MODERN SOCIAL CONDITIONS

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A STATISTICAL STUDY OF BIRTH, MARRIAGE, DIVORCE, DEATH, DISEASE, SUICIDE, IMMIGRATION, ETC., WITH SPECIAL REFERENCE TO THE UNITED STATES

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PREFACE

THE object of this book is to meet the needs of American students who are interested in the structure and growth of the population of their country. The portion of the work devoted to the statistical method is introduced in part to render the remainder of the volume more intelligible, and in part to assist those who desire to conduct a statistical investigation. It is hoped that the volume may serve for a limited time as a book of reference for those desiring information upon the topics covered. The work of the late Professor Mayo-Smith upon "Statistics and Sociology" has proved extremely valuable in this respect, but the figures have not been brought up to date. Since the appearance of this work so much has been done by the scientific world that this seems a good time to bring together part of the results of their investigations. Wherever possible the figures relating to the United States have been used, but those for foreign countries have been introduced for purposes of comparison, and to illustrate points upon which the statistics of this country are lacking.

To the faculty of the Department of the Social Sciences in Yale University I am indebted for advice and assistance throughout the work. Permission was given by the Department of Commerce and Labor of the United States to reproduce the charts and diagrams which appear in this book. They have been introduced in each case to explain a general principle and not to elucidate the particular subject for which they were originally drawn.

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CHAPTER I

HISTORY AND THEORY OF STATISTICS

HISTORY OF STATISTICS

It is difficult to imagine a period in the history of man when statistics have not existed in a rudimentary form. There was a desire on the part of the savage to keep track of the remarkable things he had done, either as an aid to his memory or an example to his contemporaries and descendants. The warrior, cutting a notch in his weapon for each foe he has slain, is collecting statistics of mortality. When man had mastered the simpler arithmetical processes, and had invented a convenient system of notation, progress was rapid. Men could now study the same problem in many different places at the same time, and the results of their investigations be combined or compared. Facts recorded in the memory are liable to be forgotten or be misrepresented in their narration, but when placed in permanent form become fixed. These records can then be filed away to be used for purposes of comparison in the future.

The advantages of statistics were early recognized by rulers who appropriated the results for their own uses. Public utility or royal greed generally furnished the motive for enumerations, which were of two kinds. A census of the population was taken that the king might know how many men would do his bidding in time of war; or, the amount of property in the kingdom was carefully computed for purposes of taxation.

The Egyptians made a cadaster of the country with the holdings carefully plotted on it. In the Bible (II Samuel, XXIV, 1-9) there is an account of the taking of a census of Israel which consumed nine months and twenty days. Many censuses were taken by the Greeks, and Solon divided the people according to their income in medimni of wheat. This must have demanded an investigation of considerable exactness. But by far the most accurate measurements of any nation of antiquity were made by the Romans. Censuses were taken from time to time after Servius Tullius, and under the Empire at intervals of five years. The population was thus enumerated over seventy times. In connection with these, the amount of property was determined with great care. From the period of Augustus surveys of the entire country, including large portions of the provinces, were made. All the information needed for such a vast dominion was collected and preserved. The Romans also entered the field of vital statistics by keeping records of births and deaths.

Regular censuses were not taken during the Middle Ages but from time to time an investigation was ordered by a sovereign. The Domesday book of William the Conqueror is a case in point. When he had conquered England he ordered a census of the country that he might know the extent of his new dominion and the tenure by which the various parcels of land were held. Among the documents of greatest interest to students of history and economics are the manor rolls of the Middle Ages. The best of these are of the monasteries and contain a mine of information upon the holdings of land, the time and manner of payments of the feudal dues, and give us a picture of the condition of the common people.

During all this time there had appeared no work which could be called entirely statistical in its nature. But when the formation of the modern state commenced and the power of the kings increased with the decline of that of the nobles, there arose again the desire to have accurate information, not only of the home country but of the resources of adversaries as well. Muenstef (1489-1552) was the first to furnish a work giving statistics of various countries, closely followed by Sansovino (1521-1586). It was reserved for Achenwall (1719-1772) to first use the word "Statistik." It comes from the Italian *statista,* which meant about the same as our statist or statesman.[1] It referred to a man who was familiar with the government of a state. Achenwall in his treatise dwelt upon "all that is remarkable in a state." The end in view was the increase in the power of the state, and, therefore, included not only information upon the resources and population of the eight principal countries of Europe, but also their constitutions and methods of administration. It, therefore, included not only certain parts of what we now term statistics, but economics and comparative politics as well.

The works which at this period were brought out on Political Arithmetic were much more like those grouped at present under the head of statistics than those by Achenwall and his contemporaries, although they bore the modern name. It has been suggested by Mayr that all grouping of facts which rests upon the quantitative observation of aggregates, should be included under the title of numerical instead of statistical method, but the common terminology will doubtless survive.[2]

Süssmilch (1707-1767) took a step in the right direction when he made use of the stability of large numbers. He noticed that in some countries the death-rate was higher than in others and attempted to account for this difference. He assumed at the same time the rôle of reformer and offered some wholesome advice upon living. He would reduce mortality and increase the average duration of life.

Schloezer (1735-1809) took for the motto of his work

[1] John, V., "Der Name Statistik—Eine Etymologisch-historische Skizze." Bern, 1883.

[2] Mayr, G. von, "The Theory and Practice of Statistics." Journ. Roy. Stat. Soc., Vol. XLVI, Sept., 1883, pp. 468-470.

"vires unitæ agunt." "Vires" was the sum of the forces of the state and included individuals, land, productions and money in circulation. "Unitæ" meant the constitution of the state and "agunt" the way in which these forces were employed and the administration of public affairs. In the last two words he was still bound to the traditions of the past, and felt that he had not given a complete study unless he had included politics. He has given a definition which is particularly happy: "History is statistics in motion; statistics, history at rest."

A new field for statistical inquiry was opened by the study of death registers. Deaths have been recorded in London since 1592, and after 1629 the age and cause of the death was included. These were given considerable circulation by being published weekly. John Graunt (1620-1674) from a study of these figures calculated a table of mortality, and showed that the population of a country could be estimated with considerable accuracy if the number and age at death of the persons dying during a year were known. He was followed by Edmund Halley (1656-1742), who was the founder of scientific life insurance, for he calculated the number of survivors at each age of a population recruited by a constant number of births. His methods can be applied only to a stationary population, but they made it possible to compute the expectation of life at any age. This paved the way for the computation of rates, and early in the eighteenth century insurance companies began to spring up. The actuaries of the various great companies in existence to-day form a body of trained men who have carried the development of the statistical method to the highest point yet reached.[1]

Early in the nineteenth century it was felt that it would be of great advantage if the men who were working in statistics could have some organization and place of meeting where ideas could be exchanged. In 1803 the Société de Statistique de Paris was founded, followed in 1834 by the

[1] A good account of the historical development of statistics may be found in Meitzen, A., "Geschichte, Theorie und Technik der Statistik," Zweite Auflage, Stuttgart und Berlin, 1903, pp. 3-54.

Royal Statistical Society of London and in 1839 by the American Statistical Association. The gain from such organizations is that it puts the men in touch with the activity of others who are working in the same field, avoids duplication and gives to all the benefit of the research of each. Publicity and permanence is given to the researches of the members by the Journal de la Société de Statistique de Paris, the Journal of the Royal Statistical Society, and the Quarterly Publications of the American Statistical Association, in which some of the papers read at their meetings and others of scientific interest appear.

In 1853 the first meeting of the International Statistical Congress was held at Brussels in order to promote uniformity in the statistical publications of the different countries that the figures might be more easily compared. Much progress was made at this meeting and at eight others which followed at regular intervals down to 1876, when the last one was held.

The International Statistical Institute was founded as the successor to the Congress, at the Jubilee meeting of the Royal Statistical Society in London in 1885. It consists of 150 paying members besides a number of honorary members. It meets biennially, its object being to hasten the advance of administrative and scientific statistics, (1) by a study of the most suitable methods to secure as much uniformity as possible in statistical schedules and tables, so as to render the results of different countries comparable, (2) by making recommendations to governments as to the information that should be obtained, and (3) by its publications. The Bulletin de l'Institut Internationale de Statistique publishes articles in English, French, German and Italian.

At present every civilized country publishes reports giving detailed statistical information about its population, wealth, trade, labor, finances, etc., in this way furnishing a comprehensive view of the activities of the people. The greater part of this material is such that it can be easily compared. The principal statistical publications of the United States are as follows:[1]

[1] Considerable information upon this point is to be found in an

United States Census 1790-1900. Published once in ten years following the taking of the census.

Statistical Abstract of the United States, Treasury Department. Yearly since 1878.

Annual Report of the Director of the Mint, Treasury Department. Since 1873.

Annual Report of the Commissioner of Labor. Since 1886.

Special Reports of the Commissioner of Labor. Irregularly since 1889.

Bulletin of the Department of Labor. Since Nov., 1895. Every other month.

Annual Report of the Interstate Commerce Commission. Since 1887.

Annual Report of the Statistics of Railways. Since 1887.

Annual Report of the Commissioner General of Immigration.

Annual Report of the Commissioner of Education.

In addition to these there are the Commissioners of Agriculture, Charity, Labor, Prisons, and Boards of Health in many of the states.[1] The vital statistics of this country are far from accurate. In but few of the States have the births, marriages, and deaths been reported with the completeness necessary for trustworthy reference. The United States Census has tried to introduce mortality statistics, but, except for the registration area, they have been incomplete.[2]

article by Lucius Page Lane, ' Aids in the Use of Government Publications,'' Pub. Amer. Statist. Assn., Vol. VII, New Series, Nos. 49, 50, Mch., June, 1900.

[1] A complete list of these Commissions can be found in ''Proceedings of the Associations of Officials of Bureaus of Labor Statistics of America, Nineteenth Annual Convention.'' Held at Washington, D. C., Apr. 28-May 2, 1903.

[2] The only States where the registration record was accepted as accurate for the Census of 1900 were Massachusetts, Connecticut, Rhode Island, New Hampshire with certain counties and cities of New York and New Jersey.

STATISTICS AND FREEDOM OF THE WILL

It was early observed that certain phenomena occurred in society with great regularity. The numbers of births and deaths, and the proportion between the sexes changed but little from year to year. Quételet (1796-1874) brought this point out very clearly and showed that it was possible to foretell not only the numbers who would take their own lives, but the method which they would employ. People were willing to admit that it might be possible to tell in advance the number of males born to a hundred females; but when it was a case of predicting the number of suicides it seemed an entirely different matter. On this account Quételet has been accused by some of having denied the freedom of the will of the individual, but he must be acquitted of this charge. In the light of the regularity of these large numbers, which repeat themselves from year to year with startling exactitude, it is little wonder that men have concluded that many of the actions which appear voluntary are controlled and commanded by some iron law. Since statistics is accused of having denied the freedom of choice in moral actions, it is necessary to disprove this charge at the start.

This regularity in the moral acts of man is not the result of blind fate which we are forced to obey, but of causes which can not only be determined but modified. The tendency to commit these acts is the result of the personal character of the individual. Every man has impulses more or less like those of his fellows, but differing as the result of inheritance, education, or environment. The impulse to steal is much stronger in a community where it is difficult for a large portion of the population to procure the means of subsistence, than where the comfort of the masses is great. A child who has been carefully reared in a good home is much less likely to commit crime than one who has been brought up in a vicious neighborhood and allowed to associate with evil companions. Education and early training will give one person the moral stamina to resist a temptation which will prove too strong for another. But the fact that certain moral acts are committed with great regularity from year to year shows that in this society there is a nearly uniform number exposed to temptation and, human nature being comparatively constant, a nearly equal percentage of these will annually commit similar acts. While society is constituted as at present, a certain number will be unsuccessful every year. Some of these will become beggars, some thieves, and others will commit suicide. The fact that these numbers change but little from one year to another, shows that temptation and the ability to resist it are a nearly constant quantity in society at present. But, fortunately, both are open to modification. Man can not only improve his own nature but he can react upon his environment.

If the physical wants of man are satisfied, the impulse to commit crimes against property is lessened. Thus we find that in periods of economic depression petty theft is particularly common. The chief argument in favor of a public school system lies in the hope that by education we shall turn out more capable and upright citizens.

Each individual has the option to do or not to do an act, and in so far he is free; but the group actions of men are constant. Nothing is more variable than the actions of an individual; nothing more stable than those of a group. But there are slow changes in the group actions of man. Murders in England are not so frequent as they were two hundred years ago. We decrease the numbers of highway robberies, not by hanging the offenders and brutalizing the public by the sight of executions, but by lighting the streets, introducing payment by check, and traveling by steam roads. It is possible for man to change his environment. Suicides are increasing throughout most of the world, but not because man is obeying some stern fate which compels any particular individual to take his own life. The struggle for existence is different for civilized than for savage man. The storm center of the struggle is now in the brain, and this breaks down from the added exertion. The prizes of life are greater than ever before, the competition for them more intense, and the disappointment at failure more keenly felt.

A certain proportion of the population will be unable to stand the pace of modern civilization and will give up the struggle. It may be that in time the organism will be better adapted to bear this strain, and the tribute paid by man to his ambitions will grow smaller. We must allow to the individual the freedom of the will or all virtue and sacrifice is vain, and it is hopeless to try to improve the condition of humanity. Statistics may take note of the regularities in the past actions of a group and conjecture with considerable accuracy its future actions, but it cannot formulate a moral law that must be obeyed by the individual.[1]

STATISTICS AS A SCIENCE

It is the uniformity in the results of the actions of men which makes possible this science, for statistics deals with the measurement of the social forces. Not only as a science does it determine the economic and social condition of a group, but it has developed a method which can be applied to other sciences.

The great difference between statistics and other sciences lies in the fact that most of them deal with matters which are largely beyond the control of man, while statistics is interested in those matters which are the direct results of man's activity.[2] The natural and physical sciences are interested in determining laws which would hold true if man were no longer on this earth. The laws of gravitation have not been changed in the years which have elapsed since they were discovered and they will continue to remain unalterable.

[1] Compare, Wagner, A., "Statistisch-anthropologische Untersuchung der Gesetzmässigkeit in den scheinbar willkürlichen Handlungen," 1864; and Drobisch, "Die Moralische Statistik und die Menschliche Willensfreiheit."

[2] Guy, W. A., "On Statistical Development, with special reference to Statistics as a Science," Journ. Royal Statist. Soc., Jubilee Vol., 1885, p. 78.

Man studies them that the buildings and bridges he erects may stand and not fall. But statistics as a science is engrossed in the study of the effects of man's acts which are largely voluntary. The laws of nature are invariable, but the facts with which statistics deal are liable to change.

In a way statistics is the most difficult of all sciences. The chemist can take his agents into his laboratory to study the effects of different combinations in his crucible; but the phenomena with which the statistician deals cannot be separated from their environment. He is not concerned with man as an individual, but only with the actions and reactions of groups of men in their different positions in society. Statistics is largely a science of observation. In those sciences which are based upon abstruse reasoning, the deductive method may be employed, but if the statistician would be sure of his ground he must rely upon the inductive method in most cases.[1]

Probably statistics is more closely related to sociology than to any other science. The problem before the sociologist is the development of the science of society and the determination of the laws which underlie its growth. It is the function of the statistician to collect the individual phenomena in which the life of a group is reflected, tabulate and group them that the sociologist may be acquainted with the group actions and, if possible, distinguish cause and effect. No student of practical sociology is well equipped for his work until he is acquainted with the statistical method, that he may obtain the correct inferences from the mass of figures with which every subject in his department is surrounded.

Economics is another allied subject, and, in fact, it was not until the latter part of the eighteenth century that economics and statistics became separate. Before this the science of statistics was supposed to cover everything that dealt with the improvement of the state, but economics has taken that field of man's activity which is concerned with the

[1] Levasseur, E., "La Population française," Paris, 1889, Vol. I, pp. 2-7.

production and utilization of wealth. Although the knowledge of man's desires and aversions has served as a basis for the formulation of most of the laws of economics, their proof has not been complete until statistical method has given its testimony on the group effects of these desires. The theory of Engel's law seems correct, but, in order that we may be certain that the postulates work out correctly, the budgets of different classes of individuals or families must be collected and tabulated. The connection between these two sciences is well shown by index numbers. Statistics develops the method and completes the computations, leaving to economics whatever practical application of them there may be.

It is only within comparatively recent times that the service which statistics may render to history has been clearly seen. The ordinary history used to contain a full account of important battles, the actions of kings and parliaments, while the lives and activities of the common people were barely mentioned. We are now giving more attention to the masses and trying to discover how they spend their time and money. From the orations of Demosthenes we learn much about the rate of interest and the way the Greeks managed their business; and even Aristophanes furnishes the prices of certain articles in Athens. The records of the religious houses on the continent give us information on the size of holdings and the rents paid for them. Here lies the field for a trained statistician, who shall create from the fragmentary records of the past a picture in which we shall see clearly the life, not of some lord or noble, but of the common man, the wages he earned, the prices he paid for his commodities and the conditions under which he labored.

The applications of the statistical method to the problems of to-day are varied. A physician is treating diphtheria by the older or by the anti-toxin method. From which of these is the rate of mortality lower? If he keeps full records of his cases he can easily tell. Has the installing of a new water plant had any appreciable effect upon the prevalence of typhoid fever? How can this be determined except by forming statistical tables? A new law is passed concerning the detention and punishment of criminals. The only way by which to determine the efficacy of this law is to calculate the percentage of recidivism under the new and old régime. Is immigration a benefit to this country? The observations of one man over a limited field will show no general result. We must make a study of the numbers and classes who enter, where they go, and what they do. Do they become criminals and paupers in large numbers? Do they affiliate with the rest of the population and absorb American ideals and aspirations? What is the effect upon the American laborer? Are certain classes better than others? Nor must we rest here, but follow those of the next generation to see if they have advanced.

Most of these questions can be answered only by statistics. An employer is in dispute with his employees. They claim that the rate of wages should be raised since the price of commodities has risen and their real wages fallen. The only way in which to decide this is by careful study of their expenditures and the formation of an index number properly weighted. These instances have been cited to show the importance of statistics in ordinary life. Every educated man should be trained along this line until he is able to detect a fallacy which lies near the surface. One great advantage of statistics is that it enables us to substitute numbers for adjectives, but if they are to be used with safety, study must be given to the method. The remainder of this chapter will be devoted to a study of the manner in which a statistical problem should be attacked.

PREPARATION FOR GATHERING THE MATERIAL

WHENEVER a statistical investigation is made there is some end in view. It may be purely scientific curiosity, or there may be some practical advantage to be gained. The probability is that the results obtained in the former will be more trustworthy than those in the latter case. If a man attempts to convince himself of the truth of some preconceived notion, he will probably be able to find figures which will satisfy him, since those which differ from his opinion will be dismissed as unimportant.

If a person whose judgment is not yet formed studies a subject he may make mistakes, but since the errors are unbiased they are apt to balance one another. It may be that a person thinks a certain phenomenon is the result of a particular cause and goes to statistics for information upon this point. He may become convinced from careful study that this is not the case, and then be in a position to follow out other causes that may have a similar effect. It is best at the start to lay all prejudice aside, and accept with proper weighting whatever reliable information can be gained, reserving judgment until the end.

In the selection of a subject care should be taken to choose one in which some genuine interest is felt. There should ever be present the desire to know. Where this desire is present the accumulation of trustworthy information is always pleasant. Without it, the work soon becomes irksome toil. The extent of the enquiry must then be determined. It is better to unduly limit the field than to attempt to include too much. A small study carefully made is more valuable than one on a large scale which is roughly sketched in. I have heard students attempt to treat the comparative healthfulness of city and country, or the iron industry, in a five minutes' paper.

There are grave dangers in the monographic method of study, where one case is selected as a type and from it conclusions are drawn to include a group of which this is a unit. When we are making a study of the budgets of families it is important to take several under apparently similar conditions and with a uniform expenditure. It is not safe to assume, before the study has been made, that one family is typical of a group. After the material has been collected, arranged and tabulated, it is then possible to say what is the manner in which families with a certain income spend their money. It may then be found that some particular family is practically identical with this group average. This may then be selected as a type, but this could not be done before the preliminary study had been made.

If an article were written on the business of any large corporation, it might be a careful and complete study of this particular company and in so far a perfectly justifiable selection, but if the attempt was then made, with this as a basis, to draw conclusions as to the operations of trusts in general, we should be forced to conclude that the limits of the monographic method had been passed.

The representative method of investigation stands midway between the monographic and the complete statistical study. Certain representative portions are selected for study in place of including the entire field. It differs from the monographic method in that it does not take one typical case to investigate but takes all the different types and so constructs a state in miniature. In geology it is not possible to dig away the surface of the earth to a depth of several hundred feet in order to determine the formation of the rock or sand, but borings at reasonable distances from one another will tell us all we desire. From its similarity to this process the representative has been called the geological method.

A tobacco buyer does not need to open every bundle of tobacco in a lot in order to reach a conclusion as to the quality of the leaf. A dozen bundles selected at random generally suffice. All that is desired by this method is to get a perfect picture on a small scale of a larger whole. If we are to make a study of some fact in a country it is often impossible, on account of the magnitude of the task, to cover the entire field. Only portions of the country can be examined, but care must be taken to have the selected parts representative. The agricultural and manufacturing sections must be included. The seaport and the inland city, the mining and the lumbering camp, those places which are growing rapidly, and those stationary or decreasing in numbers must all be given place and properly weighted if the study is to be accurate. As a check to the work it is well to include a question which was asked at the last census in order to see if there are any material variations with regard to it. If the answer to the question we can check is approximately correct, we can take it for granted that the rest of the investigation attains a reasonable degree of accuracy.

In Norway, in 1891, instead of taking the census of the entire state in the question to be investigated, a certain number of representative cities and country districts were selected. The further reduction was then made from the total population of these places by taking those of the ages of 17, 22, 27, etc., by five-year periods. Again only those persons whose names began with a certain letter were chosen and the study made of these. This gave a good approximation, for there was little difference in the concentration on the years ending in the multiple of five or ten whether in the early or later years of life, and there were no communities where one letter seemed to have any great prominence.[1]

When the subject has been selected, it then becomes necessary to determine what has already been done upon it. There is nothing more discouraging than to spend considerable time upon a piece of work, only to have the attention called to an article in which this work had been carefully done. It is, therefore, best at the commencement to go over the field with care in the best library accessible in order to avoid all duplication of work. When this has been done the student is in a position to judge whether it is better to push ahead along some particular line, or fill in some gap which has been left by those who have gone before.

Since a large proportion of the problems dealt with in statistics are dynamic, and since new figures are constantly appearing, it is often preferable for an inexperienced person to bring to the present, by an established method, some study which is now somewhat out of date, and leave to trained scientists the problems of developing new methods and carrying the research farther on. With the immense field that is offered by statistics, it is possible for any student to avoid duplication of work and do something toward increasing our knowledge of social effects.

[1] Kiär, A. N., "Die Repräsentative Untersuchungsmethode." Allgemeines Statist. Archiv., Band V, 1898, pp. 1-22.

If one person must do the work alone it is generally necessary to consult the publications of governments or states for the needed data. These are, as a rule, more accurate than those of other bodies. In some cases it may be necessary to consult newspapers or periodicals, but these are not to be trusted except for quotations of prices. The *Chicago Tribune* publishes yearly records of the murders, lynchings and suicides of this country, but a study based upon the Vital Statistics of those states in which accurate records of these phenomena are preserved is preferable to this more extensive record. It is impossible to place too high the value of intensive work. In some cases it is possible for an individual to send printed slips to several concerns asking for information, but the chances are that but a small proportion will return the desired answers.

Where a larger number of men are associated it is often possible to carry on a house-to-house investigation. This is the plan which has been followed in most of the tenement-house investigations in the various cities in this country. The possibility of error here is greater than when the work is done by one person. The district must be properly divided, and each enumerator must be given one or more blocks. If streets are allotted there is the danger that the corner houses will be counted twice or not at all. There is also the possibility for the personal equation to enter. One man will do his work more carefully than another. One will report the condition of a tenement as "fair" where another would say it was "poor." Since there is no governmental authority behind such investigation it is impossible to demand an answer to any question or gain admission to a house except by favor. The cost of such enumeration is always considerable and must be assured at the start.

Where a government is to take a census the amount of preparation required is very great. Before 1902 there was no permanent census department in this country; and each census demanded the appointment of a new chief with heads to the different sections. Then the experience that should have been gained from the previous enumeration was in large part lost. The territory must be divided and subdivided and the blanks printed and distributed.

There has always been considerable difference of opinion as to what questions should be asked. There are two classes of questions which it is not best to put. The first includes those which are inadmissible. It would be of interest to know a great many things about the private acts of a community. If such a question were asked either no answer or an untruthful one would be given. It is impossible to determine the amount of personal property owned by the various individuals who compose our population. It would be out of the question to expect accurate budgets of all the families in this country.

Whenever it is possible, questions should not be asked which arouse the suspicions of the subject. When mistrust enters the mind the answers are apt to be biased. When a statement of the amount of property owned is required, the fear of taxation often arises and inaccurate returns are made. In some cases questions in regard to religious confession are to be avoided.

It would be of considerable value if we could determine how many men in this country were total-abstainers, how many occasional drinkers, how many regular moderate drinkers and how many drank sufficiently to injure themselves. But if the questions were put to the men it is not likely that the returns would have sufficient accuracy to render them trustworthy. The number of total-abstainers might be determined, within reasonable limits, but those in the last three classes would be sadly misplaced.

The second class is made up of those questions which are unimportant. Some one might be interested to know how many men shaved themselves and how many patronized barbers, but the trouble to get this information would far outweigh its advantage. It is important that each question shall have some definite meaning. The enquiry as to the conjugal condition of the subject can easily obtain a correct answer, but if asked whether he is poor, well-to-do, or rich, the determination of the content of each category would occasion trouble. It would be difficult for the average person to distinguish between a cellar and a basement. M. Jacques Bertillon tells of a census in France in which the attempt was made to classify houses according to the number of stories. One subject wrote for information about a building with five stories in one portion and four in another, asking if it should be included in the number of those with nine stories![1] In all cases where the meaning is not apparent a full explanation should be given with the set of questions. Before adding any question to the list we must see if the value of the information will offset the annoyance to the subject, the trouble to the enumerator and the expense to the government.

We must also decide whether the card of list system is to be used in gathering the information. The cards can be sent to those parties from whom answers are desired, to be returned to headquarters. The main advantage of this system is that these cards can be in any number of places at the same time, and thus the observations be taken at the same point of time. Then, too, much expense is saved, for the persons insert the answers to the questions and the services of the enumerators is not required. On some cards all possible answers are printed and the subject asked to cross out all but his particular answer, or, to cross out or underline his answer. In other cases there are blank spaces for the answers which are to be inserted in writing. In some cases a sample card, filled out, is sent with the card containing the questions. Lack of interest and ignorance make this method impossible in most cases.

In a country where large numbers of the population are unable to read and write it is hopeless to try to get the subjects to fill out their own cards. The same difficulty is encountered where the subject can read and write, but not the official language. Under such circumstances enumerators are hired to carry the lists from door to door. These are generally bound in book form with the questions at the top

[1] Bertillon, J., "Cours élémentaire de Statistique administrative," Paris, 1895, p. 66.

of the columns and numbers at the side. In this way several cases can be recorded on the same page. This method is more expensive and takes considerable time but gives a great gain in accuracy and the lists need be printed in but one language. The principal danger here is duplication of territory, but that can be avoided by careful supervision.

GATHERING THE MATERIAL

THE factors on which most stress should be laid in gathering the material for a statistical investigation are accuracy and completeness. If a census is to be free from error, not only must all of the population be included, but the age, conjugal condition, etc., of each member must be accurately recorded.

There are several different methods of gathering the material, and the nature of the phenomena to be studied determines which of these shall be employed.

1. Limited Area at Point of Time. If we were making a study of the number of men employed by a certain railroad at a given date we should need only to consult the books of that company to determine the employees on the pay-roll at that date. If we desire to know what proportion of the rooms in the tenements of a district of a city are without windows, it is theoretically desirable that the investigation be made throughout the district at once. Such immediacy is, of course, out of the question, but the sooner it can be completed the better. This is the manner of investigation which can be best conducted by an individual or small group of persons.

2. Entire State at Point of Time. The taking of a census would naturally suggest itself as fulfilling the conditions of this division. When we have decided upon the date of enumeration the work should be pushed as rapidly as possible that only a few days may be required for gathering the information. It is necessary that the entire country be covered in this time, and, therefore, the corps of enumerators required to take the census of a modern state is very large.

3. Limited Area for Period of Time. There are certain classes of phenomena which cannot be studied once in ten years or annually, but must be continually counted. We wish to determine the amount of the foreign trade of a country. This is going on all the time, and officers must be continually present to note and record the shipments. But it is not necessary that they should be stationed throughout the country. Goods cannot leave the country without crossing the boundary. It is, therefore, sufficient to have the custom-houses at the boundary, and most frequently in those large cities where the method of transportation is changed from land to water, or from water to land. A similar method of observation is followed with respect to immigration. To collect the tax on distilled spirits it is necessary for the government to know how much is being manufactured, but since this business is carried on legally only in certain authorized places it is a comparatively easy matter to collect the revenues.

4. Entire State for Period of Time. The great mass of vital statistics gathered by modern states comes under this head. If we are to have accurate information upon the number of births, marriages and deaths during any year, the records must be gathered daily during this period. The statistics of this kind are so faultily kept in this country that it is impossible to compute a birth or death-rate for the United States. This is left to the various states, and only a few of them are sufficiently alive to the need of such information to require that a notice of each birth and death be handed in by the attending physician, midwife, or coroner.

The average student in writing a statistical article, must, as a rule, get his material from government or state reports. These, although containing what is the finished product to their compilers, are to him raw material. It is best to copy the desired tables on sheets of paper of uniform size, giving a separate sheet to each table. Then if additional information is found upon any topic, it can be inserted in its proper position. This is preferable to the note book, for there is no opportunity to preserve a proper sequence when the pages are bound before the work is completed. In every case it is important that each sheet should contain the name of the publication from which the material was taken, the volume and the page. It is then possible to verify any figure in a few minutes, and gives the reader an idea of the reliability of the authorities consulted.

It is better that the manner in which the material has been gathered should be described too minutely than too meagerly. If this information is placed in the notes it can be skipped by the hasty reader who is simply after the conclusions, but if not included at all it lays the article open to suspicion.

There are certain liabilities to error in gathering the material against which it is necessary to be on guard. If the system of self-observation is employed and the subject fills out his own card, the principal danger is from carelessness or deceit. It may be that he is too busy to give sufficient time and attention to the task and considers his duty done when he has given answers to the questions, regardless of accuracy. But a graver error comes from deceit. If the taxpayer makes out his own list of taxable property, he is almost certain to place the value of it too low, conceal a portion of his personal property, and trust that the mental reservation will not be discovered.

Ignorance also leads to errors in some cases, but these are not so great as those caused by deceit. Many persons are ignorant of their exact age and enter it as near as they can estimate. Since this may be either too high or too low the errors tend to balance one another. But biased errors such as that of the incorrect tax list are all one way. Prof. Bowley has given a good instance of this difference. If a man is riding a bicycle along a road and counts the distance by the mile-stones he passes, it is probable that the length of none of these miles is accurate, but the errors balance one another and at the close of a day's riding his computation will be nearly correct, for the miles which are too long will offset those too short. If, on the other hand, he trusts to his cyclometer and this is not correct, then all of the errors will be the same and on the same side. The longer he rides the greater will be his error in estimating the distance. The former is an unbiased, the latter a biased, error.[1]

It is important that all statements on the subject should be impartially noted and weighed. There is an ever-present danger that the investigator will dismiss as unimportant any facts which seem opposed to those already gathered, or contrary to what is to be expected. It may be that further investigation will show these statements to be incorrect, in which case this should be noted as a warning to others who might be disposed to accept them. Or these conditions may be the result of local or peculiar circumstances which will entirely explain away the apparent discrepancy in the data.

Wherever a statement is made or a set of figures met with which is taken from some other work, it is best to trace it back to its source, to be sure it has been correctly copied and that it has lost none of its original meaning by being taken from its context. If this is not done it is possible that a half truth will be accepted for a whole one. It is also advisable to accept with a grain of salt any important facts for which the proper references have not been given. Whatever material is selected must first be carefully tested as to its authority, for if this is faulty the work will have little value, regardless of the care with which it may be constructed.

ABSTRACTION OF THE MATERIAL

When all of the available material has been gathered together, it is necessary that it be so classified and combined that some information may be gained from it. The statistician is interested in the group effects of the actions of men.

[1] Bowley, A. L., "Elements of Statistics," London, 1901, p. 210.

How shall these individual lists be combined into the larger significant groups?

The first grouping should include but a comparatively small number of cases. Suppose we are making a study of the housing conditions of a large city. It is not best to classify the entire city at once in order to ascertain how large a proportion of the people live with less than one person to a room and how many with more than two persons. This would give the average for the city but it is probable that this point is of minor consideration. We should first take the city blocks and find out where there is the greatest congestion. It is then an easy matter to combine the blocks into wards, and the wards into the city. It is always easy to combine small into large aggregates by simple addition, but it is not possible to subdivide without going through the material again. It is, therefore, necessary to decide at the start what are the smallest divisions which will be needed and begin with these.

There are a very few cases in which the sole trouble is that of counting the numbers returned, but as a rule they need to be properly arranged. The manner in which the material shall be separated depends upon the nature of the investigation. In vital statistics the primary distinctions are those of sex, age, and conjugal condition. If the cards are first divided according to sex, then according to age and at last according to conjugal condition, it is possible to add each separate section and the sums of these will give the total number of cases. Where the cards are not too numerous this work can be done by hand. When it is deemed best to make the age classification by five-year groups the separation should be 0-4 years, 5-9, 10-14, etc., rather than 5-10, 10-15, since in the latter case there is always doubt as to the line of demarcation.

Two of the principal methods of classifying data are according to geographical and temporal differences. The elementary distribution by place is where the cards relating to one city or county are placed in one rack and those to another in a different rack. Thus our foreign-born population would be grouped according to their country of birth. There are numerous other methods of division according to place. Thus the death-rate from tuberculosis might be compared according to the altitude above the sea-level of certain sections. Or it might be desirable to know if there was any correlation between density of population and the general death-rate.

One of the most satisfactory divisions is according to time. The boundaries of cities, states or nations may vary from time to time, but a year is something definite. In comparing statistics according to years it is important to note whether the same period is covered in every case by the year in question, for it is very common to find that the calendar and fiscal years are not identical. The necessity of having clearly defined limits to age groups has already been mentioned. In some cases the period of time elapsed is studied, as when divorces are grouped according to the duration of married life before the granting of the separation.

The statistician is always confronted with one dilemma. It is likely that when the beginning was made to collect statistics in any country the method employed was somewhat crude and there was little choice in the way in which the tables should be formed. Since then great advances have been made and many of the tables could now be improved. Or it may be that some peculiar classification was adopted in this particular country which renders it impossible to compare its figures with those of most other countries. The question then is whether it is better to keep the old system of classification or adopt a new one. If the former policy is chosen the country is cut off from the rest of the world; if the latter, the future data cannot be compared with the past. As a rule, it is better to break with the traditions of the past and keep in line with the world's advance than to preserve the antiquated methods, for a change must come some time, and it is but delaying it at best.

Where the cards are not too numerous they can be classified by hand and then counted, but where this would involve an immense expenditure of time it is generally better to tabulate them on large sheets. Let us suppose we have a separate card made out stating the sex, age and motive of each person committing suicide during the calendar year in any state. It is required to tabulate these cases so as to include these three factors. Take a large sheet of paper, divide it into as many vertical sections as there are age groups, and as many horizontal as there are motives in the system of classification adopted. Two more columns should be added to each dimension, one for unknown and the other for totals, and to the motives should be added one for miscellaneous. Each suicide is then placed in the proper square, the male by a blue point starting at the upper left hand corner and the female by a red one in the lower right hand corner. The easiest method is to use a pencil one end of which is blue and the other red.

There are various ways of jotting down the units so that they can be easily added. One of the simplest is to place four dots in a vertical or horizontal series and denote the fifth by drawing a line through them. Another is to make four vertical parallel lines and denote the fifth by a line drawn diagonally through them. Still another is to let each unit be the side of a square and the fifth a diagonal. It makes but little difference which of these methods is employed since each of them allows the convenience and economy of adding by fives. The total numbers of males in each square can then be added in blue and of females in red. The columns can next be added in both directions and placed under the appropriate total. The sums of the totals in both columns must balance or there is some mistake in the computation.

In order to work rapidly it is better to have one person call off the cards and another mark the units on the chart. It is best in all cases to have a column for unknown and in many cases one for miscellaneous, or else the number of columns will become too numerous. This has been selected as a typical case, but the principles as given can be used in a variety of forms.

For ease in computation it is better that the numbers which are to form the total should be arranged underneath one another, since it is much more inconvenient to add them when they are in a horizontal line. Where the totals of each sheet are at the bottom and the different sheets are uniform, it is possible to get the sum of several of them by arranging them like shingles one overlapping the next sufficiently to conceal all of the figures except the rows of totals. This obviates the necessity of copying and eliminates the danger of error which always accompanies the operation.

This method of tabulation does very well where the number of cases is limited, but when they reach into the millions, as is the case with the census of a modern state, it is altogether too tedious and costly. Some method had, therefore, to be devised by which a machine could be substituted for human labor. In the United States Census of 1900 the returns of population came from the enumerators in large lists with spaces for a hundred names, and answers to twenty-eight questions. If it had been necessary to copy each of these answers on a slip or tabulate them by hand, it would have required years before the results of the enumeration could have been known. To simplify the work a card was made out with 24 vertical and 12 horizontal spaces. Each one of the 288 squares represented some fact which was recorded by punching a hole in the required spot. No writing whatever was required.

The counting of the data was done by a machine invented by Dr. Herman Hollerith of Washington, D. C. The cards, when punched, were tabulated by an ingenious machine provided with a pin box which contained a needle, set on a fine spiral spring, for each possible hole in a card. The machine used in 1890 and 1900 was operated by hand; the pin box was brought down over each card in turn; those needles which met an unpunched surface were repressed, while those which passed through a hole made an electric contact below, and by an arrangement of relays, permitting any desired combination, caused one or more of the counters or dials to register. At the conclusion of each "run" the counters were read and the results recorded. With the aid of one of these machines an experienced and capable clerk could tabulate on an average from 8,000 to 10,000 cards in a working day of six and a half hours. The importance of this system lay in the ability to count combined facts.[1]

But even this method was too slow and toward the close of the Twelfth Census work an automatic feeder was invented, so that at present about 350 cards per minute are tabulated on the average, or between 80,000 and 90,000 cards in a working day of seven hours. During the work of tabulation on the Twelfth Census cards were passed through the tabulating machine 619,574,014 times. But, notwithstanding this immense task, the volume on Population was published within one year and seven months from the census date. From these figures some idea can be gained of the vast saving obtained by means of these mechanical aids. It has been estimated that without these devices it would have required to make the three tabulations of sex, age, nativity and occupation, the time of a hundred clerks for 7 years, 11 months and 5 days.

Another advantage of this system is that it is possible to automatically detect mistakes in the punching of the cards. The wires can be so arranged that when an improbable combination comes up the card is rejected and must go back to be justified. Thus, among others, cards for the Chinese, the Japanese, the Indians, the foreign-born colored, persons over 90 years of age, persons reported as married, widowed or divorced, and yet if male under 21, or if female under 18 years of age; mothers reported as having more than ten children; children under 5 or adults over 25 reported as attending school; people under 15 years of age reported as having a gainful occupation, must all be verified.[2]

It is well to note at this point that there is a decided tendency among people, and especially the illiterate, to give answers to enquiries in round numbers. If they are either 49 or

[1] Merriam, W. R., ''American Census Taking.'' Bureau of the Census, Washington, D. C., 1904, p. 20.

[2] Additional information on this subject can be gained from an article by W. F. Wilcox in the Journ. Royal Statist. Soc., Sept., 1901,

51 years of age they are about 50 and the temptation is great to record their age as 50. Not only is this danger present in this instance but in any other where the common people are asked to give information about themselves.

Mr. E. D. Jones has made a study of the Annual Report of the Illinois Bureau of Labor Statistics, No. 7. In Table V of this report there are given the budgets of 142 employees in department stores. A critical study was made of these accounts to see how many reported in round numbers, with the following result:[1]

	Earnings	Expenditures	Savings	Board & Room	Clothing
Total number . . .	100.00%	100.00%	100.00%	100.00%	100.00%
Divisible by 5 . .	38.00%	35.21%	62.96%	43.33%	88.65%
Divisible by 10 . .	26.76%	24.65%	48.14%	31.11%	51.06%
Divisible by 25 . .	13.38%	12.68%	25.96%	5.55%	42.55%
Divisible by 100 . .	7.04%	6.34%	7.41%	2.22%	15.60%

From this table it is evident that the returns in most cases were little better than an estimate, valuable for some purposes but of little use if accuracy is demanded. The material at hand should always be critically examined and when it is discovered that the tendency to estimate is shown, the fact should be noted. Where it is not possible to send the figures back to be corrected they must be taken as they stand, but much can be gained by plotting the result and smoothing the curve.

Another interesting case of the same tendency is shown in the Second Annual Report of the New Hampshire Bureau of Labor: 1894, pp. 384-5, where the number of workmen is given who have been idle for different periods throughout that year.

pp. 526-529, a paper by H. T. Newcomb on the "Mechanical Tabulation of the Statistics of Agriculture in the Twelfth Census of the United States," Philadelphia, 1901, 33 pages, and a paper by H. Hollerith, "The Electrical Tabulating Machine," Journ. Royal Statist. Soc., Vol. LVII, Part IV, Dec., 1904, pp. 678-682.

[1] Jones, E. D., "Round Numbers in Wages and Prices," Pub. Amer. Statist. Assn., New Series, Nos. 35, 36, Sept., Dec., 1896, p. 9.

Number of Weeks Idle	Number of Workmen Reporting	Number of Weeks Idle	Number of Workmen Reporting
1	16	14	6
2	60	15	21
3	28	16	6
4	13	17	43
5	37	18	1
6	15	19	0
7	21	20	15
8	28	21	1
9	10	22	2
10	36	23	0
11	5	24	0
12	23	25	33
13	8	26	0

We see here the concentration of numbers on the 10th, 15th, 20th, and 25th weeks. It is not at all likely that there was in reality any such grouping but the temptation to report on an even 0 or 5 was too great to be resisted. The large number at 17 weeks is to be accounted for by those who reported 4 months as their period of unemployment. To reduce this to weeks 4 was multiplied by 30 and the product 120 divided by 7, giving as a result 17 1/7.

The Average. When the data which has been collected has been properly tabulated and the totals computed, there yet remains the task of reducing the figures to some convenient form for purposes of comparison. The methods most commonly employed are the average or ratio. In this way unwieldy groups are displaced by a few simple figures. We might state the total consumption of bushels of wheat in the United States and England during any year. This would be of interest, but would not be so valuable as a picture of social well-being as a statement of the per capita consumption of each country. We would now have a uniform basis and the denominators instead of being different would be identical. Thus we speak of the average weight of the University Crew, because in this way it is possible to compare more easily an eight-oar with a four-oar crew, or with the weight of an average man.[2] To give a general definition,

[1] Jones, E. D., *Op. cit.*, p. 10.

[2] Bowley, A. L., "Elements of Statistics," p. 107.

the total quantity under consideration, divided by the number to which it applies, gives an average.

It is necessary at the start to decide on the unit of comparison. The most common is perhaps the per capita unit. But as we shall see later it is sometimes necessary to include only certain classes instead of the total population. The per capita consumption of alcohol in one country may be much larger than in another, but we could not infer from this that the amount of drunkenness was greater in that country where more alcohol was consumed. It might be that in one country most of the people drank moderately, while in the other a majority of the people were total abstainers and a certain class drank to excess. In this case it would be far better to take the per capita consumption of the drinking population.[1] If we are comparing the per capita wealth of different countries we wish to know also what is the shape of the social pyramid, and whether the countries are composed of a small number of very rich and a vast number of very poor, or whether there is a large middle class of persons in comfortable circumstances.

An average used so commonly that its significance is often overlooked is the number per annum. Most of the official statistical publications appear annually, so that the difficulty of considering the element of time is seldom encountered. If, however, we should learn that in some district there were 3,500 deaths from yellow fever in the years 1885-1891, and 4,400 during 1892-1902, the decrease in mortality would be more apparent when we realized that during the earlier period there were 500 deaths per annum and in the later period only 400.

Density and areality are other cases of the average, each giving a basis for the comparison of the density of the population of different countries. Density, or the population divided by the units of area is generally employed where the country is thickly settled, and areality, or the number of

[1] Levasseur, E., "La Population française," Paris, 1889, Vol. I, p. 44.

units of area divided by the population, where the country is sparsely settled.

Compound averages are often used. Thus the extent to which a country is provided with railways may be represented by the number of miles of track per 10,000 of population or per 100 square miles of territory, or, by the "Eisenbahnsausstattungsziffer" which is the geometric mean between the relation to population and the relation to territory. Most vital statistics are given in percentages of double import. The crude birth-rate is the number of births per annum per 1,000 population. In fact, in most cases the numbers are compared by years so that the average is a compound one.

In the representation of ratios there are two methods to be employed, one by fractions, the other by decimals. Fractions should be used only where but two or three cases are to be compared and all are simple. Thus it is convenient to compare countries by saying that $\frac{1}{6}$, $\frac{1}{7}$ and $\frac{1}{9}$ of the population attend school during a portion of the year. It is always desirable that both numerator and denominator should be digits, but if a greater number is used in the denominator the numerator should be unity. It is impossible to tell at sight whether $\frac{221}{650}$ or $\frac{536}{1619}$ is the larger, and such fractions should never be employed. Another difficulty in the way of using fractions lies in the fact that, as the denominator increases, the size of the quantity decreases. This is at times confusing in dynamic comparisons.

In most cases the decimal system is to be preferred. Thus we say that there are so many suicides per million of the population. None of the objections given to the use of fractions applies to the decimal system. The frequency of the phenomena varies directly with the size of the ratios. One great advantage of the decimal system lies in the fact that it enables us to take a certain number as unity, and compare the numbers of other countries or other years with this. Thus in the formation of an index number, the average price of various commodities for a certain year selected as standard is placed at 100 and the prices of other years are compared to this. In this way it is easy to tell whether the average value of commodities in a country has risen or fallen. In a similar manner the death-rate of the total population of a country within certain ages is placed at 1,000, and the rates of mortality of the various occupations compared to this in order to show what classes of employment are the healthiest.

It is evident that before we can compute an average we must have before us a number of magnitudes, each of which is a concrete statement of fact. In the place of the actual values we shall substitute one artificial figure, which is to be intermediate and give a picture of general conditions. As in a composite photograph, the result gives no one distinguishable face, but a general impression, so the average may not agree with any one of the many units of which it is composed, but gives a good group impression. If twelve men are shooting at a mark, their shots will cluster about the center, and the average deviation from the bull's-eye will vary according to the expertness of the marksmen. In any case the shots will be grouped about this center, and if the number should be plotted according to the deviation in any direction from a line drawn through the center, the curve would be symmetrical. If the marksmen were good shots the curve would be steep and high, while if they were poor ones, the curve would be low. The center would be the highest point of the curve. If they were shooting across a valley, and during one-half of the practice a strong wind was blowing through it in one direction, and during the remainder of the practice in the opposite direction, the result would be, unless allowance had been made for this disturbing cause, a curve with two maxima, and the center or average would lie midway between them.[1]

Where several estimates of a fact have been made, and

[1] Venn, J., "On the Nature and Uses of Averages," Journ. Royal Statist. Soc., Vol. LIV, Part III, Sept., 1891, p. 441.

there is no reason, judging from the reliability of the sources, why one should be more correct than another, the average of the different judgments may be taken. This is a course which is often followed in astronomy. If one authority should state that the distance between two places was 70 miles and another place it at 80, it would be safest to estimate it at 75. If, however, one man should state that a certain person was living in a particular town and another affirm that he was in a different one, it would not be justifiable to infer that he was half way between the two. If the accuracy of one authority is known to be high and of another doubtful, it would be well to very nearly overlook and give little weight to the testimony of the less accurate.

Discrimination of this kind should always be used whereever the evidence is conflicting. This makes more apparent the advisability of stating authorities and the course of reasoning or computation followed in reaching a conclusion.

Weighted Average. Up to this point the simple arithmetic average has been described. There are times when it is necessary to properly weight the average. The index number is formed by simple average where the prices of the different articles are reduced to the percentage price of the year selected as standard, the sum taken of the prices of the articles in the list and this sum divided by the number of articles. But in this way certain articles are given more importance than they deserve. Wheat is an article of much greater importance to the family budget than pepper. If the price of pepper should double it would be scarcely noticed in the year's expenditures, but an increase of 50 per cent. in the price of wheat would bring hardship to thousands of families.

It is therefore necessary to take but once that article on the list which is least used, and multiply the other quotations by the relative importance of the articles in terms of this one selected as a standard. Thus if we take the quotation for 1890-1899 equal to 100, we find that during 1903 quotations on food were 107.1, on cloths and clothing 106.6 and on fuel and lighting 149.3. If we should take the simple arithmetic mean we should have $\frac{107.1+106.6+149.3}{3}=121.0$. But if we assume that cloths and clothing represent to the laborer an expenditure twice as large as fuel and lighting, while food is five times as important, then our fraction becomes:

$$\frac{(149.3\times1)+(106.6\times2)+(107.1\times5)}{1+2+5}=112.2.$$

There is quite a difference in this case between the simple and the weighted arithmetic average.

The idea is made clearer by the mechanical analogy in which the word *weight* originated. Suppose a uniform weightless rigid rod graduated in 100 equal divisions, and equal weights hung at the 77th, 60th, 90th, 40th, and 85th divisions from one end; the rod will then balance at a point corresponding to the unweighted average, 70.4 intervals from the same end. Now, suppose the equal weights replaced by weights of 7, 1, 3, 2, 4 lbs. respectively, and the rod will balance at a point corresponding to the weighted averages 75.8 intervals from the same end. The further any particular mass is moved, or the heavier it is, the more the center of gravity will be shifted; and this clearly corresponds to the influence we should wish the various prices to have in the statistical problem. The formula in use in statics, $x=\frac{S\,m\,x}{S\,m}$, can also be used in statistics.[1]

Geometric Average. For most cases the arithmetic mean is entirely satisfactory, but for a limited number the geometric may be preferred. If we are to compute the mean of a, b, c, the formula by the arithmetic method would be $\frac{a+b+c}{3}$, while by the geometric it would be $\sqrt[3]{a\times b\times c}$. In the latter process we multiply together the factors and take of the product the

[1] Bowley, A. L., "Elements of Statistics," pp. 112-113.

root corresponding to the total number of factors. Jevons endeavored to show that in the computation of an index number the geometric mean was to be preferred in certain cases. If we were studying the population of a community which had increased during a century from one to two millions, it would not be correct to say that it had increased at the rate of 1 per cent per annum, for such a rate would give us at the end of the century a population of 2.7 millions. We must take the geometric rate of increase or $\sqrt[100]{2}$ which would give us 1.007 per cent.[1] Except in estimating the probable future population of a country there is little use for the geometric method, and even in this case the arithmetic method is commonly used in this country on account of its greater simplicity, and the fact that it is fairly accurate.

Deviation from the Average. There are some averages which are made up from sets of figures, each one of which deviates but slightly from the average, while in other cases the deviations are wide. In such cases it is a good plan to compute the average deviation of the series of figures. We, therefore, find the deviation of each member of the series, and divide the sum of the deviations by the number of the members in the series. The ratio of this quotient to the average will give the percentage of deviation. Let us assume two series composed of ten figures, the average of each of which is 5,000. The sum of the deviations from the average in the first series is 900 and in the second 20,000. The mean deviation about the average is in the first case 1.8 per cent., and in the second 40 per cent. We should, therefore, say that in the first place the average was $5{,}000 \pm 1.8\%$, and in the second $5{,}000 \pm 40\%$. The smaller the deviation, the more nearly does each case correspond to the average and become a good representative of the type.[2] This can be well represented by

[1] Venn, J., "On the Nature and Uses of Averages," Jour. Royal Statist. Soc., Vol. LIV, Part III, Sept., 1891, p. 433.

[2] Mayr, G. von, "The Theory and Practice of Statistics" (Translation), Jour. Royal Statist. Soc., Vol. XLVI, Sept., 1888, p. 496.

the case of the marksmen shooting at a target. In all cases the shots would be grouped about the bull's-eye, but where the marksmen were not accurate the sum of the distances of their shots from the center would be much greater than where they were sharpshooters.

In the mean deviation the sign is disregarded. If this is taken into consideration the variation is, of course, zero. If, in place of this, we use the standard deviation, the sign takes care of itself. To obtain the standard deviation the square root of the sum of the squares of the individual deviations from the average is taken. Suppose we have the numbers 5, 6, 2, 6, 8, 3. The mean of these is $30 \div 6 = 5$. The deviations from the mean are 0, 1, 3, 1, 3, 2, and the squares 0, 1, 9, 1, 9, 4. The square root of the sum of these squares is $\sqrt{24} = 4.9$.

The practical value of the standard deviation is increased by the fact that it can be readily obtained by the use of a familiar theorem, that the sum of the squares of the deviations from the mean is equal to the sum of the squares of the deviations from any other arbitrarily chosen figure, less the square of the difference between the mean and that arbitrarily chosen figure when this difference is multiplied by the number of terms. In the preceding example let us select 3 as the arbitrary figure. The differences are then 2, 3, 1, 3, 5, 0, and the squares 4, 9, 1, 9, 25, 0 with a total of 48. The difference between the mean (5) and the arbitrarily chosen figure (3) is 2: its square 4. The number of terms being 6 the product becomes 24. Subtracting this from the sum of the squares of the differences (48) we have remaining 24, as the square of the standard deviation. The latter method is of great utility when the mean is an inconvenient figure to handle.

In some cases it is desirable to represent the maximum and minimum in connection with the average. We might have two series of 10 numbers, the average of which in each case was 5,000. In the first case the maximum was 5,200 and the minimum 4,800; in the second the maximum was 9,000 and the minimum 2,000. We might either state the maximum and minimum in actual numbers, or say that in the first case the average was 5,000, maximum variation 4%, minimum variation 4% ; while in the second case the average was 5,000, maximum variation 80%, minimum variation 60%. In this way the presence of any great disturbing factor in a single year of a series would be apparent.

The Mode. To obtain the simplest average there is more or less computation required, but the mode is ready made. It is only necessary to arrange and tabulate our data, and the figure which occurs the greatest number of times is the mode. The average may not be exactly represented in any of the units considered, whereas the mode is that figure which is most often repeated, and, therefore, corresponds to a certain number of concrete cases. When we speak of an average day's work for a mason, we do not mean, for instance, the total number of bricks that are laid in a city on a certain day, divided by the number of masons engaged in the task, but we mean that more masons would lay about this number of bricks in a day than would lay more or less. If a contractor hired a mason by the day he would expect that he would lay this average number of bricks per day. What we are really considering here is not an average but a mode.

A manufacturer of ready-made clothing would not make any large quantity of goods according to the measurements obtained by taking an arithmetic average of the figures for the different individuals of a group, since the garments would be likely to fit but few persons. What he is after is the mode. He will make the greatest number of garments to fit that person who is most representative among the class for which he manufactures. The mode is not in the least affected by extremes. The giant or the dwarf would have no influence upon the measurements desired by this clothing manufacturer. This is appreciated when we notice that a person whose figure is peculiar cannot be fitted to a suit except where the dealer has a large assortment. The maker was not catering for the patronage of this buyer who was hard to fit, but for the man of the crowd. Since the mode represents the most common figure it has been called the "fashionable" value.

The Median. If we arrange all the items of a group in the ascending order of magnitude, the item in the middle of the series is the median. In case there is an odd number of figures it corresponds to a concrete case, but if there is an even number the median has a value half way between the two middle ones. The numbers one-fourth and three-fourths up the list are quartiles. Those at intervals of tenths or hundredths are deciles or percentiles, but the utility of these values is very small.

The median shares with the mode the advantage of not being affected by extreme cases. It is best suited to a series of values which are more or less grouped about a well defined center with a few extreme values. It is the most valuable of all averages, on account of its accuracy and the ease with which it is found.

The median has another advantage in that it can be found by the graphic method. We can lay off on a horizontal scale equal intervals for units of measurements, and on a vertical scale equal intervals for numbers of cases. We then start at the bottom of the chart and lay off as many vertical spaces as there are units corresponding to the smallest value on the horizontal scale. From the top of this space draw a horizontal until it meets the vertical erected from the base line at the point where the value is to be found in the list of items. With this point as a base more units are then laid off, and the process repeated until all the items have been thus marked on the chart. A broken straight line is then drawn through the middle points of the vertical spaces which have been previously laid off. From the top of the broken line a horizontal line is drawn until it meets the vertical scale. From a point on the vertical scale half way between the base and the intersection with the horizontal, from the top of the broken line, a horizontal is drawn until it meets the broken line. The point of intersection lies vertically above the value on the base line, which corresponds to the median.[1]

[1] Galton, F., Report of the Anthropometric Committee of the British Association, 1891, p. 247.

A typical case will perhaps show more clearly the value of these different averages. A large store has a superintendent drawing \$50.00 per week, four buyers earning \$25.00, five men in the office \$20.00, ten clerks getting \$15.00, twenty clerks at \$10.00, and five cash boys at \$5.00. The figure which represents the mean of wages paid is:

$$\frac{(50\times1)+(25\times4)+(20\times5)+(15\times10)+(10\times20)+(5\times5)}{1+4+5+10+20+5}=\frac{625}{45}=\$13.88$$

In this case the average has been weighted according to the numbers working at different wages. The simple average would have been:

$$\frac{50+25+20+15+10+5}{6}=\frac{125}{6}=\$20.83$$

The mode is \$10.00, because there are more earning this amount than any other. The median is also \$10.00 since this number is the middle in the list when the help are arranged according to the wages paid.

If we construct a frequency curve for the items in the list, and drop a perpendicular from the center of gravity to the axis of the curve, the point where it meets the axis is the mean. If we erect another perpendicular dividing the area between the curve and the axis in two equal parts, the point where it meets the axis is the median. If we erect a perpendicular passing through the highest point of the curve, the intersection between the perpendicular and base will mark the mode.[1]

Cause of Error. It has already been stated in connection with gathering the material, that it is not justifiable to exclude any reliable evidence because it is contrary to what might have been expected. It is true in general, that the more dense the population, the higher the death-rate. But

[1] Yule, G. U., "Notes on the History of Pauperism in England and Wales from 1850," treated by the method of frequency curves, with an introduction on the method. Journ. Royal Statist. Soc., Vol. LIX, Part II, June, 1896, p. 327.

in the Jewish quarter of New York City, where the population is very congested, the death-rate is not exceedingly high. It is not justifiable to discard these figures as improbable, but the facts must be studied to see if there is anything in the mode of living of this class which will account for and explain the apparent anomaly. There is something besides mere overcrowding which increases death-rates. That is undoubtedly one cause, but the probability is that the mistake has been made of attributing to one what was the result of the combination of several causes.

A phrase which is often used in statistics, and is the excuse for much error, is "other things being equal." The trouble is that "other things" seldom are equal. We find that in most cases the proportion of illegitimate to total births is greater in the city than in the country, and hastily jump at the conclusion that there is something about city life which leads to irregularities between the sexes. This may be true, but there are certain factors in this problem which should be considered. In the first place, there is a greater proportion of unmarried men and women between sixteen and thirty years of age in the city than in the country. The expense of establishing a home is such that marriages are deferred to a later date in the cities. On the Continent the soldiers are generally stationed in the cities, and the attraction of a uniform is hard to resist. Then, too, most of the maternity hospitals are in the cities, and abandoned girls go from the country to the city in the hope that they may conceal their shame. It is evident that "other things being equal," the crude figures would show that city life leads to sexual immorality, but when all of the conditions which enter the problem are studied it is evident that a conclusion must not be too hastily reached.

The word "undoubtedly" has also been the cause of grave error in statistics. This word should never be used except in the case where the accuracy of the statement to which it applies cannot be called in question. At present there is the tendency to say that a certain statement is "undoubtedly" true, when the fact is that the author is in doubt about the matter and uses this form to mask his ignorance. When used in this incorrect sense it has a meaning a good deal like probably.[1]

There is grave danger in drawing a conclusion which shall apply to an entire group of phenomena from a few cases. Thus it would not be correct to make a study of the murders committed in the State of Massachusetts for a certain period of years in order to determine the proportion of male and female victims, and then take it for granted that this result would hold for the entire United States. If typical communities had been carefully selected throughout the country, the representative method might have been employed successfully.

It is difficult to tell how many cases should be collected before the results shown by them can be trusted. The number will vary according to the nature of the problem. It is, of course, theoretically advisable to collect *all* the cases, but this is in most instances out of the question. In any event, the more the cases the greater the accuracy, varying roughly as the square root of the number of cases. Poisson's formula affords a rough measure of the approximation to the truth of a varying number of phenomena. This is intended to deal with the ideal conditions of games of chance, but is of some assistance in vital statistics as a test of accuracy. Professor Newsholme has given the very clear application of the formula which follows:[2]

Let $\mu =$ total number of cases recorded,
$m =$ number in one group,
$n =$ number in the other group,
so that $m+n=\mu$

The proportion of each group to the whole will be respectively, $\frac{m}{\mu}$ and $\frac{n}{\mu}$. These proportions will vary within certain

[1] Blodgett, J. H., "Obstacles to Accurate Statistics," Pub. Amer. Statist. Assn., New Series, No. 41, Mch., 1898, p. 15.

[2] Newsholme, A., "The Elements of Vital Statistics," London, 1889, pp. 323-324.

limits in succeeding instances, and the extent of variation will be within the proportion represented by

$$\frac{m}{\mu}+2\sqrt{\frac{2.m.n.}{\mu^3}}$$

and

$$\frac{n}{\mu}-2\sqrt{\frac{2.m.n.}{\mu^3}}$$

It is evident that the larger the value of μ (the total number of observations) the less will be the value of $2\sqrt{\frac{2.m.n.}{\mu^3}}$ and the less will be the limits of error in the simple proportion $\frac{m}{\mu}$.

Thus if out of ten cases of cholera seven recover, how near is this to the true average of recoveries? Here the probability of recovering is represented by $\frac{7}{10}$, of dying by $\frac{3}{10}$. The possible error is given by the second half of Poisson's formula. Thus,

$$2\sqrt{\frac{2.m.n.}{\mu^3}}=2\times\sqrt{\frac{2\times7\times3}{10^3}}=2\sqrt{\frac{42}{1000}}=.4985.$$

Thus the possible error is .4098 to unity, or, in other words, the error is greater than the number of deaths. What will be the possible variation in 100,000 cases on this basis?

The average, as stated, is 70,000 recoveries out of 100,000 cases; the possible error is 40,980; therefore, the number of recoveries may be either 29,020 or 110,980, a conclusion which is an obvious absurdity.

If, however, 100 cases be collected, out of which seventy recover, the proportion is the same; but by Poisson's formula the error is only .13 to unity, and the range of recoveries out of 100,000 cases will lie between

$$70{,}000+13{,}000=83{,}000,$$
$$\text{and } 70{,}000-13{,}000=57{,}000.$$

If 1,000 cases are taken, of which 700 recover, the error will be only .04 to unity and the range of recoveries in 100,000 cases will lie between

$$70{,}000+4{,}000=74{,}000$$
$$\text{and } 70{,}000-4{,}000=66{,}000.$$

The following table will show more clearly how, with an increasing number of facts, the limits of possible error (assuming the accuracy of the facts recorded) steadily decreases:

Total Number of Cases.	Number of Recoveries.	Possible Number Recovering out of 100,000 Cases According to Poisson's Formula.
10	7	29,020 or 110,980
100	70	57,000 " 83,000
1,000	700	66,000 " 74,000
10,000	7,000	68,700 " 71,300
100,000	70,000	69,600 " 70,400
1,000,000	700,000	69,870 " 70,130

It is important that the mistake should never be made of comparing ratios which have little or nothing in common. It is, therefore, necessary to make a careful examination at the start to be sure that the unit of measurement is the same in the items to be correlated.

In a report of the Secretary of War for 1899, there was a statement that the annual death-rate per thousand from disease among the American soldiers in the Philippines was, for the first ten months of the year, 17.20. This was not an excessive rate, but the attempt was made to show that it was remarkably low. To make this statement apparent it was cited that the annual death-rate of Washington was 20.74, of Boston 20.09, and of San Francisco 19.41. At first sight it would appear that the healthfulness of the American soldier in the Philippines was entirely satisfactory, since his death-rate was surpassed by the rate in these American cities. The trouble with this reasoning lies in the fact that the comparison is not made between similar units. The death-rates in the cities are formed on the base of the total population, which includes the infants and those of advanced age among whom the mortality is always high. The soldiers are picked men, taken from a large number of applicants, so that we can be sure that at the time they left this country they were in good physical condition. We should, therefore, expect that their death-rate would be as low as that of the average American within the same age groups. When we consider that in the registration area of this country the death-rate of males between twenty and forty years of age is below 9.5 per thousand, we see that the death-rate among the soldiers was nearly twice as great as among those of the same sex and age at home.[1]

If we were trying to determine what portions of a country were the most free from the ravages of consumption, it would be necessary to make the correction for institutions. Those places where the air is driest and the possibilities for an outdoor life the best are generally selected for the erection of institutions for the treatment of tuberculosis. Also a person whose lungs were slightly affected would be likely to take up his residence in such a place. There would naturally be more deaths from this disease where there were so many suffering from it. If a crude death-rate were computed those places which were in reality most healthful would appear in a bad light. The attempt to compare two sets of figures which had something in common, but which were not uniform in all respects, has led to many serious errors, and often brought statistics into ill-deserved contempt.

As a sense of proportion is necessary to a historian, that the salient points of history may stand forth clearly, while those of lesser importance do not occupy the same prominence, so must a statistician be careful not to allow the lesson taught by his work to be obscured in a maze of figures. In writing a paper it may be advisable to state that the production of wool in a certain country increased from 126,481,-

[1] Bailey, W. B., "Mortality in the Philippines," *Yale Review*, Vol. VIII, No. 4, Feb., 1900, p. 457.

317 pounds in 1890 to 174,612,946 pounds in 1900, but if the paper is being read aloud it is far better to say that the production increased from about 125 millions of pounds in 1890 to nearly 175 millions in 1900. In case the complete figures are read the mind of the average hearer is unable to remember them, and while endeavoring to carry the one in mind until the other is reached, is as likely to remember the 317 as the 126 millions. In fact, the millions are the only significant figures, and the sums might well have been written 126.5 and 174.6 millions. In the census of 1870 the population of the United States was given as 38,558,371, but in the Southern states there was a deficiency in the enumeration which has later been estimated at over 1.2 millions. In the light of an experience like this, it is evident that if the millions were not correct, it is folly to consider the units and hundreds.

It is a question whether the greater injury to the science has been done by the men who made mistakes or the ones who attempted to deceive. Those of the first class know little about statistics, but feel themselves competent to deal with any problems to which this method of treatment applies, and as a result they give out statements and conclusions which are incorrect. They do not attempt to deceive, but since they cannot grasp the truth themselves, of course they cannot impart it to others. The second class is made up of those who know very well they are not telling the whole truth. They are largely politicians and writers of editorials for a partisan press. The believers in free trade or protection have gone to the industrial history of the United States for facts to prove that their pet theory has been responsible for most of the prosperity, and the measures of their opponents must bear the blame for most of the depression which has come to the country. Both started with a dogma and have then tried to verify it. If a fact is found which does not agree with this preconceived notion it is cast aside at once. The one aim is to gather together a mass of material which shall convince others. The desire that others may agree with them is generally to be traced to political or financial ambition. Their fault is not that they state what is false, but that they do not tell the whole of the truth as they themselves know it.

There is also a third class of men who have no use whatever for statistics and are ready to make fun of any man who puts faith in figures. It does seem at times that an unnecessary amount of time and labor is being placed upon statistical problems which have no apparent utility, and we cannot blame Le Capitaine Tic for scoffing. But the fund of information is being slowly increased in this way, and from time to time a genius comes along to synthesize it for mankind. This class does but little harm, for the one to be affected by this criticism is generally kept at his task by enthusiasm and love for his work. The objection made to one working on a statistical problem of small compass would apply to any one who is engaged in intensive investigation. There is the danger for all, that, fastening their attention upon the trees, they shall lose sight of the forest.[1]

Graphic Representation. When the results of an investigation are in proper shape for publication the question arises as to the advisability of introducing charts and diagrams. There are several advantages to be gained from their use. To the average reader there is nothing more discouraging than a long column of figures. It seems to be too much of a task to carefully follow down the series in order to determine what changes have taken place. A book or an article in which are included several pages of figures repels many at the start. There are two ways of obviating this difficulty. The one is to simply describe in the text the various changes and give a short account of the story told by a careful study of the figures, placing the statistical matter at the end of the article. The tables should always be included in the article, in order that those who are particularly interested in the problem may see the facts on which the conclusions are

[1] Foville, A. de, "Le rôle de statistique dans le present et dans l'avenir," Journ. de la Soc. de Statistique de Paris, June, 1892, pp. 211-214.

based. In this way the article is rendered readable and no detraction is made from its value. The other method is to introduce charts. It would be a tedious operation for most people to follow the production of pig iron in the United States for a period of fifty years and carry away any vivid impression of its changes, if the information was to be gained from columns of figures, but where a diagram is introduced and the rise and fall of a line describes the increase and decrease in production, the changes are brought out clearly and the diagram draws attention to itself. In this way a hasty reader can gather considerable information without even reading the text. It is desirable that the chart or diagram should be introduced at that point in the article where this particular topic is being dicussed. If the chart is of such a nature that it demands an entire page it should be placed to front the page on which the subject is being discussed, rather than be relegated to the appendix. It may be justifiable to place the pages of figures there, but never the diagrams, which are for purposes of illustration.

The mind often desires to take in several sets of figures in statistics and when it has comprehended the lesson taught by one set, it is in danger of losing it in going to another. What is needed is some method by which several sets of facts can be kept in mind at the same time.[1] This is what a diagram is peculiarly fitted to accomplish.

Suppose we are trying to determine what causes influence the marriage-rate in a country. We commence by plotting the rate for a long series of years. We then plot by a different scale on the same chart the variations in the price of wheat. There seems to have been some connection between the direction of the lines several decades ago, and when the price of wheat increased the numbers of marriages fell off. But within recent years life has become too complex for any one factor to determine the marriage-rate. If we substitute a line showing the bank clearings, or the exports and imports of the country, we get a better criterion of economic prosperity and there seems to be a connection here.

[1] Marshall, A., "On the Graphic Method of Statistics," Journ. Royal Statist. Soc., Jubilee Vol., 1885, p. 258.

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But still there is one period when there was a great decrease in the marriage-rate, which is not to be explained by the chart. We turn to history and find that there was a war at this time. It is evident that a problem in correlation of this kind is much simplified by the use of diagrams. They can not prove any point. They simply indicate the points to which it is advisable to look for affecting causes and afford a simple method of testing the correlation between two sets of figures of which one is a function of the other. It is, of course, necessary to compare the result only with the cause which produces it, but it is often difficult to determine which is the principal cause, and the graphic method enables us to eliminate the causes which have no effect upon the particular phenomena we are studying. Thus it would give us no information upon the cause of change in the marriage-rate to study the growth of the different religious denominations in a country. The mistake is often made of comparing quantities which have little in common. There are some states in which the rate of infant mortality is represented as a ratio between the number of deaths of children to the number of children, for in this way we compare the number affected to the total number liable to be affected. Care should be taken in correlating values to use only such as may have some influence to produce the effect which is being studied.[1]

Charts are used for static and dynamic representations alike, and the only distinction which can be made is that, as a rule, lines are used to represent dynamic conditions and compare the correlation between different sets of phenomena, while surfaces are more often used to compare different items at the same time. This distinction, however, is not hard and fast, but subject to exception. The two principal methods of graphic representation are by diagrams, which are geometric figures and cartograms, or maps which are shaded. Since one of the principal uses of diagrams is to render statistics clearer and make figures talk, it is important that the charts should be intelligible. They should be

[1] Bertillon, J., "Cours élémentaire de statistique administrative," Paris, 1885, pp. 93-96.

CENTRES OF
European Emigration
to the
UNITED STATES.
FOR THE
FISCAL YEAR
1902.
SCOTLAND
NORTH SEA
IRISH SEA
IRELAND
WALES
Welsh, 760.
English 13790
ENGLAND
Rotterdam
Hamburg
Bremen
GERMANY
Total Germany, 28304.
BELGIUM
Paris
FRANCE
SWITZERLAND
TYROL
ITALY
ATLANTIC OCEAN
PORTUGAL
Lisbon
SPAIN
Barcelona
BALEARIC ISLANDS
SARDINIA
MEDITERRANEAN SEA
AFRICA

THE NORRIS PETERS CO. PHOTO-LITHO. WASHINGTON, D. C.

