TAL STATISTICS.

WILLIAM FARR.

1885.

1885.

FROM A NEGATIVE BY LOMBARDI, PALL MALL.

Ever yours faithfully
W. Farr

VITAL STATISTICS:

A

MEMORIAL VOLUME OF SELECTIONS FROM THE REPORTS AND WRITINGS

OF

WILLIAM FARR, M.D., D.C.L., C.B., F.R.S.,

LATE SUPERINTENDENT OF THE STATISTICAL DEPARTMENT OF THE REGISTRAR GENERAL'S OFFICE, ENGLAND.

EDITED FOR

THE SANITARY INSTITUTE OF GREAT BRITAIN

BY

NOEL A. HUMPHREYS,

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PREFACE.

The suggestions which led to the inception of this work had their origin at the Meeting of the Sanitary Institute of Great Britain in Glasgow, in July 1883.

Professor W. T. Gairdner, in his Address as President of the section on "Sanitary Science and Preventive Medicine," dwelt forcibly upon the work of William Farr in the field of Sanitary Science. He suggested that the Institute should take steps to publish a selection from his statistical works, which might serve as an enduring monument of his fame. "The best of all possible monuments before the lessons " of his life and character have ceased to be vividly present to us."

Immediately after the Address, as Chairman of the Council, I promised that the subject should have the careful consideration of the Council, and, that if possible, the proposition should be carried into effect. In the following December the suggestion was considered by the Council; and a Committee, consisting of myself, as Chairman of the Council, Professor Corfield, Dr. Collingridge, and Professor Robinson, was appointed to consider and report upon the possibility of carrying out Dr. Gairdner's proposition. At a later meeting of the Council, the Committee was empowered to carry out the proposal, and the appointment of Mr. Noel A. Humphreys as Editor was sanctioned.

The publication of a deceased Author's works not being absolutely provided for by the regulations under which the Sanitary Institute of Great Britain was established, it was thought best to publish the work by subscription. The Committee, with the sanction of the Council, issued a circular, in June 1884, to those interested in sanitary science and health progress, which contained the following paragraphs.—

"It has long been the source of much regret amongst students of " Vital Statistics, as well as among those practically interested in this " branch of Sanitary Science, that the valuable statistical work of the " late Dr. William Farr, C.B., F.R.S., is, from the form and manner " of its publication, not generally available.

"The Sanitary Institute of Great Britain, having had the desire for " the publication of these statistics pressed upon its notice by those " capable of forming an opinion of the advantages to be derived there-

" from, and being fully impressed with the value of Dr. Farr's work, " proposes to publish a selection from the official reports, papers, and " addresses, which were contributed by that eminent statistician.

"Mr. Noel A. Humphreys, of the Registrar-General's Office, has " consented to undertake the selection and editing of this memorial of " Dr. Farr's statistical labours, which exercised so marked and so " beneficial an effect on the sanitary progress of England during the " forty years of his official career."

The result of this circular was a list of upwards of 500 subscribers, thus assuring the successful realisation of Dr. Gairdner's suggestion, which can scarcely fail to confer a benefit upon all interested in the science of Vital Statistics and Public Health.

As an earnest disciple of Dr. Farr, it gave me the greatest pleasure to assist in pressing the claims which his works have upon our grateful remembrance before the Council of the British Medical Association, when I was its President, and also before the Sanitary Institute of Great Britain.

ALFRED CARPENTER, M.D.,

CHAIRMAN of the COUNCIL
of the
SANITARY INSTITUTE.

BIOGRAPHICAL SKETCH

OF

WILLIAM FARR, M.D., D.C.L., C.B., F.R.S., &c., &c.

This memorial volume of selections from Dr. William Farr's literary work in connexion with vital statistics would be incomplete without a biographical sketch of the author. The story of his uneventful life, however, mainly consists of a chronological list of the productions of his pen.

William Farr was born at Kenley, a small, ancient, and remote village of Shropshire, on 30th November 1807. His grandfather was a small farmer in that parish, while his parents, who were in humble circumstances, migrated early in their married life to Dorrington, a small township six or seven miles from Shrewsbury. Here, while he was still an infant, he was adopted by Mr. Joseph Pryce, almost the only well-to-do resident of the neighbourhood. Dr. Farr, in a sketch of his early recollections, to be called "The Life of a Medical Student," which he began in 1833, but unfortunately never completed, thus alludes to his parents and his earliest years :—" My mother was young, and I was her " first child. At the age of two years I left my parents ; I do not " remember living with them. My mother was 'extreme in all' ; she " was a woman of violent attachment and temper, retiring and solitary " in her habits, of a strong mind, able and inclined to subsist on itself. " She was religious from duty and for consistency, rather than from " impulse or feeling, and had a good deal of superstition in her turn of " mind. The character of my father was very different ; he was good- " natured, sensible, straightforward, a Christian in faith, feeling, and " simplicity of heart." Although he did not live with his parents after he was two years old, he must have seen them frequently, as they lived at Dorrington after their migration from Kenley, at any rate until the death of his mother in 1845. His father spent the last years of his life with his son, and died in 1864 at Dr. Farr's house at Bickley, Kent.

Of his benefactor and of his childhood, Dr. Farr thus speaks in his recollections :—" To him I owe my education, the most constant and " tender care, and an example of benevolence and integrity. Would " that I could add a moment's duration to his memory ! When I first " recollect Mr. Pryce he must have been between 70 and 80 years of " age ; his health was delicate, his senses, with the exception of hearing, "were acute, his mind was vigorous and active. Dorrington is a village "situated 6½ miles from Shrewsbury. It lies on the Hereford Road; a "brook flows through its meadows; the Lawley and Caradoc rise in "the distance. No parson, no doctor, no great landed proprietor, lived "in it. Joseph Pryce was the squire, as he was not only the richest, "but the most influential man in the place. His house was constantly "open to the poor; he gave them coals and food in winter, paid the "apothecary when they were sick, established a day school, supported "a Sunday school, and was the principal founder and stay of a place of "religious worship. His acute intellect, his affection, his love of young "children, his benevolence, remained unclouded to the last. At home "I was a spoiled child. I always took refuge between Mr. Pryce's "knees when the wind blew high. I do not recollect the time when "I could not read, and after the dame's school went to Longnor school, "then the best in the neighbourhood, about a mile and a half from our "residence. * * * The schoolmaster was idle and empty-headed. I "learned writing and accounts, but did not at all distinguish myself. "The rookery and mill-ponds I remember distinctly, but the rest is "confusion. Mr. Pryce enabled B. Jones to open a day school; I "finished my school education here. I read English history, and was "taught English grammar, geography, and Latin, by Mr. Beynon, the "local dissenting minister. Mr. Beynon takes some credit to himself "for my early instruction; but, though very much indebted to "Mr. Beynon in several respects, I am sorry to say that I learned very "little grammar or Latin from him."

From these facts it is evident that Dr. Farr's educational opportunities in childhood were few, and of a most elementary character. His real education, and his classical and mathematical acquirements were mainly due to reading and private study. Even his opportunities for reading in his early years were very restricted, as may be judged by the following extract from his recollections:—"Our own library was "limited; its most conspicuous ornaments were 'Brook's Gazetteer,' "'The Whole Duty of Man,' 'Sturm's Reflections,' Timothy Priestley's "folio Bible, and various old theological works. The pictures in the "old Bible were a favourite study. With what ghastly fear, and yet "curiosity, did I look on the grim, grinning, bat-winged devils tor-"menting poor Job, and his wife muttering through them, 'Curse God "'and die.' After leaving school I read as many works as came in my "way. To Mr. J. Palmer I am much indebted; he lent me 'Smith's "'Natural History,' and 'Rollin's Ancient History.' To Latin a good "deal of attention was paid, and about 1823 (at 16 years of age) I "commenced learning Hebrew, which, with the help of 'Parkhurst's "'Dictionary,' I was at last able to read decently. About this time "the books I read were almost exclusively theological, and some "religious friends thought I might make a preacher of the Word."

He was so constant a devourer of books that his benefactor would say, "Go, look in the glass; when thou wast a little lad thy face was

" red and round, now, what a thin yellow cheek thou hast in its place ; " all is brought on by this reading, morning, noon, and night ! " He expresses his obligations to his friendly intercourse with the Williams family of Ryton ; " their society refined and enlarged my views, and " drew me into the portal of infinite thought." He thus retrospectively summarises the advantages and disadvantages of his bringing up :— " The advantages I enjoyed, the privations and the errors under which " I laboured, are obvious. In point of birth I was favoured ; my parents " were healthy, vigorous, and moral. My intellectual and inquisitive " faculties were not developed in a public school, nor by the example " and excitement of cultivated minds around me. Left to myself my " progress was wayward."

In his nineteenth year, inclination, or chance, or a combination of both, appear to have turned his attention towards medical study. He writes :—" Some apothecaries in the neighbourhood several times " expressed a wish to have me for a pupil, the objection to which was " that Mr. Pryce could not spare me, as he depended upon me for the " management of his business affairs. Besides, the old gentleman had " such a fond attachment to me, that he could scarcely rest when I was " out of his sight for an entire day. In May 1826, Dr. Webster called " accidentally one evening. The ' Encyclopædia Metropolitana,' and " the ' Quarterly Review ' containing an article on ' Contagion ' by " Dr. Gooch, were on the table. This and other matters were discussed. " The Doctor's was a striking and original mind, and left an impression " not to pass away. I called on him when I next went to Shrewsbury. " Physic seemed a field opened all at once before me. The plan " suggested was feasible, plausible, and excellent. I was to study with " G. Webster, under the doctor, become a dresser of Mr. Sutton's at " the Infirmary, and be nominally apprenticed to Mr. Wyke. On " Whit-Monday, in May 1826, I walked to Shrewsbury and called on " Dr. Webster. Through this summer I every day walked to Shrews- " bury, dressed patients at the Infirmary, read with Dr. Webster, and " returned home at evening, nearly 14 miles there and back. As " winter came on a good bay mare was purchased, and I rode to Shrews- " bury every day for two years, Sundays excepted. I thus became " tolerably acquainted with the manual and practical art of chirurgurie. " Sutton was very kind and gentlemanly in his manners, and always " took me to his private operations. With Dr. Webster I studied " anatomy in Fife. We read Celsus and Gregory's Conspectus. " The judicious and enlightened direction, and the elevated tone, " Dr. Webster gave to my studies, laid the foundation of all I shall " ever do that is useful or good. Many pass the first years of their " scientific career under well-informed industrious men, few, indeed, " under the eye of a man of genius. My medical reading was miscel- " laneous, and was gradually prolonged in the evenings till midnight. " With a Carbonarist from Turin, a Roman patriot, Dr. Webster and " I read Italian—Boccaccio, Dante, Ariosto, Tasso, Alfieri. My health

" continued good till the autumn of 1828, when I had acute bronchitis.
" During my illness Mr. Pryce was indefatigable in his care for my
" recovery."

Dr. Farr's benefactor, Mr. Pryce, who was a bachelor, and 90 years of age, was seized with pneumonia in November of the same year (1828), and died after a few days' illness, leaving a legacy of 500*l*. to promote the education and advancement of William Farr, then 21 years of age. He remained at Dorrington till the following April, and in May 1829 left Shrewsbury for London; after staying there for a few weeks he proceeded to the Paris University to prosecute his medical studies.

Dr. W. P. Bain, who enjoyed an intimate and unbroken friendship with Dr. Farr of more than fifty years duration, writes:—" I first met
" Dr. Farr in Paris in the beginning of 1830, when I went to study
" there after having passed my surgical examination in Edinburgh, and
" took lodgings in the Hotel des Grès, where he had been residing
" some time. We became intimate and attended lectures together.
" There was then a good deal of bad feeling amongst the lecturers. I
" remember at one of Lisfranc's lectures at La Pitié, in speaking of
" Dupuytreu of the Hotel Dieu, on the banks of the Seine, he called
" him 'Ce brigand au bord de l'eau.' The revolution of July gave us
" a good opportunity of seeing gunshot wounds and their treatment.
" The Hotel Dieu, La Charité, and La Pitié, were full of such cases."

During his two years' residence in Paris, Dr. Farr attended the lectures of Orfila, Louis, Dupuytreu, and Lisfranc on various branches of medical science; of Andral on hygiene; of Gay Lussac and Thenard on chemistry; of Pouillet on natural philosophy; of Geoffery St. Hilaire, Dumeril, and Blainville, on comparative anatomy and physiology; of Cuvier on the history of natural sciences; and of Guizot and Villemain on history and literature. It was during the course of his studies in Paris that the subject of hygiene, and of medical statistics bearing thereon, began to attract his special attention, and to engross his interest.

On leaving Paris, Dr. Farr and Dr. Bain travelled in Switzerland, and the latter writes:—" I had many opportunities of studying and
" admiring my friend's character. In a diary which I kept of our tour,
" I find recorded that 'Mr. Farr, while of a simple disposition, is
" 'endowed with a vastness of ideas and a philosophic mind.' He gave
" evidence then of observation and research. I well remember the
" scene at our inn at Martigny, when, after a walk to see the celebrated
" waterfall about four miles away, I returned weary and hungry to
" dinner. To my surprise, I found the entrance blocked up by at least
" a hundred of those miserable beings, the Crétins, who inhabited the
" Valais in great numbers. On inquiry of the landlord he told me that
" the gentleman inside had commissioned him to get together as many
" Crétins as he could, so that he might examine them. After some
" difficulty, I wedged my way into a room, where Mr. Farr was standing

" with a table and numerous large sheets of paper before him, on which
" he was marking the shapes of the different heads of which he had
" previously taken the contours vertically and horizontally by means of
" a leaden tape. That day we dined late."

On his return to England, after spending a short time in London, during which he appears to have commenced a course of study at University College, William Farr went back to Shrewsbury, and, probably through the influence of his friend Dr. Webster, was appointed *locum tenens* for the House Surgeon of the City Infirmary, who had been granted six months leave for the purpose of obtaining a second qualification. At the close of this six months the House Surgeon returned, but without his additional qualification, and the Governors of the Infirmary, obliged to appoint a surgeon with the double qualification, selected Mr. Yardley, whose brother is still (1885) Vicar of St. Chads, Shrewsbury. That William Farr fulfilled his hospital duties to the entire satisfaction of the pupils, may be inferred from the fact that they presented him, on his leaving, with a silver snuff-box. At this time Dr. Farr was without any medical qualification, or it is more than probable that he would have been appointed to the vacant post. It is impossible to regret what was to him, we believe, the cause of temporary disappointment, for had Dr. Farr been appointed House Surgeon of the Shrewsbury Infirmary in 1831, the chances of his subsequent devotion to medical and vital statistics would have been exceedingly small.

His Shrewsbury experience would appear to have led Dr. Farr to lose no more time in qualifying himself for practice. During the following two years he attached himself to University College, where he continued his course of medical studies, attending the lectures of Grant, Carswill, Jenner, Elliotson, and others. In March, 1832, he passed his examination for the L.S.A. at Apothecaries' Hall, which was the only medical qualification he obtained except the honorary degrees afterwards conferred upon him on the ground of "high scientific acquirements."

In 1833, Dr. Farr married a Miss Langford, of Pool Quay on the Severn, between Welshpool and Shrewsbury, and afterwards resided in Grafton Street, Fitzroy Square, where he commenced the practice and teaching of medicine. To supplement a probably precarious income he about this time wrote for various medical journals, mainly on subjects connected with vital statistics. He attempted to establish a course of lectures on what he called Hygiology, but in this respect he was ahead of his time, for no public licensing body in the United Kingdom at this time recognised even the desirability of public health lectures. The subject matter of these proposed lectures formed about the first* of a long series of papers contributed to the "Lancet," Dr. Wakley, the founder, proprietor, and editor of that journal, being

* See *Lancet*, vol. II., 1835-6.

one of the first to recognise the original talent of this young student of vital statistics.

In 1837, in conjunction with his friend Dr. R. Dundas Thomson, he edited the "British Annals of Medicine." He also in the same year wrote his valuable article on "Vital Statistics" in McCulloch's Account of the British Empire. This article, from which many extracts will be found in this volume, established his claim to a foremost place among authorities upon this hitherto neglected subject. Although it is now nearly half a century since this article was written, there is no other treatise on this subject (thoroughly and soundly treated in all its branches) that could be more profitably studied by students of vital statistics. This article may be said to be the foundation of a new science, to the development of which, with special reference to the improvement of public health, Dr. Farr devoted the greater part of the forty-five most active years of his industrious life. He also contributed in this year to the British Annals of Medicine "A method of determining the danger of "the duration of diseases at every period of their progress." During this year he lost his good friend Dr. Webster, of Shrewsbury, who left him a legacy of 500*l.* together with his library.

Among other work undertaken at this period, Dr. Farr is said to have been engaged by Sir James Clarke to assist him in revising and preparing for press his work on "Consumption," about the same time that Dr. Farr's young wife fell a victim to this disease.

In 1837 the civil registration of births, deaths, and marriages came into operation, and Mr. T. H. Lister was appointed the first Registrar-General. The necessity for skilled and scientific assistance in the compilation of statistical tables from the marriage, birth, and death registers soon became apparent, and William Farr was fortunately selected for the post of Compiler of Abstracts in the newly created General Register Office. He undoubtedly owed the appointment to the reputation he had earned in the field of medical and vital statistics by his article in McCulloch's work, and by his contributions to the "Lancet," and other medical publications. Sir James Clarke is believed to have strongly urged the claims of William Farr not only on the ground of his writings but from personal knowledge of his abilities and qualifications for literary work. The result of Dr. Farr's appointment upon English vital statistics, and indirectly upon health progress in England, most fully justified the selection, and it is now interesting to read in the Registrar-General's First Annual Report the announcement of the appointment, and the reference to "Mr. Farr, a gentleman of the "medical profession, whose scientific knowledge and intimate acquain-"tance with statistical inquiries are ample pledges of his peculiar "fitness for the post."

Dr. Farr was appointed to the General Register Office on 10th July 1839, at the modest salary of 350*l.* per annum, and thus ended his career as a medical practitioner, which he had scarcely seriously commenced. The next 40 years of his life were almost exclusively devoted to the, to him, congenial task of creating and developing a national system of vital statistics, which has not only popularised sanitary questions in England in such a manner as to render rapid health progress an accomplished fact, but which has, practically, been adopted in all the civilized countries of the world.

In 1838, the year preceding his appointment to the General Register Office, he contributed a notable paper to the "Lancet" on "Benevolent "Funds, and Life Assurance in Health and Disease"; a "History of the "Medical Profession, and its influence on the Public Health" to the "British Medical Almanac"; and a paper on "The Law of "Recovery and Mortality in Cholera Spasmodica" to the "Lancet."

The First Annual Report of the Registrar-General contains the first of that long series of letters, addressed to the Registrar-General, on the Causes of Death in England. With reference to this remarkable series of letters an eminently competent and thoroughly appreciative pen wrote of them as "from first to last marked by the same lucid "marshalling of the facts, the same masterly command of all the "resources of method and numerical investigation, the same unaffected "and vigorous English, breaking out every now and again, when "stimulated by a clear view of some wide generalisation, into passages "of great eloquence and pure philosophy."

In the first Report were sketched out various fields of investigation which it was hoped that the resources of the death register might be used for enlightening; fields of investigation which afterwards, under Dr. Farr's system of cultivation, yielded an abundant harvest of scientific knowledge. One of the first requirements which Dr. Farr set himself to fulfil was a system of statistical nosology. In this first report, based upon the deaths in the first half-year of civil registration, it was pointed out that "Each disease has, in many instances, been "denoted by three or four terms, and each term has been applied to "as many different diseases; vague inconvenient names have been "employed, or complications have been registered instead of primary "diseases. The nomenclature is of as much importance in this department of inquiry as weights and measures in the physical sciences, "and should be settled without delay."

