is in favour of assurance offices using my tables, affording them a small advantage below the age of 55 years, which such offices ought not to be expected to forego.

The observation of the Equitable agrees with that of the Amicable in indicating 52 years of age as the limit dividing human life into two well-marked periods. Both these observations being in accordance with my theory of mortality, it will hence follow that the relative mortality at different ages is the same in the Equitable as it is in the Amicable; that is to say, taking any two years of age for comparison, whatever is the proportion between the mortalities at these ages in the Amicable, the same proportion will be found existing in the Equitable. The absolute mortality in the two societies, however, is not the same, the mortality in the Amicable at any age being 8 per cent. greater than it is in the Equitable at the same age. On inspection of columns (3) and (4) of table (3), it will be seen how near the fact observed in the Equitable (exclusive of membership under five years) agrees with the village table at ages two years older. Below the age of 53 years the comparison fails, because at the correspondent age, 55 years in the village table, the limit occurs, dividing the higher from the lower rate of increase in the mortality, whilst such limit should have occurred at the age 54 in the village table, in order to render the results immediately comparable with the Equitable observation, whereof the age at which the limit occurs is 52 years. It was not thought necessary to reconstruct the portion of the village table below the age of 55 years, for the purpose of completing this comparison. The desired object will be equally well attained if the reader will bear in mind that the results in column (4), below the age of 50 years, are all to be reduced (8—3) 5 per cent., this being the reduction to be made consequent on putting back the limit one year.

There is, perhaps, no one of the results of the Amicable and Equitable observations more valuable and interesting than that just referred to, fixing the point of junction of the two series at the mean age of 52 complete years, and determining at the same time the relative mortality above and below 50, 55 years of age. The resulting relation is different from that indicated by all preceding tables, although it has been anticipated by me. In all former tables the annual rate of increase in the mortality between the ages of

52 and 55 years was 3 per cent., in the present observations of the Amicable and Equitable the annual rate of increase is 8 per cent. in the same years, leaving an excess of 5 per cent. each year. The total excess in the three years of age will consequently amount to 16 per cent. nearly; that is to say, the present observations establish the fact, that the disproportion between the mortalities above and below the age 52—55 years, is 16 per cent. greater than it has been supposed to be. The present is a favourable opportunity for remarking generally, that the comparison of old with recent observations would seem to indicate that the mortality at ages above 55 years has undergone little or no diminution; that the mortality from 10 to 55 years has decreased 15 or 20 per cent., whilst the mortality under 9 years has fallen 30 or 40 per cent.

The results from the observations of the Amicable and Equitable have been found, as has been stated, in accordance with each other, with one exception, viz., that the absolute mortality in the Amicable is at every age 8 per cent. greater than it is at the Equitable. This difference it is difficult to account for satisfactorily, as the classes of people observed and the times of observation were not dissimilar: there does not appear to be any good reason for preferring one statement to the other. The only seeming advantage which the Equitable possesses over the Amicable is in the greater comparative multitude of its facts. But notwithstanding this superiority in numbers, the Equitable results do not better accord with my theory of mortality than do the Amicable results; the chain of connection in the two series of results is the same, and the different parts of each series are consistent with, and are confirmed by, all the other parts of the same series. Whence it is to be inferred, that if there exists any inferiority in the Amicable observation, it does not arise from a deficiency in the number of facts observed, as the consistency of the resulting facts will hardly admit of being increased. Since, then, the two statements are on an equality with respect to their claims to credit and applicability to general purposes, it appeared to me desirable to form a table of mortality intermediate between the statements of the Equitable and Amicable, each statement being allowed equal weight. The results from such compound of statements are found at column (5) of tables (3) and (4). In the adjoining column (6) of the same tables, are placed for comparison the corresponding results from my chief table of "Mean Mortality," with the limit placed at 52 instead of 55 years of age. The coincidence between the two series of results, term for term, is as close as can be desired. During the twelve quinquennial stages from 30 to 90 years of age (which is the whole extent of the obser-

vation), the average deviation between the numbers according to fact, and the numbers given by theory, is 2 (2.11) per cent. The maximum deviation is at the age 50 to 55 years, where the change from one constant to another occurs; it there amounts to $7\frac{1}{2}$ per cent., which is twice as great as the deviation at any other quinquennial interval of age. Exclusive of this deviation the average deviation of the remaining eleven quinquennial stages is only $1\frac{1}{2}$ (1.61) per cent.; that is to say, above and below the point of junction, the difference between the results of the theory and the actually observed facts, is represented by the insignificant average deviation of $1\frac{1}{2}$ per cent. With such an extraordinary degree of coincidence, I have every reason to be satisfied with the statements of facts published by Mr. Morgan and Mr. Galloway. It would have been impossible to invent or fabricate facts more consonant with opinions and tables published by me ten years ago.