1.

so constructed that they may be entirely removed from their context without destroying their meaning. Therefore, at the top of every chart should be placed in clear type the nature of the investigation, and the interpretation of the lines or surfaces should be rendered easy by means of a key in a convenient location on the page. The authorities consulted in gathering the material for the chart should also be mentioned, that it may be possible at any time to verify it.

Diagrams. Points. One of the simplest means of illustration is by means of points. In this case surfaces of equal magnitude are selected and the frequency of the phenomena is represented by the number of points in each square. Thus if we were to compare the number of sheep per square mile of territory in two countries, that which had four times the number of sheep would have four times the number of points in the square. (Fig. 1.)

Lines. The system of representation by lines offers many different methods. The simplest is where the length of a line

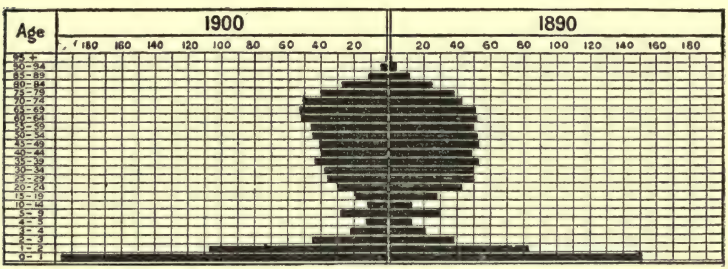

Fig. 2.

Comparative Proportions of Deaths from Pneumonia at Each Age in the Registration Area of the United States in 1900 and 1890.

represents one fact and the length of a second line another fact. Thus the tonnage of the navies of the principal countries in the world may be shown by the comparative length of lines. (Fig.2.) If it should be desirable to include the different classes of vessels included in this total, it could be done by a combination of different kinds of lines. Thus a solid, straight line could be joined to one made of dashes, and that to ones of small crosses. There is practically no limit to the different kinds of lines that can be formed.

It is possible to show dynamic changes by the same method. If in the scale used the base line represents years, and the perpendicular, quantities, we can represent the magnitudes by the height of straight lines erected at right angles to the base. Thus if we wish to represent the number of births in succeeding years in a country, we lay off on the base line equal distances for years, and then the height of the perpendiculars erected on this line will represent the number of births. If we should connect the upper ends of these perpendiculars by a line we should be able to trace the change in the numbers of births.

But there is an easier method to obtain the points necessary for drawing this line. For most cases in the preparation of diagrams plotting paper offers the easiest solution. Here the squares are already drawn, and the fifth, eighth or tenth line is usually a little heavier than the others. It is then necessary to simply decide on the unit of measurement for abscissa and ordinate. The years are usually laid off along the base line, and the magnitude to be measured on the perpendicular. All that is required is to follow up the perpendicular line above the year in question until it meets the horizontal from that point on the ordinate which corresponds to the magnitude which is being plotted. (Fig. 3.) It is not obligatory that the years should be along the abscissa and the quantities on the ordinate, although it is convenient to speak of the line rising and falling with the magnitudes. It is very rare that an equal distance on the ordinate will represent the same number of units on the abscissa. Thus a distance marking one year on the horizontal may designate a thousand births on the perpendicular. It is usually best for the base line to be placed at zero, for if this is not done the chart is made to appear on a wrong scale and the variations are intensified.

It is not good policy to have equal spaces on the same line represent different values, for certain quantities are thus given more than their true importance. An industry may be of but small importance to a country for a long period until some discovery or invention revolutionizes it. The advance will then be very rapid and to plot this on the same scale which was used for the earlier period will make the variations appear very small at the early and large at the later date. But it is preferable that the changes should appear in their

RELATIVE PRICES OF FARM PRODUCTS, 1890 TO 1903.

[AVERAGE PRICE FOR 1890 TO 1899=100.]

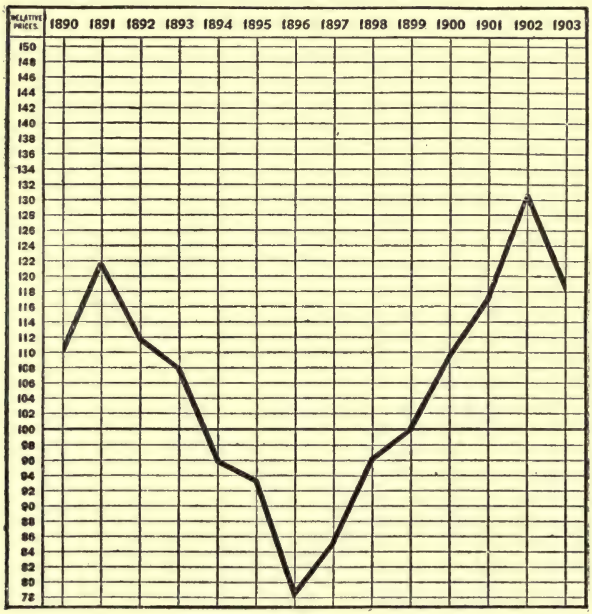

Fig. 3.

true proportion than that the scale should be distorted to make some magnitudes appear greater than they really are. Any number of lines can be drawn on one chart by changing the form of line. Where two lines are drawn for purposes of comparison on the same chart, as for instance the value of the imports and exports from year to year, it is common to shade in one way the space between the lines when the exports exceed the imports, and in another way when the opposite is true.

It is possible to smooth these broken straight lines into curves, but in most cases this is not desirable except where the irregularities of the lines are the result of careless answers. Thus when very many report themselves as 50 years of age and but a few as 49 or 51, it is a good plan to smooth this curve and obtain a number more nearly correct than that given by the subjects of the investigation. Where one phenomenon is clearly the cause of another and precedes it by a regular time, we get a curve of pursuit. Thus good times are generally reflected in an increased birth-rate, but the effect is not noticeable until the following year. The curve of births would then pursue the curve showing economic well-being, but the changes in direction would come one year later in each case.

A large proportion of the time spent by statisticians has been employed in trying to account for the changes in direction of these dynamic lines. Wherever there is such a change, there is either some cause at work more powerfully, or a cause which had formerly been operative has ceased to influence.[1]

Surfaces. The most common method of representing magnitudes by surface is to have the bases of the quadrilaterals equal and the altitudes vary with the size of the quantities to be compared or vice versa. If two or more different quantities are to be represented in the same diagram it is simply necessary to shade portions in different ways. (Fig. 4.) It is easy to compare quadrilaterals constructed in this manner for they vary directly as their height. In constructing diagrams it is often desirable to have the base equal to the number of quantities and the height to their values. If we wished to compare the wealth of two different sections of a city we might have the bases represent the numbers of the taxpayers in each section, and the height the average amount of tax paid; although the total amount of tax paid might be the

[1] Fahlbeck, P. E., "La regularité dans les choses humaines ou les types statistiques et leurs variations," Journ. de la Soc. de Statistique de Paris, June, 1900, pp. 188-200.

TOTAL VALUE OF FARM LAND WITH IMPROVEMENTS, LIVE STOCK AND FARM IMPLEMENTS: 1900
HUNDREDS OF MILLIONS OF DOLLARS
0
8
12
16
20
ILLINOIS
IOWA
OHIO
NEW YORK
PENNSYLVANIA
MISSOURI
INDIANA
TEXAS
KANSAS
WISCONSIN
CALIFORNIA
MINNESOTA
NEBRASKA
MICHIGAN
KENTUCKY
TENNESSEE
VIRGINIA
S. DAKOTA
N DAKOTA
N. CAROLINA
GEORGIA
MARYLAND
MISSISSIPP
WEST VIRGINIA
LOUISIANA
NEW JERSEY
OKLAHOMA
MASSACHUSETTS
ARKANSAS
ALABAMA
OREGON
COLORADO
S. CAROLINA
WASHINGTON
MAINE
MONTANA
CONNECTICUT
VERMONT
INDIAN TER.
NEW HAMPSHIRE
UTAH
HAWAII
WYOMING
IDAHO
FLORIDA
NEW MEXICO
DELAWARE
ARIZONA
NEVADA
RHODE ISLAND
Farmland with improvements
Live stock
Farm implements

Fig. 4.

same and represented by two diagrams of equal area, it is probable that their shapes would vary.[1]

"The age composition of a population on a given date may be represented graphically by a diagram sometimes called the age pyramid, but which might more accurately be called the age triangle. The example given (Figs. 5-6) illustrates in this way the age composition of the population of the United

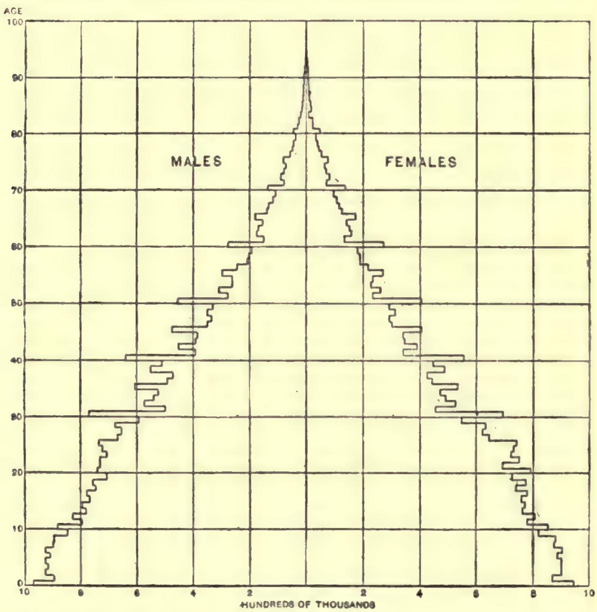

Fig. 5.

Distribution of the Population of the United States in 1900 by Sex and Age.

States at the date of the Twelfth Census. The vertical line running through the apex of the triangle is divided into 100 equal parts, one for each year of life. From this line horizontal distances are measured representing, according to the indicated scale, the number of persons reported at the specified age. Distances to the left represent males, to the right females, and the horizontal distance between the sides of the

[1] Bertillon, J., "Cours élémentaire de statistique administrative," Paris, 1895, p. 137.

AGE AND SEX, IN PERCENTAGES OF EACH ELEMENT OF THE POPULATION

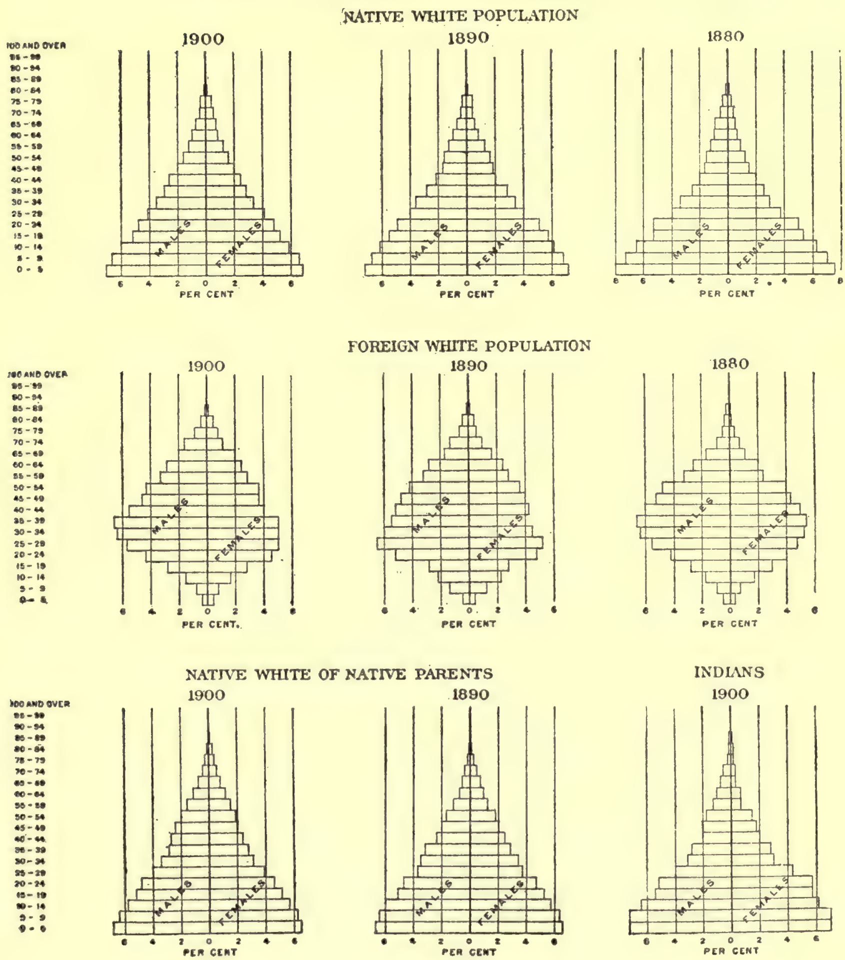

Fig. 6.

triangle at each point the total population of the specified age. Each complete square within the triangle thus represents 2,000,000 people and the entire area of the triangle represents the total population of the United States of known age, classified by sex and age."[1]

Where there are decided differences in the values of the magnitudes to be compared squares are often employed, since if both were constructed on an equal base the height of one would be very insignificant. Under similar circumstances triangles may be employed. Different portions of an equilateral triangle are often distinguished by a series of lines drawn parallel to the base, and the portion of the apex given to the class with the fewest representatives. If the wealth of a country was to be represented by such a triangle, the large numbers of the poor with their small holdings would form the base and the upper portions be given to the large property of the comparatively few very rich. Circles may also be employed, the surface of which is proportional to frequency. Since the areas of two circles vary as the squares of their radii, it is necessary, in order to construct the circles, to take the square root of the numbers to be compared. When it is necessary to compare two quantities very dissimilar in size, it is possible to include one circle within the other, or to place one of them in the upper semicircle, the other in the lower one. Very similar to these are polar diagrams where the lines all start from a common center and where the lengths of the radii vary directly with the frequency of the phenomena under consideration. (Fig. 7.) Thus the total area of such a figure might represent the total number of deaths of children from measles in a country, and the lengths of the radii the number dying in each month. In this case the circle would be divided into twelve divisions corresponding to the months and the number of cases would be recorded as by a clock, the length of the hand of which varied.

A circle may be divided by radii and different portions by

[1] "A Discussion of Age Statistics," Bulletin 13, Bureau of the Census, 1904, p. 9.

means of shading be made to show the frequency of certain phenomena. Thus the area of a circle may represent the total population of a country, and the sections included be-

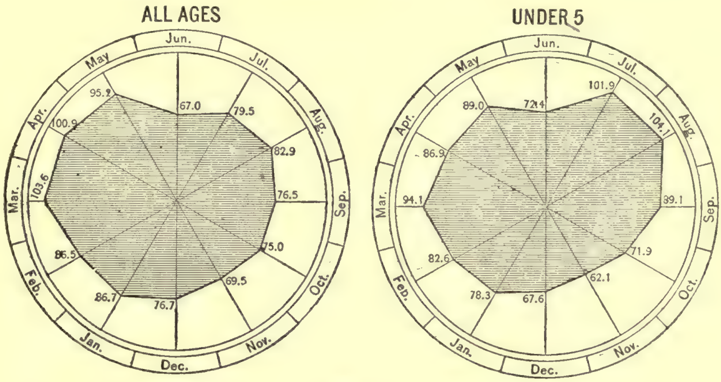

Fig. 7.
Variation of Deaths by Months in the United States in 1900.

tween the radii be the single, married, widowed and divorced. (Fig. 8.) In such cases it is possible to distinguish the different elements by various colors. Black, green, red, blue

Fig. 8.
Causes of Strikes in the United States
During the Twenty Years, 1881-1900.

and white in order furnish the most effective scheme. But where colors are employed they should always distinguish different groups and not various gradations of the same group.

To distinguish conjugal conditions it is justifiable to use different colors, and if the entire population of the country was represented by the area of a circle, the segments corresponding to the single, married, widowed and divorced could be given in different colors. But if the birth-rates of the different states in this country were to be represented in color, it would not be well to make use of several different colors. It would be better to select one color, using the lightest shade in those states where the birth-rate was the lowest, and the darkest where it was the highest. A key should be given at the bottom of the plate, showing the extremes between which each shade was to apply. In this case the shading would vary directly with the intensity of the phenomenon.

In the formation of isogenic diagrams it is preferable to use different shades of the same color. Suppose we wish to show by a diagram how the number of children born per annum per thousand married women varies according to the age and duration of married life of these women. This is really a problem where it would require a chart of three dimensions to represent these variations satisfactorily. But this difficulty can be overcome as follows.

Let the abscissa of a chart represent the varying ages of married women and the ordinate the number of years which they have been married. Then in the various squares place the number of births. To grasp the meaning of the chart would require considerable time if the figures alone were used. There are two ways in which this difficulty may be avoided. The first is to draw a series of isogens or concentric lines through the points of equal intensity. This will give the effect of a mountain, around which these lines run to mark the different altitudes. As the length of married life and the age of the women increases it will be found that the births become less numerous. A second method of showing the same variation is to draw up a key in which the different birth-rates shall be represented by different shading. Then the squares corresponding to the numbers of the key can be shaded in the required manner. Where the requisites for successful shading are not at hand it is best to leave the lowest numbers white, color the highest clear black, and by a series of parallel lines distinguish the intervening grades. Thus the next to the lowest might be formed from parallel vertical lines, the next might have perpendiculars added like the lines of a checker-board, and the next have diagonals in addition. Thus as the intensity of the phenomenon increases the lines in the square become more numerous.

Stereograms or solids are sometimes employed to represent a fact with three variables. A good example of a diagram of this kind constructed by Perozzo is to be found in the Jubilee Volume of the Royal Statistical Society.[1]

Cartograms. In many cases it is desirable that a map should be presented. Where a study is being made of the distribution of the sexes in a country it is of advantage that the eye may see in what portions the males are most concentrated, and in what the females. It is here best to use one color for a predominance of males and another for that of females. Then each color can be shaded so that where the disparity is greatest the color may be deepest. This is one of the few cases in which it is justifiable to use two colors on the same map.

Whenever it is simply a case of difference of intensity it is best to shade the portions in but one color. Black and white with paper of differing shades of gray is the best for this purpose. (Fig. 10.) Prof. Ripley has given some advice as to the proper way to make a map in order to show by shading a number of different values.[2] The principal articles needed are a piece of stiff cardboard, tracing paper or cloth, carbon paper, drawing-ink, sharp scissors, a keen penknife, a bottle of Chinese white water color

[1] Levasseur, E., "La statistique graphique," Journ. Royal Statist. Soc., Jubilee Vol., 1885, pp. 218-250.

[2] Ripley, W. Z., "Notes on Map Making and Graphic Representation," Pub. Amer. Statist. Assn., New Series, No. 47, Sept., 1899, pp. 319-322.

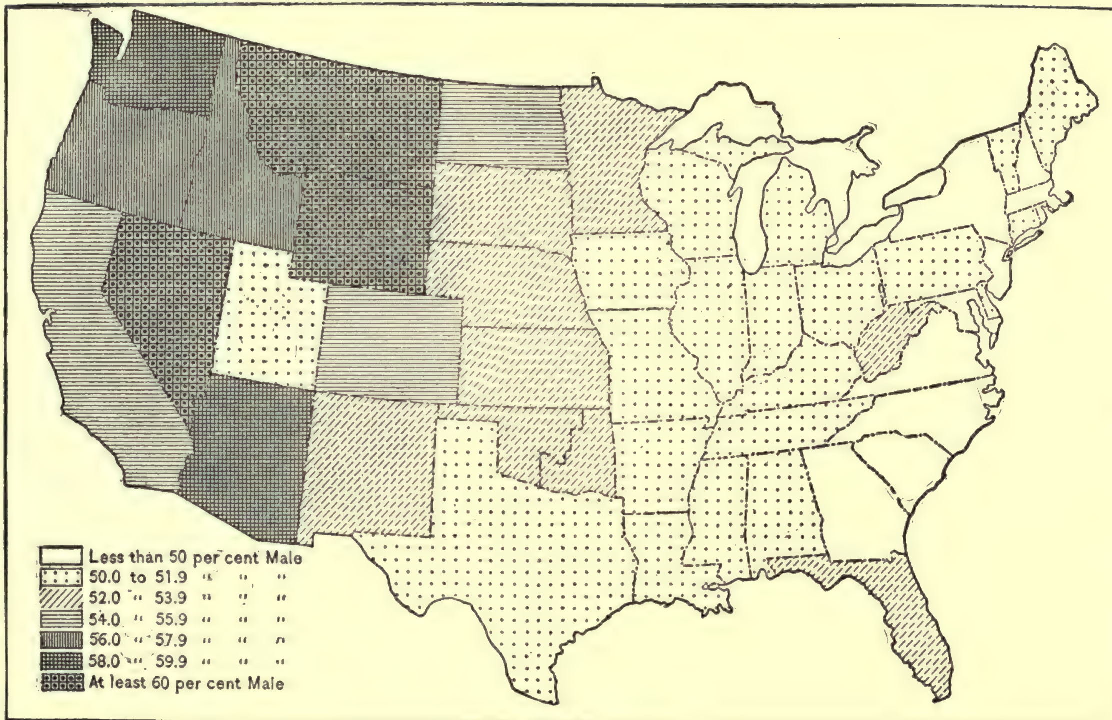

Fig. 10.

Per Cent. Male in Total Population, for States and Territories: 1900.

paint, some stickem, and a set of black and white tint papers. The map may be transferred directly to a piece of tracing cloth or it may be done on tracing paper and transferred to the cardboard by means of carbon paper. It is unnecessary to construct the outline of a map when it is so easy to copy it in this way. The remaining task is to fix the required tints in their proper places on the map. Beginning at the upper left hand corner of the map make a tracing on the prepared shading paper of the district that is to be shaded. Cut out the upper and left hand sides only, leaving the others to overlap. The lower and right hand sides are not to be cut out but pasted over by the other pieces of tracing paper. The lines of division are marked in black so as to show distinctly. In this way the entire map is shingled over. When the lower and right hand sides of the map are reached it is possible to cut it out accurately or simply trace it and then paint in all that overlaps with the Chinese white.

In case there is a coast line or irregular boundary it is generally better to paint this in with the white than to attempt to cut it out from the shading paper.

A combination of the map and diagram is sometimes used, as in the case where the railroads of a country are marked on a map by lines, the width of which varies according to the amount of business done by the different roads. A country is often divided up by curved lines to correspond to the varying altitude or density of population. Maps in relief are seldom used on account of the expense of preparation.

STATISTICAL REGULARITY

When a statistical investigation has been completed, it is possible to give the results to the public in one of two ways.

1. They may be used descriptively, and just enough said to make them intelligible to the public, without any attempt to draw conclusions. The end in view in this case is simply to tell what has been found in the course of the

enquiry. This is the method generally pursued in censuses and government statistical publications. The facts are given to the public with a little comment and each individual is at liberty to construe them as he will.

When the annual reports of the great departments are published, it is a good plan to state in the introduction the principal results which are shown in the volume, that the busy man may get a good idea of the entire book from reading a few pages. These volumes are generally of some considerable size, but this is no objection, since they are not often taken on the road for light reading but serve as works of reference. It is not a matter of much moment that they should appear at once at the close of the period treated in the volume, for it is more important that they should be exact than on time. In some cases the attempt has been made to conceal the fact that the volume was late by printing on the back, not the year to which the figures refer, but the date of publication. This attempt is too apparent to be useful or accomplish the desired result.

When the annual is in the form of an abstract of several reports, as is the case with the Statistical Abstract of the United States, it is best that it be of convenient size that it may serve as a handbook. The tables should all go back for a number of years, so that it may not be necessary to consult several volumes in order to trace changes. All volumes of this kind, which are composed almost entirely of sets of tables, should have a convenient index in order to facilitate reference to them.[1]

2. The other method is to use the material which has been collected analytically. We may arrange the groups of figures so that they shall tell their own story of cause and effect, and, if no correlation is apparent, the effect may be traceable to some cause outside the figures. The statistician is in some cases the person best fitted to draw the conclusions, for his intimate knowledge of conditions, gained from the conduct of the investigation, has given him information about

[1] Bertillon, J., "Cours élémentaire de statistique administrative," Paris, 1895, pp. 79-83.

the difficulties and limitations of the subject which can be possessed by none other. In other cases the sociologist may have given special attention to some problem, and be acquainted with the literature on the subject and conditions in foreign countries, so that he is the person best fitted to read the correct meaning into the figures.

We shall notice that there are certain regularities in all large numbers and that the larger the number of cases the greater the regularity. If we are to determine changes it is better to subdivide the numbers that the changes may be brought out more clearly.[1] In this way we may be able to determine cause and effect with sufficient certainty to conclude that we have met with a statistical law. When we speak of a law we generally mean a command to do or not to do a certain thing with a penalty for disobedience. The only law of this kind which, by any stretch of the imagination, can be called a statistical law, is the one which compels people to answer statistical questions. We speak of a statistical law when we are able to trace the effects of a man's actions to some anterior cause and find that there is always the same social result. Von Mayr gives four such classes of laws in statistics.[2]

1. Zustandsgesetze. Laws of condition. Society has more members in the earlier than in the later age groups. A stationary population has more in the upper age groups than has an increasing population.

2. Ereignissgesetze. Laws of events. Marriages are more frequent in good than in bad times. Wars diminish the birth-rate.

3. Entwicklungsgesetze. Laws of development. The death-rates of most of the civilized countries are decreasing. The average age at death is increasing.

4. Kausalitätsgesetze. Laws of causality. We try to discover how one fact is the result of some antecedent fact.

[1] Lexis, W., "Les causes des régularités statistiques," Bulletin de l'Instit. Internat. de Statistique, Tome IX, Liv. II, 1896, pp. 77-81.

[2] Mayr, G. von, "Die statistischen Gesetze," Bull. de l'Instit. Internat. de Statistique, Tome IX, Liv. II, pp. 300-307.

When the material has been gathered, tabulated, and abstracted, when the charts have been drawn and the attempt made to determine the true lesson taught by the figures and the laws which underlie their regularity, all the steps of a statistical investigation have been completed and the work is ready for the printer.

CHAPTER II

SEX, AGE AND CONJUGAL CONDITION

Sex. The primary natural distinction of population is according to sex. It is one of the few phenomena in demography which are independent of the will of the individual. Although this holds true of the individual or of society as a whole it does not apply to the various ethnic groups. While the individual has no option as to sex, or place of birth, yet the selection of a residence is free to most, and upon the way in which this choice is exercised will depend, to a considerable extent, the relation between the sexes in any country.

The proportion between the sexes affects, to a considerable extent, many of the phenomena of social life. A country with a majority of males is better fitted to enter the world's industrial competition than one in which there are more females. Since crime and suicide are in most cases the acts of males, we should expect to find these phenomena high in communities with a large proportion of males. Vice is usually more common where either sex forms a decided majority of the population. Before we condemn any community for social irregularities it is well to consider the distribution of the sexes.

Although the answers to all statistical questions are liable to error, there is none in which the possibility for mistake is so completely eliminated as is the case with regard to sex. The exact age may be unknown even to the subject and there is the temptation for some to make incorrect returns as to conjugal condition, but neither ignorance nor the attempt to deceive affects the reliability of the data on sex. That this does not always prove true has been noted by Prof. Mayo-Smith.[1]

[1] Mayo-Smith, R., "Statistics and Sociology," New York, 1896, pp. 56-57.

"One of the most remarkable is furnished by the last census of India, which returned six and a quarter million fewer women than men. This made a proportion of 958 females to 1,000 males. The proportion varied in the different provinces between 804 and 1,084 to 1,000. There has been much discussion as to whether this small proportion of women is due to omissions, or whether the number of women is really so much smaller than that of men. Undoubtedly part is due to simple omissions. Women are held in such low esteem that many males, heads of households, would simply neglect to return daughters or female servants, not thinking the matter of sufficient importance. Others having daughters of marriageable age not yet married, would neglect to return them on account of a feeling of shame, and among the hill tribes there is said to be considerable jealousy in regard to their wives and daughters. From these various causes it is believed that there were very considerable omissions in the number of females returned, the largest deficiency being between the ages of 10 and 15. At that age there were only 795 girls to 1,000 boys. It is probable that there are real causes tending to decrease the number of females. Infanticide is not now practiced to any great extent, but girls are still regarded as more or less of a burden because a dowry must be provided for them when married, so that they are less well taken care of than boys. Early marriages, child-bearing at immature age, and insufficient medical care are also fatal to the life of the female. Later on in life there is not that distinction of employments which increases the mortality of men in European countries. The mass of the people in India are engaged in agriculture, and women share equally with men in the labors of the field. Mortality tends to bear equally on the two sexes, so that it is not until the age of 60 that the numbers of surviving women is greater than the number of men."

Accurate statistics are confined almost entirely to the highly civilized nations. In any attempt, therefore, to determine the relation between the sexes throughout the world, conjecture will play a large part. The following table must, therefore, be accepted as partly an estimate.

DISTRIBUTION OF THE POPULATION OF THE CONTINENTS BY SEX.[1]

	Females to 1,000 Males.
Europe	1,024
America	973
Asia	958
Africa	968
Australia	852

There seems to be a tendency throughout the world for more births of males than of females. In the civilized world, however, there are more females than males on account of the higher mortality among males. Europe is, however, the only continent in which there is an excess of females. There are two reasons for this. The occupations in which males engage are more hazardous than those of females, and in this way reduce their numbers. In the second place migration has tended to the same end, since the majority of migrants to a foreign country are males. This has not only reduced the numbers of males in Europe, but increased them in the colonies and more recently settled countries. This is very evident in the case of Australia. Where savage peoples are continually at war the numbers of the males are reduced by battles. But this effect is more than offset by other causes. Where the means of existence are such that it is difficult to rear a family, the females are often sacrificed to the males. A father is much more anxious to have sons than daughters, since they can be of more assistance to him, and on them depends the continuance of the worship of his ancestors.

Many exogamous tribes depend upon the surrounding groups for a supply of wives. It has been claimed that the prevalence of polygamy showed that there was commonly a greater number of women than of men among savages, but as a matter of fact where one man had several wives there were numbers of men who could have none. Also the burden of the toil falls on the women, who die prematurely. But greater than any of these causes is the constant immigration

[1] Calkins, G. N., "The Geographical Distribution of Sexes," Pub. Amer. Statist. Assn., New Series, No. 20, Dec., 1892, p. 41. Taken from an article by Karl Bucher, in Allgemeines Statist. Archiv, 1891-2. Part II.

into these countries of young men who have left their homes and come to these new lands in the hope of making a fortune. This and other facts can be brought out more clearly by a study of the figures for certain countries.

DISTRIBUTION OF THE SEXES.[1]

Country.	Females to 100 Males.	Country.	Females to 100 Males.
Norway (1891)	107.5	Italy (1881)	99.5
England & Wales (1901)	106.9	Roumania (1889)	96.4
Spain (1900)	106.2	Bulgaria (1893)	95.8
Scotland (1901)	105.7	Servia (1895)	94.9
Denmark (1901)	105.2	Greece (1896)	92.1
Sweden (1900)	104.9	Venezuela 1891)	104.3
Austria (1900)	103.5	Mexico (1900)	101.7
Switzerland (1900)	103.5	Cape of Good Hope (1891)	99.0
Germany (1900)	103.2	Japan 1898)	98.3
Ireland (1901)	102.7	Brazil (1890)	98.0
Netherlands (1899)	102.5	Egypt (1897)	96.7
Finland (1898)	102.2	Canada (1891)	96.4
France (1896)	102.2	British India (1901) ...	96.3
Russia (1897)	101.1	Australia (1901)	90.7
Hungary (1900)	100.9		

There are more women than men in Europe with the exception of Italy, Roumania, Bulgaria, Servia and Greece, which have an excess of males. The number of women is relatively high in Norway, Great Britain, Spain, Denmark and Sweden. Between the states of Bulgaria, Servia and Roumania with an excess of males, and Austria with an excess of females, there stands Hungary with a practical equality. In the east and particularly the southeast of Germany, there is a considerable excess of females; in the central portions there are a few more females; in the north and northwest the sexes are about equal, and in the west there are more males.[2]

As a rule the excess of females is greater in the northern and less in the southern countries of Europe. There is no

[1] "Statistik des deutschen Reichs," Band 150, 1903, Erster Theil, p. 52.*

[2] "Statistik des deutschen Reichs," Band 150, 1903, Erster Theil, p. 53.*

adequate explanation for this unless we remember that there are more male births, so that with an equal death-rate for the sexes the males would predominate. But death reduces the numbers of the males faster than of the females, and, until within recent years, a large proportion of the immigrants to the new world have come from the more northern countries. Since there are more males than females among the immigrants, this has tended to reduce the numbers of males in Northern Europe. We see the result of the same forces to increase the proportion of males in the new countries like Brazil, Canada and Australia.

Wherever in a country there is an iron or mining industry and little chance for domestic service, there will be an excess of males. There are several cities on the Continent with an excess of males, attributable to the fact that large numbers of troops are stationed in them. The numbers of males is also large in university towns.

There is no country where the distribution of the sexes can be more advantageously studied than in the United States.

PERCENTAGE OF THE MALES AND FEMALES TO THE TOTAL POPULATION OF THE UNITED STATES IN 1900.[1]

	Males.	Females.
The United States	51.2	48.8
North Atlantic Division	50.0	50.0
South Atlantic Division	50.0	50.0
North Central Division	51.6	48.4
South Central Division	51.0	49.0
Western Division	56.2	43.8
Alaska	72.1	27.9
Hawaii	69.1	30.9

The greatest percentage of females is to be found in the District of Columbia where they constitute 52.6 per cent. of the total population, followed by Massachusetts with 51.3 per cent. and Rhode Island with 50.9 per cent. There are altogether eleven states in which the females exceed the males in numbers, but they are entirely in the North and South Atlantic divisions. This excess of females is due to the

[1] Twelfth Census of the United States, 1900, Vol. I, p. 93.

fact that we are here dealing with the older section of the country which has for decades been giving its sons as settlers to the west. If it had not been that the places of these males were in part filled by immigrants the excess of females would be even greater. In some of the cities of the North Central division there has been an immigration of Canadian women to find employment as factory operatives or domestic servants. The movements of population obey the law of supply and demand, and in those places where the textile industries are concentrated, the proportion of females is naturally larger than in the farming sections of the west. In the Western division 56.2 per cent. of the population are males, a very large proportion. In Wyoming, Montana, and Nevada the males constitute over 60 per cent. of the total population. Throughout the west, where mining and agriculture give employment to most of the workers, there are but few occupations open to women. In Alaska and Hawaii, where the numbers are being recruited by other than the native population, the excess of males is very large. This condition is usually found in new countries where the early immigrants are largely single men or married men without families. When the country has been somewhat developed and the means of subsistence assured the women follow.

Throughout the United States there were 1,815,097 more males than females in 1900. This excess of males was distributed as follows among those of different nativity.

EXCESS OF MALES IN THE UNITED STATES IN 1900 BY GENERAL NATIVITY AND COLOR.[1]

	Excess of Males.
Aggregate	100.0%
Native white—native parents	44.9%
Native white—foreign parents	2.8%
Foreign white	46.4%
Negro	*3.0%
Chinese	5.7%
Japanese	3.1%
Indian	0.1%

*Excess of females.

[1] Twelfth Census of the United States, 1902, Vol. I, p. 94.

The foreign whites and native whites of native parentage furnish over nine tenths of the excess of males in the United States. The only element in which there is a preponderance of females is that of persons of negro descent, where the males are outnumbered by 54,347.

From the previous table it would appear that the excess of males among the foreign whites and native whites of native parentage was particularly large. When, however, we consider the proportion of males to the total of each of the groups we are confronted with an entirely different set of conditions.

EXCESS OF MALES IN THE UNITED STATES IN 1900 BY GENERAL NATIVITY AND COLOR.[1]

	Per cent. of total number in each group.
Aggregate	2.4
Native white—native parents	2.0
Native white—foreign parents	0.3
Foreign white	8.2
Negro	*0.6
Chinese	86.6
Japanese	66.0
Indian	0.9

*Excess of females.

In most of the groups the sexes are quite evenly distributed, but the excess of males is very marked among those classes which have come to us from a foreign shore. When a country furnishes immigrants to another, those first to come are single males in early manhood. Later married men come alone to be followed by their families. Last come single women to obtain employment. The immigrants from some of the northern countries of Europe have passed through all of these stages, and, therefore, the excess of males among this class is not very great. But Chinese immigration was prohibited before the females entered to any extent, and the Japanese are but beginning to come. Therefore, among these two classes the excess of males is large.

[1] Twelfth Census of the United States, 1901, Vol. I, p. 95.

It is interesting to note how the proportion between the sexes has changed during the past fifty years.

RELATION BETWEEN THE SEXES IN THE UNITED STATES, 1850-1900.[1]

Census Years.	Per Cent. of Total Population.	
	Males.	Females.
1850	51.0	49.0
1860	51.2	48.8
1870	50.6	49.4
1880	50.9	49.1
1890	51.2	48.8
1900	51.2	48.8

There has never been a time in the history of this country when the females have exceeded the males in numbers. This is due to immigration, more than twenty million having entered this country, over three fifths of whom were males. From 1850 to 1860 there was a slight increase in the proportion of males, but during the next decade a decided decrease. This was due to the great sacrifice of life among the males during the Civil War. Since then immigration has increased the proportion of males until to-day the figures stand at the point they had reached in 1860. It is probable that in the future as the population is more largely recruited by natural increase, the numbers of the sexes will become more nearly equal, and the great differences at present to be met with between the east and the west will in a great measure disappear. This change is at present taking place, for between 1890 and 1900 the proportion of males in the western division was reduced from 58.7 to 56.2 per cent

Sex in City and Country. As a rule there is a greater proportion of females in the cities than in the country districts. The causes for this are readily found. The death-rate for males is usually greater than that for females, due largely to the fact that the more hazardous occupations in which men en-

[1] Twelfth Census of the United States, 1901, Vol. I, p. 94.

gage are generally found in the large industrial centers. The opportunities for employment in the country are largely confined to men. Women do not enjoy the life of a servant in a small town, but prefer to be operatives in textile mills, stenographers, or clerks in a large city. In New England in 1900 there were 486.1 males to the thousand of total population in the places over 10,000 in size, while in those under 4,000 there were 512.0 males. As a rule the proportion of females increases with the size of the city, although in the great transportation centers the males are sometimes in the majority. Where the extractive and iron industries prevail the males are generally more numerous, but in the great centers of the textile industry they are outnumbered by the females.

Age. The second great natural distinction of population is according to age. The manner in which the members of society are distributed according to age affects many social phenomena. Crime is most numerous among those in early middle life. Insanity is a disease more common among the old than the young. Blindness is an affliction of advancing years. It is, therefore, necessary, if we would compare two communities, to select the same age groups, or to reduce all to terms of some one country selected as a standard.

On account of the inaccuracies of the returns and the inconvenient length of the tables it is customary to omit the numbers for each year of life and substitute those for quinquennial age periods. It will be found that with a rapidly increasing population the numbers in the early age groups will be large, while with a stationary population there will be concentration in the middle and older age groups. Where a country is furnishing a large number of immigrants to another the numbers in the middle age groups will be depleted, while an excessive number of young and old will be left behind. On the contrary the country which gains by this change of residence will have a large number in the middle age groups. The following table gives the age classification of some of the principal countries:

AGE DISTRIBUTION OF THE POPULATION ON A BASE OF 1,000.[1]

	Under 15.	15-39.	40-59.	60 and over.
Germany (1900)	348	395	179	78
Austria (1890)	342	388	191	79
Hungary (1900)	356	379	189	76
Servia (1896)	435	381	139	45
Italy (1881)	322	388	201	89
Switzerland (1888)	321	380	205	94
France (1896)	260	392	223	125
Luxemburg (1900)	315	403	189	93
Belgium (1890)	328	389	186	97
Netherlands (1899)	348	384	175	93
Denmark (1890)	348	368	182	102
Sweden (1899)	325	366	190	119
England and Wales (1891) ..	351	405	170	74
Scotland (1891)	356	389	167	79
Ireland (1901)	304	407	180	109
United States (1900)	344	421	170	65
Egypt (1897)	422	405	134	39
Japan (1891)	335	384	193	88
Queensland (1891)	372	451	147	30

The differences which have been mentioned are now brought out more clearly. In France the population is nearly stationary and only about a fourth of the number is under 15 years of age, whereas in most of the other countries over a third is in this age group, but the numbers 60 years and over are very large. This does not afford much promise for an increase in the strength of the nation, and is to be attributed to the low birth-rate. The large numbers in the oldest age group in Denmark and Sweden are due in part to their low death-rate and in part to emigration. The large proportion of the old in Ireland is caused by the fact that the young men and women have come to America in large numbers, and left the old at home. Germany has a rapidly increasing population reflected in the fact that about 75 per cent. of its population are under 40 years, while in France only 65 per cent. are in the same groups.

[1] "Statistik des deutschen Reichs," Band 150, 1903, Erster Theil, p. 87*.

The country with a large proportion of its population in the middle age groups is better fitted than one where the numbers in the early and later years are large, to enter the world's industrial competition, for neither the children nor the old are self-supporting. A country with a deficient number of births may have a high standard of comfort at present, but the continuance of its influence among the nations is threatened. This problem of a stationary population is causing much anxiety in France at present. In Queensland we have a newly settled country where but 3 per cent. of the population are 60 or over, while over 45 per cent. are between 15 and 40. The numbers of the young are also large. The immigration to this country has been largely composed of those in the active ages, while the opportunity for labor has favored large families. In the future the proportion in the older ages will increase.

In the United States the age distribution of the population varies greatly for the different elements.

AGE DISTRIBUTION OF THE POPULATION OF THE UNITED STATES IN 1900.[1]

	Percentage in each group.			
	0-14	15-39	40-59	60 and over.
Aggregate	34.5	42.0	16.9	6.6
Native white	39.0	41.1	14.7	5.2
Foreign white	5.0	48.6	32.0	14.4
Native white—native parents	37.4	39.6	16.4	6.6
Native white—foreign parents	42.8	44.6	11.0	1.6
Negro	40.1	42.1	13.1	4.7
Chinese	3.5	44.5	46.4	5.6
Japanese	1.9	91.4	6.5	0.2
Indian	40.2	37.2	15.6	7.0

When we compare the age distribution in the United States with that in the European countries we find that the proportion in the productive ages is large and in the older groups small. This fact has increased the industrial efficiency of this country. Over 80 per cent. of the native whites are under 40. Nearly a half of the foreign whites

[1] Twelfth Census of the United States, 1902, Vol. II, pp. 52-55.

are between 15 and 40, while the numbers 40 years of age and over are remarkably large. This is due to the fact that but few children enter, while those who came a few decades ago are now advanced in years. This immigration has furnished a great force of workers. The large proportion of native whites of foreign parentage in the early age groups is to be attributed to the high fecundity of the foreign-born mothers, while the small number in the oldest group is due to the fact that comparatively few of the children of the immigrants have yet attained advanced years. The large size of families and high death-rate among the negroes has brought about the concentration in the earlier years. Since there are but few Chinese women in this country, and the immigration of this nationality has been prohibited for several years, we find but few children and a very large proportion between 40 and 60. The Japanese show the smallest number under 15 and over 40, while over nine-tenths are between 15 and 40. The immigration of this class is of recent date and formed almost entirely of those in the years of early manhood.

As a rule the population of a country arranged according to age distribution, with those under one year for a base and the numbers for succeeding years super-imposed on this, forms a pyramid with the most representatives in the early years. This is true of the native population of the United States, where the maximum number is under one year. But for the foreign-born whites the maximum is found at 30 years, for the Chinese at 40, and for the Japanese at 25. The introduction of the foreign born thus changes materially the age distribution of the aggregate population.

The accuracy of the returns as to age is not high on account of the tendency to report the age in a number ending in 5 or 0. This is especially noticeable for the illiterate, and for boarders and lodgers who were absent at the time of the enumerator's visit. The concentration is not very great under 25 but after 40 the multiples of 10 are preferred. Women are more apt to fall into this error than men. In the Census of 1900 the numbers of those of negro descent between 68 and 72 was as follows:

NUMBERS OF PERSONS OF NEGRO DESCENT IN THE UNITED STATES IN 1900.

Ages	Males	Females
68 years	7,924	6,688
69 years	7,071	5,982
70 years	20,224	22,908
71 years	3,271	2,645
72 years	4,994	4,146

Among the females this tendency was so strong that the number reporting their age as 70 was greater than the total for the other four years of the quinquennial group. When the returns are given by five-year groups the inaccuracy is less since each period includes one year in which there was concentration. The problem before the statistician is to combine the ages in such way as to render the effect of these irregularities the smallest possible. Mr. George K. Holmes has suggested that the arrangement of the years should be under 3, 3-7, 8-12, 13-17, and so on, that the especially erroneous years might be in the middle of the group. "If the system of grouping is such that each group includes some of the years of depletion which have contributed mainly to the year of concentration in that group, and includes some of the years of depletion which have contributed to the year of concentration in the next group, the effect will be to enlarge the group containing the multiples of 10 at the expense of the other groups."

Mr. A. A. Young reached the following conclusion from a study of the Census of 1890:[1] "Groups beginning with the year of concentration are more accurate than groups in which the year of concentration is the median or the last year.

(1). More persons return themselves younger than they are than older than they are. This is true for both sexes and for all classes of the population. This tendency is strongest with the colored population, and is least marked

[1] Young, A. A., "The Comparative Accuracy of Different Forms of Quinquennial Age Groups," Pub. Amer. Statist. Assn., Vol. VII, New Series, Nos. 49-50, Mch.-June, 1900, pp. 27.40.

in the native white population. For all classes the tendency is more noticeable in women than in men.

(2). On account of the tendency to report ages as less than the truth, the years of concentration are preferably placed at the beginning of the quinquennial groups.

(3). A number of persons who are 40 years old report themselves as under 40. This is true for all classes, but especially noticeable with the colored population. It seems probable that very few persons less than 40 years old report themselves as 40."

When persons become over 80 there is then the tendency to report their ages as greater than the true one. One over 90 is reported as a centenarian. This tendency is particularly strong with the negroes who, although but one sixth as numerous as the native whites, reoort over five times as many 100 years and over.

Women are much more likely than men to mis-state their age. Thus it has frequently been the case in England that the young women of 20 to 25 years of age have been more numerous than were the girls from 10 to 15 at the previous census. This is obviously impossible since there is no way in which the numbers could have been recruited except by immigration, and death had been depleting them for ten years.

The attempt made in the census of 1890 to reduce these inaccuracies by asking for the "age at nearest birthday" instead of "age at last birthday" was given up in 1900 since it resulted in great concentration on 2 years of age. A considerable number of children are always omitted from the returns, estimated in the census of 1890 to have amounted to 20 per cent.[1] There is the danger that a parent will report a child as one year old or two years old where, as a matter of fact, the child was only in the first or second year. The enumerators in 1900 were also requested to ascertain the exact date of birth whenever possible, but, notwithstanding these precautions the concentration was repeated, although to a less degree with the exception of the colored.

[1] Young, A. A., "The Enumeration of Children," Pub. Amer. Statist. Assn., Vol. VIII, New Series, No. 53, Mch., 1901, pp. 21-48.

Average Age of the Living. To obtain the average age of the living, divide the sum of the ages of all the people in a country by the total population. This figure does not give an idea of the healthfulness or length of life of a community. The presence of a large proportion of children is a sign of a healthy and increasing population, and yet the average age of the living will be low. France has a very slow growth, and, on account of the small number of children, the average age is about 4 years higher than in Germany, where it is about 27 years. A country might have a high birth-rate, but a correspondingly high death-rate might reduce the numbers of those in the early years, and give a high average age of the living. But a high infantile death-rate is one of the greatest misfortunes of a state. This condition is found in Bavaria. The young men and women may emigrate, leaving behind the very young and those in advanced years, but the productive strength of such a nation will be low, although the average age of the living is high. Some differences are found among the various elements of the population of this country.

AVERAGE AGE OF THE POPULATION OF THE UNITED STATES IN 1900.[1]

General Nativity and Color.	Both Sexes.	Males.	Females.
Aggregate	26.3 years	26.5	26.0
Native born	24.0	24.1	24.0
Foreign born	40.2	40.4	40.0
White (total)	26.6	26.9	26.4
Native white	24.2	24.2	24.1
Native white—native parents	25.4	25.5	25.4
Native white—foreign parents	20.9	20.9	20.8
Foreign white	40.3	40.5	40.0
Colored (total)	23.5	23.8	23.1
Negro	23.2	23.5	23.0
Chinese	40.0	40.8	25.8
Japanese	26.5	26.6	24.0
Indian	24.8	24.4	25.1
Aggregate in 1890	25.6	25.8	25.4
Aggregate in 1880	24.6	24.8	24.5

In the past 20 years the average age of the aggregate

[1] Twelfth Census of the United States, 1902, Vol. II, p. 58.

population has increased 1.7 years, due in part to a loss in the proportion of young among the native born and to the increase in the proportion and ages of the foreign born during this period. In England the average age of the males is 25.31 years and of the females 25.86 years; in France the males have the average of 30.69 and the females 31.19, but in the United States the age of the males exceeds that of the females. Since the males are more numerous at birth, and are not passed by the females until about the 15th year, it would appear that inaccuracies in the returns for females largely accounted for this difference. The average age of the foreign born is remarkably high, due to the almost entire absence of children in this class. The age of the native whites of native parents is almost the same as that of the total population in England. Among the native whites of foreign parents we meet with the lowest average of any in the table. This is to be attributed to the large proportion of children born of parents who at their date of entry are generally in the reproductive ages. This average is still further reduced by the fact that the parents of this element are included among the foreign born. The age of the negroes is reduced by the high birth-rate of this class, although accompanied by a high death-rate. The age of the Chinese would be still higher were it not for the fact that the ages of the children are included, which is not done with the native born children of foreign whites. The average age of the Chinese males exceeds that of the females by 15 years. A study of their age distribution reveals the cause of this. Under 15 years of age the numbers of the sexes are nearly equal, but thereafter the proportion of males increases until between 40 and 44 there are 38 males to 1 female. The Japanese have a lower age since they are just beginning to come in large numbers. The average age of the Indians is about the same as that of the native whites, but they offer the only element where the age of the females exceeds that of the males.

School Age. Since the ages prescribed by the laws of the several states differ materially, it is impracticable to present anything but a uniform average for the entire country. Before 1890 the censuses of the United States had accepted from 5 to 17 years, but in the last two enumerations the limit has been enlarged to include from 5 to 20. There were in 1900, 26,099,788 persons of school age, constituting 34.2 per cent. of the total population. The percentage among the native born is 37.8 and the foreign born but 11.6. This difference is caused by the large proportion of adults among the immigrants. The colored have 38.9 per cent. within the school age, constituting the largest proportion of any element of the population with the single exception of the native whites of foreign parentage among whom 40.7 per cent. are between 5 and 20 years of age. The figures in the United States cannot be compared with those for the European countries since each has its peculiar system of classification. They are principally of interest in determining the portions of the country in which the burden of providing educational facilities should fall the heaviest.

Besides the school age there is the voting age, which includes all males 21 years of age and over, while the militia ages in the United States are from 18 to 44 years, inclusive. From the voting age we can tell how large is the foreign vote in any place if all have been made citizens. It is of interest to know how large a proportion of the population of voting age in the Southern States is formed of negroes. The figures for militia ages give a rough idea of the numbers who might be drafted in time of war. Of greater value than either of these is the number of women of childbearing age. This is generally accepted as from 15 to 45, or 15 to 55. Without these figures it is impossible to compute a refined birth-rate.

Age in City and Country. When we consider the age distribution of the population by city or country we find some decided differences. Those in middle life are concentrated in the cities, leaving the proportion of young and old greater in the country districts. This is brought out clearly by the figures for Germany.

AGE CLASSIFICATION OF POPULATION OF GERMANY IN 1900, BY SIZE OF PLACE ON BASE OF 1000.[1]

Ages.	33 Largest Cities.	Rest of Kingdom.	Germany.
0-15 years	305	380	368
16-29 years	301	234	245
30-49 years	264	226	232
50-69 years	111	131	128
70 years and over	19	29	27
Total	1,000	1,000	1,000

Between 16 and 49 the proportion is greater in the large centers, but below and above this age period more are to be found in the smaller places. Similar differences in distribution are encountered in the United States.

POPULATION OF NEW ENGLAND IN 1900 CLASSIFIED BY SEX AND AGE ON BASE OF 1,000.[2]

	All ages.	Under 15.	15-34	35-64	65 and over.	Age unknown.
New England	1,000.0	274.1	360.4	303.9	58.9	2.7
Cities over 100,000	1,000.0	274.8	389.6	295.4	36.9	3.3
50,000 to 100,000	1,000.0	271.3	389.3	294.5	41.9	3.0
25,000 to 50,000	1,000.0	291.9	378.7	286.0	40.9	3.5
Places under 25,000	1,000.0	272.2	341.4	311.5	72.5	2.5

Here as in Germany the greatest proportion in the productive ages from 15 to 65 is to be found in the largest cities. The number per 1,000 for cities over 100,000 is 685.0; from 50,000 to 100,000, 683.8; from 25,000 to 50,000, 664.7; and under 25,000, 652.9. The number between 15 and 35 is very small in the country, since many of the youth have gone to the cities to complete an education, and since to many the cities seem to offer advantages that cannot be found in the country. This is particularly true with regard to young women who find the opportunities for profitable employment in the country very small. The population of the cities is being continually recruited from the country, taking those in

[1] "Statistik des deutschen Reichs," Band 150, 1903, Erster Theil, p. 91*.

[2] Bailey, W. B., "Urban and Rural New England," Pub. Amer. Statist. Assn., New Series, Nos. 63-64, Sept.-Dec., 1903, p. 15.

the active ages and leaving the young and old behind. Over 65 years of age there are nearly twice as many in the smaller places. The death-rate is lower in the country, and many who have spent the productive years of life in the cities go to the country for their declining years.

Sex and Age. Although in most European states there are more females than males, the ratio between the sexes varies with the different age groups.

FEMALES PER 1,000 MALES AT DIFFERENT AGE GROUPS.[1]

	Under 15.	15-40.	40-60.	60 and over.
Germany (1900)	995	1,008	1,087	1,218
Austria (1890)	1,005	1,046	1,079	1,130
Hungary (1900)	998	1,029	1,033	
Servia (1896)	969	952	925	804
Italy (1881)	963	1,021	1,005	980
Switzerland (1888)	999	1,059	1,103	1,148
France (1896)	998	1,012	1,024	1,108
Belgium (1890)	992	984	1,018	1,117
Denmark (1890)	978	1,080	1,073	1,179
Sweden (1899)	971	1,016	1,146	1,252
England and Wales (1891).	1,006	1,075	1,096	1,227
Scotland (1891)	973	1,073	1,165	1,389
Ireland (1901)	968	1,037	1,103	1,032
United States (1900)	979	969	889	987
Japan (1891)	978	962	951	1,146
Queensland (1891)	976	698	559	611

On account of the greater number of male births we find that in almost every case there are more males than females in the population under 15 years. As the ages increase the proportion of females increases, owing to the higher death-rate among the males. Then, too, the numbers in the higher age groups in Europe have been depleted by the emigration of males. In a newly settled country like Queensland the proportion of males between 40 and 60 is greater than between 15 and 40 since the early immigrants were largely males. Under 15 the numbers of the sexes are nearly equal

[1] "Statistik des deutschen Reichs," Band 150, 1903, Erster Theil, p. 91.*

since they have been furnished in large part by natural increase.

AGE DISTRIBUTION OF THE POPULATION OF THE UNITED STATES BY SEX IN 1900.[1]

Percentage in each age group.

	0-14.		15-39.		40-59.		60 and over.	
	Male.	Female.	Male.	Female.	Male.	Female.	Male.	Female.
Aggregate ...	17.4	17.1	21.3	20.7	9.0	7.9	3.3	3.3
Native white	19.7	19.3	20.8	20.3	7.6	7.1	2.6	2.6
Foreign white	2.5	2.5	26.1	22.5	17.8	14.2	7.6	6.8
Native white—native parents	10.9	18.4	20.2	19.4	8.5	7.9	3.2	3.4
Native white—foreign parents	21.5	21.3	22.1	22.5	5.7	5.3	0.8	0.8
Negro	20.0	20.1	20.4	21.7	6.8	6.3	2.4	2.3
Chinese	2.0	1.5	41.9	2.6	45.5	0.9	5.5	0.1
Japanese	1.3	0.6	87.9	3.5	6.4	0.1	0.2	*
Indian	20.4	19.8	18.9	18.3	7.9	7.7	3.2	3.8

*Less than one-tenth of 1 per cent.

In the total population of the United States the only group in which there is equality between the numbers of the sexes is over 60, while under this age the males are more numerous. This disparity is, in a large measure, caused by the immigration of males in the middle age groups, and the greater number of male births. The foreign whites have an equal number of each sex under 15, but over this the males predominate. A child is brought with the family to the new country regardless of sex, but in the older ages the males come in greater numbers. It is hard to account for the excess of males from 40 to 60 among the native born classes, unless it is due to incorrect returns by the women. The peculiar character of the Chinese and Japanese immigration is shown by the exceptional number of males in the higher age groups. Under 15 natural increase has kept the numbers more nearly equal. This table has brought out more clearly the peculiar conditions which have governed the distribution of sex and age in the United States.

Conjugal Condition. Unlike the distribution by sex and age, conjugal condition is in part the result of choice. Popula-

[1] Twelfth Census of the United States, 1902, Vol. II, pp. 52-55.

tion may be divided into two main classes, the married and the unmarried. This latter class may be subdivided into two groups, those never married and those once married. Those who have been once married may be either widowed or divorced. Marriage is due to the deliberate choice of the individual, but widowhood is the result of supervening natural causes. Therefore, a person voluntarily enters the institution of marriage assuming the risk of becoming widowed or divorced

The distribution of the population according to conjugal condition is of great social importance. First is the influence upon the increase of population, for that community in which a large proportion of the women of the childbearing age are married would have a more rapid rate of increase than one in which but a small proportion was married, unless the refined birth-rate was much lower. The death-rate is usually higher for the single, widowed and divorced than for the married. Crime, suicide and insanity are generally lower among the married. Therefore when we compare the social conditions of two communities it is desirable to eliminate as far as possible the influence due to conjugal condition. It is best in the study of this phenomenon to include only that portion of the population which is over 15 years, since but few under this age are married, and the presence of a different proportion of the population under 15 would affect the figures for conjugal condition.

CONJUGAL CONDITION OF THE POPULATION OVER 15 YEARS ON BASE OF 1,000.[1]

	Male.				Female.			
	Single	Married	Widowed	Divorced	Single	Married	Widowed	Divorced
Germany (1900).	405.9	547.1	45.2	1.8	352.2	519.7	124.9	2.5
Austria (1890)..	429.4	525.6	44.0	1.0	380.8	497.0	121.0	1.2
Italy (1880)....	404.0	536.5	59.5		326.5	537.2	136.3	
Switzerland(1888)	446.0	488.4	60.3	4.3	410.3	455.0	127.3	7.4
France (1896)..	374.3	551.4	72.5	1.8	313.0	537.4	147.3	2.3

[1] "Statistik des deutschen Reichs," Band 150, 1903, Erster Theil, p. 102.*

CONJUGAL CONDITION OF THE POPULATION OVER 15 YEARS ON BASE OF 1,000—*Continued*

	Male				Female			
	Single	Married	Widowed	Divorced	Single	Married	Widowed	Divorced
Belgium (1890)..	461.9	477.0	60.3	0.8	416.5	470.3	112.2	1.0
Denmark (1890).	385.9	552.3	58.3	3.5	366.2	506.1	123.0	4.7
England and Wales (1891)..	405.8	540.2	54.0		386.7	499.2	114.1	
Ireland (1901)..	559.3	382.5	58.2		496.6	370.9	132.5	
Queensland (1891)	577.5	392.1	30.4		340.0	591.3	68.7	

Somewhat more than a half of the population over 15 years is married in most cases. Ireland has a very small proportion, due to the fact that large numbers of the middle aged have gone to the United States to settle, leaving the young behind. The conditions of life are not easy, so that it is difficult to maintain a household. The large proportion of single among the males in Queensland is to be attributed to the fact that there are but few females in the country so that there are not enough wives for all. In France the marriages take place at an early age, and consequently the number of single is small, but of widowed is large. In all cases the proportion of single is greater among the males than the females, since the former marry at a later age. If the proportion of single is smaller among the females, that of the married might be expected to be larger. This is very seldom the case on account of the large number of widowed. These are more than twice as numerous among the females as among the males. The death-rate for males is much higher, reducing the number of married among them, and not only reducing the proportion of married, but also increasing that of the widowed among the females. The divorced in most countries, particularly where the population is largely Catholic, form but a small percentage.

In the United States the different elements of the population have a very varied distribution. In the following table the proportion of divorced and unknown has been neglected, since it seldom amounts to more than 1 per cent.

CONJUGAL CONDITION OF THE POPULATION 15 YEARS AND OVER IN THE UNITED STATES IN 1900 ON BASE OF 100.[1]

	Male.			Female.		
	Single.	Married.	Widowed.	Single.	Married.	Widowed.
Aggregate ...	40.2	54.5	4.6	31.2	56.9	11.2
Native white—native parents.....	39.7	54.9	4.5	31.0	57.7	10.6
Native white—foreign parents	54.5	42.7	2.4	44.4	49.4	5.7
Foreign white.....	29.4	63.8	6.2	19.6	64.2	15.8
Negro	39.2	54.0	5.8	29.9	53.7	15.4
Chinese	58.6	38.0	1.6	24.3	67.3	8.1
Japanese	77.7	17.5	0.3	48.3	48.0	2.2
Indian	33.7	57.0	6.9	20.1	61.4	16.0

In the European countries we found that in most cases the proportion of married was greater among the males than the females. The opposite is true in this country, due to the greater number of females in the population. The proportion of single is large among the native whites of foreign parentage, due to the large number between 15 and 25 years and the small number in the older age groups. As a result of this peculiar age distribution the proportion of widowed is small. The foreign whites are older, and consequently the proportion of married and widowed is high. The large number of widowed among the negroes is caused by their high death-rate. There are but few females among the Chinese, and this is reflected in the small number of married among the males and large number among the females. The Japanese are largely in the early and middle age groups, and the percentage of single among the males is very high. Among the females the proportion of single is the highest of any of the classes. The Indians marry young, reducing the percentage of single and increasing that of widowed.

Sex and Conjugal Condition. There is a close connection between the proportion of the sexes and the distribution by conjugal condition. Where there are but few females they marry at an early age, since they are much desired by the

[1] Twelfth Census of the United States, 1903, Vol. II, p. 81.

males as wives. Where the females are in the majority the males marry earlier, and the proportion of married among them at all ages above 20 is comparatively high. Thus in Massachusetts 40.4 per cent. of the males 15 years of age and over are single, and in Rhode Island 40.6 per cent.; while in Montana 56.8 per cent. and in Wyoming 58.7 per cent. are single. Among the females in Massachusetts 37.4 per cent. and in Rhode Island 36.9 per cent. are single; while in Montana only 24.6 per cent., and in Wyoming 24.7 per cent. are still unmarried. In New Mexico only 19.8 per cent. of the females 15 years and over are single, due in part to the influence of the climate, in part to the ethnic traits of the population, and in part to the distribution of the sexes.

In those states where the number of females is greater than that of males the proportion of married among the males ranges between 53.1 and 57.6 per cent., and for females between 45.2 and 56.7 per cent. When the males constitute from 50 to 55 per cent. of the population, the married form from 49.7 to 57.7 per cent. among them, and among the females from 55.0 to 69.6 per cent. Where more than 55 per cent. of the population are males, the proportion of married among the males is from 26.4 to 46.8 per cent. and among the females from 55.2 to 77.9 per cent. We thus see that as the proportion of males increases the percentage of married among them diminishes, while among the females it increases. It is simply the effect of the law of supply and demand applied to the study of conjugal condition.

It is interesting to note the relative proportions of males and females by conjugal condition in the United States.

PROPORTION BETWEEN THE SEXES BY CONJUGAL CONDITION IN THE UNITED STATES IN 1900 ON BASE OF 100.[1]

	Males.	Females.
Aggregate	51	49
Single	54	46
Married	50	50
Widowed	30	70
Divorced	42	58
Unknown	75	25

[1] Twelfth Census of the United States, 1902, Vol. II, p. 80.

The married should, of course, be very nearly equally divided between the sexes. There is, however, a numerical excess of 142,527 married males, due to the large number of foreign-born males who have come to this country, leaving their wives at home. Among the negroes there is a considerable excess of married females, due to the errors in enumeration. There are more males than females in the total population, and when an equal number of married is subtracted from the total for each sex, the proportion of single remaining will be much larger among the males than the females; in this case 54 to 46. The widowed are more than twice as numerous among the females than among the males, due to the greater number of marriages dissolved by the death of the husband than of the wife.

There are errors in the enumeration of conjugal condition due to both ignorance and deceit. In many cases the boarding-house keeper reports her lodgers as single, when they are in reality married, but the couples are separated at the time. There is the temptation for a married man to report himself as single if he has deserted his wife. The mother of an illegitimate child is apt to report herself as married. Persons who have been divorced often state that they are single.

Age and Conjugal Condition. The distribution of the population by conjugal condition varies according to age. Before 15 practically the entire population is single, there being but 664 males and 3,730 females at this early age who were married in the United States in 1900, and most of these were probably due to errors in enumeration. After this age the proportion of married increases rapidly.

The proportion of single continues to decrease with advancing years for both sexes. There is no age when the hope of marriage is entirely gone. Between 15 and 19 the proportion of married among the females is ten times as great as among the males. The proportion for the females continues to exceed that for the males until the 45th year is reached. After this age there are more married among the males. This is not due to the fact that the women have not married, for at all ages the proportion of single is greater among the males, but to the dissolution of marriage by death of the husband. The proportion of married reaches the maximum for females between the 35th and 44th years, and for males between the 45th and 54th. Difference in death-rate and the fact that the males postpone marriage to a later age is responsible for this. There is never a period when the proportion of widowed is not twice as great for the females as for the males. Among the males it is never but a trifle over a fourth of the total number, while for females it is nearly a third from 55 to 64, and over half after the 65th year.

CONJUGAL CONDITION OF THE POPULATION OF THE UNITED STATES IN 1900 CLASSIFIED BY SEX AND AGE ON BASE OF 100.[1]

Age.	Male. Single.	Male. Married.	Male. Widowed.	Female. Single.	Female. Married.	Female. Widowed.
15-19 years	99.8	1.0	*	88.7	10.9	0.2
20-24 years	77.6	21.6	0.4	51.6	46.5	1.4
25-29 years	45.8	52.5	1.2	27.5	68.9	2.9
30-34 years	27.6	69.8	2.0	16.6	78.0	4.6
35-44 years	16.9	78.8	3.6	11.1	79.5	8.6
45-54 years	10.3	82.2	6.8	7.8	73.9	17.6
55-64 years	7.6	79.7	11.9	6.6	60.5	32.3
65 years and over	5.7	67.1	26.4	6.0	34.2	59.3

*Less than one-tenth of 1 per cent.

The proportion of married females between 15 and 19 to the total females of this age group furnishes a good measure of the extent to which early marriages are contracted by the women of the different elements of the population in this country. 15.7 per cent. of the colored between these years are married, followed in order by the native whites of native parentage with 12.2 per cent., the foreign whites with 10.9 per cent., and the native whites of foreign parents with but 5.0 per cent. The small percentage in this last class is partly to be attributed to the large proportion of wage-earners in it. For males the proportion of married between 20 to 24 can be selected as the measure of the tendency toward

[1] Twelfth Census of the United States, 1902, Vol. II, pp. 87-90. The divorced and unknown have been omitted from this table since their numbers are insignificant.

early marriages. We find here the same order as with the females. The colored have 33.8 per cent. married, the native whites of native parentage 23.3 per cent., the foreign whites 17.1 per cent., and the native whites of foreign parentage 12.9 per cent. Many of the foreign born are married when they reach this country, while the native children of the foreign born have not yet acquired sufficient property to enable them to start housekeeping at an early age. The colored form the class which marries earliest, due in part to lack of foresight and in part to the humble establishment with which they are satisfied. The early age of marriage of the colored is reflected in the large proportion of widowed among them.

Conjugal Condition in City and Country. When we study the distribution by conjugal condition in city and country, it is necessary that we should make allowance for the differences in age, since we know that there is a continual migration of youth to the city for the advantages there offered. It is, therefore, better to compare these two classes by uniform age groups. It might be that we should find a larger proportion of single to the total population in the city than the country, and from this conclude that city life was the cause of the small number of married. But the age distribution in the cities might not be favorable to marriage. It would be, not the conditions of city life, but the age of the population which kept the proportion of the married low. To eliminate this cause of error the following table has been constructed for the different age groups. The divorced and unknown are omitted.

POPULATION OF NEW ENGLAND IN 1900 CLASSIFIED BY AGE AND CONJUGAL CONDITION ON BASE OF 1,000.

	Places over 100,000			Places under 100,000		
Years	Single	Married	Widowed	Single	Married	Widowed
15 to 34	627.4	356.7	11.7	605.5	380.2	9.5
35 to 64	165.8	696.8	130.6	135.6	746.1	109.0
65 and over	84.4	419.8	491.5	72.9	477.1	443.9

There is a greater disparity between the sexes in the large cities so that there must be a large proportion of single among the numerically superior sex. From 15 to 34 there are more single and widowed in the large cities. On the contrary there are more married in the smaller places. This is but natural, for the cost of living is considerably higher in the large centers. "Many prefer to remain single to a greater age in the city on account of the difficulty of setting up a suitable establishment. The man has become accustomed to a certain standard of living, and feels that, if he marries, he will have to give up many pleasures which he has begun to look upon in the light of necessities. A wife to him is not an economic advantage. There are more opportunities for a young woman to support herself in a large city than elsewhere; and she may be unwilling to renounce her independence, and assume the cares of a home. Club life tends to intensify this feeling with both sexes. The large apartment building in these great centers makes housekeeping much easier for the wife, and partially overcomes this objection to taking the care of a home. It is by the farmer that the need of a wife is most severely felt, for to him she becomes an economic advantage, and in the sparsely settled districts, where social intercourse is slight, the home must be the great center. We should, therefore, expect that in the small places there would be earlier marriages than in the large centers."[1] From 35 to 64 there are still more single and widowed in the large cities. The number of widowed in the large exceeds that in the small places more than 20 in 1,000. In the oldest age group we find there are more in the large cities who never marry. The number of married in the large places is so much lower not only because of the presence of those who have never married, but because the marriages have been in many cases broken up by the death of one of the parties. It is now safe to say that as a rule life in the city is not as conducive as life in the country to the formation of homes.

[1] Bailey, W. B., "Urban and Rural New England," Pub. Amer. Statist. Assn., Sept.-Dec., 1903, New Series, Nos. 63-64, p. 27.

CHAPTER III

BIRTHS

If society is to continue it must be constantly recruited by births. In the newly settled countries the population often increases by means of immigration, but if a community is to have a healthy growth the number of births must exceed that of deaths. To furnish this increase births and deaths may both be numerous or both may be small. It is by no means a matter of indifference by which of these methods there is an excess of births, for a high mortality means loss and suffering to a community. The primary object is to reduce the death-rate, and if the country is prosperous, and the conditions of existence easy, the births will generally prove sufficient to provide a slow yearly increase.

If we are to obtain accurate statistics of births it is necessary that every case be reported to the proper authorities by the attending physician or midwife. Formerly the records of baptism furnished the sole means of ascertaining the numbers of births, and there was no machinery provided by which these scattered records could be brought together. At present every birth is supposed to be reported to the local office of the Board of Health or of Vital Statistics by the attending physician on a blank provided for that purpose. These slips are sent to the central office and in the Annual Report of the Board of Health the total number of births for the year is given according to the place of birth, age, nationality, and sometimes according to the religion of parents. In some reports the number of the birth and the duration of married life of the parents are included.

A birth-rate is a ratio between the number of births during a year and the total population at the middle of the year. It is therefore necessary that these figures be collected in two different ways. The population is found by means of a census taken once in 5 or 10 years, and for any intercensal year the population is estimated, on the assumption that the rate of increase is at the same rate which prevailed during the previous period. There is, of course, the liability of error in this estimate, but it should not be very great where the growth is not much disturbed by migration. It is not possible to get accurate information as to the births in the same way once in ten years, for during this period the parents may have died or moved away, or many of the births may have been forgotten. The attempt which was made in the United States to get accurate information for a single year at the time of the census proved unsuccessful. It is necessary that the births be recorded as they take place, and even this cannot always be accomplished. There are but very few states in this country where the returns are made with the degree of completeness to render them reliable. It takes time to educate the people into the necessity of making returns which seem to them to serve no useful purpose, since a birth is thought to have but little significance outside the family. There is at the same time the desire on the part of the mother of an illegitimate child to conceal her shame, and many births thus go unrecorded. The place on which pressure should be brought to bear is the members of the medical profession, a body of trained men, continually increasing in intelligence and reliability. On the back of the certificate of birth in New York is the following: "Within ten days from the time of a birth, this form of report must be filled out and returned to the Bureau of Records.