The subjects both of nomenclature and classification of diseases received constant study and consideration in these annual reports, and out of chaos order and system were evolved.

In connexion with his official contributions to the Registrar-General's Reports, special reference should be made to the Supplementary Reports, dealing with English mortality statistics during the two decennia 1851–60, and 1861–70. These two Reports, in the form of letters addressed to the Registrar-General, especially the last, published in 1874, take a very high place among what have been aptly styled the "statistical classics of William Farr."

The Supplementary Report, dealing with the 10 years 1861–70, may be described as the crowning effort of Dr. Farr's labour at the General

Register Office, as there is scarcely a subject in the wide field of vital statistics which is not more or less exhaustively discussed in that Report both from a theoretical and a practical standpoint.

It is needless, however, here to dilate upon the contents of these Reports, a large proportion of which forms the bulk of the present volume, classified and arranged under subject-headings for convenience of reference, and accompanied by an alphabetical index.

The health aspect of mortality statistics was from the first the main lesson which Dr. Farr sought, and was eminently successful in his endeavours, to treat with the help of his well-devised and soundly-constructed system of vital statistics. He struck the keynote of his 40 years' work in the General Register Office in the following words to be found in his first letter in the First Annual Report :—" Diseases " are more easily prevented than cured, and the first step to their " prevention is the discovery of their exciting causes." Few will be inclined to dispute the beneficient influence of Dr. Farr's work upon health progress, especially in towns, but the authority to which we have above referred asserted that its " indirect influence (an influence " the source of which may not have been generally recognised) upon " practical medicine must have been very great. The constant endeavour " after exactness of diagnosis and precision of nomenclature is itself a " wholesome discipline which re-acts inevitably upon treatment."

In or about 1841 William Farr migrated from Grafton Street to Stoke Newington, and early in the following year married his second wife, Miss M. E. Whittall, daughter of Joseph Whittall, of Deal, but previously of Shropshire. The issue of this second marriage (his first wife died childless) were eight children, of whom one son and four daughters survived him.

The pages of the " Lancet " contained many contributions from his pen during the first few years of his service in the General Register Office, and it may be noted that in 1839 he delivered an oration on medical reform at the anniversary meeting of the British Medical Association.

Dr. Farr's name is especially identified with the history of the Statistical Society, the foundation of which was in some measure due to the institution of the Statistical Section of the British Association (of which Dr. Farr was also an active member), and to an attempt on the part of some of its members to limit its specific objects of inquiry. The Statistical Society was founded on 15th March 1834, and Dr. Farr was elected a Fellow in 1839. His first contribution to the Journal of the Society was a paper on " The Mortality of Lunatics " in 1841, many extracts from which will be found in this volume. In 1846 he read a paper on " Influence of Scarcities and of the Prices of Wheat on the " Mortality of the People of England." In 1849 he read a paper on the " Civil Service of England, with observations on the constitution " of Funds for Fatherless Children and Widows." In 1852 a paper on " Influence of Elevation on the Fatality of Cholera." In 1853 a paper on "Income and Property Tax," from which some valuable extracts find place in the following selections. In 1857 a paper "On "the Pay of Ministers of the Crown." In 1865 a paper on "Infant "Mortality, and on alleged inaccuracies of the Census." In 1866 a paper on "Mortality of Children in the principal States of Europe." Having filled the office of Treasurer of the Society from 1855 to 1868, he was elected President in 1871, and delivered inaugural addresses at the opening of the two sessions of the Society in 1871–2 and 1872–3, during both of which he was President. His last contributions to the Journal of the Society were two papers on the "Valuation of Railways, Tele- "graphs, Water Companies, Canals, and other Commercial Concerns, "with Prospective, Deferred, Increasing, Decreasing, or Terminating "Profits." These papers were read in 1873 and 1876. The selections in this volume have of necessity been almost exclusively confined to purely vital statistics, and therefore include no extracts from many of these papers, which, although deservedly held in high repute, deal with subjects which could not be so classed.

Dr. Farr had no official connexion with the Census of 1841, although his earnest representations on the subject probably conduced to the inquiry of that year including a complete enumeration of the ages of the people which had been omitted at the previous Census. At each of the three following Censuses he was appointed an Assistant Commissioner, and not only had the statistical control of the published tables, but wrote, with but inconsiderable exceptions, the whole of the Census Reports for 1851, 1861, and 1871. These three elaborate reports contain some of Dr. Farr's best work, and have contributed liberally to the selections in this volume.

In the Registrar General's Fifth Annual Report (dated August 1843), was published Dr. Farr's English Life Table, No. 1, based on the deaths in England and Wales in 1841, and on the Census enumeration in the same year. The objections to such use of the mortality returns for a single year, even when the population basis is as large as that of England and Wales, are obvious; but the rates of mortality in that year were fairly average rates, and the results of the Life Table, No. 1, were in remarkable agreement with those yielded by his subsequent tables, which had a far more extended basis. The Life Table, No. 2, was published in the Twefth Annual Report, dated 10th January 1853, and was based upon the deaths in the seven years 1838–44, and the enumerated population in 1841, the middle of that period. The Life Table, No. 3, was published as a separate volume, on the authority of the Registrar General, by Messrs. Longman and Co., in 1864. This Life Table was based upon the 6,470,720 deaths registered in England and Wales during the 17 years 1838–54, and the two Census enumerations in 1841 and 1851. The title of the work was "Tables of Lifetimes, Annuities, and Pre- "miums, with an introduction by William Farr." In the Life Table Part of this volume will be found extracts from this introduction, dealing with the general construction of the tables. Those interested in the more technical aspect of the subject, and especially in the infinite variety of formulæ dealing with different branches of life insurance, must, however, be referred to the work itself, the introduction to which has been, not inappropriately, described as "a very elegant treatise." Only those officially connected with Dr. Farr in the General Register Office, and who worked on this laborious volume (of more than 700 pages) under his superintendence, had the means of fully realising the unremitting attention he gave to every detail of the work, or the intense and unvarying interest he maintained in every successive process. It is not easy to forget the expression of his countenance, beaming with pleasure and triumph, almost childlike in its unaffected simplicity, when (during the progress of the Life Table, No. 3,) he reached the office one morning with a small page or two of MS., containing *one* of those formulæ which had taken him *all the night* to work out.

Before quitting the subject of Dr. Farr's Life Tables, reference should be made to his Healthy District Life Table, which was contributed in 1859 to the Royal Society, in a paper "On the Construction of Life "Tables, illustrated by a new Life Table of the Healthy Districts of "England." This is not the place to speak of the value of this Life Table as a standard of actually attained healthiness in England. Extracts from this paper find place in the Life Table Part of this volume, where will also be found reference to other life-table work of Dr. Farr's, published from time to time in the Registrar General's Reports.

In or about the year 1846, Dr. Farr moved from Stoke Newington to Melina Place, St. John's Wood, where a large circle of friends enjoyed his society and hospitality. Here he resided until 1860, when he went to live at Bickley, in Kent. During these years his official salary rose slowly, until in 1855, on the urgent representations of Major Graham, who had been appointed Registrar General in 1842, in succession to Mr. Lister, the Treasury granted him, in consideration of his eminent services in connexion with mortality and census statistics, a special allowance of 200*l.* per annum, which raised his salary as Superintendent of the Statistical Department of the General Register Office to 800*l.* We may here state, that at subsequent periods his salary was finally raised, in 1874 ,to 1,100*l.*, of which 300*l.* was in the form of special allowance for exceptional services. It may be remarked that his salary would probably, at this last-mentioned change, have been further increased except for the fact that the salary of the Registrar General, as Chief of the Office, did not exceed 1,200*l.*

In 1852 was published his celebrated Report upon "The Mortality of "Cholera in England, 1848–49." This undoubtedly added much, not only to our knowledge of the causation and methods for prevention of cholera, but also to the reputation of the author. Considerable extracts from this Report are given in the following pages, as also from his special Reports upon the subsequent cholera epidemics in 1853–4 and 1865–6, in which his theories as to the causation of this disease and to its dissemination by means of a polluted water supply, were to every impartial mind most conclusively corroborated. His history of the outbreak of cholera in East London, and of his investigations as to its causation, and his conclusions drawn from the results of those investigations, form a lasting monument of his acumen, his power of induction, and his patient determination to elucidate the truth in face of every difficulty, to say nothing of the fearlessness which led him to expose himself not only to the risk of infection in the midst of this remarkable outbreak, but to the unforgiving animosity of those intimately connected with the vested interests of the London Water Companies. Dr. Farr's disinterested services to London, and to science in connexion with the cholera epidemics, and the lasting benefits resulting therefrom, through improvements in the quality of the metropolitan water supply, have never been sufficiently appreciated, much less duly acknowledged.

Dr. Farr gave evidence before the Select Committee on Assurance Associations which sat during 1852–53, and in 1853 he published a paper on "A System of Life Assurance which may be carried out, and "would (1) be equitable in its operations; (2) afford the best security; "(3) be well adapted to the wants of the people, as it would afford all "the advantages of an insurance office and some of those of a bank; "and (4) operate at less risk, less expense, and lower premium than "small offices; and (5) also make a considerable source of national "revenue." It was, however, more than 10 years before a scheme of Government insurance was seriously entertained by the Government; but in 1865 Dr. Farr was commissioned to draw up a "Memorandum "for the use and guidance of the Chancellor of the Exchequer (W. "E. Gladstone), in the development of the Government system of "insurance." The system of Post Office insurance, which came into operation in 1864, was undoubtedly due in a great measure to the initiation of Dr. Farr, whose English Life Table, No. 3, was adopted as the basis for the tables of premiums, and who acted as consulting actuary during the early years of its operation, with scant recognition in the way of remuneration. While it must freely be admitted that Government insurance has not hitherto attained the success which was anticipated, its comparative failure must be attributed to want of judgment in its management, and in the regulations by which it is controlled, rather than to any unsoundness in the conception of the scheme, or in the tables upon which the premiums are based.

Dr. Farr took an active part and interest in the International Statistical Congresses held successively in Brussels, Paris, Vienna, London, Berlin, Florence, The Hague, St. Petersburg, and Buda-Pesth, between 1853 and 1876. At most of these Congresses he attended as the official delegate of the English Government, and by his personal influence as the founder of the English national system of vital statistics contributed materially to the remarkable development of the closely allied sciences of vital statistics and of practical hygiene which has taken place throughout the civilized world during the past thirty years, and especially in England and on the continent of Europe. The full bearing of Dr. Farr's work on health progress in England and abroad has indeed been more fully appreciated on the continent and in America than has been the case in England.

Dr. Farr contributed many papers to the British and Social Science Associations. From a paper read before the Social Science Association in 1858, on the "Influence of Marriage on the Mortality of the French People," extracts find a place in this volume. He contributed a paper to the British Association in 1861 on "Recent Improvements in the Health of the British Army." In 1864 he delivered an address as President of Section F. (Economic Science and Statistics) of the British Association; and in 1866 an address as President of the Public Health Section of the Social Science Association. It was mainly owing to the influence of Dr. Farr that this section of the Association was not disestablished in 1877, when he wrote a paper setting forth his considerations in favour of its maintenance. He was an active member of a Committee appointed by the British Association for the Promotion of Uniformity of Weights and Measures, which sat between 1866 and 1874; and contributed a paper to Section F. of the British Association in 1869 on International Coinage. He was also a member of the Anthropometric Committee of the British Association between 1876 and 1881; and in 1876, 1877, and 1878, contributed his last three papers to Section F. of this Association, "On the practicability of "adopting a common measure of value in the assessment of Direct "Taxation," on "Some doctrines of Population," and on "Babbage's "Analytical Machine." In 1878 he also contributed a paper to the Social Science Association on "Density or Proximity of Population; its "advantages and disadvantages."

It is impossible within the limits of this sketch to do more than enumerate some of the more important subjects in connexion with which the advice and assistance of Dr. Farr was from time to time sought and obtained by the Government. He was a member of the Committee appointed in 1858 to report on the preparation of Army Medical Statistics, and of the Royal Commission for Inquiry into the Sanitary Condition of the Army in India appointed in 1859. He gave evidence before the Royal Commission on the Condition of Miners in Great Britain in 1864, and contributed some valuable statistical information on the subject, which was fully adopted and endorsed in the report of the Commissioners. Selections from the contributions of Dr. Farr, printed at length in the Appendix to that Report, are reproduced in the section of this volume dealing with Class Mortality. He, moreover, gave important and valuable evidence, full of statistical information, before the Royal Commission on Water Supply, and before the Royal Sanitary Commission, both of which sat in the years 1868 and 1869. Among other subjects on which he was actuarially consulted by the Government may be mentioned the Superannuation of the Metropolitan Police, on which he prepared an exhaustive report, with a complete set of tables in 1860.

Dr. Farr, notwithstanding a slight constitutional tendency to bronchitis, enjoyed exceptionally good health up to the year 1876, when he was in his 69th year. While attending the Statistical Congress, at Buda-Pesth, in the autumn of that year, however, he suffered from an attack of dysentery, which left him much weakened ; and in December of the same year he lost his second wife. Although he afterwards enjoyed fairly good health, those who were in the way of seeing him continually could not fail to observe that he never fully recovered from the two severe shocks he suffered in the autumn of 1876.

When the retirement of Major Graham, after an eminently successful administration of civil registration as Registrar-General for nearly 40 years, became imminent, Dr. Farr not unreasonably entertained hopes that he might be appointed to the vacant post, and in 1879, with a view to sparing himself the fatigue of railway travelling, which had begun to be irksome to him, left Bickley, and again took up his residence in London, in Portsdown Road, Maida Vale. This step was taken in the prospect of prolonged official service.

The marked success which attended the administration of civil registration in England during the 40 years 1840–80, may be mainly attributed to the combined influence of Major Graham and Dr. Farr. Major Graham possessed in an exceptional degree the power of organization, with strong business capacity, and gave close and laborious attention to detail; these combined qualifications made him eminently fitted to be the administrative chief of nearly 3,000 registration officers, and of a central office with a staff of nearly 100 clerks of different grades. He felt the deepest interest in the success of civil registration over which he so ably presided, and scarcely less interest in the welfare of those who served under him. The services of Major Graham, in the eyes of the public, who are singularly ignorant about the inner working of Government departments, were to some extent overshadowed by the well-deserved esteem in which Dr. Farr's talents and services, in utilising the results of civil registration, were held by the public and the press. Not only abroad, but by a large section of the English press, was Dr. Farr regarded and spoken of again and again as the Registrar-General. This tendency to ignore the more silent and hidden work of Major Graham, which was, however, none the less indispensable to the success of civil registration, on the part of an ill-informed public and press, cannot be admitted as any palliation of the unaccountable omission of the Government to confer on him at his retirement some mark of their appreciation of so long, so devoted, so successful a public service. Under all the circumstances of the case it is pleasant to refer to the *entente cordiale* which marked the long continued official relations between these two eminent public servants. Major Graham felt, we believe, genuine pride in the success and extended usefulness, as well as in the public

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appreciation of the Chief of his Statistical Department, and in the valedictory conclusion of his last Annual Report thus alludes to Dr. Farr's services: "Lastly, I must express to Dr. Farr, whom in "1842 I had the good fortune to find here presiding over the Statistical "Branch, my gratified acknowledgment of the important services he "has ever since rendered. He is acknowledged throughout Europe, "the United States, East Indies, and the Colonies, as one of the first "statists of the day. To his scientific researches I attribute any "reputation that may have accrued to the General Register Office "of England and Wales from the time I accepted office in the "Department."

On the retirement of Major Graham in 1879, Dr. Farr applied to the Government to be appointed as his successor, asking to be allowed to hold, even for a short time, the post of Registrar-General, with which his name had been so frequently, but erroneously, identified. The refusal of this appointment to Dr. Farr, and the appointment of Sir Brydges Henniker as Registrar-General, are matters of such recent history that they need not be dwelt upon here. The partial failure of health under which Dr. Farr was suffering at the time, probably weighed with the Government in deciding not to do what would have been a graceful and magnanimous act, in recognition of the distinguished and valuable services of Dr. Farr. The public and the medical profession strongly sympathised with Dr. Farr in the disappointment he felt at the refusal of his request for promotion. Immediately the decision of the Government in the matter was announced, Dr. Farr sent in his resignation, and applied for superannuation. In a letter he addressed to the "Times," in explanation of the circumstances of his resignation, the following passage occurs: "Although warned by the recent state of my health "that I was in want of rest rather than of increased duties and "responsibilities, I was induced, by the hope of enlarged opportunities "of rendering assistance in the approaching Census, and in the promo- "tion of public health and sanitary statistics, to become a candidate for "the post of Registrar-General. Failing to obtain that promotion, I "no longer hesitated to seek that retirement which my friends had "previously urged upon me."

The official career of Dr. Farr closed on the 1st of February 1880, when he was superannuated upon an allowance of 800*l.* per annum, and soon after his retirement unmistakeable symptoms of softening of the brain set in, which gradually obscured the intelligence of his highly organised intellect. He died on 14th April 1883, rather more than three years after his retirement from the public service. He was buried at Bromley Common Church, by the side of his wife, whose loss, coming as it did at a time when his health had been shaken by illness, inflicted upon him a shock from which he seemed never thoroughly to recover.

The British Medical Association took an early opportunity to mark the full appreciation entertained by the general body of the medical profession of the conspicuous talents and public services of Dr. Farr

The Committee of Council of the Association in the spring of 1880, soon after Dr. Farr's superannuation, passed the following resolution:—"That the Gold Medal of the Association be awarded by the Committee "of Council of the British Medical Association to William Farr, M.D., "F.R.S., D.C.L., C.B., as an expression of their high appreciation of "his long, unwearied, and successful labours, in behalf of statistical "and sanitary science; as a recognition of the light he has thrown "upon many physiological and pathological problems, and on account "of the extraordinary services his work has rendered to the advance-"ment of the health of the nation." The presentation of the Gold Medal took place at the 48th Annual Meeting of the British Medical Association in the Senate House at Cambridge, on 12th August 1880. The President of the Council (Dr. Alfred Carpenter) addressed Dr. Acland, who had been deputed by Dr. Farr, in consequence of his illness, to receive the medal, in the following words:—"Professor "Acland, you have been requested by Dr. Farr to receive, on his "behalf, this Gold Medal, which is the highest honour that the "Association has the power to give, or our profession to confer. In "conveying it to him, to whom it has been voted, you will kindly tell "him that this medal is voted only for the very highest services in the "profession. He has given, in the knowledge of all men, these highest "services, and they have been long continued; for he has given a "life-long labour to sanitary work and to vital statistics—labours which "in themselves have had little that was attractive; labours which "have brought to him but barren rewards; but they have been labours "which lie at the foundation of all researches in medical science. It "is a great grief to the Association that Dr. Farr has been unable to "be present in person, and that this, like many other rewards in life, "has come when life's labour is nearly done; but it will be a great "solace to him, Dr. Acland, that this will be conveyed to him through "yourself, through one who is held in high estimation, who stands so "high in public and professional regard, who has spent the greater "part of his life in an endeavour to raise the study of natural science "in Oxford, and thus place professional education upon a broad basis." Dr. Acland, in reply, stated that he would "to the best of his ability "convey to Dr. Farr, the valued friend of them all, the Gold Medal "which he had just received, and would inform him that it was the "highest testimony which the profession could give of esteem and "regard for the great services he had rendered to the profession and "to the country; indeed, it must be said for services rendered to the "world." The presentation was made amid the loud cheers of those present in the Senate House, which was well filled. The medal was accompanied by an engrossed scroll on vellum, bearing a copy of the resolution.