The numbers in table (4) are derived from the numbers in the preceding table: in table (3) the mortality is shown independently for each quinquennial interval of age; in table (4) is shown the accumulated effect of the mortality in all previous stages, by its operation on an assumed number of living at a given age. The table will be sufficiently intelligible without further explanation. I would wish, however, to direct attention to the two series of actual and theoretical results at extremely high ages, in that part of the table having reference to the Amicable observation. If the theory is to fail anywhere, it might be expected to fail at extreme ages; nevertheless, it will be easy to show that my theory represents the facts more nearly than does Mr. Galloway's adjusted table at the ages from 80 to 95 years; the fact observed between the ages of 80 and 95 years being included, although it is entitled to no regard, as it rests on only eleven observed deaths. Assuming in all cases the number living at the age of 55 years in the Amicable to be 1000, there would survive at the ages 80, 85, 90 and 95 years respectively, according to the fact observed, 170, 61, 15 and 3; and according to Mr. Galloway's adjusted table, 173, 70, 20, and 3,—the respective deviations from the observed facts being 3, 9, 5, and 0, or 17 in all. On reference to columns (1) and (2) of table (4), it may be seen that at the same ages the corresponding deviations between my theory and the observed facts are, 0, 3, 0, and 1, being 4 in all; that is to say, Mr. Galloway's deviation from the fact at the four extreme ages is represented by 17; whilst that of my theory is represented by 4 only, which is less than one-fourth part of Mr. Galloway's deviation.

(1).—TABLE exhibiting the Mortality experienced in the *Amicable Assurance Society* during 33 years, ending the 5th April, 1841: the mortality of three classes of members being separately expressed, each being denoted by the proportional numbers who died during successive periods of five years of age, out of a constant number of 100 supposed to be alive at the commencement of each of such periods of age; also, showing the numbers of deaths on which the resulting rates of mortality are respectively founded.

Interval of Age.	Of Members admitted since 5th April, 1808.		Of Members admitted previous to 5th April, 1808, without distinction of duration of Membership.	Mortality per cent. of the Total of Members during the 33 years.	Numbers of Deaths on which annexed results are respectively based.			
	Membership under 5 years. (1)	Membership above 5 years. (2)			(1)	(2)	(3)	Total. (4)
30—35	3.65	—	—	3.32	17½	5½		23
35—40	4.83	(3.62)		4.21	27	17	1	45
40—45	4.07	6.27		5.66	21½	44	11	76½
45—50	4.36	7.80	8.14	6.86	18	63	18	99
50—55	5.43	8.98	12.76	9.04	16½	69	46	131½
55—60	8.52	13.46	13.17	12.58	19	89	72	180
60—65	13.88	18.17	22.39	19.78	21½	94	148	263½
65—70	14.25	25.97	26.00	25.12	11½	93½	160	265
70—75		34.14	38.15	37.01	10	75½	199	284½
75—80		48.29	48.14	48.51	2½	51	163	216½
80—85		51.74	66.18	64.31		17	117	134
85—90			73.10	74.93		6½	43	49½
					165	625	978	1768

(2).—TABLE exhibiting, at successive quinquennial intervals of age, the Rates of Mortality experienced in the *Equitable Assurance Society* during 66 years, to the 1st of January, 1829; distinction being made of three classes of members, arranged according to the length of time they had been members of the Society when their mortality was observed.