" 'And for every omission to make the report of any death, birth or marriage, the person guilty of such omission shall be guilty of a misdemeanor; and in addition thereto the offender shall also be liable to pay a fine of one hundred dollars to be recovered in the name of the Department of Health of the City of New York, before any justice or tribunal in said city having jurisdiction of civil actions.'

"N. B. This law is designed to secure a faithful report of birth from the attending physician, or some one of the persons who were present at the birth. This law will be rigidly enforced, both as regards the Medical Attendant and the Parents of the Child."

Birth-Rate. It would be of no value to compare the numbers of births in two different countries regardless of the size of the population, for a country like Germany should have more births than a small one like Switzerland. What we need is some convenient measure for the frequency of this phenomenon. This is found in the birth-rate. It has been accepted by the civilized world that the crude birth-rate is the number of births per annum per 1,000 of total population. If a city with a population of 100,000 has 4,000 births during a year the crude birth-rate of that place is $\frac{4,000 \times 1,000}{100,000} = 40$ per 1,000. In this way it is possible to compare the figures for several countries, keeping one figure of the ratio constant. There are decided differences in the rates for the European countries.

BIRTH-RATE PER 1,000 TOTAL POPULATION [1]

	1857-99	1900
Hungary	42.9	39.3
Austria	38.0	
Prussia	37.7	36.1
Germany	37.2	35.6
Italy	36.6	32.9
Spain (1888-99)	35.6	34.4
England and Wales	32.3	28.7
Scotland	32.2	29.6
Denmark	31.3	29.8
United Kingdom	31.1	28.2
Norway	30.7	30.1
Belgium	30.1	28.9
Sweden	28.7	26.9
Ireland	23.8	22.7
France	23.7	21.4

[1] Sixty-third Annual Report of the Registrar General of England, 1900, p. 123.

From the table we see the great difference in the birth-rates in Europe, since Hungary has a rate nearly twice as high as that for France. It is not possible to trace any appreciable influence due to race, for countries widely different in race have rates which are nearly alike. In most cases social condition or the age distribution has the greatest effect. But there is nothing in the realm of vital statistics which is harder to explain than the reason why one country has a high birth-rate and a neighboring one a low rate. To account for and increase the abnormally low rate in France has taxed the ingenuity of her best trained statisticians and sociologists. As a rule where the death-rate is high the birth-rate is correspondingly high. In Hungary and Austria this is the case, while in France both are low. Where the means of existence can be gained with a reasonable amount of exertion, the genetic force is sufficient to repair all loss from death, and furnish a slow yearly increase. Conditions are hard in Ireland and besides the middle-aged have emigrated, so that the proportion in the childbearing period is small. In Sweden, Norway, and Denmark the death-rate is low, so that the numbers can be preserved with a moderate birth-rate.

As a rule the birth-rate is higher in a warm than a cold climate. The women reach puberty and marry younger, so that the child-bearing period in the married state is prolonged. When marriages take place at an early age there are generally more births than when they are deferred. Hot weather causes a high infant mortality, so that a large number of births is required to afford any increase to population. There is also considerable improvidence, and children are brought into the world with but little regard for their future. "In India the birth-rate is said to be nearly 48 per 1,000, greater than in any country of Europe except Russia. The women marry at the age of fifteen, and among the higher and middle classes there is a general feeling that the paternal hearth is disgraced by the presence of a girl who has arrived at womanhood unmarried. Notwithstanding the enormous birth-rate, population grows but slowly on account of the abnormal death-rate, which, even if we omit the frequent occurrence of famine and epidemic disease, reaches on an average 41 per mille. What is true of India would probably be true of other hot countries inhabited by uncivilized races."[1]

Although the crude birth-rate affords a good means of noting the changes in a single country over a long period, it cannot be very satisfactorily used for different countries on account of the peculiarities of distribution by sex, age and conjugal condition. Legitimate births are the result of the parturitions of married women, and a country with but a small proportion of married women of child-bearing ages could not expect such a high birth-rate as a country where a large proportion were within this group. It is more accurate to compare the birth-rates per 1,000 females between 15 and 45 years. In this way each country is placed on an equality with all others and differences of sex and age classification are eliminated. It is usually the case that a new country with but a small proportion of women will have a low crude birth-rate, but a high refined birth-rate, since children are desired as an economic advantage and reproduction approaches the limit of the genetic force.

Another refinement is made for the legitimate birth-rate where the figures refer to the number of births per 1,000 married women between 15 and 45. This is perhaps the most satisfactory of any rate, in that it gives the best picture of the fecundity of the married women, the class from which the increase of the population should come. In like manner the refined illegitimate birth-rate is the number of illegitimate births per 1,000 unmarried women between 15 and 45.

Dr. Newsholme has given a good instance of the differences to be noted, by a comparison of the various rates.[2]

[1] Mayo-Smith, R., "Statistics and Sociology." New York, 1896, p. 69.

[2] Newsholme, A., "Vital Statistics." London, 1885, pp. 72-73.

LEGITIMATE BIRTH-RATES IN KENSINGTON AND WHITE-CHAPEL, 1891.

	Kensington.	Whitechapel.	Percentage excess of birth-rate in Whitechapel over that in Kensington.
A	21.8	39.9	83%
B	61.6	172.1	177%
C	215.4	328.3	53%

A=Birth-rate per 1,000 inhabitants.
B=Birth-rate per 1,000 women aged 15-45 years.
C=Birth-rate per 1,000 married women aged 15-45 years.

ILLEGITIMATE BIRTH-RATES IN KENSINGTON AND WHITE-CHAPEL, 1891.

	Kensington.	Whitechapel.	Percentage excess of illegitimate birth-rate of Whitechapel over that in Kensington.
A	1.19	1.26	6%
B	3.35	5.44	62%
C	4.68	11.43	136%

A=Birth-rate per 1,000 inhabitants.
B=Birth-rate per 1,000 women aged 15-45 years.
C=Birth-rate per 1,000 unmarried women aged 15-45 years.

The accurate method shows that the legitimate birth-rate is 52 per cent. higher in Whitechapel, instead of 83 per cent. as by the first method, or 177 per cent. by the second. The reason for the great difference lies in the fact that there are many unmarried female servants in Kensington, who increase the number of women between 15 and 45 but do not add an equal number to those who form the denominator for the third ratio. When we consider the illegitimate birth-rate on the basis of the total population there appears to be but little difference between Whitechapel and Kensington, but when we consider only those who can be the mothers of these illegitimate children, the unmarried women at child-bearing age, there is an excess of 136 per cent. This case brings out more clearly the point which has already been made, that in the formation of a ratio only those phenomena should be compared between which there is a relation of cause and effect. Thus the legitimate birth-rate is the ratio between the number of children born and the number of married women of child-bearing ages. All the males, the females under 15 and over 45, and the unmarried women between these ages, can be excluded, since from them there are no legitimate births. Unfortunately the refined birth-rates are seldom included in government publications, so that in most cases we must be contented with the crude birth-rate.

Changes in the Birth-Rate. The birth-rate of a country is fairly constant from year to year, showing the statistical regularity in large numbers. This is brought out by the birth-rate for Prussia from 1891-1900, inclusive.

BIRTHS PER 1,000 POPULATION IN PRUSSIA, 1891-1900.[1]

Year.	Birth-Rate.	Year.	Birth-Rate.
1891	39.3	1896	38.4
1892	37.7	1897	38.1
1893	38.9	1898	38.3
1894	38.0	1899	37.8
1895	38.3	1900	37.5

The average birth-rate for this period was 38.2, the sum of the rates for the 10 years was 382.3, and the sum of the variations from the average 4.1. This gives an average variation for the period of less than 1.1 per cent.

There are, however, considerable variations when we consider a long period. There are no figures in this country which have sufficient accuracy during several decades except for Massachusetts, but in Europe there are several countries which furnish the material for such comparison.

BIRTHS PER 1,000 POPULATION[2]

	1841-50	1851-60	1861-70	1871-80	1881-90	1891-1900
Germany	36.1	35.3	37.2	39.1	36.8	36.1
Austria	37.6	36.9	38.2	39.0	37.9	37.1
France	27.2	26.2	26.1	25.4	23.9	22.1
Belgium	30.5	30.4	32.2	32.7	30.2	28.9
Denmark	30.5	32.5	30.7	31.5	31.9	30.2
Sweden	31.1	32.8	31.4	30.5	29.0	27.1
Norway	30.7	33.0	30.9	30.9	30.8	30.4
England and Wales.	32.6	34.2	35.4	35.5	23.5	30.0

We see that in no case except Germany was the rate as high in the decade 1891-1900 as in the decade 1841-1850.

[1] "Preussische Statistik," No. 169, 1903, p. 12.

[2] "Statistik des deutschen Reichs," Band 150, 1903, Erster Theil, p. 202.*

In France there has been a steady decrease and at no period has the rate been as high as it was at the preceding decade. In three cases the maximum was reached between 1851-60, and in four cases from 1871-80. Although there had in most cases been an increase since the earliest decade, by the last period in the table the rate was in all cases but one at the lowest point, showing the tendency toward a decrease.

C. Juglar thinks that changes of this kind are not shown so clearly by the crude birth-rate as by the total numbers of the births.[1] He therefore made a study of the change in some of the European countries, putting in one column the years in which there was an increase over the preceding year, and in another column those in which there was a decrease. From a study of these columns he reached the conclusion that there had been three periods characterized by general changes. From 1850 to 1870 there was an increase in most of the countries. There was then a sharp decline, owing to the war, followed by an increase which lasted until the crisis of 1882. The rate was then fairly low until 1890, when came an increase continuing until 1900. This was not the case in France, where there was an uninterrupted decrease from 1890 to 1900.

This decrease in the birth-rate is found in numerous places. Thus in Berlin we meet with the following conditions.

NUMBER OF LEGITIMATE BIRTHS PER 1,000 MARRIED WOMEN IN BERLIN[2]

1876	240
1877-79	220
1880-82	199
1883-85	184
1886-88	174
1889-91	166
1892-94	151
1895-97	138

[1] Juglar, C., "Y a-t-il des periodes pour les mariages et les naissances comme pour les crises commerciales?" Bull. de l'Institut. Internat. de Statistique, Tome XIII, Liv. IV, 1903, pp. 8-17.

[2] This and the two following tables are taken from an article in the Journal of the Royal Statistical Society, Dec., 1900, pp. 611-612.

The birth-rate is formed in this table per 1,000 married women, regardless of age, and shows an uninterrupted decrease from the beginning to the end of the period covering 22 years.

LEGITIMATE BIRTHS PER 1,000 MARRIED WOMEN UNDER 45 YEARS OF AGE IN COPENHAGEN

1880	270
1885	252
1890	237
1895	215

This table shows still another method of forming a birth-rate, but is practically identical with one including the married women from 15 to 45, since but very few under 15 are married.

BIRTHS PER 1,000 MARRIED WOMEN IN EACH AGE GROUP IN DENMARK

Age Group	1878-82	1885-94
Under 25 years	508.3	491.4
25-30 years	396.2	390.8
30-35 years	319.0	297.0
35-40 years	236.4	227.6
40-45 years	117.1	111.9
45-50 years	13.4	11.7

Enough figures have been given to make it apparent that in most of the European countries the birth-rate was considerably lower at the end than in the middle of the last century. The same tendency is seen in the figures for Massachusetts.

BIRTHS PER 1,000 POPULATION IN MASSACHUSETTS

1856-60	29.51	27.38	27.11
1861-65	25.34		
1866-70	26.07	26.89	
1871-75	27.62		
1876-80	24.25	24.69	25.86
1881-85	25.09		
1886-90	25.86	26.70	
1891-95	27.62		
1896-1900	27.00		
1901	25.07		
1902	24.58		

From 1856 to 1860, inclusive, the rate was 29.51, and since that period there has not been a single year in which the rate has reached this point. The Civil War reduced the rate during the next five years and by the death of large numbers of the young men has had a lasting effect upon the marriages and consequently the births. By decades there was a decrease during the first three periods, but in the last ten-year group an increase. In the last quinquennial group there was a decrease, which has been more noticeable during the last two years, so that the figures for 1902 were, with six exceptions, the lowest for over 50 years.

The birth-rate for the native born is much lower than for the foreign born.

BIRTHS PER 1,000 OF POPULATION IN EACH GROUP IN MASSACHUSETTS

	Native Born	Foreign Born
1850	19.49	49.98
1855	18.90	59.20
1860	18.41	66.68
1865	14.48	57.76
1870	15.93	57.62
1875	16.50	55.40
1880	16.22	47.90
1885	16.43	45.87
1890	16.49	47.82
1895	16.58	50.40

The rate for the foreign born is about three times as high as for the natives. This is due to two facts. The foreign-born element is composed very largely of those in the middle-age groups, with a larger proportion of married than is the case with the native born. According to the United States Census of 1900, 45.4 per cent. of the native born females were between 15 and 45 years, while of the foreign born, 65.0 per cent. were between these ages; and 17.2 per cent. of the native women were married and in the child-bearing ages (15-45), while 32.8 per cent. of the foreign-born females were married and within the same years. Thus we see that about twice the proportion of foreign women are married and in the child-bearing ages as is the case with the native women. Therefore the crude birth-rate should be considerably higher for the foreign element of the population. But this will not account for all the difference in birth-rates. The fecundity of the foreign-born mothers is undoubtedly greater than of the native, and to this must be attributed in part the higher birth-rate among the foreign.

In the following table the error due to the difference in sex distribution has been eliminated.

BIRTHS PER 1,000 WOMEN BETWEEN 15 AND 45 YEARS OF AGE IN MICHIGAN

Five-year Periods	Native	Foreign
1870-74	124	231
1875-79	127	235
1880-84	122	221
1885-89	117	227
1890-94	111	232

There are several reasons for this decrease in the birth-rate which has been shown in the preceding tables. There is a tendency for a greater proportion of the population to remain permanently single, and for those who marry to postpone matrimony to a later age. This is particularly true of the cities where the expense of housekeeping obliges many to defer marriage. In the country districts single life is not pleasant and a wife is an economic utility. Children in the country find more work fitted to their strength and are of greater assistance to the family than in the city. Families in the country are larger than in the city. Since the proportion living in cities is increasing, the birth-rate of the total population has decreased. Certain writers claim that the increased use of intoxicants has reduced the birth-rate by limiting the ability to beget children. This claim is made particularly for France. This reasoning is open to suspicion, for France is not the only country in which people drink to excess, and in many countries the amount of pure alcohol consumed has decreased, while at the same time the birth-rate has diminished. It is very doubtful if civilization has diminished appreciably the ability of either sex to produce children. It is claimed that the military system of conscription in Europe has taken the young men from home at the time when they would be contracting marriage, and by the manner of life they lead while in the army rendered them unwilling to assume the burdens of an establishment when their period of service is ended.

But greater than any other cause is "the deliberate and voluntary avoidance of child-bearing on the part of a steadily increasing number of married people, who not only prefer to have but few children, but who know how to obtain their wish." The desire to improve their social position acts so powerfully upon many families that they are willing to sacrifice anything to obtain this end. The presence of children would mean increased expenditure upon necessities, and where the family is at present straining every nerve to associate with people whose incomes are greater, such expense must be avoided. Then, too, the care of children would take too much of the time of a woman who wants her energy for social functions, and cannot be bothered by the cares of a large family. There is present in many cases the wish to assure to the children a good social position. Recognizing the power of wealth in the world they feel that their children cannot keep their place in society unless a certain income is assured them. This desire works on the middle and wealthy classes alike. The French peasant is unwilling that his little farm shall be divided among many heirs, since it is large enough to support but one household. The family of great wealth does not wish to lose prestige by a division of its wealth, and so the number of children is kept small, or, as in England, the landed estate goes to the eldest son, and the younger ones seek a career in the army or some learned profession. Some French sociologists have attributed the large families among the French in Canada and the small ones at home to the influence of the law of primogeniture.

The highest birth-rate is found among the lowest classes. With these there is thoughtlessness for what the morrow may bring, and there is little danger that their descendants will be more miserable than they themselves. With the breaking down of the mediæval fixed class distinctions, and the increase in liberty which has followed that movement which brought about the French Revolution, there has come a better opportunity for a man to improve his social station, and to obtain any position to which his talents fit him. The ambition to succeed has risen with the value of the prizes to be gained, and made men unwilling to bear any burdens which it is felt might hinder them in the race for distinction. A family is viewed in this light and consequently marriage is deferred and the birth-rate kept low.

War and Birth-Rate. The influence of a war is felt in a country by a diminution in the birth-rate during the period of conflict, to be followed by a sudden rise at its close. In some cases the rate during the year or two after the war will be higher than it was immediately before the war. Von Mayr has shown the effect of the war of 1870-71 in Bavaria. Before the war there were about 16,000 births per month in the country. During the war the number sank to about 14,000. As soon as the war was over the numbers assumed their former level, and when the troops returned the births increased still more, so that by March, 1872, they reached 18,450. In this study the dates for the births have been placed nine months earlier than they actually occurred in order that they might coincide with the time of the conceptions, and thus show more clearly the immediate influence of the disturbing cause. The birth-rate in Germany in 1870 was 40.1, in 1871 it fell to 35.9, but in 1872 it rose to 41.1. This same effect can be noticed during the Civil War in the United States. The only state in which accurate statistics were kept at this period is Massachusetts, so that we cannot note the changes over a large area.

BIRTHS PER 1,000 TOTAL POPULATION IN MASSACHUSETTS [1]

Year	Birth-Rate	Year	Birth-Rate
1860	29.28	1864	24.17
1861	28.63	1865	23.87
1862	25.92	1866	26.16
1863	24.20	1867	26.17

[1] Vital Statistics of Massachusetts, 1856-95, Pub. Doc. No. 34, p. 736.

During the war the young men are obliged to leave their homes to go to the seat of hostilities. This not only removes the husbands who are at the age to become fathers, but also takes away those who would marry during this period. If the conflict is prolonged and severe, the loss of the male element is felt for a long time. Thus in Massachusetts the rate has never since reached the level of the five years before the outbreak of the Civil War. But aside from the absence of the men there is an additional influence in the general disturbance of business and the high prices of necessities. Whenever periods of economic depression come or the cost of living is particularly high, there is a decrease in the birth-rate. Not only are married men at such a time unwilling to increase the size of their families, but single men postpone marriage until economic prosperity returns. The effect on marriage is so noticeable that the discussion of the influence of national prosperity will be deferred to the next chapter.

Births in City and Country. It is impossible to make any general statement which shall apply to all cases, although it is true that in most cases the crude birth-rate is lower in the country than in the cities. In Germany the birth-rate for the entire country is from 4 to 6 per cent. higher than for the cities of 50,000 inhabitants and over. The figures for Hungary are quite similar to those for Germany.

BIRTHS FOR 1,000 POPULATION IN EACH CLASS IN HUNGARY [1]

	Cities	Country Districts
1878-80	38.5	44.1
1881-85	38.2	41.8
1886-90	37.9	43.5
1891-93	37.1	41.8

In Massachusetts the average birth-rate for the 28 incorporated cities for the five census years, 1870, 1875, 1880, 1885, 1890, was 28.4 per 1,000, while for the rural remainder of the State it was 22.0.

[1] Matlekovits, A. von, "Das Königreich Ungarn," Leipzig, 1900, Vol. I, p. 127.

It was formerly the case that the cities were "man consuming," requiring that their numbers be kept up by immigration from the country. As time went on conditions changed, until to-day the cities furnish a large proportion of their own increase. At first the birth-rate in the country was higher than in the cities, but gradually that in the cities has gained until it has surpassed the country rate. This is brought out clearly by the statistics for Sweden.[1]

BIRTHS PER 1,000 POPULATION IN SWEDEN

	Rural Population	Urban Population
1816-40	33.34	30.95
1841-50	31.30	29.29
1851-60	32.82	32.53
1861-70	31.20	32.95
1871-80	30.21	32.13
1881-90	28.65	31.07

In the great mining and industrial districts of England the birth-rate is high on account of the early marriages of the women. At the same time the birth-rate is high since the excessive infant mortality by reducing the suckling period diminishes the intervals of child-bearing. The proportion of the married is greater in the country, but this is in part counterbalanced by the greater proportion in the middle age groups in the cities. It is quite common for couples recently married to move to the suburbs on account of the lower price of rent and the fact that infant mortality is much reduced where there is plenty of fresh air and sunlight. When the children are old enough to enter the high school, the families often return to the city that they may obtain the benefits of better educational facilities. Cities differ so greatly from one another in the distribution of their population by sex, age and conjugal condition, caused largely by the character of the predominant industry, that statements which apply to one type of city will not hold true for another.

[1] A careful study of this phenomenon is to be found in Dr. A. F. Weber's "The Growth of Cities in the Nineteenth Century," Vol. XI of the Columbia Studies in History, Economics and Public Law, New York, 1899.

The birth-rates of the large cities are slowly decreasing. Thus the rate for London from 1861 to 1870, inclusive, was 35.4 per 1,000 of total population; from 1881 to 1890, 33.2; and from 1891 to 1900, 30.3. The rate for Paris decreased from 24.3 in 1891 to 21.3 in 1901. This is but one manifestation of the decrease in the general birth-rate.

Social Position and Birth-Rate. There is undoubtedly some connection between the social condition of the different classes in the population and their birth-rates. As was stated earlier in the chapter, the poor have the highest birth-rate since they reproduce with little thought of the future. There is no danger that they will lose in social standing and the presence of a large family is considered a good reason why charity is deserved. As a result the poor classes contribute a greater number than their proportion would warrant to the increase of the population. This tendency is not so dangerous in the country districts as in the large cities. It is well to note in this connection that the wealthy are generally in the upper age groups and that from the old the number of births is naturally small. Those who in their early years of married life are reproducing may later increase considerably in wealth.

The following table was presented by Dr. J. Bertillon before the meeting of the International Statistical Institute at St. Petersburg in 1897.

BIRTHS PER 1,000 WOMEN 15-50 YEARS OF AGE

Classification	Paris	Berlin	Vienna	London
Very poor quarters	108	157	200	147
Poor quarters	95	129	164	140
Comfortable quarters	72	114	155	107
Very comfortable quarters	65	96	153	107
Rich quarters	53	63	107	87
Very rich quarters	34	47	71	63
Total	80	102	153	109

We see that in every case as the social position improves the birth-rate decreases, so that there are only about a third as many births among the highest as the lowest class.

A study was made of Amsterdam for the period 1891-94 to determine whether the birth-rate was higher among the lower classes. The average birth-rate of the city was placed at 100 and the rate in six different quarters of the city compared to this average. The quarters are arranged from the poorest to the wealthiest.

BIRTH-RATES IN DIFFERENT QUARTERS COMPARED TO TOTAL BIRTH-RATE IN AMSTERDAM, 1891-94[1]

Quarters	Comparative birth-rate
I	118.2
II	112.9
III	105.0
IV	89.3
V	71.7
VI	64.4
Amsterdam	100.0

We have here the curious coincidence that there are about three times as many births in the poorest as in the richest quarter. Although there has been no exhaustive study of this subject yet made in the United States, it is evident that the rate of increase of the wealthy classes is low.

The attempt was made in Paris to determine whether there were more living children among families of the rich or the poor. The city was divided in six sections, grouping the arrondisements according to wealth.

NUMBER OF CHILDREN PER 100 FAMILIES IN PARIS IN 1896[2]

Classification	Number of children
Very poor	156
Poor	144
Comfortable	131
Very comfortable	129
Rich	129
Very rich	127
Paris	140

[1] Verrijn-Stuart, C. A., ''Natalité, mortinatalité et mortalité enfantine selon le degré d'aisance dans quelques villes et un nombre de communes dans les Pays-Bas,'' Bull. de l'Institut Internat. de Statistique. Tome XIII, Liv. II, 1902, pp. 357-368.

[2] Bertillon, J., ''Nombre d'enfants par familles,'' Journ. de la Soc. de Statistique de Paris, Apr., 1901, p. 134.

There is the same order which was found for the birth-rates but the distinctions are not so marked, due to the fact that the higher rate of mortality among the poor classes has reduced the number of surviving children to a greater extent than among the wealthy. The desire of the upper classes to keep the number of their children small is reflected very clearly in their low birth-rate, but the number of survivors is nearly as great as among the poor.

Cauderlier's Laws of Birth.[1] All marriages have a mean fecundity during the first year after marriage. In the same way we shall find that there is a mean fecundity for the second year after marriage, and so on for each succeeding year. Instead of determining the fecundity for single years it is better to simplify the process by taking three-year groups.

We can easily determine the number of legitimate conceptions which have taken place in a country in the year 1900. These conceptions are the result of the marriages celebrated within the past 18 years, since there are but few births from marriages of longer duration.

We now divide the marriages of the past 18 years into six groups of three years each.

The first group includes those marriages which took place 0-2 years previous.

The second group includes those marriages which took place 3-5 years previous.

The third group includes those marriages which took place 6-8 years previous.

The fourth group includes those marriages which took place 9-11 years previous.

The fifth group includes those marriages which took place 12-14 years previous.

The sixth group includes those marriages which took place 15-17 years previous.

[1] Cauderlier, G., "La loi qui règle les naissances," Journ. de la Soc. de Statistique de Paris, Jan., 1902, pp. 11-27; and Feb., 1902, pp. 44-62.

$F_{0\text{-}2}M_{0\text{-}2}$ = the number of conceptions in 1900 from the marriages which occurred within that and the two previous years.

$F_{3\text{-}5}M_{3\text{-}5}$ = the number of conceptions in 1900 from the marriages which took place 3-5 years ago.

The total number of legitimate conceptions during 1900 is represented by CL. $CL = F_{0\text{-}2}\,M_{0\text{-}2} + F_{3\text{-}5}\,M_{3\text{-}5} + — — + F_{15\text{-}17}\,M_{15\text{-}17}$.

All the marriages which took place within the past 18 years have not continued until 1900. Therefore the coefficients of survivorship $S_{0\text{-}2}$, $S_{3\text{-}5}$, $S_{6\text{-}8}$, etc., are introduced to show the number of marriages which have lasted until 1900.

The number of legitimate conceptions is now expressed by $CL = F_{0\text{-}2}\,S_{0\text{-}2},\,M_{0\text{-}2} + F_{3\text{-}5}\,S_{3\text{-}5}\,M_{3\text{-}5} + — — + F_{15\text{-}17}\,S_{15\text{-}17}\,M_{15\text{-}17}$.

$S_{0\text{-}2}$, $S_{3\text{-}5}$, $S_{6\text{-}8}$, etc., are practically constant since the death-rate is quite uniform.

We can, therefore, substitute $I_{0\text{-}2}$ for $F_{0\text{-}2}\,S_{0\text{-}2}$, $I_{3\text{-}5}$ for $F_{3\text{-}5}\,S_{3\text{-}5}$, etc.

The formula now becomes $CL = I_{0\text{-}2}\,M_{0\text{-}2} + I_{3\text{-}5}\,M_{3\text{-}5} + — — + I_{15\text{-}17}\,M_{15\text{-}17}$. We thus get the number of legitimate conceptions which have come from the marriages consummated within the past 18 years and still existing.

The coefficients $I_{0\text{-}2}$, $I_{3\text{-}5}$, etc., have a ratio between one another which can be calculated.

$I_{0\text{-}2}$ was taken as the standard and M. Cauderlier calculated the ratios as follows:

$$
\begin{aligned}
I_{3\text{-}5} &= 0.8\,I_{0\text{-}2}\\
I_{6\text{-}8} &= 0.6\,I_{0\text{-}2}\\
I_{9\text{-}11} &= 0.4\,I_{0\text{-}2}\\
I_{12\text{-}14} &= 0.2\,I_{0\text{-}2}\\
I_{15\text{-}17} &= 0.1\,I_{0\text{-}2}
\end{aligned}
$$

This is a mathematical statement of the tendency for conceptions to become less frequent as the duration of marriage increases.

The formula will finally become $CL = I_{0\text{-}2}\,(M_{0\text{-}2} + 0.8\,M_{3\text{-}5} + 0.6M_{6\text{-}8} + 0.4M_{9\text{-}11} + 0.2M_{12\text{-}14} + 0.1M_{15\text{-}17})$.

I_{0-2} is called the index of fecundity and it is easy to obtain its value.

It is necessary to add that the computation of the value of the fecundity in the later years in terms of that of the first three years after marriage must be made independently for any country whose natality is studied.

From the study of this phenomenon in Europe, Cauderlier concludes that there are four causes which principally affect the birth-rate:

(1) The number of marriages. As these increase the number of births increases and this is the more noticeable since it is the recent marriages which furnish the most births, and an increase in marriages is soon reflected in an increase of births.

(2) The age at marriage. When the age is high there are not so many births as when it is low.

(3) The progress of hygiene. It is important that the numbers of the population be at least maintained, and when there is a high state of hygiene most of the children live, requiring a smaller number of births to offset the deaths than when conditions are bad. This increased mortality not only affects the children but the mothers as well, requiring from the survivors a higher fecundity to replace the numbers lost by death, than where the number of the mothers is but little depleted.

(4) Economic conditions. Whenever economic conditions improve the birth-rate increases.

Sex at Birth. There is no better example of the regularity of large numbers than the proportion between the sexes at birth. For small groups this regularity is not apparent, but when large numbers are taken we find that there are but slight differences in the various countries, and that the variations from year to year are small. The death-rate for males in civilized countries is higher than for females, and it is a beneficent provision that at birth the males are slightly more numerous than the females.

NUMBER OF MALE BIRTHS TO 1,000 FEMALE BIRTHS, 1881-90 [1]

Country	Living Births	Still Births	Total Births
Norway	1,061	1,274	1,067
Austria	1,059	1,306	1,065
France	1,047	1,427	1,062
Prussia	1,054	1,278	1,062
Germany	1,053	1,280	1,060
Sweden	1,054	1,355	1,060
Bavaria	1,052	1,373	1,059
Switzerland	1,047	1,323	1,058
Hungary	1,052	1,284	1,056
Belgium	1,045	1,325	1,055
Italy	1,060	1,309	1,049

There are about 106 male to 100 female births in Europe and the variations are within very small limits. In Massachusetts from 1891 to 1900, inclusive, there were 105.6 male to 100 female among the live born, and 158.6 among the still born.[2] In Rhode Island from 1854 to 1901 there were 104.9 male to 100 female births.[3]

The reason a child should be of one sex rather than the other is shrouded in mystery. Apparently the desire of the parents has nothing to do with it since there are some families where all of the children are males and others where all are females. It is claimed, however, that mothers more often desire sons, thus accounting for the excess of males, but the mother of an illegitimate child, feeling the disgrace, cares but little about its sex. True it is that the excess of males is less for illegitimate than for legitimate births.

NUMBER OF MALE BIRTHS TO 100 FEMALE BIRTHS IN BELGIUM [4]

Period	Legitimate	Illegitimate
1841-50	105.48	102.54
1851-60	105.44	102.53
1861-70	105.39	103.03
1871-80	104.88	102.37
1881-90	104.63	102.35
1900	105.30	101.94

[1] Matlekovits, A. von, "Das Königreich Ungarn," Vol. I, p. 129.

[2] Sixtieth Rept. of the Births, Marriages and Deaths in Massachusetts, 1902, p. 148.

[3] Forty-ninth Registration Rept., Rhode Island, 1901, p. 124.

[4] Annuaire statistique de Belgique, Tome XXXII, 1901, p. 105.

Levasseur maintains that the mother desires the first child to be a boy, but thereafter is indifferent. The first child born is more likely to be male than any succeeding one. In Rome it was found that the proportion of male births decreased as the age of the parents increased.

NUMBER OF MALES TO 100 FEMALES AMONG THE LEGITIMATE LIVING BIRTHS IN ROME, 1894-96[1]

Age of Father	Male Births	Age of Mother	Male Births
Under 25 years	113	Under 20 years	113
25-35 years	106	20-30 years	106
35-45 years	105	30-40 years	106
45 years and over	105	40 years and over	104

Dr. Braidotti has found that in the town of Udine the number of males to 1,000 females among the first born was 1,082, while among the total births it was 1,049.

Another theory is that the child has in a majority of cases the sex of the older parent. As a rule the father's age exceeds that of the mother, and we have just seen that male births are more frequent than female. In support of this is the table for births in France in 1892 where, as a rule, the proportion of male births increases with the excess in the age of the father over that of the mother. In many cases where the mother is older than the father there is an excess of female births.

NUMBER OF MALE TO 100 FEMALE BIRTHS IN FRANCE IN 1892, ACCORDING TO THE AGE OF THE PARENTS[2]

	Age of Father				
Age of Mother	Under 25 years	25-35	35-40	45 and over	Aggregate
Under 20	100	110	107	132	107
20-30	104	106	105	104	105
30-40	115	104	105	105	104
40-50	88	106	107	106	107
50 and over	75	64	87	67	82
Aggregate	99.5	101	105	105	105

One of the most recent theories is that when the food sup-

[1] Raseri, E., "Les naissances en rapport avec l'âge des parents," Bull. de l'Institut Internat. de Statistique, Tome X, Liv. II, 1897, p. 101.

[2] Turquan, V., "De la durée de la génération en France," Journ. de la Soc. de Statistique de Paris, Vol. XXXVII, June, 1896, p. 227.

ply is plentiful female births are more frequent, but when it is difficult to obtain food the children born are more likely to be males. This is in keeping with the harmony of nature to provide more mouths when there is food for more, on the assumption that the births of females will increase the reproductive force of the community more rapidly than that of an equal number of males. The attempt was made to assure a male birth by insufficient nourishment of the mother during part of the period of pregnancy, but the success was not great.

The excess of males is always greater for the still births than for the living births. This is, to a great extent, to be explained by the fact that the male at birth is usually larger than the female, and, therefore, the danger at parturition is greater.

The sex of twins at birth presents one peculiarity. As is the case with single births there are a few more males than females born. According to the theory of probability, in 50 per cent. of the cases the twins should be of different sexes, and in 50 per cent., of the same sex at birth. This is not the case, for we find that in Prussia in 1902, in 5,124 cases both were males; in 4,888 cases both were females, and in 6,238 cases they were mixed. The latest theory to account for this peculiar distribution is that in some cases the twins came from two ova in separate envelopes, while in others both of the ova are enclosed within the same envelope. Where the former is the case the law of probability holds and there are as many cases in which the sex is different as there are in which it is the same. But in the latter case the twins are of the same sex and thus the proportion is disturbed.

A similar condition is found with triplets. In Prussia in 1900 there were 35 cases of three males, 39 of two males and one female, 38 of one male and two females, and 42 of three females.

Dr. A. Geisler made a study of the twins born in Germany from 1881 to 1894, inclusive, to see if there was any connection between the sex of the twins and of the other children born when both twins were of the same sex. It was found that when both of the twins were male it was likely that there would be more male than female births both before and after the birth of the male twins. When both were females the opposite was true. Thus when both twins were male, 53.9 per cent. of the children born before the twins, and 64.8 per cent. of those born after, were male. When both of the twins were female, 50.4 per cent. of the previous births and 65.5 per cent. of the subsequent ones, were female. When the twins were of both sexes the ratio of males to females among the other children to the marriage was 105.8 to 100, or about the same as that for the total births in the country.[1]

Births by Seasons. Births are, as a rule, most frequent in the latter months of the year. In Rhode Island from 1854-1901 the total births were distributed by seasons as follows:[2]

January-March	23.81%
April-June	23.60%
July-September	26.21%
October-December	26.38%

In Massachusetts the distribution is very similar.

BIRTHS IN MASSACHUSETTS 1876-95, REDUCED TO A STANDARD OF 100[3]

Months	Monthly Ratio	Quarterly Ratio	Half-yearly Ratio
January	95.6		
February	98.6	97.4	
March	98.0		96.5
April	94.9		
May	94.0	95.6	
June	98.4		
July	104.1		
August	106.6	105.0	
September	104.4		103.4
October	101.3		
November	101.5	101.8	
December	102.7		

[1] Geissler, A., "Zur Kenntniss der Geschlechtsverhältnisse bei Mehrlingsgeburten." Allgemeines Statist. Archiv, 1896, Vierter Jahrgang, pp. 537-544.

[2] Forty-ninth Registration Report, Rhode Island, p. 126.

[3] Vital Statistics of Massachusetts, 1856-95, Pub. Doc. No. 34, p. 736.

In Massachusetts during this same period the marriages were most frequent during September, October and November. Since but about a fourth of the births are first-born it is clear that the effect of the time of marriage upon the season of the total births is but small. In general the births are more frequent in the latter part of the year corresponding to conceptions in the spring and early summer. Levasseur thinks that one reason why there are so many conceptions in May is due to the celebration of a great many marriages immediately after Lent.[1] In July there are many illegitimate conceptions among the people in the country districts as the sexes are thrown together at work in the fields. In the cities the births are more evenly distributed throughout the year than in the country. This is probably due to the fact that there is not the seasonal activity in labor.

In Berlin the maximum number of legitimate births falls in January and February, while for the illegitimate the maximum is reached in February and April. The minimum generally falls in October for both classes. Therefore May, June, and July seem to be the months in which occur the greatest number of conceptions, although among the illegitimate the maximum is reached in the summer rather than the spring. The marriages show two points of greatest frequency, in April and October. But April is a much greater month for conceptions than October. Thus the period of the year in which nature is rejuvenated is the time when new life comes to humanity.[2]

Illegitimate Births. Although the mistake is often made of considering illegitimacy as a measure of morality, it deserves careful study, since a child born out of wedlock is much

[1] Levasseur, E., "La population française," Paris, 1891, Vol. II, p. 22.

[2] Hirschberg, E., "Bilder aus der Berliner Statistik." Volkswirtschaftliche Zeitfragen, Heft 200, 1904, pp. 6-7. A study has also been made of the hours of the day at which births most frequently occur, with the probable reasons for this distribution. Raseri, E., "Les naissances et les décès suivant les heures de la journée." Bull. de l'Institut. Internat. de Statistique, Tome XI, Liv. I, 1899, pp. 144-147.

more liable to die in infancy, and if it survives, its likelihood of becoming a criminal or pauper is greater than that of the legitimate child. There are several different methods of stating the illegitimate birth-rate.

(1) The number of illegitimate births per 1,000 total population. This shares the advantages and disadvantages of the crude birth-rate. It takes no notice of the differences in the composition of societies by sex, age and conjugal condition.

(2) The number of illegitimate births per 1,000 unmarried women of child-bearing ages. This is the most satisfactory of all methods, but unfortunately is not in common use.

(3) The proportion of illegitimate to total births. This is probably the rate most frequently used, but has little to commend itself, since one of the numbers in the ratio has but little casual relationship to the other. For some reason the total number of births might increase during a year, while the number of illegitimate remained constant. By this method the rate of illegitimacy would decrease without any diminution in actual numbers.

(4) The proportion of illegitimate to legitimate births. This is open to the same objections as the previous method. Any cause which deferred marriage might at the same time increase the illegitimate and reduce the number of the legitimate births. Thus the increase in illegitimacy would be unjustifiably intensified.

(5) Dr. Moriz Ertl has given a method for measuring illegitimacy which he thinks can serve as a basis for the comparison of immorality in different countries. Multiply the number of illegitimate births from 100 unmarried women of child-bearing ages by the percentage of the unmarried to the total fertile women, and divide this product by the number of births from 100 women of child-bearing ages.[1]

This method is complicated and has but little to recom-

[1] Ertl, M., "Uneheliche Geburt und Legitimation." Statist. Monatschrift, XIII Jahrgang, Wien, 1887.

Zwiedineck-Sudenhorst, O., von, "Die Illegitimität in Steiermark." Statist. Monatschrift, XXI Jahrgang, Heft, 4.

mend it. There is no rate to be preferred to the number of illegitimate births per 1,000 unmarried women of child-bearing ages, but unfortunately it is not in general use.

Turning to the statistics of this phenomenon we find great variations.

ILLEGITIMATE BIRTHS PER 1,000 TOTAL BIRTHS[1]

	1881-85	1886-90
Austria	147	149
Sweden	103	104
Germany	93	93
Belgium	83	89
France	81	85
Prussia	81	81
Norway	82	76
Italy	76	74
Great Britain	50	48
Switzerland	49	48
Holland	31	32

Austria has a rate of illegitimacy which is nearly five times as high as that for Holland. The number of countries in which there was an increase in the later over the earlier period is nearly equal to that in which there was a decrease and the changes in all cases have been small.

The rate of illegitimacy in the United States is very low. In Massachusetts from 1856-91 it was 13 per 1,000 total births.[2] In Rhode Island in 1901 there were 13 illegitimate per 1,000 total births,[3] and in Connecticut in 1901 the rate was 11.6.[4]

ILLEGITIMACY IN BELGIUM[5]

	I	II	III	IV
1841-50	12.45	7.43	0.23	1.62
1851-60	11.64	7.91	0.24	1.67
1861-70	13.01	7.13	0.22	1.76

[1] Matlekovits, A. von, "Das Königreich Ungarn," Vol. I. pp. 129-130.

[2] Vital Statistics of Massachusetts, 1856-95, Pub. Doc. No. 34, p. 742.

[3] Forty-ninth Registration Report of Rhode Island, 1901, p. 140.

[4] Report of State Board of Health of Connecticut, 1902, p. 251.

[5] Annuaire statistique de Belgique, Tome XXXII, 1901, p. 105.

ILLEGITIMACY IN BELGIUM—*Continued*

	I	II	III	IV
1871-80	12.89	7.20	0.23	1.84
1881-90	10.81	8.47	0.25	2.13
1900	12.42	7.45	0.22	1.70

I=Number of legitimate to 1 illegitimate birth.
II=Number of illegitimate to 100 total births.
III=Number of illegitimate births per 100 total population.
IV=Number of illegitimate births per 100 unmarried women of child-bearing ages.

We have here for one country the rate reckoned in several different ways, and covering a long period. Although there have been temporary fluctuations, the rate has held quite constant. In England there has been a decided decrease within the past 50 years, although the average age at marriage has increased.

In Berlin it was found that more than 10 per cent. of all legitimate children, and over 40 per cent. of all first-born children were conceived before marriage. In 29 per cent. of the marriages it was found that there was actual proof of the probability of offspring before the marriage was consummated. About 25 per cent. of all the births in Berlin are conceived outside of matrimony. This is not altogether a sign of depravity, for to certain classes in Germany the betrothal is as sacred as the marriage.[1]

The rate of illegitimacy is high in the West Indies.

PERCENTAGE OF ILLEGITIMATE TO TOTAL BIRTHS[2]

Jamaica (1896)	60.8
Jamaica (1897)	61.1
British Guinea (1895)	72.6
Trinidad (1896)	58.1
St. Lucia (1895)	59.38
Grenada (1895)	49.50
Bermuda (1895)	13.2

It is evident that conditions here are bad, as the report says, "So long as the present irresponsibility is possessed by those who cause this stream of social impurity to flow over

[1] Hirschberg, E., "Bilder aus der Berliner Statistik." Volkswirtschaftliche Zeitfragen, Heft 200, 1904, pp. 5-6.

[2] Jamaica, Annual Rept. of the Registrar-General, for year ending March 31, 1897.

the land, nothing better can be, indeed worse must be, expected."

In No. IV of Vol. I of the Boletin Demografico Argentino, published by the Minister of the Interior of the Argentine Republic in October, 1900, there is a review of the population of Corrientes since 1800 by Cayetano Ripoli. In the article is a table giving the number of legitimate and illegitimate births during the century.

AVERAGE YEARLY NUMBER OF BIRTHS IN CORRIENTES

	Legitimate	Illegitimate
1800-1804	273	125
1815-1820	162	141
1825-1829	101	142
1845-1849	175	301
1895-1899	304	682

At the beginning of the century the legitimate births were about twice as numerous as the illegitimate, while at the end of the century the proportion had been reversed and the illegitimate were twice as frequent as the legitimate births. This is not entirely the result of bad morals, but in large part of the excessive marriage fees which lead many persons, not of otherwise irregular lives, to live together without the religious ceremony.[1]

The rate of illegitimacy often varies greatly for different sections of the same country. In the northern counties of England the rate is much higher than in the southern. It is supposed that the rate in the United States is higher in certain of the Southern States on account of the presence of a large proportion of the colored. No country shows these variations better than Austria.

ILLEGITIMATE TO 100 TOTAL BIRTHS IN AUSTRIA, 1881-95[2]

Austria	14.77
Istrien	2.74
Görz and Gradiska	2.78
Salzburg	27.19
Kärnthen	43.46

In this case the two provinces in which the rate is lowest

[1] Noted in the Pub. Amer. Statist. Assn., New Series No. 54, June, 1901, p. 55.

[2] Prinzing, F., "Die Kindersterblichkeit in Oesterreich." Allgemeines Statist. Archiv., Band VI, 1902, p. 201.

are contrasted with those in which it is the highest, with the result that the rate in Kärnthen is nearly 20 times as high as in Istrien.

As a rule the rate of illegitimacy is higher in the cities than in the country districts. The proportion of unmarried is greater in the cities, on account of the tendency to defer marriage to a later date. In the cities the poor are crowded together in tenements, where in many cases a healthy family life is impossible. The idle rich, who are intent upon pleasure, are more concentrated in the cities. The small wages paid to many young girls, together with the excitement of city life and the desire for display, lead many astray. In the country districts the people are better acquainted and there is a sort of censorship over them which is wanting in the cities where they are known to but few. Women often come to the cities to conceal their shame and be confined in the large lying-in hospitals, thus increasing the numbers of births. Cities which are but little superior in size to the surrounding towns do not have a high rate, but cities with a large industry or shipping interests, places where soldiers, students, or women as servants are common, are the ones which are most likely to have a large proportion of illegitimate births. There is one consideration which must not be overlooked. Where it is viewed as a disgrace to be the mother of an illegitimate child, these births are not so frequent as where it is partially overlooked. Public opinion can act as a decided deterrent to this misfortune.[1]

ILLEGITIMACY IN BAVARIA IN 1895[2]

Size of Place	Illegitimate per 100 Total Births
Under 500	11.63
501- 1,000	12.63
1,001- 2,000	12.68
2,001- 5,000	12.98
5,001- 20,000	13.25
20,001-100,000	16.56
Over 100,000	26.79
Total	14.27

[1] *Cf.* Levasseur, E., "La population française," Paris, 1891, Vol. II, pp. 33-34; and Lindner, F., "Die unehelichen Geburten als Sozialphänomen," Leipzig, 1900, pp. 81-88.

[2] Lindner, F., *Op. cit.*, p. 110.

It is seldom that a case is found where the agreement is so constant, but here as the size of place increases the ratio of illegitimate to total births increases, and in places over 100,000 is more than twice as high as in places under 500.

ILLEGITIMACY IN AUSTRIA IN 1896 [1]

Size of Place	Illegitimate Births per 100 total population	Illegitimate Births per 100 total births
Under 500	0.45	12.8
500- 2,000	0.45	10.6
2,000- 5,000	0.70	15.6
5,000-10,000	0.93	20.2
10,000-20,000	0.71	20.4
Over 20,000	1.25	32.5
Total	0.61	15.0

In this case the increase is nearly as regular as in the previous one. The increase in the two columns is not uniform on account of the variations in the legitimate birth-rate for the places of different sizes.

Little can be determined about the influence of religious denominations upon the rate of illegitimacy, since the rate is higher, as a rule, among the lower classes, and the denomination to which the greatest proportion of the poor belongs would, from the effect of social position, have a high rate.

The influence of occupation upon illegitimacy is quite strikingly shown in the statistics for Austria. In the following table if the child is legitimate the occupation of the father is taken, and if illegitimate, that of the mother is taken.

PERCENTAGE OF ILLEGITIMATE TO TOTAL BIRTHS IN DIFFERENT OCCUPATIONS IN AUSTRIA IN 1896 [2]

Agriculture	10.0
Industry	9.8
Commerce and Transportation	13.6
Domestic Service	92.9
Liberal Professions	2.6
Without Profession	98.8

Among the liberal professions the rate is the lowest, or about twice as high as for the total population in New Eng-

[1] March, L., "La nouvelle statistique autrichienne du mouvement de la population." Journ. de la Soc. de Statistique de Paris, March, 1900, p. 99.

[2] March, L., *Op. cit.*, p. 100.

land. When we come to the domestics the rate is astounding. Most of the women in this class are unmarried, and even if the births were not numerous the proportion of illegitimates would be high.

At the birth of their child the mothers of illegitimate are usually younger than those of legitimate children. One reason for this lies in the fact that the illegitimate is generally the first birth, while with the legitimate not more than one fourth are first born.

AGE OF MOTHERS AT BIRTH OF 1,000 CHILDREN IN EACH CLASS IN AUSTRIA-HUNGARY IN 1899[1]

Age of Mothers	Legitimate	Illegitimate
Under 17 years	1.7	17.6
17-20	56.3	174.7
20-24	264.0	375.3
24-30	257.0	198.0
30-50	419.3	231.2
Over 50	0.4	0.5
Unknown	1.3	2.7
Total	1,000.0	1,000.0

More than half of the mothers of illegitimate children are under 24, while less than a third of the mothers of legitimate children are under the same age at the birth of their children. Mothers of illegitimate children have twice as many births between 17 and 24 years as between 30 and 50, while mothers of legitimate children have but three-fourths as many. It is the young women who are less able to control their passions or are led astray by promise of marriage.

In Austria-Hungary in 1899, 52.7 per cent. of the children born from mothers under 17 years of age were illegitimate, while from 17 to 20 years the percentage was only 24.0 and from 30 to 50 only 5.3.

In Berlin in 1902 the five-year group in which the most legitimate births took place was when the mothers were from 25-29, inclusive, while for illegitimates the maximum was reached while the mothers were between 20 and 25.

As a rule, where the marriages take place at an early age

[1] Rath, Z., "Sur la methode la plus simple de mesurer la fecondité des mariages." Bull. de l'Instit. Internat. de Statistique, Tome XIII, Liv. II, 1902, p. 270.

there are fewer illegitimate births than where it is necessary for the people to defer marriage for a considerable length of time. As a rule, it is only on the males that the difficulty of procuring a living works to retard the age of marriage. The women marry at about the same age notwithstanding the difficulty of maintenance.

Where either sex is greatly in excess the illegitimate birth-rate is higher than where they are evenly divided. It seems to make but little difference which sex predominates, although in "Statistik des Deutschen Reichs," Neue Folge, Band 44, we find these words: "Where the unmarried men are numerous in proportion to the unmarried women, on account of the great temptation to which the latter are exposed, the frequency of illegitimate births is extraordinarily high."

It was found to be true in Bavaria that where the size of the average holdings of land was small there was less tendency to illegitimacy than where the holdings were large, and but few of the peasants were able to possess land. This seems to show that land holding makes the people more careful, and when it is possible for a family to own a home of its own there is greater care of the children and a better moral life.[1]

Where the law places hindrances in the way of marriage the rate of illegitimacy is apt to be high. Thus in Bavaria marriages were difficult until the law of 1868 was passed, when these legal obstacles were removed, and at once the rate of illegitimacy declined.

ILLEGITIMATE BIRTHS PER 10,000 TOTAL BIRTHS IN BAVARIA[2]

1826	2,050	1868	1,997
1836	2,107	1871	1,520
1846	2,054	1891	1,409
1856	2,114	1896	1,406
1859	2,357	1897	1,394
1862	2,250	1898	1,361
1865	2,250		

[1] Lindner, F., "Die unehelichen Geburten als Sozialphänomen." Leipzig, 1900, pp. 178-186.

[2] Rubin, M., "Population and Birth-Rate Illustrated from Historical Statistics." Journ. Royal Statist. Soc., Dec., 1900, p. 620.

There has been no decided change in the rate of illegitimacy in recent years. In some places it is slowly increasing, in others there has been a slight decrease. The rate is usually higher in the cities than the country, and, since the proportion living in cities is increasing, there is a force here working against morality. Where the system of obligatory military duty is in force, the soldiers acquire habits which do not lead them to marry and settle down. There is the desire for pleasure which makes many men hesitate to accept the responsibility of a family. The temptation to have luxuries is greater than many of the girls can resist, and the sale of their bodily charms seems the easiest way to get them. But the greater industrial opportunities open to women make it comparatively easy for a self-respecting girl to earn a decent living. Where the law makes it possible to institute a search for the father, a large proportion of such children is often legitimized.

Still-Births. The children which do not survive parturition are recorded as still-born. Unfortunately all countries do not define this term in the same way. Thus in France and Belgium a child which dies before its birth is registered is considered as still-born, and since three days are allowed for registration, it often happens that children which have lived one or two days are reported as still-born. In most of the other European countries infants which had completed six months of intra-uterine life, but had never breathed, are considered as still-births. Where the parents are Catholic there is the desire that the child be baptized, and in many cases it is reported to have lived, when, in reality, it was still-born.

Matters are still further complicated by the fact that in some countries the still-births are included in the number from which the birth-rate is computed. In England the still-born are noted, but are not included among either the births or deaths. In most of the European countries they are added to the births. In England no birth is considered to have taken place unless the child actually breathed, while on the Continent the fact that the child was well formed and viable is considered sufficient to be recorded as a birth. It makes but little difference which method is followed, but it would be desirable to have it uniform. Otherwise, it is impossible to compare the birth-rates of different countries until this variable has been eliminated

STILL-BIRTHS PER 100 TOTAL BIRTHS, 1887-1891[1]

Holland	4.76	Austria	2.85
France	4.60	Norway	2.75
Belgium	4.56	Denmark	2.72
Switzerland	3.80	Sweden	2.62
Italy	3.67	Hungary	2.00
Germany	3.53		

The variations shown in this table are quite considerable. The high rate in France and Belgium is in large part attributable to the law which allows three days for registration. Economic condition and medical care are the principal causes which increase the numbers.

In Massachusetts the rate has been slowly increasing during the past 30 years.

STILL-BIRTHS PER 100 TOTAL BIRTHS IN MASSACHUSETTS[2]

1872-76	2.9
1877-81	3.0
1882-86	3.2
1887-91	3.4
1892-96	3.4
1897-1901	3.6

Although the probability of giving birth to a dead child is greater at the first than at any succeeding parturition, the percentage of still-births increases with the advancing age of the mother. This fact is shown clearly by the statistics for Austria.

[1] "Movimento della popolazione in alcuni stati d'Europa e d'America." Bull. de l'Institut. Internat. de Statistique, Tome VII, Liv. II, p. 2

[2] Sixtieth Report of the Births, Marriages and Deaths in Massachusetts, 1902, p. 140.

STILL-BIRTHS PER 100 TOTAL BIRTHS BY AGE OF MOTHER IN AUSTRIA IN 1896[1]

Age of Mother	Legitimate	Illegitimate
Under 17 years	1.57	4.26
17-20 years	1.67	3.03
20-25 years	1.86	3.21
25-30 years	2.17	3.73
30-40 years	2.74	4.33
Over 40 years	3.88	5.17
Age unknown	5.63	6.22
Total	2.65	4.11

The same tendency is shown in the following table for Paris with the exception that the probability that the first-born will not be a living birth is brought out more clearly.

STILL-BIRTHS PER 100 TOTAL BIRTHS BY AGE OF MOTHER AT PARIS IN 1896[2]

Age of Mother	Still-Births
15-20 years	9.92
20-25 years	7.19
25-30 years	7.57
30-35 years	9.08
35-40 years	11.43
40-45 years	10.76
45 and over	15.96
Total	8.43

When the mother is under 20 a large proportion of the births are first-born, and since the danger that this child will be born dead is great, the proportion of still-births in the earliest age group is high. Aside from this fact, the immaturity of the mother appears to have no disastrous effect. When the mother is over 45 the probability that the child will be still-born is over twice as great as when the mother is between 20 and 30.

The attempt has been made to show that the occupation

[1] March, L., "La nouvelle statistique autrichienne du movement de la population." Journ. de la Soc. de Statistique de Paris, March, 1900, p. 98.

[2] Loua, T., "La nationalité légitime à Paris." Journ. de la Soc. de Statistique de Paris, March, 1904, p. 111.

of the parents has an influence upon the number of still-births, but the evidence is not very convincing, since there is little uniformity in the returns for the different countries. In the following table are given the figures for Austria and Prussia.

STILL-BIRTHS PER 100 TOTAL BIRTHS BY OCCUPATIONS IN AUSTRIA AND PRUSSIA [1]

	Legitimate		Illegitimate	
	Austria	Prussia	Austria	Prussia
Independent	3.02	3.53	4.17	4.63
Agriculture	2.39	3.43	3.81	4.21
Industry	2.95	2.74	4.40	4.64
Trade and Transportation	3.05	2.99	3.62	5.04
Servants	3.06	3.20	4.11	4.47

It has been claimed that the occupation of the father has an influence upon the probability that a child will be still-born. Among the glass-blowers there was a tendency to syphilis, since the men used the same tubes. There are certain occupations, as for instance those in which quicksilver is used, where the child is liable to inherit disease. But the principal effect is that where the constitution of the men is undermined the children may not be well formed. But this is not the direct result of the occupation itself, but rather of the manner of living which is determined by the occupation. It may be that the men in some unskilled and underpaid trade are not able to support themselves and wives as they should be, and the insufficient food and clothing leads to still-births. There is no doubt that the conditions under which people live have an effect upon this phenomenon. With insufficient light and bad air the body becomes weakened so that healthy children are not to be expected. Where the women work for long hours at hard labor or in a cramped position the danger is increased. Thus among the agricultural classes in Europe in the summer, when the

[1] Rosenfeld, S., "Der Einfluss von Beruf und sozialer Stellung auf die Totgeburtenquote." Jahrbücher für Nationalök. und Statistik, Oct., 1903, p. 527.

hours of labor in the fields are the longest, the number of still-births is the greatest.

The proportion of still-births is always greater among the illegitimate than the legitimate.

STILL-BIRTHS PER 100 TOTAL BIRTHS 1887-1891[1]

	Legitimate	Illegitimate
Belgium	4.43	5.96
France	4.27	7.82
Italy	3.59	4.69
Saxony	3.52	4.37
Prussia	3.51	4.77
Bavaria	3.20	3.53
Austria	2.64	4.10
Norway	2.58	3.92
Sweden	2.50	3.65
Hungary	1.90	3.06

As we have seen, there is a difference in the probability of still-births according to the age of the mother. This probability among the mothers of illegitimate children should not be great since the mothers are young, but this is more than offset by the fact that they are generally first births and for them the probability of still-birth is high. There is also the fact that the mother of an illegitimate child often works up to the time of her confinement, and the mental anguish in addition is such that the danger of a still-birth is increased. Moreover, these mothers come from the lower classes in society and the care they get in delivery is not as good as for the better class of legitimate mothers. It was commonly supposed that one reason why the mothers of illegitimate children had so many still-births was due to the fact that abortion had been attempted and had failed. Dr. J. Bertillon seems to think that this is not the case, but that it is misery which causes this high rate.[2] In the city of Paris, 1886-90, per 1,000 births there were the following still-births.

	Legitimate	Illegitimate
Born in the home of the mother	59	57
Born outside the home of the mother	130	118

[1] Lindmer, F., "Die unehelichen Geburten als Sozialphänomen." Leipzig, 1900, p. 181.

[2] Bertillon, J., "La mortalité, par âge, avant la naissance." Journ. de la Soc. de Statistique de Paris, May, 1893, p. 178.

Probably two-thirds of the illegitimate mothers go to hospitals to give birth to their children, while only about 5 per cent. of the legitimate mothers go there, and then it is because they expect a difficult delivery. This concentration of bad risks is what makes the rate of still-births so high for the legitimate mothers in the hospitals. Many of the illegitimate mothers are also very poor, and it seems to be a fact that poverty, leading to bad housing conditions, is a principal cause for the high mortality among illegitimate children.

Still-births are more frequent among males than females, and this fact has been generally attributed to the greater size of the male at birth. Dr. J. Bertillon admits the truth of this, but shows that the mortality of the male exceeds that of the female throughout the fœtal life.[1]

Multiple Births. A phenomenon which occurs with considerable regularity for large areas is that of multiple births. In about 99 cases in 100 there is but one child at a birth. The figures for some of the principal European countries follow.

CASES OF MULTIPLE BIRTHS PER 100 PARTURITIONS[2]

Sweden	1.45	Prussia	1.26	Austria	1.17
Bavaria	1.38	Germany	1.24	Switzerland..	1.16
Denmark.....	1.34	Scotland	1.22	France	0.99
Norway	1.32	Italy	1.21	Belgium	0.97
Holland	1.30	Saxony	1.20	Spain	0.85

In Massachusetts from 1882-1901 there were 107 living births to 1 case of twins. In 1901 there were in the state 726 cases of twins, 9 of triplets, and 1 of quadruplets.

In Connecticut in the 10 years, 1892-1901, there were 4,321 cases of twins, 20 of triplets, and 1 of quadruplets.

In Rhode Island from 1854-91 there were 319,411 cases

[1] A careful study of the fœtal death-rate has been made by Dr. J. Bertillon, "La mortalité, par âge, avant la naissance." Journal de la Soc. de Statistique de Paris, Vol. XXXIV, May, 1893, pp. 167-181.

[2] Mayo-Smith, R., "Statistics and Sociology." New York, 1896, p. 80.

of single births, 3,393 of twins, 35 of triplets and 1 of quadruplets.

In Belgium from 1841-1885 there were 52,315 cases of twins, 677 of triplets, 8 of four, and 1 of five at a birth.

Prussia from 1826-80 had 85 cases of four, and 3 of five at a birth.

Cases of more than three at a birth are extremely rare. As a rule, we may say that in about 1 case in 100, twins are born, and in 1 in 10,000, triplets. Cases of quadruplets are so infrequent that all trace of regularity is lacking.

As the mother advances in years the probability of giving birth to twins increases. This is shown by the figures for Munich.

NUMBER OF TWINS TO 1,000 PARTURITIONS IN EACH AGE GROUP IN MUNICH, 1880-1896[1]

Age of Mother	Number of Twins
18 to 20 years	5
21 to 25 years	8
26 to 30 years	12
31 to 35 years	16
36 to 40 years	21
41 to 45 years	20
Total	11

The same tendency is shown by the figures for St. Petersburg, although there is not the regularity which was exhibited by the table for Munich.

NUMBER OF TWINS TO 1,000 PARTURITIONS IN EACH AGE GROUP IN ST. PETERSBURG, 1882-1892[2]

Age of Mother	Number of Twins
16 to 20 years	6
21 to 25 years	9
26 to 30 years	14
31 to 35 years	21
36 to 40 years	22
41 to 45 years	16
46 to 50 years	18
Total	14

[1] Bertillon, J., "La Gémellité selon l'âge de la mère et le rang chronologique de l'accouchement." Journ. de la Soc. de Statistique de Paris, May, 1898, p. 147.

[2] Bertillon, J., *Op. cit.*, p. 148.

The probability of giving birth to twins increases with the number of the parturition. It is less at the first than at any succeeding accouchement.

NUMBER OF TWINS IN 1,000 PARTURITIONS IN ST. PETERSBURG, 1882-92[1]

Order of Accouchement	Number of Twins
1st	8
2nd	10
3rd	13
4th	15
5th	19
6th	21
7th	22
8th	23
9th	26
10th	28
following	28
Total	14

When we come to combine the age of the mother with the number of accouchement we find the regularity still more striking and are forced to conclude that both of these factors have an influence on the probability of a multiple birth.

NUMBER OF TWINS IN 1,000 PARTURITIONS IN EACH CATEGORY BY AGE OF MOTHER AND ORDER OF ACCOUCHEMENT IN ST. PETERSBURG, 1882-92[2]

	Number of Accouchement			
Age of Mother	1st	2nd or 3rd	4th, 5th or 6th	7th and over
16-20 years	6	7	0	0
21-25 years	8	9	17	0
26-30 years	12	12	17	20
31-35 years	13	19	19	26
36-40 years	10	17	20	26

It is possible that the previous conceptions make it more likely that twins will be born, or that these previous parturitions are a sign that there is a high fecundity, which is reflected in the birth of twins. The sex of twins does not appear to be at all dependent upon the age of the mother.

[1] Bertillon, J., *Op. cit.*, p. 149.

[2] Bertillon, J., *Op. cit.*, p. 149.

CHAPTER IV

MARRIAGE

The study of marriage has great sociological interest, since on it depends, to a considerable extent, the perpetuation and preservation of society. The home forms a great social unit, intended not only to promote the happiness of the parents, but to assist in the training of the children, that they may in time be fitted to assume their share of the burden of the state. Therefore whatever concerns the formation and duration of marriage is of interest not only to the sociologist, but to the citizen who has at heart the interests of society. The effect of war and economic crises to lower, and of prosperity to increase the marriage-rate; the changes in the age at marriage; its duration, and dissolution by death or divorce; the fecundity of the wives; the effect of social position upon the size of families;—all these questions cannot fail to interest one who is a student of the problems of society.

Marriage-Rate. There are several different ways in which marriage-rates are computed.

(1) Number of persons married per annum per 1,000 of total population. This is probably the method in most general use and might be called the crude marriage-rate, corresponding to the crude birth-rate.

(2) Number of marriages per annum per 1,000 of total population. This figure is exactly half the size of the previous one and differs simply in the fact that the number of couples is taken instead of individuals married.

(3) Number of persons married per annum per 1,000 marriageable persons. This includes all single, widowed and divorced over 15 years of age. There is no upper limit

to the age when the possibility of marriage ceases. In this it differs from the denominator of the refined birth-rate. This rate has the advantage of including in the ratio only such numbers as are liable to be affected by the marriages taking place throughout the year.

PERSONS MARRIED PER 1,000 TOTAL POPULATION IN 1900[1]

Hungary	17.7	Denmark	15.3
Spain	17.7	United Kingdom	15.1
Belgium	17.2	Scotland	14.6
Prussia	17.1	Italy	14.3
Germany	17.0	Norway	13.9
England and Wales	16.0	Sweden	12.3
France	15.5	Ireland	9.6
Switzerland	15.5		

The figures can be compared with those for the New England states for the five years 1893-97.

New England	17.54	Massachusetts	18.10
Maine	16.80	Rhode Island	17.10
New Hampshire	20.18	Connecticut	15.70
Vermont	16.70		

It appears from this table that the marriage-rate in New England is higher than in most of the European countries. In New England the sexes are quite equally distributed and the proportion in the middle-age groups is large. Both of these factors favor a high marriage-rate.

Instead of comparing the rates of marriage for different countries from any of the figures already given it will be well to introduce the refined marriage-rates.

NUMBER OF PERSONS MARRIED PER ANNUM PER 1,000 UNMARRIED PERSONS 15 YEARS AND OVER, 1878-82[2]

Hungary	72.6	France	45.5
Saxony	60.8	Belgium	40.0
Prussia	51.0	Scotland	39.6
England and Wales	50.2	Sweden	36.9
Denmark	47.9	Ireland	23.1
Italy	47.5		

[1] Sixty-third Annual Report of the Registrar-Gen. of England, 1900, pp. 124-61.

[2] Bertillon, J., "Eléments de démographie," 1896, p. 33.

The high marriage-rate in Hungary is attributed by Dr. Bertillon to the high death-rate, which dissolves the marriages, and the frequent remarriage of the widowers. By the crude marriage-rate France was higher than Italy, but by this more accurate method Italy leads. This is due to the large proportion of old in the French population, among whom the probability of marriage is low. By both of the methods the rate for Ireland is the lowest. This must be attributed to emigration, which removes large numbers of those in the middle-age groups, and to the bad economic condition of the country.

There are considerable differences between the rates for the sexes.

NUMBER OF MARRIAGES PER ANNUM PER 1,000 MARRIAGEABLE PERSONS OF EACH SEX[1]

	Males	Females
Württemberg	64	45
England	62	53
Austria	58	50
Bavaria	57	44
France	57	46
Sweden	53	37
Italy	49	49
Massachusetts	61.5	46

These figures comprise the statistics of about eight millions of marriages in the countries included in the table and are therefore representative. In every case but one the rate for males exceeds that for females. This is due in part to the higher death-rate for males, which increases the number of widows in the higher ages, for whom the chance of remarriage is small. There are, as a rule, more females than males over 15 years of age, and if all the males married there would be some of the females left unmarried. In some of the Western states in this country it is probable that the refined marriage-rate is considerably higher for the females than the males, but, unfortunately, we have no good statis-

[1] Vital Statistics of Massachusetts, 1856-95. Pub. Doc. No. 34, p. 725.

tics. A table has been formed by Mr. W. F. Wilcox which compares the proportion of married by sex for various age groups in Michigan and England. Although it does not show the marriage-rate it gives some idea of the chances of marriage by sex for a new and an old community.

NUMBER OF MARRIED PERSONS PER 1,000 IN EACH AGE GROUP[1]

	Michigan	England	Michigan	England
	Male		Female	
	1890	1881	1890	1881
15-19 years	2	5	90	25
20-24 years	159	221	496	331
25-34 years	624	659	814	681
35-44 years	836	826	878	765
45-54 years	870	845	829	711
55-64 years	855	779	706	581
65 years and over	727	587	422	326

We thus see that in an older country the males have a better chance to marry than in a newly settled one, while the women have a greater probability in Michigan than in England.

In most countries the marriage-rate is slowly decreasing.

NUMBER OF MARRIAGES PER 1,000 POPULATION[2]

	1876-80	1881-85	1886-90
Hungary	9.6	10.3	8.9
Prussia	8.0	8.0	8.1
Germany	7.8	7.7	7.9
Austria	7.8	7.9	7.7
Italy	7.5	8.0	7.8
France	7.6	7.5	7.2
Belgium	6.9	6.8	7.1
Great Britain	7.1	7.1	6.9
Switzerland	7.4	6.8	7.0
Denmark	7.8	7.7	7.0
Norway	7.2	6.6	6.3
Sweden	6.6	6.5	6.1

[1] Wilcox, W. F., "Marriage Rate in Michigan, 1870-90." Pub. Amer. Statist. Assn., New Series, Nos. 25-26, March-June, 1894, pp. 1-11.

[2] Matlekovits, A. von, "Das Königreich Ungarn," Vol. I, p. 114.

There are only four countries in the table which had a rate in the last higher than in the earliest period. In all other cases there had been a decrease. Where a country has an increasing population the percentage of children is large and the crude marriage-rate is kept low. When this increase has continued for a period of sufficient length to allow the children to reach marriageable ages the marriage-rate may increase. The principal cause for this decline is foresight, and is reflected in the increasing age at marriage.

The effect of the age distribution of the population upon the marriage-rate is shown very clearly by the figures for the native and foreign born elements in Massachusetts.

NUMBER OF PERSONS MARRIED PER 1,000 POPULATION IN EACH GROUP IN MASSACHUSETTS[1]

Year	Native-Born	Foreign-Born
1850	16.24	35.35
1855	16.68	38.70
1860	15.82	34.26
1865	16.94	34.04
1870	17.02	30.05
1875	14.48	22.85
1880	16.05	21.58
1885	15.26	23.72
1890	15.09	27.06
1895	14.81	26.80

From this table it would appear at first sight that the marriage-rate of the foreign exceeded that of the native-born very decidedly, the excess varying from 34 to 132 per cent. But when we consider the difference in the age distribution of the two elements, it becomes apparent that a large proportion of this excess disappears. Thus by the census of 1885 it was found that the foreign-born formed but 7.3 per cent. of the population under 15 years, while between 15 and 60 they formed 34.6 per cent., and over 60, 29.4 per cent. They are therefore most heavily represented in those ages when marriages occur. This brings out clearly the danger of comparing unlike quantities, and the advantage of the refined over the crude marriage-rate.

[1] Vital Statistics of Massachusetts, 1856-95. Pub. Doc. No. 34, p. 728.

War and the Marriage-Rate. While a country is at war its marriage-rate generally falls off, owing to the absence of large numbers of young men who are with the armies in the field, and the unsettling of business which accompanies warfare. The rate of wages does not rise to balance the advance in the price of commodities, and with the result of the conflict in doubt the young men do not feel like assuming any additional burdens. But when the war is over the rate not only reaches the level which was maintained before the war, but surpasses it. The young men have now returned to their homes and there is throughout the country a feeling of relief and hopefulness.

In 1866 Prussia was at war with Austria, and whereas the Prussian rate in 1865 was 18.2, it fell to 15.6 in 1866, rising to 19.3 in 1867. At the same time the Austrian rate fell from 15.5 in 1865 to 13.0 in 1866.

In the great war of 1870-71 this was shown very clearly. The Prussian rate in 1869 was 17.9; in 1870 it fell to 14.9, and remained at 15.9 in 1871. But in the two years after the close of the war it rose to 20.6 and 20.2, the highest recorded rates. In France the rate in the year before the war was 16.5, while during hostilities it fell to 12.1 and 14.4. When the war was over it rose to 19.5 and 17.7, the two highest French rates recorded.[1]

The same effect was caused by the Civil War in the United States. Massachusetts has statistics of marriages covering this period.

PERSONS MARRIED PER 1,000 TOTAL POPULATION IN MASSACHUSETTS

1860	20.15
1861	17.72
1862	17.68
1863	17.36
1864	19.87
1865	20.60
1866	22.15

[1] Ogle, W., "On Marriage Rates and Marriage Age, with special reference to the Growth of Population." Journ. Royal Statist. Soc., Vol. LIII, Part II, June, 1890, pp. 225-56.