The following are a few of the honorary degrees and distinctions which were conferred upon him from time to time in recognition of his high scientific attainments, and especially for his services to the science of vital statistics, and to public health. In 1847 the honorary degree of M.D. of New York was conferred upon him. In 1852 he was elected an Honorary Member of the Institute of Actuaries. The distinction of Fellow of the Royal Society was conferred upon him in 1855; and in 1857 the Royal Medical and Chirurgical Society elected him an Honorary Fellow in the distinguished company of Dr. Virchow. In the same year the honorary degree of D.C.L. was conferred upon him at Oxford. About this time he also received the honour of election as Corresponding Member of the Institute of France. Ten years later, in October 1867, he was elected an Honorary Fellow of the King and Queen's College of Physicians in Dublin. Lastly, at the time of his retirement, he was, on the recommendation of Lord Beaconsfield, gazetted a Companion of the Civil Division of the Order of the Bath.

As soon as Dr. Farr's retirement from the Registrar-General's Office became known, a very general feeling was expressed that the occasion called for some public recognition of the exceptional value of his services. With a view to carrying out this project a Committee was formed, of which the Earl of Derby accepted the Chairmanship, and a subscription list was opened. The amount subscribed was 1,132*l*., which, at Dr. Farr's request was invested in Bank of England Stock for the benefit of his three unmarried daughters, in order to supplement the very slender provision which he had been able to make for their support after his death. On Dr. Farr's death in 1883, the Government contributed 400*l*. to this Testimonial Fund, which was then closed, and the net proceeds invested in accordance with the expressed desire of Dr. Farr. In an Appendix to this volume will be found a list of the subscribers to this fund, and the balance sheet of the treasurer, as audited on the closure of the fund.

That Dr. Farr was a man of undoubted genius few who are really acquainted with his work could fail to recognise. This opinion is only enhanced by the knowledge of the comparatively slight educational advantages he enjoyed in his youth, and of the fact that in turning these slight advantages to the fullest account he was in the truest sense a self-taught man. He was, however, not only a thorough mathematician (although no record exists of his ever having had any instruction in mathematics), but was an accomplished linguist. He spoke French fluently, and read equally well the German, Italian, and the classic languages. An appreciative friend of Dr. Farr's, who accompanied him to Florence in 1867, when the International Statistical Congress was held there, remembers with pleasure the respectful and almost affectionate regard in which he was held by the eminent statistical delegates who met there, including M. Quetelet and M. Engel. His address, delivered in French, upon the mortality from cholera in East London in 1866, describing its sudden outbreak, and its as sudden cessation when the supply of polluted water which was its cause ceased, was listened to with breathless attention.

Dr. Farr, moreover, in addition to his special acquirements, was endowed with a large and open mind. He had been from his youth a great and general reader, had a constant and insatiable desire for information in all branches of knowledge, and had a genuine love of the true and beautiful in art and literature. He took a liberal, in the best sense of that word, and broad view of all social and political problems, for his heart was large as well as his mind.

Those who had the privilege and pleasure of his friendship, or even of his acquaintance, enjoy and treasure the memory of the man, quite apart from the inevitable respect and admiration they feel for his talents and his services. With scarcely an exception, Dr. Farr has been invariably spoken of with respectful appreciation. It would be hard indeed to believe that he could have had a private enemy, for he was not only essentially modest and unassuming in his manner, but he was always ready to see and appreciate merit, being especially free from jealousy of the success or suspicion of the motives of others. These qualities made him a somewhat bad judge of character, and exposed him to imposition from scheming speculators, who were desirous of and too frequently obtained his name and support in the furtherance of disastrous financial ventures. For this want of worldly wisdom, and of due caution in putting his actuarial reputation and his money at the mercy of others, he paid dearly. If he had possessed more self-assertion, not to say selfishness, and less trust in others, his worldly success would undoubtedly have been greater, but his character would have been the less loveable. By all those who were brought into immediate official contact with him, the memory of the "dear old Dr." will long be cherished, and many a kind word and act affectionately remembered.

He was devoted to his home ties, and lovingly indulgent to all around him. He was a delightful and delighted host, and although, in consequence of his extensive and varied information and acquirements, his conversation was always welcome, he was not what is called a great talker, whereas he was a thoroughly good listener. His keen enjoyment of and his evident participation in the pleasures of others, especially in the pleasures of children, the simplicity of his tastes, and his ready power of self-forgetfulness when surrounded by young people, were among his most marked and pleasing characteristics. None who knew him really well will ever forget the almost magnetic effect of his ever ready, spontaneous, thoroughly hearty, and most musical laugh.

Through life his capacity for work, and his complete absorption therein, combined with the rare but invaluable capacity for putting it aside when he left his study, was alike the source of astonishment and admiration among his friends. This, however, did not entirely save him from absent-mindedness, which at times was the cause of amusement to himself as well as to others, and which is held to be excusable and not altogether unnatural in those much given to deep mental study. His old friend Dr. Bain, with reference to this absence of mind, communicates the

following recollection: "Not many years ago, after having spent the
" previous day and night under his hospitable roof at Bickley, I accom-
" panied him in a walk to Bromley Common church, where he had to
" attend a vestry meeting, with the understanding that I should after-
" wards accompany him to town. I sat a long time in church, in fact,
" I read through the whole of St. Mark, without seeing him come out
" of the vestry. I had heard one or two doors shut, but did not take
" much notice, until I thought the meeting was a very long one.
" Wishing to make my observations, I went to one or two doors, but
" heard no response to my first gentle, and then loud knocking. I soon
" realised that I was imprisoned, and made furious attempts to break
" open the doors, and to reach the high windows, but with no result.
" The prospect was anything but a pleasant one, for the church was
" some distance from the road, and no house was near. After a con-
" siderable time, however, I was delighted to hear a key inserted in one
" of the outlets, and a church attendant appeared, who explained that
" the gentleman had left the church by another door, adding that it
" was entirely by accident that he himself had returned, having left
" something behind. I walked quietly into Bromley station, nearly two
" miles off, and found my worthy friend, who had lost his train, was
" reading Lucretius, and evinced no surprise at my appearance, nor
" apparent recollection of previous events."

This slight and imperfect sketch of the life, works, and character of Dr. Farr is written by one in whose earliest recollections the memory of his genial face, bright voice, and happy laugh is still vivid, and who was fortunate and privileged to spend five-and-twenty years in almost daily official intercourse with him. To those who did not know him personally the sketch may appear somewhat partially drawn. It has been written, however, in full confidence that all those who knew him will see no exaggeration, but only an honest attempt to do justice to his talents, his work, and his many inestimable qualities as a man.

The portrait of Dr. Farr, which forms the frontispiece to this volume, is reproduced from a photograph taken, in 1878, by Messrs. Lombardi and Co., of Pall Mall, London.

The Editor.

VITAL STATISTICS.

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OF

PART I.—POPULATION.

PART I.—POPULATION.

Introduction.

Population, as the natural basis of all vital statistics, necessarily demands preliminary consideration in any work dealing with that subject. Our knowledge of the statistics of the English population is almost exclusively derived from the facts collected at the decennial Census enumerations, and dealt with in the published official reports. Dr. Farr may be said to have statistically presided over the three Censuses in 1851, 1861, and 1871, and he wrote the greater part of each of those three reports. Those who have had cause for studying these and preceding Census reports cannot fail to recognise the greatly increased value with which Dr. Farr's influence invested the later reports. It is inevitable that the interest of each Census report should be, in a great measure, superseded by the appearance of the succeeding report. It has, therefore, been the object in the following selection to choose only those portions appearing to possess practical and permanent value in their relation to one or other of the branches of vital statistics forming the several divisions of this work. Some of the most valuable extracts deal with the laws and principles which govern the increase of population, and with the influence of marriage-rates and of birth-rates upon such increase. The variations in the proportions of sex, age, and civil or conjugal condition, are essentially important elements of Census investigations, and are indispensable to the useful study of marriage, birth, and death statistics. Scarcely less important, as a branch of the Census inquiry, are the occupations of a population, whether viewed from an industrial standpoint or in their bearing upon the health and mortality of the people. The next series of selections deals with infirmities, especially with statistics of blindness and deaf-mutism. Lastly comes an article upon the economic value of population.

It is necessary to bear in mind, with regard to all Census statistics, that they are, in England at any rate, simply the tabulated results of facts furnished by householders in their schedules on the enumeration day. The imperfect education of a large proportion of householders in this country (householders, so called, include the head of each separate family) necessarily impairs the accuracy of much of the information collected, especially of that relating to occupations. Other causes lead to inaccuracies in the return of the ages and infirmities of the population. There is every reason to believe that the facts collected at each successive enumeration are more accurate than those collected at the previous Census, but, while absolute accuracy can scarcely be expected, there is no good ground for doubting that, with ordinary caution in the deductions to be drawn from them, Census figures form trustworthy bases for vital statistics of infinite value, political as well as social. The inherent defects of Census figures should not, however, be lost sight of, especially by those who clamour for more detail, and seem to forget or to ignore the nature of the machinery by which a Census enumeration is effected. Occupation statistics furnished in the Census schedules can, for instance, never be made to answer the purpose of a thorough industrial Census. The difficulties arising from double and indefinite occupations, from the confusion between masters and journeymen, and between those actually engaged in and those retired from the various occupations, must tend to depreciate the value of this branch of Census statistics, so long as these statistics are solely dependent upon information supplied in householders' schedules. The obstacles in the way of successfully dealing with the information thus supplied are boldly stated in the last Census Report (1881), and should be carefully and fully considered before the time arrives for making preparation for the next Census in 1891. For the benefit of those who may be desirous to use the Census figures for 1881 as a basis for scientific investigation of the vital statistics of urban or rural sanitary districts during the current intercensal period, ending with the next Census in 1891, it may here be stated that the Census report for 1881 gives the sex and age distribution of the population of each urban and rural sanitary district as constituted in that year. The civil or conjugal condition of the population of each of the 47 urban sanitary districts having in 1881 a population exceeding 50,000 persons is also given in that report. The proportions of sex, age, and conjugal condition change so slowly that it may be assumed, without affecting the trustworthiness of the calculations based upon such assumption, that the *proportions* found to exist at the last Census will be maintained until 1891. This assumption will render it possible to estimate the numbers of males and of females living (at each quinquennial or larger age-period) in each year, in every urban and rural sanitary district, as well as in registration counties, districts, and sub-districts; and also to estimate the numbers married, single, and widowed in each town having a population of 50,000 and upwards in 1881.—(EDITOR.)

1.—SCOPE OF ENQUIRY AT FIRST SIX CENSUSES.

The inquiries undertaken at the Census of Great Britain in 1851 were of a much more extensive character than those which had been pursued in the course of any previous Enumeration, as will be apparent from the following brief summary of the results of each :—

The first Census, taken in 1801, under the superintendence of Mr. Rickman, showed the number of persons, distinguishing the sexes, in the various Counties, Hundreds, and Parishes of Great Britain,—the number of Houses and of the *Families* by which they were occupied,—and a rough statement of the occupations of the people, under the three classes of (1) "Persons chiefly employed in Agriculture," (2) "Persons chiefly employed in Trade, Manufactures, or Handicraft," and (3) "All other persons not comprised in the two preceding classes." It also included an abstract of the Parish Registers from returns made by the Clergy, giving in each Hundred, or Wapentake, &c., of England and Wales, the number of Baptisms and Burials at every tenth year from 1700 to 1780, and in each year afterwards, and the number of Marriages in every year since 1753.

The Census of 1811 was taken upon the same plan as that adopted in 1801, and the same particulars of information were given; the only difference being that in 1811 the number of *Families* occupied in the three above-mentioned classes was shown instead of, as in 1801, the number of *Persons;* and in 1811, the number of houses *building* was shown separately from the number of other uninhabited Houses. The

Abstract of the Parish Registers was also repeated, showing the number of Baptisms, Burials, and Marriages which had occurred in every Hundred in each of the ten preceding years.

In 1821 information was for the first time attempted to be supplied respecting the *Ages* of the population; but as it was left optional, both to the Census Officers and to the parties themselves, how far the investigation should be pursued, the Return upon this point (which gave the numbers in quinquennial periods up to 20, and thence at decennial intervals) proved, to a considerable extent, deficient and unsatisfactory. In other respects the particulars inquired into at this Census were precisely the same as in 1811.

The inquiry of 1831 embraced several additional particulars, principally in elucidation of the various classes into which the people are divided by their different occupations. While the classification of 1811 and 1821,—viz., that of *Families* into the three classes of (1) Those employed chiefly in Agriculture; (2) Those employed chiefly in Trade, Manufactures, and Handicraft; and (3) Others not comprised in the two preceding classes,—was still retained, a further subdivision was made *as to the Male Population of* 20 *years of age and upwards.* This was shown, in each parish, under the following heads:—

1. Agriculture { Occupiers employing labourers. Occupiers not employing labourers. Labourers employed in Agriculture.
2. Employed in Manufacture, or in making Manufacturing Machinery.
3. Employed in Retail Trade, or in Handicraft as Masters or Workmen.
4. Capitalists, Bankers, Professional, and other Educated men.
5. Labourers employed in labour not Agricultural.
6. Male Servants.
7. Other males, 20 years of Age.

The number of Male Servants *under* 20 was also given; and the number of Female Servants, without any distinction as to age.

In the printed Abstract of the Returns was given, at the end of each County, a detailed list of the particular Trades or Handicrafts included in the 3rd of the above classes, and the number of persons employed in each.

The inquiry as to the *ages* of the population was not repeated in 1831 beyond the distinction, above mentioned, of males above and under 20.

At this Census the *area* of each parish and township was given for the first time, being the result of a computation made by Mr. Rickman from maps.

At the Census of 1841 several alterations and additions were introduced. The number of *Families* was not given, and the statement as to occupations was not made, as before, for each *Parish*, nor was the previous classification adopted. The inquiry, however, embraced several particulars not before noticed, and the investigation as to those hitherto given was pursued with greater minuteness and accuracy. Thus, in each Parish was shown the number of persons who were born within the County, and of those born elsewhere; while, of the population of each Hundred, was shown how many were born in Scotland, Ireland, the British Colonies, and in foreign parts.

The Ages of the parish population were shown in the two divisions of "under 20" and "20 and upwards"; and the Ages of the entire population of the Country were shown, under Counties, Hundreds, and large Towns, in quinquennial periods. So, the occupations of the people were exhibited, under Counties and large Towns, in a very extensive and detailed classification, in which the precise employment (if any) of every individual *person* was stated, and the whole population was distributed according to their various pursuits. The population of *Parliamentary Boroughs* was supplied for the first time; the boundaries being those assigned in pursuance of the Reform Act. In other respects the information previously obtained was again given, and the Parish Register Abstract, though of minor utility since the introduction of the system of General Registration by Civil Officers, was again repeated.

At the Census in 1851 it was resolved to exhibit not merely the statistics, as before, of Parishes, and, more completely, of Parliamentary and Municipal Boroughs, but also of such other large towns in England and Scotland as appeared sufficiently important for separate mention, and of all the Ecclesiastical Districts and new Ecclesiastical Parishes which, under the provisions of various Acts of Parliament, have during the last 40 years been created in England and Wales. In addition also to the inquiry concerning the Occupation, Age, and Birthplace of the population, it was determined to ascertain the various Relationships (such as Husband, Wife, Son, Daughter)—the Civil Condition (as Married, Unmarried, Widower, or Widow)—and the number of persons Blind, or Deaf and Dumb. Further, under the impression that the 5th section of the Act would authorise such an inquiry, the design was formed of collecting statistics as to the accommodation afforded by the various Churches and other places of public religious worship throughout the country, and the number of persons generally frequenting them; and also as to the existing Educational Establishments, and the actual number of scholars under instruction. It was, however, subsequently considered doubtful whether, upon a rigid construction, the Census Act rendered it compulsory upon parties to afford information upon these particulars; and the inquiry was therefore pursued as a purely voluntary investigation. It was not deemed necessary to procure, as at former Censuses, any abstract of the Parish Registers for the ten preceding years; the general system of Registration of Births, Deaths, and Marriages, which had been for that period in full operation, affording more complete and trustworthy information as to changes in the aspect of the population referable to the operation of these events. —(Census Report, 1851. Enumeration, Vol. I., pp. ix–xi.)

2.—Union or Registration Counties.

The Legislature in 1834 * entrusted to the Poor Law Commission the power of forming new districts, called *unions*, without any such reference to county limits as was observed in the constitution of the analogous hundreds, sessional divisions, and lieutenancy subdivisions. These unions, having staffs of officers, and rating powers, were in 1836 made the basis of the 626 registration districts in which the births, deaths, and marriages have been since registered, and the population enumerated. Each of 608 districts comprises one union; and 18 comprise two to four, and in the aggregate 40 unions. And as the districts consist of sub-districts, the sub-districts of parishes and townships, so the districts were grouped together to form the counties, with which they were made to coincide as nearly as was practicable without breaking up the fundamental unit—the district or union which was presided over by an

* 4 & 5 Will. 4. cap. 74, s. 26.

elected and *ex-officio* board of guardians wielding great administrative and rating power. The union counties thus constituted differed little in many instances from the old counties, and in the aggregate only transferred 1,053,423 out of a population of 22,712,266 from county to county. For the sake of maintaining the union counties properly constituted intact, the requisite changes would involve no great sacrifice; but should it be held to be desirable, the disparity might in many instances be greatly and advantageously reduced by well-considered alterations of the existing unions. The subject was discussed in the Census Report of 1851; and it will be evident from the following extract that the new divisions of the country are better suited to administrative purposes than the old divisions descending to us from a time when the population was uncivilized, and in number inconsiderable.

"The cause of the discrepancy between the 'registration counties' and the other counties arises from the circumstance that, in many cases, the boundaries of the old counties were rivers; on which, subsequently, at fords and bridges, important towns arose, the markets and centres of meeting for the people of all the surrounding parishes. These towns have been made the centres of the new districts, as at them it is most convenient for the guardians to meet, and the officers to reside. Thus Wallingford in Berkshire is the natural centre of the district, which is nearly equally divided by the Thames; and the Thames is here, as it is in a lower part of its course, the county boundary separating Oxfordshire from Berkshire. The people of the parishes of Bensington, Ewelme, Crowmarsh, North Stoke, Berrick-Prior, Warborough, and Dorchester, on the north side of the river, in *Oxfordshire*, meet at Wallingford market, and are in many ways intimately associated with the people on the south side of the river in *Berkshire;* hence it was quite justifiable to unite the parishes so related on both sides of the Thames in the Wallingford Union—the Wallingford district. The whole district is placed in the 'registration county' of Berks; though part of it is in the old shire of Oxford. [And this is reasonable, for if these people are properly associated in one union, they should on many grounds be united in one county. The same remark applies to the city of Oxford, which is now partially in Berks; the whole of it should be transferred to Oxfordshire.] In the same way the greater part of the other discrepancies is accounted for. The old shire boundaries often run near towns; and the districts, which have not been arbitrarily framed, consist of 624 of the towns, with the surrounding parishes, sub-divided into sub-districts; while the registration counties are aggregates of the districts which have their central towns within the limits of the old shires. In the counties which, like Norfolk, Suffolk, and Essex, were originally well divided, little change has been made; in others, the defect of the old subdivisions into counties has been partially modified, without any further substantial innovation than the substitution of *districts* for the obsolete *hundreds*." (Census Report, 1871, Vol. 4, p. xxxvii.)