Interval of Age.	Dying in Five Years out of 100.				Deaths observed in each Quinquennial Interval.			
	Membership from ½ to 5½ years. (1)	Membership from 5½ to 15½ years. (2)	Membership above 15½ years. (3)	Total. (4)	½ to 5½ (1)	5½ to 15½ (2)	Above 15½ (3)	Total. (4)
					(1)	(2)	(3)	(4)
20—25	3.33	—	—	3.63	39	10	2	51
25—30	3.50	—	—	3.64	87	26	1	114
30—35	3.21	4.67	—	3.79	107	96	4	207
35—40	5.04	5.39	—	5.23	167	180	18	365
40—45	4.65	5.86	7.77	5.62	130	229	66	425
45—50	5.67	6.59	8.32	6.72	120	239	137	496
50—55	8.98	8.99	10.53	9.48	134	262	215	611
55—60	10.30	11.99	13.53	12.32	98	247	294	639
60—65	11.59	15.78	18.34	16.52	61	215	362	638
65—70	19.98	23.89	25.61	24.55	41	195	395	631
70—75	—	31.56	34.41	33.76	—	122	355	477
75—80	—	47.33	45.44	45.61	—	41	247	288
80—85	—	—	52.85	52.85	—	—	122	122
85—90	—	—	68.58	68.58	—	—	45	45
					984	1862	2263	5109

(3.)—TABLE representing the Mortality experienced in the *Amicable* and *Equitable* Assurance Societies among their members of more than five years' standing, being the results from combining columns (2) and (3) of the preceding tables; with which are compared results from published theoretical tables which have been constructed on the principle that the rate of mortality increases 3 per cent. each year, under 52—55 years of age, and increases 8 per cent. each year above that age.

Interval of Age.	Amicable.		Equitable.		Amicable & Equitable combined.		Deaths observed.	
	Fact observed.	Village Table at Ages three years older.	Fact observed.	Village Table at Ages two years older.	Fact.	Table of Mean Mortality.	Amicable.	Equitable.
30—35	Insuffi-	5.17	4.66	5.02	4.91	4.93	—	100
35—40	cient.	5.96	5.50	5.79	5.73	5.69	—	198
40—45	6.70	6.88	6.17	6.68	6.44	6.57	55	295
45—50	7.85	7.92	7.13	7.70	7.49	7.57	81	376
50—55	10.09	9.53	9.62	9.04	9.85	9.10	115	477
55—60	13.38	13.45	12.77	12.52	13.08	12.87	161	541
60—65	20.50	19.10	17.32	17.82	18.93	18.30	242	577
65—70	25.99	26.73	25.01	25.03	25.50	25.66	253½	590
70—75	37.14	36.64	33.76	34.47	35.47	35.28	274½	477
75—80	48.32	48.80	45.61	46.21	46.98	47.18	214	288
80—85	64.31	62.56	52.85	59.74	58.98	60.80	134	122
85—90	74.93	76.34	68.58	73.68	71.93	74.69	49½	45
							1579½	4086

(4.)—TABLE in connection with the preceding table (3), showing, according to the facts observed in the *Amicable* and *Equitable*, and according to theoretical tables, the proportional numbers which would have survived at different ages relatively to an assumed number of 1000 surviving at the age of 55 years.

Age.	Amicable.		Equitable.		Amicable & Equitable.		Northamp- ton Table of Mortality.	" Village " Table, usually known as the " Carlisle."
	Fact observed.	Village Table at Ages three years older.	Fact observed.	Village Table at Ages two years older.	Fact.	Table of Mean Mortality.		
30	Insuffi-	1445	1409	1427	1430	1421	1791	1395
35	cient.	1371	1344	1355	1360	1351	1638	1329
40	1294	1289	1270	1276	1282	1274	1485	1257
45	1207	1200	1191	1191	1199	1190	1327	1177
50	1112	1105	1106	1099	1109	1100	1167	1092
55	1000	1000	1000	1000	1000	1000	1000	1000
60	866	865	872	875	869	871	833	892
65	689	700	721	719	705	712	667	753
70	510	513	541	539	525	529	503	588
75	320	325	358	353	339	343	340	410
80	166	166	195	190	180	181	192	241
85	59	62	92	76	74	71	76	110
90	15	15	29	20	21	18	19	35
95	3	2	—	3	—	2	2	7