The decided fall at the commencement of the war is made evident. This decrease continued for three years, followed by an increase which became so marked at the cessation of hostilities and return of the troops that the rate attained the height of 22.15, a point which it has never since reached.

Economic Condition and the Marriage-Rate. It is by no means a recent discovery that there is a connection between economic prosperity and the marriage-rate. It was seen that when it was difficult for people to obtain a livelihood on account of the high price of provisions, the marriage-rate would fall. The problem was to discover what offered the best measure of this difficulty, and in England the price of wheat, in Germany that of rye was selected. When the rate of wages varied but little and the industrial system was simple, this comparison sufficed. Until about the middle of the nineteenth century the price of wheat and rye was a factor of considerable importance in determining the marriage-rate. When the price of grain advanced the rate of marriage fell, and vice versa.

But as the industrial system has become more complex, it is no longer possible to trace the rise and fall of economic prosperity in the variations of the price of wheat. Dr. Wm. Ogle proposed as a better measure of prosperity, the value of the export trade, since this tends to vary with the amount of employment in a country.[1] He found that in the 50 years from 1839 to 1888 there were but eight years in which the marriage-rate and the value of the exports had moved in different directions in England. Taking the period as a whole the marriage-rate had decreased while the value of the exports had increased, but the yearly oscillations had been in the same direction. The cause of difference in general direction of the two curves was probably caused by the change in the standard of living for the working classes. When there was a large amount of unemployment he found

[1] Ogle, W., "On Marriage Rates and Marriage Ages." Journ. Royal Statist. Soc., Vol. LIII, Part II, June, 1890, pp. 253-289.

that the marriage-rate decreased. He concluded that when the greatest proportion of women were at work, there was the highest marriage-rate, since they were able to help their husbands.

While agreeing in the main with these ideas, Mr. R. H. Hooker emphasized the fact that there was no connection between the general shape of the two curves, but that all the agreement lay in the oscillations.[1] They changed at the same time and in the same direction. He found that the maximum coefficient was obtained by correlating the marriages of one year with the exports of a half-year earlier. It is thus apparent that the change in trade comes first, followed by that in marriage. We have here a good example of the curve of pursuit.

Prof. Pareto has applied the method of interpolation to this problem and carried it out to a high degree of accuracy.[2] He considered both the value of the exports and the quantity of coal mined. He felt that some agricultural factor should have been included, and thought that to obtain sufficient accuracy several factors should be studied simultaneously.

There is also a connection between the variations in the rate of marriage and the rate of pauperism in a country.[3] The number of paupers is always greatest when there is the most unemployment, and when hard times come upon a country. We have seen that in times of economic depression the marriage-rate decreases, and the amount of pauperism gives a good picture of economic conditions.

From these references it becomes clear that the marriage-rate is considerably influenced by economic causes, and that many people prefer to postpone marriage until a spirit of

[1] Hooker, R. H., "Correlation of the Marriage Rate with Trade." Journ. Royal Statist. Soc., Vol. XLIV, Part III, Sept., 1901, pp. 485-492.

[2] Pareto, V., "Quelques examples d'application des méthodes d'interpolation à la statistique." Journ. de la Soc. de Statistique de Paris, Nov., 1897, pp. 367-378.

[3] Yule, G. U., "Investigation into Causes of Changes in Pauperism in England." Journ. Royal Statist. Soc., June, 1899, p. 265.

hopefulness is general throughout a country. They feel that when conditions are bad and the outlook dark is no time to assume added responsibilities.

Probability of Marriage. This refers to the probability that a person of a certain age will marry during the year, and is expressed by means of a ratio. It is generally computed by taking the number of marriages during a year of persons within an age group to 1,000 unmarried persons within the age group. To the ratio of the number of marriages to the total number of marriageable women from 15 to 45 years of age, M. Cauderlier has given the name matrimoniality.[1] He has shown very clearly the effect of the age at marriage upon the value of this ratio.

Let us suppose that there are every year 10,000 women arriving at the age of 15 years. If we ignore the mortality the number of women 15-45 years of age is 30×10,000=300,000.

Let us assume that there are 8,000 marriages per annum, and change the age at marriage to see the effect upon the matrimoniality.

If the marriages take place at 20 years the number of single women is

5×10,000=50,000 from 15 to 20 years of age.
25× 2,000=50,000 from 20 to 45 years of age.
Total=100,000

The rate is therefore 80 per 1,000.

If the marriages take place at 40 years the number of single women is

25×10,000=250,000 from 15 to 40 years of age.
5× 2,000= 10,000 from 40 to 45 years of age.
Total=260,000

The rate is 30.77 per 1,000.

Suppose in the third case that all the women marry in their 30th year. There would be 15×10,000=150,000 unmarried women.

The rate would be 66.67 per 1,000.

[1] Journ. de la Soc. de Statistique de Paris, Feb., 1901, pp. 52-3.

Thus we see that where all of the women eventually marry the rate is lower than where only a part of them marry, but at an earlier age.

M. Cauderlier thinks the really correct way to consider this question is to compare the annual number of marriages to the number of women who arrive each year at the mean age of marriage. To this ratio he has given the name marriageability.

By using this method the rate in France is 869 per 1,000 and Belgium 946.

The probability of marriage is usually computed for five or ten-year periods, not only for each sex, but for those who have never married and for the widowed and divorced.

NUMBER OF PERSONS MARRIED ANNUALLY FROM 1,000 IN EACH CATEGORY IN SWITZERLAND, 1879-82.[1]

	Males			Females		
	Bachelors	Widowers	Divorced	Spinsters	Widows	Divorced
Under 20 years	5	...	...	16	56	...
20-24 years	49	175	167	82	113	119
25-29 years	103	280	262	103	109	168
30-34 years	83	275	243	65	89	134
35-39 years	55	206	170	40	63	87
40-44 years	32	150	120	24	35	39
45-49 years	19	97	93	14	20	39
50-54 years	11	60	73	6	9	22
55-59 years	6	37	39	2	4	9
60-64 years	4	22	29	1	2	4
65-69 years	2	10	20	...	1	...
70 and over	1	2	5	...	...	...

We see from a study of the table that the probability of marriage for bachelors reaches the maximum between 25 and 34, while for spinsters it is from 20 to 29. For maids under 20 it is over three times as high as for bachelors of the same age group. Over 30 the rate is always higher for bachelors than maids. Widowers at all ages have a greater

[1] Bertillon, J., "The Fate of the Divorced." Journ. Royal Statist. Soc., Vol. XLVII, Sept., 1884, p. 520. Translated from Journ. de la Soc. de Statistique de Paris, June, 1884.

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probability of marrying than have bachelors. They have shown that they desired marriage since they have already married once. They often feel the need of another wife to rear the children which have been left to them by a previous wife. The need of a companion to take the place of the one already lost must have its influence. They have an establishment already fitted up and can better afford to marry than the average bachelor. The rate for widows is but slightly higher than for maids and in some countries is lower in the early ages. The rate for the divorced of both sexes is higher than for those never married, and in the upper ages higher than for the widowed. In many cases the divorce is not sought until the opportunity for remarriage is assured.

NUMBER OF PERSONS MARRIED ANNUALLY PER 1,000 UNMARRIED PERSONS 15 YEARS AND OVER IN EACH GROUP IN MASSACHUSETTS IN 1890 [1]

Bachelors	54.69
Widowers and Divorced Males	73.28
Maids	58.48
Widows and Divorced Females	15.92

The highest rate is for widowers and the lowest for widows. The widowers have a larger proportion in the early years than have the widows, on account of the deaths of mothers in child-bearing. The bachelors have a lower rate than the maids on account of the large proportion of unmarried among the males from 15 to 25. They do not commence to marry at an early age as the maids. The rate for widowers is still farther increased by the small proportion of their numbers between 15 and 30. Rates of this kind cannot be compared very successfully on account of the differences in age distribution.

Conjugal Condition at Marriage. As a rule about 80 per cent. of marriages are between bachelors and maids. The combination which next to this is most frequent is between

[1] Crum, F. S., "The Marriage Rate in Massachusetts," Pub. Amer. Statist. Assn., New Series No. 32, Dec., 1895, p. 34.

widowers and maids. Then follow marriages between bachelors and widows, and widowers and widows. In Prussia if we take the persons who contract marriage according to their conjugal condition, we shall find that out of 100 bachelors marrying, about 95 choose maids, and 5, widows or divorced women; of 100 widowers, about 75 marry maids, and 25, widows or divorced women; of 100 maids, about 88 take bachelors, and about 12, widowers or divorced men; of 100 widows about 60 marry bachelors, and about 40, widowers or divorced men.[1]

CONJUGAL CONDITION AT MARRIAGE IN HUNGARY, 1876-85[2]

Bachelors with maids	75.04%
Bachelors with widows	4.64%
Bachelors with divorced	0.26%
Widowers with maids	9.50%
Widowers with widows or divorced	9.97%
Divorced with divorced	0.14%
Divorced with maids	0.32%
Divorced with widows	0.13%

In Hungary the proportion of the marriages of widowers is extremely large and there are about twice as many widows who marry widowers as marry bachelors. A ratio as large as this is seldom found.

MARRIAGE BY CONJUGAL CONDITION IN FRANCE IN 1885[3]

	Rural	Urban	Dept. of the Seine
Bachelors and Maids	874.0	833.5	795.5
Bachelors and Widows	30.4	44.8	62.5
Bachelors and Divorced	0.03	0.3	1.6
Widowers and Maids	65.0	76.9	87.1
Widowers and Widows	22.9	40.6	46.1
Widowers and Divorced	0.03	0.2	0.3
Divorced and Maids	0.28	2.5	5.0
Divorced and Widows	0.17	0.5	1.2
Divorced and Divorced	0.20	0.7	0.1
Total	1,000.0	1,000.0	1,000.0

[1] Mayo-Smith, R., "Statistics and Sociology," New York, 1896, p. 106.

[2] Matlekovits, A. von, "Das Königreich Ungarn," Vol. I, p. 118.

[3] Levasseur, E., "La population française," 1891, Vol. II, p. 85.

Marriages between bachelors and maids are much more frequent in the rural districts of France than in Paris. There are twice as many widows who marry in Paris. The marriages of divorced women are more than ten times as frequent in Paris. As a rule remarriages are more frequent in the cities than the country districts. This is due in part to the greater expense of an establishment in the cities, so that those who are already provided with one are at a considerable advantage, and in part to the higher mortality of the cities, which dissolves the first marriage.[1]

Men have a greater tendency to remarriage than women. This is brought out clearly by the marriages in Massachusetts during 1901.

CONJUGAL CONDITION AT MARRIAGE IN MASSACHUSETTS IN 1901[2]

		Females			
Males	Total	1M.*	2M.	3M.	4M.
Total	24,891	22,561	2,229	98	3
1M.	21,710	20,530	1,151	27	2
2M.	2,942	1,915	973	54	
3M.	222	108	98	15	1
4M.	17	8	7	2	

* These columns refer to the first, second, third or fourth marriage which the persons have contracted.

There are nearly a thousand more females than males marrying for the first time. Where men have married before they have a greater tendency to take women who have been previously married than is the case with men contracting their first marriage. Thus bachelors take maids about 20 times where they take but once a woman who has lost one husband, but where the men have been married twice previously they are more likely to choose a widow than a maid. More than twice as many men as women are contracting a third marriage, and more than five times as many a fourth.

[1] Recent statistics on the subject in Prussia and Belgium can be found in Preussische Statistik No. 179, 1902, p. 17, and Annuaire statistique de Belgique, Tome XXIII, 1900, p. 112.

[2] Sixtieth Report of Births, Marriages and Deaths in Massachusetts, 1902, p. 162.

In Berlin the figures have been collected so that we can distinguish the remarriages of the widowed and divorced.

CONJUGAL CONDITION AT MARRIAGE IN BERLIN IN 1902[1]

Males		Females							
			Widows			Divorced			
		Maids	2M.	3M.	4M.	2M.	3M.	4M.	Total
Bachelors ...		16,038	506	22	1	282	18		16,867
Widower ...	2M.	1,176	296	22	4	89	8	1	1,596
Widower ...	3M.	63	51	4		5			123
Widower ...	4M.	5	2			1			8
Widower ...	5M.		1						1
Divorced ...	2M.	363	66	7	1	55	4		496
Divorced ...	3M.	28	10	1		4			43
Divorced ...	4M.	2					1		3
Divorced ...	5M.	1							1
Totals		17,676	932	56	6	436	31	1	19,138

As is usually the case the number of maids who marry exceeds that of bachelors, but the widowers and divorced males are more numerous than the widows and divorced females, although the difference in the numbers of the divorced is small. In all cases the widowers prefer maids to widows or divorced women, but the widows at the third and fourth marriage are taken by widowers more often than by bachelors. A larger proportion of divorced males marry divorced females than is the case with bachelors or widowers.

It is of interest to note the frequency of remarriage according to the age of the contracting parties.

MARRIAGE BY AGE AND CONJUGAL CONDITION IN CONNECTICUT IN 1901[2]

	Age of Grooms									
	12-15	15-20	20-30	30-40	40-50	50-60	60-70	70 and over	Unknown	Total
1M.		100	4,679	1,201	158	17	4		1	6,160
2M.			107	328	219	129	38	7		828
3M.			2	13	25	21	10	6		77
4M.					1	2	1	2		6
5M.						1				1
6M.								1		1
Unknown			18	8	7	4	1	1		39
Total..		100	4,806	1,550	410	174	54	17	1	7,112

[1] Veröffentlichungen des statistischen Amts der Stadt Berlin, 1902. Supplement I, p. 50.

[2] Rept. State Board of Health, Connecticut, 1902, p. 254.

MARRIAGE BY AGE AND CONJUGAL CONDITION IN CONNECTICUT IN 1901[1]

	Age of Brides									
	12-15	15-20	20-30	30-40	40-50	50-60	60-70	70 and over	Un-known	Total
1M.	8	948	4,721	581	65	13	3	1	3	6,343
2M.		3	203	247	156	48	12	2		671
3M.			4	10	11	10	2			37
Unknown		9	34	10	5	1	1		1	61
Total..	8	960	4,962	848	237	72	18	3	4	7,112

There are no remarriages of males under 20 years and but three of females. Between 20 and 30 the remarriages of females are more frequent than of males, but in every succeeding group the males are more numerous. After the fortieth year remarriages are more frequent than first marriages for both sexes. After this age a spinster is not as likely to marry as a widow. The qualities which made them sought by men still render the widows more attractive than the spinsters.

In England the proportion of remarriages has been steadily decreasing during the past 30 years.

NUMBER OF REMARRIAGES PER 1,000 TOTAL MARRIAGES IN ENGLAND[1]

	Widowers	Widows
1871-75	138.2	100.2
1876-80	136.2	98.0
1881-85	126.0	98.2
1886-90	119.0	83.0
1891-95	112.8	79.2
1896	103.0	73.0
1897	98.0	69.0
1898	95.0	68.0
1899	92.0	67.0
1900	94.0	68.0

At all periods the marriages of widows have been less frequent than those of widowers. The rate for both sexes in 1900 was over 30 per cent. lower than it had been from 1871 to 1875. The average age at marriage has been increasing in England, so that there are fewer widowed in the early ages. The rate of mortality has been on the decrease

[1] Sixty-third Annual Report of the Registrar-General of England, 1900, p. 9.

and the length of life consequently increasing so that the parties lose their mates at a later age than formerly. The probability of marriage decreases in advanced age and since more often the widowed are in the upper age groups the marriages among them have declined.

Since it is well known that in some cases a second marriage was already contemplated before a decree granting divorce had been handed down by the court, it might appear probable that the period to elapse between marriages would be greater in case the first was dissolved by death rather than divorce. Dr. J. Bertillon has given us a set of figures upon this point for Switzerland.[1]

PERIOD ELAPSED BETWEEN THE DISSOLUTION OF THE FIRST AND CONTRACTION OF THE SECOND MARRIAGE IN SWITZERLAND, 1879-81

	Males		Females	
	Widowers	Divorced	Widows	Divorced
Less than 1 year ...	32.3%	30.0%	9.5%	19.4%
1 year	26.0%	25.5%	26.4%	28.2%
2 years	13.6%	15.1%	15.2%	16.6%
3 years	8.2%	10.6%	13.2%	12.7%
4 years	4.8%	5.3%	9.1%	6.8%
5-9 years	10.8%	10.1%	19.6%	12.5%
10 years	4.3%	3.4%	7.0%	3.8%
Total	100.0%	100.0%	100.0%	100.0%

In this table only those remarriages are considered which occurred within ten years after the dissolution of the previous marriage. Among the males the remarriages took place a trifle earlier for the widowed than the divorced. In many cases the father is left with young children which require immediate care. More remarriages occur during the first two years than during the succeeding eight. Among the females the case is reversed and the period elapsed is greater for the widowed than the divorced. Only about 50 per cent. of the widows considered in the table marry during the first three years, while over 60 per cent. of the divorced take a second husband. The tendency to marry at

[1] Bertillon, J., "The Fate of the Divorced," Journ. Royal Statist. Soc., Vol. XLVII, Sept., 1884, p. 521.

an early date is therefore greater among the widowed than the divorced for the males, and the opposite for the females.

Age at Marriage. It is important to note the age of the contracting parties at marriage, since upon this point depends much of sociological interest to the community. Where marriage is deferred the length between generations is great and the increase of population slow, since those marriages which take place at an early age have a greater fecundity. Early marriages may occur when the means of subsistence are easily obtained or the people are careless about the future. When marriage is deferred it may be that it is not easy to establish a home or because the people exercise greater foresight.

The average age of all males marrying in Massachusetts in 1901 was 29.25 years and of all females 25.80 years. The average of the men marrying for the first time was 27.34 years, and of maids 24.63.[1]

In Norway the average age of bridegrooms is 30.66 years, of brides 27.83; in Prussia, of bridegrooms, 29.56, of brides 26.52; in England, of bridegrooms 28.37, of brides 26.08. The age of the bridegrooms in Massachusetts is about the same as for these European countries, and for brides a trifle lower. Although these figures are of interest they do not have the importance of those giving the percentage of the bridegrooms and brides by age groups.

AGE AT MARRIAGE IN EUROPE, 1870-82[2]

	Percentage in Each Age Group			
	Males			
	Under 20	20-30	30-40	40 and over
Russia	37.8	43.9	11.8	7.4
Scotland	3.1	68.8	18.8	9.3
England	3.3	73.4	14.4	8.9
Prussia	0.6	67.2	22.6	9.6
Bavaria	0.2	55.5	30.0	14.3
Italy	1.1	61.9	26.1	10.9
France	2.4	62.3	25.1	10.3
Sweden	0.1	58.9	28.8	12.2
Norway	1.7	62.1	24.6	11.6

[1] Sixtieth Report of Births, Marriages and Deaths in Massachusetts, 1902, p. 159.

[2] Levasseur, E., "La population française," 1891, Vol. II, p. 214.

AGE AT MARRIAGE IN EUROPE, 1870-82 [2]

	Percentage in Each Age Group Females			
	Under 20	20-30	30-40	40 and Over
Russia	58.0	33.2	6.2	2.6
Scotland	13.5	68.9	13.1	4.5
England	14.4	68.8	10.9	5.9
Prussia	10.3	69.7	14.9	5.9
Bavaria	6.4	64.8	20.6	8.1
Italy	16.9	65.8	12.5	4.7
France	21.2	59.6	13.7	5.6
Sweden	5.5	65.0	22.2	7.2
Norway	0.9	59.1	27.6	12.4

The females have a greater percentage than the males in the early age groups in all cases. Between 20 and 30 the proportion of males is slightly larger, and increases with advancing age. In Russia the marriages take place much earlier than in any other country on account of the national customs and the peculiar system of land tenure. In Norway and Sweden there is a small proportion under 20, largely due to economic reasons, although climatic conditions may have some influence. Bavaria has the largest proportion of males in the highest age group due in large measure to the frequent marriages of widowers.

Although the age at marriage generally has considerable influence upon the rate of increase of the population, this is not always the case, as is shown by the figures for France and Austria.

AGE AT MARRIAGE IN AUSTRIA AND FRANCE IN 1896 [1]

	Percentage in Each Age Group			
	Husbands		Wives	
	Austria	France	Austria	France
0-20 years	0.1	1.8	14.8	18.1
20-30 years	64.6	67.1	63.4	64.4
30-40 years	22.9	22.9	15.2	12.7
40-50 years	7.0	5.0	4.6	3.2
50-60 years	3.8	2.2	2.0	1.6
60 and over	1.6	1.0		
Total	100.0	100.0	100.0	100.0

[1] March, L., "La nouvelle statistique autrichienne du mouvement de la population," Journ. de la Soc. de Statistique de Paris. March. 1900, p. 94.

The marriages in France take place at an earlier age than in Austria, due, possibly, to better economic conditions and the general custom of providing a daughter with a dowry. And yet the increase of population is much slower in France than in Austria. This must be attributed to greater foresight and the desire to limit the number of children.

The proportion of marriages by age distribution has a decided difference when we consider the first or subsequent marriages.

AGE AT MARRIAGE IN ENGLAND IN 1900 ON BASE OF 1,000[1]

	Bachelors	Widowers	Spinsters	Widows
All ages	1,000	1,000	1,000	1,000
Minors	56	0	174	1
21-24 years	413	10	434	25
25-29 years	343	70	259	113
30-34 years	110	126	75	174
35-39 years	40	155	28	190
40-44 years	16	150	11	161
45-49 years	7	144	5	130
50-54 years	3	113	2	78
55 and over	2	195	1	95
Age unknown	10	37	11	33

As we should expect, the proportion in the early age groups is higher for those who are marrying for the first time than for the widowed. Over 75 per cent. of the bachelors and over 85 per cent. of the spinsters in the table are married before their 30th year, while but 8 per cent. of the widowers and less than 14 per cent. of the widows to remarry are under 30. The five-year group with the most marriages for bachelors and spinsters is 21-24, and for widowers and widows 35-39. Less than a half of the widows who marry are 40 and over, while over 60 per cent. of the widowers are in the same age group.

AGE AT MARRIAGE IN MASSACHUSETTS IN 1901[2]

Ages	Total Males	Total Females	Bachelors	Maids	Widowers	Widows
Under 20	399	3,758	399	3,751	...	7
20-25 years ...	7,977	10,427	7,917	10,239	60	188

[1] Sixty-third Rept. of the Registrar-General of England, 1900, p. 12.

[2] Sixtieth Rept. of Births, Marriages and Deaths in Massachusetts, 1902, p. 159.

AGE AT MARRIAGE IN MASSACHUSETTS IN 1901

Ages	Total Males	Total Females	Bachelors	Maids	Widowers	Widows
25-30 years ...	8,506	6,169	8,199	5,719	307	450
30-35 years ...	3,938	2,359	3,351	1,849	587	510
35-40 years ...	1,839	1,063	1,216	625	623	438
40-45 years ...	925	523	420	229	505	294
45-50 years ...	515	286	124	97	391	189
50-60 years ...	212	67	20	7	192	60
60-65 years ...	134	47	11	11	123	36
65-70 years ...	87	18	3	2	84	16
70 and over ...	57	12	1	...	56	12

The conditions in Massachusetts are not decidedly different from those in England. The maximum number of maids who marry is between 20 and 25, but for bachelors the maximum is between 25 and 30. The greatest number of widows marry between 30 and 35, while the maximum for widowers is reached five years later. This is what might have been expected, for we have already seen that the difference between the average age at marriage of the males and females is greater in this country than in England.

AVERAGE AGE AT MARRIAGE BY CONJUGAL CONDITION IN ENGLAND IN 1900[1]

	Age of Husbands	Age of Wives
Bachelors with Spinsters	26.39 years	24.71 years
Bachelors with Widows	34.35 years	36.19 years
Widowers with Spinsters	42.19 years	32.97 years
Widowers with Widows	49.75 years	44.95 years
Average age of all bachelors	26.68 years	25.12 years
Average age of all widowers	45.02 years	37.46 years
Average age of all spinsters	27.39 years	25.23 years
Average age of all widows	42.35 years	40.74 years

When a bachelor marries a spinster his average age is eight years younger than when he takes a widow, and widowers who marry spinsters are over seven years younger than those who choose widows. Spinsters who are taken by bachelors are eight years younger than those who are selected as wives by widowers. There is the same difference

[1] Sixty-third Annual Rept. of the Registrar-General of England, 1900, p. 12.

in age between those widows who marry bachelors and those whose mates are widowers. The greatest disparity in ages is where widowers marry spinsters. In this case it is more than ten years. The only case in which the age of the wife exceeds that of the husband is in marriages between bachelors and widows. There is a tendency in most cases for the marriages to be between those whose ages are nearly equal. The widowers of greatest age select the oldest of the widows, and the younger bachelors choose the maids who are nearer their age.

The average age at marriage has been slowly increasing during the past few decades owing to greater foresight and the desire for a higher standard of living.

AVERAGE AGE AT MARRIAGE IN MASSACHUSETTS

	Bachelors	Maids
1864	27.0	20.7
1865	26.4	22.8
1870	26.3	23.6
1875	26.3	23.6
1880	26.5	23.8
1885	26.8	24.2
1890	27.2	24.3
1895	26.9	24.4
1901	27.3	24.6

The increase in age at marriage has been much greater for the brides than the grooms, amounting for the former to nearly four years in a period of less than forty years.

In England in 1873 the average age of bachelors at marriage was 25.6 and of spinsters 24.2 years. In 1900 the figures were 26.7 and 25.1 respectively.

As a rule, in a year when the marriage-rate is particularly high the average age at marriage is low. The rate is largely influenced by economic causes and when the future seems bright the young men feel justified in trying to establish a home. This tendency to postpone marriage is shown not only in the increase of the average age at marriage, but by the decrease in the marriages of minors.

PERCENTAGE OF PERSONS UNDER 20 AT MARRIAGE IN RHODE ISLAND[1]

1856-60	20.79
1861-65	14.42
1866-70	14.74
1871-75	14.75
1876-80	13.59
1881-85	9.65
1886-90	9.19
1891-95	9.48
1896-1900	8.92

There has been a steady decrease in the proportion of early marriages in Rhode Island, since from 1896 to 1900, inclusive, they were less than half as numerous as forty years before. This is by no means confined to the United States, but in all portions there seems to be the desire to insure the future and provide better homes than can be done at this early age.

NUMBER OF MINORS PER 1,000 MARRIAGES IN ENGLAND[2]

	Husbands	Wives
1871-75	81.6	223.2
1876-80	77.8	217.0
1881-85	73.0	215.0
1886-90	62.2	200.2
1891-95	56.2	182.6
1896	53.0	174.0
1897	51.0	170.0
1898	51.0	168.0
1899	50.0	165.0
1900	51.0	163.0

The decrease in the marriages of minors has been more rapid for the males than for the females in England, for while the males were less than a third as numerous as the females in the latest period, they formed a much larger fraction than this in the earliest period.

[1] Forty-ninth Registration Rept. Rhode Island, 1901, p. 149.

[2] Sixty-third Annual Report of the Registrar General of England, 1900, p. 10.

NUMBER OF EARLY MARRIAGES PER 1,000 TOTAL MARRIAGES IN HUNGARY [1]

	Grooms under 24 years		Brides under 20 years	
	Hungary	Budapest	Hungary	Budapest
1854	447	...	420	...
1864	358	...	274	...
1875	...	193	...	229
1876	330	...	348	...
1880	340	143	377	199
1885	349	80	398	131
1890	252	54	374	125
1895	240	56	410	106

The early marriages among the males in Hungary were only about half as numerous in 1895 as forty years previous, but among the females there had been but little change. As has been previously stated, although the men may be led to postpone their marriages, the women they select as wives are not much older than was previously the case. In the cities the case is different. There are more occupations open to them so that they can now support themselves, and do not need to rely entirely upon a husband for maintenance. They are, therefore, in a better position to defer marriage. The early marriages in Budapest are only about a fourth as numerous for both sexes as in Hungary, and during the past twenty years the decrease has been rapid and continuous.

As a rule the age at marriage is lower in the country than the cities. In the rural districts life has fewer attractions for a single man than is the case in the cities, and at the same time a wife can be an economic advantage. The cost of living is greater in the large cities and the price of rent much higher.

AGE AT MARRIAGE IN HUNGARY IN 1892 ON BASE OF 1,000 [2]

	Age of Bridegrooms					
	Under 24	25-30	31-40	41-50	51-60	Over 60
Hungary	266	496	131	61	33	13
27 cities	135	523	220	70	36	16
Budapest	55	464	344	93	31	13

[1] Matlekovits, A. von, "Das Königreich Ungarn," Vol. I, p. 117.
[2] Matlekovits, A. von, "Das Königreich Ungarn," Vol. I, p. 116.

AGE AT MARRIAGE IN HUNGARY IN 1892 ON BASE OF 1,000

	Age of Brides					
	Under 20	21-24	25-30	31-40	41-50	Over 50
Hungary	396	327	143	74	41	19
27 cities	245	336	221	129	49	20
Budapest	123	268	315	216	58	20

There are five times as many bridegrooms married under 24 in Hungary as in Budapest, but between 30 and 40 there are nearly three times as many in Budapest. The difference is nearly as great in the case of the brides. In the whole country there are more brides under 20 than in any other group in the table, while the maximum in the 27 large cities is between 21 and 24, and in Budapest is not reached until 25-30.

Where the size of cities increases it is often the case that the proportion of young men to the total who marry decreases. This is true in Austria.

AGE AT MARRIAGE ACCORDING TO SIZE OF PLACE IN AUSTRIA IN 1896[1]

Size of place	Percentage of bridegrooms under 24 to total bridegrooms
0- 500 inhabitants	11.0
501- 2,000 inhabitants	14.1
2,001- 5,000 inhabitants	13.6
5,001-10,000 inhabitants	12.0
10,001-20,000 inhabitants	7.4

We see that with the exception of the smallest places the age at marriage increases with the size of place, and that in the large cities there are few males married under 24 years. The exception in the case of the very smallest towns is probably due to the misery in them, which causes the young men to defer marriage.

The average age at marriage varies according to social position and is usually higher for the upper classes in society. This has been brought out very clearly in England.

[1] March, L., *Op. cit.*, p. 94.

AVERAGE AGE AT MARRIAGE IN ENGLAND, 1884-85[1]

	Bachelors	Spinsters
Miners	24.06	22.46
Textile hands	24.32	23.43
Shoemakers, tailors	24.92	24.31
Artisans	25.35	23.70
Laborers	25.56	23.66
Commercial clerks	26.25	24.43
Shopkeepers, etc.	26.27	24.22
Farmers and sons	29.23	26.91
Professional and independent class	31.22	26.40

When the amount of time which is required to learn a trade is small and the opportunity for advancement limited, it is possible for a person to enter upon his life-work at an early age. But where there is the necessity for long and expensive training, and the return in the first few years of practice is small, as in the legal and medical professions, it is almost impossible for an ambitious man to marry at an early age. Hence we find the age at marriage of the professional classes is high. But this does not affect the females to the same degree, and as the age at marriage of the husband increases the difference between the ages of the husband and wife increases.

The average age at marriage is not quite as satisfactory as a table giving the proportion marrying by age groups for the different occupations in Austria.

AGE AT MARRIAGE BY PROFESSIONS IN AUSTRIA IN 1896[2]

Occupations	Percentage in Each Age Group								
	Under 20	20-24	24-30	30-35	35-40	40-50	50-60	60-70	70 and over
Agriculture	0.19	13.44	52.25	13.85	6.97	7.38	4.23	1.45	0.24
Industry	0.04	12.08	55.96	15.16	6.77	5.98	2.95	0.91	0.15
Commerce and transport	0.07	6.48	48.79	20.97	10.02	8.33	3.74	1.46	0.14
Domestics	0.00	6.79	52.62	21.25	9.86	6.02	2.95	0.51	0.00
Liberal professions	0.05	5.42	39.13	24.84	12.04	9.05	5.32	3.13	1.02
Without professions	0.00	15.08	55.69	11.45	5.55	5.41	3.13	2.70	0.99
Average	0.12	11.94	52.9	15.49	7.41	7.01	3.76	1.34	0.24

[1] Mayo-Smith, R., "Statistics and Sociology," 1896, p. 104.

[2] March, L., *Op. cit.*, p. 96.

Agriculture and industry have the largest proportions in the early age groups, while commerce and transportation, and the liberal professions have the most in the upper age groups. The liberal professions form the only group in which half of the marriages take place after the thirtieth year. Domestics have the largest proportion between 24 and 35.

If we divide the ages of the husbands and wives into five-year groups from 15 to 50, and then make one for those from 50 to 59, and another for those 60 and over, we find that of the marriages which took place in Paris in 1901 34 per cent. had the husband and wife in the same age group. In 8 per cent. of the cases the husband was in a lower age group than the wife, while in 58 per cent. the husband was in a higher age group. In 10 per cent. of the cases they were born in the same year and in 75 per cent. of the cases the husband was older than the wife.[1]

This most interesting table with regard to the comparative ages of husbands and wives at marriage relates to Berlin.

COMPARATIVE AGE AT MARRIAGE OF HUSBAND AND WIFE IN BERLIN IN 1902[2]

Age of Husband	Number of Marriages at Which the Wife is Younger Than the Husband by				
	Under 5	5-10	10-15	15-20	20 Years and over
Under 25	2,672	176			
25-29	4,094	1,899	56		
30-34	883	1,115	441	14	
35-39	259	359	339	121	5
40-44	129	153	129	94	26
45-49	75	81	83	83	49
50-54	44	60	65	.51	54
55-59	27	40	35	19	51
60 and over	10	15	40	23	81
Totals	8,193	3,898	1,188	405	266

[1] March, L., "Familles parisiennes en 1901," Journ. de la Soc. de Statistique de Paris, Jan., 1904, p. 27.

[2] Veröffentlichungen des statistischen Amts der Stadt Berlin, 1902, Supplement I, p. 51.

COMPARATIVE AGE AT MARRIAGE OF HUSBAND AND WIFE IN BERLIN IN 1902

Age of Husband	Number of Marriages at Which the Wife is Older Than the Husband by				
	Under 5	5-10	10-15	15-20	20 Years and over
Under 25	1,787	316	57	21	6
25-29	1,600	339	90	19	6
30-34	373	127	37	12	5
35-39	137	48	24	4	3
40-44	62	16	5	1	1
45-49	32	10	1	1	
50-54	26	7	1		
55-59	12	1			
60 and over	1				
Totals	4,030	864	215	58	21

In 13,950 cases the husband is older than the wife and in 5,188 cases younger. When the husband is under 25 there are nearly as many cases in which the wife is older as there are in which she is younger, but when the husband is over 60 there is but one case in which his age is exceeded by that of his wife, while in 169 cases he is older. When the husband is under 30 his wife is most frequently less than 5 years younger than he; between 30 and 44 the wife is 5-10 years younger; from 54-54 she is 10-15 years younger; over 55 she is most frequently over 20 years younger.

Marriages by Seasons. There is a tendency for marriages to be concentrated at certain portions of the year from economic causes, national customs and religious influence.

In every country there are two periods of concentration. One comes in October and November when the harvesting is completed and there is leisure and a supply of ready money. This is the result of an economic cause. The other comes in April and May, when those marriages occur which would naturally have taken place in Lent. In some cases the rate is low during December on account of Advent. Where a country is strongly Catholic the influence of religious festivals is more noticeable than in Protestant countries like Switzerland and Sweden. In Massachusetts there is a change taking place. June is becoming the fashionable month for weddings and in 1901 more were celebrated in June than in any other month. The change was also apparent for the two periods in the table. In 1901 in Massachusetts 18.22 per cent. of the marriages took place in the first three months of the year, 28.53 per cent. in the second, 23.76 per cent. in the third, and 29.49 per cent. in the last three months.

MONTHLY RATIO OF MARRIAGES REDUCED TO A STANDARD OF 100[1]

Months	Massachusetts, 1856-75	Massachusetts, 1876-95	1876-80 Switzerland	1876-80 Germany	1876-80 Austria	1876-80 Italy	1876-80 France	1876-80 Sweden
January	108.7	97.0	71	92	93	121	118	41
February	95.9	92.4	125	122	284	167	147	55
March	62.5	54.9	83	65	21	84	52	80
April	97.8	101.8	115	109	40	105	109	109
May	102.7	89.5	137	122	103	88	104	88
June	104.1	126.2	98	93	94	78	114	108
July	85.8	82.1	85	84	72	63	94	70
August	81.0	80.1	77	67	61	72	71	52
September ...	104.5	112.0	90	85	74	90	89	67
October	114.3	129.4	116	135	114	100	110	152
November	151.6	147.8	134	155	249	125	135	170
December	92.9	89.1	76	77	7	110	63	198

In Rhode Island for the 38 years previous to 1892 the greatest number of marriages was in the month of November. Since then, with the exception of 1895 and 1899, the greatest number has been in June. The general distribution has been as follows: the largest proportion in the last quarter; the next largest in the second quarter, followed by the third quarter, and in the first quarter with the smallest proportion.[2]

The influence of religious belief is shown by the following table for Hungary:

[1] Vital Statistics of Massachusetts, Pub. Doc. No. 34, p. 730.
[2] Forty-ninth Registration Rept., Rhode Island, 1901, p. 143.

MARRIAGES BY MONTHS IN HUNGARY IN 1892 ON BASE OF 1,000[1]

	Total	Roman Catholic	Evangelical	Reformed	Jews
January	117	157	136	155	64
February	200	144	128	127	73
March	22	4	32	90	94
April	31	75	82	82	58
May	116	116	101	88	98
June	61	67	57	46	98
July	36	35	30	28	68
August	40	42	35	27	104
September	44	48	40	36	86
October	88	83	76	53	60
November	222	225	235	141	106
December	23	4	48	127	91

Since a large proportion of the population of the country is engaged in agriculture, the marriages are particularly common immediately after the harvests are gathered. From June until the end of September the people are busied with the crops and the number of marriages is small. In December, March and April, at the time of Advent and Lent, the number of marriages is reduced by the influence of the church. The Protestants, since they live in the same localities as the Catholics, tend to have their marriages at the same seasons from custom, but in December and March the numbers of them do not fall so low. The Reformed, who belong almost entirely to the agricultural classes, have their marriages concentrated in the winter months. The Jews are not confined to any particular month either by religion or occupation. Hence we find that marriages with them are quite evenly distributed throughout the year.

Mixed Marriages. It is most common for a man to marry a woman of the same race, religion and social position as himself, since such persons naturally associate more and have greater similarity of taste, but mixed marriages are by no means rare, and are continually on the increase, owing to greater mobility and freedom of intercourse.

In Prussia, 1875-90, 94.77 per cent. of Evangelical men, 88.20 per cent. of Catholic men, and 94.79 per cent. of Jewish

[1] Matlekovits, A. von, "Das Königreich Ungarn," Vol. I, p. 119.

men married women of the same religious faith. Among the other Christian sects 58.82 per cent. of the men married within their sect. Aside from this last group the Jews seem to exercise the greatest independence, for they constitute only 1.25 per cent. of the total population.[1]

The European countries have a much smaller proportion of foreigners in them than is the case in the United States, and consequently the marriages between persons of different nationality are not common. Native women are much more likely to marry foreign men, than are native men to take foreign wives.

The United States, with its large proportion of foreign-born, and the different nationalities so widely scattered throughout the land, ought to offer the best of facilities for the study of this problem, but, unfortunately, the States do not keep accurate records on this point. We have, however, the statistics of parentage for 1900 from the Twelfth Census. Of the persons of foreign parentage 75.3 per cent. had both parents born in the same foreign country, 5.1 per cent. of mixed foreign parentage, and 19.6 per cent. with one parent foreign and one native. In 13.1 per cent. of the cases the father was foreign and the mother native, while in 6.5 per cent. the father was native and mother foreign.

The proportion of intermarriages varies greatly for the different nationalities.

WHITE PERSONS IN THE UNITED STATES IN 1900, HAVING BOTH PARENTS BORN IN A SPECIFIED COUNTRY OR ONE PARENT SO BORN AND ONE PARENT NATIVE BORN[2]

	Percentage with Parentage			Percentage with Parentage	
	Foreign	Mixed		Foreign	Mixed
Austria	93.9	6.1	Ireland	80.4	19.6
Bohemia	91.2	8.8	Italy	96.5	3.5
Canada (English)	51.9	48.1	Norway	86.9	13.1
Canada (French)	78.4	21.6	Poland	97.2	2.8
Denmark	86.5	13.5	Russia	97.8	2.2
England	63.6	36.4	Scotland	67.6	32.4
France	64.5	35.5	Sweden	92.1	7.9
Germany	79.7	20.3	Switzerland	73.7	26.3
Hungary	97.2	2.8	Wales	70.3	29.7

[1] Zeitschrift des Königlich-Preussischen Statistischen Bureaus, 1901.
[2] Twelfth Census of the United States, Vol. I, 1901, p. 191.

The smallest proportion of whites with both parents born in the same country is shown for those of English-Canadian parentage, who seem to intermarry most with the native population. Then follow in order of prevalence of intermarriage England, France, Scotland, Wales and Switzerland. These are countries from which we have been getting immigrants for a long time, and it is possible that these large proportions are due to intermarriage between natives of these countries and natives of this country who are of the same parentage. The smallest proportion of intermarriage with natives of this country is shown for Russia, Hungary, Poland, Italy, Austria and Bohemia. These countries have been furnishing us with immigrants for a comparatively short time. Where the language of the foreigner is an impediment to social intercourse the amount of intermarriage is small.

There is but one case (the English-Canadians) in which the number of children from foreign mothers and native fathers exceeds that from foreign fathers and native mothers. This excess of foreign-born fathers is partly due to the greater number of male than female immigrants.

The principal cases of mixed foreign parentage in the United States in 1900 follow.[1]

Father Born in	Mother Born in	Persons of Mixed Foreign Parentage
England	Ireland	92,003
Ireland	England	76,458
Ireland	Canada (English)	67,417
England	Canada (English)	58,377
Scotland	Ireland	44,605
Ireland	Scotland	42,777
Germany	Ireland	42,523
Canada (English)	Ireland	41,861

These eight combinations account for nearly half of the cases of mixed foreign parentage in this country. In but one case has difference in language offered an impediment to marriage. The Irish have figured in every combination except one, showing their ability to mix with the different ele-

[1] Twelfth Census of the United States, Vol. I, 1901, p. 193.

ments of our population. The children from these unions have constituted a desirable addition to our numbers.

There is also a tendency for persons to marry within the same occupational group. This was much stronger in the middle ages than at present, since at that time labor was much less mobile.

PROPORTION OF THE MARRIAGES BETWEEN PERSONS OF THE SAME OCCUPATIONAL GROUP IN AUSTRIA IN 1896[1]

	Percentage of Husbands Marrying Women in the Same Group	Percentage of Wives Marrying Husbands in the Same Group
Agriculture	86.5	76.7
Industry	27.4	77.0
Commerce and transportation	4.5	31.0
Domestics	43.5	2.3
Liberal professions	6.2	43.3
Without professions	74.5	2.3

There are decided variations in the rate for the different sexes. The intermarriages are most common among those engaged in agriculture. The husbands do not go outside the little village for wives, and agriculture is the only industry in these small places. Men at work in factories do not marry women in the same line of work, not because they prefer others, but because there are not enough women in industry to provide wives for all of them. This is shown by the high percentage of intermarriage for the women of this group. This same tendency is shown in commerce and transportation. The cooks and butlers marry domestics in nearly half of the cases but in only 2.3 per cent. of the cases is this true for the women. This is explained by the presence of so many more females than males as domestics. The males in the liberal professions seldom marry women within the same group, but probably select them most often from those who are living at home and not engaged in any occupation. The number of the males in this group is much greater than that of the females among whom intermarriage is more frequent.

[1] March, L., "La nouvelle statistique autrichienne du mouvement de la population," Journ. de la Soc. de Statistique de Paris, March, 1900, p. 96.

We can say then that the higher the social station of the man the less likely is he to choose a wife from the same occupational group with himself.

Where the men belong to the upper classes they naturally go farther for their wives than when they are members of the lower classes.

PROPORTION OF MEN MARRYING WOMEN FROM THE SAME DISTRICT OR COMMUNE IN AUSTRIA IN 1896[1]

	Percentage of Marriages in the District Where Both Parties Were Born	Percentage of Marriages in the Commune Where Both Parties Were Born
Agriculture	80.5	46.5
Industry	43.0	19.0
Commerce and Transportation	27.0	16.0
Domestics	27.0	11.0
Liberal professions	24.0	13.0
Without professions	57.0	30.5

Those in agriculture take wives from the same district or commune more frequently than any other group. In industry we see that they leave home to work in the factory of the neighboring town, and although marriages are not common between those from the same commune they often occur between those from the same district. Domestics have often gone to the large cities for employment and the proportion in both cases is small. The members of the liberal professions go the farthest for their wives. They are, as a rule, the ones who have traveled most and have the widest range of acquaintance.

Fecundity of Marriage. The increase of population is dependent upon the number of marriages and the fecundity of the wives. In some countries the rate of marriage is low, but the number of births per marriage is sufficiently high to replace the numbers lost by death, besides furnishing an annual increase. In other cases the marriage-rate is high, but the increase of population slow on account of the small number of children per marriage. By the fecundity of marriage is meant the average number of children born per

[1] March, L., *Op. cit.*, p. 96.

marriage. In this case the number is not considered per annum, but for the entire duration of the marriage. To obtain the number it would be best to follow the marriages which occurred in any year until they were all dissolved, recording the births which took place from them. The sum of these births, divided by the number of marriages would give the fecundity. The child-bearing period in woman is limited, and almost all of the children are born within the first twenty years of married life. It would be necessary to follow these marriages for but twenty years instead of the entire married life. But it is obviously impossible to follow these marriages for even such a length of time, so that this method must be discarded. Assuming the number of marriages to remain constant for a period of twenty years, if the number of births in any year is divided by the number of marriages celebrated in the same year, the quotient will be a close approximation to the fecundity of marriage, or the average number of children to a marriage. But the number of marriages in most civilized countries is increasing, so that it becomes necessary to divide the births by the marriages of some previous year. Dr. Farr found that the mean age of the mothers at the birth of their children was six years greater than at marriage. We therefore divide the number of births in one year by the number of marriages six years previous.

The fecundity of marriage is a very variable quantity. In the first place it varies according to the age of the mother. A woman 30 years of age is much more likely to give birth to a child during the year than one who is 40. There is another variation due to the difference in the duration of married life. In the second or third year after marriage a birth is more probable than is the case if the marriage has continued for 15 or 20 years. A third variable is the age of the husband. A woman of 25 is much more likely to give birth to a child when her husband is 30 than when he is 60 years of age. The fecundity of women lasts from their 15th to their 55th year, and men can beget children from the 20th to the 70th year. There are thus $40 \times 50 = 2{,}000$ different rates of fecundity. If we admit that there is a possibility for marriage to be fecund for 30 years, we have 2,000×30=60,000 possible rates of fecundity.

Dr. Z. Rath has suggested that the easiest way by which to gather the data needed for the computation of fecundity would be to obtain answers to the following questions at the death of either party to a marriage.[1]

1. What is the age of the deceased?
2. What is the age of the surviving consort?
3. When was the marriage contracted?
4. What was the total number of births from the marriage?

This would be particularly valuable in countries which did not take a census. It would furnish statistics about the termination of marriage by death, and the length of the different marriages. It would give information about the duration of marriages and the number of children born from them. We could also tell if there was any connection between the age of the wives at marriage and the fecundity. The information could probably be trusted, for, as a rule, the answers about the dead are more accurate than those with reference to the living. It would omit some information about those found dead, and about children born after the death of the husband, but neither of these cases are numerous.

The fecundity of marriage in Europe varies between two and five.

NUMBER OF BIRTHS PER MARRIAGE[2]

Italy	(1870-74)	4.5	(1891-95)	4.4
France	(1865-69)	3.0	(1890-94)	2.1
Prussia	(1865-69)	4.0	(1890-94)	4.2
England	(1870-74)	3.9	(1890-94)	3.8
Austria	(1870-74)	3.7	(1890-94)	4.1
European Russia	(1870-74)	4.9	(1890-94)	5.5
Sweden	(1870-74)	3.9	(1890-94)	4.3

[1] Rath, Z., "Sur la méthode la plus simple de mesurer la fécondité des mariages," Bull. de l'Instit. Internat. de Statistique, Tome XIII, Liv. II, 1902, pp. 275-77.

[2] Raseri, E., "Sur les variations du taux de natalité et sur l'âge moyen des époux, suivant les conditions économiques," Bull. de l'Instit. Internat. de Statistique, Tome XI, Liv. I, 1899, p. 155.

France has the lowest rate of any European country, less than half as high as that for Russia. The other countries vary but little, having about four children per marriage. These figures have been computed by dividing the number of births in a year by the number of marriages in the same year. If the number of marriages in the sixth year previous had been taken, the fecundity would have appeared a trifle larger, but the order of the countries would not have been disturbed.

Unfortunately we cannot introduce the figures of the United States for purposes of comparison, since there is no data from which they can be computed. In Massachusetts from 1890-1900 the fecundity varied between 2.8 and 3.2 per marriage, considerably lower than any European country except France. It is probably considerably higher in some of the Western States. It has been suggested that since such a large proportion of the growth of this country has been furnished by immigration, the native population has withheld its increase. Certain it is that the fecundity of the foreign is greater than that of the native-born element.

FECUNDITY OF MARRIAGE IN MASSACHUSETTS

	Native	Foreign
1850	2.5	5.0
1855	2.4	3.7
1860	1.9	3.5
1865	2.1	4.5
1870	2.2	4.4
1875	2.4	4.4
1880	2.2	5.0
1885	2.4	5.0
1890	2.4	4.3

We see that the figures for the foreign are about twice as high as those for the native-born. The foreigners seem to keep about the same fecundity as in the countries from which they came, while the natives have limited theirs. This is probably due in large measure to the fact that the native element forms the upper class, and with these the fecundity is low. They are trying to maintain or raise their social position, and it is considered important that the size of family be kept small.

The same condition is seen in Michigan.

FECUNDITY OF MARRIAGE IN MICHIGAN[1]

	Native	Foreign
1875-79	3.6	6.5
1880-84	3.3	6.5
1885-89	3.0	4.9
1890-94	3.0	5.1

We are here dealing with one of the more recently settled States, and, as we should expect, the fecundity is greater than in Massachusetts, but even in this case the number of children per marriage is nearly twice as great for the foreign as the native-born.

The number of children where one of the parents is native and the other foreign is midway between the numbers when both are native or both foreign.

FECUNDITY OF MIXED MARRIAGES IN MASSACHUSETTS[2]

	Native Husband and Foreign Wife	Foreign Husband and Native Wife
1882	1.9	2.6
1883	2.0	2.7
1884	2.1	3.0
1885	2.2	2.9
1886	2.2	2.8
1887	2.1	2.6
1891	2.6	2.9
1892	2.7	2.9
1893	2.6	2.9
1894	2.9	3.1
1895	2.5	2.8

It appears, from the study of conditions in Massachusetts, that it is the desire of the father, rather than that of the mother, which determines the number of children

[1]Annual Report of Vital Statistics for Michigan, 1894.

[2]Dumont, A., "Essai sur la natalité au Massachusetts," Journ. de la Soc. de Statistique de Paris, Oct., 1897, p. 352.

which shall be born to a marriage. Where the father is immigrant and the mother native the number of children is greater than where the mother is immigrant and the father native. It is not a loss in the power but in the willingness to have children that gives a low fecundity in Massachusetts.

As a rule the fecundity is greater in the lower than in the upper classes of society. Verrijn-Stuart has given the results of an investigation which was made in Holland to determine in what classes there were the most births to a family. A study was made by the representative method of some of the urban and rural portions of the country concerning the marriages consummated 1877-81. These families were then followed until 1897 to see in what classes the most births occurred. In the table the poorest families are in the first and the wealthiest in the last group.

SOCIAL POSITION AND FECUNDITY IN HOLLAND [1]

	Births per Family	
Social Class	City	Country
I	5.61	5.19
II	5.21	5.09
III	4.35	4.75
IV	4.18	4.50
Total	5.30	5.07

Among the poorer classes the fecundity is greater in the city, while with the wealthy classes it is greater in the country. In both city and country as the wealth increases the number of children to a marriage decreases. Among the poorer classes only 18.10 per cent. of the children were in families under three, while in the upper class 31.81 per cent. of the children were in these small families. Families with over six children contain 52.18

[1] Verrijn-Stuart, C. A., ''Natalité, mortinatalité et mortalité enfantine selon le dégré d'aisance dans quelques ville et un nombre de communes rurales dans les Pays-Bas,'' Bull. de l'Instit. Internat. de Statistique, Tome XIII, Liv. II, 1902, p. 361.

per cent. of the children among the poor and only 30.78 per cent. among the rich. The author thinks that it is fecundity which determines the degree of poverty in the lower classes, while the degree of luxury determines the fecundity in the upper classes.

In Prussia 1889-1900 the legitimate fecundity of the families in independent circumstances was 5.09, while that of the employees was only 3.69. The reason for this was that in many cases among the poor, children were born before marriage, and in this way the number born after marriage was reduced.[1]

Statistics with regard to fecundity according to the religious confession of the parents have been gathered by Prussia.

FECUNDITY OF MARRIAGE BY RELIGIOUS CONFESSION IN PRUSSIA, 1875-1890[2]

Creed of Father	Creed of Mother		
	Evangelical	Catholic	Jewish
Evangelical	4.35	3.30	1.78
Catholic	3.34	5.24	1.66
Jewish	1.58	1.38	4.21

The highest fecundity is found where both parents are Catholic and next where both are Protestant. Where the father is Catholic and the mother Protestant the rate is almost exactly the same as where the creed of the parents is reversed. There is no very decided loss in fecundity from unions between these two classes of communicants. The number of children to a family when both parents are Jewish is nearly as high as for the other classes, but when one parent is Jewish and the other Christian, the fecundity is very low. Such a distinction as that of religion has but little value in a study of this phenomenon since the social position of the members of the different sects may vary, and

[1] Rosenfeld, S., "Der Einfluss von Beruf und sozialer Stellung auf die Totgeburtenquote," Jahrbücher für Nationalök. und Statistik, Oct., 1903, p. 529.

[2] Zeitschrift des Königlich-Preussischen Statist. Bureaus, 1891.

this has much more influence upon fecundity than religion. The fact of nationality is also overlooked in any such division.

It is of interest to note not only the average number of births to a family, but the way in which the births are distributed according to size of families. The average fecundity would be the same if every married woman gave birth to three children, or if half of them had no children and half of them six children, but the effect upon the future welfare of society would be decidedly different.

The State of Connecticut has published a list of the births which took place within its boundaries for the ten years, 1892-1901, distinguishing the order of the birth. Not only has this been done but a separation was made of those of native from those of foreign-born mothers. In this way it is possible to tell whether the American or the foreign mothers have the larger families.

BIRTHS ACCORDING TO SIZE OF FAMILY IN CONNECTICUT, 1892-1901 [1]

	Number of Mothers			Number of Mothers	
At Birth of	Native	Foreign	At Birth of	Native	Foreign
1st child	30,669	31,525	13th child	158	410
2nd child	22,234	18,596	14th child	69	236
3rd child	15,555	15,689	15th child	38	138
4th child	10,604	12,619	16th child	19	65
5th child	7,284	9,722	17th child	9	33
6th child	4,936	7,158	18th child	4	24
7th child	3,361	5,152	19th child	3	11
8th child	2,139	3,536	20th child	2	5
9th child	1,423	2,480	21st child		2
10th child	852	1,683	22nd child		1
11th child	474	1,019	23rd child		2
12th child	270	645	10-20th child...	86	392
			Unknown	407	570
			Total	100,596	101,650

The number of children born from native is very nearly equal to that from foreign mothers during this period, but

[1] Rept. State Board of Health, Connecticut, 1902, p. 260.

their distribution by size of family is entirely different. The American mothers at birth of their first child are nearly 50 per cent. more numerous than foreign mothers, and at the second child are about 20 per cent. more numerous. More than half of the children born from American mothers were first or second births, while only about 40 per cent. of the children of foreign mothers were within the same groups. After the second child the births from foreign mothers are more numerous and as the size of family increases the difference becomes greater. At the tenth birth the numbers from foreign mothers are about twice as great, and at the fourteenth over three times as great. No native mothers had more than twenty children. We thus see that the fecundity of the foreign far surpasses that of the native mothers. By the Census of 1900 from a total of 173,524 married women only 66,301 were foreign whites. We thus see that about a third of the married women gave birth to half of the children.

We have the figures for Paris, showing the number of living children to a marriage according to the duration of the marriage.

NUMBER OF SURVIVING CHILDREN PER MARRIAGE IN PARIS, 1901 [1]

Children	Total	Families Where the Marriage Has Lasted More Than 15 Years	25 Years
0	25.0	17.8	17.1
1	31.9	26.8	26.5
2	22.1	24.7	24.6
3	11.1	14.7	14.9
4	5.3	7.9	8.3
5	2.5	4.1	4.4
6	1.2	2.1	2.2
7	0.5	1.0	1.1
8	0.2	0.5	0.5
9	0.1	0.2	0.2
10	0.03	0.1	0.1
11 and over	0.02	0.04	0.05
Total	100.0	100.0	100.0

[1] March, L., "Familles parisiennes en 1901," Journ. de la Soc. de Statistique de Paris, Feb., 1904, p. 50.

Exactly a fourth of the total families have no children, but the proportion of childless marriages decreases as the duration of marriage increases. Some of the marriages have not lasted long enough to permit the birth of children. About 80 per cent. of the total marriages have two children or less, while less than 70 per cent. of those which have continued for 25 years are in the same groups. 20 per cent. of the total families have from 3 to 6 children, while 30 per cent. of the long-term marriages have from 3 to 6. Families with two children are more numerous than the childless ones where the marriages took place over 15 years ago, but with the total the childless are more numerous than those with two children.

The presence of large families is dependent not only upon the duration of the marriage but upon the age of the mother at marriage. This is shown by the following table for Berlin:

SIZE OF FAMILIES IN BERLIN, 1885-86, ON BASE OF 1,000[1]

	Age of Mother at Marriage					
	Under 20	20-25	25-30	30-35	Over 35	Total
Childless Marriages	73.5	96.7	135.1	221.1	478.6	162.6
With 1 child	75.9	87.2	99.2	132.0	179.7	105.4
With 2 children ..	98.2	111.6	120.3	141.6	131.3	118.9
With 3 children ..	104.3	119.7	118.6	132.2	88.0	116.1
With 4 children ..	108.5	104.9	117.9	120.8	57.2	106.3
With 5 children ..	95.6	95.5	95.8	90.3	33.8	88.4
With 6 children ..	93.4	88.2	79.3	72.0	12.4	79.0
With 7 children ..	66.0	70.5	73.1	38.4	7.9	59.7
With 8 children ..	65.8	67.5	68.4	20.7	3.4	48.2
With 9 children ..	47.8	49.7	37.0	14.5	4.1	36.0
With 10 children ..	52.8	42.1	26.8	7.5	1.4	29.7
With 11 children ..	34.5	24.5	11.2	2.8	0.7	16.1
With 12 children ..	34.6	23.1	8.2	3.1	0.6	14.8
With 13 children ..	18.9	11.7	3.7	1.6	0.3	7.5
With 14 children ..	12.5	6.2	2.8	0.4	0.1	4.4
With 15 children ..	8.1	4.8	1.1	0.1	0.2	2.9
With 16 and more children	11.7	6.1	1.4	0.9	0.3	3.9
Total	5,529.7	4,878.2	4,110.6	2,931.2	1,339.9	4,082.6

[1] Böckh, R., "Die statistiche Messung der ehelichen Fruchtbarkeit," Bull. de l'Instit. Internat. de Statistique, Tome V, Liv. I, 1890, p. 184.

The average fecundity of the marriages in Berlin is 4.08, while it was 5.53 when the mothers married under 20 and but 1.34 when they were over 35. The period from 20 to 35 is that of greatest fruitfulness. Nearly half of the marriages when the mother is over 35 are childless, while only 7.4 per cent. are not blessed with children when the mothers married at the earliest age. When the mothers are over 25 at marriage the families without children are more numerous than those with any definite number. There is no case in which those with one child are most numerous. If the marriage is fruitful it is likely that more than one child will be born. The proportion childless or with one child is greatest when the mother was over 35 at marriage; with two, three or four children when the mother was between 30 and 35; with five, seven and eight children with the mother between 25 and 30 at marriage; with nine children when the mother was between 20 and 25; and with six and ten and over when the mother was under 20. The probability of having a numerous family is increased when the mother marries at an early age.

The fact that mothers are generally comparatively young at the birth of their children is shown by the table for Rhode Island.

AGE OF MOTHERS AT BIRTH OF CHILDREN IN RHODE ISLAND IN 1901[1]

	Percentage of Total Mothers
Under 20	3.64%
20-24	22.02%
25-29	29.72%
30-34	22.82%
35-39	15.42%
40-44	5.46%
45 and over	0.63%
Unknown	0.29%
Total	100.00

More mothers are between 25 and 29 at the birth of their

[1] Forty-ninth Registration Rept., Rhode Island, 1901, p. 134

children than any other quinquennial group. Those from 20 to 24 are nearly equal to those from 30 to 34. The decrease is very rapid from 40 to 44 and after this age reproduction practically ceases. Nearly 80 per cent. of the births take place before the mother reaches her 35th year.

Not only does the age of the mother affect the probability of the birth of children but that of the father as well.

AVERAGE AGE OF MOTHER AT BIRTH OF CHILDREN IN FRANCE [1]

	Age of Mother
When father is under 20 years	24 years 5 mos.
20-24 years	23 years 3 mos.
25-29 years	25 years
30-34 years	28 years 5 mos.
35-39 years	31 years 10 mos.
40-44 years	35 years 5 mos.
45-49 years	38 years
50 and over	39 years

The only case in which the age of the mother exceeds that of the father is when the father is under 20 years. Between 20 and 30 the parents are of nearly the same age and the difference between their ages increases as the father is older.

AVERAGE AGE OF FATHER AT BIRTH OF CHILDREN IN PARIS [2]

	Age of Father
When mother is under 15 years	32 years 2 mos.
15-19 years	27 years 10 mos.
20-24 years	29 years 6 mos.
25-29 years	32 years 2 mos.
30-34 years	36 years
35-39 years	40 years
40-44 years	44 years 1 month
45-49 years	46 years 6 mos.
50 and over	46 years 3 mos.

It is a peculiar fact that when the mother is under 15

[1] Turquan, V., "De la durée de la génération en France," Journ. de la Soc. de Statistique de Paris, Vol. XXXVII, Juin, 1896, p. 230.

[2] Turquan, V., *Op. cit.*, p. 230.

the father is older than when the mother is between 15 and 24. As the parents become older their ages become more nearly alike. When the mother is over 50 her age exceeds that of the father.

We have statistics of births for France showing the ages of both parents at the births of their children.

THE PROPORTION OF LEGITIMATE CHILDREN IN FRANCE BORN TO PARENTS OF DIFFERENT AGES IN 100,000 LEGITIMATE LIVING BIRTHS[1]

Age of Father	Age of Mother					
	Under 20	20-25	25-30	30-40	Over 40	Totals
Under 20 years	102	123	75	47	7	354
20-25 years	942	3,302	1,141	374	18	5,777
25-30 years	1,900	12,295	9,655	2,769	87	26,706
30-40 years	598	8,022	16,575	21,984	1,133	48,312
40-50 years	38	434	1,573	10,575	3,864	16,484
Over 50 years	7	51	139	1,063	1,107	2,367
Total	3,587	24,227	29,158	36,812	6,216	100,000

57 per cent. of the children in France are born of mothers under 30 while 33 per cent. have fathers under the same age. More than a fifth were born when both parents were between 30 and 40. The next largest number was when the father was between 30 and 40 and the mother from 25 to 30. Ten times as many children were born when the mothers were under 20 as when the fathers were at this age. In three times as many cases the father was over 40 as was true of the mother. As a rule the parents at the birth of their children are younger in France than in most European countries.

In New South Wales it was found that, as a rule, the age of the father exceeded that of the mother by five years. This was, therefore, accepted as a standard and the fecundity computed.

[1] March, L., "La nouvelle statistique autrichienne du mouvement de la population," Journ. de la Soc. de Statistique de Paris, March, 1900, p. 98.

FECUNDITY OF MARRIAGE IN NEW SOUTH WALES, 1893-96[1]

Age		Probability of Birth	Average Number of Children to Women
Wife	Husband	During the Year	Marrying at Age in First Column
20	25	0.445	7.2217
21	26	0.428	6.7797
22	27	0.413	6.3559
23	28	0.398	5.9572
24	29	0.385	5.6535
25	30	0.372	5.1829
30	35	0.318	3.4885
35	40	0.279	1.9941
40	45	0.200	0.7496
45	50	0.048	0.1060
50	55	0.002	0.0029

The fecundity is high in New South Wales and where the wife was from 20 to 22 at marriage there were over six children born to a marriage, and from 23 to 25 over five children. It then decreases very rapidly and when the age of the mother at marriage is over 50 it becomes a negligible quantity. The probability of giving birth to a child during the year decreases with the advancing age of the mother, but by no means as rapidly as the fecundity. Whatever children are born to mothers who marry at a comparatively advanced age, come soon after marriage.

The birth-rate is usually the highest where the age of the parents at marriage is young. This is brought out clearly by the figures for some of the provinces of Austria.

BIRTH-RATE AND AGE OF PARENTS AT MARRIAGE IN AUSTRIA, 1886-95[2]

Provinces	Births to 1,000 Population	To 100 Marriages There Were with the Husband Under 24 Years	Wife Under 20 Years
Bukowina ...	46.0	21.72	35.84
Galicia	45.6	19.35	30.56
Dalmatia	40.0	18.78	23.51
Salzburg	31.3	5.54	5.69
Tirol	29.8	5.58	4.16
Vorarlberg ..	28.4	5.01	4.13
Austria	39.0	14.50	16.83

[1] Coghlan, T. A., "Deaths in Childbirth in New South Wales," Journ. Royal Statist. Soc. Sept., 1898.

[2] Prinzing, F., "Die Kindersterblichkeit in Oesterreich," Allgemeines Statist. Archiv, Band VI, 1902, p. 200.

In the table three provinces with a high birth-rate are contrasted with three in which the rate is low. Where the rate is high the proportion of early marriages is large. This is not always the case but generally where marriage is postponed so that the high fertility of the early years is lost the average fecundity per marriage is low.

The maximum point of legitimate natality is reached at an early age so that the decline begins, in the case of the male, after the 25th and in that of the female, after the 18th year. The legitimate fertility does not remain at the same level for many years together, but declines immediately after reaching the highest point. This latter statement rests upon the assumption that the birth of children is dependent upon two facts, the ability and the desire to have children. As a rule the desire for additional children varies inversely with the size of the family. Not only does the number of children increase with the advancing age of the parents, but the moral factor also increases. In the early years the physical factor is more powerful than the moral, but in later years the opposite is the case. Therefore the number of births decreases rapidly after the maximum is reached.

The legitimate fertility of women reaches its climax in marriage at the age of 18 or 19 years and declines above and below this age. It vanishes at 58. The male generative power reaches its climax in marriage at the 25th year, and declines above and below this age. It reaches its vanishing point about 70.[1]

The influence of the age at marriage upon the fecundity is shown by the following table of monogenous natality for Budapest, 1897-1900.

We thus see that the highest fecundity is reached when the parents marry at an early age. This fact is of even greater importance for the wives than for the husbands.

[1] Körösi, J., "An Estimate of the Degree of Legitimate Natality," Journ. Royal Statist. Soc., Dec., 1894, pp. 692-96.

NUMBER OF CHILDREN BORN TO 100 MARRIAGES IN BUDAPEST ACCORDING TO THE AGE OF THE FATHER OR MOTHER AT MARRIAGE[1]

Age of Mother	Number of Children	Age of Father	Number of Children
Under 20 years	370.18	Under 25	365.93
20-25 years	315.98	25-30 years	300.59
25-30 years	268.93	30 40 years	259.89
30-35 years	193.66	40-50 years	177.30
35-40 years	133.54	50-60 years	81.45
40-45 years	58.84	Over 60 years	29.32
Over 45 years	60.39		
Unknown	260.80	Unknown	22.25
Total	276.23	Total	276.23

There is one variable introduced in most of the tables which is liable to detract from the uniformity of the statistics. It is incorrect to compare marriages of different duration. That one which has continued for twenty years would naturally have been blessed with more children than one which was dissolved after three years. In the following table the attempt has been made to remedy this error in part by including only those marriages which have lasted for twenty years.

FECUNDITY OF MARRIAGES OF 20 YEARS' DURATION IN BERLIN, 1885[2]

Age of Mother at Marriage	Number of Children to 100 Marriages
Under 20 years	573
20-25 years	544
25-30 years	427
Over 30 years	300
Total	434

[1] Körösi, J., "Weitere Beiträge zur Statistik der ehelichen Fruchtbarkeit," Bull. de l'Instit. Internat. de Statistique, Tome XIII, Liv. III, 1903, p. 7.

[2] March, L., "Familles parisiennes en 1901," Journ. de la Soc. de Statistique de Paris, Feb., 1904, p. 60.

By excluding all short-term marriages a very high fecundity is obtained, but it is nearly twice as great when the wives married before 20 as when they deferred marriage until the 30th year or after.

It is interesting to compare the probability of a mother giving birth to a child according to the age of the mother for some of the cities and countries of Europe.

NUMBER OF BIRTHS ANNUALLY PER 100 MARRIED WOMEN BY AGES[1]

Ages	Paris, 1896	France, 1896	Budapest, 1890	Norway, 1874-76	Berlin, 1887-90
Under 20	35.1	36.6	42.8	41.3	50.3
20-24	26.3	31.3	35.8	57.9	56.3
25-29	15.8	25.6	29.2	43.0	33.6
30-34	11.0	17.0	20.6	36.0	22.5
35-39	6.2	11.0	14.7	30.0	14.5
40-44		4.5	5.9	18.1	6.0
45-49	1.2	0.6	0.7	3.3	0.7
50-54		0.06	0.07	0.16	0.02

The highest natality is for Norway, where, with the exception of the earliest age groups, the rate is more than twice as high as for Paris. In this city the rate is very low for the higher ages. Berlin has a rate about twice as high as Paris. With the exception of Norway and Berlin the rate is the highest in the earliest ages and then steadily decreases.

Not only does the monogenous natality vary according to the age of the wife, but also according to that of the husband.

NUMBER OF BIRTHS ANNUALLY PER 100 HUSBANDS BY AGES[2]

Age of Father	Norway, 1874-6	Budapest, 1889-92
15-19 years	27.0	?
20-24 years	49.8	61.7

[1] March, L., "Familles parisiennes en 1901," Journ. de la Soc. de Statistique de Paris, Feb., 1894, p. 30.

[2] Körösi, J., "An Estimate of the Degree of Legitimate Natality," Journn. Royal Statist. Soc., Dec., 1884, p. 697.

NUMBER OF BIRTHS ANNUALLY PER 100 HUSBANDS BY AGES

Age of Father	Norway, 1874-6	Budapest, 1889-92
25-29 years	43.6	35.8
30-34 years	37.7	27.1
35-39 years	30.3	21.1
40-44 years	22.5	13.8
45-49 years	12.8	7.2
50-54 years	6.3	3.5
55-59 years	2.6	1.7
60-64 years	1.33	0.7
65-69 years	0.66	0.4
70-74 years	0.32	0.2

Under 20 the rate is not as high as in the succeeding group. This may be due to the fact that the youngest wives do not have the youngest husbands. But aside from this exception the rate decreases as the age of the husband increases. The natality continues at a high rate for a longer period in Norway than in Budapest.

When we turn to the bigenous natality we find that the highest rate is found when the father is in a higher age group than the mother. The difference in their ages should generally be five years to obtain the maximum. An increase in the age of the mother has a greater retarding influence than a similar increase in the father's age. This is because, as the age of the father increases, the difference between the ages of the father and mother grows greater.

NUMBER OF BIRTHS ANNUALLY PER MARRIAGE IN BUDAPEST BY THE AGES OF THE FATHER AND MOTHER[1]

Age of Father	Age of Mother						
	Under 20	20-24	25-29	30-34	35-39	40-44	45-49
20-24 years	(48.0)	35.0	27.3	(22.8)			
25-29 years	44.2	40.7	33.9	25.8	22.1	(16.0)	
30-34 years	40.4	33.2	30.8	22.7	18.4	7.4	(1.8)
35-39 years	(35.6)	31.2	26.0	22.3	17.5	8.7	0.8
40-44 years		25.0	21.4	17.3	15.7	9.0	1.3
45-49 years		(19.7)	18.9	14.1	10.8	5.6	1.1
50-54 years		(22.2)	(20.2)	12.5	10.2	3.7	0.4
55-59 years			(15.8)	11.2	7.6	3.0	0.3

[1] Körösi, J., *Op. cit.*, p. 700.