3.—Houses.

Definition of a house.—What is a house? appears to be a question admitting of an explicit answer. And the enumerators of the United Kingdom were instructed to class under that category every habitation; each separate house comprising by definition all the space within the external and party walls of the building. Thus it became impossible to count either each room or each storey as a separate house, although it might be separately occupied or owned, or might even have attached to it the privileges of voting.

On the continent, each hotel, however numerous may be its occupiers or tenants, is reckoned as one house; and the English practice was formally sanctioned, after discussion, by the official delegates of the various Governments of the world at the London session of the International Statistical Congress.*

Scotland is the only country of Europe in which the definition of "house" has hitherto offered insuperable difficulties. In that country the population of 3,062,294 souls has sufficient space,—19,639,377 acres,—giving six acres and more to each inhabitant; while houses in the open country enjoy the perfect security which is sought within the walled cities of the continent; yet Scottish families, instead of living on the earth in pure air, with the sky over their dwellings, in many instances prefer lying stratum over stratum in flats, opening into a common staircase,—"a continuation of the street," as it has been called,—which receives the organic emanations of the families on each floor. In several of the towns they, at the various Censuses up to 1851, conferred the names of houses on these flats or *floors* as they would be called in England, *étages* as they would be called in France.† And the Scottish Commissioners, who possessed many local advantages, do not appear to have been more successful in 1861 than we were in 1851, in getting the actual number of houses in Scotland.‡ This must be borne in mind in comparing the houses of Scotland with those of England and of other countries.

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* M. Legoyt, in his report of the proceedings in Committee, observes:—"La "section est tombée d'accord sur la définition du mot 'maison,' et sur les faits "intérieurs et cataracteristiques auxquels la maison doit être reconnue. Elle a "refusé notamment d'attribuer cette désignation aux divers étages dont peut se "composer une construction affectée à l'habitation, lors mêmes que ces étages "seraient occupés par des familles distinctes, et qu'ils auraient un escalier séparé." —*Rep. on Stat. Cong.*, p. 153.

† Johnson has been quoted in support of the notion, held by some persons in Scotland. A "house" he defines as (1) a place where a man lives; a place of "human abode"; (2) "any place of abode," &c. &c. Now it does not follow that, because a house is "a place wherein a man lives," that *every place* wherein a man lives is a house; for instance, a tent, a barge, a ship, a cell, or a chamber, is not a house. In the example which Johnson quotes, "Sparrows must not build "in his house eaves," Shakespeare finely characterizes the house by its eaves: the man living under his own roof, not under another man's "flat." Again there is the other quoted passage:

"The bees with smoke, the doves with noisome stench,
"Are from their hives and houses driven away."

Here a dovecote is a "place of abode," but it is not a house in the Census sense; and there is a difference between cell and hive. Johnson defines "flat"; and he was acquainted with Scotland, yet he nowhere intimates that "a flat" is "a house"; so that his authority is explicitly against the extension of the name of the part to the name of the whole of a building.

If any doubt remains on the subject, it will be dispelled by the following quotation from Boswell, who so faithfully reflects Johnson's opinions in the Journal of the Tour in the Hebrides. After citing a certain baronet, upon the perils of walking the streets of Edinburgh at night, he adds:—"The peril is much abated by the care "which the magistrates have taken to enforce the laws against throwing foul water "from the windows; but, from the structure of the HOUSES in the old town, which "consist of many STORIES, in each of which a different FAMILY lives, and there "being no covered sewers, the odour still continues. A zealous Scotsman would "have wished Mr. Johnson to be without one of his five senses upon this occasion. "As we marched slowly along, he grumbled in my ear, 'I smell you in the dark!' "but he acknowledged that the breadth of the street, and the loftiness of the "buildings on each side, made a noble appearance.—*Boswell's Life of Johnson, Croker's edition*, p. 270.

‡ Report on Census of Scotland, p. xxvii.

We have, in conformity with the practice since 1801, for the sake of uniformity, enumerated as houses all the distinct buildings which were inhabited, as well as uninhabited houses, and houses building; and after thus avoiding the inextricable difficulties of the "flats," we have still many heterogeneous structures mixed up with houses in the ordinary sense of that word. The house is a variable unit; it includes in the Census the hut on the moor, the castle on the hill, and the palace; so that every one of these structures, and of the intermediate mansions and cottages, is reckoned as a house. The ordinary house varies in size and structure in town and country,—in its cubical contents, in its hearths, in its doors, and in its windows; so that, to give a correct view of the accommodation which houses afford the population, and of their value, and of their sanitary influences, a special inquiry is indispensable. —(Census Report, 1861, pp. 7–8.)

Houses building.—The houses building were first enumerated in 1811; and the enumeration has been since repeated at every Census. In a country under depopulation the old houses fall into decay; many houses are uninhabited; and few new houses at a Census are "building." And as the question, Is England increasing or decreasing —decaying or flourishing—was seriously discussed during the last French war, it was thought that the inquiry into the "houses building" might assist in its solution.*

Upon comparing the number of "houses building" with the total numbers standing, this result is elicited:—in 1811 to 1 house building there were 114; in 1831 the proportion was 1 to 105; in 1861 it was 1 to 144.

This seems to imply that since 1831 this "indication of prosperity" has taken an unfavourable turn.

The question requires investigation, as it is by no means so simple as it appears to be on the surface.

Houses are built to replace old houses, and to provide for the new families of the increasing population. If we assume, for the sake of illustration, that *one* house in 100 falls into decay every year, so as to require reconstruction, the 3,431,533 houses of 1851 would be reduced, by the decay of 328,116, to 3,103,417 in ten years; but the houses in 1861 amounted to 3,924,199, or to 492,666 in excess of the houses in 1851; the new houses sufficing to replace the old houses, and to leave the enormous surplus, must upon this estimate have amounted to 820,782, or to 82,078 annually on an average.

If an equal number of houses is built every year, and they last on an average the same number of years, the proportion which the number of houses building bears to the number of houses existing will depend on the mean time it takes to build a house. Thus, if the houses of a place amount to 1,000, and each lasts 100 years, the 1,000 houses will be kept up by the erection of 10 new houses every year; and if each of the 10 houses is built in a year the numbers "building," corresponding to those at the Census, will, on an average, be 10. If each house takes 2 years for its construction, 20 houses building will figure in the Census return; if the houses are built in half a year on an average, 5 only will be building, for 5 built in the first half of the year, and 5 in the second half of the year, make 10 annually.

The change in the proportion of the houses building to the subsisting houses is probably the consequence of the more rapid system of construction which is now carried on in the towns. Thus if houses,

* Preface to Census Report, 1811, p. x.

including huts and cottages, as well as castles and palaces, were built at the rate of 82,078 a year, then the 27,305 building in 1861 would imply that they were built on an average in about 4 months. If the houses were built on such a system as to require $5\frac{1}{2}$ months for completion in 1831, and 4 months in 1861, the difference in the proportion of houses building in 1831 and in 1861 would be accounted for by this cause alone. (Census Report, 1861, Vol. 3, pp. 8–9.)

At each Census since 1811 the number of houses "building" has been returned. The number increased from 16,207 in 1811 to 27,444 in 1841, and remained nearly the same in 1851–61, but in 1871 the numbers ran up to 37,803. One house was "building" or being built to 114 standing inhabited and uninhabited in 1811; to 105 in 1831; to 144 in 1861; to 120 in 1871. The number of houses "building" on the Census day, as we pointed out in 1861, depends not only on the number erected annually, but on the *time* employed in the process, so that a decline in the number enumerated on one day does not imply a decline in the number of houses built yearly. The architect there cited is of opinion that houses on an average are built in six months (1861), but that is by no means certain. The houses building vary with the season; and with the facilities small builders find of obtaining advances of money. But as we know that houses are built in as short a time now as in previous Censuses, and as the season of the year has been the same, it is quite certain that the increase of "houses building" to 37,803 on the last Census day implies a rapid increase in the number of new houses. This is proved, too, by houses inhabited and uninhabited in ten years having increased by 596,263, that is at the rate of 59,626 new houses yearly. But new houses were also built in the same period to replace the houses out of 3,924,199 existing in 1861 that fell to decay or were taken down; assuming, as was done in 1861, that houses last about 100 years, and perish at the rate of one per cent. annually, then at the end of the ten years 375,223 houses must have disappeared. The new houses built in the ten years replaced these houses and added 596,263 to their number, so about 971,486 new houses have been built in the 10 years; of which about 920,194 inhabited were of the annual value of 14,907,143*l.*, and worth at 15 years' purchase 223,607,145*l.* (Census Report, 1871, Vol. 4, p. xxx.)

4. NUMBERS.

Principle of population.—The policy which England, since 1751, has pursued in respect to population was directly condemned and opposed by an acute and diligent critic, who endeavoured to establish a new doctrine, and to deduce, from what he designated "the principle of "population," the most adverse inferences. His doctrine has held such sway for some years in the works of political economists, and has such a direct reference to practice, that we shall notice two or three of its fundamental propositions.

Thomas Robert Malthus was born in 1766 at the Rookery in Surrey, amidst a poor and healthy, but not a very intelligent agricultural population. His father, an accomplished speculative man, was one of the executors of Jean Jacques Rousseau, and placed young Malthus under the tuition of Mr. Graves, the author of the Spiritual Quixote, and of Gilbert Wakefield. After proceeding to Cambridge in 1784, Malthus became a Fellow of Jesus College in 1797, under the conditions of celibacy which still linger as traces of the monastic system in our universities. In consequence, apparently, of a friendly controversy with his father, he wrote and published the first edition of his "Essay "on Population" in 1798; chiefly with a view to combat the doctrines of Condorcet and Godwin, who held that the human race was perfectible, and was advancing towards an ideal standard of excellency. His paradox was at direct issue with theirs, as the "principle of "population" rendered vice and misery, he contended, inevitable in all ages.

Population, we know, cannot increase indefinitely; its limit is as absolute as the limits of the world, or of the matter of which the world is composed; and in Great Britain the rate of increase is retarded by the premature mortality, the vice, the postponement of marriages, and the celibacy of the inhabitants. But Malthus went further in his doctrine; he insisted that the increase of mankind is the chief source of misery, and that extensive abstinence from marriage, or the repression of population, is to be regarded as the fundamental condition of human happiness. Population, he argued, is necessarily limited by the means of subsistence; but population increases naturally in a geometrical progression, or as 1, 2, 4, 8, ..., while subsistence cannot increase at a faster ratio in the same time than is expressed by the arithmetical progression 1, 2, 3, 4 . . . . .; consequently population is checked, and the checks which repress the superior power of population, and keep it on a level with the means of subsistence, are all resolvable into moral restraint [celibacy], vice [licentiousness], and misery [famines, plagues, disease]. Such was in short his doctrine. The ranks of this army—the population of every country—are full; the supply of the commissariat is limited; therefore, the number of annual recruits remaining invariable, any decrease of the deaths in battle must be followed by an equivalent increase in the deaths by famine and fever; or, if the deaths from all causes are to decrease, the number of annual recruits must be diminished. Jenner had recently discovered an antidote to the poison of small-pox. It was declared immediately to be no benefit to mankind. "I feel not the slightest doubt," says Malthus, "that if the "introduction of the cow-pox should *extirpate the small-pox*, and yet "the NUMBER OF MARRIAGES CONTINUE THE SAME, we shall find a "very perceptible difference in the *increased mortality of some other* "*diseases*." And again: "The operation of the preventive check—"*wars—the silent though certain destruction of life in large towns* "*and manufactories—and the close habitations and insufficient food of* "*many of the poor—prevent population from outrunning the means of* "*subsistence*; and, if I may use *an expression which certainly at first* "*appears strange, supersede the* NECESSITY *of* GREAT and RAVAGING "EPIDEMICS *to* DESTROY WHAT IS REDUNDANT. If a WASTING PLAGUE "were TO SWEEP OFF TWO MILLIONS in ENGLAND, and SIX MILLIONS "in FRANCE, it cannot be doubted that, after *the inhabitants had* "*recovered from the dreadful shock*, the proportion of BIRTHS to "DEATHS would rise much above the usual average in either country "during the last century."*

"What prevents the population of hares and rabbits from over-"stocking the earth?" demands a distinguished disciple, in a chapter on the increase of mankind.†

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* Malthus on Population, B. II. chap. xiii.; see also B. I. chapters i. and ii., and the work, *passim*.

† John S. Mill, Political Economy, i. 10. 2.

One of the corollaries from the doctrine was a plan for the gradual abolition of the poor laws, by declaring that no child born from any marriage taking place after a given date "should ever be entitled to "parish assistance."

All that is peculiar in this doctrine, all that is erroneous, and all that has shocked the public opinion of the country, ever since its enunciation, flows from a flagrant oversight; which might be pardoned in a young, hasty controversialist, but should assuredly have been at once taken into account when it was discovered in the light of Sir James Steuart's original analytical work that had been first published in 1767.* Malthusianism had, however, become a sect; had been persecuted; and was modified and softened, but still upheld, by its disciples.

Sir James Steuart, who wrote before Adam Smith, lays down the fundamental principle of Malthus, but limits it by a preceding over-ruling proposition. (1.) We find, he says, the *productions of all countries*, generally speaking, *in proportion to the number of their inhabitants;* and (2.), on the other hand [as Malthus asserts], *the inhabitants are most commonly* in *proportion* to the *food.* Steuart then shows that the food of the world may be divided into two portions: (A.) the natural produce of the earth; and (B.) the portion which is created by human industry. (A.) corresponds to the food of animals, and is the limit to the number of savages. (B.) is the product of industry, and *increases* (all other things being equal) in proportion *to the numbers of civilized men.* The whole of the chapter on Population in Steuart's work should be consulted. Malthus, it will be observed, loses sight of this analysis, and throughout his work confounds the yield of the untilled earth with the *produce* of *human industry;* which increases at least as rapidly as the numbers of civilized men, and will increase until the resources of science are exhausted and the world is peopled.

The *population* that a country sustains does not depend exclusively on the amount of *subsistence existing* at any one time. The produce of a country is limited chiefly by the character of the inhabitants. For if, as an example, *twenty-one millions* of men from any part of Europe were put in the place of the people of Great Britain after harvest, the various produce would not be maintained in succeeding years; and in the hands of Caffres, of American Indians, or of the wretched inhabitants of Terra del Fuego, however great the stock of subsistence may be at the beginning of a ten years' occupation of these fertile islands, it is evident that, at the end, both the subsistence and the people would vary with their industry, but would decline, and be, comparatively to the actual produce, inconsiderable in amount. Future generations of Britons, if they have genius, science, skill, and industry —and if they are more numerous—will necessarily produce more than the country now yields.

It does not follow, as the theory of Malthus assumes, that a diminution of the number of the people in 1800 or in any other year would have had for its result the division of a larger share of subsistence among the survivors; for in that year a failure of the crops was followed by a severe famine, although the number of families to be fed was not by one-half so many as the number at present in these islands. And, conversely, the share of each person's produce is not diminished as the population increases; for the share of the produce of every kind that falls to a family in the most populous state of America is

* The works of Sir James Steuart of Coltness, Bart., published by his son, General Sir James Steuart, 1806, vol. i.

incomparably greater than the share of the Indian hunter's family when there was not one person to every square mile of territory.

In the rudest state, where men live on fish, or fruit, or game, the population is rarely limited by the amount of subsistence existing, but directly by the skill, industry, and courage of the savage; for any improvement in the use of the net, hook, bow, spear, or weapon is followed by an increase of the tribe; while any diminution of its courage or industry is followed by extermination or decay. In the pastoral or in the civilized state, the same causes, operating on a larger scale, produce effects still more striking.

The character of every race of men is the real limit to its numbers in the world, if allowance be made for accidents of position and time.

Population is often out of the place where it is wanted, or could be most productive; but the population of the world is not, as Malthus assumes, redundant; and not only is there a paucity of men of transcendent genius in all countries, but few persons who have occasion to undertake or who accomplish great industrial, political, warlike, or other operations ever find that the men of skill, industry, and entire trustworthiness—of whom they can dispose, either in the highest or the lowest departments—are superabundant. Every master knows that good men—and every man that good masters—*are scarce.*

The idle who will not work, the unskilful who cannot work, and the criminal classes who cannot be trusted, are, however, it may be admitted, whether numerous or few, always redundant. But as the disciples of Malthus, if there were "two millions of such people in Great Britain," would not hear the public executioner invoked for their destruction, neither can we admit the validity of the argument of that writer when he attempts to reconcile us to the loss of lives by shipwrecks, explosions, small-pox, close habitations on low sites,—by the ignorance of men, the fevers of towns, or the blind fury of pestilences,—which are fatal to all classes of the nation. New births may repair the numbers, but never fill the places, of the dead.

The assumption that subsistence increases at a rate corresponding to any arithmetical progression rests on no authentic observations. The produce of this country has never been valued at stated intervals. Capital, however, increases, it is always assumed, when terms of years are considered, in a geometrical progression; and at compound interest the increase is much more rapid than the increase of population in any European state. The interest of money, indicating the annual increase of value, is the produce of property, and bears a rather close analogy to the increase "of the means of subsistence." At 3 per cent. per annum compound interest the value of capital is doubled in 24 years; and a population increasing at 3 per cent., which is near the natural rate, doubles in the same time; while actually the British population has increased at the rate of 1·329 per cent. annually for the fifty years 1801–51; and has doubled in 53 years. Thus—if we take this indication—the means of subsistence have increased faster than the numbers of the people; for, while the population has doubled, the value of capital under investment at 3 per cent. compound interest has quadrupled. The PRODUCE of Great Britain, which in the present state of commerce *is always convertible into the "means of subsistence,"* has probably not increased at a lower ratio; and no one can pretend, in the absence of the exact facts, that the ratio has been arithmetical.

The assertion falls to the ground that the disappearance of small-pox, of cholera, or of other epidemics, must be followed immediately by famine, or by an increase of other diseases. The principle may hold of "rabbits," and of animals that have no power of creating subsistence; but its application to civilized men is absurd.—(Census Report, 1851, Occupations, vol. I., pp. liv–lvii.)

It is true that all plants and animals have the power of multiplication; and man in conformity with that law has the power of doubling his numbers every twenty-five years under favourable conditions, and within definite limits of space and time, the limit being soon attained without the exercise of skill and industry in supplying his wants; but his struggles for the means of living, as a race, were greater at first when his numbers were fewer than they are now in England. The numbers of mankind never actually increase as the numbers in the geometrical series 1, 2, 4, 8, 16, 32, 64, 128, 256, 512 . . . . . indefinitely; and subsistence never increases as the numbers in the arithmetical series 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 . . . . . indefinitely. But the population of a country may increase in geometrical progression for a certain number of years, and so may its subsistence, understanding by that all that supplies men's wants. Mr. Malthus found when he wrote that the population of the United States had been said for a century and a half to double itself every 25 years; and now it is known by the Census that the population, after the year 1790, increased very regularly at the rate of 3 per cent. annually for the seventy years ending with 1860; at that rate population doubles itself in 23½ years. The increase, however, was not "by procreation only," but partly by excess of births and partly by immigration of blacks from Africa, of whites from Europe. Population increased in geometrical progression at a certain rate, but subsistence also increased in geometrical progression at a faster rate; so that the pressure of population on subsistence grew less and not greater. In the last 10 years productive labour slackened and the flow of population ebbed; during the civil war English emigrants returned to England; there was loss of life in the field, and although for lack of a national system of registration it cannot be set forth in figures, the marriage and birth-rates must have declined, for the population increased, not 3 per cent., but 2 per cent. annually between the two Censuses of 1860–70. Yet the produce increased, the wheat from 173 to 288 million bushels; the value of all live stock from 218 to 305 millions of pounds sterling.