Having now brought to a conclusion my remarks on the valuable facts furnished by the *Amicable* and *Equitable* Assurance Societies, the reader must be left to judge for himself, whether or not sufficient evidence has been adduced to show that human mor-

tality is subject to a law, according to age, admitting of being as clearly defined as any law regulating the motion of the heavenly bodies. The reader may consider with himself whether it is at all probable that ordinary tables of mortality, consisting as they do

of a series of crude and undigested numbers, having no apparent connection one with another, could approach so near to tables constructed on the principles of a very simple theory, without the latter being the prototypes of the former, the latter being the universal form which all facts in mortality have a tendency to assume. It is not believed that any argument against the truth and applicability of that theory can be drawn from the slow progress which it has made among the persons who are most qualified to judge of its merits, but who are at the same time most biassed by opposing interests. I may mention, however, that some progress has been made towards the general adoption of this theory. One of my theoretical tables (village mortality) has been used by a London assurance-office, as the basis of all its calculations of mortality, for the last fourteen years. Another of my theoretical tables (mean mortality) has been similarly used by another London assurance-office for more than five years past. The difference between the scales of premiums of offices which do and which do not use my tables, is not perceptible to a casual observer: the difference is ideal rather than actual, the amount of difference being too small to be of any practical effect; but in the principles of construction the difference between my tables and the tables of any other person is as great as it is possible to conceive. In the common tables there is not one number having any apparent or expressed connection with any preceding or succeeding number. In all my tables there is not to be found one number which is not indissolubly bound to every other number in the table by simple and perfectly defined relations. In the common tables the successive decrements of life from one year of age to another are governed by no law, and vary at the caprice of the calculator. In all my tables such decrements from birth to extreme old age are governed by a mathematically expressed law, which produces in the successive results a degree of uniformity or regularity not possible to be surpassed even in imagination.

Fleet-street, London, Sept., 1842.

ON DISEASE OF THE NERVES OF THE FACE.

To the Editor of THE LANCET.

SIR,—I beg to forward you the two following cases of disease of the facial nerves; the first characterised by acute pain in the branches of the fifth pair, the second by palsy of the portio dura. I remain, Sir, your obedient servant,

R. H. SEMPLE, Surgeon.

Islington, Sept. 12, 1842.

Elizabeth Ball, ætat. 54, a healthy-looking woman, an inmate of the Islington work-
No. 991.

house, has generally enjoyed good health, with the exception of suffering occasionally from indigestion, and once, two years since, from an attack of pneumonia. About six weeks ago she first experienced a slight dimness of sight in the right eye, which, however, on examination did not present any peculiar appearance. At that time she also complained of a pricking, shooting pain in the same eye, together with pain in her forehead, face, and right ear. As no morbid appearance could be detected, and no derangement of health was apparent, she was merely recommended to bathe the eye with cold water, which, however, did not afford any relief. Since that time the pain has become gradually worse, and her health has been much impaired.

On re-examination this day, Oct. 13, 1841, the following appearances present themselves. She complains of a shooting, throbbing, burning pain in the right eye, and a sensation, as she expresses it, as if the eyeball were too large for its socket. The same kind of pain extends to the forehead as far as the vertex, backwards to the ear and occiput, and down the neck; to the right side of the nose as far as the external aperture of the right nostril, and to the upper maxillary bone, the pain originating at the situation of the infra-orbitary foramen. The upper eyelid is completely drawn over the ball of the right eye, so as completely to obstruct vision. She has no power to lift it up, and the attempt made to draw up the lid causes excruciating pain and violent action of the orbicularis palpebrarum, which immediately draws down the lid again. The falling of the lid, therefore, is not owing to palsy of the levator palpebræ superioris, but to spasmodic contraction of the orbicularis palpebrarum. When the lid is elevated, though this is done with great difficulty, she is able to see very distinctly; there is, therefore, no disease of the optic nerve, or of any of the structures of the eye itself; and the only peculiar appearance presented by the eye is, that the pupillary aperture is oval instead of round. This last appearance is probably owing to some sympathetic affection of the lenticular ganglion, which supplies the pupil with nerves.

She says that since her illness her hearing on the right side has been impaired; the power of smelling and of taste are, however, quite perfect. The pain in the parts above described is not constant, but subject to violent exacerbations and remissions, and is much increased by pressure on the regions affected. She complains of derangement of her general health; she has a sour taste in her mouth; no thirst whatever, nor any desire for food; she has vomited several times this morning; bowels moderately open; urine scanty and high-coloured; tongue covered with a thick, white fur; pulse 84, regular.