In this table those rates have been bracketed which were formed from such a small number of data that it was feared they could not be trusted.

Powys has criticised the conclusion of Körösi that the younger the wife the greater the fertility.[1] He claimed that the fact had been overlooked that a large proportion of the marriages of young women under 20 were compulsory, *i. e.,* contracted after conception had followed illicit intercourse. He thought that all ante-nuptial conceptions should be deducted from the number of births. He therefore computed the number of births which occurred during the first year after marriage, according to the age of the wife.

BIRTHS WITHIN ONE YEAR AFTER MARRIAGE IN VICTORIA AND NEW SOUTH WALES PER 100 UNPREJUDICED MARRIAGES

Age of Wife	New South Wales, 1893-98	Victoria, 1897
Under 20 years	25.0	21.67
20-24 years	38.7	32.91
25-29 years	39.6	41.16
30-34 years	30.5	37.72
35-39 years	16.0	19.73
40-44 years	4.1	7.89

The fecundity in New South Wales reaches the maximum when the wife is 24.5 years of age, and in Victoria when she is 27.0 years. The more rapid development of the women in New South Wales is probably due to the warmer climate. The mean fecundity in New South Wales is when the women are 27 years old and in Victoria when they are 28.26 years of age.

When we consider the husbands in Victoria we find that the maximum fertility is reached when they are 32.41 years and the mean when they are 36.71 years of age. This is higher than is the case with the wives and shows that the maximum of fertility is reached at a later age for the men than the women.

These figures for Australia show that the opinion of

[1] Powys, A. O., "Data for the Problem of Evolution," Biometrika, Vol. I, 1901-2, pp. 30-34.

Körösi, that the younger the wife the greater the fecundity, does not hold for the Anglo-Saxon race. The woman reaches her greatest reproductive vigor between 24.5 and 27.0 years according to the climate, and the man at about 32 years. These are also the two ages of maximum physique for the race.

There seems to be no doubt as to the fact that when the parents marry at an early age the number of children is much greater than when marriage is deferred.

LIVING BIRTHS PER 100 MARRIAGES ACCORDING TO THE AGES OF THE PARENTS AT MARRIAGE IN BUDAPEST, 1897-1900[1]

Age of Mother	Age of Father Under 25	25-30	30-40	40-50	Over 50	Total
Under 20 ...	405.37	364.48	321.91	(351.16)	*	370.18
20-25	369.00	295.73	321.42	259.34	*	315.98
25-30	292.56	287.98	258.73	256.32	(155.26)	268.93
30-35	(251.35)	211.69	203.12	164.62	(98.11)	193.66
35-40	*	(129.78)	142.13	119.70	(103.78)	133.54
Over 40	*	*	42.06	54.84	26.82	43.32
Total	365.93	300.59	259.89	177.30	66.09	276.23

( )=less than 100 cases.
* =less than 25 cases.

From considering the columns of totals we see that the fecundity diminishes as the age of either parent increases. And not only this, but it is greater when both of the parents are young. Advancing age of the father affects the fecundity much less than when the mother was old at the time of marriage. When the mother was over 30 at marriage, the fecundity of marriage was greater when the father was nearly the same age than when he was much younger.

Up to this point the fecundity has been studied according to the ages of the parents. We now turn to note the effect of the duration of marriage upon this phenomenon. It stands to reason that in most cases the number of births per marriage will be greater when the marriage has lasted for a considerable length of time, than when it has been but recently consummated.

[1] Körösi, J., "Weitere Beiträge zur Statistik der ehelichen Fruchtbarkeit," Bull. de l'Instit. Internat. de Statistique, Tome XIII, Liv. III, 1893, p. 8.

NUMBER OF LIVING BIRTHS PER 100 FAMILIES ACCORDING TO THE DURATION OF THE MARRIAGE IN BUDAPEST, 1897-1900[1]

Duration of Marriage	Number of Births
Under 5 years	76.68
5-10 years	168.50
10-15 years	231.16
15-20 years	280.81
20-25 years	325.07
25-30 years	346.58
Over 30 years	409.30
Average	276.23

As the duration of marriage increases the number of children becomes greater. The increase in the size of family where the marriage has lasted for a long period is remarkable. Either there are many births very late in the married life, or the fecundity of marriage is decreasing. There are only a fourth as many births per 100 marriages in Paris or Copenhagen after the married life has lasted for 25 years, as is the case in Budapest.

France is troubled by the slow rate of increase of the population. It is not that the people do not marry young enough, or that a sufficiently large proportion does not marry. Only a small proportion of the marriages are sterile, but the fecundity after the first few years of marriage is extremely low. The number of births according to the duration of marriage in Paris is compared with that in Austria to see if it is possible to determine the period when the Austrian rate surpasses that of Paris to the greatest extent.

ANNUAL LIVING BIRTHS PER 100 MARRIAGES ACCORDING TO DURATION OF MARRIAGE[2]

Duration of Marriage	Number of Births Paris, 1901	Number of Births Austria, 1895-99	Ratio of Austrian to Parisian Rate
0-2 years	25.3	48.7	1.9
3-4 years	19.9	36.0	1.7
5-9 years	9.2	27.5	3.0
10-14 years	4.7	18.0	3.6
15-19 years	2.2	10.6	4.8
20 and over	0.28	2.2	6.8

[1] Körösi, J., *Op. cit.*, p. 6.

[2] March, L., "Familles parisiennes en 1901," Journ. de la Soc. de Statistique de Paris, Jan., 1904, p. 28.

The rate in Paris is the nearest to that of Austria during the third and fourth years of marriage. After this there is a steady increase in the ratio, showing that the probability of birth is much smaller after the first few years. The result of this is to make the average size of the family in France extremely small on account of the absence of large families. It is not lack of ability but of desire of the parents which keeps the birth-rate low.

The number of children born per family varies not only according to the duration of marriage but to the age of either parent at widowhood. When one parent dies the survivor is left with a family which varies, as a rule, according to the age at widowhood. There are not many figures upon this point, but the following tables for Budapest will suffice.

FECUNDITY OF MARRIAGE ACCORDING TO THE AGE OF WIDOWHOOD IN BUDAPEST, 1897-1900 [2]

Age of Mother at Widowhood	Number of Children to 100 Families
Under 20 years	52.00
20-25 years	99.32
25-30 years	165.84
30-35 years	228.40
35-40 years	272.96
40-45 years	298.89
Over 45 years	325.14
Unknown	256.13
Total	276.23

When the mother is left widow before her 25th year there has been less than one birth to the family. When the mother is ten years older the number of births is more than doubled, and when she is 45 the number is tripled. After that age the increase is naturally small.

When we consider the cases in which the father is widowed, the differences are not great and are entirely in degree.

[1] Körösi J., "Weitere Beiträge zur Statistik der ehelichen Fruchtbarkeit," Bull. de l'Instit. Internat. de Statistique, Tome XIII, Liv. III, 1903, p. 13.

FECUNDITY OF MARRIAGE ACCORDING TO THE AGE OF WIDOWHOOD IN BUDAPEST, 1897-1900 [1]

Age of Father at Widowhood	Number of Children to 100 Families
Under 25 years	(45.45)
25-30 years	104.03
30-40 years	194.32
40-50 years	273.82
50-60 years	309.94
Over 60	342.39
Unknown	271.98
Total	276.23

It is not until the father is 30 years old when widowed that there is a child per marriage. Between 30 and 40 the number doubles and from 50 to 60 becomes three times as great. These differences from the figures relating to the mother are caused in large part by the greater age of the father at marriage.

Bigenous tables comparing the fecundity of marriage by the duration of marriage and the age of the parents at marriage, and the duration of marriage and age of the parents at widowhood, have been published by J. Körösi, in Bulletin de l'Institut Internationale de Statistique, Tome XIII, Liv. III, 1903, pp. 1-20. They are too long to give in this connection, but in general we may say that the fecundity increases when the duration of marriage is long and the age of the parents at marriage young. In the same way it increases with duration of marriage and early age at widowhood.

From the study of the valuable material for Budapest which was accessible to Körösi, he has computed the ages at which men and women should marry in order to obtain the maximum natality.

1. The period of male life from which the women between 18 and 34 ought to choose husbands includes only five years.

2. The wives of all these ages have the greatest chance of becoming mothers with husbands between 25 and 30 years.

3. Consequently women under 28 ought to choose older

[1] Körösi, J., *Op. cit.*, p. 13.

husbands and those over 28 should select husbands younger than themselves.

1. The extent of the most suitable female period is sensibly longer, embracing for the male between 24 and 46 years, eleven instead of five years.

2. The husbands of these ages have the greatest chance of becoming fathers with wives between 18 and 29 years.

3. At all these ages, in order to have the greatest chance of offspring, the fathers ought to be older than the mothers.

Therefore, in order to obtain the greatest possible fecundity, the females ought to select in their younger years older husbands, and in advanced ages younger ones; but the males ought always to select younger wives.

As the age of the mother progresses, the age difference between the husband and wife ought to become less.

The age difference best fitted to obtain a maximum fecundity is as follows,

With mothers of 18 years the father should be 7 years older.[1]

With mothers of 20 years the father should be 5 years older.

With mothers of 25 years the father should be 3 years older.

With mothers of 30 years the father should be 2 years younger.

With mothers of 34 years the father should be 5 years younger.

As the age of the father increases his age advantage ought always to increase.

With fathers of 25 years the mother should be 6 years younger.

[1] Körösi, J., "An Estimate of the Degree of Legitimate Natality," Journ. Royal Statist. Soc., Dec., 1894, pp. 700-702.

In the same number of the Journ. Royal Statist. Soc., F. Galton illustrated the table of Körösi by means of an isogenic diagram. If A represents the father's age, B the mother's age, and C the percental birth-rate for a year, $A+B+C=93$. This will hold true if the mother is not older than the father, if she is not under 23, or over 40.

With fathers of 30 years the mother should be 9 years younger.

With fathers of 35 years the mother should be 14 years younger.

With fathers of 40 years the mother should be 16 years younger.

With fathers of 46 years the mother should be 17 years younger.

There is no great necessity in most countries at present that the couples should be so matched in years that the maximum of fecundity would be obtained, for the increase of population is sufficiently rapid. Dr. Ogle once computed for England how great would the reduction in the marriage-rate need to be in order to produce a stationary population. In 1888 the birth-rate was 30.5 and the death-rate 17.8. In order to have the population stationary the birth-rate must be reduced to the level of the death-rate. This could be accomplished either by the marriage of fewer women, or by their marriage at a later age, or by a combination of the two methods. If we assume that the illegitimate birth-rate will remain stationary at 1.4 per 1,000, the legitimate would need to be reduced to 16.4. There were at this time 4.2 births per marriage. The marriage-rate should therefore be $\frac{16.4}{4.2}=3.9$ per 1,000. This would give the number of couples, and to obtain the number of persons who should marry it is only necessary to multiply 3.9 by 2. The marriage-rate should, therefore, be 7.8, whereas it was actually 16.2 in 1888. But by deferring the age at marriage, the necessary reduction in the marriage-rate would not be great. If the marriages were postponed for five years, the fecundity would be reduced to 3.1. With this fecundity it would require a marriage-rate of 10.6 to give a birth-rate of 16.4. With an illegitimate rate of 1.4 and a legitimate rate of 16.4 we have a total of 17.8, or the same as the death-rate. "If one quarter of the women who now marry were to remain permanently celibate, and the remaining three quarters were to retard their marriages for four years, the birth-rate would be reduced to the level of the present death-rate."

Sterility. Couples which have been married but a short time should be excluded from a study of this phenomenon, but when the marriages have continued for 15 or 25 years without offspring they can be classed as sterile. In Paris in 1901 about 25 per cent. of the families had never had any births, but when we consider those which had lasted for 25 years, only 17 per cent. were sterile.

In 1885 only 11 per cent. of the marriages in Berlin which had continued for 25 years were sterile. In Oldenburg 9 per cent. of the marriages which had been dissolved by the death of one of the parties were sterile. Pearson thought that the sterility of those marriages in England which had lasted for 15 years was between 6 and 7 per cent.

The proportion of sterile marriages is affected by the age of the wife at marriage. When she is married at the age when the fecundity is the highest, the proportion of sterile marriages is low. We can compare the figures for Berlin and Norway upon this point.

PERCENTAGE OF TOTAL MARRIAGES WHICH ARE STERILE [1]

Age of Wife at Marriage	Berlin (1885)	Norway (1874-76)
15-20 years	5.7	2.8
20-25 years	7.5	3.9
25-30 years	10.4	5.8
30-35 years	16.6	9.7
35-40 years	28.8	16.3
40-45 years	63.3	26.3
45 years and over	85.9	73.3

In all groups the percentage of sterile marriages is greater in Berlin. In Norway, when the wife is under 35 at marriage, only about 5 per cent. of the marriages are sterile, but when she is 45 or over, nearly three fourths have no children.

In 1626 there was founded the House of Nobility in Sweden, and everyone who would be a member of the nobility

[1] March, L., "Familles parisiennes en 1901," Journ. de la Soc. de Statistique de Paris, Feb., 1904, p. 55.

must be registered in this House. There was, at the same time, provided for each family a special book in which the births, marriages and deaths which had occurred in the family must be recorded. 76.6 per cent. of the families which were registered in this way have since become extinct, and a study of those which are no longer in existence has been made.

In the following table the families have been grouped according to the number of generations which they endured.

PERCENTAGE OF MARRIAGES WHICH WERE STERILE AMONG THE EXTINCT FAMILIES OF SWEDEN [1]

	Number of Generations					
	I	II	III	IV	V	VI
Families of two generations	13.72	63.68				
" " three "	8.76	19.64	64.15			
" " four "	10.75	17.09	20.79	62.07		
" " five "	18.31	17.29	23.08	21.36	75.00	
" " six "	10.26	10.00	19.35	14.29	17.07	70.00

About two thirds of the marriages of the final generation were sterile in every case, but, with this exception, the proportion was about the same as is the case in Europe to-day.

It is necessary to distinguish between families in which there are no living children and those in which there have been no births.

FAMILIES WITHOUT LIVING CHILDREN ACCORDING TO THE DURATION OF MARRIAGE IN FRANCE IN 1896 [2]

Duration of Marriage	Percentage of Households With No Living Children
From 0 to 2 years	47.7
3 4	23.3
5 9	15.5
10 14	12.5
15 19	11.6
20 24	11.3
25 49	12.2
50 years and over	13.8

[1] Fahlbeck, P. E., "La noblesse de Suède," Bull. de l'Instit. Internat. de Statistique, Tome XII, Liv. I, 1900, p. 178.

[2] Bertillon, J., "Nombre d'enfants par familles," Journ. de la Soc. de Statistique de Paris, Apr., 1901, pp. 131-32.

The proportion of families without children decreases until the 25th year of married life, after which there is an increase. The reason for this is that the parents have reached such an advanced age that they can no longer expect children, while some have lost all the children they ever had. But from this we must not conclude that the sterility of marriage is greater for the couples which have been united for over 50 years, than for those between 25 and 50 years.

Duration of Marriage. The welfare of society demands that the marriages which are consummated shall last for a considerable number of years, that the children resulting from them may be reared with the guidance and care of both parents. When divorce is common, or the death-rate extremely high, it is probable that a large proportion of the marriages will be dissolved before the children have reached early manhood or womanhood, and are able to care for themselves. We frequently see a widow struggling to support and educate a number of young children, since the marriage is more likely to be dissolved by the death of the husband than of the wife. During the past century the duration of marriage has been considerably increased on account of the steady decrease in the death-rate.

It was found in Berlin in 1895-96 that, under present conditions, a marriage just celebrated stood an even chance to endure for 25 years. When this point is reached one-half of the surviving marriages should continue for 12½ more years. When the fiftieth anniversary is reached the chances are even that the couples will enjoy four more years of married life. Of those which reach the sixtieth anniversary one-half have at least two more years of married life before them.

Looking at the subject in a different way we may say that, out of 1,000 marriages, 500 will reach the twenty-fifth year; 333 the thirty-second; 100 the forty-fifth; and 34 the fiftieth year of married life.[1]

[1] Hirschberg, E., "Bilder aus der Berliner Statistik," Volkswirthschaftliche Zeitfragen, Heft 200, 1904, pp. 8-9.

The duration of marriage in Paris, 1882-86, is given in the following table:

DURATION OF THE MARRIAGES DISSOLVED BY THE DEATH OF EITHER PARTY IN PARIS, 1882-86[1]

In 1,000 Marriages Dissolved by Death There Have Lasted for	
1 year	35.6
2 years	31.6
3 years	30.3
4 years	31.6
5 years	32.6
6 to 7 years	57.4
8 to 10 years	82.4
11 to 15 years	124.2
16 to 20 years	115.6
21 years and over	459.1
Total	1,000.0

The duration was not quite as great as in Berlin, but it must be borne in mind that the figures relate to a period ten years earlier, and that the death-rate is continually decreasing. Many of the marriages in Paris had been celebrated early in the century so that a comparison between the two cities should not be attempted. About 30 per cent. of the marriages which were dissolved had not lasted more than 10 years, and more than half of them less than 20 years. The duration of marriage in the country districts is considerably greater than is the case in the large centers, for the age at marriage is lower in the country, and the death-rate is not so high as in the cities.

Dr. Farr computed the duration of marriage in England to be 27 years. When the marriage was dissolved by the death of the wife the widower lived for 9.44 years, and when the husband died first the widow survived his death for 11.31 years.

As a rule the average duration of married life is greater where the marriages are dissolved by the death of the husband, than is the case where the wife is the

[1] Bertillon, J., "Cours élementaire de statistique administrative," p. 487.

first to die. The dangers of parturition cause the deaths of many wives during the years immediately following marriage. This, together with the fact that more marriages are dissolved by the death of the husband than of the wife, is brought out clearly by the figures relating to Prussia.

DURATION OF MARRIAGE IN PRUSSIA IN 1902[1]

Duration of Marriage	Number of Marriages Dissolved By the Death of Husband	Wife
0 to 5 years	5,895	6,515
5 - 10 years	7,091	5,977
10 - 15 years	8,061	5,770
15 - 20 years	8,225	5,195
20 - 25 years	8,988	5,091
25 - 30 years	10,300	5,737
30 - 35 years	9,242	5,566
35 - 40 years	7,597	4,682
40 - 45 years	6,104	4,263
45 - 50 years	5,965	2,815
Over 50 years	2,764	2,160
Unknown	24,040	16,317
Total	102,272	70,008

Nearly 50 per cent. more marriages are dissolved by the death of the husband than of the wife. When the marriages have lasted less than five years more are dissolved by the death of the wife than of the husband, but, after this period, the deaths of the husbands are more numerous. This dissolution of so many more marriages by the death of the husband than of the wife is caused not only by the higher death-rate for males than for females of the same ages, but the fact that the age of the husband generally exceeds that of the wife. The deaths of the females are most numerous during the first five years, followed by a steady decrease at each quinquennial group until the end of the 25th year. With the males there are the most deaths between the 25th and 30th years, with a steady increase to this point followed by a regular decrease.

The duration of married life is generally greater for the

[1] Preussische Statistik No. 183, 1903, p. 21.

upper than for the lower classes of society. Their home surroundings are superior, they are better nourished, and their occupations are neither so dangerous nor unhealthy as those of the laborers. In the following table for Prussia the marriages which have been dissolved are not included, but the study is limited to those which still endure.

DURATION OF EXISTING MARRIAGES BY SOCIAL CLASSES IN PRUSSIA[1]

Number of Years Married	Higher Classes	Hand Workers	Clerks	Domestics	Laborers
Under 5 years	17.6%	22.2%	31.6%	30.1%	34.2%
5 to 9 years	17.4%	20.2%	19.8%	19.4%	23.7%
10 to 14 years	15.2%	16.4%	15.2%	14.6%	14.7%
15 to 24 years	25.5%	22.8%	18.7%	19.5%	18.3%
25 years and over .	24.3%	18.4%	14.7%	16.4%	9.1%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

When we consider the upper classes we find that about 50 per cent. of their marriages have lasted 15 years or over, while the hand-workers, who stand nearest to them, have but a trifle over 40 per cent. of these long-term marriages, and the laborers, at the foot of the list, less than 30 per cent. This is rendered still more remarkable when we consider that the age at marriage is generally greater for the upper than the lower classes.

We have a set of figures for Berlin, showing the number of years which marriage lasts according to the age of the wife and the number of children per marriage.

DURATION OF MARRIAGE IN BERLIN, 1885-86, ACCORDING TO THE AGE OF THE WIFE AT MARRIAGE AND THE NUMBER OF CHILDREN PER MARRIAGE[2]

Number of Children per Marriage	Age of Wife at Marriage Under 20	20-25	25-30	30-35	Over 30
Without children	26.42	21.45	20.32	18.30	15.15

[1] Seutemann, "Kindersterblichkeit sozialer Bevölkerungsgruppen insbesondere im preussischen Staate und seiner Provinzen," Tübingen, 1894. Noted in Pub. Amer. Statist. Assn., New Series Nos. 35-36, Sept., Dec., 1896, p. 41.

[2] Böckh, R., "Die statistische Messung der ehelichen Fruchtbarkeit," Bull. de l'Instit. Internat. de Statistique, Tome V, Liv. I, 1890, p. 185.

DURATION OF MARRIAGE IN BERLIN, 1885-86, ACCORDING TO THE AGE OF THE WIFE AT MARRIAGE AND THE NUMBER OF CHILDREN PER MARRIAGE

Number of Children per Marriage	Age of Wife at Marriage Under 20	20-25	25-30	30-35	Over 30
With 1 child	18.25	15.82	18.30	17.79	18.12
With 2 children	21.47	18.44	19.80	19.63	18.85
With 3 children	22.61	21.59	21.02	21.33	20.39
With 4 children	24.65	22.37	24.23	24.32	21.44
With 5 children	26.28	25.17	26.52	24.55	25.77
With 6 children	30.14	28.54	28.59	27.31	21.54
With 7 children	29.34	29.37	29.56	27.51	22.85
With 8 children	32.61	30.54	31.13	27.37	21.20
With 9 children	35.36	32.90	30.67	32.01	29.38
With 10 children	37.24	33.18	31.71	29.88	20.92
With eleven children and over	38.11	35.07	29.41	31.11	35.88
Total	27.93	24.81	23.48	20.21	17.57

When the wife was under 20 at marriage the duration of the marriage is somewhat over 10 years greater than when she was over 30. In all cases but one the duration of marriage was least when one child was born. This is probably due to the fact that many of these mothers died during parturition, and also that, when the marriage has proved fruitful, more than one child is born if the marriage endures. The fact that there was but one birth shows that the marriage was dissolved early. When no children were born some of the marriages were dissolved by the early death of one of the parties, but many, although sterile, endured for a long period. As a rule, the duration of marriage increased with the number of children born. It was about twice as great when eleven or more children were born as when there was but one birth. Some of the marriages where but one birth occurred may have lasted for a long time, but none of those with large families could have been dissolved early. The average in the latter case is therefore much greater. When we compare families of any size where the mother was under 20 at marriage with those of the same size in which she was from 30 to 35, we find no grave differences in the duration, and yet the difference, when all of the marriages are considered amounts to 7.7 years. The reason for this is that there is a greater proportion of large families where the mother was young than when she had passed her 30th year before marrying.

An interesting study has been made of the period which had elapsed since the marriage of those who were still married and of those widowed and divorced in Paris in 1901.

DURATION OF MARRIAGE IN PARIS IN 1901[1]

Percentage of Marriages of Different Duration in 100 Total Marriages

Period Elapsed Since Marriage	Total	Widowed & Divorced	Married Couples	Married Couples in France, 1896
0- 2 years	9.8	3.3	12.3	8.1
3- 4 years	7.5	3.6	9.0	8.3
5- 9 years	17.0	10.4	19.4	14.9
10-14 years	15.5	12.5	16.6	14.9
15-19 years	13.8	13.6	13.8	13.9
20-24 years	11.6	13.7	10.9	13.2
25-49 years	23.7	39.8	17.7	24.4
50 years and over	1.1	3.1	0.3	2.3
Total	100.0	100.0	100.0	100.0
Average duration	17.25	24.33	15.25	19.0

The average length of the period which had elapsed since the marriage of those who were at this time widowed or divorced was nearly 25 years, while for the married it was but 15 years. 40 per cent. of the married couples had been married less than 10 years, while but 17 per cent. of the widowed and divorced had been married so recently. The marriages of 43 per cent. of the widowed and divorced had been celebrated more than 25 years previous, while but 18 per cent. of the marriages which still endured were of such long duration. When we compare the married couples of Paris with those of France, we find that the proportion which have been married less than 15 years is larger in Paris. while the long-term marriages show a greater proportion outside the capital. This must be explained by the fact that the couples recently married come to Paris in large numbers, while those who are advanced in years go into the country, together with the influence of the high death-rate in Paris, which dissolves many marriages at an early date.

[1] March, L., "Familles parisiennes en 1901," Journ. de la Soc. de Statistique de Paris, Jan., 1904, p. 24.

Divorce. Although marriages are intended to endure as long as both parties to the contract are living, the courts have found it necessary to annul some of them for various reasons. There is no uniformity in the practice of different countries. Some grant a legal separation, which allows the parties to live separate, but forbids remarriage. Others grant a divorce by which one or both of the parties are allowed to remarry. In the United States divorces are generally granted by the courts, but, since the matter is left in the hands of the states, there is no uniformity in the different portions of the country. Some states in which the period required to obtain legal residence is short, and the grounds upon which a divorce is granted are numerous, have obtained an unenviable reputation in this respect. The attempt has been made to overcome this condition in some states by refusing to recognize a divorce granted in another state for grounds which would not have been judged sufficient in the state where the petitioner formerly lived, and where he really had his residence. Thus Utah, before 1878, had a law by which a divorce could be granted to a person who merely declared his intention to become a resident and gave incompatibility of temper as a ground. But several states have since declared such a decree null and void, and a person who took advantage of the decree to marry again to be guilty of bigamy. There is, however, in most states, little necessity for the resident to go to another state in order to obtain a decree, for, unless it is a question of alimony or the right to the children from the marriage, a large proportion of the cases are not contested, and a divorce follows.

Unfortunately there are but a few of the states in this country which publish statistics on divorce. It is, therefore, impossible to give any recent figures for the United States as a whole. In 1889 Hon. Carroll D. Wright published for the Department of Labor the result of a careful investigation on marriage and divorce in the United States from 1867 to 1886, including an appendix relating to marriage and divorce in certain countries in Europe. The portion which relates to marriage is "thoroughly incomplete and unsatisfactory," while that on divorce is very valuable and furnishes the basis for all the statistical studies which have been made upon this subject, in so far as they deal with the entire country. The year 1885 is therefore the latest date on which it is possible to compare the figures for the European countries and the United States.

NUMBER OF DIVORCES GRANTED IN 1885[1]

United States	23,472	Great Britain and Ireland	508
France	6,245	Roumania	541
Germany	6,161	Holland	339
Russia	1,789	Belgium	290
Austria	1,718	Sweden	229
Switzerland	920	Australia	100
Denmark	635	Norway	68
Italy	556	Canada	12

The number in the United States is greater than in all of the other countries combined, while Germany and France furnish more than half of the remainder.

But figures of this nature are unsatisfactory since they do not take into consideration the size of the countries, and what we need is a ratio of the number of divorces to a certain number of population, or, better still, to a certain number of marriages. The latter method is preferable to the former since a country might have an unusually large proportion of single persons who should not be included in a study of the frequency of divorce, and the rate be made to appear lower than was really the case. In the following table this difficulty has been eliminated:

FREQUENCY OF DIVORCE IN EUROPE[2]

	Divorces per 1,000 Marriages
Germany (1889-93)	17.

[1] Willcox, W. F., "The Divorce Problem," Columbia College Studies in History, Economics and Public Law, Vol. I, No. I, N. Y., 1891, p. 12.

[2] Yvernes, E., "Essai d'une statistique internationale des divorces et des separations de corps," Bull. de l'Instit. Internat. de Statistique, Tome XI, Liv. I, 1899, p. 57.

FREQUENCY OF DIVORCE IN EUROPE

	Divorces per 1,000 Marriages
England (1890-94)	1.6
Austria (1890-94)	a 4.8
Bavaria (1890-94)	b 14.
Belgium (1891-95)	11.
Denmark (1875-84)	13.
France (1890-94)	21.0
Italy (1890-94)	c 2.8
Holland (1891-95)	12.
Prussia (1891-95)	d 18.
Sweden (1890-94)	10.6
Switzerland (1891-95)	40.

a=divorces+judicial separations.
b=requests for divorce.
c=judicial separations.
d=divorce cases brought to trial.

The rate for England is very low, but it must be borne in mind that divorce can be obtained only for adultery, and demands, when the husband is at fault, that it be accompanied with bigamy, incest, rape, or other vice contrary to nature. In Italy, where the rate is also very low, a judicial separation may be obtained on several grounds, but remarriage is forbidden. The population of the country is largely Catholic and the church is opposed to divorce. As a rule, divorce is more common where a large proportion of the population is Protestant. Switzerland has a rate about twice as high as any other European country. It must be borne in mind that divorce does not measure the amount of domestic infelicity, but the amount of legal remedy offered by the courts. The proportion of unhappy marriages cannot be twenty times as great in Switzerland as in England.

In this country it is usual for the official reports of the various states to represent the frequency of divorce by the number of marriages to one divorce. The criticism on this method is that as the frequency of the phenomenon increases the size of the number by which it is represented decreases. Since it is the method commonly employed in the United States, it may be best to introduce it in this table.

FREQUENCY OF DIVORCE IN THE UNITED STATES IN 1902[1]

State	Number of Marriages to One Divorce
New Hampshire (1901)	8.3
Vermont	10.0
Maine	6.0
Rhode Island	8.4
Connecticut (1901)	13.9
Ohio	8.8
Indiana	7.6
Michigan (1900)	11.0

From these figures the high rate of divorce in this country is made apparent. When there are only about ten times as many marriages as divorces in a country in a year, the problem of the preservation of the home becomes serious. Switzerland had the highest rate of any European country, and yet, from 1891 to 1895, inclusive, there was but one divorce to 25 marriages, and in Belgium, in 1900, one to 83 marriages.

Divorce is a problem not simply in social statics but in social dynamics as well. We wish to know not simply whether divorces are more frequent in one country or state than in another, but whether they are on the increase or decrease. If the worst has been passed there is reason for hopefulness as to the future. It is impossible, on account of the lack of reliable statistics, to trace the changes in many of the American states, but for New England this can be done.

CHANGES IN THE RATE OF DIVORCE IN THE NEW ENGLAND STATES[2]

Year	Number of Marriages to One Divorce				
	Rhode Island	Maine	New Hampshire	Vermont	Massachusetts	Connecticut
1880	10.1		7.7	20.0	26.8	13.9
1885	11.0		10.9	28.8	26.4	13.3
1890	13.0		9.5	18.3	31.8	13.2
1895	9.4	8.4	9.9	9.7	24.2	15.9
1900	8.5	6.8	9.3	13.2	19.3	15.5

[1] Dike, S. W., "The National League for the Protection of the Family," Annual Report for 1903, pp. 9-11.

[2] Forty-ninth Registration Rept., Rhode Island, 1901, p. 162.

From 1850 to 1900 there has been, in every case but one, an increase in the rate of divorce, but from 1890 to 1900 the increase has not been rapid, and there is good basis for the hope that we have seen the worst in this respect. Public opinion is becoming aroused, and the various religious denominations are bringing their influence to bear, in order that the remarriages of divorced persons may cease.

This increase in the rate is not confined to the United States. The figures for Belgium show an increase that has not been equalled in this country.

CHANGES IN THE RATE OF DIVORCE IN BELGIUM [1]

Year	Number of Marriages to One Divorce
1840	1,175
1865	739
1880	182
1890	130
1900	83

In England there seems to be an increase, while in France and Switzerland there is little change. In Germany, since the new law of 1900 went into effect there has been a decrease.

Unfortunately we have no statistics more recent than the Report of the Commissioner of Labor in 1889 as to the frequency of divorce in the different portions of this country. From a careful study of this Report, Prof. W. F. Willcox reached the conclusion that the rate was highest in the Western division of the country, lowest in the Eastern, while the Central stood about midway between the two.[2] About 1870 the rates in the Southern States were quite uniform, while those in the Northern States were much alike. Since then the North and South Atlantic States have been coming more nearly alike, while the rates in the North and South Central States have been approaching. The distinctions are now not so much between North and South as between East and West. Prof. Willcox offers the following

[1] Annuaire statistique de Belgique, Tome XXXII, 1901, p. 20.

[2] Willcox, W. F., "The Divorce Problem," pp. 37-40.

solution for this change: "All over the civilized world we find two great currents of migration in progress, one from the rural districts to the cities and the other from long settled districts to newly opened territory. Now it is a general fact that the divorce rate is higher where either one of these currents stops, than at its source. Each of these two streams of migration seems to involve a process of natural selection whereby the most energetic and self-reliant, and also the most discontented, dissatisfied and even criminal classes are sifted out and drawn off to new homes."[1]

When we consider the question of divorce in urban and rural districts in the United States, we find that in about 95 per cent. of the cases the rate is higher in the counties in which large cities are situated, than in the counties where the population is principally rural. The same difference is to be found in Europe, and as a rule, a larger proportion of the population is reported as divorced in the cities than in the rural districts. This is brought out clearly by the figures for France.

NUMBER OF DIVORCED PERSONS PER 10,000 POPULATION IN FRANCE[2]

Year	France	Department of the Seine	Urban	Rural
1885	2.20	9.4	3.8	0.70
1890	3.00	10.4	4.4	1.30
1895	3.50	10.8	5.0	1.72
1900	3.68	9.3	5.3	2.02

The reason for this difference lies in the fact that the ambitious and discontented classes gravitate toward the cities, and that life in a large center demands a greater nervous tension than in a village community. The age at marriage is higher in the city than in the country and, as a rule, the proportion of divorces is greater among those who marry late, than those who marry early in life. Al-

[1] Willcox, W. F., "A Study in Vital Statistics," Polit. Science Quart., 1893, Vol. VIII, pp. 95-96.

[2] Statistique générale de la France, Paris, 1901. Noted in U. S. Senate Document No. 12, Fifty-eighth Congress, p. 35.

though it is commonly asserted that if a couple marries early, proper discretion is not exercised in the choice of a mate, the fact remains that their individual peculiarities seem less aggressive, and they are more likely to live together until the marriage is dissolved by death. If the proportion of Catholics to Protestants were not so much greater in the cities of the United States than in the rural districts it is likely that the unfortunate preëminence of the cities in the matter of divorce would be even greater.

Where it has been possible to draw any conclusions from carefully collected statistics, it appears that divorce is more common among Protestants than Catholics. The impossibility of remarriage within the church doubtless deters many, but there is a difference in the philosophy of marriage. To the Catholic it constitutes an ideal state, which, once entered into, should never be abandoned. To the most radical Protestant marriage is celebrated in order to increase the happiness of the contracting parties, and, as soon as it fails to do this, becomes no longer a holy but an unholy union. Between these two extremes are ranged the various denominations, recognizing the necessity of separation for one or more causes. At present the contest wages principally over the question of remarriage.

The idea seems quite common that the rate of divorce is much higher among the blacks than the whites in the United States. In fact the Report of the Commissioner of Labor said that "it is probably true that in nearly all the states named in this immediately preceding table, where the colored population is very dense, nearly if not quite three-fourths of the divorces granted were to colored people."[1] This was on the supposition that the returns were incomplete. Prof. Willcox, however, from a careful comparison of the counties in which the blacks are very numerous with those in which they constitute but a small proportion

[1] The States mentioned in the table are Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Texas, and Virginia. Report of the Comm. of Labor, 1889, p. 132.

of the population, reaches the conclusion that "the average negro rate is rather below that of the Southern whites, but is increasing much more rapidly than the other, and in a few localities or states may have already reached or passed it."[1]

It seems that the rate is lower among the foreign than the native born, but differences in religious confession may account for this in large measure.

It is interesting to know how long the couples have lived together before the granting of the divorce. Taking the total number of divorces in the United States from 1867 to 1886, inclusive, the average duration of married life was 9.17 years. When the divorce was granted to the husband it was 8.97 years, and when to the wife it was 9.27 years. The period which elapsed between the actual separation of the parties and the granting of the divorce was about three years. Therefore the actual amount of time which the couples lived together was but a trifle over six years. More divorces are granted during the fourth year after marriage than during any other single year. Nearly 8 per cent. are granted to those who have been married twenty-one years or over. The duration of the marriage before divorce varies according to the cause for which the decree is granted.

DURATION OF MARRIAGE BEFORE DIVORCE IN THE UNITED STATES, 1867-1886[2]

Cause	Average Duration in Years When Divorce Was Granted to		
	Husband	Wife	Total
Adultery	7.84	9.51	8.58
Cruelty	9.75	9.25	9.31
Drunkenness	10.92	10.97	10.96
Desertion	9.80	9.14	9.41
Neglect to provide		8.67	8.67
Combination of causes	8.72	9.35	9.23
Total	8.97	9.27	9.17

The number of divorces granted for adultery is most

[1] Willcox, W. F., "The Divorce Problem," p. 32.

[2] Report of the Comm. of Labor, 1889, p. 182.

numerous during the third year after marriage, while for drunkenness the number granted during each year from the fourth to the eighth inclusive is more numerous than during the third year.

The causes for which divorces have been granted in this country are as follows:

DIVORCES IN THE UNITED STATES, 1867-1886, BY CLASSIFIED CAUSES[1]

	To Husband	To Wife	Total
Adultery	58,184	29,502	67,686
Cruelty	6,122	45,473	51,595
Desertion	51,485	75,191	126,676
Drunkenness	1,434	12,432	13,866
Neglect to provide		7,955	7,955
Combination of above causes	7,426	32,419	39,845
All others	7,889	13,204	21,093
Total	112,540	216,176	328,716

If we exclude all those cases in which it was judged that the marriage was illegal and include only the proper divorces for known cause, we have the following percentages:

Desertion	40.15%
Adultery	21.45%
Cruelty	16.35%
Drunkenness	4.40%
Neglect to provide	2.52%
Imprisonment	0.87%
All others	14.26%
Total	100.00%

The only cause for which more divorces were granted to the husband than to the wife was adultery. For desertion the ratio was near 1½ to the wife to 1 to the husband; for cruelty 7.4 to 1; and for drunkenness 8.6 to 1. Naturally, under neglect to provide, the wife only can be the libellant.

Statistics are lacking for a study of the age of the parties at the time of the granting of the divorce in the United

[1] Report of the Commissioner of Labor, 1889, pp. 169-170.

States. There are, however, figures upon this point for some of the European countries.

AGE OF PERSONS AT TIME OF DIVORCE IN SWITZERLAND, 1886-1890 [1]

Age	Husband	Wife
Under 30 years	19%	29%
30-39 years	38%	36%
40-49 years	26%	24%
50-59 years	13%	9%
60 years and over	4%	2%
Total	100%	100%

For both husband and wife the maximum falls between 30 and 39 years. The divorces granted to wives under 30 are more numerous than to husbands of the same group, but for all ages above this the proportion for the husbands exceeds that for the wives. This is due to the fact that the males are older than the females at marriage.

The figures relating to Belgium differ but little from those for Switzerland.

AGE OF PERSONS AT TIME OF DIVORCE IN BELGIUM, 1891-1900 [2]

Age	Husband	Wife
18-20 years	0.21%	0.63%
21-24 years	1.67%	5.64%
25-29 years	11.93%	17.99%
30-34 years	23.01%	24.90%
35-49 years	51.88%	42.68%
50 years and over	11.30%	8.16%
Total	100.00%	100.00%

The proportion of persons who, at the time the decree was handed down, were under 30, is not so great in Belgium. Until the 34th year the proportion for wives is greater than for husbands. Slightly more than a half of the wives, and 63 per cent. of the husbands were 35 or over.

[1] Yvernes, E., "Essai d'une statistique internationale des divorces et des separations de corps," Bull. de l'Instit. Internat. de Statistique, Tome XI, Liv. I, 1899, p. 56.

[2] Annuaire statistique de Belgique, Tome XXXII, 1901, p. 113.

There is a difference in the age classification in Austria between those who were divorced and those to whom judicial separations were granted. In the following table the ages do not refer to the time at which the divorce was granted, but the time at which the request was made. This is certainly somewhat earlier, but the period by which the petition antedates the decree is not given.

AGE OF PERSONS AT PETITION FOR DIVORCE IN AUSTRIA, 1890-94[1]

	Divorces		Judicial Separations	
Ages	Husband	Wife	Husband	Wife
Under 20 years	..	3%	..	2%
20-30 years	24%	50%	16%	31%
31-40 years	46%	35%	43%	28%
41-50 years	21%	11%	28%	20%
51-60 years	7%	1%	10%	7%
61 years and over	2%	..	3%	2%
Total	100%	100%	100%	100%

A fourth of the husbands and a half of the wives who petitioned for divorce were under 30. This is a greater proportion at this early age than in either of the other countries noted. The age classification for those who petitioned for judicial separation is very similar to those who obtained divorces in the other cases.

Catholics in Austria can obtain only a judicial separation. If we assume that the same period elapsed between marriage and divorce for both Protestants and Catholics we are forced to the conclusion that the Catholics marry at a later age. This is not probable. The alternative is that the duration of marriage before separation is greater for Catholics than Protestants. This is undoubtedly true, and due in large measure to the influence of the church.

The presence of children usually acts as a deterrent to divorce. The parents are willing to endure much, rather than have their children share the disgrace of a separation. Then too, neither parent wishes to be deprived of the privi-

[1] Yvernes, E., *Op. cit.*, p. 48.

lege of caring for them, and the love which both parents feel for their offspring serves as a bond of union.

The solution of the divorce problem will prove extremely difficult. It is felt in many quarters that the law is too lax upon this subject, since the attainment of a decree in most states is a very simple matter when the case is not contested. Many remedies have been proposed. Some argue that marriage is made too easy, and is, therefore, hastily entered into. But experience has shown that where legal restrictions are placed upon marriage, the rate of illegitimacy is increased. It seems, however, unjust to oblige two persons to live together when they are no longer a source of happiness to each other, and when, in many cases, all respect and affection have been turned into disgust. Under such circumstances it would seem that a separation was almost imperative. The question resolves itself largely into one as to the number of causes for which divorce shall be granted, and whether remarriage shall be permitted. If this is forbidden there is the possibility of vice, but, at the same time, some divorces would undoubtedly be avoided. All attempts to settle this problem by legislation will prove futile, for it is but lopping off a branch here and there, instead of striking at the root of the matter. Whenever in the world's history the sacredness of the family has declined, divorce or indifference has flourished. The fact that marriage is a holy union and not a social convenience should first be impressed upon the mass of the people. Then attempts to make the home surroundings better by means of model tenements, to decrease the abuse of liquor, to make it possible, by means of parks and playgrounds, to rear a family of healthy children, will work for the reduction of divorce.

CHAPTER V

DEATH

From one who is interested in the problems connected with the growth and happiness of society, there is nothing which more deserves study than the statistics of mortality. The natural increase of population is dependent upon the excess of births over deaths. Although the birth-rate gives a good measure of the vitality of a population, it is not to be compared to a death-rate as an index of physical prosperity. An excessive death-rate may be counterbalanced by a high birth-rate, but this wasteful method of recruiting the numbers will not offset the misery due to the needless loss of life. Even if the population of a country is increasing, it is not a matter of indifference that a large proportion of the children born does not survive infancy, and that pestilences now and then sweep over the country, destroying young and old alike. We are now accustomed to look upon the death-rate as one of the principal measures of civilization. We no longer consider it a melancholy but unavoidable circumstance that life in cities is short. We realize that unsanitary conditions, lack of sufficient air and light, and improper food are, to a great extent, responsible for the excessive death-rate and impoverished constitution of the urban population, and, where we find medieval conditions prevailing, we look upon them not as a misfortune simply, but as the result of criminal neglect and ignorance.

The study of death-rates is interesting, not solely as an index of the healthfulness of a community, for the knowledge of the success which has already attended man's efforts in nearly eliminating some preventable diseases gives us hope for the future. The connection existing between the death-rate and the various related factors, such as density of population, age distribution, occupation, climate, and physical or social environment, is worthy of careful study. When we consider that the science of life insurance rests upon the probability of death, we get an idea of the immense practical value of this branch of vital statistics.

Death-Rates. The crude death-rate is the number of deaths per annum per 1,000 of the total population. Thus, if a city with a population of 110,000 had 2,200 deaths during a year, the death-rate would be $\frac{2{,}200 \times 1{,}000}{110{,}000} = 20$.

The crude death-rates for the principal European countries are as follows:

ANNUAL NUMBER OF DEATHS PER 1,000 TOTAL POPULATION[1]

	1875-99	1900
Hungary	32.7	26.9
Spain (1888-99)	30.4	29.4
Austria	28.8	25.4
Italy	26.7	23.7
Germany	24.4	22.1
France	22.0	21.9
Switzerland	20.8	19.3
Belgium	20.3	19.3
Scotland	19.4	18.5
England and Wales	19.3	18.2
United Kingdom	19.1	18.4
Denmark	18.5	16.9
Ireland	18.1	19.6
Sweden	17.1	16.8
Norway	16.7	15.8

The differences shown by this table are very great when we consider that the rate for Hungary is nearly twice as great as that for Norway. As a rule, the Northern countries, Denmark, Norway and Sweden, seem to have the lowest rate: the Southern countries, including Spain and Italy, the highest; while the countries lying between these extremes, Ger-

[1] Sixty-third Annual Rept. of the Registrar General of England, 1900, p. 123.

many, France, Belgium, and the United Kingdom, have rates which are neither as low as the first nor as high as the second group. The case of Hungary is peculiar, and due, to a large degree, to the high birth-rate, which furnishes a large proportion of children, among whom the mortality is always large.

It is impossible to introduce, for purposes of comparison, the statistics for the United States, since the records for a large portion of the country are altogether lacking or too poorly kept to be trustworthy. The best that can be done is to give the figures for the registration area.[1] The death-rate for this area in 1890 was 19.6 and, in 1900, 17.8. The rate is, therefore, about the same as in the European countries with the lowest mortality. We shall see later, when the effect of the age distribution upon the death-rate is considered, that it is not safe to conclude from the crude death-rate that conditions in the United States are much better than in Europe.

The death-rates in the registration states follow.

DEATHS PER 1,000 POPULATION IN THE UNITED STATES[2]

	1890	1900
Connecticut	18.6	17.0
District of Columbia	23.7	22.8
Maine		17.5
Massachusetts	19.3	17.7
Michigan		13.9
New Hampshire	18.2	18.0
New Jersey	19.7	17.4
New York	19.6	17.9
Rhode Island	20.9	19.1
Vermont	17.0	15.8

The differences in rate are not great for the states here given. The high rate in the District of Columbia is due to

[1] This includes Connecticut, Maine, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Rhode Island, Vermont and the District of Columbia, together with 153 cities of 8,000 population or over. In this way about 38 per cent. of the entire population of the United States is included.

[2] Twelfth Census of the United States, 1902, Vol. III, p. 64.

the fact that the population is almost entirely urban, and to the presence of a large proportion of negroes, among whom the rate of mortality is high. If we assume that the records for Michigan are complete, the low rate must be attributed to the large rural population, and the high proportion in the the middle age groups, where the mortality is low.

The principal utility of the crude death-rate is for comparison of the changes in the mortality of one country, rather than of conditions in different countries. The age distribution of a population does not change rapidly, but that of different countries is by no means similar. Thus one country from which there is a large migration may have a comparatively small proportion in the middle age groups, but a large one in the young and advanced ages. A newly settled country, on the contrary, will have the middle age groups well represented, but a small proportion of very young and very old. Between 5 and 55 years of age the death-rate is generally lower than the total death-rate, while below and above this period it is higher. Therefore it is but natural that the rate in a new country is low. The question is whether this is due simply to an environment which is conducive to a high degree of healthfulness or to the age distribution of the population. Thus the death-rate for certain ages may be exactly the same in two cities, but, on account of differences in the age distribution. the total death-rates may vary.

Suppose two cities A and B have exactly the same rate for the same ages. Under 10 years the rate is 100 per 1,000, and over 10 years it is 10 per 1,000. In A the population is composed of 100 under 10 years and 900 over this age, while in B there are 150 under 10 years, and 850 over it.

In A there will be from the 100 children	10 deaths
and from the 900 over 10 years	9 deaths

The total number of deaths in A will be 19 in every 1,000 of the population, or a crude death-rate of 19.

In B there will be from the 150 children	15 deaths
and from the 850 over 10 years	8.5 deaths.

The total number of deaths in B will be 23.5 in every 1,000 of the population or a crude death-rate of 23.5.

The death-rate in B is thus 4.5 per 1,000 higher than in A, and yet the healthfulness of the two cities is exactly the same, and the apparent difference is caused by the presence of a greater proportion of children in B.[1]

It is, therefore, apparent that the crude death-rate does not furnish a satisfactory standard for the comparison of mortality in different countries. Some scheme must be devised by which the errors due to differences in age distribution may be eliminated. This has been done by the adoption of a standard population, to which all countries shall be compared. If the death-rates for certain ages were computed for different countries, it would be possible to compare them age by age, but what is desired is one figure which shall determine the relative healthfulness. If in one country in certain age groups the death-rate was high, but in others it was low, the resultant would be doubtful. We wish to compare the death-rates which would result if the age distribution of the countries was the same. To do this we must adopt a standard population for purposes of comparison. Thus we may select any one of the countries, under consideration as the standard, or some different country may be selected, and the others referred to this one. When the age classification has been decided upon, and some one country has been selected as the standard, the next step is to compute the mortality coefficient for each age group of the different populations to be compared. We then multiply the number of persons in each age group of the standard population by the mortality coefficient of the different populations. The sum of these products will give the death-rate on a standard of population for each one of the various ethnic groups under consideration.

Dr. Ogle used twelve groups of 5 years each, and also made allowances for difference of sex as well as of age distribution, but Dr. Körösi, after considerable experimentation, found that he could reach very similar results by using but four age groups, and the saving in labor was very great. The groups which he finally adopted were 0-1 years,

[1] Newsholme, A., "Elements of Vital Statistics," London, 1899, p. 105.

1-20, 20-50 and over 50 years. This method of determining the death-rate according to a standard population may be made more intelligible by a concrete example.

In this case the age distribution of Sweden is selected as the standard, and a calculation is made as to what the death-rate of Austria would be if its age distribution was the same as that of Sweden.

DEATH-RATE OF AUSTRIA WITH THE POPULATION OF SWEDEN AS STANDARD[1]

Age Groups	Age Classification of the Population of Sweden	Mortality Coefficients in Austria	Deaths in Austria per 1,000 Persons of Standard Population
0- 1 years	2.65%	30.67%	8.13
1-20 years	39.81%	1.90%	7.56
20-50 years	38.62%	1.20%	4.63
Over 50 years	18.92%	5.39%	10.20
Total	100.00%		30.52

2.65 per cent. of the population of Sweden are under 1 year of age. There are 306.7 deaths in Austria per 1,000 at this age. Therefore, if there were 2.65 per cent. of the population under one year, the number of deaths of infants per 1,000 of total population would be $306.7 \times .0265 = 8.13$. In the same way we compute the rate for each age group, and the sum of the products will be 30.52. We have, therefore a death-rate which can be directly compared with that of Sweden, or with any other country where the age distribution of the population of Sweden has been taken as the standard.

At a meeting of the International Institute of Statistics in Vienna in 1891 Dr. Ogle clearly showed that a difference in age distribution could appreciably affect death-rates. With this end in view he found the sex and age distribution per 10,000 total population of seven European countries. He then applied to each group in the different countries the death-rate which prevailed in England, and found out how

[1] Körösi, J., "Ueber die Berechnung eines internationalen Sterblichkeitsmasses," Bulletin de l'Instit. Internat. de Statistique, Tome VIII, Liv. I, 1895, p. 147.

great were the differences in the total rates of the countries, caused by the variations in the distribution of the population.

The death-rates computed in this way were as follows:

Austria (1880)	18.82 per 1,000 of total population
England and Wales (1881)	18.88
Germany (1880)	19.21
Italy (1881)	19.33
Switzerland (1880)	19.38
Holland (1879)	20.18
France (1881)	21.31

The figures mean that the composition of the population of Austria and England was such that a low death-rate might be expected, while in Holland and France conditions were such that, aside from all considerations of healthfulness, a high death-rate would be probable.

In commenting upon these figures Dr. Ogle said: "Were these death-rates put before the general public, they would scarcely escape falling into serious error, for they would almost certainly ascribe to difference of healthfulness differences merely due to the different composition of the population in regard to age and sex."

In a similar way it is possible to tell how much of the difference in the death-rates of cities is due to conditions of healthfulness. Mr. C. E. Burnap has computed this for certain cities in Masachusetts.

CORRECTED DEATH-RATES IN MASSACHUSETTS CITIES IN 1885[1]

	Standard Death-Rate	Factors for Correction for Age Classification	Recorded Death-Rate	Corrected Death-Rate
Boston	18.32	1.0551	24.61	25.96
Worcester	19.34	0.999	19.40	19.38
Lowell	17.94	1.0774	20.73	22.33
Cambridge	17.98	1.0750	20.99	21.56
Fall River	18.10	1.0699	22.51	24.08

[1] Burnap, C. E., "Mortality in Twenty-three Massachusetts Cities," Pub. Amer. Statist. Assn., New Series No. 34, June, 1896, p. 78.

The first requisite was a standard death-rate for the cities. To obtain this he took the average death-rate for 20 years of the different age groups of the population of the State. These rates were then applied to the various age groups of the city populations, and in this way the standard death-rate for each city was obtained. The standard death-rate for Boston, 18.32, bears the same ratio to the death-rate for the State, 19.32, as does 1 to 1.0551. This latter figure then becomes the factor for correction for age classification in future years when the crude death-rate for the cities is given. The death-rate for Boston in 1885 is given in the State Report as 24.61. But we have seen that the age distribution of Boston is favorable to a low death-rate. If the composition of this city had been the same as that of the state in which it is situated the rate would have been 25.96. In this way we can detect the influence of city life upon the health of the urban population. From the recorded rate the mortality in Cambridge appears higher than in Lowell, but when the correction has been made, conditions are seen to be better in Cambridge. Before we attempt to compare the total death-rates for different communities these corrections for differences in age distribution should be made.

It is possible to estimate from the number of deaths which occur during a short period what would be the annual death-rate in case the number of deaths did not change during succeeding periods of equal length. Many large cities publish every week or month the number of deaths which has occurred. Let us suppose that in a city of 108,027 there were 41 deaths during a certain week. If we assume that there are 52 weeks to the year, we might multiply 41 by 52, take 2,080 as the probable number of deaths for the year, and work out the weekly rate on this basis. But if we are desirous of greater accuracy we shall find that there are 52.17747 weeks to the year. We might then substitute the more correct number for 52 and proceed as before. But the objection to this method is that we should have to multiply the number of births for every week by this rather unwieldy number before we could compute our rate. It is far simpler to divide the population by 52.17747. This will need to be done but once, and the quotient will then serve throughout the year as the weekly population of the city. $108{,}127 \div 52.17747 = 2{,}072$. If there were 41 deaths during the week the annual death-rate for the year becomes $\dfrac{41 \times 1{,}000}{2{,}072} = 19.8$. If, during the following week there are 50 deaths we have but to substitute 50 for 41 in the final operation.[1]

Death by Sex. It is an almost invariable rule that the death-rate for males exceeds that for females. This is due, in large part, to the greater unhealthfulness of the occupations of the males. They are more exposed to death by accident, and to the harmful dusts or poisons of the mine or workshop. At the same time the use of intoxicants, and excesses of various kinds weaken the constitution and render the male less able than the female to resist disease. This excess of male deaths is shown by the figures for Massachusetts.

DEATHS PER 1,000 OF EACH SEX IN MASSACHUSETTS[2]

	Males	Females		Males	Females
1860	19.3	18.4	1885	20.2	19.0
1865	21.7	19.6	1890	20.0	18.9
1870	19.5	18.6	1895	19.9	18.2
1875	21.8	20.5	1900	18.9	17.5
1880	20.3	19.3			

There is not a year in which the rate for males did not exceed that for females, and, with the exception of 1865, when the effect of the mortality from the Civil War was felt, the excess in the rate for males has been quite uniform.

In some cases a comparison has been made between the absolute number of male and female deaths in a country,

[1] Newsholme, A., "The Elements of Vital Statistics," London, 1899, pp. 85-87.

[2] Sixtieth Rept. of Births, Marriages and Deaths in Massachusetts, 1902, p. 194.

but this is misleading and liable to error. The proportion between the sexes varies in different countries, and where the greater number is exposed to disease we should expect to find more deaths. Thus 72.1 per cent. of the population of Alaska in 1900 were males, and there might have been three times as many deaths of males as of females within its boundaries before the death-rate of the former exceeded that of the latter. If we had not known the proportion between the sexes, and had learned that the deaths of males were twice as numerous as those of females we should have concluded, erroneously, that the mortality among the males was much higher than among the females. It is, therefore, to be preferred, in every case, that the number of deaths per 1,000 of each sex be used for purposes of comparison.

Throughout the registration area of the United States the death-rate for males is higher than for females.

NUMBER OF DEATHS PER 1,000 OF EACH SEX IN THE REGISTRATION STATES[1]

	Males	Females
Total population (1890)	20.4	18.5
Total population (1900)	18.1	16.5
White population (1890)	20.2	18.3
White population (1900)	18.0	16.3
Colored population (1890)	28.9	26.1
Colored population (1900)	25.9	24.7

Here, as in the previous table, the excess in the rate for males is considerable. Since the difference is, to a great extent, to be attributed to the differences in occupation, it would be expected that in those countries where the labor of the women is more nearly like that of the men the death-rates of the sexes would be more nearly alike. This we find to be the case. Thus in Italy and Ireland the death-rate of the females is about 95 per cent. that of the males, while in England it is less than 90 per cent. that of the males. This is also supported by the fact that where women and men do similar work in factories the healthfulness of the sexes is very nearly equal.

[1] Bureau of the Census, Bulletin 15, Washington, 1904, p. 9.

Death by Age. There are more deaths per 1,000 of children during the first year of life than during any other year. The probability of death decreases until about the tenth year, when it reaches the minimum. From this point there is an increasing probability of death during the year as the person advances in age. This does not mean that there are more deaths annually of persons between 89 and 90 than there are of those between 9 and 10, for those between 89 and 90 who are exposed to the risk of death are by no means numerous. It simply means that if 1,000 should enter the 9th year and an equal number the 89th year, there would be a larger number to reach the 10th than the 90th year. It is, therefore, better, in studying the mortality at different ages, to compare the number of deaths between certain ages with 1,000 of population at the same ages, than the number of deaths between certain ages to 1,000 of the total population, or to compare the number of deaths in certain age groups to the total number of deaths. If we wish to compare the mortality of those between 25 and 35 in some city in 1890 with that in 1900, we should take the rate per 1,000 of population between 25 and 35, rather than the rate per 1,000 of total population, for it might be that in the interim there had been a large immigration of persons in these early years, so that these ages were particularly heavily represented. The result by the second method might be higher than the age distribution of the population would warrant. It is almost invariably the case that where there is a high birth-rate and a large proportion of infants, the death-rate is higher than in a country with a low birth-rate, and comparatively small number of children, but we must not infer from the crude rate that the healthfulness of the former population was low. It would be necessary to compare the rates by ages or by means of a standard population before we could reach an accurate conclusion.

DEATHS PER 1,000 POPULATION AT CERTAIN AGES IN THE REGISTRATION AREA[1]

	1890	1900
All Ages	19.5	17.3
Under 5 years	64.5	49.9
5-14 years	5.3	3.8
15-44 years	9.4	7.9
45-64 years	21.3	20.3
65 years and over	76.6	82.8

As a rule the death-rate is lower than the total death-rate between the years 5 and 55, while it increases rapidly above and below these extremes.

It is interesting to note the distribution of deaths in a country where there is a low birth-rate and consequently small proportion exposed to the dangers of infant mortality, and in a country with a high birth-rate. France and Austria are good subjects for such a comparison. It must be borne in mind that this does not reflect the healthfulness of the two countries, but simply the age distribution of those dying.

DEATHS BY AGE GROUPS IN FRANCE AND AUSTRIA PER 1,000 TOTAL DEATHS.[2]

	Austria		France	
0- 1 year	300.0		165.4	
1- 5 years	157.8	540	68.7	288
5-10 years	43.1		18.2	
10-20 years	39.1		35.5	
20-30 years	51.0		60.5	
30-40 years	49.6		61.8	
40-50 years	53.4	460	70.3	712
50-60 years	75.5		95.2	
60-70 years	96.0		148.0	
Over 70 years	134.5		276.4	

In Austria over 50 per cent. of the deaths were of chil-

[1] Bulletin of the Census, No. 15, Washington, 1904, p. 9.

[2] March, L., "La nouvelle statistique autrichienne du mouvement de la population," Journ. de la Soc. de Statistique de Paris, March, 1900, p. 101.

dren under 10 years, while in France only about 25 per cent. of the deaths were of the same ages. Over 50 per cent. of the deaths in France were of those over 50 years, while barely 30 per cent. of the deaths in Austria were of those who had reached the same mature years. It is evident from this table that the duration of life in France is greater than in Austria, or that the proportion in the early years is greater in Austria, the probable result of a higher birth-rate. Both of these suppositions are correct.

DEATH-RATES FROM CERTAIN DISEASES IN THE REGISTRATION AREA OF THE UNITED STATES DURING THE YEAR ENDING MAY 31, 1900, PER 100,000 POPULATION AT THE CORRESPONDING AGES

	Under 5	5-14	15 and over	15-44	45-64	65 and over
Measles	106.5	7.4	1.3			
Scarlet fever	70.0	19.7	0.9			
Diphtheria	285.7	75.1	2.5			
Whooping cough	118.6	2.3	0.2			
Influenza	24.6	2.6		6.8	34.0	278.5
Diarrheal diseases	1,018.7	13.5		12.8	48.6	274.5
Cerebro-spinal fever	39.3	7.4	2.3			
Erysipelas	16.3	0.3		2.3	7.8	24.3
Consumption				252.4	232.5	260.1
Cancer	1.3	0.8		20.5	194.8	454.3
Apoplexy and paralysis				20.1	215.2	1,189.1
Heart disease and dropsy				57.2	293.9	1,259.4
Pneumonia				78.3	234.7	805.4
Bronchitis	259.7	5.3		5.3	34.0	291.6
Appendicitis				11.7	8.2	9.1
Bright's disease				42.2	195.7	544.9

The diseases mentioned in the early part of the table are those which are peculiar to childhood. Diphtheria is the most fatal of these, followed by whooping cough and measles. The mortality from these causes after the 15th year is a negligible quantity. Diarrheal diseases carry off more children than any one cause, and after the 45th year, the death-rate from this disease increases. Similar variations are noticeable for bronchitis, and, after the 65th year, the rate is higher than for children. Diphtheria is the most fatal disease for those from 5-14 years of age. From 15-44 consumption is far and away the most fatal disease. In fact the deaths from this cause are more than three times as numerous as from pneumonia, which is next in order of magnitude. For those from 45 to 64 the six principal fatal diseases are in order, heart disease and dropsy, pneumonia, consumption, apoplexy and paralysis, Bright's disease, and cancer. The mortality from each of these is, practically, between 200 and 300 per 100,000 in this age group. For those 65 and over heart disease and dropsy, apoplexy and paralysis are most to be feared. For both of these the rate is over 1,000 per 100,000. The only case in which there is a figure of like magnitude is from diarrheal diseases for those under 5 years. The rates for pneumonia, cancer, and Bright's disease are also very high among those 65 and over.

Average Age at Death. If the sum of the ages of the persons dying during any period is divided by the number of deaths, the quotient is the average age at death. There is a mistaken idea in many minds that the average age at death gives a measure for the healthfulness of a community, that if conditions are favorable to longevity, the average age is high, but, if the surroundings are unhealthy, the age at death is low. In other words, a high average age at death is looked upon as a sign of the physical welfare of a group. It is of course desirable that the life of every individual should be prolonged as much as possible, but the conditions with regard to health are not the only ones which affect the average age at death. If a population has been considerably recruited by immigration it is probable that the average age at death will be high, for most of this class have passed childhood before coming to their new home. If the birth-rate is high there will be a large number of infants exposed to the excessive mortality of the early years of life. These births are usually most frequent when economic conditions are favorable, and when there is a spirit of hopefulness throughout the population. But the fact of so many births would imply many deaths among infants, which would lower the average age at death, although conditions in that community were most satisfactory. When we compare the age at death in different occupational groups it is necessary to keep this same fact of age distribution in mind. Undoubtedly the age at death of bank presidents is high, but it is not justifiable from this fact to conclude that it is a particularly healthy occupation, for long years of training are required to fit a man for this position, and it is seldom that one attains the honor before he is at least in middle life. The average age at death of married men is higher than that of bachelors, but this would not argue that marriage was the sole cause of this difference.

There is, however, considerable interest attached to the following set of figures for the United States:

AVERAGE AGE AT DEATH IN THE REGISTRATION STATES DURING THE YEAR ENDING MAY 31, 1900[1]

	Registration States	Cities in Registration States	Rural Part of Registration States
Total	36.8	32.4	44.7
Males	35.8	31.0	44.3
Females	38.0	33.9	45.1
Native whites of native parents	38.4	31.2	44.6
Males	37.2	29.1	44.2
Females	39.6	33.3	45.1
Native whites of foreign parents	14.6	13.0	20.1
Males	14.2	12.7	19.5
Females	15.1	13.4	20.8
Foreign whites	55.2	53.4	60.2
Males	54.7	52.6	60.5
Females	55.6	54.3	59.8
Colored	27.6	26.6	31.4
Males	27.5	26.3	32.3
Females	27.6	26.9	30.6

The average age at death of the native whites of foreign

[1] Twelfth Census of the United States, Vol. III, p. 85.

parents is but a trifle more than one third as great as that of the native whites of native parents, and only about one fourth as great as that of the foreign whites. This is due to the large proportion of young among the children of the foreign born. The average age of the colored is just one half as great as that of the foreign whites. The negroes have a high birth-rate and a correspondingly high death-rate, while there are but few children among the foreign born. We must not conclude from this table that for corresponding ages the rate of mortality is higher among the children of the foreign born than among those born abroad. The disparity is due entirely to differences in age distribution. The average age at death of the females exceeds that of the males in every instance except for the foreign whites, and the colored in the rural districts. There are generally more females than males in the upper age groups, while the infant mortality of males is the greater.

If we consider the deaths at all ages in the entire registration area, the average ages at death of white persons having mothers born in the specified countries were as follows in 1900: Scotland, 48.6; France, 45.7; England and Wales, 45.1; Ireland, 42.8; Germany, 41.1; Bohemia, 26.7; Russia, 17.4; Hungary, 17.4; Poland, 14.5; and Italy, 13.9. At a first glance at these figures we might be led to think that certain nationalities found life in the United States much more healthful than others, but a closer study will reveal the fact that those peoples which have been among us the longest have the highest age at death, since the parents have reached advanced years, and some of their children are in middle life. This is, of course, not true for the Russians, Poles, and Italians, who have but recently come to this country in large numbers, and whose children are, to a large degree, still in infancy.

The average age at death in most countries is slowly increasing. This is in part due to the success which has attended the efforts of medicine to combat disease and to better hygiene. The age at death in Rhode Island has changed as follows during the past forty years.[1]

[1] Forty-ninth Registration Rept., Rhode Island, 1901, p. 171.

1861-65	29.32 years	1881-85	33.99 years
1866-70	32.42 "	1886-90	33.42 "
1871-75	30-16 "	1891-95	33.96 "
1876-80	31.21 "	1896-1900	34.53 "

It is interesting to note the average age at death of those who succumb to different diseases.

AVERAGE AGE AT DEATH FROM CERTAIN DISEASES IN THE REGISTRATION AREA DURING THE YEAR ENDING MAY 31, 1900[1]

	All Ages	15 Years and Over
Measles	4.4	32.3
Scarlet fever	5.9	26.9
Diphtheria	5.8	28.6
Whooping cough	1.8	41.0
Typhoid fever	28.8	33.1
Diarrheal diseases	12.3	59.1
Erysipelas	36.1	54.1
Consumption	35.3	37.4
Cancer	57.2	57.8
Apoplexy and paralysis	63.2	64.5
Heart disease and dropsy	54.3	58.8
Pneumonia	31.5	53.2
Bright's disease	50.5	59.8

Measles, scarlet fever, diphtheria, whooping cough, and diarrhea are peculiarly the diseases of childhood. Apoplexy and paralysis, cancer, Bright's disease, heart disease and dropsy are fatal to the old. Typhoid fever, pneumonia, and consumption attack those in middle life. The tendency at present is for humanity, having survived the diseases of childhood and middle life, to fall a victim to those of old age. We cannot eliminate all disease but we can prolong life.

Deaths by Sex and Age. We have seen that the death-rate for males is considerably higher than for females, but the males outnumber the females at birth and consequently

[1] Twelfth Census of the United States, 1902, Vol. III, p. 86.

more of the former are exposed to the high infantile mortality. It is possible that the difference in age distribution may account for the higher male death-rate. The only way in which this can be decided is to compare the mortality of the sexes by ages. In the following table this has been done for the population of the registration area of the United States.

DEATHS PER 1,000 POPULATION OF EACH SEX AT CERTAIN AGES IN THE REGISTRATION STATES[1]

	1890		1900	
	Males	Females	Males	Females
All ages	20.4	18.5	18.1	16.5
Under 5 years	68.8	60.1	54.4	45.4
5-14 years	5.3	5.4	3.9	3.8
15-44 years	9.9	8.9	8.3	7.6
45-64 years	23.0	19.7	21.4	19.2
65 years and over	78.3	75.1	85.9	80.0

We find that at every age the rate for males was higher than for females in 1900. The difference was the smallest between 5 and 14, and in 1890 the rate for the females was higher than for the males between these ages. In England the death-rate for females exceeds that for males between 10 and 15 years, while between 5 and 10 and 15 and 20 it is as high. In most countries the rate for females is lower than that for males at all ages. It would seem that the dangers of childbearing would bring the rate for women in early middle life as high as that for the men of the same years, but this is not the case. The accidental and violent deaths of men in the dangerous occupations more than offset these.

Since the death-rates for females are at all ages lower than for males, we should expect that those communities in which there was a relatively large proportion of females would have a low death-rate. This is the case in most large cities, where the women come for work as domestics, and in

[1] Bureau of the Census, Bulletin 15, Washington, 1904, p. 9.

the cities where the textile industries offer employment to large numbers of them. If the death-rates are not low in such places it is the result of a peculiar age distribution, or the unhealthfulness of the locality or the occupations.

Deaths by Conjugal Condition. Since the single are largely in the early, the married in the middle, and the widowed in the later age groups it is impossible to compare the total death-rates of those of different conjugal condition on account of the lack of uniformity in age distribution. Thus the death-rate of the white males in the registration area of the United States in 1900 was for single, 16.6; married, 16.4; and widowed, 62.6. From this it would appear that the death-rate for the widowed was four times as high as for the married. It would not do to conclude from this, that, as soon as a married man lost his wife, his probability of dying during a year was increased fourfold. It means that he has been transferred to a class where the age distribution is such that a high death-rate is probable. If we are to obtain instructive statistics of the influence of conjugal condition upon mortality we must compare the rates for the same age groups.

DEATH-RATES AT CERTAIN AGES BY SEX AND CONJUGAL CONDITION FOR THE REGISTRATION AREA IN 1900 [1]

	15-44 Years		45-64 Years		65 Years and Over	
	Males	Females	Males	Females	Males	Females
Single	9.4	6.2	33.3	21.8	107.8	88.7
Married	8.1	9.1	20.4	17.4	75.0	65.5
Widowed	19.6	12.2	37.6	24.8	116.4	88.7

We find that in every case the rate for the widowed is the highest, followed by that for the single, with the married the lowest. It may be that the reason why the rate for the widowed is so much higher from 15 to 44 is that the period selected is too long, and that the widowed are largely in the latter ten years, where the death-rate is higher than in the earlier years of this period. To determine this point it is

[1] Twelfth Census of the United States, 1902, Vol. III, p. 92.

necessary to select shorter periods, and the figures relating to Bavaria have been chosen.