The increase of produce from 1850 to 1860 may be inferred from two orders of facts. The number of farms rose from 14 to 20 hundred thousand, while the area of improved land from 113 grew to 163 million acres; and the value of live stock rose from 109 to 218 millions of pounds. Population only increased in those ten years from 23 to 31 millions.*

And in the earlier years, though not recorded, the produce increased undoubtedly as nearly in geometrical progression as the population counted at each census; and if the early censuses prove that population increases, the recent censuses prove that subsistence increases in geometrical progression. Had Malthus had before him the returns of produce as well as population in America, he could scarcely have fallen into the error of laying it down that, while population increases in a geometrical, subsistence increases in an arithmetical progression.

There is a limit to the increase of both people and produce: but the tendency now is, as men endowed with skill, weapons, tools, and

* See Journal of Statistical Society, Vol. xxxviii, pp. 74-6; and United States Census.

marvellous machines are diffused over the world, to create subsistence faster than population.

In the first edition of his work* Malthus lays it down that (1) "population cannot increase without the means of subsistence," that (2) "population does invariably increase where there are the means of "subsistence;" and (3) "that the superior power of population cannot "be checked without producing misery or vice."† Shrinking from the explicit expression evidently implied by his argument that "the superior "power of population cannot be checked without producing misery or "vice," he left out of account the fact that at the prolific age a large proportion of the women of every civilized population is unmarried and virtuous; this being only partially recognized in the subsequent editions under the phrase "moral restraint." Instead of simply stating that the population is kept down by any causes that diminish the births and increase the deaths, he uses in the last edition the vague phrase, "the "checks which repress the superior power of population, and keep its "effects on a level with the means of subsistence, are all resolvable into "moral restraint, vice, and misery."‡

The theory is as misleading in practice as it is defective in statement, and, as expressed, erroneous in fact. It assumes that the restraint of population is the corner-stone of policy. Had this principle been accepted by the people, the population of the kingdom instead of amounting to thirty-two millions would have remained, as it was at the beginning of the century, sixteen millions. England, in the presence of the great continental states, would have been now a second-rate power; her dependencies must have been lost; her colonies have remained unpeopled; her industry crippled for want of hands; her commerce limited for want of ships. The legal insurance of the people by the land against death by starvation, the efforts to stem the tide of epidemics, the science of healing, hygienic improvement of every kind, must have languished under the cold shadow of this doctrine; and in its name the endeavour to save the lives of children by sanitary measures is even now denounced as either futile or mischievous. And logically it leads to the policy of depopulation; for if increase causes misery, decrease, by parity of reasoning, causes happiness: this principle of population being the fewer the happier. It is a policy that diminishes the numbers of the wise and the good, but has no effect on the masses. Families under this policy die out. Classes, distinguished for any virtue, that accept the restraint under vows, provide for its extinction. The hermits and saints, that forewent "wedded love," and children, at the same time that they provided for their own eternal bliss provided for the extinction of sanctity on earth; while our universities offered by fellowships, forfeited on marriage, one of which Malthus had just acquired at Jesus College, a premium on protracted celibacy, they discouraged the multiplication of their ablest men.§ The economists, the misers, the philosophers, in the same way eliminate prudence, acquisitiveness, and science from the ranks of their race. They are like flowers all bloom. Low pay makes the officers of the army and navy perforce Malthusians, and discourages the propagation of prowess. Few aristocracies are self-sustaining; and if there is a natural tendency in wealth to accumulate by intermarriage, that may lead to its dispersion.

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* There is a copy of the first edition in the library of the Statistical Society. It was published in 1798, the year after he was made a fellow of Jesus College, Cambridge, and when he was 32 years of age.

† p. 37.

‡ 6th edition, Vol. I., p. 24.

§ In 1797. *See* Memoir in Principles of Political Economy, 2nd edition, p. xxxv.

of "rabbits," and of animals that have no power of creating subsistence; but its application to civilized men is absurd.—(Census Report, 1851, Occupations, vol. I., pp. liv–lvii.)

It is true that all plants and animals have the power of multiplication; and man in conformity with that law has the power of doubling his numbers every twenty-five years under favourable conditions, and within definite limits of space and time, the limit being soon attained without the exercise of skill and industry in supplying his wants; but his struggles for the means of living, as a race, were greater at first when his numbers were fewer than they are now in England. The numbers of mankind never actually increase as the numbers in the geometrical series 1, 2, 4, 8, 16, 32, 64, 128, 256, 512 . . . . . indefinitely; and subsistence never increases as the numbers in the arithmetical series 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 . . . . . indefinitely. But the population of a country may increase in geometrical progression for a certain number of years, and so may its subsistence, understanding by that all that supplies men's wants. Mr. Malthus found when he wrote that the population of the United States had been said for a century and a half to double itself every 25 years; and now it is known by the Census that the population, after the year 1790, increased very regularly at the rate of 3 per cent. annually for the seventy years ending with 1860; at that rate population doubles itself in 23¼ years. The increase, however, was not "by procreation only," but partly by excess of births and partly by immigration of blacks from Africa, of whites from Europe. Population increased in geometrical progression at a certain rate, but subsistence also increased in geometrical progression at a faster rate; so that the pressure of population on subsistence grew less and not greater. In the last 10 years productive labour slackened and the flow of population ebbed; during the civil war English emigrants returned to England; there was loss of life in the field, and although for lack of a national system of registration it cannot be set forth in figures, the marriage and birth-rates must have declined, for the population increased, not 3 per cent., but 2 per cent. annually between the two Censuses of 1860–70. Yet the produce increased, the wheat from 173 to 288 million bushels; the value of all live stock from 218 to 305 millions of pounds sterling.

The increase of produce from 1850 to 1860 may be inferred from two orders of facts. The number of farms rose from 14 to 20 hundred thousand, while the area of improved land from 113 grew to 163 million acres; and the value of live stock rose from 109 to 218 millions of pounds. Population only increased in those ten years from 23 to 31 millions.*

And in the earlier years, though not recorded, the produce increased undoubtedly as nearly in geometrical progression as the population counted at each census; and if the early censuses prove that population increases, the recent censuses prove that subsistence increases in geometrical progression. Had Malthus had before him the returns of produce as well as population in America, he could scarcely have fallen into the error of laying it down that, while population increases in a geometrical, subsistence increases in an arithmetical progression.

There is a limit to the increase of both people and produce: but the tendency now is, as men endowed with skill, weapons, tools, and

* See Journal of Statistical Society, Vol. xxxviii, pp. 74–6; and United States Census.

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The state of nations in the present day, and the history of past ages, prove that the maintenance of equilibrium between subsistence and population is a complicated question. It has been left hitherto to the sense of both sexes. Malthus had the merit of contending that it admitted of scientific investigation; that its problems should be sought in the statistics of nations in every stage of civilization; that it entered into the national policy, inasmuch as it was a matter that concerned, in the highest degree, not only particular individuals, but the whole community, the State. Reduce the constituent roll of a nation too low, and it cannot struggle with success against other forms of life in nature; it cannot hold its own in the face of other powers; it can undertake no great concerted operations; solitary minds in remote dwellings are not quickened by collision with other minds; the quantity of life is lessened on the earth,* and the chances diminished of the rise of men of genius, to whom the world owes progress in the sciences, discoveries in the useful arts, and triumphs in fine art and literature.

Ill effects of too many people willing to work can for centuries only be felt when they are blindly crowded in particular spots, when their labour is not organised, when their acquisitions are insecure, when their dwellings are dens, and when the supply of subsistence is not rendered, continuous, and within due limits equal, by storage, by commerce, by skilful distribution, and by wise laws: then zymotic disease is spread, periodic famines are fatal, and the wretched people are on inadequate diet starved.

The evils of indiscriminate intermarriage of imperfect natures accumulate. Errors on either side of excess or defect are punished as inexorably by the law of population as they are by the law of gravitation. If tribes of men will not breed domestic animals, or cultivate the soil, nothing can sustain them by the side of civilized races. If men and women will not work they may not eat. If classes of men drink alcohol to excess; if they consume impure water; if they herd in rookeries; and if they lead idle, criminal, vagabond lives; they perish. Nature is implacable; the degradation of the human race is made difficult; it is stopped by death. The best races in the end have the best chance of living from generation to generation. And against the severity of the life struggle have to be set the excitements of the battle, the energy it calls forth, and the perpetual selection of finer varieties of the race for survival. England through its centuries of history owes some of its greatness to this principle; it has been led by it step after step up to heights of glory.

The struggle is a consequence, science teaches, of the evolution of the living matter of the earth into higher forms; and that evolution is not yet at an end.

Mr. Darwin applies the doctrine of Malthus "to the whole vegetable " and animal kingdom"; and recognizing "the struggle for existence " amongst all organic beings throughout the world which inevitably " follows from the high geometrical ratio of their increase," he makes it the basis of a vast generalization.† After discussing the question he thus concludes, "all that we can do is to keep steadily in mind that each " organic being is striving to increase in a geometrical ratio; that each

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* Sir W. Petty, by a calculation which he describes in one of his Essays on Political Arithemetic, but which it would be difficult to verify, asserts, in opposition to "some sceptics," that two mountains of Ireland were as weighty as all the bodies " that had ever been from the beginning of the world to the year 1680." Be this as it may, the weight of the human race alive at one time does not exceed 60 million tons; for only a small fraction of the surface of the earth exists in the highest form of life.

† Origin of Species, 3rd edition, Introduction, p. 4, p. 67, and p. 82.

"at some period of its life, during some season of the year, during each "generation or at intervals, has to struggle for life and to suffer great "destruction. When we reflect on this struggle we may console "ourselves with the full belief that the war of nature is not incessant, "that no fear is felt, that death is generally prompt, and that the "vigorous, the healthy, and the happy survive and multiply."

This struggle reigns over the whole animal kingdom; nor is man, as is too well known, an exception; but Mr. Darwin modifies the principle which ascribes the great check of population to "misery." Reason too gives man certain prerogatives; for as we have seen it controls fertility, thus adjusting in time and place the results to the infinite varieties of the openings in life, and further, in his humanity man has a protection against the casualties and misfortunes which overwhelm inferior species. The human family, the clan, the town, the tribe, the nation, all acknowledge even now the claims of children, of the sick, of the wounded, and of the infirm, to help in time of trouble. Few men refuse to bind up the wounds of their fellow men. (Supplement to 35th Annual Report, pp. xv–xviii.)

Law of Population.—A population increases in regular geometrical progression when the births exceed the deaths, and the ratio of the births and of the deaths to the population remains constant. Thus in England every 100 persons living in 1801 had increased to 132 in 1821; and every 100 persons living in 1821 had increased to 132 in 1841; the 100 persons living in 1801 had, therefore, increased to 175 in 1841, and at the same rate will amount to 200 in the year 1850, 300 in the year 1879. The mean rate of increase was ·0141 annually; that was probably the excess of the births over the deaths. Grain, fruit, animals also, increase in geometrical progression; but the increase of capital, at compound interest, is the most familiar example of this kind of progression, and may render it intelligible to the general reader. Thus at 1·41 per cent. increase annually, 100 persons became 132 in 20 years, and 175 persons in 40 years; upon the same principle that 100*l*., put out at 3 per cent. per annum compound interest in 1801, would have amounted to nearly 181*l*. by the year 1821, and to 326*l*. by 1841.

Some statistical writers have given the 10th part of the increase in 10 years as the annual rate of increase. According to this mode of reasoning, as the population of England increased 75 per cent. in 40 years, it must have increased 37½ per cent. in 20 years, and 1·9 per cent. annually; while the actual increase was 32 per cent. in 20 years, and 1·41 per cent. annually; and, by the same reasoning, money that increased 226 per cent. in 40 years, must have borne an interest of 5½ per cent. per annum; while, as has been just stated, money bearing an interest of 3 per cent. per annum would increase 226 per cent. in 40 years, at compound interest.

The increase in 10 years is derived from the increase in one year, by multiplying 1 + the annual rate of increase 10 times into itself. Thus the increase of the population in one year was ·0141; 1 became 1·0141 in a year; and 1·0141, multiplied 10 times into itself, is 1·1507; 20 times, 1·3241. To obtain, therefore, the annual rate of increase from the increase in 10 years, the 10*th root*, and not the 10th part of the decennial rate of increase (1·1507), must be taken.*

* Let p denote the population at any time; p' the population at any previous time; n the number of intervening years; then $\sqrt[n]{\frac{p}{p'}} = r = 1 +$ the annual rate of increase. The division of the logarithm of 2 or 3 by the logarithm of r gives the number of years in which, *at that rate*, the population will double, or triple, &c.

It appears that about 19 in 20 of the people in this country are born in wedlock. In order, therefore, to understand the rate of increase by birth, it will be necessary to inquire how many persons are married, by how many marriage is foregone, and how long marriage is delayed after puberty? In the two last years (30th June, 1839–41), 123,405 women were married annually; hence it is probable that 113,361 women, who had not been married before, were married annually at a mean age of 24·3 years; for it appears from the facts cited in the report that the first marriages of females are nearly 92 in 100 of the total marriages, and are solemnized at that mean age. Let it be assumed, for a moment, that *all* the 113,361 women married at the same age—24·3 years—half a year earlier or half a year later; then if the number of women in the population who entered upon that age be known, the proportion married will be at once demonstrated. It appears from the census returns that the number of women who attained the age in question was about 143,830; and 143,830 is to 113,361 nearly as 100 to 79; the result therefore is, that 79 in 100 women who attain the marriage age (24) are married, and that 21 in 100 are never married. It has been assumed that all the marriages are performed at the same age, to make the proposition more intelligible; but it is evident that the terms of the proportion between the numbers who do or do not marry will not be materially affected by the distribution of the persons over the ages indicated by the registers.

In this investigation I only take the first marriages, because the first marriages represent the number of *persons* who marry annually; the rest of the total marriages, in a long interval of time, being repetitions of the act of marriage by the same individuals, many of whom in the ordinary marriage registers are counted twice; for the returns show that by re-marriages about 100 women marry 108 men, and 100 men 113 women.

It is not so easy to determine the proportion of men who do not marry; but I shall give the results of the same kind of reasoning applied to men, as has been applied to individuals of the other sex. It may be deduced from the ratio of the first to the total marriages, that 123,405 marriages (the average number), imply the annual marriage of 108,386 men, and from the census abstracts that about 132,236 men were enumerated at the mean age (25·5 years) at which men are first married; so that of 100 men enumerated who attain the average age at which marriage is consummated, 82 do marry and 18 do not marry; but the number 132,236 was derived directly from the number of men enumerated, and should be augmented, to include the men (soldiers, sailors, &c.) absent, and escaping enumeration at that age in greater numbers, probably, than at other ages. If we add 7,420 to the males enumerated, on the assumption that the numbers of the two sexes living at the mean age of 25·5 are nearly equal, which is probably the fact, it will be found that the proportion of men who marry is 78, or one less than the proportion which was found for the female sex. The actual difference, it will be observed, between the number of men and women enumerated who attain the respective ages is 11,594; but 4,180 of the number is accounted for by the disparity of age, as the women living at the age of 25·5 were 139,650, and not 143,830.

By reason of the re-marriages, the absolute number of women who marry is greater than the absolute number of men; the proportion is 1·000 to 1·046; and, latterly, as 113,361 spinsters, and 108,386 bachelors, have been married annually, the marrying women have been 4,975 a year more numerous than the men; while, as is shown in the preceding paragraph, if the number of both sexes at the same age is equal, the women living at the age 24·3, according to the census returns, were 4,180 more numerous than the women living at the later mean age, 25·5 years, at which men marry. The near coincidence affords a remarkable example of the secret adjustments which exist, and of the laws which regulate all social combinations. More women are married than men; but the women are married at an earlier age, when the number of them living is greater than the number of men living at the age when men marry; so that, at the respective ages of marriage, about 79 in 100 of each sex marry. Of 100 women married, 8 were widows; of 100 men, 12 were widowers. It is infinitely improbable that a husband and wife should die at the same moment; for every marriage, therefore, a widow or widower will be ultimately left; and if the number of marriages and of married persons remained stationary in England for a considerable number of years, as 123,405 marriages take place, 123,405 widows *or* widowers would be left every year, namely, 61,702 widows and 61,702 widowers, or 50 widows and 50 widowers to every 100 marriages, if the expectation of life in both sexes were the same at the age of marriage, in such sort that it might be strictly inferred, when 8 in 100 women married were widows that 8 in 50 widows married again, and by the same rule that 12 in 50 widowers married again. As the number of marriages, however, has increased for many years, and the expectation of life among women at the nuptual age is greater than that of men, it is probable that about 1 in 3 widowers and 1 in 4 widows re-marry.

The fact that one-fifth of the people of this country who attain the age of marriage never marry, and that the women, though capable of bearing children at 16, and certainly nubile at 17, do not marry until they attain a mean age of 24·3, the men until they are 25½, proves that prudence, or "moral restraint," in Mr. Malthus's sense of the term, is in practical operation in England to an extent which had not been conceived, and will perhaps scarcely be credited when stated in numbers.

The births of 1,006,132 children, or 503,066 annually, were registered in the two last years (June 1839–1841), when the mean population (without correction for males absent) was 15,716,775. The annual rate of mortality calculated on this population in the two years was ·02245, the rate of birth ·03201, the excess of the rate of birth was therefore ·00956. But the annual increase in the population in the 10 years, 1831–41, was ·01333, or ·00377 more than the excess of the rate of birth over the rate of mortality will account for. As nearly all the deaths are registered, and the number of immigrants from Ireland and Scotland can scarcely have been greater than the emigrants from England, the rate of birth must have been $\cdot 03201 + \cdot 00377 = \cdot 03578 = (\cdot 02245 + \cdot 01333)$ to account for the increase of the population, unless the mortality in the two years was much below the average, which there is reason to believe was the reverse of the fact. According to this statement, 100,000 persons lost 2,245 persons by deaths, gained 3,578 by births, and, consequently, increased 1,333 in the year; 3,201 of the 3,578 births having been registered, and 377 escaped registration.

The annual births were $503{,}066 + 59{,}280 = 562{,}346$; and, although the precise proportion of illegitimate births is not yet known, I shall assume, from the incomplete information in my possession, that 5 per cent. (28,117) of the children were illegitimate, which would imply that 534,229 children were born annually in wedlock, namely 4·7 to each woman married$\left(\frac{534{,}229}{113{,}361}\right)$, and 4·3 to each marriage $\left(\frac{534{,}229}{123{,}405}\right)$.

The latter is the usual, the former the best mode of stating this relation; for the object is to show the fecundity of women in different countries at different times; and the second marriages of women are, in this point of view, only a means of extending the period of childbearing to its natural term, and they cannot, on the average, be so fruitful as the first marriages, with which they are confounded. The marriages increased 1 per cent. annually in the previous 14 years; and, though we do not know at what date the persons were married from whom the 534,229 births sprang, it would certainly be at a period sufficiently remote to imply a less number that 113,785. The actual fecundity of the married women of this country may probably be expressed accurately enough, if a correction be made for the increase of marriages, and for the illegitimate children borne before and after marriage by women who marry, at 5 children to every woman married, and 4·5 children to every wedding. The 5 children replace the 2 parents, and those persons who from early death or from other circumstances bear no children.

The number of women living and enumerated, June, 1840, was, in round numbers, 1,630,000 aged 15–25; 1,272,000 aged 25–35; 900,000 aged 35–45; and these three ages, at which 3,802,000 women were living may be considered the ages of childbearing, the middle period being that in which the greater number of children are produced.

The 3,735,000 women living in the 2 years, June, 1839–41, between the ages 15–45, gave birth to 562,346 children annually: 66 women produced 10 children every year: only 1 in 7 women (6·6) at the childbearing age gave birth to a child in the year. Children are occasionally borne at 15, or as late in life as 55; but if the mothers of the 562,346 children had all been aged 17–40, there would have been only 1 annual birth to 5 women living of that age. It has been calculated that, on an average, 2 years intervene between the birth of every child;* or that of 2 women one has a child every year. After a correction has been made for unprolific women, the difference between 1 in 2, and 1 in 5 or 6, corroborates the previous result, and shows how much, notwithstanding the increase of population, the reproductive force is repressed by prudence.

The population of this country may have increased, and may increase by an augmentation in the number of marriages and births; or by a diminution in the number of deaths, and the consequent prolongation of life. The annual number of births may be increased in two ways: by an increase of the number of persons married, and by earlier marriages, which shorten the interval elapsing between successive generations. Thus 113,361 women were annually married (for the first time) in each of the two years ending June 30th, 1841, when 160,000 women attained the age of 20. If 10,000 be subtracted for sickness, infirmity, and incapacities of various kinds, 150,000 will remain who might have married, and thus have augmented the numbers married by one-third (32·7) per cent. The increase by birth, exclusive of illegitimate children, is about 3·4 per cent. annually; and if the marriages and births be increased one-third, or in the above ratio, the increase by birth will rise to 4·3 per cent., leaving, after subtracting the loss by death, (which shall be supposed to remain stationary at 2·2 per cent.,) instead of 1·3, the present rate, 2·1 per cent. annually as the rate of increase, raised to this height by the greater number of married childbearing women.

I shall not discuss the litigated question whether early marriages are more fruitful than late marriages; for, if even women who married at a

* Dr. Granville and Mr. Finlaison, Parl. Friendly Soc. Rep., 1825.

mean age of 30 bore as many children as women married at 20, it will be immediately perceived that the annual number of births, and the rate of increase, will be widely different in the two sets of circumstances. It may be assumed that at the birth of their children the age of the mothers will be advanced equally in both cases—six years, for instance, on an average—from the time of marriage; the mean age at the time the children are born will consequently be 36 years and 26 years. The interval from the birth of the mothers to the birth of the children will be 36 years and 26 years; and, according to the same law, the interval from the marriage of the mothers to the marriage of the children will be equally 36 years and 26 years. Now, in this case, altogether independently of the reduction by death in the 10 years, if the same number of women continue to marry, and if the expectation of life and the fecundity of the women remain unchanged, the births will be raised above or depressed below the present number, in the inverse ratio of 36 and 26 to 30. At present, the interval from generation to generation, from the birth of the parents to the birth of their children, may be 30 years; in the case of the early marriages, a generation would be reproduced every 26 years; of the late marriages, every 36 years; and, as by the hypothesis, the number born in *each generation* would be the same, the number born *in a given time* would differ in the ratio of the intervals which separated the generations.

If the annual number of births preserve the same ratio to the population, a decline of the rate of mortality will raise the rate which regulates the growth of the population. Reduce, for example, the annual rate of mortality from 2·245 to 2·000, and you raise the rate of increase from 1·333 to 1·578 per cent., unless ·215 be simultaneously subtracted from the rate of increase by birth, which would be likely enough to happen in nature. It is scarcely necessary to add, as a corollary deducible from this statement, that where the births are equal in two nations, or in the same nation at distant periods of time, the population will be proportional to the duration of life; that where the births are 1,000 annually, and the mean duration of life 25 years, the population will be 25,000; but that if the duration of life be by any means extended to 50 years, the population will ultimately become stationary at 50,000.

From the incomplete registration of births, the limited number of facts on which the age at marriage and the proportion of first marriages are calculated, and the complications arising from the increase or decrease of the population by birth, death, immigration, and emigration, I do not advance the preceding numerical statements as absolutely correct or definitive; and I hope to be able to resume the examination of these important subjects at a future time, when more extensive materials have accumulated and have been analyzed. None of these qualifications will, however, invalidate the general principles; and the facts prove, beyond all question, that the population of the country is susceptible of an immense expansion; that it is voluntarily repressed, and always has been repressed, to an extent which has not been clearly conceived or stated; and that the means in the hands of nature, and of society, for increasing and diminishing the population are simple, efficient, and quite compatible with our ideas of the benevolence of the divine government of the world.

Writers upon population have, perhaps, exaggerated the influence of the increase of population on the strength and prosperity of states; but its importance is unquestionable, and it must always be interesting to understand the laws which regulate the death—the reproduction of individuals; and which, in the midst of the struggles of the antagonist forces of disease and death, the losses by war, want, vice, and error, ensure the perpetuity and life of nations.

It is not my intention—and it would be out of place here—to discuss the questions, whether the population of England is increasing too fast or too slowly? whether any steps should be taken to accelerate or retard its progress? whether the Government should encourage or discourage population; or, after obtaining and publishing all the information that can be procured on the subject, leave public opinion and private prudence to come to their own conclusion and to take their own course? I shall merely notice very briefly how the rate of increase in the population is raised or lowered instinctively; as the indications of nature will be found valuable guides by all who seek to influence the opinions and conduct of mankind.

When the rate of increase is to be lowered, the usual course appears to be to defer to the extent required the period of marriage. If the supplies of subsistence were cut off, if science and industry were unable to convert a larger proportion of the materials of nature into food, and all the outlets and demands of emigration were closed, the population might unquestionably be brought to a stationary condition without increasing the deaths—*by reducing the number of marriages.* At present one fifth of the women who attain the age of 24·3 years never marry; if one-half of the women who attain that age never married, and illigitimate births did not increase, the births would ultimately not exceed the deaths, and the population would remain stationary. But the same end would be almost as effectually and less harshly attained, though four-fifths of the women who arrived at the mean age of marriage continued to marry, if instead of beginning to marry at 18, none married under 23, and the mean age of marriage were raised to 30 years; for the interval from generation to generation would be thus extended, the children to a marriage diminished, and the number of women at 30 would be reduced by the loss of the younger lives. The reduction to a stationary condition is put as an extreme hypothetical case, and as one not likely to be called into requisition; but it is evident that if the population could thus reduce itself to a stationary condition, it possesses still greater facilities for reducing the rate of increase any number of degrees below the present standard, without increasing the mortality. If we put another purely hypothetical case, such, for instance, that the population of the south midland division of the kingdom is increasing too rapidly; that the competition among labourers is threatening to be too severe; that their wages will not, in the end, support their families; that relatively to the means of employment and subsistence—the land, capital, and industrial enterprise—the inhabitants are likely to be too numerous; what, in these circumstances, would be the course pointed out by nature for those classes most directly exposed to privation to pursue? Would it not be to defer the present early marriages? And if the 25 in 100 women of Bedfordshire and Huntingdonshire, the 23 in Cambridgeshire, the 22 in Northamptonshire, the 22 in Hertfordshire, the 18 in Buckinghamshire, who now marry under age, deferred the period of marriage until they were 21, 22, 23, or 24 years of age, until they had gained some experience of life, and accumulated some of the means of living, physiologists and economists would probably agree in saying, that this increase of the prudence, which is now in operation, would not—except in special cases—be calculated to deteriorate the health or intelligence of their families. It is well worthy of remark and of careful consideration, that the number of persons who marry under age, as well as the number of marriages and of births, is much greater in some counties than in others; but it must not be thence inferred that the population is increasing too fast in those counties; for it may happen that a population increasing at a slow rate is increasing too fast, and that another population increasing at double the velocity is barely meeting the demands for hands and skill—in the harvest-field of labour. I stated the case of the south midland counties, therefore, merely as an illustration of the doctrine that, if any part of the population of this country is increasing too fast, the means of repression are simple, would not be harsh in their operation, and are at the command of the immediate sufferers.

The population is increased most naturally by reversing the process described—by earlier instead of later marriages—while a somewhat higher proportion of women marry, leaving still a large residue, including all afflicted with hereditary ailments, and thus affording scope for the selection, which is invariably, though perhaps insensibly, exercised in large masses, and must tend to elevate the moral and intellectual, as well as the physical qualities of the race.

Dr. Price, at the close of the last century, excited alarm by a forcibly drawn picture of the depopulation of the kingdom; and no sooner had the census demonstrated that Dr. Price's fears of depopulation were groundless, than the "increase of population in a geometrical progression," enunciated in the theory of Mr. Malthus, turned the gloomy forebodings of speculators in quite an opposite direction. Both these writers contributed essentially to the development of the true theory of population; both rendered important services to mankind by their investigations; but the facts since elicited, and the further prosecution of the inquiries which they commenced, have shown that while the study of the doctrine of population is fraught with instruction, and is suggestive of prudence, it is calculated to inspire a calmer confidence in the ordinances of nature, and to confirm our faith in the destinies of England. The expansion of which the reproductive force in the population is susceptible, and the progress of science and industry, must set at rest all dread of popopulation; which has apparently never prevailed for any length of time since the earliest historical ages. The population, it has been proved, has increased in a geometrical progression ever since the first census in 1801: and the rate of progression has been such that, if it continue, the numbers will have doubled in 1850: double the number of families will exist, and must be supplied with subsistence in England: but there will also be double the number of men to create subsistence and capital for her families, to man her fleets, to defend her inviolate hearths, to work the mines and manufactories, to extend the commerce, to open new regions of colonization; and double the number of minds to discover new truths, to confer the benefits and to enjoy the felicity of which human nature is susceptible. If the proposition of Lord Bacon be sound, as it unquestionably is, that the "true greatness (of a state) consisteth essentially in population and "breed of men," time has confirmed his prescient assertion, "that out "of doubt none of the great monarchies, which in the memory of time "have risen in the habitable world, had so fair seeds and beginning "as hath this estate and kingdom." * If the population of England had remained stationary from the age of Elizabeth, and had now not exceeded the population of Belgium; or even if the population had been stationary from the time that Malthus wrote, the empire

* Of the True Greatness of Great Britain, Lord Bacon's works, vol. i. p. 502. It is to be regretted that Bacon did not complete this essay; it commences very much in the manner of Machiavelli's "Discorsi," and was probably intended to infuse a little courage into James I.

could scarcely have attained its present power, or sustained its present greatness. Should the time nevertheless come, when the country is sufficiently populous, and it should be desirable to retard or stop the progress of population—the analysis of the marriages, births, and deaths, in connexion with the census returns, will show, as has been already proved, that this may be effected without raising the mortality. The principle of "an increase of the population in geometrical "progression" has nothing in it fatal, irresistible, inexorable; upon a rigorous analysis of the facts, it is seen that it consists of nothing but an excess of births over the deaths, and becomes a negative quantity, or "a decrease of population in geometrical progression," if the births cease to maintain the same ratio to the population; and the births may always be reduced rapidly by retarding the period and number of marriages: so that the mathematical terror, "a geometrical "progression," cannot alarm any one in the light of day. I do not desire to disguise or underrate the gravity of the fact, that the population of England has increased, as the censuses prove,—and the excess of births over deaths leaves beyond doubt—in a geometrical progression for 40 years, and at a rate by which, if continued, it will double every 49 years. But what has called so many millions of people into existence in 40 years? Why have the English increased so much more rapidly than other nations? By what force has the high rate of increase been sustained; and what gave it the velocity of this geometrical progression, but the creative energy and intelligence of the country and race? And can any one fear for the conduct and fate of this people, if they should feel themselves called upon to rear fewer children—to marry less early than during the last 40 years? Will not the same intelligence and energy which increased, diminish the rate of increase to any extent, when they take the form of prudence?

I have only discussed the increase of the people so far as it is immediately connected with and explained by the registered marriages, births, and deaths. But I may illustrate the practical bearing of the inquiry by one inference, and by noticing a fallacy which has perhaps had some influence on the opinions and conduct of practical men.

The growth of a population depends upon the excess of births over deaths; and the number of births is regulated by the number of marriageable women; whence it follows that where there is a permanent demand for labour in colonies, men and women should be induced to immigrate in equal numbers. Colonies can only be *planted by families*. In New South Wales (1841) the number of free females was 40,425, the number of free males 61,324;* 17,551 of the females, and 18,802 of the males were married; now, if 20,000 persons of each sex were under the age of 20, it is evident that the free men were to the free women above 20 nearly as 40,000 to 20,000, and that the immigration of 20,000 marriageable women might double the number of married persons,—double the number of births; which must otherwise remain less than the deaths until the excess of males has perished. The principle holds in all cases. The negro race will probably not experience a higher mortality in the West Indies, than can be replaced by the births in favourable circumstances;† but the population can only be permanently augmented by the immigration of females and males in equal numbers.

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* Mr. Porter, in Statistical Companion, by C. R. Weld, 1843, p. 7.

† Major Tulloch has shown that the deaths were more numerous than the births, and that the black population decreased in the West India Islands before their emancipation from slavery.—Annals of Medicine, vol. i. p. 399.

The fallacy to which I have referred rests on this doctrine: "the "population is increasing in a geometrical progression, the means of "subsistence in an arithmetical progression, and unless wars, destructive "epidemics, marshes, dense towns, close workshops, and other deadly "agents, carry off the excess of the numbers born—unless the outlets "of life and blood be left open—the whole people must be exposed to "a slow process of starvation." This has been considered by some the doctrine of population. The nature of the increase in geometrical progression has been already examined; and there is no evidence whatever to prove that while capital increases in geometrical progression (compound interest) the subsistence and power of the people of these islands have increased, or will increase, in arithmetical, and not in geometrical progression. It is not known how much subsistence has increased in the last 40 years; and it is pure empiricism to pretend to say that the rate of progression has been, or will be arithmetical, if anything more be meant by that formula than the plain incontrovertible fact that the increase of subsistence is limited. But independently of these considerations, and of any matters of controversy which it would be inconvenient to advert to here, the facts in the previous part of this paper dispose of the fallacy,—which, if it cannot be employed by any but the most depraved to sanction the destruction of life, might slacken the zeal of some in ameliorating the public health, by lending a colour to the dreadful notion that the excess of population is the cause of all the misery incidental to our condition or nature; and that the population might at the same time be diminished and saved from starvation, by epidemic diseases, unhealthy employments, or pestilential localities. What are the facts? An increase of the deaths can only diminish the population if the number of births remain stationary. It has been shown that the number of births may be increased to an incredible extent; experience has proved that the births almost invariably increase when the mortality increases; and it will be seen, in the Tables of the Report, that where the mortality is greatest, the births are most numerous and the population is increasing most rapidly. An increase of the mortality is therefore no specific for establishing an equilibrium between subsistence and population. The more, in fine, the doctrines of population are studied, the more deeply must be impressed upon the mind the sacredness of human life, and of the safeguards by which it has been surrounded by God and the laws. (Fourth Annual Report, pp. 133–46.)

It is not intended to discuss here what has been sometimes called the *Law of Population*, further than briefly to state how the increase of population depends on many elements, which vary and produce various results—sometimes identical in the mere numbers which they present at the census, but different under all other aspects.

The numbers, and consequently the increase or decrease, of people in a civilized country, depend upon the age at marriage and the age of the parents when their children are born—the numbers who marry, the fertility of the marriages—the duration of life—the activity of the migration flowing into or out of the country. These acts more or less influence each other, and in the present state of statistical observation, the precise effect of a change in any one of them involving others cannot be determined. It will be sufficient to indicate the effect of a change in each element, while the others remain constant.

1. The numbers of the population bear a definite relation to the duration of life, or to the mean lifetime. Thus, if the mean lifetime of

a population is 30 years, then if the births are 100,000 a year and remain uniform, the population will be 30 times 100,000, or 3,000,000. Now, the births remaining the same, let the lifetime be gradually extended to 40 years; then the population will become 4,000,000; or if the lifetime is extended to 50 years, the population, from the extension of life alone, will rise from *three* to *five* millions. The deaths, upon this hypothesis, will be equal to the births; and the same in number when the population is *five*, as when it is *four*, or *three* millions. It is probable that the mean lifetime of the great body of the population did increase from the year 1801 to 1821, when the increase of population was greatest in Great Britain.

2. The interval from the birth of one generation to the birth of their descendants of the generation following, bears also a definite relation to the numbers, which increase as the interval is shortened. Thus, if the population increases at the rate of 1·329 annually, and if the intervening time from generation to generation is $33\frac{1}{3}$ years, it follows that the increase from generation to generation is 55 per cent.; or that every 1,000 women are succeeded, at the interval of $33\frac{1}{3}$ years, by 1,553 women; every *two* couples, male and female, by *three*. If the interval is contracted, and the increase from 1,000 to 1,553 takes place in 30 years, the annual rate of population increases, simply on this ground, from 1·329 to 1·477 per cent.; and, as we assume by hypothesis that the births and the lifetime remain the same, the population would be ultimately one-ninth part more numerous than it was under the former conditions. Early marriages have the effect of shortening the interval between generations, and tend in this way to increase the population.

3. An increase in the fertility of marriages will evidently cause an increase in the population.

4. In ordinary times, a large proportion of the marriageable women of every country are unmarried, and the most direct action on the population is produced by their entering the married state. Thus in the South Eastern Division, comprising Surrey, Kent, Sussex, Hants, and Berks, the number of women of the age of 20 and under the age of 45 amounted, at the last census, to 290,209; of whom 169,806 were wives, and 120,403 were spinsters or widows. 49,997 births were registered in the same counties during the year 1850, or 10 children were born in 1850 to every 58 women living in 1851. Of the children, 46,705 were born in wedlock, 3,292 were born out of wedlock; consequently, 36 wives bore in the year *ten* children, and of 366 unmarried women of the same age (20–45) *ten* also gave birth to children. A change in the matrimonial condition of a large proportion of the 120,403 unmarried women, out of 290,209 women at the child-bearing age, would have an immediate effect on the numbers of the population; and, if continued by increasing the rate of birth to the living through successive generations, would operate on population like a rise in the rate of interest on the increase of capital.

5. The effect of migration on the numbers of the population is evident. It is probable, that the immigration of Irish has contributed to the increase of the population in England; and it is certain that the emigration from the United Kingdom contributes largely to the increase of the population of the United States. The emigrants are a self-perpetuating body in healthy climates; and they increase faster abroad than the general population at home, as they contain an excess of the population at the reproductive age; so that, if their numbers are added together, it is certain that we get in the aggregate, a number much below the number of survivors. The population of the United Kingdom, including the army, navy, and merchant seamen, was 21,272,187 in 1821, and

about 27,724,849 in 1851; but, in the interval, 2,685,747 persons emigrated, who, if simply added to the population of the United Kingdom, make the survivors and descendants of the races, within the British Isles in 1821, now 30,410,595.

6. Finally, the numbers of the population are increased by an abundance of the necessaries of life; and reduced by famines, epidemics, and public calamities, affecting the food, industry, and life of the nation. The pestilences of the middle ages—the famine, the influenza, and the cholera of modern times—are examples of one class of these agencies; the security, and freedom which England has latterly enjoyed, are examples of the beneficent effect of another class of influences, not only on the happiness of the people, but also on the numbers which the country can sustain at home, and can send abroad to cultivate, possess, and inherit other lands.