PERCENTAGE OF DEATHS FOR CERTAIN AGES BY SEX AND CONJUGAL CONDITION IN BAVARIA, 1881-90 [1]

	Single		Married		Widowed		Divorced		Total	
Ages	Male	Fem.	Male	Fem.	Male	Fem.	Male	Fem.	Male	Fem.
30-35 ...	1.19	0.88	0.70	0.96	2.09	1.27	2.67	1.16	0.87	0.95
35-40 ...	1.55	1.06	0.90	1.11	2.31	1.22	2.27	1.68	1.05	1.11
40-45 ...	2.00	1.23	1.10	1.13	2.51	1.35	2.78	1.35	1.28	1.16
45-50 ...	2.38	1.57	1.48	1.18	2.82	1.44	4.50	1.71	1.64	1.29
50-55 ...	2.98	2.06	1.95	1.57	3.14	1.91	3.70	2.30	2.13	1.71
55-60 ...	3.88	2.64	2.65	2.25	3.75	2.63	4.47	2.90	2.90	2.42
60-65 ...	5.51	4.11	3.83	3.59	5.24	4.06	6.86	4.76	4.26	3.85
65-70 ...	7.59	6.05	5.74	5.63	7.25	6.15	8.70	9.06	6.35	5.95
70-75 ...	11.37	9.80	8.63	8.75	10.86	9.66	12.34	14.36	9.79	9.47
75-80 ...	16.93	15.37	13.79	14.39	16.34	15.11	14.58	26.67	15.42	15.07
80 and over	27.08	26.45	23.00	24.14	28.50	25.72	23.33	45.00	26.91	25.82

The death-rate among males is at all ages lower for the married than the single. The female rate is lower for the married than the single after the 40th year, but the dangers of childbearing increase the mortality in the early years of married life. The lower rate among the married men is doubtless due to the fact that those who marry are in a way the selected risks, while the weak, the diseased, and those among whom the mortality is naturally high, are forced to remain single. Then, too, the excesses of various kinds are greater among the single. The married man leads a more ordered life, and is better cared for in sickness than the single. The widowed have a higher rate of mortality than the married, for grief and misfortune lower the vitality, and the care and comfort of the consort is missed. The rate among the divorced is the highest for any class. They have shown that they are not fitted for married life, and dissipation is often the cause of the separation. It is but natural that the death-rate among this class should be high.

It would be possible to bring out these differences in the

[1] Prinzing, F., "Die Sterblichkeit der Ledigen und der Verheirateten in Bayern," Allgemeines Statist. Archiv, Band V, 1898, p. 240.

mortality more clearly if the total rate could be expressed by one figure. But this is impossible on account of the differences in age distribution except by the formation of a standard population. This has been done for the figures for Bavaria.

DEATH-RATE PER 1,000 OF STANDARD POPULATION IN BAVARIA 1881-90[1]

	Male	Female
Single	37.44	29.77
Married	26.19	26.75
Widowed	40.70	30.25
Divorced	47.33	41.25
Total	29.6	28.3

By this table the differences are made more apparent. The men gain much more than the women from marriage, in so far as a decrease in the death-rate is concerned. The only case in which the rate for females exceeds that for the males is for the married. For both sexes the rate for the divorced is by far the highest. There is a difference of more than 21 per 1,000 between the death-rate for the divorced and married among the males, while among the females it is only 14.5.

The mean after lifetime of those who are 26 years of age in Bavaria is as follows:

Married males	37.86 years
Single males	32.44
Married females	37.33
Single females	36.66

It is, of course, incorrect to attribute all of the additional years of life among the males to the regulating influence of marriage, since, by selection, the healthiest males are the ones to marry: but, since a similar selection is operative with respect to the females, it is safe to say that marriage tends to prolong the lives of males to a greater extent than it does those of the females.

[1] Prinzing, F., *Op. cit.*, p. 241.

Deaths by Seasons. The most common method for the seasonal classification of deaths is by months. But at the outset we are confronted by an obstacle. If we desire the absolute number of deaths which occur by months, it is a case of the simple addition of those which take place on each day of the month. The number of deaths during the year divided by the number of months, will give the average number of deaths per month. This quotient is taken as the unit, or 100, and the frequency of death in the different months is expressed in percentages of this unit. But the months are not of equal length, and, by this method, we shall not obtain an accurate measure of the effect of the season. Greater heat and humidity may make August weather less healthful than that of September, but a month of 31 days would, other things being equal, have more deaths than one of 30. It is, therefore, desirable to adopt a method by which the differences in the length of the months shall be eliminated. The most satisfactory method of doing this may be shown by taking a concrete instance.

In Connecticut, during the year ending Dec. 31, 1901, there were 14,852 deaths. If we assume the standard month to contain 31 days there were $\frac{14{,}852 \times 31}{365} = 1{,}261$ deaths in 31 days. There were during the month of January, 1901, 1,456 deaths in 31 days. This gives $\frac{1{,}456 \times 100}{1{,}261} = 115.4$ per cent. of the standard. During February there were 1,387 deaths in 28 days. In 31 days there would have been $\frac{1{,}387 \times 31}{28} = 1{,}536$ deaths. This gives $\frac{1{,}536 \times 100}{1{,}261} = 121.8$ per cent. of the standard. In both of these cases the mortality was considerably above the average rate for the year. In May, a month of 31 days, there were 1.067 deaths. The percentage of the standard was $\frac{1{,}067 \times 100}{1{,}261} = 84.6$.

Another method is to place the total for the year at 1,200, thus making the standard in each month equal to 100. The variations for each month are then represented by percentages. This method gives a comparison of the number of deaths which occurs by months, but since a part of this variation is caused by the difference in the length of the months, the influence of the seasons, with the effect of heat and cold, is not brought out so clearly as by the previous method.

By a still different method the proportion of deaths in each month is given per 1,000 total deaths during the year. This is the method commonly employed in the United States Census. It is doubtful if this gives a very clear picture of the seasonal changes, for if we are to compare the mortality by months, it is better that the average number of deaths per month be taken as the standard.

When the death-rate for all ages is considered, we find that there are generally two points of greatest frequency, the one in the winter, and the other in the summer. When a country is in a northern latitude, the highest point is reached in the winter, and when in a warmer clime, the maximum mortality falls in the summer. When a country like France or Germany is under consideration, there is no great difference in the height of the two maxima. As a rule, the mortality in cities is greater in the summer months, on account of the overcrowding and lack of fresh air. In the country districts the deaths are more numerous in the winter. In either case it is the severity of the weather and extremes of temperature which have the worst effect. Thus a year in which the weather in the winter is very cold, and in the summer excessively hot, is much more unhealthy than one in which the winter is moderate and the summer comparatively cool. The cold weather of winter is dangerous for the old, while the heat of the summer carries off many infants.

In the United States the distribution of deaths by months is as follows:

NUMBER OF DEATHS IN EACH MONTH PER 1,000 IN KNOWN MONTHS IN THE REGISTRATION AREA DURING THE YEAR ENDING MAY 31, 1900[1]

	All Ages	Under 5 Years	5-59 Years	60 Years and Over
June	73.7	79.5	74.3	66.4
July	87.3	119.7	76.6	68.4
August	83.3	105.4	76.0	70.3
September	75.4	86.2	72.8	67.6
October	73.2	66.1	78.3	73.1
November	70.5	60.1	76.3	72.5
December	78.1	68.4	81.9	83.0
January	86.7	78.0	89.1	92.5
February	83.5	79.3	84.4	86.7
March	102.8	91.8	101.3	117.5
April	99.3	86.8	99.0	113.6
May	86.2	78.7	90.0	88.4

For all ages the highest mortality was reached in March. There was a secondary high point in July, and another in January. The concentration in certain months was much greater for those under 5 years, and here the maximum occurred in July, with August far above the average. The distribution of the deaths of persons from 5 to 59, inclusive, was much more uniform, with the summer and autumn lower than the winter and spring. The mortality of those 60 and over was very great in March and April. In fact a greater number died in these two months than in either of the other two age groups in any two months. The smallest number of deaths of those under 5 occurred in November, while for the middle age group the minimum fell in September and for the old in June. This supports the statement made on an earlier page that the mortality of children was small in the winter, while that of the old reached its lowest point in the summer.

The seasonable variations in the death-rate by age groups are, to a great extent, due to the fact that the old and young die from different diseases. This is brought out more clearly if we make a study of the mortality by months or seasons from certain diseases.

[1] Twelfth Census of the United States, 1902, Vol. III, p. 97.

DEATHS FROM CERTAIN DISEASES BY SEASONS PER 100,000 OF POPULATION IN THE REGISTRATION STATES DURING THE YEAR ENDING MAY 31, 1900[1]

	June-Aug.	Sept.-Nov.	Dec.-Feb.	Mch.-May
All causes	419.7	378.0	424.9	506.4
General diseases	109.5	65.4	51.0	68.6
Measles	2.3	1.3	4.8	6.4
Scarlet fever	1.7	1.8	3.7	3.5
Diphtheria	5.5	8.4	10.1	7.7
Whooping cough	4.0	2.6	3.3	4.1
Malarial fever	1.5	1.7	0.9	1.0
Influenza	1.1	1.1	5.6	21.3
Typhoid fever	5.2	9.8	6.0	4.4
Diarrheal diseases	80.3	32.8	8.9	10.3
Cerebro-spinal fever	2.7	1.8	1.5	2.0
Old age	11.3	11.8	13.9	16.1
Consumption	40.4	40.2	43.8	51.4
Diseases of nervous system	51.6	47.8	53.5	61.1
Diseases of circulatory system	32.9	34.6	41.2	45.8
Diseases of respiratory system	30.9	44.6	89.8	114.0
Diseases of digestive system	23.5	21.9	22.1	25.4
Diseases of urinary system	24.1	24.2	27.1	29.4
Affections connected with pregnancy	6.1	4.6	6.5	9.1

This table serves a double purpose in that it not only shows the classes of diseases from which come the greatest mortality, but at the same time the seasonal variations. During the summer the general diseases are in the lead, while the diarrheal diseases alone carry off more persons than any of the large groups, except the one in which it is included. A large proportion of these deaths are of infants. The general diseases claim the most victims during the autumn, but less than half of them are now to be attributed to diarrheal diseases. The number of deaths from general diseases is, however, only about three fifths as great as it was during the summer. But the deaths from diptheria have increased and typhoid fever reaches the maximum at this season. The approach of winter is shown in the increase of deaths from diseases of the respiratory system. During the winter the general diseases have dropped to third place. The diseases

[1]Twelfth Census of the United States, 1902, Vol. III, p. 98.

of the respiratory system now lead, followed by those of the nervous system. Diptheria and scarlet fever are now at their highest point. In the spring the diseases of the respiratory system are far in the lead. With the exception of the general diseases, all of the groups have reached their maximum. Influenza now becomes very fatal. Diarrhea, which claimed twice as many victims as the diseases of the respiratory system in the summer, now claims but one tenth as many. Consumption causes more deaths than any other single disease in every season except the summer, when diarrhea is particularly fatal.

It might bring out more clearly the influence of the seasons upon the mortality from the different diseases, if, in each case, the total number for the year was placed at 1,000, after the method adopted by the United States census.

DEATHS IN EACH QUARTER PER 1,000 IN KNOWN MONTHS IN THE REGISTRATION STATES DURING THE YEAR ENDING MAY 31, 1900

	Jan.-Mch.	Apr.-June	July-Sept.	Oct.-Dec.
General diseases	205.5	218.0	408.5	168.0
Measles	417.0	350.0	100.3	132.7
Scarlet fever	365.5	284.6	119.4	230.5
Diphtheria	294.1	210.5	188.1	307.3
Whooping cough	268.0	248.3	299.8	183.9
Malarial fever	170.8	203.1	353.9	272.2
Influenza	435.0	466.5	24.5	64.0
Typhoid fever	212.9	151.9	292.8	342.4
Diarrheal diseases	69.6	136.8	683.4	110.2
Cerebro-spinal fever	217.8	289.0	301.3	191.9
Old age	294.4	260.6	212.3	232.7
Consumption	268.1	264.5	236.9	230.9
Diseases of nervous system	267.1	265.1	236.9	230.9
Diseases of circulatory system	286.7	262.3	210.3	240.7
Diseases of respiratory system	394.0	289.2	103.2	213.6
Diseases of digestive system	250.1	260.6	255.8	233.5
Diseases of urinary system	275.7	257.1	227.1	240.1
Affections connected with pregnancy	296.0	299.0	202.1	202.9

We are now able to see more clearly in what quarter of the year there is the greatest mortality from specified diseases. In the first quarter there fall the maxima from measles, scarlet fever, old age, consumption, and the diseases of the nervous, circulatory, respiratory, and urinary systems; in the second quarter from influenza, diseases of the digestive system, and affections connected with pregnancy; in the third, from whooping cough, malarial fever, diarrheal diseases, and cerebro-spinal fever; in the fourth, from diphtheria and typhoid fever. Those which are due to sudden changes in temperature, or "catching cold," are most severe in the first quarter. The concentration in particular months is the greatest for influenza, where 62 per cent. of the deaths from this cause are in March and April. The diarrheal diseases, caused to a great extent by excessive heat and improper food, have a tremendous mortality in the third quarter.

A study has been made by E. Raseri of the hours of the day at which deaths are most frequent.[1] These appear to be from two until five in the afternoon. Haushofer maintains that deaths are most frequent when the organic functions are in their full activity, while, during the night, when these functions are lowered, human life is less threatened. Between two and seven of the afternoon the pulse is more frequent, and the temperature increases in a healthy as well as a sick person. This he considers to be the reason why deaths are most frequent during the afternoon.

Mortality and Density of Population. Fresh air and sunlight are needed to ensure health. Where houses are crowded so closely together that it is impossible for the sun to reach some of the rooms, and what light enters these rooms comes from a shaft which is not open to the air, it is impossible to expect that the inmates can be as healthy as those who live where there is abundance of light and air. For centuries the conditions of filth which prevailed in cities caused a death-rate which was excessively high. In fact,

[1] Raseri, E., "Les naissances et les décès suivant les heures de la journée," Bulletin de l'Instit. Internat. de Statistique, Tome XIX, Liv. I, 1899, pp. 145-48.

very few of the large cities of the world preserved their numbers by natural increase, and they earned the title of "man destroying" cities.

It was early noticed that those cities with the greatest density of population had the highest death-rates. Dr. William Farr, when Registrar General of England, tried to discover whether there was a connection between these two phenomena which was sufficiently constant to admit of mathematical demonstration. He would find a formula by which it would be possible to determine, with reasonable accuracy, what would be the probable death-rate of a city whose density of population was known, from the figures for the density and mortality of some other place in the same country. This would, of course, be an empirical formula. Any formula of this kind would apply to but one set of conditions, and could not be expected to hold for different countries or even for one country over a long period of time.

In the Supplement to the Fifty-fifth Report of the Registrar General is included a table which gives the death-rates for different districts, grouped according to the density of the population. With these figures as a basis, Dr. Farr set about to determine what connection there was between the density and the mortality. From an earlier study he had concluded that the death-rate varied as the sixth root of the density. In this case, however, if d and d′ represent the density of the population in two places and m and m′ the mortality of the same places, he found that $m'=m\left(\frac{d'}{d}\right)^{0.11998.}$ To raise a number to the 0.11998 power is nearly the same as to extract the eighth root. Therefore the formula becomes $m' : m : : \sqrt[8]{d'} : \sqrt[8]{d}.$ The table from which he drew this conclusion follows.

CONNECTION BETWEEN DENSITY OF POPULATION AND DEATH-RATES IN ENGLAND[1]

Number of Persons to a Square Mile	Mean Crude Death-rate	Death-rate According to Farr's Formula
138	14.75	16.36
149	15.73	16.52
187	16.30	16.99
214	16.66	17.28
307	16.92	18.08
435	17.59	18.89
662	18.46	19.90
1,281	18.59	21.62
1,803	19.53	22.56
2,437	20.13	23.43
3,299	20.90	24.33
5,329	21.96	25.84
4,295	22.71	25.15
5,722	24.47	26.07
19,584	30.70	30.40

The total area had a density of 471 to the square mile and a death-rate of 19.08. One of the districts had a density of 19,584 per square mile. We wish to find its probable death-rate. We use the formula $m' : m : : \sqrt[8]{d'} : \sqrt[8]{d}$. In this case $m = 19.08$, $d = 471$, $d' = 19{,}584$ while m' is unknown. $\frac{m'}{19.08} = \sqrt[8]{\frac{19{,}584}{471}}$. $m' = 30.40$. The mean crude death-rate was 30.70, so that the rate according to Farr's formula was quite a close approximation.

The variation of the death-rate with the density of the population is not at all constant until we reach those districts where there is considerable congestion of the population. It makes but little difference to the health of a community whether there are two or four persons to the acre, but it surely is by no means immaterial to have two hundred or five hundred to the acre. When a certain point is reached,

[1] Supplement to the Fifty-fifth Report of the Registrar General, p. 47.

all additional persons simply increase the overcrowding and add to the dangers from various infectious diseases.[1]

There are many factors besides density of population which influence the death-rate. In fact the number of people to the acre does not mean so much as the sanitary conditions under which they live. Tenements in which filth abounds, and where part of the rooms are dark or poorly lighted are more likely to have a high mortality, than those which are more crowded, but are built along sanitary lines and kept clean and well aired. This is brought out clearly by a study which A. Newsholme made of the Peabody Buildings in London.[2] During the year 1890 the number of persons to the acre in London was 59 and in the Peabody Buildings, 751. The death rate in London was 17.4. Therefore, according to Farr's formula, the death-rate in the Peabody Buildings should have been $m'=17.4\left(\frac{751}{58}\right)^{0.11998}=24.21$. But the actual death-rate was only 16.49, showing that in the case of these model tenements Farr's formula did not apply at all.

It was found that during the twelve years ending with 1885 the death-rate for the Peabody Buildings was a trifle lower than that for London during the same period. Below 5 years, and between 15 and 25 were the only ages when the rates for these tenements were higher than for London. From 1882 to 1890 the infantile death-rate in the Peabody Buildings was 139.2 and in London 151.9 per 1,000 births. The diseases which are the result of direct infection, such as scarlet fever and diphtheria, were a trifle more fatal, while whooping cough and measles were much more fatal in these buildings than throughout the metropolis as a whole.

[1] A good treatment of this subject is to be found in the chapter on Density of Population and Mortality in Newsholme's "Vital Statistics."

[2] Newsholme, A., "Vital Statistics of the Peabody Buildings and other Artisans' and Laborers' Block Dwellings," Journ. Royal Statist. Soc., Mch., 1891, pp. 70-111.

The death-rate from tuberculosis was also higher in the Peabody Buildings. We, therefore, find that although the total death-rate was no higher in these model tenements, notwithstanding the fact that the congestion of the population was much greater than in the rest of London, the deaths from infectious diseases were more frequent.

Although it is possible to reduce the mortality of crowded sections by proper housing and sanitary precautions, it is generally the case that districts with a high density of population have a greater death-rate than those which are more sparsely settled. This is brought out clearly by a study of the mortality of Massachusetts by districts. In six of the counties of this State in 1900 the density of population per square mile was 663, and the death-rate 18.5. In the other eight counties of the State the density was 135, and the death-rate 17.2. The density of the entire State was 269, with a death-rate of 18.2.

The death-rate in cities is usually higher than in the country. This is apparent from a study of the American states in which accurate statistics are kept.

RURAL AND URBAN RATES OF MORTALITY IN THE UNITED STATES IN 1900[1]

	Total	Cities	Rural
Connecticut	17.0	17.0	16.9
Maine	17.5	20.5	16.9
Massachusetts	17.7	17.9	17.1
Michigan	13.9	15.3	13.3
New Hampshire	18.0	18.8	17.5
New Jersey	17.4	18.8	15.5
New York	17.9	19.2	15.2
Rhode Island	19.1	19.2	18.8
Vermont	17.0	17.6	16.9

There is not a single state in which the urban mortality does not exceed the rural. Within the past few years the urban rate has declined more than the rural, on account of the improvement in sanitary conditions and the education of the masses.

Not only is the urban death-rate higher than the rural, but, as a rule, the rate increases according to the size of

[1] United States Census Bulletin No. 83, 1901.

the city. In the following table the cities in Massachusetts are arranged according to their magnitude, in order to show the relation between this fact and their death-rates. The total death-rate is per 1,000 of total population, while the rates from the various diseases are per 10,000 of population.

DEATH-RATES IN CITIES OF MASSACHUSETTS, 1894-95[1]

	I	II	III	IV
Total death-rate	23.2	19.5	18.0	16.7
Deaths from consumption	31.5	20.8	20.1	19.1
Pneumonia	24.7	17.1	15.2	14.1
Typhoid fever	3.1	3.1	2.4	3.3
Diphtheria and croup	15.6	6.2	6.8	5.8
Scarlet fever	3.2	2.9	1.6	2.1
Cholera infantum	10.9	14.8	9.5	8.9

I. One city with population of more than 100,000.
II. Nine cities with population from 50,000 to 100,000.
III. Ten cities with population from 25,000 to 50,000.
IV. Nineteen cities with population from 10,000 to 25,000.

The total death-rate follows the same order as that of the size of the cities. From pneumonia and diphtheria the death-rate falls very rapidly as the cities decrease in size. The same order is not regularly maintained in every case but there is a traceable connection, and in no case except typhoid fever is the rate as high in the third or fourth as in the first class.

There is a marked difference in the excess of urban over rural death-rates when the various age groups are compared. This is apparent from the figures for the registration states.

DEATHS PER 1,000 IN EACH AGE GROUP FOR THE REGISTRATION STATES DURING THE YEAR ENDING MAY 31, 1900[2]

	Under 1	Under 5	5-14	15-24	25-34	35-44	45-64	65 and over
States	159.3	49.9	3.8	5.7	8.3	10.5	20.3	82.8
Males	177.2	54.4	3.9	5.8	8.5	11.0	21.4	85.9
Females	141.1	45.4	3.8	5.5	8.1	10.0	19.2	80.0
Cities	184.7	59.7	4.3	5.9	9.1	12.1	24.3	90.9
Males	205.3	65.0	4.3	6.3	9.8	13.1	26.3	95.2
Females	163.7	54.4	4.2	5.6	8.5	11.0	22.3	87.6
Rural	117.4	34.4	3.2	5.3	6.8	8.0	15.7	76.8
Males	131.0	37.6	3.2	5.2	6.4	7.8	16.0	80.0
Females	103.6	31.2	3.2	5.3	7.3	8.2	15.4	73.6

[1] Vital Statistics of Massachusetts, 1856-95, Pub. Doc. No. 34, p. 821.

[2] Twelfth Census of the United States, 1902, Vol. III, p. 80.

In infancy and old age the excess of the urban over the rural death-rate is the greatest, while, from 5 to 44, inclusive, there is no great difference. It may be that the most active of the country population go to the cities in the early years, leaving the more feeble behind, and in this way the mortality in city and country is more nearly alike for several years. There seems to be no doubt that the stress of life in the large centers produces a high mortality. The difference in the death-rates between the sexes is less in the country than in the city. In fact, from the 15th to the 45th years the mortality of females exceeds that of males in the rural districts. This is probably due to the fact that the occupations of the males are more healthful in the country than in the city.

Mortality according to Occupations. There are certain occupations which are considered to be particularly unhealthy, and it is but natural that in these the death-rate should be high. This unfortunate condition may be due to poisonous gases or substances with which the workman is occupied, it may be that he is forced to keep a cramped and uncomfortable posture for several hours at a time, the temperature in which he carries on his work may be excessive, or there may be great liability to death from accident. From any of these causes the mortality in some lines of work may be high. But it is never safe to attribute a high death-rate to any such causes until after careful study.

The mistake is often made of comparing the number of deaths per 1,000 engaged in one occupation with the number of deaths per 1,000 in some different kind of work. It may be that in one trade the average age of the workers is considerably lower than in another. Since the death-rate of adults increases with advancing years, the rate should be the higher among that group whose average age is the greater. It is therefore misleading to compare the death-rates by occupations regardless of age distribution. If we are to proceed correctly there are two methods which may be followed. The death-rates of the different occupations may be compared for the same age groups, or a standard population may be adopted, and the rates for the different occupations computed from this as a base. In either case we shall avoid the error due to differences in age distribution. If we compare the average age at death in different occupations we expose ourselves to a similar error. What sense would there be in comparing the average age at death of printers with that of newsboys? The mortality of certain occupations in which great muscular strength is required is doubtless reduced by the fact that those engaged in them are select risks. None but the strongest can enter, while, if those of ordinary physique should attempt it, the death-rate would be much higher.

In the census of 1900 the attempt was made to determine the mortality according to occupations for the registration states of the United States. There is always considerable difficulty in classifying occupations and the figures cannot be accepted as absolutely accurate. They show a praiseworthy attempt to collect and tabulate data upon this question and deserve a place in a study upon this subject.

DEATHS OF MALES IN OCCUPATIONS BY AGE GROUPS PER 1,000 MALES IN EACH GROUP FOR THE REGISTRATION STATES DURING THE YEAR ENDING MAY 31, 1900[1]

	All Ages	15-24	25-44	45-64	65 and over
All occupations	15.0	5.1	8.8	19.9	98.4
Professional	·15.3	4.8	7.6	20.7	105.6
Clerical and official	13.5	7.2	11.1	19.9	55.9
Mercantile and trading	12.1	2.6	6.7	19.9	93.8
Public entertainment	15.4	5.2	11.6	23.8	68.0
Personal service, police and military	12.9	5.9	8.2	19.9	64.0
Laboring and servant	20.2	7.7	13.9	31.9	126.6
Manufacturing and mechanical industry	13.8	4.4	8.4	20.2	105.4
Agriculture, transportation and outdoor	15.8	4.6	6.6	14.7	96.7
All other occupations	6.5	3.1	6.5	12.7	55.5

15 out of 1,000 engaged in gainful occupations died during the census year. The highest rates were for the laboring

[1] Twelfth Census of the United States, 1902, Vol. III, p. 261.

and servant class, those engaged in agriculture, transportation and other outdoor industries, and in public entertainment. The lowest were the mercantile and trading class, and the personal service, police and military class. The laboring and servant class have the highest rate at all ages. It is difficult to realize why those in agriculture and other outdoor occupations should have such a high rate. But when we study the figures more carefully, we see that they have a death-rate lower than the average for every age group. The reason for the high mortality at all ages is apparent when we learn that those in this class constitute 24.8 per cent. of the workers from 15 to 24, inclusive, but 44.8 per cent. of those 65 and over who are in gainful occupations. The reason is that a greater proportion of them are found in the upper age groups where the mortality is greater.

If we study the mortality from certain selected diseases for some of the occupational groups some interesting results are shown.

DEATHS OF MALES IN DIFFERENT OCCUPATIONS FROM CERTAIN DISEASES PER 100,000 OF POPULATION IN THE REGISTRATION STATES FOR THE YEAR ENDING MAY 31, 1900[1]

	I	II	III	IV	V
Typhoid fever	37.9	28.3	51.1	29.4	32.8
Rheumatism	7.4	5.5	6.6	6.8	9.0
Consumption	182.2	165.8	376.8	262.1	147.2
Diseases of nervous system	263.4	171.5	199.9	172.6	221.3
Heart disease	176.8	145.5	192.5	150.0	211.1
Pneumonia	143.8	133.4	249.2	138.9	140.0
Diseases of the liver	29.0	31.4	32.0	26.7	26.1
Diseases of urinary system	168.4	140.9	167.3	134.6	145.5
Suicide	16.2	20.2	20.6	20.4	19.0
Other accidents and injuries.	61.1	46.0	220.2	88.4	139.6
Cancer	51.7	52.0	66.5	53.3	69.2

I. Professional.
II. Mercantile and trading.
III. Laboring and servant.
IV. Manufacture and mechanical industry.
V. Agriculture, transportation and other outdoor.

[1] Twelfth Census of the United States, 1902, Vol. III, pp. 262 ff.

The professional class has a high rate of mortality from diseases of the nervous system. Among clergymen the rate reaches 438.6; among physicians and surgeons, 405.1; among lawyers, 356.6. The intellectual activity of these classes is high and the strain upon the nervous system correspondingly great. The mercantile and trading classes have a low death-rate from all diseases and the deaths from accident are very few. The laboring and servant class have an excessive rate from consumption. Among servants the rate reaches 430.3. This is doubtless due to the indoor life they lead and the lack of fresh air and outdoor exercise. On the other hand, deaths from diseases of the nervous system were only 115.6. Laborers have a very high rate from pneumonia. The deaths from accident among laborers are 235.1, more than twice the average rate from this cause among all occupied males. The manufacturing and mechanical industry class has a medium rate for most diseases, but this varies for the different groups of workmen. Cabinet makers and upholsterers have a high mortality from consumption, but a low one from accident. Cigar makers have a very high rate from all causes but particularly from consumption and pneumonia, doubtless due to the unhealthy nature of the substance in which they work, and the bad air in the workrooms. The rates for machinists are quite low. The rate from consumption among marble workers is 540.5, more than twice the average rate in this class. Textile operatives have a very low rate for almost all diseases. This may be traced to the factory legislation of the various states by which the conditions surrounding work are made highly sanitary. The textile factories are usually quite large, and the mills of considerable size are more carefully inspected than the smaller establishments in other lines of production. The agriculture, transportation and other outdoor class has a high death-rate from rheumatism, heart disease, and cancer, but a low one from the other diseases. Among farmers, planters, and farm laborers the rate from consumption is only 111.7, showing the favorable influence of outdoor country life. The rate from cancer and heart disease is high, but these are both diseases of advanced years, and we saw that the proportional representation of the farmers in the upper age groups is large. Steam railroad employees have a rate of 410.1 from accident. This is nearly four times as great as that among all occupied males.

In the following table the death-rates of certain occupational classes are given for three age groups.

NUMBER OF DEATHS IN THE REGISTRATION STATES PER 1,000 IN EACH AGE GROUP FOR THE YEAR ENDING MAY 31, 1901

	25-44	45-64	65 and over
Boot and shoemakers	3.4	11.2	77.9
Farmers and farm laborers	4.6	13.2	96.8
Tailors	5.6	19.9	113.6
Clergymen	6.2	20.8	123.4
Merchants and dealers	6.7	20.4	104.8
Carpenters and joiners	6.8	16.4	98.9
Sawyers	6.9	20.1	94.7
School teachers	7.0	21.6	97.4
Textile operatives	7.6	18.2	119.9
Blacksmiths	7.6	20.0	134.3
Iron and steel workers	7.8	22.0	100.4
Steam railroad employees	7.9	15.7	65.0
Physicians and surgeons	8.7	21.4	113.7
Marble and stone workers	9.3	24.7	122.9
Hackmen, teamsters, etc.	9.9	16.7	75.3
Saloon and restaurant keepers	11.7	22.6	47.5
Apothecaries and pharmacists	11.8	29.2	104.3
Brewers and distillers	12.2	32.4	138.9
Bookkeepers and clerks	13.3	25.2	90.1
Servants	13.5	36.0	110.7
Laborers	14.0	31.6	127.3
Cigarmakers and tobacco workers	14.6	31.0	120.6

In the preceding table the occupations have been arranged in the order of the death-rate from the 25th to the 44th years, inclusive. The boot and shoe makers not only have the lowest rate in this, but also in the following age group. The saloon and restaurant keepers had the lowest rate 65 years and over. This, however, is not convincing, for there were but 1,010 in this group, a number too small to afford a safe basis for any accurate conclusions. Farmers and farm laborers had a low rate for all the age groups. Servants, laborers and cigarmakers have the highest rates in the first group, and, with one exception, the highest in the second group. Brewers and distillers have the highest mortality in both the second and third groups. The great classes of iron and steel workers, textile operatives, and steam railroad employees occupy a position midway in the list.

It would be much more satisfactory if one figure could be made to represent the death-rate at all ages for different occupations. To compute this the percentage of all occupied males in the different age groups was taken as standard and these percentages multiplied by the death-rates of the different occupations at each of these age groups. The sum of these products gave the death-rate which would have resulted if the age distribution in each occupation had been the same as that of all occupied males. This enables us to compare the healthfulness of the various occupations when due allowance has been made for differences in age distribution.

DEATHS PER 1,000 OCCUPIED MALES BY INDUSTRIES IN THE REGISTRATION STATES FOR THE YEAR ENDING MAY 31, 1900, WITH THE AGE DISTRIBUTION OF THE TOTAL OCCUPIED MALES

Boot and shoemakers ...	8.79	Textile operatives	14.88
Farmers and farm laborers	11.02	Clergymen	15.21
Steam railroad employes.	12.74	Blacksmiths	15.96
Carpenters and joiners ..	13.04	Physicians and surgeons.	16.28
Hackmen, teamsters, etc.	13.51	Marble and stone workers	17.19
Tailors	13.65	Bookkeepers and clerks..	18.53
Lawyers	13.72	Apothecaries and pharmacists	20.36
Merchants and dealers ..	14.21	Brewers and distillers ..	20.81
School teachers	14.32	Cigarmakers and tobacco workers	21.64
Saloon and restaurant keepers	14.36	Servants	21.78
Iron and steel workers..	14.66	Laborers	22.30

In connection with this table it is important to remember that the death-rate per 1,000 occupied males was 15.0. About half of the examples given are above and about half are below this average.

Dr. Tatham, as Registrar General, constructed tables from four age groups to show the comparative mortality of occupations in England, 1890-92. The average mortality of all males of the population between 25 and 65 years of age was placed at 1,000. The mortality of occupied males was 953 and of the unoccupied 2,215. The comparative mortality of the different groups was as follows:

Clergyman, priest, minister	533
Gardener, nurseryman	553
Farmer, grazier	563
Schoolmaster, teacher	604
Grocer, etc.	664
Carpenter, joiner	783
Barrister, solicitor	821
Fisherman	845
Shopkeeper	859
Medical practitioner	966
Tailor	989
Bricklayer, mason, builder	1,001
Butcher	1,096
Printer	1,096
Plumber, painter, glazier	1,120
Cotton manufacturer (Lancashire)	1,176
Carman, carrier	1,284
Slater, tiler	1,322
Brewer	1,427
Inn keeper, hotel servant	1,659
Potter, earthenware manufacturer	1,706
File maker	1,810

As a rule the outdoor occupations are more healthy and those in which the income permits a life of considerable comfort, like clergymen, teachers, lawyers, etc. Those which necessitate labor indoors, with injurious dusts, or where the worker is exposed to great temptation from intoxicants, have a high mortality.

It was found in Dublin that the mortality of children seemed to vary according to the occupation of the father.

DEATHS PER 1,000 AT DIFFERENT AGES IN DUBLIN, 1883-85[1]

	0-4 Years	5-19 Years
Total	83.00	9.14
Professional and independent	21.98	3.41
Middle class	59.22	8.13
Artisan and petty shopkeeper	70.93	8.93
General service class	110.31	10.74

[1] Humphreys, N. A., "Class mortality statistics," Journ. Royal Statist. Soc., Vol. L, June, 1887, p. 282.

The children of the professional and independent classes have a very low rate of mortality, while those of the general service class, whose income is small and precarious, have an excessive rate. This, of course, is not due to the occupation of the father directly, but to the fact that the housing conditions among the poor cause a high infantile death-rate.

As a rule the healthfulness of farming is greater than that of the occupations which are carried on in cities. This holds with regard to all age groups.

MORTALITY OF GARDENERS AND NURSERYMEN IN ENGLAND, 1890-92[1]

	General Male Population		Gardeners and Nurserymen	
Ages	Deaths	Mortality per 1,000	Deaths	Mortality per 1,000
25-35 years	173	7.67	94	4.14
35-45 years	227	13.01	115	6.59
45-55 years	275	21.37	150	11.63
55-65 years	325	39.01	194	23.29
25-65 years	1,000		553	

If the number of deaths among the male population of England is placed at 1,000, there are only 553 among the same number of gardeners and nurserymen, and the death-rate at each age is only a trifle more than half as great for the latter class.

The death-rate for prisoners is considerably higher than for the average population of the same ages. The reasons for this are not hard to find. No matter how clean and sanitary the prisons may be, the conditions of life are unnatural, and in most cases intercourse between the inmates is forbidden. When long-term or life-convicts are considered, there is a spirit of hopelessness which is depressing, and lowers the vital forces. Then too, in many cases, the prisoners are not as able-bodied as the average males. They have often carried on no steady occupation, and have taken to crime from poverty or because, from lack of training or physical strength, they could not earn good wages at a trade.

Among soldiers the mortality is usually greater than among

[1] Oliver, T., "Dangerous Trades," London, 1902, p. 1296.

the males of corresponding ages outside the army. It is easy to see why the rate should be high when they are stationed in the tropics, or when on a campaign exposed to the inclemencies of the weather, wearied by forced marches, and sleeping with but little protection from the elements. But even when stationed at home the rate is high. Several causes doubtless combine to produce this result. They are, as a rule, single men, and the mortality is generally greater for this class than for the married. Their necessary bills are paid, and their earnings are largely spent on intoxicants and immorality. There is the restraint of military life, which has a bad effect on the spirits, causing loss of sleep and leading to drinking. Sleeping in barracks is not healthful and often causes tuberculosis. Night guard duty and uniforms made rather for display than convenience and health render them in too many cases the victims of pneumonia.[1] The soldiers are a selected body of men, among whom the mortality should be low, and when we find the opposite to be the case it must be attributed to the manner of life they lead.

The conditions which affect the mortality in different occupations have been well summed up by Dr. Bertillon.[2]

Sedentary occupations exposing the person to the weather, such as coachmen and waggoners. These are very unhealthy.

Occupations, not necessarily sedentary, exposing the person to the weather. These include farmers, nurserymen, market-gardeners, and gamekeepers, who have a low rate of mortality.

Outdoor occupations exposing the workman to inhale hard particles of dust. Marble workers and quarrymen have a high rate.

Occupations exposing the workman to inhale hard particles of dust in a confined atmosphere. Machine and tool makers, cutlers, needle and knife makers have a very high mortality.

[1] Oliver, T., "Dangerous Trades," London, 1902, pp. 166-181.

[2] Bertillon, J., "Morbidity and Mortality According to Occupations," Journ. Royal Statist. Soc., Vol. LVI, Dec., 1892, pp. 586-88.

Occupations exposing the workman to inhale soft dust. Millers, bakers, sweeps, and spinners are less unhealthy than the preceding class.

Occupations exposing the workman to excessive heat, smoke, or steam. Glass workers and stokers have a high rate, while blacksmiths are comparatively healthy.

Occupations exposing the workman to absorb hurtful substances. File cutters, printers, potters, plumbers, and tobacconists have a very high rate.

Occupations exposing the person to the enticements of alcohol. Inn keepers and brewers have an excessive rate.

Occupations exposing the workman to numerous accidents. Coal miners and railroad employees would have a low rate except for accidents.

Sedentary occupations. Some of these have a low mortality, and others a high one, but this seems to depend upon the atmosphere they breathe. If this is pure they are not necessarily unhealthy.

Professional classes. These callings generally presuppose a certain amount of means, so that the rate among them is comparatively low.

It appears then that a person need not fear exposure to the weather if he is exercising. Working in a confined atmosphere, where hard particles of dust are present, or where the workman is exposed to hurtful substances, is particularly injurious. Excessive drinking induces disease, and renders the person less able to combat any sickness which may come upon him.

Deaths from Principal Diseases. There have been and are at present several different methods of classifying diseases, but the one which is here adopted is that which was used in the "Twelfth Census of the United States." There are eight main divisions, each including several specific diseases. In this study those only are included in which the death-rate was over 10 per 100,000 of total population in the registration states in 1900. The deaths from these diseases were as follows:

DEATHS PER 100,000 OF POPULATION IN THE REGISTRATION STATES DURING THE YEAR ENDING MAY 31, 1900[1]

	Total	Cities	Rural
General diseases	759.0	835.6	648.9
Measles	14.8	18.2	9.9
Scarlet fever	11.0	13.0	7.4
Diphtheria	31.7	43.1	15.2
Whooping cough	14.0	16.4	10.6
Influenza	29.1	25.3	34.6
Typhoid fever	25.4	25.3	25.5
Dysentery	13.0	12.5	14.0
Diarrhea	13.7	14.7	12.2
Enteritis	49.2	67.7	22.6
Cholera infantum	50.8	57.6	41.0
Inanition	17.0	19.1	13.9
Old age	53.1	38.4	74.4
Premature birth	33.4	40.0	23.9
Debility and atrophy	43.7	55.6	26.6
Diabetes	10.6	10.1	11.4
Hydrocephalus	12.6	16.5	6.9
Consumption	175.9	204.8	134.1
Cancer	62.1	59.8	65.3
Diseases of the nervous system	214.0	208.3	222.3
Meningitis	36.3	43.5	25.8
Apoplexy	76.1	73.8	79.5
Paralysis	31.7	22.2	45.5
Convulsions	24.5	28.4	18.9
Diseases of the brain	17.2	15.5	19.5
Diseases of the circulatory system	154.5	148.3	163.6
Diseases of the heart	137.3	131.4	145.8
Diseases of the respiratory system	279.3	335.1	199.0
Pneumonia	193.3	233.1	135.9
Bronchitis	49.7	61.4	32.7
Diseases of the digestive system	93.0	94.6	90.6
Gastritis	14.0	13.5	14.8
Diseases of the liver	21.7	22.6	20.4
Peritonitis	15.8	16.3	14.9
Diseases of the urinary system	104.8	117.2	87.0
Bright's disease	81.5	95.4	61.5
Diseases of the female organs of generation	11.8	13.7	8.7
Affections connected with pregnancy	26.3	27.6	24.5
Accidents and injuries	83.7	84.2	83.0
Drowning	11.3	10.4	12.6
Railroad accidents	10.3	9.2	11.9
Total deaths	1,729.3	1,861.3	1,539.2

[1] Twelfth Census of the United States, 1902, Vol. III, pp. 113-114.

Instead of discussing this table as a whole we will take up the separate groups of diseases in order.

General Diseases

Measles. The death-rate from measles has increased from 10.7 to 14.8 since 1890, although in the total registration area there has been a slight decrease. In England and Wales the death-rate in 1899 was 31.5. The mortality in the cities of the registration states was nearly twice as high as in the rural districts. The rate for females was slightly higher than for males. The rate was highest among native white children having one or both parents foreign (28.3) and lowest among the foreign whites (2.6). This is due to the small proportion of children among the latter class. The death-rate among children of mothers born in Italy was 67.0 for the registration area, a rate nearly three times that of any other group with foreign mothers. This is peculiarly a disease of childhood, and 85.1 per cent. of the total deaths from this cause among males, and 80.2 per cent. among females were of persons under 5 years of age. The death-rate was the highest in the Southwest Central region (51.7), and the South Mississippi River belt (40.7). Deaths were most frequent in the spring and least in the fall of the year, those in March being about seven times as numerous as in October.

Scarlet Fever. The death-rate from scarlet fever had decreased from 13.0 in 1890 to 10.7 in 1900. The rate in England and Wales in 1899 was 11.7, and in Germany 1897-1901, 20.0. The rate in the cities was nearly twice as high as in the rural districts. The rate was about four times as high for the native whites as for the colored. The foreign born had the lowest rate of any class in the country, but this is explained by the small proportion of children among them. The disease was very fatal for children of mothers born in Russia and Poland. The rate for males exceeded that for females, and the disparity was particularly noticeable under one year of age. For all classes the rate was the highest under 5 years, although there has been a decrease of over 30 per cent. since 1890. That this is particularly a disease of childhood is shown by the fact that 62.9 per cent. of the deaths of males and 66.6 per cent. of those of females were of persons under 5 years of age. The mortality from this disease was greatest in the northwestern section of the United States, and lowest in the southwestern. During the first half of the year the rate was the highest, and lowest in the last, reaching the maximum in February and the minimum in September.

Diphtheria and Croup. In 1890 the death-rate per 100,000 of population was 95.4 while in 1900 it had fallen to 40.3. In England and Wales in 1899 the rate was 32.5, and in Germany, 1897-1901, 31.1. The rate in the cities of the registration states (52.8) was more than twice as high as that in the rural districts. The rate for males was slightly higher than for females. The rate for the whites was nearly 50 per cent. higher than for the colored. Deaths from this disease are most frequent among children, with 67.4 per cent. of the deaths of males, and 61.7 per cent. of those of females occurring among children under 5 years of age. In fact the average age at death from this disease was 5.4 years. These diseases were most fatal in the Appalachian region and least so in the South Atlantic and Gulf coast region. The highest mortality on record was reached in November, December, and January, and the lowest in June, July and August.

The great decrease in the mortality from diphtheria is due to the introduction of the anti-toxin treatment. During the years 1849-94 there were admitted to the City Hospital of Dresden 1,403 cases of diphtheria, and 316 deaths occurred, making the percentage of deaths 22.5. The first injection of anti-toxin was on Sept. 5, 1894, and in the four years 1895-98 there were 434 cases and 35 deaths, or 8.1 per cent. of the cases resulted fatally. It might be better to compare these cases with those which came to the hospital in the few years immediately preceding the introduction of the new treatment. In the four years 1891-94 there were 336 cases and 115 deaths, giving a mortality of 34.2 per cent. When we compare with this the 8.1 per cent. of fatal cases after the new treatment was used, the results are even more striking.[1] We have here one of the cases in which medical science has made the greatest progress.

Whooping Cough. The rate for this disease has decreased from 18.2 in 1890 to 14.0 in 1900. In England and Wales the rate in 1899 was 31.9. Among the colored in the registration states the rate (31.3) was more than twice as high as among the whites (13.7). The foreign whites had a rate of only 0.9, but this is due to the small proportion of children among them. The rate in the cities is more than 50 per cent. greater than in the rural districts. The female death-rate is a little higher than the male. Under 1 year of age the rate is 354.0 per 100,000, and under 5 years it is 129.7. For measles and whooping cough the maximum mortality is reached during the first year of life, but for scarlet fever and diphtheria it comes a year or two later. Over one half of the deaths from whooping cough occur before the end of the first year, while 96.6 per cent. of the male deaths, and 94.4 per cent. of the female deaths are of children under 5 years of age. The deaths from this disease are most frequent in the Southwest, and least frequent on the Pacific coast. There are two periods of great intensity for this disease, one in March and the other in August, while the lowest points are reached in June and October.

Influenza. It is impossible to determine whether the rate from influenza has decreased in recent years in the United States, since no returns were made upon this disease in the census of 1890. In England and Wales the rate in 1899 was 39.1, much higher than in this country. The rate for females in the registration states was nearly a half higher

[1] Prinzing, F., "Sonderabdruck aus der Festschrift zum fünfzigjährigen Bestehen des Stadtkrankenhauses zu Dresden," noted in Pub. Amer. Statist. Assn., New Series No. 58, June, 1902, p. 93.

than for males. Among the colored the mortality was considerably higher than among the whites. The rate in the rural districts was 34.6 and in the cities, 25.3. Among the white population the rate was the highest for those whose mothers were born in Ireland. The mortality from this disease was greatest for children under 5 years, and persons over 45 years of age. Under 5 years the mortality of males exceeded that of females, but for all above this age the rate was higher among the females. The mortality was greatest in the Southeastern or Gulf States, and lowest in the Western States. Nearly three-fourths of the deaths from this cause occurred in March, April, and May, while July, August, and September combined contributed less than 3 per cent. of the cases.

Typhoid Fever. The death rate from typhoid fever has decreased from 46.3 in 1890 to 33.8 in 1900 for the registration area. In England and Wales the rate in 1899 was 19.9. The rate in this country was, in all cases, higher for males than females. There was very little difference in the mortality between city and country. The deaths were most frequent in the age group from 15 to 24, although the variations at the different ages were smaller for this than almost any disease. Although it was particularly fatal in youth, it claimed its victims at all ages. Over 50 per cent. of the deaths were of persons betwen 15 and 34 years of age. If a narrow strip along the Atlantic coast and the Gulf of Mexico is excepted, the rate was the highest in the southern states to the east of New Mexico. It was lowest in the northern tier of states. From September until November, inclusive, the deaths were most frequent, while from April until June, inclusive, the rate was the lowest.

Typhoid fever is sometimes taken from contaminated food, but by far the largest proportion is from an infected water supply. There have been several epidemics of this disease during which persons in a certain district of a city were affected. It is, therefore, very important that all possible precautions be taken to keep the water supply of a city from contagion. It has been found that where the city assumes the function of distributing the water, examining and controlling the water shed, and reservoirs, the deaths from typhoid fever are less frequent than where the families separately procure their own supply.

In Massachusetts a study has been made of the connection between the death-rate from typhoid fever and the percentage of the population supplied with public water.[1]

	Death-rate from Typhoid Fever per 100,000 Population	Percentage of Population Not Supplied with Public Water
1856-65	92.9	75.44
1866-75	80.8	58.94
1876-85	47.4	31.75
1886-95	36.4	13.93

As a continually greater proportion of the population has been supplied with public water, the death-rate has diminished. The effect of the improved water supply is here very apparent. The entire cause for this change cannot be attributed to the fact that the city furnishes the water, for improvements are continually being made by filtering or proper care, by which the possibility of contagion is diminished. Medical science has made some advances in its ability to combat the disease. In order to tell how much of this decline in the rate of mortality is to be attributed to the change in the water supply, it would be necessary to know the rate among those who were not furnished with water by the municipalities.

Jersey City and Newark furnish an interesting comparison of the effect of pure water upon the mortality from typhoid fever.

DEATHS PER 100,000 POPULATION FROM TYPHOID FEVER

	Jersey City	Water Supply	Newark	Water Supply
1889	...	A	90.0	A
1890	90.8	A	62.8	A
1891	94.5	A	96.4	A

[1] Vital Statistics of Massachusetts, Pub. Doc. No. 34, p. 781.

DEATHS PER 100,000 POPULATION FROM TYPHOID FEVER[1]

	Jersey City	Water Supply	Newark	Water Supply
1892	52.4	A	42.1	B
1893	59.8	A	22.2	B
1894	66.1	A	16.6	B
1895	73.6	A	23.1	B
1896	60.9	A & B	20.9	B
1897	21.4	B & C	14.4	B
1898	36.3	B & C	13.2	B
1899	15.0	B & C	27.5	B
1900	21.3	D	20.0	B

A=Passaic River at Belleville (Below Paterson and Passaic).
B=Pequannock River.
C=Passaic River at Paterson Falls (Above Paterson and Passaic).
D=Passaic River at Little Falls (Above Paterson and Passaic).

We see that while Newark and Jersey City took their supply from the same source, 1889-91, the death-rates were nearly alike. Then Newark changed to the Pequannock River, and immediately the rate fell. Jersey City had a rate twice as high as Newark until it too changed its supply, going up the river in order to avoid contagion. Since then the rates for the two cities have been much the same, although only about a fourth as high as before the change was made. No more striking proof than this could be given of the necessity of providing a city with good water.

Diarrheal Diseases. The diseases grouped under this title are cholera infantum, cholera morbus, colitis, diarrhea, dysentery, and enteritis, but in this place they will all be considered together. In the group of principal diseases the rates for dysentery, enteritis, and cholera infantum were given separately. From this group of related diseases the rate for the registration states in 1900 was 132.3, while in 1890 it was 178.7. The rate in the cities (156.7) was much higher than in the rural districts (97.2). Among the colored the rate was 189.7 and among the whites 131.1, while among the foreign whites it was only 52.1. The low rate for the foreign is due to the small proportion of children among

[1] Annual Report of the Dept. of Health of Newark, New Jersey, 1900.

them. If we take the class with the largest proportion of children, the native whites of foreign parents, the rate reached the height of 220.2. The death-rate for males was almost invariably higher than for females. The greatest mortality was for children under 1 year of age, where the rate was 3,833.9 per 100,000. Under 5 years the rate was 1,022.6. In England and Wales the rate for children under 5 years during 1899 was 1,128.5. In cities the death-rate for children under 1 year was nearly twice as great as that in the country districts for the same age, showing the effect of improper feeding, and the intense heat of the city tenements. The death-rate for white children under 1 year of age was highest for those whose mothers were born in France (9,567.2) and lowest for those whose mothers were born in Poland (2,994.6). The death-rate for white children of native mothers was 3,059.2. Slightly over four-fifths of the male deaths and three-fourths of the female are of children under 5 years of age. The average age at death from these diseases in the registration area was 12.3 years. The mortality was the greatest in the Gulf Coast, and the Southwest Central regions, while it was lowest on the Pacific Coast. More than two-thirds of the deaths from these diseases occurred in the months of July, August, and September, while the lowest point was reached during the winter months. During the remainder of the year there was no great difference between the rates for city and country, but during the summer months the rate in the city was nearly three times as high as in the rural districts. The effect of life in these city tenements will be discussed under the head of infant mortality.

Small-pox. According to the returns of the Twelfth Census the total number of deaths from small-pox during the year ending May 31, 1900, was 3,484. The periodical epidemics of this disease were formerly much dreaded, but isolation and vaccination have succeeded in greatly reducing its prevalence and virulence. That vaccination has reduced the probability of death from this cause is very apparent.

The records for several cities in England, during epidemics of small-pox have been collected, showing the effect of vaccination to reduce the proportion of deaths.[1]

		Vaccinated			Unvaccinated		
	Period	Cases	Deaths	Rate	Cases	Deaths	Rate
London	1891-1900	125	0	0.0	672	153	22.8
Sheffield	1887-88	353	6	1.7	228	100	43.9
Dewsbury Union ...	1891-92	44	1	2.2	174	56	32.1
Warrington	1892-93	33	2	6.0	32	12	37.5
Gloucester	1892-93	26	1	3.8	680	279	41.0
Manchester	1892-93	11	0	0.0	36	7	1.94
Bradford	1893	17	0	0.0	57	23	40.3

With one exception, the percentage of mortality was over ten times as great among the unvaccinated as the vaccinated. The case of London, in which there were 125 cases and no deaths where the patients had been vaccinated, is most remarkable.

In Sheffield, 1887-88, London, 1892-93, Dewsbury, 1891-92, Narrington, 1892-93, Leicester, 1892-93, and Gloucester, 1895-96, there were small-pox epidemics. The statistics of these towns for the years in question show the following conditions:

	Recoveries	Deaths	Totals
Vaccinated	8,283	461	8,744
Unvaccinated	1,499	822	2,321
Total	9,782	1,283	11,065

Only about 5 per cent. of the vaccinated died, while nearly 40 per cent. of the cases among the unvaccinated resulted fatally.[2]

Dr. N. A. Humphreys has stated the advantage which has been gained to the world by the introduction of vaccination.[3] The mean annual death-rate from small-pox at all

[1] Sykes, J. F. J., "Small-pox in London," Discussion, Public Health, Jan., 1902.

[2] Macdonnell, W. R., "On the Influence of Previous Vaccination in Cases of Small-pox," Biometrika, Vol. I, 1901-2, pp. 375-76.

[3] Humphreys, N. A., "Vaccination and Small-pox Statistics," Journ. Royal Statist. Soc., Sept., 1897, pp. 536-537.

ages in England and Wales, which was 408 per million in the twelve years for which records exist prior to compulsory vaccination, fell to 126 per million in the 42 years since vaccination was made compulsory, although this latter period includes the world-wide epidemic of 1871-72.

The greater part of this decline occurred among children under the age of 10 years.

The age incidence of small-pox has changed under the influence of infant vaccination. Although originally a disease of childhood, it is now more one of the middle aged.

Efficient infant vaccination confers complete immunity from the disease for children under the age of 10 years.

Both the small-pox attack-rate and the mortality is much lower among those who have been vaccinated in infancy than among those who have not.

In the light of these facts parents who object to the vaccination of their children should have scant sympathy. There have undoubtedly been cases of tetanus induced by the use of impure vaccine, but, with proper precaution, the saving in infant life by vaccination is very great.

Old Age. The death-rate from old age in the registration area in 1900 was 54 per 100,000 of population, while in 1890 it was 44.9. In England and Wales the rate from this cause in 1899 was 99.2. The rate in the rural districts of the registration states in 1900 was 74.4 and in the cities 38.4. This difference is in part due to the greater proportion in the upper age groups in the country districts and in part to a more careful diagnosis of diseases in the cities. The rate for the foreign whites (83.4) was much higher than for any other class, owing to the large proportion of old people in this class. On the other hand the rate for the native whites with one or both parents foreign was only 6.9. In this class there is the greatest proportion in the early age groups. There was very little difference between the rates for white and colored. Among the children of the foreign born the rate was higher among those whose mothers were from Scotland or Ireland than from Italy or Poland. The children of those races which have been coming to this country for a long period are older and more liable to death from this cause than the children of the races which have but recently migrated to us in such large numbers. For both sexes the greatest proportion of deaths from old age occurred among those from 80 to 84 years of age. Only 15.2 per cent. of the deaths of males and 21.4 per cent. of those of females were of persons under 65 years. The deaths from this cause were most numerous in March and the lowest in the summer months.

Consumption. The total number of deaths reported as due to consumption in the United States in 1900 was 109,750, of which 53,626 were males, and 56,124 were females. In the registration area the rate was 187.3 per 100,000 of population. In England and Wales in 1899 the rate was 133.8. In 1900 pneumonia was the only disease to claim more victims than consumption, while before this date more deaths had been due to consumption than any other single cause. These deaths are all the more unfortunate when we consider that this is a preventable disease, brought on by improper living conditions. Plenty of fresh air and sunlight will kill the germs, and yet it is estimated that there are eight millions of people in this country who will eventually die from consumption unless strenuous efforts are made to combat the disease. Working in a confined atmosphere, and living in damp, poorly ventilated rooms, the dwellers in the tenements of the great cities fall easy victims to the great white plague.

Dr. Edward O. Otis has written as follows concerning this disease: "We must continually insist upon the danger of tuberculous sputum, and hence the positive danger, always present, of promiscuous spitting; and, secondly, insist upon the importance of wholesome living—fresh air, good food, rest, and cleanliness. We shall never stamp out consumption by directing our efforts solely against the source of infection. We must also labor to promote conditions of wholesome living: teach the people the elements of personal and house hygiene; teach them what is and how to obtain this wholesome living. On these two lines of effort must we depend in our exertions to stamp out the disease."[1]

In the registration states the rate for males was 182.8 and for females, 158.3. It was formerly the case that the death-rate from this disease was higher for females than for males, but this is no longer the case in most countries. In Massachusetts, 1859-61, the rate from consumption per 10,000 of each sex was 33.5 for males and 40.3 for females. In 1899-1901 the rate for males was 19.3, and for females 17.4. This change took place gradually, but the male rate passed that for females in 1894. The decrease in the rate for males between 1859 and 1901 was 42.4 per cent., and for females 56.8 per cent.

If we compare the number of deaths from consumption by sexes for Massachusetts and England we find that the excess of male deaths appeared somewhat earlier in England.

DEATHS FROM CONSUMPTION BY SEX IN MASSACHUSETTS AND ENGLAND[2]

Deaths of Females to 1,000 Males in Equal Numbers Living

	Massachusetts	England
1851-60	1,296	1,076
1861-70	1,095	1,006
1871-80	1,154	918
1881-90	1,094	871
1891-1900	995	773

With the exception of the decade 1871-80 in Massachusetts there has been in both countries a steady decrease in the proportion of female to male deaths.

The ratio of female to male deaths varies considerably by age groups. This point is brought out clearly by the following table:

[1] Otis, E. O., "The Tuberculosis Problem and Some Suggestions in Dealing with it," Boston Medical and Surgical Journal, Feb. 2, 1905.

[2] Abbott, S. W., "The Decrease of Consumption in New England," Pub. Amer. Statist. Assn., New Series No. 65, Mch., 1904, pp. 5-6.

DEATHS FROM CONSUMPTION IN MASSACHUSETTS BY SEX AND AGE GROUPS[1]

Deaths of Females to 100 Males in Equal Numbers Living

Ages	1859-61	1899-1901
0- 4 years	104	94
5- 9 years	105	169
10-14 years	238	225
15-19 years	171	137
20-29 years	122	99
30-39 years	130	86
40-49 years	113	72
50-59 years	87	59
60-69 years	90	63
70-79 years	92	78
80 and over	108	103
Total	120	90

At the earlier period the ages 50-79 were the only ones in which the deaths among females were less numerous than among males, while at the later period the deaths among males were more frequent at all ages except from 5 to 19, inclusive, and over 80. From 10 to 14, inclusive, are the years when the deaths among females surpass those among males to the greatest extent. From 50 to 59, inclusive, the ratio of female to male deaths reaches the lowest point.

Consumption is preëminently a disease which attacks both sexes in the most vigorous years of life. Children suffer from it comparatively little. In the United States it claims over half of its victims from those who are between 20 and 40 years of age. In some countries consumption causes more than half of the deaths in certain age groups. In Belgium, 1885-94, 53 per cent. of the deaths from the 20th to the 30th years were caused by tuberculosis, and in Vienna, 1891-92, 64.3 per cent. of the deaths within the same age group were due to the same single cause.

To illustrate the differences in the proportion of total deaths at different ages which are due to tuberculosis the following table has been introduced:

[1] Abbott, S. W., *Op. cit.*, pp. 17-18.

TUBERCULOSIS IN AUSTRIA IN 1896[1]

Out of 1,000 Deaths at Each Age Group There Were Caused by Tuberculosis	
Under 3 months	16.79
3-6 months	50.57
6 months-1 year	65.11
1-2 years	97.87
2-3 years	111.32
3-4 years	100.76
4-5 years	102.37
5-6 years	107.82
6-10 years	151.82
10-15 years	284.94
15-20 years	477.40
20-30 years	504.81
30-40 years	414.14
40-50 years	301.52
50-60 years	201.07
60-70 years	108.82
Over 70 years	26.92
Total	134.36

From the 2d to the 6th year 10 per cent. of the deaths are from this single cause; from the 10th to the 15th years, over one fourth; from the 15th to the 20th, nearly a half and from the 20th to the 30th, over a half. The proportion gradually increases until this maximum is reached, followed by a continual decrease.

The negroes die from consumption in great numbers. In 1900 the death-rate in the registration states was 431.9 for the colored, compared to a rate of only 170.5 for the whites. In the cities, the colored rate is 471.0. The negroes seem unable to resist diseases which attack the lungs. This may be in part due to some constitutional weakness, but it is probably to be traced to the fact that in the cities their homes are usually in the poor quarters, poorly lighted and ventilated. Even in the rural districts the rate is considerably higher than among the whites. A large proportion of the negroes in the rural districts of the South live in huts of one room, where the isolation of a person who is suffering from consumption is practically impossible.

If we consider the mortality from this disease among

[1] March, L., "La nouvelle statistique autrichienne du mouvement de la population," Journ. de la Soc. de Statistique de Paris, Mch., 1900, p. 104.

whites according to the nationality of the mother, we find that in every age group, with the single exception of the one including those under 15, the rate is highest among those whose mothers were born in Ireland. But in no case do the figures approach those for the colored. Compare the number of deaths in 1900 per 100,000 in each age group in the registration area among the white and colored population.

	White	Colored
Under 15 years	31.8	246.0
15-44 years	234.8	587.4
45-64 years	320.8	518.0
65 years and over	252.3	548.7

In no age group the rate for the colored less than twice as great as for the white, while under 15 the colored mortality is frightful. It is here almost exactly 8 times as high as among the whites.

In the United States the deaths due to consumption are most numerous in the Pacific Coast region and the states east of the Mississippi and between the 33d and 39th degrees of latitude. Tennessee, North Carolina and Virginia are the states in this group where the rate is the highest.

We have seen that the death-rate from consumption is higher in the cities than in the rural districts. It is also true that as a rule, the rate increases with the size of the place. This is largely due to the fact that in most cases the overcrowding is greater and the sanitary conditions poorer in the large than the small cities. Figures have been collected for Austria which bear upon this point.

TUBERCULOSIS IN AUSTRIA IN 1896[1]

Size of Place	Deaths from Tuberculosis to 1,000 Total Deaths
0- 500 persons	113.11
501- 2,000 persons	122.09
2,001- 5,000 persons	138.50
5,001-10,000 persons	164.61
10,001-20,000 persons	168.41
Over 20,000 persons	194.12

[1] March, L., "La nouvelle statistique autrichienne du mouvement de la population," Journ. de la Soc. de Statistique de Paris, Mch., 1900, p. 104.

These figures are not as satisfactory as would be a set comparing the number of deaths to the total population, rather than the number from one cause to the number from all causes. The number of deaths from tuberculosis per 1,000 of total population might not have varied in the different cities, while a decrease in the other factor of the ratio, the total number of deaths, would alone have caused the variation. But, as a matter of fact, the total death-rate in Austria increases with the size of place quite regularly, and since the number of deaths from tuberculosis compared to the total deaths increased as the cities were larger, it is evident that the proportion of deaths from this cause to the total population in the places of different size would have shown an even greater increase.

In 1900 the density of Maine, New Hampshire, and Vermont, was 30.2 per square mile, while that of Connecticut, Massachusetts, and Rhode Island was 296.7. The death-rate from consumption per 10,000 population, 1892-1901, was 16.4 in the former group of states and 19.7 in the latter.[1] Of course not all of this difference is due solely to the density of population, but, in large measure, to the allied fact that a much greater proportion of the population in the former group was engaged in farming and other outdoor occupations.

A study has been made of the deaths from consumption in the different counties of Massachusetts, covering the period 1871-1900, to determine if proximity to the seaboard had an effect upon the rate.[2]

DEATHS FROM CONSUMPTION IN MASSACHUSETTS PER 10,000 POPULATION, 1871-1900

All seaboard counties except Suffolk	31.1
Worcester County	27.9
The Connecticut River counties	27.5
Berkshire County	23.7

[1] Abbott, S. W., "The Decrease of Consumption in New England," Pub. Amer. Statist. Assn., New Series, No. 65, Mch., 1904, p. 3.

[2] Abbott, S. W., *Op. cit.*, p. 4.

Suffolk County was excluded because there were several institutions in this county to which consumptives were admitted from the other counties.

The proportion engaged in industry is greater in the eastern part of the state, but if this variable is overlooked the figures show that, as the distance from the seaboard increases the deaths from consumption decrease.

There is no question concerning the truth of the statement that occupation has an effect upon the rate of mortality from tuberculosis. The following figures for Austria are not computed quite satisfactorily, but they show this tendency.

TUBERCULOSIS IN AUSTRIA IN 1896 [1]

	Deaths from Tuberculosis to 1,000 Total Deaths
Agriculture	111.63
Industry	174.66
Commerce and transportation	147.79
Domestics	143.08
Liberal professions	98.06

The members of the liberal professions, with their larger incomes, are able to live under better conditions than the other groups, and the mortality from tuberculosis is comparatively low. The outdoor life of those engaged in agriculture renders them less liable to death from consumption. Those in industry have the highest proportion, due to their indoor work and poor housing accommodations. The domestics spend a large proportion of their time indoors, but it is in the homes of the well-to-do, where they are free from the crowded conditions of the tenements.

In Switzerland, 1879-90, the proportion of total deaths which was due to tuberculosis was higher for those engaged in industry than for those in any of the other large occupational groups. The table gives the figures by age groups.

[1] March, L., *Op. cit.*, p. 104.

TUBERCULOSIS IN SWITZERLAND, 1879-90[1]

Deaths from Tuberculosis per 1,000 Total Deaths

Age Groups	Raw Materials	Industry	Transportation
Total	97	224	178
15-19 years	210	359	306
20-29 years	289	492	443
30-39 years	268	437	370
40-49 years	181	302	249
50-59 years	117	180	140
60-69 years	58	90	66
70-79 years	19	26	19
80 and over	3	4	3

Less than 10 per cent. of the deaths of those engaged in the production of raw materials are due to tuberculosis, while 22.4 per cent. of those in industry are due to the same cause. For all of the occupations the greatest proportion of deaths due to this cause is between 20 and 30 years of age. Almost half of the deaths of those between these ages engaged in industry are caused by consumption. When we consider that this is a preventable disease the magnitude of these figures seems to grow.

A far better method of comparing the mortality of the different occupations from consumption is to put the average mortality of all the groups at 100, and express the death-rates of the several occupations on this as a base.

TUBERCULOSIS IN SWITZERLAND BY OCCUPATIONS AND AGE GROUPS, 1879-90[2]

The Average Mortality for Each Age Group is Placed at 100

Occupation	20-29	30-39	40-49	50-59
Agriculture	48	51	54	64
Forestry	28	54	55	52
Railroads	49	55	65	72
Shoemaker	116	108	112	152
Tailor	154	134	150	161
Locksmith	194	252	261	354
Cooper	146	271	221	173
Painter	214	207	249	209
Watchmaker	206	198	184	168

[1] Herkner, H., "Die Sterblichkeit landwirtschaftlicher und gewerblicher Bevölkerungsgruppen in der Schweiz," Jahrbücher für Nationalök. und Statistik, III Folge, 27 Band, I Heft, Jan., 1904, p. 58.

[2] Herkner, H., *Op. cit.*, p. 58.

From this table we see how relatively free from consumption are the outdoor laborers, while those who work in confinement, with dangerous dusts or poisons, have a high rate. It is also interesting to note that in some cases where the mortality from tuberculosis is small in the early age groups, it increases in the later ones, and where it is high in the early ones it decreases later. The more unhealthy the occupation the sooner are those carried off who are inclined towards tuberculosis. In the healthier occupations the candidates for consumption seem to be able to ward off the disease until a later date, when the proportion rises.

In March, April and May falls the maximum number of deaths from consumption, while in the late summer the lowest point is reached.

It was formerly supposed that a person suffering from consumption was doomed to certain death from the disease. He was carefully shielded from all draughts and exposure to the weather, with the result that death usually followed after an illness of varying length. Then came the realization that pure air, and plenty of it, was a prime necessity if a cure was to be effected, and patients were advised to move to the mountains or certain places where a considerable altitude appeared to offer the best chance for relief. The opportunity to live an outdoor life was considered particularly good in Southern California, and numbers flocked there in search of help. But these changes were possible only to those possessed of some property, and the great majority of sufferers were unable to avail themselves of this cure. It is now recognized that cures can be effected for those who are suffering from this disease in its incipient stages without the necessity of long and expensive journeys. Therefore, sanitoria are springing up in most of the states, where patients can be treated near their homes. The proportion of cures in these places is very high. But the work of the societies which are formed to fight this disease is not limited to those who are already affected. A great campaign of education is being systematically carried on, the motive of which is to teach the people how to live, to show them that fresh air and sunlight are necessary to health. There is not a city or village in this country where education of this kind is not needed. As a result of the attention which has been given to this subject in recent years, there has been a decided improvement, and the death-rate from tuberculosis has fallen rapidly.

In Massachusetts the records have been kept for over 50 years and bear their eloquent testimony upon this point.

DEATHS FROM CONSUMPTION IN MASSACHUSETTS PER 10,000 POPULATION

1851-60	39.9	1891-1900	21.4
1861-70	34.9	1901	17.5
1871-80	32.7	1902	15.9
1881-90	29.2		

Here we find that during this period the death-rate has been nearly cut in half. The saving in misery and suffering from this change can hardly be estimated. The figures for Boston, which run back to 1830, seem to show that an increase in consumption came at about the time of the large Irish immigration, which occurred late in the forties. This may have been a contributing cause, but it seems more likely that the rapid rise in the factory system and the crowding of tenements with a mass of poverty-stricken inmates was more likely to have caused this increase. At this time the sanitation of factories and the conditions of the tenements had received but scant attention.

In England in 1838 the number of deaths from consumption per 10,000 population was 38.0, while in 1896 it had fallen to 13.07. At the end of 50 years the rate was only about a third as high as it had been at the commencement of the period.

The decrease in England has been more rapid for females than males. The percentage reduction at different age groups for the two sexes from 1851-60 to 1891-95 has been computed by Dr. Newsholme.[1]

[1] Newsholme, A., "Elements of Vital Statistics," London, 1899, p. 237.

PERCENTAGE REDUCTION IN CONSUMPTION DEATH-RATE IN ENGLAND BETWEEN 1851-60 AND 1891-95

	All Ages	0-	5-	10-	15-	20-	25-	35-	45-	55-	65-	75 +
Males	37	65	63	66	55	50	37	18	16	19	34	39
Females	53	67	58	57	59	59	53	45	44	46	51	51

At all ages except between 5 and 15 the reduction for females has been greater than that for males, and for both sexes the reduction was smallest between 35 and 65. As a result of this, the age at which the mortality from consumption reaches a maximum has been postponed. Between 1851 and 1860 the maximum for males fell between the ages of 20 and 25, and for females between 25 and 35. In 1891-95 the maximum for both males and females was between 35 and 45.

Cancer. The deaths in the registration area from cancer in 1900 were 60.0 per 100,000 of the population, while in 1890 they were 47.9. In England and Wales in 1899 the rate was 82.9 and in 1890 67.6.

The death-rate in the rural districts was slightly higher than in the cities, but this is largely due to difference in age distribution. The rate for females was nearly twice as high as for males, 79.8 to 44.2.

There were but very few deaths from this disease of persons under 15, but from this point the increase is very rapid. From 15 to 44 it was 19.6 per 100,000 of these ages, from 45 to 64 it was 183.5, and for those 65 and over it was 447.3. Only about a fourth of those who died from cancer were under 50 years of age.

For the age groups 44 and under the rate for the colored was a trifle higher than for the whites, but above this age the rate for whites was much higher. For those 65 and over it was 459.2 for whites and 272.9 for colored.

In every 1,000 deaths of males at all ages from definitely located cancers 430.6 were due to cancer of the stomach, 145.6 to cancer of the liver, 104.2 to cancer of the head, face, and neck, 95.5 to cancer of the mouth and throat.

In females of all ages 276.2 were due to cancer of the uterus, 244.7 to cancer of the stomach, 157.8 to cancer of the breast, and 125.9 to cancer of the liver.