All these causes affecting the increase of the population of Great Britain, and the precise extent to which each operates, will ultimately be known by means of a continuous series of such observations as have been commenced at this census.—(Census Report, 1851; Enumeration, Vol. I., pp. xxxi–ii.)

Increase and Decrease of Population.—The natural increase of population, instead of proceeding at the actual rate of about 1·3, would, it is said, be in the end 1·8 per cent. annually; it would go on indefinitely, and would double the population every 39 years; at the natural rate actually prevailing, upon this hypothesis the population will double itself in 55 years. This question has, therefore, to be discussed.

Mr. Malthus calculated that the unrestrained principle of population would fill not only the earth with men, but people all the planets of all the suns that shine in the visible universe.* And latterly the President of the Health Officers of London, finding that the proportion of children that die under five years of age is more than 40 per cent. of the total deaths in England and Wales, remarks:†—"If this were not so, the increase "of population would be prodigious; for it is the means whereby the "annual excess of births over deaths is kept down to the reasonable "proportion of 12·8 per 1,000 of the population. If it reached to 18 per "1,000 * * the population would be doubled in rather less than 40 "years. Consider for a moment the consequences of this. * * In 40 "years the population of England and Wales would be over 45,000,000 "* * in 120 years * * it would be near 182,000,000. * * This "sort of thing could never last; for in about 240 years the population "of England and Wales, unless it was exported in huge masses, would "reach to rather more than 1,550 millions, and it would be as thickly "placed over the whole country as it is in London at the present moment." At the rate here called "reasonable," the population by the hypothesis would double itself every 54½ years, so that the time in which the dreaded

* Malthus had the following passage in one edition of his Political Economy: "If any person will take the trouble to make the calculation, he will see that if the necessaries of life could be obtained without limit, and the number of people could be doubled every 25 years, the population which might have been produced from a single pair since the Christian era would have been sufficient, not only to fill the earth quite full of people, so that four should stand upon every square yard, but to fill all the planets of our solar system in the same way, and not only them, but all the planets revolving round the stars which are visible to the naked eye, supposing each of them to be a sun, and to have as many planets belonging to it as our sun has." [Quotation from Malthus' "Principles of Political Economy," p. 227, in Godwin on "Population," p. 484. I do not find the passage in the second edition of the "Principles"].

† On the Estimation of Sanitary Condition. By H. Letheby, M.B., pp. 20–21.

catastrophe would overwhelm this nation could only be deferred 87 years by the continued Herodian sacrifice. On a par with this is Dr. Price's illustration of the power of compound interest: "One penny put out at " our Saviour's birth to five per cent. compound interest would in the " year 1791, have increased to a greater sum than would be contained " in three hundred millions of earths, all solid gold."*

There is evidently something singularly seductive in these applications of the abstract doctrine of series in geometrical progression to actual facts: even Justice Blackstone is led by geometrical progression to make the following statement:—

"The doctrine of lineal consanguinity is sufficiently plain and obvious; but it is " *at the first view astonishing to consider the number of lineal ancestors which* " *every man has*, within no very great number of degrees; and so many different " bloods is a man said to contain in his veins, as he hath lineal ancestors. Of these " he hath two in the first ascending degree, his own parents; he hath four in the " second, the parents of his father and the parents of his mother; he hath eight in " the third, the parents of his two grandfathers and two grandmothers; and by the " same rule of progression, he hath an hundred and twenty-eighth in the seventh; " a thousand and twenty-four in the tenth; and at the twentieth degree, or the " distance of twenty generations, every man hath above a *million of ancestors*, as " common arithmetic will demonstrate." This is further explained in the note. " This will seem surprising to those who are unacquainted with the increasing " power of progressive numbers; but is palpably evident from the following table " of a geometrical progression, in which the first term is 2, and the denominator " also 2; or, to speak more intelligibly, it is evident, for that each of us has two " ancestors in the first degree; the number of whom is doubled at every remove, " because each of our ancestors has also two immediate ancestors of his own.

Lineal Degrees.	Number of Ancestors.	Lineal Degrees.	Number of Ancestors.
1	2	11	2,048
2	4	12	4,096
3	8	13	8,192
4	16	14	16,384
5	32	15	32,768
6	64	16	65,536
7	128	17	131,072
8	256	18	262,144
9	512	19	524,288
10	1,024	20	1,048,576

" A shorter method of finding the number of ancestors at any even degree is by " squaring the number of ancestors at half that number of degrees.† Thus 16 (the " number of ancestors at four degrees) is the square of 4, the number of ancestors at " two; 256 is the square of 16; 65,536 of 256; *and the number of ancestors at 40* " *degrees would be the square of 1,048,576*, or upwards of a *million millions*." [Chitty's Blackstone's Commentaries, 21st Edition, Vol. 2, pp. 203–204.

Mr. Malthus argues that population, if unrestrained, will double itself every twenty-five years‡; but let it be assumed that the doubling period is lower, or equal to 33⅓ years—that is the mean interval between two generations—according to the common reckoning, then, beginning at one end of the series, a pair in 40 such periods (1,333 years) will yield more than a million millions of descendants; and beginning at the other end and proceeding backwards, according to Mr. Justice Blackstone each descendant has more than a million millions of ancestors!

The fallacy that deceives Blackstone in the latter case is the want of continuity in the law of the series; a man has, it is true, four ancestors

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* Price's Observations on Reversionary Payments, vol. I. p. 314.

† Let a = first term, n the number of terms, and r the rate; then evidently $ar^{\frac{n}{2}} r^{\frac{n}{2}} = ar^{n}$.

‡ Which implies an annual rate of increase of 2·81 per cent.

in the second degree, because the marriage of brother and sister is prohibited and there is a fusion of four bloods; but as the marriage of first, second, and every order of cousins is permitted under this law, no more than four ancestors are indispensable to the fortieth man in descent; without the prohibition the whole of the human race might evidently be traced up to two ancestors—and two bloods. The mind is led on through the first step, as Blackstone was, to the inference that because a man has a father and a mother, and 2 grandfathers and 2 grandmothers—he must have 8 great grandfathers and great grandmothers, and so on; which is not necessary, and if pursued far enough becomes improbable, absurd, impossible.

The hypothesis of increase of population in geometrical progression had been advanced before,* but Malthus in his practical applications of it brought it home to the public mind, and led to further researches, and to exciting controversies. Godwin—a man of genius—whose work on Political Justice had suggested the controversial essay of Malthus in 1798, answered it in his *Enquiry concerning Population,* and Sadler collected a great many facts in his work.† The facts at the disposal of the respective writers were numerous, but they were incomplete, and in England the statistical facts we now possess respecting the conjugal condition of the men and women living at the several ages were then entirely absent, as the information in the early censuses was meagre. All that is further wanted now in the English Birth Schedule to clear up this vital question conclusively is the entry of the ages of the mother and father at the birth of their children, and the order of the births.‡ Instead of discussing the principle of population and the hypothesis of increase in geometrical progression—which its authors have reduced to absurdity—I propose to state enough of what is known to prove that a reduction in the rate of mortality can be attended by none but the most salutary effects to the nation.

Population is sustained when the births equal the deaths in the same time; when the deaths exceed the births population declines, and when the births exceed the deaths population increases. Migration is here left out of account. The balance is affected by the changes in each of two variables; thus, if the population of England was stationary the deaths would be at the rate of 2·447 per cent., the births 2·447 also; the difference is *zero;* but the population increases, as we have seen, so the deaths are at the rate of 2·242, and the births not only equal but surpass the deaths in every 100 of population by 1·264, which is therefore the natural increase. The mean lifetime in England is 41 years. Should it become as long as it is in the healthiest districts it will be 49 years; and instead of 1 death and 1 birth to 41 living there will be 1 death and 1 birth to 49 living, the latter implying an annual rate of 2·041. An increase of the years men live involves a decrease of the annual mortality, but not necessarily any increase of population; for the birth-rate may fall to an equivalent extent.

The death-rate of a population is under control, but not to the same extent as the birth-rate, which depends on voluntary marriage and fertility, which have hitherto been marvellously regulated so as to meet generally the demand for men. Thus, England has an increasing

* Voltaire, after giving it as his opinion that the population of Europe had tripled since the time of Charlemagne, adds with his incisive common sense: "J'ai dit "triplé, et c'est beaucoup; car on ne propage en progression géométrique. Tous "les calculs qu'on faits sur cette prétendue multiplication sont des chimères "absurdes." *Dict. Philosophique*, Art. *Population.*

† Godwin on Population, 1820. Sadler on Law of Population, 2 Vols., 1830.

‡ Done in the Registers of our Australian Colonies.

industry and a vast colonial empire to people, so the births are numerous. In France the death-rate in the ten years was 2·36, differing a little (0·12 in excess) from that of England; but the birth-rate was only 2·63 in France instead of 3·51 as it was in England. France had no colonial demand for population, and so the population was not depressed by a high death-rate but by a low birth-rate. The increase of population was only 0·27 per cent. per annum.

Many species of animals have, as the geological records of the world show, perished; and man could never have survived the perils of his early historic, to say nothing of his prehistoric, life had his race not been endowed with a reserve of reproductive force sufficient to repair the recurrent wastes of famines, wars, and plagues. At the present hour in England half of the women of the child-bearing ages are unmarried; and though the annual births maintain an actual excess over the deaths, they are kept down to half their possible number. A flow of prosperity in the country is immediately followed and marked by the launch of a whole fleet of marriages. The ruin of an industry or the depression of a trade implies a stagnation of marriages. There are thousands of couples always on the look-out, ready to embark as the prospects brighten.

It has been observed that after the ravages of plagues the births increase, so the aching voids are filled up as regards mere numbers. Under ordinary conditions an increased death rate is attended by an increased birth-rate, so as either to maintain the population stationary or increasing, according to the exigencies of the case. This is only possible within certain limits, for an excessive death-rate is attended with such waste that it cannot be overtaken by the births; the population declines, or is only sustained by immigration. We have the means of establishing this law by English observations.—(Supplement to 35th Annual Report, pp. ix.–xii.)

Influence of Birth-rate upon Population.—The *births*, again, are under control to an extent which has not yet been duly appreciated, but is now rendered clear by the census. This will be shown by an examination of the facts. Leaving unregistered births out of account, the number of children registered as born in wedlock during the ten years 1861–70 was 7,043,090; the wives, all between the ages of 15 and 55, were more than three millions one hundred and fifty thousand, and the number of unmarried women of those ages was full two million seven hundred and ninety thousand, who bore only 457,006 children in the ten years. But as the greater part of the children of this country are borne by women of the age 20–40 we may take them here as the basis of calculation, and then to every 100 wives of that age 35·87 children were born annually (1861–70); while to every 100 spinsters and widows living of the same age only 3·34 children were born. But in 1871 the number of wives enumerated at the age 20–40 was 2,080,991, who at the above rate would give birth to 746,452 children in the year. And the number of spinsters and widows of the same age was 1,423,360, who, if married with the same fertility as the wives, would in that year have borne 510,559 children, but at the actual registered rate only bore 47,540 children, leaving 463,019 over.

The married women are to some extent a selected class, and so, striking off 333,931 from the unmarried women of the age 20–40, there are left 3,000,000 married or marriageable women, living through 1861–70, who at the rate actually observed among the wives would have borne 10,761,000 children, instead of 7,500,096.

At the birth rate cited, to every wife of 20–40 a child is born nearly *every three years* (2·8); but in some counties the mean interval between each birth approaches $2\frac{1}{2}$ years, and looked at physiologically it might, after allowing for wives with no children and other drawbacks, be reduced to two years, which, with the additional marriages, would have the effect of doubling the number of births. There is, therefore, no doubt that even in England the number of births in wedlock admits of great expansion, and would receive it in the event of great demands on the resources of the nation to fill up its ranks from losses in war, from the ravages of a decimating plague, from the efflux of a great emigration; or to meet any extraordinary development of commerce and industry.

Then, as only 78,225 of the young women of the ages 15 to 21 are wives, of ages ranging in number from 151 at 15 to 43,652 at 20, there remains a further reserve of 1,246,743 maidens unmarried; so that England is in truth fertile in men, *ferax hominum*, and holds an ample reserve to meet whatever demands may be made upon her by fate in the future. (Census Report, 1871, vol. 4, pp. xv.–xvi.)

Censuses and Population Registers.—In the intervals between two Censuses there is a continual inflow and outflow of people of all ages, some entering the gates as visitors, some as settlers, some as new-born infants; and others leaving it as travellers, as emigrants, as passengers to that "country from whose bourne no traveller returns." If we had had such registers of population as have been recommended by the Statistical Congress, starting from the nominal list of the Census of 1861, the numbers who came into the country in any way would be added to the register, and the numbers who left would be struck off; the difference between the incomers and the outgoers, added to the numbers of 1861, should, when the balance is struck, equal the population of the Census of 1871.

Unfortunately, no such population register exists; but it does not follow that we have no means of determining approximately the inward and outward movement of the people. Statistics is in some respects, in the present day, dealing with men like trigonometry dealing with lines and angles, able to deduce from certain given data others of which there is no trace; from a basis of observed facts other facts can be determined; thus by means of the English Life Table, the number of persons enumerated at the several ages, the number of persons born in other countries at successive Censuses, and the number of English birth in other parts, it is possible to determine the income and outgo of people from the English and Welsh divisions of these islands.

For the exact determination, accurate enumerations of the population, complete registers of births and deaths, and true returns of all emigrants and immigrants, are required. We may assume that the enumeration of the population was rather more complete in 1871 than in 1861 or 1851; but this may be left out of account. The births have been more fully registered every year since the Act came into operation in 1837, yet some are still missed; but the births in the preceding ten years can be very accurately calculated from the number of their survivors enumerated under ten years of age on the Census Day. That has accordingly been done, and the calculated can be compared with the registered numbers in the three decennia, 1841–71. (Census Report, 1871, Vol. 4, p. xxiii.)

The finally revised results of the eighth decennial Census show that on the 3rd April 1871 the total population of England and Wales was 22,712,266, having increased by 2,646,042 persons, or at the rate of 13·19 per cent. since the Census of 1861. This the largest decennial increase, relatively as well as actually, that has taken place since

1831-41; and some, at least, of the causes which have led to this arrest of the tendency of the population to increase at the decreasing rate observed from 1811 to 1861 will no doubt be elucidated when the analysis of the conditions, occupations, and birth-places of the people is completed. But the effect of a particular cause or set of causes in augmenting or diminishing the rate of increase between any periods can at the utmost be traced approximately so long as the marriage, birth, and death registers, an obviously defective record of emigration, an entire absence of knowledge respecting immigration, and a Census taken once only in every ten years, are the sole available guides. The interest of the public at large in statistical inquiry is as yet undeveloped sufficiently to justify an attempt to establish a Population Register,* or a record of the migration of every person going into or coming from Scotland, Ireland, or elsewhere beyond seas; and it is of little use to speculate upon the nearness or remoteness of the probability of obtaining statistics complete enough to demonstrate the part played by each of the many factors concerned in producing a growth or decline of the population. (34th Annual Report, p. vii.)

Period in which Population doubles itself.†—The rate at which the population of Great Britain increased from 1801 to 1851 is such, that if it continue to prevail uniformly the population will double itself every 52·5 years; in England and Wales the period of doubling on the same hypothesis is 51·0 years. (Census Report, 1851; Enumeration, Vol. 1, p. xxx.)

5. Density and Proximity.

Proximity.—The population may be looked at in another point of view. Every person is in direct or indirect communication with other persons surrounding him; and the extent, intimacy, and number of the relations between people depend very much upon the degree of their proximity. If the persons, houses, villages, towns, are twice as far apart from each other in one country as they are in another, the force and interaction of the two communities will differ to an inconceivable extent. Proximity can be expressed with the same precision as density of population, upon the same hypothesis of equal distribution; and its relative value in different countries and districts is equally interesting. Thus, the people of England were, on an average, 152 yards asunder in 1801, and 108 yards asunder in 1851; the mean distance apart of their houses was 364 yards in 1801, and 252 yards in 1851. On the line of proximity depends the distance which an enumerator, or a messenger who has to call at every house, travels on his mission. A messenger to deliver 1,000 letters at 1,000 houses of average proximity in 1801
42. would travel 206 miles (362,000 yards); in 1851, to deliver 1,000 letters at 1,000 houses of average proximity he would travel only 143 miles (252,000 yards). The population on the same area has doubled; the

* Population registers are kept in Sweden, Belgium, and Holland. By a decree of His Majesty the King of Italy, dated 4th April 1873, a register of the fixed population is to be established in that country: it is to consist of three parts, one relating to houses, one to families, and one to individuals. For each person the register is to show the name, surname, and sex; the names of his parents; the place and date of his birth; his civil condition, whether single, married, or widower, and if married the name of his wife, ulterior changes of condition being duly posted up; his rank, profession, or occupation; his residence; his declared civil domicile; and a reference to the folio relating to families under which he will be found inscribed.

† See also *Principle of Population*, last paragraph but one on p. 15; and *Law of Population*, note to p. 19, for formula to calculate the number of years in which a population will double itself.

proximity has increased—the separation has diminished—in the ratio of 3 to 2. In the London division the mean proximity in 1801 was 21 yards, in 1851 it was 14 yards. The population on the same area increased 146 per cent., or in the proportion of 100 to 246; the difficulty of personal communication, of delivering letters, parcels, goods, to every person—expressed by multiplying the distance from person to person into the numbers—increased only 57 per cent., or in the proportion of 100 to 157. (Census Report, 1851; Enumeration, Vol. i. p. li.)

Density.—Density implies degree of proximity of people to each other; but it may be convenient to express explicitly this important relation of nearness, of neighbourhood which differs so much, not only in foreign countries, and in colonies, but in English counties. The proximity may be here given in a few illustrative instances. It is deduced by dividing first the area of a country by the population. Now the acreage of England being constant and the population increasing, the number of acres to a person is continually diminishing; thus the number of acres to a person was 4·12 in 1801 and 1·64 in 1871; and going back to a period for which there is a probable estimate of population, the end of Elizabeth's reign (1600), there were then 7·71 acres of land to each person living. The acres of land to each person in the three successive periods were 7·71, 4·12, and 1·64 acres, and the proximity expressed in yards was 208, 153, and 96.

It will be noticed that the difficulties of intercommunication between all the individuals of a population do not increase as much as its numbers; for if the population of a county has increased four-fold the distance to be travelled by a messenger proceeding from person to person, or from house to house, is only doubled; and generally the distance to be travelled in going from person to person in two equal counties is inversely as the square root of the numbers on the same area. This has an important bearing on every kind of intercommunication. The distance to be travelled in going from person to person in England and Wales, if the 9,060,993 persons living in the middle of the year 1801 had been equally distributed would have been 781,086 miles; while the distance to be travelled in visiting the 22,782,812 living in the middle of 1871 would only have been 1,238,553 miles.

The mean distance from house to house in 1801 was 364 yards; in 1871 only 221 yards. On the hypothesis of uniform distribution the distance to be travelled by a postman, for instance, in visiting all the houses would have been 325,744 miles in 1801, and only 536,345 miles in 1871.

It will be seen how much the concentration of the people in houses diminishes the distance to be travelled; it is reduced in the ratio that the square root of the number of persons to a house bears to unity.

The concentration of houses in cities while it increases the proximity of masses of the people diminishes the distances to be travelled in visiting the houses of those cities, and at the same time economises the connecting roads and all the other channels of communication. (Census Report, 1871, Vol. 4, p. xxviii.)