"The excess of deaths from cancer of the female generative and mammary organs reduces the proportions due to cancer of the other organs or parts, as compared with the proportions given for the males, but when cancer of the generative and mammary organs are excluded, the death-rate of males from other forms of cancer exceeds that of the female."[1]

The deaths from cancer and tumor in the United States were most frequent in the Pacific Coast region and in most of the more Northern states, while they were less frequent in the Southern states.

In an article by Laspeyres there is made the attempt to show that the mortality from cancer varies with the density of population.[2] The period covered in the study was between 1891-95 in Prussia. The figures refer to the number of deaths from cancer per 10,000 population between 30 and 80 years of age. In 10 districts where the density of the population was 14 per square kilometer, the rate for males was 14.1 and for females 13.3. In 14 districts with a density of 26 the rate was for males 17.1 and for females 17.0. In 10 districts with a density of 80 the rate for males was 20.1 and for females 19.4.

Cancer is one of the few diseases from which the death-rate has been on the increase in recent years. Attempts are being made all over the civilized world to discover some successful method of combating the disease, but at present success cannot be said to have followed these efforts. The following statistics for Massachusetts show the extent of this increase.

DEATHS FROM CANCER IN MASSACHUSETTS PER 10,000 POPULATION[3]

1875	3.5	1890	6.2
1880	5.6	1895	7.0
1885	5.6	1900	7.1

[1] Twelfth Census of the United States, 1902, Vol. III, p. 187.

[2] Laspeyres, "Ein Beitrag zur Krebsstatistik." Centralblatt für allgemeine Gesundheitspflege, Vol. XX, 1901, p. 242.

[3] Sixtieth Rept. of Births, Marriages, and Deaths in Massachusetts, 1902, p. 225.

The death-rate has more than doubled in 25 years.

In England and Wales the increase has been nearly as rapid.

DEATHS FROM CANCER IN ENGLAND AND WALES PER 1,000,000 POPULATION

	Total	Male	Female
1851-60	317	195	434
1861-70	384	242	519
1871-80	468	312	617
1881-90	589	430	739
1896	764	618	901
1899	829	672	977

It will be seen that the increase for males has been much more rapid than for females. The cancerous affections of males are internal to a greater degree than is the case among females. Part of this increase may be real, and part hypothetical, from the fact that the disease is better diagnosed at present than was formerly the case. When the cancer was external there was little difficulty in determining its nature, but when it was internal this was not so easy. We see that there has been a much greater increase in internal than external cancer. If the cases had been properly diagnosed there is no apparent reason why the increase should have been more rapid for the one than the other. We are therefore led to conclude that part of the increase in the rate of mortality from cancer in recent years is due to the fact that many cases are now assigned to the proper cause which were formerly given to some other.

It has been claimed that one reason why there is more cancer at present is that a larger proportion of the population is in the upper ages where the mortality from cancer reaches a maximum. The only way in which to determine this point is to compare the number of deaths by age groups. When this is done part of the apparent increase is seen to disappear.

In comparing the mortality from any disease at different periods or in different countries it is important to take into consideration the age classification of the population. In the "Contemporary Review," for July, 1899, Dr. Woods Hutchinson wrote: "Those of the profession who see the most of cancer are almost unanimously of the opinion that it is slowly increasing, and almost equally so that this is due to the greatly diminished death-rate from the diseases of infancy and childhood and young adult middle life, and hence the much larger number of individuals which reach and pass adult life. In short, to use a Hibernicism, cancer is increasing because more people are living long enough to die of it."

This error had already been pointed out in a paper by Geo. King and Dr. A. Newsholme, "On the Alleged Increase of Cancer," read before the Royal Statistical Society in May, 1893. "Cancer is par excellence a disease of mature life. In a population of 1,000,000 adult males, aged from 25 to 35, about 95 would die annually from cancer; while there would be about 2,530 deaths among 1,000,000 males from 55 to 65; and 4,405 deaths in 1,000,000 males aged from 65 to 75. Therefore, to take the deaths from cancer at all ages in a community, and to compare them with the total population in order to arrive at the cancer death-rate may introduce an error sufficiently serious to vitiate the results. If there be a larger proportion of lives below, say, 50 years of age, the fraction formed by dividing the number of deaths from cancer by the total population will give an unduly small ratio; whereas, if the lives above 50 years be in excess, the ratio will be unduly large. Now the age distribution of one district may differ materially from that of another, and the age distribution of the males in a community may differ from that of the females, and the age distribution of the same district may possibly differ at different periods."[1]

Diseases of the Nervous System. In the registration area of the United States the deaths from diseases of the nervous

[1] In the Journal of the Institute of Actuaries for July, 1901, is to be found an article by Richard Teece on "The Increase of Cancer," followed by an interesting and valuable discussion. In the same number the article by Geo. King and A. Newsholme is reprinted.

system in 1900 were 217.2 per 100,000 of the population, compared to a rate of 247.4 in 1890. In England and Wales the rate for the same diseases in 1899 was 207.7.

The rate in the registration states in 1900 was higher in the rural districts (222.3) than in the cities (208.3). When compared with 1890 there was a decrease in the death-rate from these diseases in the registration cities, but an increase in the rural districts of the registration states. The rate for males was about 10 per cent. higher than for the females. In the rural districts the rates for the whites and colored were nearly the same, but in the cities the rate for the colored was much higher.

In the registration states the rate was the highest for infants under 1 year of age (1,702.6), and for persons 65 years of age and over (1,508.2). When we compare these figures with those for 1890 we find that for children under 1 year there was a decrease of 981.1, while for persons 65 years and over there was an increase of 162.1. The only cases in which there was an increase was for persons 45 years of age and over. 32.5 per cent. of the deaths of males and 44.3 per cent. of those of females were of children under 5 years.

The average age at death from diseases of the nervous system was 39.9 years in 1900, an increase of 8.2 years since 1890.

The deaths from this class of diseases were quite evenly distributed throughout the year, reaching the highest point in March and April, and the lowest in the Autumn.

Apoplexy and Paralysis. In 1900 the rate from these diseases per 100,000 of population was 99.4, and in 1890, 84.5. The rates for the sexes were nearly equal, but were much higher for both in the rural districts than in the cities.

The mortality from these diseases was highest for those 65 years and over, where it reached 1,208.4 in the registration states. The rate for the colored was higher than for the whites at all ages. Over 62 per cent. of the deaths of both sexes were of persons 60 years of age and over. That these diseases are peculiarly those of advanced years is shown by the fact that the average age at death from these causes in 1900 was 63.2 years.

Convulsions. The death-rate from convulsions per 100,000 in 1900 in the registration area of the United States was 33.1, while in 1890 it was 56.2. The rate for males was about a fourth higher than for females. In the cities the rate was about a half higher than in the rural districts. This disease was almost entirely confined to children, and 95.4 per cent. of the deaths of males and 91.3 per cent. of those of females were of children under 5 years of age. The death-rate of the white per 100,000 under 5 years was 282.9, and of the colored 823.3. This rate for the colored was far in excess of that for any children of foreign born mothers. The death-rate from convulsions was much higher in the northern than the southern section of this country.

Diseases of the Circulatory System. In 1900 the death-rate from the diseases of the circulatory system in the registration area was 150.1, having increased from 134.2 in 1890. In England and Wales the rate from these diseases was 170.8 in 1899. In England the death-rate for females exceeded that for males, but in the United States it was 161.4 for males and 147.8 for females. In the rural districts the rate (163.6) was higher than in the cities (148.3).

The mortality for these diseases was greatest for infants under 1 year and persons 65 years and over, where it reached the height of 1,316.4. The rate for the colored was higher than that for the whites at all ages, except for infants under 1 year of age. Nearly a half of the deaths from these diseases were of persons 60 years of age and over. The death-rate was highest along the Pacific coast and lowest in southeast portions of the country. The deaths reached the maximum from March until May, and were lowest in the summer months.

Heart Disease and Dropsy. Under this title are included deaths from pericarditis, organic diseases of the heart, and dropsy. In 1900 the death-rate from these diseases in the registration area was 140.9 per 100,000 of population, compared with 132.1 in 1890. The rate in the rural districts (156.8) was higher than in the cities (136.0). There was very little difference between the rates for males and females. The rate for the colored was nearly 50 per cent. higher than for the whites. The rate was the highest for persons 65 and over. Among this class it was 1,255.1 in the registration states. For all persons 45 years of age and over the rate was higher for males than for females. That these diseases are particularly fatal to those in advanced years is shown by the fact that about a half of the deaths were of persons 60 years and over. For those dying at 15 years of age or over the average age was 58.8 years in 1900. The proportion of deaths from these diseases was greatest in the Pacific Coast region and the heavily timbered regions of the northwest, while it was lowest in the southwest central region.

There can be no question about the increase of heart disease during the past half century. In Massachusetts we have the figures upon this point since 1850.

DEATHS FROM HEART DISEASE PER 10,000 POPULATION IN MASSACHUSETTS[1]

	Males	Females	Total
1850	3.72	3.34	3.54
1855	5.38	3.86	4.60
1860	5.76	5.46	5.61
1865	7.07	5.69	6.35
1870	7.30	5.93	6.60
1875	8.17	7.82	8.06
1880	10.20	9.19	9.68
1885	11.97	11.00	11.46
1890	15.58	14.95	15.26
1895	15.01	13.55	14.26
1900	13.99	13.35	13.67

The rate increased without interruption until 1890, but

[1] Sixtieth Rept. of Births, Marriages and Deaths in Massachusetts, 1902, p. 227.

since then there has been a decrease. The present rate is, however, nearly four times as high as the one reported in 1850. Although some discredit may be cast upon the earliest figures, there has undoubtedly been a very real increase in the mortality from this cause.

Diseases of the Respiratory System. The death-rate from this class of diseases in the registration area of the United States in 1900 was 279.5 per 100,000 of population, compared to a death-rate of 330.3 in 1890. In England and Wales the death-rate from the same diseases in 1899 was 324.1.

The death-rate in the cities of the registration states in 1900 was 335.1, while in the rural districts it was only 199.0. The death-rate for males was about 10 per cent. greater than for females. The maximum rate of mortality was found among infants under 1 year of age, where it was 2,974.3. Children under 5 and persons 65 and over died at nearly the same rate from these diseases. For the former group the rate was 1,138.2, and for the latter, 1,173.1. For those 5 to 14 years and 65 years and over the death-rate of females exceeded that of males. At all other ages the rate of mortality was higher for the males.

Throughout the registration area the death-rate for the colored exceeded that for the whites at all ages except those 65 and over. For infants under 1 year the rate for the whites was 2,790.2 and for the colored, 7,110.5. The magnitude of this rate becomes apparent when we consider that 7 out of every 100 children born among the colored do not complete the first year of life on account of this one cause. Among the children of mothers born in Italy the rate of mortality was almost as high as among the colored. Children of mothers born in the United States had a lower infantile death-rate from this cause than children of foreign born mothers, with the exception of those from Scotland, Bohemia, and Poland.

Over 40 per cent. of the deaths of both sexes from these diseases were of children under 5 years of age. Taken by quinquennial age groups from 25 to 80 years, the rate was not lower than 30.0 nor higher than 45.9 among the males, and not lower than 26.9 nor higher than 60.6 among the females.

The deaths from this class of diseases were most frequent in the first four months of the year, with the maximum in March, while, during the summer months, the mortality was comparatively low. In August there were less than a fifth as many deaths as in March.

Pneumonia. During the census year ending May 31, 1900, there were 105,971 deaths from this cause reported in the United States, of which 58,340 were males and 47,631 females. In the registration area, where alone the deaths were reported with reasonable accuracy, 10.9 per cent. of the deaths were from this cause. The death-rate was 192 per 100,000 in 1900 and 186.9 in 1890. This made the rate of mortality from this disease greater than from any other single cause, and, unfortunately, it seems to be increasing. In England and Wales in 1899 the death-rate from pneumonia was 125.5 (males, 149.8: females, 102.7).

In the registration states there has been a decrease in the rate in both the cities and the rural districts since 1890, although it has been very small. The rate in the cities was about 80 per cent. higher than in the rural districts in 1900. The rate among the colored was more than 50 per cent. greater than among the whites. In the registration states the rate was higher for those 65 years and over than for any other age group, 773.4 per 100,000 population. At this age group the rate for females exceeds that for males, although in all the other age groups the rate for males is the higher. In the cities about one person in every 100, 65 years and over, died annually from this disease. In the rural districts the rate at this period was only two-thirds as high. For those 65 years and over the death-rate for the whites was higher than for the colored, but from 45 to 64 the rate for the colored was 50 per cent. higher than for the whites, and under 45 the rate for the colored was more than twice as high. For the negroes in this country diseases of the lungs are particularly fatal, and their constitution seems unable to withstand the changes of a northern climate. While, in the registration states the rate for the whites decreased from 195.1 in 1890 to 191.1 in 1900, that for the colored increased from 190.7 to 302.1 during the same period.

While the death-rate of persons under 15 years of age was 194.6 for those whose mothers were born in the United States, it was 452.2 when the mothers were born in Hungary, and 1,039.9 when they were natives of Italy. The children of native parents had a lower rate than children of mothers of foreign parentage except when the mothers were born in Scotland.

38.9 per cent. of the deaths of males, and 37.6 per cent. of those of females were of children under 5 years of age. The average age at death from pneumonia in the registration area in 1900 was 31.5 years.

It was found in Austria that the proportion of the total deaths which were due to pneumonia increased with the size of the place.

NUMBER OF DEATHS FROM PNEUMONIA TO 1,000 TOTAL DEATHS IN AUSTRIA IN 1896[1]

0- 500 persons	78.48
501- 2,000 persons	83.97
2,001- 5,000 persons	92.86
5,001-10,000 persons	87.14
10,001-20,000 persons	95.04
Over 20,000 persons	104.21

The only exception to the increase is in places from 5,001-10,000 in size. One reason why the rate of mortality from this disease increases with density of population is owing to the infectious nature of the disease. It was long supposed that pneumonia was the result of a hard cold which settled

[1] March, L., "La nouvelle statistique autrichienne du mouvement de la population," Journ. de la Soc. de Statistique de Paris, Mch., 1900, p. 104.

on the lungs. We now realize that the sputum of a pneumonia patient, when dried, gives off germs which spread the disease. Dr. Beverley Robinson says: "Pneumonia or lung fever, should be classed among the infectious diseases. It is disseminated by contact. It is taken by the attendants who nurse the patient, and who breathe more or less constantly the contaminated air of the sick room filled with his expired breath, which is frequently the great carrier of infection."[1] The danger from an infectious disease is always increased where the population is congested, and we are not surprised to find it more common in the large than the small cities.

In a paper before the Connecticut Medical Society in May, 1904, Dr. O. T. Osborne said: "Among the inmates of damp, ill-ventilated, dark and crowded dwellings, pneumonia occurs the most frequently, although prolonged exposure to the cold, and especially such exposure after exhaustion, is a predisposing cause. Also, the presence of some other infection, such as measles, whooping cough, influenza, or typhoid fever, is a frequent cause of this disease. As for tubercle bacilli, so are these dark tenement houses breeding places for the pneumococci, and certain houses can positively be stigmatized as pneumonia breeders. From these places the pneumococcus is disseminated, and no walk in life is safe from its onslaught. The disease is also certainly communicable directly, hence pneumonia should be a reportable disease, and the boards of health should begin to disinfect tenement rooms after pneumonia as they now do after a case of tuberculosis.[2]

Bronchitis. In the registration area of the United States the death-rate from bronchitis per 100,000 population was 48.3, compared with 74.4 in 1890. In England and Wales the rate from the same disease in 1899 was 161.3.

[1] Noted in New York Medical Journal and Philadelphia Medical Journal, Vol. LXXXI, No. 6, Feb. 11, 1905, p. 295.

[2] Osborne, O. T., "The Management of Pneumonia," New York Medical Journal and Philadelphia Medical Journal, Vol. LXXXI, No. 1, Jan. 7, 1905, p. 18.

The rate for females was slightly higher than for males in the registration states in 1900, but in England and Wales the rate for males surpassed that for females. The rate for the cities of the registration states (61.4) was nearly twice that of the rural districts (32.7).

The highest death-rates from bronchitis in the registration states were for infants under 1 year of age (874.3), children under 5 years of age (266.5), and persons 65 years and over (269.2). From 5 to 44 years the rate was less than 5.0. For infants under 1 year the rate in the cities (1,099.0) was more than twice as high as in the rural districts (503.6). When compared to 1890 the figures show a decrease of about 50 per cent. in the death-rates from this disease at each age.

For those 65 years and over the death-rate among the whites was higher than among the colored, but in all the other age groups the white rate was far surpassed by the colored. For infants under 1 year the rate for whites in the registration area was 810.7, and for colored 1803.3. In every 100 births the colored lose one more child during the first year from this disease than do the whites. Between the ages of 5 and 45 the death-rate of the colored was over three times as high as among the whites. The constitution of the negro seems unfitted to withstand the sudden changes in temperature and the cold winters of the northern states. This was pointed out with reference to pneumonia, and is again apparent from this study of bronchitis.

The death-rate for infants whose mothers were born in the United States was 618.9, while for infants whose mothers were born in Italy it was 2,616.8 and in France, 1,936.2. Most of the Italians in the eastern portions of the United States came from Southern Italy, and diseases of the throat and lungs prove fatal to their children. The climate is probably responsible for this in large measure, although overcrowding, unsanitary tenements, and improper feeding may contribute by weakening the system and rendering it less able to resist disease.

61.4 per cent. of the deaths of males from this disease and 49.1 per cent. of those of females were of children under 5 years of age. The average age at death from bronchitis in 1900 was 28.9 years, compared to 27.3 in 1890.

Diseases of the Digestive System. In the registration area in 1900 the number of deaths from this class of diseases per 100,000 population was 98.5, increasing from 91.5 in 1890. The rate for males in the registration states (93.4) was almost the same as that for females (92.5). In the cities the rate was 94.6 and in the rural districts 90.6. The highest rate was for infants under 1 year (604.6) and for persons 65 years of age and over (399.7). In every age group except 15 to 44 the rate for males was higher than for females.

For those 65 years and over the whites had a higher death rate than the colored, but in all other age groups the colored rate was the higher. For infants under 1 year of age the rate for whites was 611.9, and for colored 1,401.5. Lack of proper care and feeding is responsible for most of this difference. The rate for infants whose mothers were born in this country was 567.3, while for those whose mothers were born in Bohemia it was 1,303.4, and in France, 1,025.1.

21.3 per cent. of the deaths from these diseases among males were of children under 5 years, and 17.8 per cent. of those of females were in the same age group. The average age of those dying from this class of diseases in the registration area in 1900 was 37.8, compared to 35.3 years in 1890.

The proportion of deaths due to diseases of the digestive system was greater in the heavily timbered region of the northwest, and the prairie region, and least in the North Atlantic and Middle Atlantic coast regions. The deaths were quite evenly distributed throughout the year.

Diseases of the Liver. There are included under this head jaundice, inflammation and abscess of the liver, and other diseases of the liver. From these diseases there were in the registration area of the United States in 1900, 22.7 deaths per 100,000 of population, a slight decrease from the rate of 24.1 in 1890.

In the registration states in 1900 the rate for males (25.0) was about 40 per cent. higher than that for females (18.3). For the males the rate in the cities was higher than in the rural districts, while for the females the opposite was true.

The rate from these diseases was highest for those 65 years of age and over (117.4), followed by those from 45 to 64 (50.9). At every age the rate for males is higher than for females. For persons under 65 years of age the rate for the colored exceeds that for the whites, but for persons 65 and over the rate for the whites is over twice as high as for the colored.

84.7 per cent. of the males dying from these diseases were 40 years of age and over, while 80.9 per cent. of the females fell within the same groups. These are peculiarly diseases of adult life. The average age at death from diseases of the liver in the registration area in 1900 was 48.2 years, compared to 47.9 in 1890.

Peritonitis. The death-rate from peritonitis in the registration area in 1900 was 17.5 per 100,000 of population. The rate had remained at practically the same figure as in 1890, when it was 17.4.

In the registration states the rate for females (19.9) was considerably higher than for males (11.6). The death-rate in the cities was but a little higher than in the rural districts. The rate was highest for those 65 years and over (27.3), but in the other age groups it varied only between 12.0 and 16.7. The rate of mortality therefore appears to be quite uniform throughout life. At all ages the rate for the colored is considerably higher than for the whites. For those under 15 the excess amounts to over 100 per cent., gradually diminishing to those 65 and over, where it was only 40 per cent. greater. The age distribution of those dying from this disease was quite different for the two sexes. Thus 38.0 per cent. of the males to die were under 20 years, while only 22.8 per cent. of the females were under the same age. 35.1 per cent. of the males dying were between 20 and 45, while 56.4 per cent. of the females were in the same middle age groups. Over 45 years the proportion of male deaths was again greater. The average age at death from peritonitis in the registration area in 1900 was 31.8 years. In 1890 it had been 33.2 years.

Diseases of the Urinary System and Male Organs of Generation. In the registration area in 1900 the death-rate from this class of diseases was 102.2 per 100,000 of population, whereas in 1890 it had been but 70.7. In England and Wales the death-rate due to this class of diseases was 48.5 (males, 60.2; females, 37.4).

The rate for males in the registration states (120.9) was nearly 50 per cent. higher than that for females (88.8). The rate in the cities was 117.2 and in the rural districts 87.0. The rate was highest for those 65 years and over (734.2), followed by that for those from 45 to 64 (223.0). Below 15 years the male rate was somewhat higher than that for females. From 15 to 44 the rate for females was the higher. Above this age the male rate was again the higher and for persons 65 years and over the male rate was 1,009.1, and the female 483.9. For all under 65 years the rate for the colored was about twice as high as for the whites, but for those 65 and over the colored excess was only about 35 per cent.

65.5 per cent. of the males who died from this class of diseases in the registration area in 1900 were 50 years and over, and 53.7 per cent. of the females were above the same age. Here again we are dealing with the diseases of adult life. Deaths from this class of diseases reached the maximum in March and the minimum in August.

Bright's Disease. In the registration states in 1900 Bright's disease caused 81.5 deaths per 100,000 population. It must, therefore, be classed next to pneumonia and tuberculosis, as the most fatal single disease in the United States. The rate for males (89.0) was about 20 per cent. higher than for females (74.0). The city death-rate (95.4) was

19

more than a half higher than that for the rural districts (61.5).

The death-rate from Bright's disease was greatest for those 65 years and over, where it reached 529.5, but for those from 45 to 64 it was 192.2. For those under 65 the rate for the colored was about twice as high as for the whites, and for those 65 and over the colored rate was about 60 per cent. in excess of that of the whites.

Diseases of the Female Organs of Generation. In the registration area in 1900 the death-rate per 100,000 of the female population was 12.6, increasing from 10.4 in 1890. The rate from these diseases was about a half higher in the cities than in the rural districts. The changes in the rate at the different ages were very slight. It was 17.0 from 15 to 44, 19.5 from 45 to 64, and 17.6 for females 65 years and over. In every age group the rate was higher for the colored than the whites, although the excess grew less with advancing years. 75.6 per cent. of the deaths from these diseases was of females between 20 and 50 years of age. The average age at death from diseases of the female organs of generation was 39.1 in 1900, and 41.8 in 1890.

Affections Connected with Pregnancy. The death-rate from these causes in the registration area in 1900 was 26.2 per 100,000 of female population. In 1890 the rate was 30.5. The rate in the cities was slightly higher than in the rural districts of the registration states. Since 1890 the rate in the cities has decreased but in the rural districts there has been an increase. The rate for the colored (28.6) was slightly higher than for the whites (26.3), but since 1890 the decrease in the rate among the colored has been greater than among the whites. 83.9 per cent. of the deaths from these causes were of females between 20 and 40 years of age. The average age at death from affections connected with pregnancy was 29.9 in 1900, and 29.6 in 1890. The deaths from these causes in the registration states were most frequent in March, April and May, and least common in September, October and November.

Deaths by Accident and Injury. The total number of deaths reported by the Twelfth Census as due to accident and injury in the United States during the census year ending May 31, 1900, was 57,513, of whom 43,414 were males and 14,099 were females. In the registration area the rate was 96.0 per 100,000 population in 1900, while in 1890 it had been 91.9. In the registration states, however, there had been a slight decrease during the same period, from 85.0 in 1890 to 83.7 in 1900.

As might have been expected, the rate in the cities was somewhat higher than in the rural districts, and since 1890 the rates for these sections have become more nearly equal. The rate for males (125.4) was nearly three times as great as that for females (42.2). This is but natural, since the more dangerous occupations such as railroading and mining employ males to a very large extent.

In the registration states the number of deaths from accident and injury per 100,000 population in corresponding ages in 1900 was as follows:[1]

	Under 15	15 to 44	45 and over
Total	63.7	73.4	131.2
Males	80.6	122.3	187.8
Females	46.7	24.9	75.8
Cities	68.2	73.1	139.7
Males	86.1	122.4	206.7
Females	50.3	25.9	77.9
ural	57.2	73.9	122.6
Males	72.7	122.1	169.5
Females	41.3	23.1	73.5

Under 15 the rate for males was less than twice as great as that for females. At this early age neither sex has begun to enter the factories, mines, and workshops to any considerable degree, and both are exposed to the risk of accidental death from falling, drowning, etc., although the more active life of the boys exposes them to more of the dangers. From 15 to 44 there are about five times as many deaths among the males as the females from these causes. The men are now actively engaged in their life work, while the women are at home attending to their duties as house-

[1] Twelfth Census of the United States, 1902, Vol. III, p. 253.

wives. Thus while the rate for females was only about half as great as in the preceding age group, that for the males had increased about 50 per cent. For the males 45 and over the rate has again increased about 50 per cent. over what it was from 15 to 44. For the females it has more than tripled. The reason for this very large increase in the female rate is possibly due to the fact that many of the women in the oldest age group have become widows and forced to earn a living. In this way they are more exposed to accident and injury than when they spent most of their time at home.

The differences in the age distribution of the males and females who met death by accident or injury in the registration area in 1900 may be made clearer by a study of the proportion of deaths at the different ages to the total deaths from these causes.

NUMBER OF DEATHS AT EACH AGE PER 1,000 AT KNOWN AGES

	Males	Females
Under 10 years	149.2	321.5
10-39 years	504.5	290.7
40-59 years	228.7	157.1
60 and over	117.6	230.7

Under 10 years the proportion of deaths among females to the total deaths from these causes is more than twice as great as among the males. This does not mean that more females than males under 10 years die from accident and injury, for we saw that at no age is the male rate much less than twice as high as the female. It simply means that since the sexes are exposed more nearly to the same dangers of accidental death in childhood than at any other period, while the danger to the males is very much greater in the middle age groups, the proportional mortality of the females will surpass that of the males in childhood. Nearly three fourths of the male deaths are of persons from 10 to 59, inclusive, while less than a half of the female deaths fall within the same age group. After the 60th year the proportion of female deaths is again in excess. As pointed out before, the widows are now forced to earn their own living, and the proportion in the oldest age groups is greater for the females.

The average age at death from accidents and injuries, exclusive of suicide, in the registration area in 1900 was 33.5 years, while in 1890 it was 32.9 years.

The deaths from these causes were most frequent in the summer months, reaching a maximum in July, and least frequent in the winter.

In Connecticut in 1900 accidental and violent deaths caused 4.4 per cent. of the mortality. During the years 1891-1900 there were the following deaths throughout the state from these causes: [1]

Fractures and contusions	921
Railroad injuries	386
Gun-shot wounds	183
Burns and scalds	164
Poisoned	316
Drowning	1,030
Suffocation	165
Other accidents	1,068
Falling	484
Total	5,217

Drowning causes more accidental deaths than any other single cause, closely followed by fractures and contusions. It would be interesting to know the sex and age of those dying from the various causes. These are given for the year 1900.

	Under 10	10-30	30-60	60 and over	Male	Female
Fractures and contusions	6	23	41	49	79	45
Railroad injuries	3	31	52	13	103	6
Gun-shot wounds	4	5	8	1	18	2
Burns and scalds	48	6	11	17	36	46
Poisoned	14	9	26	7	34	23
Drowning	23	55	33	8	117	9
Suffocation	14	0	1	1	11	5
Other accidents	18	27	60	47	115	37
Falling	5	4	12	22	34	10

[1] Report of the State Board of Health of Connecticut, 1901, p. 144.

In some cases the age of the deceased was not given, so that the total of the age groups is not in all cases identical with that of the sexes. The maximum number of deaths from burns and scalds, and suffocation was for children under 10 years; from drowning the maximum was between 10 and 30; from railroad injuries, gun-shot wounds, poison, and other accidents, from 30 to 60. From burns and scalds, and suffocation, there were more deaths under 10 years than over this age. To the old a fall or a fracture is likely to prove fatal. The only cause from which there were more deaths among the females than the males was burns and scalds. As is natural, the number of females meeting death from railroad injuries and gun-shot wounds was very small. When we consider the total number of cases we find that about three males met death by accident or injury to one female.

During the months of April, May and June, 1899, the commissioner of labor of New York State, acting in coöperation with the chief factory inspector, tried to obtain a complete list of the accidents which occurred in a selected list of factories in the state. On the supposition that the same rate was maintained throughout the year, he computed the number injured to each 1,000 employed in various industries. The figures were by no means accurate, but showed how defective had been the reports handed in before this time.

NUMBER OF PERSONS INJURED TO 1,000 EMPLOYED IN THE FACTORIES OF NEW YORK STATE DURING 1899[1]

Stone and clay products	15.18
Metals, machinery and apparatus	26.57
Wood	18.42
Leather, rubber, pearl, etc.	3.21
Chemicals, oils and explosives	44.06
Pulp, paper and cardboard	41.46
Printing and allied trades	9.19
Textiles	8.91
Clothing, millinery, laundering, etc.	1.35
Food, tobacco and liquors	13.51
Public utilities	37.28
Building industry	26.20

[1] Bulletin of the Department of Labor, No. 32, Jan., 1901, p. 25.

The violent deaths which occurred in England and Wales in 1901 were as follows:[1]

	All Ages		Under 10		10-64		65 and Over	
	Male	Female	Male	Female	Male	Female	Male	Female
Mines, quarries, etc.	1,016	1	0	0	981	1	35	0
Vehicles and horses	2,308	382	270	162	1,784	159	254	61
Ships, boats, docks	332	2	1	0	319	2	12	0
Building operations	185	0	0	0	173	0	12	0
Machinery	204	12	6	2	186	10	12	0
Weapons and implements	131	18	7	5	118	11	6	2
Burns, scalds, explosions	1,224	1,530	923	1,019	229	354	72	157
Poisons and poisonous vapors	305	210	62	54	213	140	30	16
Drowning	2,358	406	407	114	1,806	270	145	22
Suffocation	1,026	938	934	897	70	31	22	10
Falls	1,507	1,303	157	101	845	420	505	782
Weather agencies	300	137	42	37	203	64	55	36
Otherwise or not stated	1,145	332	230	148	815	125	100	59
Total	12,041	5,271	3,039	2,539	7,742	1,587	1,260	1,145

The greatest single cause of accidental deaths in England and Wales among the males was drowning, closely followed by vehicles and horses. For the females burns, scalds and explosions caused the most deaths, while falls were responsible for nearly as many. As was the case in Connecticut, burns, scalds and explosions caused the death of more females than males. From suffocation and falls the number of males only slightly exceeded that of females. Although a thousand males met death in mines and quarries, there was but a single female to die in this manner. The deaths of the females were less numerous in those industrial operations in which male help is almost entirely employed. Thus in mining, shipping and building there are more than 500 deaths among males to 1 among the females.

[1] Sixty-fourth Rept. Registrar Gen. of Births, Marriages and Deaths in England and Wales, 1901, pp. 244-252.

At all ages there were a trifle more than 2 deaths of males from accident and injury to 1 of females. Under 10 years, however, there were more than 80 per cent. as many female as male deaths, and 65 and over the numbers were nearly equal. There are only 21 deaths of children under 10 from shipping, mining, machinery, weapons and implements. These find their victims from those who are actively engaged in these occupations. The deaths from burns, scalds and suffocation are almost entirely in the early years of life. Among the females the deaths from vehicles and horses are more common under 10 than in either of the other age groups. The men are in danger of death from these causes throughout life, but a large proportion of the females to meet death thus are young girls, many of whom are run over while playing in the streets. Between 10 and 64 years, in the active period of life, there are about 5 males to meet death by accident to 1 female. About 65 per cent. of the male deaths from these causes fall between the 10th and 64th years, while less than 30 per cent. of the female deaths are within the same age group. For the age group 65 and over there are not only more deaths among the females from burns and scalds, but from falls the number of female surpasses that of male deaths by over 50 per cent.

The frequency of accidental and violent deaths varies greatly in the different countries. In the following table the deaths are per million of population from 1887 to 1893:[1]

Italy	347	Switzerland	557
France	329	Belgium	333
England and Wales	555	Sweden	412
Scotland	621	Norway	469
Ireland	347	Denmark	225
Germany	375	Massachusetts	381
Prussia	404	Rhode Island	682
Austria	271	Uruguay	499
Hungary	233	Japan	485

[1] "Movimento della popolazione in alcuni stati d'Europa e d'America," Bull. de l'Institut Internat. de Statistique, Tome X, Liv. I, 1898, p. 33.

As a rule the most highly industrial states like England, Prussia and Rhode Island have a high rate, while those in which there is not so much industrial development, like Italy, Austria and Hungary have a lower rate. The growth of manufacture, steam railroads and electric lines increases the liability to death from accident.

A great number of the accidental deaths in this country can be traced to the two great industries of coal mining and railroading. Since the greatest coal mining state in the country is Pennsylvania, this might well be selected to furnish the figures required.

FATAL ACCIDENTS FROM COAL MINING IN PENNSYLVANIA, 1891-1898 [1]

	Anthracite		Bituminous	
	I	II	I	II
1890	289	3.46	539	1.85
1891	289	3.46	549	1.82
1892	328	3.05	590	1.69
1893	310	3.22	513	1.95
1894	318	3.14	453	2.21
1895	340	2.94	426	2.35
1896	298	3.35	429	2.33
1897	353	2.84	490	2.04
1898	347	2.89	467	2.14

I=number of employees to 1 killed.

II=number killed per 1,000 employees.

During the years covered by the table there were over 8,000 miners who lost their lives. It appears that the mining of anthracite coal is more dangerous than that of bituminous. In the former the rate of mortality is a little over 3, and in the latter about 2 per 1,000 employees. In a study made by Mr. F. L. Hoffman in the Engineering and Mining Journal for November 24, 1900, of the fatal accidents in the coal mines of the United States and Canada, 1890 to 1899, he concluded that the rate of mortality from accidents to coal miners was 2.64 per 1,000 employees.

The causes of the accidental deaths to bituminous coal miners in Pennsylvania, 1895-98, were as follows:

[1] Bulletin of the Dept. of Labor No. 32, Jan., 1901, p. 16.

Fall of coal, rock, timber, etc.	67.0%
Blasting, powder explosions, etc.	2.6%
In shafts	0.5%
Cars and machinery	16.9%
Fire damp and gas	5.4%
Other	7.6%
Total	100.0%

In England and Wales during the year 1901 about 50 per cent. of the fatal accidents to coal miners were from the falling of coal, about 12 per cent. from explosions of fire damp, and 12 per cent. from machinery.

We have the following statistics for accidents in the mines in France during 1891:[1]

	Accidents	Killed	Wounded	Total Victims
Single accidents	1,081	247	834	1,081
Accidents with 2-5 victims	68	41	113	154
Accidents with 6-10 victims	2	7	7	14
Accidents with over 10 victims.	1	62	10	72
Total	1,152	357	964	1,321

There was, during this year, only one accident in which more than 10 people lost their lives. As the number of persons involved in the accident becomes greater, the probability that it will result fatally increases. Thus in the one large accident there were more than six times as many killed as injured, while in the single accidents the ratio of the injured to the killed was nearly 4 to 1.

The railroads are the cause of a vast number of deaths in this and other countries. Some idea of the magnitude of this cause can be gained from the fact that from 1888 to 1903, inclusive, there were 113,160 persons killed by the railroads of the United States.[2]

[1] Keller, O., "Division des accidents du travail en accidents individuels et accidents collectifs," Journ. de la Soc. de Statistique de Paris, Apr., 1893, pp. 113-15.

[2] The figures for railroad accidents in the United States are taken from the Statistics of Railways in the United States for the year ending June 30, 1903, prepared by the statistician of the Interstate Commerce Commission, pp. 106-131.

During the year 1903 their numbers were as follows:

	Killed	Injured
Employees	3,606	60,481
Passengers	355	8,231
Other persons	5,879	7,841
Total	9,840	76,553

The following fatal accidents resulted from the movement of trains to employees in the United States during the year ending June 30, 1903:

Coupling or uncoupling	281
Collisions	574
Derailments	219
Parting of trains	22
Locomotives or cars breaking down	40
Falling from trains, locomotives or cars	551
Jumping on or off trains, locomotives or cars	198
Struck by trains, locomotives or cars	1,151
Overhead obstructions	96
Other causes	276
Total	3,408

Of the 355 fatal accidents to passengers from the running of trains during the same period, 123 were killed in collision, 50 by derailments, 128 by jumping or falling from trains, locomotives or cars, and 35 by being struck by trains, locomotives or cars.

The following accidents were to persons other than employees from the running of trains during the year ending June 30, 1903:

Collisions	87
Derailments	40
Parting of trains	9
Locomotives or cars breaking down	4
Falling from trains, locomotives or cars	449
Jumping from trains, locomotives or cars	462
Struck at highway crossings	895
Struck at stations	390
Struck at other points along the track	1,925
Other causes	292
Total	5,842

The liability to death from accidents on the railroads of this country can be shown more clearly if we compare the number of employees or passengers killed to the number who are employed on or carried by the trains. This is done in the following table for the 10 years 1894-1903:

NUMBER OF EMPLOYEES, TRAINMEN OR PASSENGERS ON THE RAILROADS OF THE UNITED STATES FOR ONE KILLED OR INJURED

	Employees		Trainmen		Passengers	
	Killed	Injured	Killed	Injured	Killed	Injured
1894	428	33	156	12	1,668,791	178,210
1895	433	31	155	11	2,984,832	213,651
1896	444	28	152	10	2,827,474	178,132
1897	486	30	165	12	2,204,708	175,115
1898	447	28	150	11	2,267,270	170,141
1899	420	27	155	11	2,189,023	151,998
1900	399	26	137	11	2,316,648	139,740
1901	400	26	136	13	2,153,469	121,748
1902	401	24	135	10	1,883,706	97,244
1903	364	22	123	10	1,957,441	84,424

The death of so many employees, most of whom are in the prime of life, is a great economic loss to the community. A large proportion of these accidents is due to the carelessness of the workmen, or the unwillingness of the companies to expend the money needed to install safety appliances. That these figures are far higher than they should be, can be best shown by the introduction of the corresponding figures for the United Kingdom in 1902.

One passenger killed to	198,036,545 carried
One passenger injured to	1,623,250 carried
One employee killed to	1,324 employed
One employee injured to	151 employed

The probability of death per passenger carried is about 100 times as great in the United States as in the United Kingdom, and the English employee stands about a third as great a chance of being killed as the American. It is true that the average length of passenger trips in the United States is greater than it is in England, but this can account for but a small part of the difference in death-rate. There is urgent need that the American roads adopt better safety appliances.

Suicide. The deaths from suicide differ from those due to any other cause in that they are the result of the intention of the victims. This is not the place to discuss the temporary insanity of any person who voluntarily ends his life, or whether it is ever justifiable to commit suicide. This is a problem for the philosopher rather than the statistician. To state a few facts and to endeavor to explain them is all that can be done on this point.

The suicide-rate is as follows in certain countries:

SUICIDES PER 1,000,000 POPULATION, 1887-93[1]

Saxony	324	Hungary	114
Denmark	251	Massachusetts	96
France	227	England and Wales	82
Switzerland	219	Rhode Island	68
Germany	206	Uruguay	64
Prussia	200	Norway	64
Japan	162	Italy	54
Austria	161	European Russia	31
Belgium	125	Ireland	25
Sweden	125	Spain	21

The variations between the rates for the different countries are very great. The rate for Saxony is the highest, closely followed by that for Denmark. It is commonly supposed that the Germanic races show the strongest tendency to suicide. This is certainly borne out by the figures for Europe. The members of the Celtic and Latin races do not have this tendency to the same extent. In a country where the different races are found, the portion where the Germanic stock is the more heavily represented has a higher rate than the portion where the Latin is pre-

[1] Movimento della popolazione in alcuni stati d'Europa e d'America,'' Bull. de l'Institut Internat. de Statistique, Tome X, Liv. I, 1897, p. 34.

dominant. Thus in that portion of Switzerland, where the population is German to a great extent, the rate is higher than where the Italian or French elements are in the majority. In the registration area of the United States the rate of suicide per 1,000,000 of population between the ages of 45 and 64 is 41.5 among those whose mothers were born in Germany, and 42.3 in Scandinavia, while among those whose mothers were born in Italy it is 6.6 and in Ireland 7.3. That the Germans in this country committed suicide more than the Irish has long been noticed. Gen. Francis A. Walker wrote on this point: "He (the Irish) dies by every form of injury except suicide. With indomitable gaiety and hopefulness, he refuses to look upon this world as wholly bad, or to quit it until his time has come. The Germans, on the other hand, are the great suiciding people among us."

In the registration states the rate per 1,000,000 was as follows in 1890 and 1900:[1]

	1900	1890
Connecticut	105	67
District of Coumbia	101	91
Maine	108	..
Massachusetts	93	84
Michigan	87	..
New Hampshire	100	98
New Jersey	91	81
New York	106	95
Rhode Island	91	81
Vermont	99	81

There are no great differences in the rates of the states and they would come at about the middle of the list of European countries.

There was in every one of the states an increase in the rate for 1900 over that for 1890. In almost every European country there has been a decided increase since accurate records have been kept. In France the rate in 1830 was 54 per 1,000,000; in 1840 it had increased to 82; in 1850, to 103; in 1860, to 112; in 1870, to 133; in 1880, to 178; and, as

[1] Twelfth Census of the United States, Vol. III, 1902, p. 255.

we saw from a previous table, the rate from 1887 to 1893 was 227. The increase since 1830 has, therefore, been fourfold. During the century the rate for Prussia has more than doubled.

In the cities the rate has increased even more rapidly than in the rural districts. From 1854 to 1893 the increase in Vienna was considerable.

SUICIDES IN VIENNA PER 1,000,000 POPULATION [1]

1854-58	153	1874-78	295
1859-63	141	1879-83	320
1864-68	197	1884-88	315
1869-73	199	1889-93	307

The highest rate was reached from 1879 to 1883, when the increase over the previous period was very rapid.

As a rule there are about 4 males who commit suicide to 1 female. The rates vary for different countries, but almost never are there less than 75 per cent. or more than 85 per cent. of the total cases males.

THE SEX RELATION IN SUICIDE [2]

States	Per Cent. Males	Per Cent. Females
Sweden (1831-74)	78.7	21.3
Norway (1856-73)	76.4	23.6
England and Wales (1863-90)	74.5	25.5
Belgium (1836-76)	82.2	17.8
Prussia (1816-76)	81.3	18.7
Bavaria (1866-76)	80.4	19.6
France (1836-76)	77.1	22.9
Austria (1851-77)	82.2	17.8
Italy (1864-77)	79.8	20.2
Saxony (1847-76)	79.7	20.3

In the United States the relation is but little different from that in Europe.

[1] Bratassivic, "Die Selbstmorde in Wien während der Jahren 1858-94," Statist. Monatschrift, Wien, Jahrg. XXI, Heft 5.

[2] Hoffman, F. L., "The Sex Relation in Suicide," Pub. Amer. Econ. Assn., Vol. IV, 1894-1895, p. 23.

SEX RELATION IN SUICIDE

States	Per Cent. Males	Per Cent. Females
Massachusetts (1851-92)	77.4	22.6
Vermont (1866-92)	75.3	24.7
Rhode Island (1865-92)	77.0	23.0
Connecticut (1886-92)	83.2	16.8
New Hampshire (1886-91)	80.2	19.8
Michigan (1876-91)	76.6	23.4
Minnesota (1888-90)	80.0	20.0
California (1885-92)	84.9	15.1
Total average	78.4	21.6

The temperament of woman seems to enable her to bear misfortune better than man. He leads a more active life, is usually more ambitious, and the failure to gain some desired end seems to affect him more seriously. The life of woman is more centered in her home. where she is shielded from the stress and storm of life.

The variations in the proportion of male to female suicides from year to year are very small. When we consider the nature of this phenomenon this regularity is most striking. This can be shown very clearly by the figures for Germany.

NUMBER OF FEMALE TO 100 MALE SUICIDES IN GERMANY 1893-1902[1]

1893	25.0	1898	26.8
1894	25.4	1899	27.2
1895	26.9	1900	26.8
1896	27.6	1901	25.2
1897	26.1	1902	26.3

During the 10 years the proportion was never lower than 25.0 nor higher than 27.6. There are few phenomena in the entire realm of social statistics which show smaller variations than this.

[1] Vierteljahrshefte zur Statistik des Deutschen Reichs, 13 Jahrgang, 1904, Erstes Heft, p. 169.

The tendency to commit suicide usually increases with advancing years. There are sometimes cases of quite young children taking their lives from disappointment over expected promotion at school, or from the fear of punishment. When, as in the case of the Report of the State Board of Health for Connecticut for 1898, we find it reported that an infant under 1 year of age committed suicide during that year, we are confronted with an absolute impossibility, for suicide implies the ability to form the resolution to end life. This case should have undoubtedly been reported as an accident.

If the suicides are arranged in age groups of 10 years it is found that in England in 1901 the maximum number of males was between 45 and 54, while that of females was from 35 to 44. As a rule the maximum for females is reached at an earlier age than for males.

When we compare the suicide rates by sex and age, we find that in the early years the rate for females approaches most nearly that for males.

SUICIDE BY SEX AND AGE PER 100,000 OF POPULATION IN PRUSSIA, 1883-90 [1]

Age	Male	Female
10-15 years	3.1	0.9
15-20 years	17.9	9.2
20-25 years	36.0	12.5
25-30 years	32.4	9.6
30-40 years	44.1	9.9
40-50 years	68.3	12.8
50-60 years	86.8	16.7
60-70 years	95.2	18.8
70-80 years	98.2	20.2
Over 80 years	104.4	20.4

The rate for females is more nearly equal to that for males from the 15th to the 20th years, when there are less than twice as many males. The ratio then begins to increase, and 40 years and over, the rate for the males is about five times as great as that for the females.

In England we find a different set of conditions.

[1] Prinzing, F., "Trunksucht und Selbstmord," Leipzig, 1895, p. 25.

NUMBER OF SUICIDES IN ENGLAND AND WALES IN 1901[1]

Ages	Males	Females
10-14 years	5	6
15-19 years	48	74
20-24 years	140	79
25-34 years	364	144
35-44 years	471	168
45-54 years	520	147
55-64 years	442	114
65-74 years	253	64
75-84 years	63	5
85 and over	12	2
Total	2,318	803

For all ages there were about 3 times as many male as female deaths, but under 20 those of the females were more numerous. Women reach maturity earlier than men, and, on account of unhappy love affairs often take their lives in the early years, but after business failures begin to trouble the men, the number of the males increases very rapidly, so that in the later years they far surpass the females.

The number of suicides per 1,000,000 of population of each age group for Massachusetts from 1881-85 was as follows:[2]

Ages	Males	Females
10-20 years	8	12
20-30 years	125	40
30-40 years	174	55
40-50 years	244	61
50-60 years	355	77
60-70 years	424	126
70-80 years	600	76
80 and over	219	23

In Massachusetts the rate from 10 to 20 years is higher for females than for males. The maximum rate for the females

[1] Sixty-fourth Annual Report of the Registrar Gen. of Eng. and Wales, 1901, pp. 258-59.

[2] Dewey, D. R., "Statistics of Suicides in New England." Pub. Amer. Statist. Assn., New Series Nos. 18-19, June-Sept., 1892, p. 81.

is reached from the 50th to the 60th years, while for the males it is deferred until from the 70th to the 80th years.

The proportion of deaths from suicide at each specified age per 1,000 deaths at known ages from this cause in the registration area of the United States in 1900 was as follows:

	Male	Female
Under 20 years	20.0	108.3
20 to 39 years	379.0	527.5
40 to 59 years	415.6	257.2
60 to 79 years	173.5	94.0
80 years and over	11.9	13.0

From this table we see that nearly two thirds of the female suicides occur before the 40th year, while less than two fifths of those of the males are thus early in life. More suicides occur among the males between the 40th and 60th years than before this period, while, among the females, there are less than half as many during these 20 years of mature life as during the earlier ages. The motives which impel the females to suicide have, in many cases, reached the maximum of intensity during the early years, while the causes which affect the males are strongest later in life.

There seems to be no doubt concerning the fact that conjugal condition has its influence upon the rate of suicide. A few instances will clearly establish this point.

NUMBER OF SUICIDES PER 100,000 POPULATION OVER 15 YEARS OF AGE IN PRUSSIA, 1883-90[1]

	Male	Female
Single	38.8	12.9
Married	49.8	10.0
Widowed	155.2	19.4
Divorced	195.2	32.8

All persons under 15 years were very properly excluded, since they are nearly all single, and in these early years the rate of suicide is a negligible quantity.

[1] Prinzing, F., "Trunksucht und Selbstmord," Leipzig, 1895, p. 26.

In the registration area of the United States during the census year ending May 30, 1900, the rate per 100,000 of population was as follows:

	15-44 Years		45-64 Years		65 Years and Over	
	Male	Female	Male	Female	Male	Female
Single	15.2	7.0	56.0	10.7	77.3	12.5
Married	18.2	7.4	35.5	6.2	40.8	7.7
Widowed	51.5	7.8	67.6	6.9	68.5	9.1

The period from 15 to 44 is a trifle too long to give accurate information upon the influence of conjugal condition upon suicide, for the rate increases with advancing years, and the proportion of the single is the largest in the beginning of this period, while the married are more evenly distributed throughout it, and the widowed are most numerous in the later years. The period from 45 to 64 is better for the purpose in hand. Here we see that among the males the rate is the lowest for the married, somewhat higher for the single and highest for the widowed.

It is but natural that if the influence of differences in age distribution were eliminated, the rate for the married should be lower than for the single or widowed. The men who later take their lives have often shown in early years symptoms of mental disorder which deter women from accepting them as husbands. The married lead more ordered lives than the unmarried, and are less liable to commit excesses of various kinds. The influence of marriage is generally more favorable to the male than to the female, if the reduction of the suicide-rate is alone considered. The rate is higher for the widowed than for the single or married. Grief at the loss of the husband or wife becomes a prominent motive. On account of the limited number of cases, it is difficult to obtain sufficient data with regard to the divorced, but from what has been collected the rate of suicide among this class appears to be high. The presence of children in the family is a deterrent to suicide. The parent feels a duty to provide for the children, and, although he might end his troubles if alone in the world, continues to struggle on, that his offspring may not be left uncared for. This motive is very strong among the widowed. Many a woman without children feels that in losing her husband her interest in the world is gone, and in her grief and loneliness decides to take her life. But when young children are left to her she feels that her mission in the world is to rear them.

The influence of the seasons upon suicide is quite uniform for most countries. The maximum is usually reached in the spring or early summer, and from this point decreases gradually to the beginning and end of the year. In the following table the number of deaths in each month is referred to a standard of 100, for Germany and Massachusetts, while the 3,400 deaths which occurred in the registration area of the United States in 1900 are distributed per 1,000 deaths in known months.

	Germany (1872-85)	Massachusetts (1856-95)	United States (1900)
January	78	80	80.4
February	85	77	63.7
March	90	100	80.4
April	119	129	102.4
May	122	111	106.5
June	126	117	79.3
July	121	110	90.9
August	108	101	86.2
September	99	99	78.1
October	92	93	85.1
November	80	93	74.7
December	70	89	72.3

Although the tables do not agree in every particular, the same general course is noticeable. During the autumn and winter the rate is low, and in the spring and summer is above the average. It is apparently not the intense heat of summer which causes the greatest number of deaths, for in no case are the rates for July and August the highest. It is rather the unsettling influences of the spring, when the constitution has not yet become accustomed to the change in temperature. The female organism is apparently affected sooner by the seasonal changes than the male, and the maximum rate is reached earlier in the year than is the case with the male.

It has been claimed that humidity has an effect upon the rate of suicide and that on damp and cloudy days there are more cases than on pleasant ones, but this has not been satisfactorily proved.

With regard to day of the week, the most suicides occur on Sunday, Monday and Tuesday, while the smallest number takes place on Saturday. It is easy to see why the rate on Saturday should be low, since that is the usual pay-day. In many cases a large proportion of the money is spent in dissipation on Saturday night and Sunday. When Monday comes, the pockets are empty, the spirits depressed from the recent debauch, and the victim lacks the courage to take up the work of the week. Morselli has suggested that the reason why the suicides of females are so frequent on Sunday is due to the influence of religious excitement.

It is evident that there is a connection between education and suicide. Those countries in which the standard of education is the highest and the proportion of illiterates the smallest seem to have the highest rate of suicide. But education is only one of the criteria of civilization. Where this is the highest there is the most crowded into life. All the machinery of existence runs at a greater speed. The more highly civilized the community the greater the tension under which the inhabitants live. As a result of this continuous haste the nerves give way and suicide is often the result. This feverish haste is more common in the cities than in the rural districts, and the suicide rate of the cities is almost invariably higher than that of the country in which they are situated. In the statistics for the registration states this difference is quite considerable.

NUMBER OF SUICIDES PER 100,000 POPULATION IN EACH AGE GROUP IN THE REGISTRATION AREA OF THE UNITED STATES DURING THE YEAR ENDING MAY 30, 1900

	15-44 Years	45-64 Years	65 Years and Over
Total	10.3	21.0	26.8
Cities	11.8	23.5	24.7
Rural	7.8	18.1	23.3

For the age group 65 and over the rural rate exceeded that for the cities, but from 15 to 44 the city rate was considerably higher.

With regard to occupation, the less skilled trades generally have a lower rate than the liberal professions, notwithstanding the fact that poverty and misery bear more heavily upon the poorly paid occupations. The statistics upon this point are rather unsatisfactory, but there is no doubt that among prisoners and soldiers the rate is very high. When a prisoner is incarcerated for life it is but natural that he should become discouraged, and look upon death as a relief. This is particularly common where the system of solitary confinement is in force.

In the Austrian army the suicide-rate per million was 1,220 from 1875 to 1887 and is continually increasing. The rate in the German army was 670 per million, 1878-1888, and in the Italian army over 400.

As a rule the rate for the army abroad is higher than for the troops at home. In Algeria the rate was more than twice as high from 1872 to 1889 as it was for the troops stationed at home. In the English army the rate in the home service was 230 per million, but in the division of Bengal, 1882-88 it was 480.[1] Homesickness and a distaste for military life are said to cause a large proportion of deaths. In France and Germany the fear of punishment is a powerful motive. Among the under officers the rate is nearly twice as high as among the troops, due to disappointment and jealousy. Life in barracks is at best monotonous and army discipline rigorous, but when to this is added the unhealthy climate of the tropics it is easy to see why the rate among the soldiers stationed abroad is high. Upon this point of the soldier's mortality R. A. Skelton has written: "The more important cause of the intensity of military suicide remains to be ascertained. We believe that the explanation lies at the very root of military conditions. The sol-

[1]Emery, F. P., "Suicide in the European Armies," Pub. Amer. Statist. Assn., New Series No. 15, Sept., 1891, pp. 67-68.

dier's training is essentially destructive of individualism; he comes to consider himself a mere unit in a huge aggregate of individuals, battalions of whom still constitute mere fighting units which must be prepared to sacrifice themselves if necessary to a particular stratagem. The soldier's very trade consists in placing at the disposal of others that of all possessions most valued by man—his life. Is it, then, surprising that he should have less hesitation than other men in removing it?"[1]

In Europe the rate of suicide is considerably higher among Protestants than Catholics. This fact proves but little since those races among which the suicidal tendency is small, like the Italian, Spanish, etc., are largely Catholic, while the Germanic element, which furnishes a high proportion of suicides, is Protestant. It is therefore ethnic peculiarities rather than religious confession which must be held responsible for this difference. But when we take the population of the same country we find that, as a rule, the portion which is Protestant furnishes more suicides in proportion to its numbers than the Catholic. The different economic condition of these classes may to a certain extent affect the rate, but, when all is said, it is likely that the religious confession has some influence. The Catholic is more apt to accept his faith unquestioningly, while the Protestant is taught to think for himself, and select his own articles of faith. This continued thought upon and uncertainty as to these great problems of human existence are likely to prove unsettling. In the Catholic religion the need for absolution is felt, and it is not likely that any priest would grant this to a person whom he knew to be contemplating suicide.

The order of preference in the methods chosen to commit suicide shows great variations in different countries. Thus, in Italy, where the weather is mild, the temperament of the people excitable, and many of the men carry arms, the favorite methods are by drowning, shooting and cutting. But

[1] Skelton, R. A., "Statistics of Suicide," The Nineteenth Century, Vol. XLVIII, 1900, p. 475.

where the climate is severe, and the people forced to spend a greater share of their time indoors, as in Denmark and Russia, hanging is the leading method.

According to the Twelfth Census of the United States, those taking their lives in the registration area in 1900 were distributed as follows according to method:

	Males	Females
Drowning	112	52
Poison	551	364
Shooting	764	53
Other means	1,203	301
Total	2,630	770

From a study which was made of the cases in the United States noted during the 5 years 1897-1901, the percentage of males and females employing the following methods is taken.[1]

	Males	Females
Shooting	38.3%	12.0%
Drowning	6.3	13.9
Poison	23.6	41.4
Cutting	8.9	5.2
Gas	6.0	9.1
Jumping	4.5	5.5
Hanging	9.6	9.1
Miscellaneous	2.8	3.8
Total	100.0	100.0

Shooting appears to be the favorite method in the United States, closely followed by poison, with hanging, drowning, cutting and gas following in order. When, however, we distinguish between the sexes, we find that shooting is chosen by about a third of the males, and poison by nearly a half of the females. The men prefer a method which is quick and certain, while the women wish death to be painless and the body without disfigurement. Shooting and poison are generally more common in the early age groups, while hanging

[1] Bailey, W. B., "Suicide in the United States, 1897-1901," Yale Review, May, 1903, p. 74.

is chosen by the aged. Shooting, poison and gas are the motives which seem to be increasing in favor. Suicide by throwing oneself before a railway train has, of course, been possible only within recent years. Deaths by asphyxiation and jumping (generally from a high building) are naturally almost entirely confined to cities. Hanging and drowning are, on the other hand, more frequent in the rural districts.

Although it is a comparatively simple matter to determine the method employed by the suicide in taking his life, it is by no means easy to discover the motive which prompted the act. In many cases the victim is unknown, or there is no apparent reason for the deed. In many cases the family attempts to conceal the real motive. In fact, it is doubtless true that many cases of suicide are returned as accidental deaths, when there is a reasonable doubt upon this point and no motive can be found. In many cases a number of possible motives are offered, rendering it impossible to decide which was the determining one. It is, therefore, necessary to bear in mind that in any statistics upon this point great accuracy cannot be expected.

The following table gives some information upon this point for Prussia, France and Italy:

DISTRIBUTION OF 1,000 SUICIDES ACCORDING TO SEX AND MOTIVE[1]

	Prussia (1873-75)		France (1866-75)		Italy (1872-77)	
	Male	Female	Male	Female	Male	Female
Mental disorders	229	441	252	415	280	417
Physical diseases	61	64	127	118	82	73
Weariness of life	127	97	45	29	43	7
Passions	27	63	17	45	49	75
Vices	129	21	149	56	12	1
Domestic affliction	48	51	138	164	96	90
Financial trouble	41	12	65	18	170	27
Misery	35	18	48	36	101	52
Remorse, shame, etc.	103	108	64	52	42	27
Despair, unknown	199	125	95	67	125	231
Total	1,000	1,000	1,000	1,000	1,000	1,000

[1] Morselli, H., "Suicide," New York, 1882, p. 278.

Prof. Mayo-Smith made the following comment upon this set of figures: "One sees immediately the great dominance everywhere of mental disorders as the cause of suicide. It is never less than one fourth of the whole number, and is oftener one third. This, doubtless, points to a fact, while at the same time showing a tendency, which is very prevalent, to allege insanity as the cause of suicide. Closely connected with mental disorders are suicides from emotional causes, such as remorse, shame, despair and domestic affliction. Of less importance are causes ascribed to passion, vice and weariness of life. On the other hand, physical suffering, under the head of disease and misery, plays a very considerable part."[1]

From the study of suicides in the United States 1897-1901 to which reference was made, the proportion of male and female suicides, arranged according to motive, is as follows:

	Males	Females
Despondency	20.5%	19.4%
Business loss	16.7	4.4
Insanity	13.0	15.7
Ill health	12.5	15.3
Disappointed in love	8.1	12.3
Domestic trouble	7.0	10.3
Fear of disgrace	5.5	5.0
Alcoholism	5.0	1.1
Grief	3.4	7.2
Chagrin	2.9	3.1
Miscellaneous and unknown	5.4	6.2
Total	100.0	100.0

There is always present the tendency to classify the case as despondency when the cause is unknown, or to enter it under insanity when the family is endeavoring to conceal the real motive.

Business loss and alcoholism cause a much larger proportion of male than female suicides. On the other hand, the more emotional causes, such as disappointment in love, do-

[1] Mayo-Smith, R., "Statistics and Sociology," pp. 251-52.

mestic trouble and grief. bear more heavily upon the females.

Under 20 years of age the proportion of suicides from disappointed love and chagrin is higher than at any succeeding decade. Business loss does not become a prominent motive before the 30th year, and reaches the maximum between 40 and 50. Domestic trouble, insanity, and alcoholism, are the highest from 40 to 60. Ill health and despondency increase with advancing years.

It is a severe arraignment of modern life that suicide is so common among the civilized nations. And, unfortunately, the tendency of the past few decades would point to a still higher rate in the future. The desires of man are continually increasing. Ambition and intense competition allow but little rest to the man who would succeed. There is the desire to enjoy life to the full, and even in what should be recreation, the same unfortunate haste is apparent. The century run is happily a matter of history, but with the advent of the automobile comes the desire to drive one faster or farther than has ever been done before. All this breaks down the nerves and is a school for suicide.

Infant Mortality. One of the best measures of the civilization of a country is the rate of mortality among infants. Where this is excessive it is usually the case that the sanitary conditions are bad, that there is considerable overcrowding, and that but little attention is paid to the food and care of the child.

The infantile death-rate is generally computed on a different base than any other rate. In some cases it is reckoned as the annual number of deaths of infants under 1 year of age to 1,000 of the same age living at the middle of the year in question. But the usual method is to compute the annual number of deaths of infants per 1,000 births during the same year. Adopting the latter method we have the following rates for certain European countries:

ANNUAL NUMBER OF DEATHS UNDER 1 YEAR TO 1,000 LIVING BIRTHS, 1891-95 [1]

Saxony	280	Prussia	205
Bavaria	272	Italy	183
Russia (1886-93)	270	Switzerland	151
Austria	246	Scotland (1885-90)	120
Germany	222	Sweden (1881-90)	97

In the Twelfth Census of the United States the corresponding figure for the registration area for the year 1900 was 149.4. But even this figure is too high, since the number of births, which forms the denominator of the fraction, was too small, on account of imperfect returns. The mortality in the United States is, therefore, lower than that in the countries of Southeastern or Central Europe, but when the more northern countries like Denmark, Scotland, Norway and Sweden are considered, we find the rates lower than in this country. This is because the hot weather of the southern countries is particularly fatal to infants.

Although the present rate of infant mortality may appear excessive, remarkable reductions have been made in the rate within a comparatively short period. Thus in the city of London, between 1730 and 1749, 74.5 per cent. of the children born died under 5 years of age. During 1750-69 this had been reduced to 63 per cent.; from 1770-89 to 51.5 per cent.; from 1790-1809 to 41.3 per cent.; from 1810-29 to 31.8 per cent. At present about 24 per cent. of the children die within 5 years of birth. Thus, in about 175 years, it has come to pass that instead of three fourths of the children dying, three fourths of them survive.

The infant mortality is usually highest during the first month of life, gradually diminishing during the remainder of the year. In large cities, however, although there is a decrease during the first half of the year, this is followed by an increase during the latter months. This can be best illustrated by the figures for England.

[1] Prinzing, F., "Die Kindersterblichkeit in Oesterreich," Allgemeines statist. Archiv, Band VI, 1902, p. 203.

ANNUAL DEATH-RATE PER 1,000 AT EACH MONTH OF AGE IN ENGLAND IN 1875 [1]

Age in Months	Healthy Districts	Liverpool District
0	447.51	672.19
1	145.49	316.72
2	102.05	226.78
3	87.16	209.37
4	81.09	205.25
5	75.54	203.65
6	70.54	204.89
7	65.97	209.17
8	61.85	216.42
9	58.32	227.30
10	55.28	241.80
11	52.86	260.23

The deaths during the first month are, in large part, due to premature birth, atrophy, or some congenital malformation. Naturally the deaths from these causes are not much more frequent in the large cities than in the healthier rural districts. Later in the year come the deaths from the diseases of infants, such as diarrhea and whooping-cough, while the dangers from dentition are now added. The zymotic diseases are commonly more fatal in the cities than the country. These account for the increase in the city mortality in the latter months of the year, so that at the close of this period the rate in Liverpool was almost 5 times as high as in the healthy districts of England.

It is well to note, at this point, the principal causes of infant mortality.

The deaths from premature birth, debility and atrophy are usually in the first month of life and due to the condition of the mother. When she is immature or has been obliged to do hard work during the final months of pregnancy the danger of death from these causes is considerably increased.

[1] Jones, H. R., "The Perils and Protection of Infant Life," Journ. Royal Statist. Soc., Mch., 1894, p. 10.

DEATHS OF INFANTS UNDER 1 YEAR OF AGE PER 1,000 BIRTHS OF EACH SEX IN ENGLAND AND WALES, 1895[1]

Cause	Males	Females
Debility, atrophy, inanition	25.1	20.3
Diarrhea, dysentery, cholera	22.5	19.9
Convulsions	21.4	16.6
Premature birth	21.0	16.9
Bronchitis	19.0	15.0
Pneumonia	11.1	8.1
Enteritis	7.8	6.6
Whooping-cough	4.5	5.1
Tabes mesenterica	4.6	3.7
Atelectasis and Congenital malformation	3.9	3.4
Accident and negligence	3.1	2.9
Measles	3.0	2.5
Dentition	2.9	2.4
Inflammation of brain and membranes	2.9	2.3
Tubercular meningitis	2.6	2.0
All remaining causes	20.6	17.3
Total	176.2	144.3

Körösi, from the study of 29,813 children who died under 10 years of age has collected the following statistics upon this.[2]

	Percentage of Children Dying Under 10 Years of Age from	
Age of Mother	Uterine Causes	Diarrhea
Under 20 years	57.5%	26.3%
20-30 years	36.0	21.9
30-35 years	26.9	18.1
Above 35 years	28.8	19.3

We thus see that where the mother is under 20 years, more than a half of the deaths of children under 10 years are due to some uterine cause, but when the mother is between 30 and 35 only about one fourth die from the same causes. Not only are these youngest mothers too immature to give birth to healthy and well-formed children, but in many cases they are

[1] Newsholme, A., "Vital Statistics," p. 125.

[2] Körösi, J., Transactions of the Internat. Congress of Hygiene and Demography, London, 1891, Vol. X, p. 262.

incapable of giving their children the needed care. As a result, the deaths due to improper feeding are very numerous when the mothers are under 20.

Deaths from diarrhea and convulsions are due almost entirely to improper feeding. There seems to be no substitute which will successfully take the place of the mother's milk. Dr. Hope, the Assistant Medical Officer of Health for Liverpool, investigated 1,000 fatal cases of diarrhea which occurred among children under 5 years of age. He reached the conclusion that under 3 months of age, for every death from diarrhea of a child fed entirely at the breast, there were 15 deaths from the same number who received other food in addition to breast milk. Among an equal number fed entirely on artificial food, there were 22 times as many deaths as when they were fed partly or entirely at the breast.

It was reported by the Statistisches Jahrbuch der Stadt, Berlin, that in that city if an equal number of children were selected at birth and fed on mother's milk, animal milk, and milk substitutes, the deaths under 1 month of those fed on animal milk would be about 6 times, and those on milk substitutes 16 times as numerous as those fed on mother's milk. The trouble is not so much that these are not the natural food for the child, as that they are allowed to putrefy during the summer months. Thus, the daily number of deaths of children fed on mother's milk is not much greater in the three summer than during any three of the remaining nine months of the year, while among those fed on animal milk the deaths are nearly 3 times as frequent in the summer, and on milk substitutes nearly 5 times as frequent.

In Wurtemburg the mortality of breast-fed children during the first year is 13.5 per cent., while that of the artificially fed is 42.7 per cent. It has been found that in some cases the mortality of children is at the lowest during periods of industrial depression, since the mothers are unable to obtain work in the factories, and, therefore remain at home to suckle their children.

At present this practice is becoming less common owing to the decree of fashion, and the fact that an increasing number of married women are finding employment in factories.

In many cases mothers give soothing-syrup to their children to make them sleep, that the work of the household may be done without interruption. H. R. Jones mentions a custom which is quite common in North Wales. Before the mother leaves home for her day's work in the factory, she places a lump of sugar in the bottom of a cup, puts on this from 1 to 4 drops of laudanum, as she thinks the child requires, adds a little hot water, and then gives this to the child, who sleeps until she returns. In some cases a mistake is made and enough given to kill. In most cases the stomach of the child is injured. The practice is now generally prohibited by law.

The infant mortality is usually much higher in the cities than in the rural districts. Thus, in the registration states of the United States the death-rate of children under 1 year in 1900 was 165.8 in the cities, and 108.7 in the rural districts.

In Massachusetts, 1891-97, the infant mortality was 154.6 per 1,000 births. In the cities the rate was 164.2, and in the towns and smaller places 129.5.

Since the death-rate for illegitimate children is higher than for legitimate, and the proportion of illegitimate is higher in the cities than the country districts, it is well to separate these classes before concluding that the urban conditions are the cause of the high mortality.

DEATHS OF INFANTS UNDER 1 YEAR PER 1,000 BIRTHS IN PRUSSIA, 1893-97 [1]

	Cities	Country Districts	Total
Legitimate	197	185	189
Illegitimate	373	332	351

The mortality in the cities is greater than in the country for both the legitimate and illegitimate children, leaving here no avenue of escape from the conclusion that the condi-

[1] Prinzing, F., "Die Kindersterblichkeit in Stadt und Land," Jahrbücher für Nationalök. und Statistik, Jena, 1900, p. 596.

tions of urban life are to a great extent responsible for this difference.

When, however, we consider the mortality during the first months of life, we are confronted with a slightly different condition.

DEATHS OF INFANTS UNDER 1 MONTH PER 1,000 BIRTHS IN PRUSSIA, 1893-97[1]

	City	Country
Legitimate	53	60
Illegitimate	107	103
Total	58	63

We now see that the mortality during the first month is lower in the cities than the country, in Prussia. The principal reason for this is doubtless due to the fact that the children more frequently take cold in the country. The mortality of the illegitimate children is higher in the cities. The illegitimate children in the country are more often accepted as part of the family, while in the cities the mothers are obliged to go to work to support themselves.

Dr. Prinzing thinks that the three principal factors which count for most in the health of a child are (1) the food, principally milk, (2) the protection of the child against cold, (3) general intelligent care. It is much more difficult to get fresh milk in the city than in the country, but the protection of the child against cold is poorer in the country. In support of this statement he cites the fact that diarrheal diseases are more fatal in the cities, but whooping-cough is more fatal in the country.

The number of deaths of infants under 1 year per 1,000 legitimate births in Prussia for a considerable number of years is as follows:

	Country	All Cities	Large Cities Except Berlin	Berlin
1876-80	183	211	238	271
1881-85	186	211	237	254
1886-90	187	210	219	241
1893-97	185	197	208	205

[1] Prinzing, F., *Op. cit.*, p. 608.

We see from this table that the death-rate in the cities is at every period higher than in the country districts, but while the rate in the country has remained practically stationary during this entire period, that in the cities has been decreasing. It is in the large cities, and particularly Berlin, that this decrease has been most noticeable. Between 1876-80 the rate in Berlin was 88 per 1,000 higher than in the rural districts, while, from 1893-97, this difference had been reduced to 20. This example is only typical of a general fact. By the building of model tenements, the introduction of parks and breathing places into the crowded sections, and the establishment of day nurseries, the decrease in the mortality of infants in the cities has proceeded more rapidly than in the country.

The comparison of the mortality of city and country is practically the same as that according to density of population. In England in 1891, where there was less than 1 acre to an inhabitant, the death-rate of infants was 151 per 1,000 births; where there were more than 1 and less than 3 acres per person the rate was 131; and where there were more than 3 acres per person the rate was 120.

In 1891 a study was made of Vienna to see if there was any connection between overcrowding and infant mortality. With this end in view the city was divided into many sections, according to the proportion of the population which lived more than 4 to a room.[1] The results were striking.

Out of 100 Dwellings What Per Cent. Were Overcrowded	Infant Mortality
Over 8 per cent.	388 to 429
6-8 per cent.	363 to 407
4-6 per cent.	300 to 398
2-4 per cent.	303 to 308
1-2 per cent.	213 to 243
Under 1 per cent.	140 to 237

We here see more clearly than in the case of the density of population the influence on the infantile death-rate.

[1] Prinzing, F., *Op. cit.*, p. 640.

Where under 1 per cent. of the dwellings are overcrowded the death-rate is less than one half as great as where over 8 per cent. are overcrowded. The number of persons per acre is not so good a measure of unsanitary conditions as the number per room. This fact was pointed out very forcibly by Dr. Newsholme in his paper on "The Vital Statistics of Peabody Buildings:" "The number of rooms occupied by each family is of much greater importance in relation to health than the number of persons living on a given acre, as this fact throws important light on the state of each tenement as regards overcrowding. Given houses properly constructed and drained, and given cleanly habits on the part of the tenants, increased aggregation of population on a given acre has no influence in raising the death-rate, except in so far as it is accompanied by overcrowding in individual rooms, an evil which is by no means necessary under the circumstances named. In other words, there is no causal relationship between density of population *per se* and a high mortality. The true index of density is the number of persons to each occupied room."

The death-rate for illegitimate is always considerably higher than that for legitimate children. The rates for the principal European countries are as follows:

ANNUAL DEATHS OF INFANTS UNDER 1 YEAR PER 1,000 BIRTHS[1]

	Legitimate	Illegitimate
Bavaria (1883-93)	280	355
Austria (1883-93)	218	302
Prussia (1883-93)	208	357
Italy (1883-93)	193	264
Spain (1878-82)	192	303
France (1883-92)	168	286
Belgium (1883-89)	160	247
Switzerland (1883-93)	160	230
Sweden (1891-93)	106	174
Norway (1883-92)	97	155

[1] "Movimento della popolazione in alcuni stati d'Europa e d'America," Bull. de l'Instit. Internat. de Statistique, Tome X, Liv. I, 1897, p. 24.

In most cases the illegitimate rate is a half higher than the legitimate. The reasons for this are quite apparent. In many cases the illegitimate children are not born healthy and well-formed, for an attempt at abortion has been made, and the period of pregnancy has been filled with worry for the mother. The social position of the mothers is almost invariably low, and at the time of confinement they receive poor care. Soon after delivery these mothers must go to work to earn a living and the child is often neglected. In many cases the mothers are unable or unwilling to provide for their children, with the result that they are abandoned, and must be cared for in institutions, where the mortality is generally high.

Accidental and violent deaths are all too common among children. In England over 2 per cent. of the children born meet death by violence during the first year of life. In Liverpool between 1870-80 this reached the height of 14 per cent. The children are neglected during the day and by means of falls and suffocation the deaths are very numerous. In many cases the mother sleeps with the child and suffocates it in bed. In a large proportion of cases this is due to drunkenness on the part of the mother. In the following table the total number of cases in each column is 1,000.

DISTRIBUTION OF DEATHS OF INFANTS FROM VIOLENCE IN ENGLAND[1]

	Suffocation	Other Causes
Sunday	283	180
Monday	124	132
Tuesday	137	145
Wednesday	116	139
Thursday	115	136
Friday	107	128
Saturday	118	140

On Monday the parents go to work and, as the amount of money to be spent on intoxicants diminishes, we find a corresponding decrease in the proportion of violent deaths up to and

[1] Jones, H. R., "The Perils and Protection of Infant Life," Journ. Royal Statist. Soc., Mch., 1894, p. 41.

including Friday. Then comes the pay-day for the week and the deaths increase on Saturday to a slight extent, but on Sunday, when the results of the debauch are most clearly felt, and the mothers are in many cases sleeping off the effects, we find that there are more than twice as many deaths from suffocation as on any other day of the week.

The connection between the economic position of the parents and the mortality of their children is very apparent. When the families are crowded into unsanitary tenements, with insufficient light and air, and the clothing and food of the children are not suitable, it is but natural that the death-rate should be higher than in the houses of the better classes, where the children have the benefit of careful nursing and medical attendance.

ANNUAL DEATHS OF INFANTS UNDER 1 YEAR PER 1,000 BIRTHS IN PRUSSIA BY OCCUPATIONS[1]

Almshouse people	421.5
Menials	331.9
Day laborers	251.2
Steady workmen	228.4
Independent	215.9
Private officials	211.1
Public officials	203.1

Over a third of the children of menials and those dependent upon public charity for support die during the first year. When the workmen obtain steady employment the deaths of their children are less frequent than when they live from hand to mouth. Among the last three classes, with assured incomes and good positions, but a trifle more than a fifth of the children perish in infancy.

In the United States the infant mortality is much greater among the negroes than the whites. In the registration area in 1900 the deaths of infants under 1 year per 1,000 births was 143.4 for the whites, and 297.0 for the negroes. Part of

[1] Seutemann, ''Kindersterblichkeit sozialer Bevölkerungsgruppen inbesondere in preussischen Staate und seiner Provinzen,'' Tübingen, 1894. Noted in Pub. Amer. Statist. Assn., New Series Nos. 35-36, Sept.-Dec., 1896, p. 40.

this excess was probably due to difference in ethnic tendencies, but a far larger part to the fact that the economic position of the negroes is much lower than that of the whites. Throughout the registration area a large proportion of the negroes inhabit the cities and almost invariably are they found in the poorest districts. Their income is rather precarious, and a large proportion of negro women work outside their homes during the day, so that their children do not receive the necessary care.

There is no class in society where the seasonal influences are so clearly shown as in the case of infants. The heat of the summer is particularly fatal to them. This is felt in both city and country, but in the cities, where the air comes from heated roofs and down narrow streets, the effect of hot weather is most apparent. In the following table the total number of deaths for the year is placed at 100, in order to bring out clearly the influence of the seasons upon the infantile death-rate.

INFANT MORTALITY IN LEIPZIG AND SAXONY BY MONTHS[1]

Month	Leipzig (1891-95)	Saxony (1891-94)
January	5.36	6.65
February	5.10	6.50
March	5.82	7.42
April	5.54	7.22
May	6.54	8.23
June	6.87	8.16
July	17.90	11.06
August	18.37	13.66
September	11.18	10.51
October	7.18	8.04
November	4.94	6.05
December	5.26	6.41

In Leipzig the concentration in the summer months is much greater than in Saxony but the variations are similar in both. Nearly 50 per cent. of the deaths in Leipzig are during the 3 months of July, August and September, while

[1] Prinzing, F., "Kindersterblichkeit in Stadt und Land," Jahrbücher für Nationalök. und Statistik, Jena, 1900, p. 637.

in Saxony over a third of the deaths are grouped within the same 3 months.

Not only are the infantile deaths most frequent during the summer, but in those weeks of summer when the heat is most intense, the number of deaths is most excessive. Thus, in Berlin, in 1902, in the 2 weeks during which there was the highest average temperature of the year, there was a greater number of deaths among children than during any other 2 weeks of the year.[1]

A large proportion of the infant mortality in the world at present could be avoided if the community was willing to devote more time and thought to the subject. Modern business methods seem to demand that manufacturing industries be located in the centers of cities in order to enjoy the advantages of cheap transportation, but this does not necessitate that the wife and children of the workman live in congested districts. Cheap and rapid transportation would enable the workman to attend to his duties in the heart of the great city while his family enjoyed a healthy life in the suburbs. After all is done, thousands will find it necessary to live in the crowded districts, but playgrounds for the children and parks where the mothers can go for a change from the overheated air of the small, overcrowded living rooms will do much to improve conditions. Day nurseries, where children can be left by mothers who must go out to work, will reduce the mortality due to neglect. If more attention were paid to domestic training in the public schools the young women might be better fitted to assume the duties which motherhood thrusts upon them. Factory legislation, regulating the hours of labor for married women, and demanding for mothers a certain period of unemployment after confinement, has been of much assistance, and more is to be expected along the same line in the future.

Changes in the Death-rate. Many causes have conspired to materially reduce the death-rate during the past century.

[1] Hirschberg, E., "Bilder aus der Berliner Statistik," Volkswirthschaftliche Zeitfragen, Heft 200, 1904, p. 15.

Medical science has made great advances. Not only have new methods for the treatment of various diseases been discovered, by which the case mortality has been much reduced, but the manner by which diseases are communicated has been given careful study. The anti-toxin method of treating diphtheria is an instance of the former, and the discovery of the communicable nature of tuberculosis, pnuemonia and typhoid fever of the latter. The part played by mosquitos in the spread of disease has claimed attention only within recent years. The nature of, and a possible cure for cancer, aside from the surgical removal of the diseased tissue, is being given profound study by the members of the medical profession at present.

That it is the duty of the state to consider the health of its members and safeguard the bodies of the future generations is generally recognized. The disposal of the sewage and supply of pure water in sufficient quantity is considered a proper field for municipal enterprise. The freedom of the individual to neglect his own health or injure that of others is being continually curtailed in the United States. The hours of labor for women and children are in many states regulated by statutory enactment, and children must have attained a certain age before they are allowed to become operatives in factories. Employers must obey certain requirements with regard to the health and safety of their employees. The rooms must be light and well ventilated, the machinery be equipped with proper safety appliances, fire escapes be provided, and means taken to render the occupations which are naturally dangerous on account of poisonous or injurious dusts or vapors more healthful. Landlords are no longer allowed to erect buildings which shall be fire traps or culture tubes for microbes. It is felt that no room is fit for human habitation which does not open upon a street, yard or shaft of reasonable dimensions. Many cities have felt themselves justified in buying and tearing down unsanitary tenements in crowded districts, that their places might be taken by a broad thoroughfare, playground, or park.

But perhaps the most hopeful sign of all is the crusade against disease which is being made into the homes of the poorer classes. Authorities of public health and protection can do much to prevent disease, but in the last analysis, pressure from without is less potent than individual enlightenment. The law may decree the erection of sanitary dwellings but these are of little avail, unless the tenants observe the ordinary rules of cleanliness and ventilation. Bath tubs may be useful when the coal supply is stored in them, although the health of the community would be better served if they fulfilled the purpose for which they were intended. The housewife may be justified in keeping windows closed when they look upon a dark, ill-smelling air-shaft, but when they open upon a street or court it is inexcusable to have stale air fill the rooms. The lesson must be brought home to the people that they are themselves responsible for much of the disease and consequent misery among them.

When we consider all that has been done along this line during the past 50 years, we should expect to find that the death-rate had been materially reduced. It is necessary to bear in mind that the mortality is generally higher in the cities than the country, and that the proportion of the population living in cities has been steadily increasing. Thus in the State of Massachusetts the total death-rate has remained nearly constant for a half century, while the rate in both city and country has decreased.

Notwithstanding the more rapid increase of the urban than of the rural population there has been a gradual reduction in the death-rates of the European countries during the past few decades. This fact is brought out clearly in the following table:

DEATHS PER 1,000 OF TOTAL POPULATION IN EUROPE BY DECADES[1]

	1841-50	1851-60	1861-70	1871-80	1881-90	1891-1900
Germany	26.8	26.4	26.9	27.1	25.1	22.2
Austria	32.8	30.8	30.3	31.5	29.5	26.6

[1] "Statistik des deutschen Reichs," Band 150, 1902, Erster Teil, p. 203.

DEATHS PER 1,000 OF TOTAL POPULATION IN EUROPE BY DECADES—CONTINUED.

	1841-50	1851-60	1861-70	1871-80	1881-90	1891-1900
France	23.3	23.9	23.6	23.7	22.1	21.5
Belgium	24.4	22.6	23.7	22.9	20.6	19.1
Denmark	20.4	20.6	19.9	19.5	18.6	17.4
Sweden	20.6	21.7	20.2	18.3	16.9	16.3
Norway	18.2	17.1	18.0	17.0	17.0	16.2
England and Wales.	22.4	22.2	22.6	21.4	19.2	18.2

In every case the rate is considerably lower for the latest than the earliest decade. The decrease has not been continuous in every country, but there is no exception to the fact that during 1871-80 the rate was higher than during 1881-90, while the rate for the latter period exceeded that for 1891-1900. During the period included in the table the decrease has been from 10 to 20 per cent.

A very interesting study has been made of the death-rates of the provinces in France at different periods. The figures at the head of the columns represent the death-rates in the provinces, the figures at the margin the periods, and the figures in the body of the table the number of provinces. Thus from 1821 to 1830 there were 19 provinces with an average rate between 29 and 28.

NUMBER OF PROVINCES IN FRANCE WITH DEATH-RATES FROM [1]

Years	40-35	34-30	29-28	27-26	25-24	23-22	21-20	29-18	17-16	15-14
1801-10	24	36	13	8	2					
1811-20	16	41	13	9	3	1				
1821-30	11	37	19	9	4	3				
1831-40	6	31	13	17	10	2	4			
1841-50	2	17	15	14	19	11	1	4		
1851-60		12	14	13	14	21	4	5		
1860-69		11	10	16	12	18	11	5		
1877-86		8	9	7	14	22	18	11	5	
1889		3	5	8	6	20	23	17	2	2
1892		2	3	5	9	16	25	17	8	1

[1] Fortin, P., "Les derniers renseignements officiels sur les mouvements de la population en France." Etudes Religieuses, Philosophiques, Historiques et Littéraires, 1895, p. 648.

The decrease in the death-rate is very apparent from this table. During 1801-10, 97 per cent. of the provinces had a rate of 26 or over, while in 1892 in only 12 per cent. of the provinces was the rate so high. At the earliest period there was no province with a rate as low as 23, while at 1892, 59 per cent. were below that figure. From 1801 to 1840 the mode was from 34 to 30, while from 1841-5 it was 25-24, from 1851-86 it was 23-22, and in 1889 and 1892, 21-20.

For some diseases the decrease has been much more rapid than for others. In the following table the rates for various diseases are given at 5 different periods:

DECREASE OF MORTALITY FROM VARIOUS DISEASES IN GERMANY, 1877-1901[1]

	Deaths per 100,000 Population.				
	1877-81	1882-86	1887-91	1892-96	1897-1901
Small-pox	1.5	1.4	0.4	0.2	0.04
Measles	27.6	35.5	27.6	23.9	21.3
Scarlet fever	56.8	42.0	21.2	17.9	20.0
Diphtheria and croup	99.8	122.3	99.7	84.1	31.1
Typhoid fever	43.6	30.2	20.6	12.1	10.4
Petechial fever	2.6	0.6	0.2	0.1	0.06
Puerperal fever	14.4	11.5	8.0	6.6	5.1
Pulmonary consumption	357.7	346.2	304.0	255.5	218.7
Acute diseases of the respiratory organs	308.6	314.5	279.5	274.1	258.5
Acute diseases of digestion without diarrhea	147.3	127.7	120.0	121.6	137.1
Diarrhea and vomiting	116.8	125.4	138.2	135.0	150.7
Other diseases	1,426.7	1,362.4	1,260.6	1,177.1	1,129.8
Accidents	36.4	34.2	33.2	32.8	36.4
Suicide	31.0	29.0	25.4	26.1	24.5
Other violent deaths	1.8	1.7	1.7	1.9	2.0
Total deaths per 1,000 population	26.73	25.83	23.46	21.71	20.46

Deaths from violence and diseases of the digestive appara-

[1] Vierteljahrhefte zur Statistik des deutschen Reichs, 12 Jahrgang, 1903, Drittes Heft, Berlin, p. 177.

tus have remained nearly constant while those from diarrhea and vomiting have increased. But in all other cases there has been a decrease. This is perhaps the most marked in the case of pulmonary consumption, where there has been a decrease of 140 during the period under consideration. For some diseases like consumption, petechial and typhoid fever, the decrease has been quite gradual. In diphtheria and croup the fall was very sudden after the discovery of a new method of treatment. Deaths from small-pox and petechial fever are now very rare.

It might be interesting to compare with the German figures those for Massachusetts for a different period.

DEATHS FROM CERTAIN DISEASES PER 100,000 POPULATION IN MASSACHUSETTS [1]

	1856-75	1876-95
Small-pox	14.6	0.7
Measles	15.9	9.0
Scarlet fever	88.2	26.3
Diphtheria	33.3	72.2
Croup	38.5	24.2
Typhoid fever	86.2	41.3
Dysentery	51.1	15.6
Cholera infantum	107.1	106.6
Consumption	357.0	278.0
Pneumonia	121.9	168.4

Here the rate for cholera infantum has remained stationary, that for diphtheria and pneumonia has increased, but in all other cases there has been a decrease. The rates for 1876-95 in Massachusetts and 1877-96 in Germany are not far apart, except that measles seems a more frequent cause of death in Germany. The rate for diphtheria and croup in Massachusetts (96.4) is but little different from that in Germany.

From the study of the preceding table it is evident that the greatest gain has been made in fighting the contagious diseases. This is brought out more clearly by the following set of figures:

[1] Vital Statistics of Massachusetts, 1856-95. Pub. Doc. No. 34, pp. 769-771.

DEATH RATES FROM CONTAGIOUS DISEASES IN BRUSSELS, 1874-1896 [1]

	Death-rate from All Causes per 1,000 Population	Deaths from Contagious Diseases per 10,000 Population
1867-71	29.2	49.9
1872-76	27.4	21.3
1877-81	25.3	15.3
1882-86	24.7	18.8
1887-91	22.2	14.2
1892-96	20.0	11.4
1897	16.3	6.3

Although the rate from all diseases in 1897 was 56 per cent. of the rate in 1867-71, that from contagious diseases was only 16 per cent. of that at the former period. This table shows what can be done by a public-spirited board of health. In many American cities similar attempts have met with like results, which make us hopeful of the future.

Life Tables. [2] Nothing has ever impressed mankind more forcibly than the uncertainty of human life. No assurance can be given that a person, apparently in the best of health, with years of usefulness ahead, will not soon fall a victim to disease and death. Although it would be difficult to foretell the date of the death of any individual, yet there is nothing to which the theory of probability has been applied with greater success than to the determination of the probable future lifetime of a large number of individuals. What is extremely uncertain for the individual, becomes reasonably certain for the mass. For a study of this

[1] "Ville de Brussels. Service d'hygiene, son organisation, et son mode de fonctionnement," Dr. E. Janssens, Brussels, 1898, pp. 52. Noted in Pub. Amer. Stat. Assn., New Series No. 44, Dec., 1898, p. 176.

[2] For a more complete study of this subject the student is advised to consult: Westergaard, H., "Die Lehre von der Mortalität und Morbilität," Jena, pp. 1-205. Newsholme, A., "Vital Statistics," London, 1899, pp. 255-314. Meech, L. W., "System and Tables of Life Insurance," Norwich, Ct., 1886. Farr, W., "Vital Statistics," edited by N. A. Humphreys, London, 1885, pp. 225-494.

nature, dealing with large numbers of cases, statistics is of peculiar value.

The problem with which we are confronted is to determine from the births of any year how many will survive the first year of life, and from this point how rapid will be the annual reduction in the number of the living, until death shall claim the last survivor. It would appear that the most desirable method would be to follow all those born in a country during any year until the time when the oldest should have died. In this way it would be possible to determine how many died during any year, and the number of survivors at any age. There is, however, no country in which the statistics of population are kept with sufficient accuracy to make this method possible. Both internal and external migration is so extensive that it is out of the question to follow throughout life all the births which occur in any year.

Most of the European countries and many of the North American states publish annually a report giving, among other statistics, the number of births and deaths. An enumeration of the population is also taken once in 5 or 10 years. When we compute how many deaths of persons of any age occur annually in a population per 1,000 individuals of the same age, we are in a position to form a table of mortality. The deaths do not all occur at the beginning of the year, but are scattered with considerable regularity throughout the year.[1] Therefore if we were to determine the coefficient of mortality for those 15 years of age, we could not compare the number of deaths of persons of this age throughout the year to the number at this age on January 1. It would be necessary to take the mean between those 15 and 16 years of age. The coefficient would thus be $\frac{d_{15}}{\frac{1}{2}(l_{15}+l_{16})}$.

In actuarial notation l_x denotes the number living at the age x, and d_x the number of deaths from these during the same

[1] For infants under 1 year the deaths are much more frequent during the first and second months after birth than during any other of the twelve months.

year. The number living in the middle of the year is $\frac{1}{2}(l_x + l_{x+1}) = P_x$. This is known as the mean population. Where the deaths are recorded during the calendar year, and the census is taken at approximately July 1, the numbers recorded in the census under each age will correspond to the P_x column. Where the rate of mortality is obtained by following a number of persons from year to year, as is the case in life insurance, it is necessary to calculate the mean population.

The coefficient of mortality, obtained by dividing the annual number of deaths at a given age by the mean population at that age, becomes thus $\frac{d_x}{P_x} = m_x$.

If l_x is the number living at the beginning of the year x, and l_{x+1} the number living at the end of the year, d_x is equal to the number who died during the year or $l_x - l_{x+1}$. The probability that a person of the age x will live to the end of the year is $\frac{l_{x+1}}{l_x}$, while the probability that a person of the same age will die during the year becomes $\frac{d_x}{l_x}$. The probability that the person will survive the year is represented by p_x, and that he will die before the end of the year by q_x. The formulæ for the probability of death or survival are therefore $p_x = \frac{l_{x+1}}{l_x}$ and $q_x = \frac{d_x}{l_x}$.

The formula $p_x = \frac{l_{x+1}}{l_x}$ may be developed into $p_x = \frac{2 - m_x}{2 + m_x}$. From the numbers of the population at the different ages in the Census and the annual deaths recorded in the Reports of Vital Statistics, we found it possible to obtain the coefficient of mortality at each age or m_x. From this coefficient we are enabled to calculate the probability of living through any year of age. Since $p_x = \frac{l_{x+1}}{l_x}$ we are now in a position to build up a life table.

Such a table begins with a certain number of living births, which for convenience is placed at 10,000 or 100,000. To this number we attach the symbol l_0. The number living at the end of the year, or l_1 is the product of the number living at the beginning of the year by the probability of surviving the first year of life, or $l_1 = p_0 l_0$. The number of deaths during the first year (d_0) is equal to the difference between the number living at the beginning and end of the year, $d_0 = l_0 - l_1$. From the number living at the beginning of the first year (l_1), the survivors of that year are obtained by multiplying by the probability of surviving to the beginning of the second year. Thus $l_2 = p_1 l_1$. This process is continued until that year, when the probability of survival is zero. In this last year the number of deaths during the year will be equal to the number entering the year. Since every individual must either survive or die during the year, $p_x + q_x = 1$. When the probability of survival is known, the determination of the probability of death is simply a matter of subtraction: $q_x = 1 - p_x$.

MASSACHUSETTS LIFE TABLE FOR MALES

Based on the Mortality of the Five Years, 1893-97

Age_x	d_x	l_x	P_x	Q_x	E_x	m_x	p_x
0	8,849	51,350	46,343	2,264,048	44.09	.19095	.82569
1	1,794	42,501	41,604	2,217,705	52.18	.04313	.95778
2	818	40,707	40,298	2,176,101	53.46	.02030	.97990
3	559	39,889	39,609	2,135,803	53.54	.01411	.98599
4	424	39,330	39,118	2,096,194	53.30	.01084	.98922
5	316	38,906	38,748	2,057,076	52.88	.00815	.99188
6	252	38,590	38,464	2,018,328	52.30	.00655	.99347
7	205	38,338	38,235	1,979,864	51.64	.00536	.99464
8	170	38,133	38,048	1,941,629	50.92	.00447	.99556
9	146	37,963	37,890	1,903,581	50.14	.00386	.99616

MASSACHUSETTS LIFE TABLE FOR MALES—CONTINUED.

Based on the Mortality of the Five Years, 1893-97

Age_x	d_x	l_x	P_x	Q_x	E_x	m_x	p_x
10	123	37,817	37,755	1,865,691	49.33	.00326	.99675
11	110	37,694	37,639	1,827,936	48.49	.00292	.99709
12	104	37,584	37,532	1,790,297	47.63	.00277	.99722
13	111	37,480	37,424	1,752,765	46.76	.00297	.99703
14	135	37,369	37,301	1,715,341	45.90	.00362	.99640
15	159	37,234	37,154	1,678,040	45.07	.00428	.99573
16	181	37,075	36,984	1,640,886	44.26	.00489	.99511
17	195	36,894	36,796	1,603,902	43.47	.00530	.99471
18	211	36,699	36,593	1,567,106	42.70	.00577	.99425
19	226	36,488	36,375	1,530,513	41.94	.00621	.99381
20	241	36,262	36,141	1,494,138	41.20	.00667	.99335
21	255	36,021	35,893	1,457,997	40.48	.00710	.99292
22	268	35,766	35,632	1,422,104	39.76	.00752	.99251
23	280	35,498	35,358	1,386,472	39.06	.00792	.99212
24	289	35,218	35,073	1,351,114	38.36	.00824	.99179
25	296	34,929	34,781	1,316,041	37.68	.00851	.99153
26	301	34,633	34,482	1,281,260	37.00	.00873	.99131
27	305	34,332	34,179	1,246,778	36.32	.00892	.99112
28	309	34,027	33,872	1,212,599	35.64	.00912	.99092
29	313	33,718	33,561	1,178,727	34.96	.00933	.99072
30	316	33,405	33,247	1,145,166	34.28	.00950	.99054
31	318	33,089	32,930	1,111,919	33.60	.00966	.9903
32	319	32,771	32,611	1,078,989	32.93	.00978	.99026
33	319	32,452	32,292	1,046,378	32.24	.00988	.99017
34	320	32,133	31,973	1,014,086	31.56	.01001	.99004
35	322	31,813	31,652	982,113	30.87	.01017	.98988
36	325	31,491	31,328	950,461	30.18	.01037	.98968
37	328	31,166	31,002	919,133	29.49	.01058	.98948
38	331	30,838	30,672	888,131	28.80	.01079	.98927
39	334	30,507	30,340	857,459	28.11	.01101	.98905
40	337	30,173	30,004	827,119	27.41	.01123	.98881
41	341	29,836	29,665	797,115	26.72	.01150	.98857
42	346	29,495	29,322	767,450	26.02	.01180	.98827
43	352	29,149	28,973	738,128	25.32	.01215	.98792
44	359	28,797	28,617	709,155	24.63	.01255	.98753
45	368	28,438	28,254	680,538	23.93	.01302	.98706
46	379	28,070	27,880	652,284	23.24	.01359	.98650
47	393	27,691	27,494	624,404	22.55	.01430	.98581
48	410	27,298	27,093	596,910	21.87	.01513	.98498
49	429	26,888	26,673	569,817	21.19	.01608	.98404

MASSACHUSETTS LIFE TABLE FOR MALES—CONTINUED.

Based on the Mortality of the Five Years, 1893-97

Age_x	d_x	l_x	P_x	Q_x	E_x	m_x	p_x
50	448	26,459	26,235	543,144	20.53	.01798	.98307
51	466	26,011	25,778	516,909	19.87	.01808	.98208
52	483	25,545	25,303	491,131	19.23	.01909	.98109
53	502	25,062	24,811	465,828	18.59	.02023	.97997
54	520	24,560	24,300	441,017	17.96	.02140	.97888
55	539	24,040	23,770	416,717	17.33	.02268	.97758
56	561	23,501	23,220	392,947	16.72	.02416	.97613
57	585	22,940	22,647	369,727	16.12	.02583	.97450
58	608	22,355	22,051	347,080	15.53	.02757	.97280
59	636	21,747	21,429	325,029	14.95	.02968	.97075
60	659	21,111	20,781	303,600	14.38	.03171	.96878
61	677	20,452	20,113	282,819	13.83	.03366	.96689
62	691	19,775	19,429	262,706	13.28	.03557	.96505
63	709	19,084	18,729	243,277	12.75	.03786	.96285
64	729	18,375	18,010	224,548	12.22	.04048	.96032
65	748	17,646	17,272	206,538	11.70	.04331	.95761
66	769	16,898	16,513	189,266	11.20	.04657	.95449
67	789	16,129	15,734	172,753	10.71	.05015	.95107
68	810	15,340	14,935	157,019	10.24	.05424	.94719
69	827	14,530	14,116	142,084	9.78	.05859	.94307
70	840	13,703	13,283	127,968	9.34	.06324	.93869
71	845	12,863	12,440	114,685	8.92	.06793	.93430
72	847	12,018	11,594	102,245	8.51	.07306	.92951
73	842	11,171	10,750	90,651	8.11	.07833	.92462
74	831	10,329	9,913	79,901	7.74	.08383	.91954
75	816	9,498	9,090	69,988	7.37	.08977	.91409
76	794	8,682	8,285	60,898	7.01	.09584	.90854
77	769	7,888	7,503	52,613	6.67	.10249	.90251
78	741	7,119	6,748	45,110	6.34	.10981	.89591
79	707	6,378	6,024	38,362	6.01	.11736	.88915
80	672	5,671	5,335	32,338	5.70	.12596	.88150
81	632	4,999	4,683	27,003	5.40	.13496	.87357
82	590	4,367	4,072	22,320	5.11	.14489	.86490
83	546	3,777	3,504	18,248	4.83	.15582	.85544
84	499	3,231	2,981	14,744	4.56	.16739	.84554
85	452	2,732	2,506	11,763	4.31	.18037	.83455
86	402	2,280	2,079	9,257	4.06	.19336	.82369
87	353	1,878	1,701	7,178	3.82	.20752	.81199
88	307	1,525	1,371	5,477	3.59	.22392	.79863
89	263	1,218	1,086	4,106	3.37	.24217	.78399

MASSACHUSETTS LIFE TABLE FOR MALES—CONTINUED.

Based on the Mortality of the Five Years, 1893-97

Age_x	d_x	l_x	P_x	Q_x	E_x	m_x	p_x
90	220	955	845	3,020	3.16	.26036	.76963
91	181	735	644	2,175	2.96	.28106	.75357
92	146	554	481	1,531	2.76	.30353	.73647
93	116	408	350	1,050	2.57	.33143	.71569
94	88	292	248	700	2.40	.35484	.69863
95	66	204	171	452	2.22	.38596	.67647
96	48	138	114	281	2.04	.42105	.65218
97	33	90	73	167	1.86	.45206	.63128
98	23	57	45	94	1.65	.51111	.59292
99	15	34	26	49	1.44	.57692	.55224
100.........	9	19	14	23	1.21	.64286	.51351

In the life table for Massachusetts the number of births of both sexes is placed at 100,000, of which 51,350 are males. This number is therefore taken as the base for the table. Looking at the p_x column we find that the probability of surviving the year increases until the 12th year, when the highest point of the entire life is reached. The decrease is but slight until about the 70th year, after which the diminution becomes very marked. The probability of death during the year following birth is very high, and it is not until the 86th year that the same height is again reached.

There are three columns in the table which require some explanation. Each age in the P_x column is the mean between l_x and l_{x+1}. Thus, for instance, $P_{30} = \frac{l_{30}+l_{31}}{2} =$

$$\frac{33{,}405+33{,}089}{2} = 33{,}247.$$

The Q_x column is found from the sum of the numbers in the P_x column from the year x to the last year in the table. Thus $Q_x = P_x + P_{x+1} + — + P_z$ where z is the final year in the table. It signifies the total number of years to be lived by those who have reached a certain age. Thus, those who have reached the 96th year have 281 complete years to live. During the 95th year there are 66 to die, and if we assume the deaths are distributed evenly throughout the year, they may be credited with 33 complete years of life. The 138 who reached the 96th year must have completed the 95th. Therefore we have $Q_{96}=281+33+138=452$. In a similar manner the numbers for each year are computed.

The figures in the E_x column represent the mean future lifetime or expectation of life of those living at each age in the table. The expectation of life of any person can be obtained by the formula $E_x=\frac{Q_x}{l_x}$. Referring to the Massachusetts life table we see that the expectation of life is greatest at the third year, when it is 54.83 years, more than 8 years greater than at birth. This is on account of the high mortality during the first years of life.

There is another term, used somewhat loosely, which is often confused with the expectation of life. The probable duration of life means the age at which a number of individuals of equal age will be reduced by death to one half. Thus in the Massachusetts life table the 51,350 births will be reduced to 25,675 during the 51st year. The probable duration of life at birth is a little over 51 years. The expectation of life is only 46.61 years. The expectation of life gives a far better criterion of the vitality of a population than the probable duration of life. If we assume that the births are reduced to one-half during the 51st year, the probable duration of life would not be in the least affected if no person should survive the 60th year, but the productive force of the population would be vastly diminished.

When we are dealing with a stationary population there are several quantities which are identical. The number at any age out of whom one dies annually is equal to the expectation of life at that age. The mean age at death of all persons is also identical with the mean expectation of life at birth. But in an increasing population where the births constantly exceed the deaths in number, the mean age at death is kept at a low figure by the number of young among the dying. Thus, in England and Wales, 1881-90, the mean age at death was 30.5 years, and the mean expectation of life at birth, 43.7 years.

If the deaths of a generation were regular, so that out of 1,000 births 10 died each year, the expectation and the probable duration of life would be identical. But aside from the heavy infant mortality, a large proportion of deaths occurs after middle life. As a result of this, the probable duration exceeds the expectation of life. In the advanced years, however, most of the lives will soon end, while but a few will be prolonged for many years. Until about the 60th year the probable duration is greater than the expectation of life, but after this date the order is reversed.

It would be of great interest to note the changes in the expectation of human life since the beginning of the Christian era, but unfortunately there are no accurate statistics of mortality which antedate the 17th century. Ulpianus in the 3d century calculated the expectation of life of a person 15 years of age at about 30 years. That for males of the same age in Massachusetts in 1897 was 46.53 years. We must not accept the figures of Ulpianus as accurate, but there has undoubtedly been a considerable lengthening of human life during this period.

John Graunt, from a consideration of the Bills of Mortality of London 1629-36 and 1647-58, computed, somewhat crudely, the table of survivorship of that city. A second study was made of the years 1728-57. A third was made by Dr. Farr for the period 1861-70.

TABLE OF SURVIVORSHIP FOR LONDON

Ages	1629-58	1728-57	1861-70
0 years	100	100	100
6 years	64	54	69
16 years	40	50	65
26 years	25	44	60
36 years	16	35	54
46 years	10	25	46
56 years	6	17	37
66 years	3	10	25
76 years	1	4	11
80 years	0	3	7

These tables were not constructed in exactly the same manner, and that by Dr. Farr is the most accurate, but it is possible to see from them how great has been the improvement during two centuries. At the age of 26 in the first period only one-fourth survived; a century later and over two-fifths were left, while after another century three-fifths remained. At the 56th year of age there were over six times as many survivors from the same number of births in the 19th as there had been in the 17th century. The improvement has been more rapid in the cities than in the country districts. "Within a period of 25 years, London reduced its death-rate from 50 to 25, thereby increasing the average length of life from 25 to 37 years . . . Within a century Vienna has reduced her death-rate from 60 in the 1,000 to 23."[1]

Edmund Halley was the first to compute the expectation of life on the base of a census and bills of mortality. His figures refer to Breslau for the years 1687-91. It is interesting to compare with his figures those for the males of England and Wales 1881-90.

EXPECTATION OF LIFE

Ages	Breslau, 1687-91	England, 1881-90
0 years	29 years	43.6 years
5 years	41 years	52.7 years
10 years	40 years	49.0 years
20 years	34 years	40.3 years
30 years	28 years	32.5 years
40 years	22 years	25.4 years
50 years	17 years	18.8 years
60 years	12 years	12.9 years
70 years	8 years	8.0 years
80 years	.. ....	4.5 years

The difference in the expectation of life at birth is nearly 15 years in favor of the later figures. It is difficult to realize all the advantage which such an increase in the duration of human life can bring to a state.

We have several tables for England showing the expecta-

[1] Weber, A. F., "Growth of Cities," N. Y., 1899, pp. 355-56.

tion of life at different ages at widely separated dates in the 19th century. By grouping these tables the eye is enabled to take in at a glance the changes which have occurred.

EXPECTATION OF LIFE AT DIFFERENT AGES BY VARIOUS LIFE TABLES

Ages	Northampton 1780	Carlisle 1815	Equitable 1825	Equitable 1834	English, No. 3, Males 1838-54	Ogle, Males 1871-80	Tatham, Males 1881-90
0	25.2	38.7	..	..	39.9	41.3	43.7
10	39.8	48.8	48.8	48.3	47.0	47.6	49.0
20	33.4	41.5	41.1	41.4	39.5	39.4	40.3
30	28.3	34.3	34.0	34.5	32.8	32.1	32.5
40	23.1	27.6	27.4	27.4	26.1	25.3	25.4
50	18.0	21.1	20.8	20.4	19.5	18.9	18.8
60	13.2	14.3	15.1	13.9	13.5	13.1	12.9
70	9.6	9.2	9.8	8.7	8.4	8.3	8.0
80	4.8	5.5	5.4	4.7	4.9	4.8	4.5
90	2.4	3.3	2.6	2.6	2.8	2.7	2.4

The most noticeable fact to be seen in these tables is the very considerable increase in the expectation of life at the early years. As the ages increase the difference between the early and later periods grows continually smaller, until, when middle life is reached there is but little change. The great saving has been in infant life. Many who formerly perished live until middle life. They may be somewhat weakened in physique and do not reach advanced age. But the productive force of the nation is vastly increased by the greater number who survive to years of usefulness.

In the United States as well there has been an increase in the expectation of life. The life insurance companies are continually making large gains from the fact that the actual number of deaths on which they are obliged to pay claims is less than the expected number given in the experience tables.

The only state which has kept accurate vital statistics for a period of sufficient length to enable comparisons of value to be made is Massachusetts. In 1793 Dr. Edward Wigglesworth published a life table based on death records collected prior to 1789.[1] The number of deaths of which he had record was 4,893, and the age-classification in the census at his disposal was unfortunately limited, but his calculation enjoyed for many years the confidence of the courts in that state. Let us compare with this the expectation of life of males and females in Massachusetts in 1897.

EXPECTATION OF LIFE IN MASSACHUSETTS AT TWO PERIODS

Ages	1789	1897 Males	1897 Females
0	28.15	44.09	46.61
10	39.23	49.33	50.70
20	34.21	41.20	42.79
30	30.24	34.28	35.85
40	26.04	27.41	29.00
50	21.16	20.53	22.10
60	15.43	14.38	15.74
70	10.06	9.34	10.36
80	5.85	5.70	6.56
90	3.73	3.16	3.73

We see from this table that in the course of a century the expectation of life at birth has increased 16 years for males and 18 for females. In making this comparison it is assumed that the rates for both sexes were identical at the earlier date. Since at no period is the difference for the sexes more than 2½ years, the accuracy is not affected to a considerable degree. Until the 40th year the difference is quite considerable, but after this age there has apparently been no great increase in the expectation of life. This is the same fact which was noticed in the figures for England.

In 1855 Mr. E. B. Elliott published a table for that year, based upon 16,086 deaths, from about two thirds of the population of Massachusetts.[2] It is interesting to see if

[1] Wigglesworth, E., "Table showing the Probability of the Duration, the Decrement and the Expectation of Life, in the States of Massachusetts and New Hampshire, formed from Sixty-two Bills of Mortality on the Files of the American Academy of Arts and Sciences, in the year 1789." Memoirs of the American Academy of Arts and Sciences, Vol. II, p. 133.

[2] Sixteenth Registration Report, Massachusetts, 1857.

there has been any considerable increase in survivorship during the latter half of the 19th century in this state.

TABLE OF SURVIVORSHIP FOR MASSACHUSETTS AT DIFFERENT AGES OUT OF 10,000 BIRTHS

Ages	1855	1893-97
0	10,000	10,000
10	6,873	7,487
20	6,437	7,167
30	5,748	6,615
40	5,078	5,988
50	4,409	5,275
60	3,597	4,272
70	2,475	2,869
80	1,059	1,266
90	118	259

If we assume that the productive age of man commences at the 20th year, we find that in 1897 there were, from every 10,000 births, 700 more individuals to take up and carry on the work of the world. At the 40th year there were 900 more engaged in doing their share. Even at the 60th year the world had the advantage of the labor of 700 more workers than had been the case 40 years previous. It is hard to estimate the saving in pain and suffering and the gain in productive capacity which this change has brought with it. Not only is the world's work better done, but the children enjoy the assistance and advice of their parents for a much longer period. The result of this should be better citizens.

CHAPTER VI

THE GROWTH OF POPULATION

SINCE an enumeration of the population is taken only once in 5 or 10 years it is necessary to estimate the numbers in the intercensal years. If we were to compute the birth-rate for the year 1906, the probable population at the middle of that year would be required. But if no census figures were available for any year subsequent to 1900 it would be necessary to have recourse to a mathematical computation.

It might appear that the most satisfactory method would be to add to the population in 1900 the difference between the births and deaths during this period. This does not take into consideration the changes caused by migration. To attempt to determine the balance of migration is out of the question, and therefore this method must be discarded as impracticable.

The two remaining methods which are commonly employed are the arithmetical and geometrical. The arithmetical, as the more simple, may properly be considered first. It is desirable to know the size of a certain city in 1906. This city in 1900 contained 120,000 inhabitants. But this figure alone would not enable us to approximate its size at the later date. It is necessary to know how rapid had been the increase previous to 1900. In 1890 the population was 100,000. During the decade ending in 1900 the city had enjoyed a yearly increase of 2,000. If we assume the same number to have been added to the population during the remaining 6 years, we shall estimate the numbers in 1906 at 132,000.

The geometrical method takes into consideration an additional factor. The arithmetical method assumes that the same number will be yearly added to the population. But, as when rolling a snow-ball, a larger amount is added to its volume with each revolution, so when a population is growing at a uniform rate, the numerical addition becomes larger with each succeeding year. If a population continues to advance, while the birth and death-rates remain constant, the net addition to the numbers will increase with each succeeding year. Thus, if the excess of the birth over the death-rate is yearly 5 per 1,000, the natural increase of a city with a population of 100,000 would be 500 during the first year, while, at a later date, when the city contained 120,000 inhabitants, the natural increase would amount to 600.

If a population is increasing at the rate of 2 per cent. per annum, each unit of population at the beginning of the year will be equal to 1.02 at the end of the year. At the end of the second year, instead of 1.04, it will be 1.02×1.02 or $(1.02)^2 = 1.0404$. At the end of a decade it will be $(1.02)^{10} = 1.22$.

But more often this problem is approached from the opposite direction. There are given the numbers of the population at two successive decades, while the yearly rate of increase during the period is desired. If a city with a population of 100,000 in 1890 increased to 120,000 in 1900, the yearly rate of increase would be 1.84 per cent. Thus, $\sqrt[10]{\frac{120{,}000}{100{,}000}}$ will give the unit of population plus the yearly rate of increase. This is done most readily by logarithms.

$$\begin{aligned} \text{Log. } 120{,}000 &= 5.079181 \\ \text{Log. } 100{,}000 &= 5.000000 \\ \hline & 0.079181 \end{aligned}$$

Divided by 10 this becomes 0.007918, which is the logarithm of 1.0184. Subtracting the unit we are left with an increase of 1.84 per cent.

Let us suppose that in this case also we desire an estimate of the population in 1906. $120{,}000 \times (1.0184)^6$ will give the desired figure. Multiplying the logarithm of 1.0184 by 6 we have $0.007918 \times 6 =$

$$\begin{aligned} & 0.047508 \\ \text{Log. } 120{,}000 &= 5.079181 \\ \hline \text{Log. } 133{,}871 &= 5.126689 \end{aligned}$$

The population in 1906 by the geometrical rate of increase is probably 133,871. With the same data the result by the arithmetical method is 132,000.

Since the results by the two methods differ by nearly 2,000 it becomes a matter of some importance which method is adopted. To put the rule to be followed in a nutshell: where the rate of increase for several decades has been nearly equal or tending toward acceleration, the geometric method is to be preferred. Where the population has been increasing for some time, but at a constantly diminishing rate, the arithmetical method will give more accurate results. The United States Census Bureau has adopted the arithmetical method for estimating the probable size of the cities of this country since 1900, finding by experimentation that this was likely to give a closer approximation than any other method.

There are four other methods which may be used either alone or as a check upon some other method of estimating the population. It is claimed that there exists in this country a constant relation between the number of votes cast and the total population. The census authorities, in estimating the population of the cities of the United States decided that this method could not be employed. "The number of votes cast at an election in a large city, affected as it is by the ratio of males to population, the ratio of adult males to all males, the ratio of citizens to male adults, the ratio of legal voters to citizens, and the ratio of actual voters to legal voters, stands in no constant or uniform relation to the population. In Albany, Columbus and Dayton there were less than four inhabitants to each vote cast at the presidential election of 1900, while in several northern cities there were more than eight, and in certain southern cities more than twelve to each vote cast."[1]

In most of the cities in this country there is published annually a directory. There is no uniformity of practice with respect to the classes to be included in this book. In all cases the adult males are supposed to be given, but a large number of the floating population of the large cities is

[1] "Methods of Estimating Population," Twelfth Census of the United States, Bulletin No. 135.

naturally omitted. The age limit, below which names are not given varies from 16 to 21 years. Unmarried women, engaged in remunerative employment, are usually included, but married women are seldom included. Care is not always taken to remove the names of all who are no longer inhabitants. Since the practice in these matters is not uniform throughout the country, it is impossible to make an accurate estimate. In some cases estimates are made by the publishers of the directories, but in a large proportion of the cases the numbers were found to be exaggerated.

In most of the states a census of the population of school age is taken annually and published in state or municipal reports. From these figures estimates of the total population can be made. Their accuracy depends upon the fact that the assumed ratio between the school census and the total population is constant, and that the census is complete. In most cities there is a decreasing proportion of children of school age, and in some cases it was found that there were more children actually attending school than were included in the school census. If the enumeration of those of school ages is carefully made, this is probably the most accurate of the subsidiary methods.

It is a comparatively easy matter to keep track of the number of inhabited houses of a city. If the number of dwellers per house is assumed to be constant, it is not difficult to estimate the population at an intercensal year. But the number of persons per house is constantly changing, and it makes considerable difference whether the new buildings are to be homes for single families or large apartment houses. This last method has therefore but little value.

To estimate the population it is probably better to use either the arithmetical or geometrical method according to the rate of increase during the previous decades. When this has been done, it is well to change or correct the estimate by the use of those subsidiary methods which seem to insure greatest accuracy.

To increase the numbers of his subjects has usually been part of the policy of a ruler, and a steady growth in the population of a country has been considered desirable.

Where a nation has been surrounded by strong or growing neighbors, to remain stationary or fall behind has often been to court conquest or dismemberment. Where large stretches of territory are left uncultivated from lack of laborers, it is but natural that this should be deplored, since the settlement of this area would mean not only a greater reserve of men in time of war, but an increase in the productive force and tax-paying capacity of the nation.

The population of a country tends to become as large as the productivity of the soil and the stage of the arts will permit. On the collection or hunting stage the numbers are, of necessity, small. The spoils of the chase will support but a sparse population and when game becomes scarce one tribe is sure to trespass upon the territory which a neighboring tribe considers its own. War, with the attendant loss of life, follows.

When the increased need for subsistence had led to the domestication of animals, it became possible for more and larger groups of people to obtain nourishment from the same territory. But the addition of animal's milk to the food supply made larger families possible by lessening the period which must elapse between the successive births of children. Since life on the pastoral stage required for the sustenance of each group a considerable area, and since a more rapid increase of numbers had been made possible by shortening the period during which the mother was obliged to suckle her child, it was not long before the available pasturage had been occupied. Since each group was striving to increase the size of its herds, and find grazing land for them, conflicts between the groups were inevitable. These conflicts differed from those on the hunting stage in that, in addition to the desire for more territory, booty and captives to be enslaved were eagerly sought.

It was not, however, until the knowledge and practice of agriculture became general, that a country could be thickly settled, and a steady increase of population made possible. Now was the world in possession of a food supply which could be transported to a considerable distance, or stored for the time of need. The forests, which had sheltered the game from which a few hunters lived, were cleared, that multitudes might be supported from the grain which this soil could produce. Cities of considerable size sprang up, where navigable water made it possible to cheaply transport food supplies from a distance. Rome with a population of a million souls was fed from her granaries in Sicily and Egypt. When these cities were situated in the center of large plains, or where transportation by water was impossible, these centers of population were small, since they obtained their food supplies from the surrounding territory, and the cost of shipment of goods by land was so great that no supplies of small value in large bulk could be brought from a distance. This limitation in the methods of transportation and the necessity of having a walled town convenient for the purpose of security accounts for the fact that the towns and small cities which dotted medieval Europe were separated by such inconsiderable distances. The ambition of warring nobles, the rivalry of cities, and the influence of the church were exerted to encourage the natural increase of the population. But when the available land was under cultivation the only means by which a larger population could be supported was by increasing the supply of land, improving the methods of agriculture, or a less wasteful consumption of commodities. Since the preventive checks to the increase of population did not meet with approval, the positive checks became operative. The cities deserved their title of "man-destroying." The population within the walls became more and more crowded, sanitary methods and precautions were unknown, with the result that the mortality, particularly of infants, was frightful. From time to time plagues and pestilences would sweep the country with awful loss of life. But they apparently taught no lessons, and a high birth-rate would in time recruit the numbers. Small wonder then that at several different times further growth of Paris and London was prohibited. The various crusades and the petty wars which kept Europe in a state of continuous conflict for centuries must have caused a tremendous loss of life. In this connection the periods of famine to which portions of Europe were frequently subject must not be overlooked. Each city with its surrounding territory was, to a large degree, an independent economic unit, the city furnishing the manufactured articles, and the land about it the agricultural products. Bad seasons were sure to come, when the crops were a partial failure. There might be plenty within 500 miles, but this supply might as well have been on another planet so far as the suffering communities were concerned. There was no way by which the surplus of one locality could balance the deficit of another. The result was famine with its train of suffering and death. For several centuries these three positive checks to the increase of population had kept the numbers down to the limit imposed by the available food supply. Few of the cities had grown to any great size. The Greeks tried to solve the problem by sending forth colonies which, in some cases, became as powerful as the mother city.

When it appeared that the population of Europe was about to become stationary, two new factors of immense import to the world were introduced. The importance of the discovery of America dawned on the world. For over a century the new world was prized on account of the possibilities it offered for exploitation, but gradually the advantages to be gained from its settlement became apparent. The European countries vied with one another to discover or appropriate new lands. Colonies would be founded in them which should owe allegiance to the mother country, and offer excellent opportunities for favorable trade. The mother country would manufacture for the home market and the colonies. The latter, in exchange for these manufactured articles, should furnish raw materials to the parent. A new apple of discord was thus presented to the nations of the old world. It was not until late in the nineteenth century that the old world saw the opportunity which would be afforded by this new territory to absorb its surplus population. Relieved of the necessity of producing its own food supplies, and turning its attention to manufacture, the population was no longer limited by the ability of the old world to produce food. Even the agriculture of the old world became more productive as scientific methods were applied. The doctrine of Malthus seemed disproved and the question of the reappearance of the pressure of population upon the food supply seemed too remote for discussion.

The second great cause to affect the growth and distribution of the population of the world was the application of steam to machinery. It was no new thing for a country to be thickly settled before the introduction of power machinery. For centuries the valley of the Nile had been densely populated. But when machinery was applied to locomotion, the distribution of the population underwent almost a revolution. It now became possible to establish industries wherever superior advantages were offered, without giving any consideration to the fertility of the surrounding territory. It made but little difference where the food supply was produced, since railways and steamships would bring it to any place where a demand arose. As a result of this, cities have had during the past century a remarkable growth. The economies resulting from the concentration of industry could be brought about without considering the agricultural resources of a single country. By this means each locality has been able to do that work for which is was best fitted, to the inestimable advantage of the world. England has become more densely populated than would have been thought possible a century ago. The United States has been able to settle its great prairies, introducing expensive machinery, since it was producing not for this country alone, but for the markets of the world.

The great cities which have arisen are no longer vampires, living upon the life-blood of the country. There were probably very few cities of considerable size in the Middle Ages in which the number of deaths did not exceed that of the births. Their growth was due entirely to migration from the rural districts. The rural exodus is a powerful factor at present, yet a large part of the growth of the modern city is due to natural increase. At last the people of the civilized world are learning how to live in large cities. The disposal of the sewage, the provision of pure water, sunlight and fresh air in the houses of the cities are matters which are rapidly coming into the control of, and being regulated by the public authorities. As a result of these measures the death-rates in the large centers have been decreasing rapidly during the past score of years. There has been no corresponding fall in the birth-rate, with the result that the natural increase of the population has been accelerated.

Of the population of the world, about one half is found in Asia, and nearly a half of the remainder is in Europe. Accurate statistics of the growth of the population of Asia are lacking, and we must be satisfied with the figures for Europe or those countries which have been settled by, or come under the influence of, the European nations. If we compare the size of the population of some of the principal European countries at the beginning and end of the 19th century, we are struck by the differences in the comparative increase.

POPULATION OF CERTAIN EUROPEAN COUNTRIES IN MILLIONS[1]

	1801		1901
European Russia	40.0	European Russia	112.8
France	26.8	Germany (1900)	56.4
Germany	25.0	Austria-Hungary (1900).	45.4
Austria-Hungary	25.0	Great Britain and Ireland	41.5
Italy	17.5	France	38.6
Great Britain and Ireland	16.3	Italy	32.5
Spain	6.0	Spain (1897)	18.1

Russia, with her vast natural resources, offering such opportunity for growth, has easily maintained her lead in numbers. France, with her commanding position in 1801, has been left far in the rear by Germany. During the same period she has been passed by Austria-Hungary, and Great Britain and Ireland. The effect which the great change in the relative size of these leading nations has had upon European politics can be easily perceived. The population of Germany increased 7 millions, and that of Austria-Hungary 4 millions during the closing decade of the century, while the growth of France was less than a half million.

The significance of these changes will be brought out more clearly if we substitute for the actual size of the countries at different periods, the rate of increase.

[1] Bertillon, J., "Rapport sur le dernier recensement," Bull. de l'Institut Internat. de Statistique, Tome XIII, Liv. II, pp. 93-95.

RATE OF YEARLY INCREASE OF THE POPULATION IN DIFFERENT EUROPEAN COUNTRIES[1]

Russia (1851-86)	1.47%	Norway (1855-91)	0.82%
England & Wales (1851-91)	1.21	Sweden (1850-90)	0.80
Denmark (1850-90)	1.09	Great Britain (1851-91)	0.78
Spain (1846-87)	1.07	Austria (1850-90)	0.76
Holland (1849-89)	0.98	Hungary (1850-90)	0.69
Belgium (1856-90)	0.86	Switzerland (1850-88)	0.59
Germany (1850-90)	0.84	Italy (1848-91)	0.58
Scotland (1851-91)	0.83	France (1851-91)	0.27
Ireland (1851-91)	—0.45%		

To group the countries in the table, we find that Russia has had a yearly increase of about 1.5 per cent., England and Wales of 1.2 per cent., Denmark, Spain, and Holland, of about 10 per cent., Belgium, Germany, Scotland, Norway, Sweden, Great Britain, and Austria, of about 0.8 per cent., Hungary, Switzerland, and Italy of about 0.6 per cent., and France with only one fourth of 1 per cent. We find Ireland in the anomalous position of having had a yearly decrease of a half of 1 per cent., in place of the customary increase.

It would be of interest to know whether the increase in numbers during the past century had varied inversely with the density of the population at the beginning of the period. We might expect to find that where the population was dense in 1800 the increase during the next century would not have been so rapid as where it was sparse. The following table will give the desired information upon this point:

DENSITY OF THE POPULATION OF EUROPE DURING THE NINETEENTH CENTURY[2]

	Population per Square Kilometer at Beginning	Middle	End of Century
Germany	46.0	65.0	104.2
Austria	44.6	58.4	85.8
Hungary		40.9	58.5
Russia in Europe		10.8	19.2
Servia	14.0	19.8	47.9
Greece		16.4	37.6

[1] Matlekovits, A. von, "Das Königreich Ungarn," Vol. I, p. 141.

[2] "Statistik des deutschen Reichs," Band 150, 1903, Erster Theil, p. 187*.

ENSITY OF THE POPULATION OF EUROPE DURING THE NINETEENTH CENTURY—CONTINUED.

	Population per Square Kilometer at Beginning	Middle	End of Century
Italy	54.4	79.7	106.6
Spain	20.5	21.7	35.9
Portugal	31.8	38.0	54.8
Switzerland	54.8	59.8	83.2
France	51.6	66.4	72.2
Belgium	128.5	153.8	229.0
Denmark	24.1	38.2	63.6
Sweden	5.7	8.5	12.3
Norway	2.7	4.6	6.9
England and Wales	58.9	118.7	212.5
Scotland	20.9	37.4	55.9
Ireland	63.9	80.2	55.1

In the case of Ireland, France, Italy and Switzerland, the countries with the lowest rates of increase, the density was in every case over 50 per square kilometer at the earliest date. Yet the two countries with the greatest density, Belgium and England and Wales, have increased at a much more rapid rate. The increase of Norway and Sweden, with the sparsest population, has not been so rapid as that of Germany or Belgium, where the density is far greater. There seems to be, then, no close relation between the density of population and the rate of increase. This is not peculiar since the natural resources of a fertile country will support a much more dense population than a sterile one, and since trade allows a country to be settled regardless of its production of food supplies.

In the case of Italy, France, Great Britain, Ireland, Sweden and Norway the rate of increase was more rapid during the first than the latter half of the 19th century, while in Germany, Austria, Spain, Portugal, Switzerland, Belgium, and Denmark the increase was more rapid during the latter half of the century. With the exception of Sweden and Norway, where the physical nature of the countries seems to preclude the probability of a dense population, and of Belgium, which has become a beehive of industry, those countries which had the densest population in the beginning of the century had a more rapid increase early than late in the century. It thus appears that, notwithstanding the opportunity which commerce offers a nation to increase regardless of its natural resources, those countries are likely to have the most rapid increase in the future where the soil is not entirely appropriated, or so cultivated as to realize its possibilities. A country which is continually producing more food stuffs than are consumed at home is bound to grow, a continually increasing proportion devoting their energies to the manufacture of those articles which have formerly been obtained from other countries in exchange for the means of subsistence.

There is no country which illustrates these changes more clearly than the United States. The increase of the population of this country, as shown in the following table, is little short of phenomenal.

INCREASE OF THE POPULATION OF THE UNITED STATES, 1790 TO 1900, BY MILLIONS[1]

Census Years	Population	Increase	
		Numbers	Percentage
1900	75.6	12.9	20.7
1890	62.6	12.5	24.9
1880	50.2	11.6	30.1
1870	38.6	7.1	22.6
1860	31.4	8.3	35.6
1850	23.2	6.1	35.9
1840	17.1	4.2	32.7
1830	12.9	3.2	33.5
1820	9.6	2.4	33.1
1810	7.2	1.9	36.4
1800	5.3	1.4	35.1
1790	3.9	..	..

From 1790 to 1860 the population added about a third to its numbers every decade. In 1870 there was a deficiency in the enumeration of the Southern States. There is no accurate knowledge of the amount of this, but it was estimated by the census authorities that the population in 1870 should have been reported as 39.8, instead of 38.6 millions. The increase during the decade ending 1870 should then have been 26.6

[1] Twelfth Census of the United States, Vol. I, p. 20.

per cent. and during the decade following, 26.0 per cent. Since 1860 the rate of increase has been slowly diminishing, but is still more than twice as great as that of Europe as a whole.

In the early decades of this century the natural increase of the population was very rapid. The economic motive for limiting the size of the family was wanting, for there was plenty of new land to be had for the asking. When the land of the East became taken up, and there seemed to be no chance for the large families in the home town, there lay the plains of the middle West for settlement, and the most energetic of the young men and women were not slow to seize the opportunity.

The exceptional opportunities offered by this country not only caused a rapid increase from the loins of its own people, but attracted millions from the old world, who sought to improve their condition by coming to this land of plenty. Since 1820 over 20 millions of immigrants have come to these shores. Down to 1845 the numbers were quite insignificant, but since then, with the variations caused by differences in economic prosperity, there has been a remarkable increase, so that during 1905 more than a million immigrants entered our ports. The vast number of arrivals has undoubtedly affected the numbers and character of our present population. It is, of course, impossible to tell what would have been the population of this country without this addition. There are some who claim that we should have had the same rapid increase in numbers without the immigration; that when our people saw these foreigners with a lower standard of living settling among them, they were unwilling to bring into the world children who should be obliged to compete with the new arrivals, and accept a rate of wages which seemed quite satisfactory to those accustomed to the old world conditions. This argument is based upon the rate of increase in this country during the early decades of the 19th century. During this period the increase was very rapid and yet there were but few immigrants. Since 1860, although the stream of immigration has poured into our land with increasing volume, instead of an acceleration, there has been a retardation in the rate of increase. With these facts in mind, it has been assumed that the immigration has caused a conscious lowering of the birth-rate, sufficient to account for this retardation. The fundamental error in this argument is the assumption that the rate of increase of the native population would remain constant during the century. The possibility of providing for the future of large families, when there are boundless stretches of fertile land to be had for the asking, changes when the best of this land has been taken. The early settlers in this country became a land-owning class, and to place their children in the same class has become a problem of increasing difficulty. The standard of living of the descendants of these settlers has been steadily rising, and to give a large family the advantages the parents have enjoyed is no easy matter. To assume that the rate of increase which prevailed under the anomalous position in which the country was situated at the commencement of the nineteenth century will continue seems illogical.

In those states from which we have accurate statistics the fecundity of the foreign is greater than that of the native mothers. It is indisputable that the average income of the native is larger than that of the foreign-born fathers. Throughout the world, the average size of family varies inversely with the economic position of the social classes. Since the economic well-being of the natives is higher than that of the foreign-born it is not peculiar that their rate of increase should not be so rapid. If we had no foreign-born here to do the more menial tasks, they would have to be done by natives or remain undone. It seems doubtful whether, without the assistance which has been given to us by immigrants, our resources could have been developed so rapidly. It may be that the rate of wages along some lines has been lowered by the competition of those who were accustomed to a lower standard of living, and the presence of those who were willing to work for low wages has delayed the invention and introduction of labor-saving devices. The effect of immigration has been to substitute foreign for native-born unskilled laborers to a certain extent in this country. We have had a European population half as large as our own, sending to us yearly since 1850 its entire natural increase. These foreign-born among us rear a family much larger than the native-born. It may be that the fear of competition affects the native parents, but in Massachusetts in 1850, before the competition of the immigrant was seriously felt, the average number of children born to the foreign was twice as great as that to the native mother. The higher wages received in this country enable the immigrants to rear a large family on the standard of living to which they have been accustomed. The numerous children are not a permanent economic disutility, for as soon as the law permits they are put to work to swell the family income. The immigrant is more prone to save money as his income increases than to raise his standard of living. By the second generation, however, the standard of living has been considerably raised. The advantage of providing their children with a good education is more clearly seen, and some races, like the Jews, make conspicuous sacrifices to attain this end. But if this is to be accomplished, the size of the family must be limited, and among the second and third generations the large families of the immigrants are rarely found.

This vast number of immigrants which we have received from the old world has not been sufficient to stop the increase of any of the European countries, with the single exception of Ireland. It has made possible a higher birth-rate than would probably otherwise have been the case. Those countries with the most rapid natural increase have sent us the greatest numbers.

Another fact which has retarded the rate of increase of the population of this country has been the growing concentration of such large numbers in the cities.

PROPORTION OF THE POPULATION OF THE UNITED STATES LIVING IN PLACES OVER 8,000

1790	3.4 per cent	1850	12.5 per cent
1800	4.0 "	1860	16.1 "
1810	4.9 "	1870	20.9 "
1820	4.9 "	1880	22.6 "
1830	6.7 "	1890	29.2 "
1840	8.5 "	1900	33.1 "

During the past century, the proportion living in places of 8,000 or over has increased from 4.0 to 33.1 per cent. It is an almost invariable rule that the number of children born per marriage is greater in the country districts than in the cities. Then, too, the infant mortality is far higher in the cities, so that a smaller proportion of those born reach maturity than in the rural districts. Few cities in Europe were self-maintaining until the nineteenth century, and even at the present day a large proportion of the growth of many of the large cities on the continent comes from without. The economic advantage from a large family is greater in the country than the city. There are but few lines of employment in the cities which are open to children under 16 years, and in most of these there is danger that the healthy physical and moral growth of the child will be checked. Since by legislative enactment the age at which children may be employed in factories is being steadily raised, it becomes more and more difficult for the workman in the city to rear a large family. In the rural districts different conditions exist. There are countless tasks upon the farm which are fitted to the strength and ability of children. These are in no respect injurious to the health, but afford excellent training for the head and hand. The economic motive which, in the cities, exerts such a powerful influence to limit the size of the family, is almost entirely absent in the country. The agricultural population has always been considered the great storehouse of the health and vitality of a nation. But the great prizes in the industrial and financial world are found in the cities. Therefore the most ambitious of the young men and women of the rural districts are continually leaving their home towns to go to the great centers, that they may enter the fierce competition for these high places. Thousands from the country districts of the North Atlantic states have migrated to the greater possibilities of the Middle West. The result has been that the least energetic have been left upon the farms of the Northeast. We can no longer look to them to furnish the quota of active, energetic spirits which formerly came from them. Since the proportion living in the rural districts is constantly decreasing, and since, in some portions of the country, the farming population is no longer composed of the earlier vigorous and virile stock, we must expect a slower natural increase. Large numbers of immigrants will doubtless continue to come from the old world, but unless we can devise some plan for their proper distribution after arrival, to offset their present tendency to settle in the overcrowded centers of the East, it seems likely that neither will they continue so anxious to come nor we to receive them. All signs seem to indicate that this country will never again have that rapid rate of increase which it enjoyed before the Civil War.

Although there are still large stretches of territory in the country which have not yet been brought under cultivation, and although the present methods of tillage are, to a great extent, wasteful and unscientific, producing only a fraction of what may reasonably be expected in the future, it is open to grave doubt if an increase of 30 per cent. per decade is longer desirable. As the population of the country increases it will be found necessary to improve the methods of production, but perhaps as much attention will need to be given to the problem of consumption. A campaign of education is needed to show the people of this country the proper selection and preparation of food.

For nations which are surrounded by strong neighbors it may appear imperative that the numbers should increase as rapidly as those of their natural rivals, but for the United States the economic and social well-being of the people is more important than their numbers. It has, however, been invariably the case that when the rate of increase of a nation seemed to slacken, the legislators have at once passed or proposed measures to stimulate it.

Rome was almost continually at war, and to take the places of those who perished in battle, and to provide a population at all commensurate with her ambitions, demanded a high rate of fecundity. Under the Republic this problem was successfully met, and her legions were, to a large extent, recruited from the sturdy farmers of Italy.

When, however, she had become mistress of the world, and her conquered provinces sent their tribute of grain, these farmers left the fields untilled to flock to the capitol that they might be supported by the frumentaria and congiaria. Pleasure became the watch-word of the hour. The shouts of the masses were for "panem et circenses." Labor became as banausic as it had been in Greece. "Proletarius," from a term of honor, became one of reproach. Rich and poor alike refused to marry and rear families. All the laws which were passed to persuade the people to have large families were of no avail. The economic motive was lacking and the attempt by law to overcome the spirit of the times was a failure. Rome was doomed and these legal measures never got below the surface to touch the mainsprings of life.

France, at the commencement of the last century, left the flower of her youth scattered over the battlefields of Europe. Napoleon needed men for his armies and offered inducements to the fathers of large families. In various forms these inducements have been continued throughout the century. But France has been numerically passed by one after another of the European states, and her population is at present nearly stationary. This condition has been the cause of much anxiety to the French statesmen and sociologists and many attempts have been made to divine its causes. To some the system of conscription is the cause, since it takes the young men away at the ages when they would be saving money to start a home, and by accustoming them to the irregularities of army life makes them unwilling to marry and assume the burdens of a family. But Germany has a similar system. To others excessive smoking and drinking are undermining the virility of the French youth. But France does not contain all the people who smoke or drink to excess. Others have thought that the French system of the division of property was at fault. Where each child gets an equal share upon the death of the parents, there is an added motive to keep the numbers of the children small. The holdings of the French peasants are ordinarily small, and if they are divided among five or six children, the portions will no longer be large enough to support a family. M. Jules Bertillon has concluded that the difference in the methods of the division of property at death is responsible for the higher natality among the French in Canada than in the home country. It seems more likely that the opportunities offered by the undeveloped resources of Canada are rather responsible for the difference.

It is admitted that the economic motive is generally the basis of the desire to limit the size of the family. It is therefore felt that the best way in which to combat this tendency is by artificially weakening this motive, or offering financial inducements to large families. It has been suggested that as every adult male in France owes certain duties to the state, he should be offered a choice in the manner in which they should be fulfilled. One duty is to contribute to the population. This is not done until he has married and begotten three children. If, at a certain age, he has not performed this duty, he shall pay a yearly tax to the state. For the bachelor this tax shall be the highest, gradually diminishing at marriage, and at the birth of the first and second children. When three children have been born his contributions shall cease. In case he rears a larger family, he shall receive an income from the state for each additional child. It is hoped by thus reducing the burden upon the parents to stimulate large families. The fault of such a scheme is that it will not be effective upon that class of people which it is particularly desirable to reach. The caisse des écoles and cantines scolaires have been formed to make it easier for the poor to rear and educate their children. None of these measures will affect the deep-seated sentiment of frugality which characterizes the French peasantry. As long as the people insist upon the present standard of living, no rapid increase in the population can be anticipated until either the income of the masses is increased, or improvements in the methods of production make the necessities of existence much easier.

In the United States it is felt in many quarters that a related problem exists. The increase of the population of this country is not generally considered to be too slow, and the attempt has been made to show that a retardation in the rate of increase was to be expected as the natural resources of the country became more fully exploited, and the proportion living in cities grew larger. But the native stock does not contribute its fair share to this increase. The average size of family among the wealthy classes in this country is probably smaller than among the poorer. If this were not the case it would be contrary to the experience of those European countries which have carefully investigated this question. As a result, the most rapid increase is from those classes which are least able to equip their children for the battle of life. There are several reasons which unite to produce this result. Those fathers who by industry and frugality have acquired a moderate property are usually conservative. The desire to give their children advantages which they themselves never enjoyed impels them to keep the size of their families small. There are others who, spurred by social ambition, find their income continually smaller than their needs. They wish to rise to the class which is financially above them, and every energy is bent to accomplish this end. Whatever does not favor this pursuit is put aside. To such, children are an impediment. Others have reached that social or financial eminence where they desire to found a family, but that the children may occupy an exalted position it is felt that the property must not be too much subdivided. Among this class large families are not the rule. The professional classes are not usually enabled to enter upon their chosen calling until close upon the 25th year, and many years must elapse after this before they are in a position to marry. As a result of this postponement of marriage, the number of children is usually small. Prof. E. L. Thorndike, writing upon the subject of the decrease in the size of American families, says with regard to college graduates: "The most plausible explanation is that of conscious restriction of offspring. Greater prudence, higher ideals of education, more interest in the health of women, interests of women in affairs outside the home, the increased knowledge of certain facts of physiology and medicine, a decline in the religious sense of the impiety of interference with things in general, the longing for freedom from household cares,—any or all of these may be assigned as the motive for restriction. The only other explanation is the physiological infertility of the social, racial group to which college men and their wives belong . . . In the case of artificial restriction there would appear in the statistics an increase in the number of small families, and a proportionate decrease in large families, whereas in cases of diminished reproductive capacity, there would appear in the statistics a falling off in the size of all families. As a matter of fact, the statistics show a general decline in the size of all families, and point to the conclusion that the decrease is due to incapacity rather than voluntary restriction."

The time is probably far distant when we shall be able to tell how large a share of this decrease in the size of families is due to conscious restriction and how large to incapacity, but until the biologist has been able to show that a life of comfort tends to produce infertility, it is well to accept the more hopeful view, and attribute this restriction in the size of families among the more cultured classes to volition.

As yet no accurate study has been made of the fecundity of this country, and none can be attempted until the vital statistics of the states are more completely recorded. Therefore it would be vain to propose a remedy until the state of affairs is known. From time to time proposals are made for free meals for school children, which would take from the parents part of the necessity for their support. In all such socialistic proposals there lurks the danger of pauperization. The fact that the workman is given to understand by society that he must support his own children doubtless impels him to exercise considerable care as to their number, but there is no force more suitable than prudence to limit the power of the genetic force. The state certainly has no authority to limit the size of the family of a normal individual. There seems to be no general complaint that the families of the poor are too small, and, therefore, no extraneous inducements are needed in this quarter. If the desire of perpetuating the family name, and living throughout the ages is not sufficient to persuade those who occupy superior financial positions to marry and beget children, no legislative enactment similar to those previously passed would be efficacious. Surely if there be any matter which is the personal concern of the individual family, it is this. Enough if each father knows why his children are one, three, or five in number. No other family is injured by whatever limitation of his family he may think necessary. Our country surely is confronted with a sufficient problem in safeguarding the rights of its members, without concerning itself over the rights of those unborn and undesired.

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