Method of calculating Density and Proximity.—Let the area of a place be expressed by A in any superficial units, and the population by P: then $\frac{P}{A} = D =$ mean population on those several units. This is generally called the density of population, and by M. Prony the specific population. It enables us to express with precision the notions conveyed when we say this country is populous, that is thinly peopled, that is a desert; the value of D in the latter case being *zero.*

We have taken a square mile as the measuring unit of area in the table, which implies that although the number of people may differ on every square mile of a country, still on an average of the whole the number is as there stated. Thus the populousness of the several countries can be compared.

Now, instead of dividing the population (P) by the area (A), we may divide the area (A) by the population, and then $\frac{A}{P} = a =$ the mean area to each person. It may be called, for the sake of convenience, the areality of the population; it is the mean number of acres or hectares, square yards, or any other units expressed by A, to each unit of population. $a = \frac{1}{D}$, so a is the reciprocal of D. Divide the area by the Houses (H) and we have $\frac{A}{H} = a' =$ areality of Houses.

The nearness of house to house or of person to person varies in every part of a country, but assuming that the mean areality is given, the mean proximity of each person can be at once determined, as the proximity varies in the ratio of the square roots of the areality.

Thus the areality of the population of England in 1871 is expressed by 1·64 acres, or of 7,928 square yards to a person; in 1801 it was 19,934 square yards to a person; and the proximity of person to person, which was 96 in 1871, was 152 in 1801.

Assuming that there were five persons to a household in 1801, and the same number in 1871, then the proximity of the households is found by multiplying the proximity of persons by the square root of 5. It would be 339 in 1801, and 214 in 1871.

Again, as persons are grouped together in houses, houses are grouped together in towns, and if the areality of towns is determined by the same convention as in the case of persons and houses, the proximity of towns can be determined by the same method.

The general formula for proximity when the areality $\frac{A}{P} = a$ is given is—

$$p = 2\left(\frac{\cos 30^\circ}{3}\right)^{\frac{1}{2}} a^{\frac{1}{2}} = \frac{2^{\frac{1}{2}}}{3^{\frac{1}{4}}} a^{\frac{1}{2}}$$

$$\frac{2^{\frac{1}{2}}}{3^{\frac{1}{4}}} = c \text{ is a constant, and } \log c = 0\cdot0312347.$$

NOTE.—The *degree* of proximity may be expressed by taking contact as unity and dividing this unit by the distance from person to person. (Census Report, 1871, Vol. 4, p. xxviii.)

6. SEXES.

*Sex proportion of Population.**—The enumeration of the population of England and Wales at the various Censuses shows that there is an excess of females living over males living, and it is noteworthy that this excess is greater now than it was some years ago.

* This subject, with special reference to its effect upon the death-rate of a population, was discussed in a paper by the Editor, read before the Statistical Society in 1874 on "*The value of Death-rates as a Test of Sanitary Condition.*"

NUMBER of MALES LIVING to every 100 FEMALES LIVING (exclusive of the portion of the Army, Navy, and Merchant Seamen abroad).

Census Years.	To 100 Females the Number of Males in England and Wales.
Mean of 1821-31 - -	96·35
„ 1831-41 - -	95·87
„ 1841-51 - -	95·80
„ 1851-61 - -	95·51
„ 1861-71 - -	94·96
„ 1871-81 - -	94·84

Thus to every 100 women living in England and Wales at the Censuses of 1821 and 1831 the mean proportional number of men living was 96·35, but this number fell in 1841 and 1851 to 95·80, and fell still further in 1861 and 1871 to 94·96.

This disparity in the proportion of males and females living is attributable to the higher rate of mortality, and the much greater amount of emigration among males than among females. The emigration returns of 1877 show the relative proportion of the *sexes* of emigrants of *English origin;* when they have been published for a series of years they will throw some light on this interesting point. The number of male emigrants of *English* origin in 1877 was 39,829, and of female 23,882. (40th Annual Report, p. xx.)

7. AGES.

Census Enumeration of Ages.—The ages of the British population were first returned in 1821: in 1801 and 1811 "age" formed no head of inquiry. In 1821 the answers to the question of age were "purposely "left optional, both as regarding the returning officer, and the persons "to whom the question was to be proposed by him." Yet the returns of ages, under this voluntary inquiry, embraced 8 ninths of the persons enumerated; and where no returns were made it was apparently the fault of the overseers, rather than of the people; for the omission was not in individual returns, but in whole parishes and townships. In 1831 the number of males of 20 years of age and upwards was demanded; and the inquiry extended no further in this direction. In 1851 the name and age of each person were written in a schedule, either by the head of the family or by the enumerator; as indeed had been done, with a little less accuracy, in 1841.

The ages of 52,565 vagrants and others were not stated in 1841, and nearly as many ages of the same classes were, probably, omitted in 1851; but as it is necessary for the purposes of calculation to distribute the numbers *proportionally* over the several periods of life, it was deemed most convenient to carry out this distribution at once, by inserting their probable ages in the books, with distinctive marks to indicate the interpolation. With this qualification, the numbers, as they were returned, of males and females separately, under 5 years of age, of 5 years and under 10 years, and for each subsequent quinquennial period of life up to 100, are given in the Tables for each of the 11 divisions, the 52 counties, the 624 registration districts, the 2,190 sub-districts of England and Wales; for the two divisions, the 32 counties, and some towns of Scotland; and for the Islands in the British Seas.

Mr. Rickman noticed that in 1821 and 1831 the number of males *under twenty* years of age and the number of *twenty* years of age and upwards were nearly equal; and this proportion has since been regarded as invariable, or it has been assumed that the males of the age of *twenty* and upwards are equal in number to a fourth part of the whole population. The Census of 1851, however, reveals a very different state of things. (Census Report, 1851; Occupations, Vol. 1, p. vi.)

In 1851 the precise age at the last birthday of each person in this country was, under the Census Act, for the first time demanded; and the opinion which we entertained, of the probable general accuracy of the returns within well-defined limits, is confirmed by the tabular results. The mean age of the females, as they are returned in England, exceeds the mean age of the males by *ten months;* so that the tendency in women to understate their ages has only operated on comparatively small numbers; and there is no doubt of their general truthfulness.

A comparison of the series of numbers living at different ages, and of the numbers of males and females at the same ages, confirms this view; but it indicates, at certain ages, some evident mis-statements, which a comparison with the returns of ages in 1841 enables us to calculate and define. Persons of the age of 20 in 1851 must have been 10 years of age in 1841, and persons of the age of 25 in 1851 must have been of the age of 15 in 1841; and as there is a certain number of losses by death, it is evident that, excluding the effects of migration, the numbers at the age 20–25 in 1851 must be less than the numbers living at the ages 10–15 in 1841, of whom they (20–25) are the natural survivors. What are the statements which the abstracts of ages express?

1841. The number of girls, age 10–15, was - 1,003,119
1851. The number of young women, age 20–25 was, as stated in the returns - - 1,030,456

Now, as the first number could never have swollen in the ten years to the magnitude of the second, we are driven to the hypothesis that in 1841 and 1851 the heads of families returned several thousands of ladies of the higher ages at the age of 20–25; and the hypothesis is confirmed by comparing the diminished numbers returned at the age of 30–35 in 1851 with the numbers returned as 20–25 in 1841, where it is evident that the latter number is in deficiency as much as the former number is in excess.

1841. The number of young women of the age of 20–25, as stated in the returns, was - 973,696
1851. The number of women of the age of 30–35, as stated in the returns, was - - 768,711

(Census Report, 1851; Occupations, Vol. 1, pp. xxiii–iv.)

Effect of Birth Rate on Ages of Population.—If the numbers of births in each year were equal, and if all men lived a hundred or any other definite number of years, the numbers that, at a Census, would be found living at each age, would be equal; so the old men would be as numerous as the young men, and as the children, in the population. The great disparity in the actual numbers living at the five ages shows conclusively that few of the people of this country have hitherto lived the natural lifetime. Thus to a *hundred thousand* children and young people under the age of 20 there are only 68,593 of the *second age* (20–40); 36,895 of the *third age* (40–60); 14,803 of the *fourth age* (60–80); and 1,355 of the *fifth age*.

The whole of these differences is, however, not due to premature death, but to the gradual increase of births (Census Report, 1851; Occupations, Vol. 1, p. xvi.)

The population is now younger than it would be by the natural standard; but as one of the causes of the depression of age operates with more force in other countries where the mortality is greater, the people would be on an average older in Great Britain than elsewhere, were it not for the interference of the increase of births within the last hundred years, by which the proportion of children and young persons has been so much increased that it may be questioned whether the people of any country in Europe are so young as the people of England and Scotland.

The English Life Table enables us to show what the distribution of the population would have been in 1851 if the mortality had remained uniformly at the same rate, and the births had been stationary. To 100 persons at ages under 20 years the proportions at four vicennial ages, commencing at 20, 40, 60, and 80 years, would, upon this hypothesis, be 81, 63, 33, and 3; while the actual proportions are 69, 37, 15, 1.

One practical consequence may be immediately deduced from this fact:—Although the births of Great Britain and the mortality remain stationary, the population will go on increasing; for the same number of births which, within the 20 years 1831–51 have produced persons under 20 years of age, will produce nearly an equal number in the next 20 years; but the survivors at the ages 20–40 will be many more than the number now living at those ages; and the numbers at each succeeding age will increase until the population ultimately amounts to *forty-one* times the births.

The First Census of Great Britain, it will be recollected, was taken in 1801. The ages of the population were first discriminated in 1821. Only a portion of the deaths and births in England were returned, as burials and baptisms according to the rites of the Church of England, up to 1837, when the Act for the Registration of Births, Deaths, and Marriages came into operation. Even since that date a certain number of births has escaped registration, and the accounts of the immigration and emigration are incomplete, so that, through the want of data, the investigation of the profound change that has been wrought in the constitution and distribution of the population as to age is attended with extraordinary difficulty. The general nature of the change can, however, be satisfactorily explained.

Assume that a small community of 4,114 persons has been sustained for a long period by 100 annual births, and that the mortality has been such that the numbers at each years of age, from the first to the tenth, are found at a census to be 90, 83, 79, 76, 75, 74, 73, 72, 71, 71, and slowly diminish, so that there are 66 in the 21st year, 53 in the 41st year, and so on decreasing to the last age. Now, let the births from any cause suddenly increase, and instead of 100 be 200 annually, then the population will increase, and if a census is taken at the end of 20 years it will be found that the population under 20 years of age is, instead of 1,449, twice that number, or 2,898. While the numbers of the population under the age of 20 years were to the numbers of the age of 20 years and upwards at the first census as 1,449 to 2,665, the proportions at the second census will be as 2,898 to 2,665. The births remaining the same, if a third census is taken at the end of forty years the numbers under 20 years will be found to be still the same as at the second census (2,898); but the numbers at the age 20-40 will be doubled, and instead of 1,204 be 2,408. The proportional numbers under—and at or above 20 years of age—will be as 2,898 to 3,869. Finally, at the end of a century the population will consist of 8,228 persons, of whom 2,898 will be under 20 years of age, and 5,330 will be of the age of 20 years and upwards. The population at each age will be in the original proportions; but all the parts of which the whole number is composed will be doubled. The disturbance in the *proportions* of the youthful and the adult population will be greatest for some years after the increase of births commences, and will gradually disappear as the wave of population advances, unless the number of births increases every year, and maintains the population in an intermediate stage between the first state and the last change in the illustration. The community will in successive periods contain an excess of boys; of boys and youths; of boys, youths, and young men; of persons in the first (0–20), second (20–40), and third (40–60) ages; and the general temper, strength, and intellectual state of the population will exhibit, to the eyes of the attentive observer, corresponding changes. Some such change as that here sketched has taken place in Great Britain; but the increase of births, at first gradual in the last century, has since proceeded at a rate accelerated but variable in the several classes of the population and in the different parts of the British Isles. (Census Report, 1851; Occupations, Vol. 1, pp. xix–xx.)

Effect of Prolongation of Life on Population.—The prolongation of the life of generations, as well as the increase of births, tends to increase the numbers living at one time; that is, the numbers of the population. Thus, of 100,000 children born in Liverpool, only 44,797 live to the age of 20, while in Surrey that age is attained by 70,885 out of the same number of children born: the probable lifetime is about 6 years in our unhealthiest towns, 52 years in Surrey, and other comparatively healthy parts.* In Manchester, where the mortality is high, 100,000 annual births only sustain, at the ages 20-40, a male population of 38,919; while in all England and Wales, where the mortality is now much lower, the same number of births produces a constant force of 61,215 men at that age; and at other ages similar disparities in the numbers living exist. Now, the mortality was not much less in all England formerly than it is now in Manchester; and the great diminution in the mortality of England evidently took place at such a period of the last and present centuries as left proportionally more survivors at the ages 20–40 in 1851 than at the corresponding ages in 1821, for the dangers and loss of life incurred by the generations born in the 40 years 1781–1801 were greater than those which were encountered by the generations born in 1811–31. (Census Report, 1851; Occupations, Vol. 1, pp. xxii–xxiii.)

Factors of Population.—Leaving immigration out of account, the numbers found by the Census living in the country at any age depend on two totally distinct factors: (1) on the numbers born in the year of their birth, and (2) on the numbers of them that (*a*) die or (*b*) leave the

* See Registrar General's 5th Report, 8vo. pp. 46, 47.—In Manchester 100,000 children born are reduced to about half that number (49,910) in *six years*.—Registrar General's 7th Report, p. 334.

country between the date of birth and the date of enumeration. The mean ages of a population may therefore be reduced in three ways: (1) most obviously by a high rate of mortality shortening their lives, inasmuch as numbers living at the advanced ages will all thereby be reduced; (2) by the emigration of adults in undue proportion; and (3) less obviously but as certainly by increase of births, for then the numbers at advanced ages are fewer than they should be in *proportion* simply because the numbers of children born years ago, of which adults are the survivors, were fewer than the children born in recent years. Thus the 806,722 men of the age of 50–60 in the year 1871 are the survivors of the 1,689,578 boys of the age of 0–10 when the Census of 1821 was taken; and if the boys of that early age had amounted in 1821, as they did in 1871, to 2,896,209, the 806,722 men of 50–60 would have been raised in the same proportion to about 1,400,000, the expected number of surviving men at that age half a century hence.—(Census Report, 1871, Vol. 4, pp. xii–xiii.)

Length of a Generation.—The Egyptians, or the Greeks, discovered that there was an average interval of *a hundred* years between the births of children and the births of their great grandfathers; or that the interval in ascending a genealogical table from the birth of the son to the birth of the father was about $33\frac{1}{3}$ years. This time, called a *generation,* has been found to agree with modern observation; "but," says Sir Isaac Newton, who adopts the computation, "if the reckoning " of generations proceed by the eldest sons, they are shorter, so that " three of them may be reckoned at about 75 or 80 years; and the " reigns of kings are still shorter, because kings are succeeded not " only by their eldest sons but sometimes by their brothers; and " sometimes they are slain or deposed, and succeeded by others of an " equal or greater age, especially in elective or turbulent kingdoms." "Kings reign,"* he adds, "one with another, about 18 or 20 years " apiece." Many of the errors of the ancient chronologies arose from the confusion, under the term "generation," of the long complete life of man with the portion of that life extending to the birth of the next generation; or with the reigning years of kings in times of violence and often of anarchy. Generations overlap each other so that a man who completes his life lives nearly $66\frac{2}{3}$ years contemporaneously with his children, $33\frac{1}{3}$ years with his grandchildren, and many years with the great grandchildren of the eldest branches of his family; his direct influence extends to the second, third and fourth generations.—(Census Report, 1851; Occupations, Vol. 1, pp. xv–xvi.)

Centenarians.—Many instances are cited of men living in the ancient world more than a hundred years; and Lord Bacon in his History of Life and Death, quotes as a fact unquestioned that a few years before he wrote, a morris dance was performed in Herefordshire, at the May-games, by eight men, whose ages in the aggregate amounted to eight hundred years. No populous village in England was then without a man or woman of fourscore years old. In the seventeenth century, some time after Bacon wrote, two Englishmen are reported to have died at ages greater than almost any of those which have been attained in other nations. According to documents which are printed in the Philosophical Transactions of the Royal Society, Thomas Parr lived 152 years and 9 months, Henry Jenkins 169 years. The evidence in these extraordinary instances is, however, by no means conclusive, as it evidently rests chiefly on uncertain tradition, and on the very fallible memories of

* Newton's Works, tom. V. pp. 37–40.

illiterate old men; for there is no mention of documentary evidence in Parr's case, and the births date back to a period before the parish registers were instituted by Cromwell in 1538.

Until the system of Registration and the Census have been for many years in operation, the evidence of extreme ages must remain indecisive; but there can be now no doubt that some of the twenty-one millions of people in Great Britain have lived a *century; which may therefore be considered the circuit of time in which human life goes through all the phases of its evolution.*—(Census Report, 1851; Occupations, Vol. 1, pp. ix–xii.)

In the Report of 1851 we questioned the value of the evidence alleged in support of some historical instances of extreme longevity, and since then the instances investigated tend to show that while a certain number of individuals in each generation live, as the ancients discovered, 100 years (*sæculum*) or more, the number of such cases is exaggerated among the illiterate in every country where birth registers are not kept. It must not, however, be assumed for a moment to be impossible that a small remnant out of a vast number of people should live over a century. The probability is the other way; for under an ascertained law the numbers of a generation fall off at a rate of mortality continually increasing, but yielding a series of lives terminating at no definite point; and man goes through successive changes, which are not completed in less than a hundred years, to which term a perfect life may in ages to come approximate. All that is here insisted on is that these exceptional instances are now rare, and require the support of strong evidence, which should only be accepted after having undergone the searching criticism of competent inquirers. The Census itself, by recording the ages every ten years, tends to check the disposition to put on the dial of life as age advances, and it is probably to this that must be ascribed the progressive diminution since the year 1841 of recorded centenarians, rather than to any decline of their actual numbers. The persons of the age of 100 and upwards when the ages were first returned amounted in 1821 to 216, and in 1841 to 249; in the two Censuses following to 215 and 201; in 1871 the number fell to 160, to 41 men and 119 women. Many of these men and women must have been born before 1771,—before Lord Liverpool, a prime minister now historic, was born —in the early part of the reign of George III.; and in those years the births certainly exceeded the births previous to 1721, of which the centenarians of 1821 were the survivors.

Numbers returned of the age 100 and upwards.

Sex.	1821.	1841.	1851.	1861.	1871.
Males - - -	68	83	78	55	41
Females - -	148	166	137	146	119
Total - -	216	249	215	201	160
Born in or before -	1721.	1741.	1751.	1761.	1771.

The registry of Baptisms in the church since the sixteenth century and the civil Registration of Births in operation since 1837 have led to a more exact knowledge of the ages of the population in England than in some other countries, and if the people had all been taught to read and write, the ages would have no doubt been returned as accurately as they have been in Sweden. As it is, a certain excess has been thrown on the decennial years, 50, 60, 70, and so on, at the expense of the contiguous ages. These inequalities are rectified in the graduated table, where the numbers are distributed at the several ages by the method of differences, which takes into account the law of the decrement of the living in England, either by age or emigration. The numbers between the ages of 15–25, and every successive decenniad, agree with those returned, for no attempt has been made to correct any but accidental mistakes.—(Census Report, 1871, Vol. 4, pp. x–xi.)

The interest which attaches to cases of reputed centenarianism has induced me to bring together into one view the particulars of such cases as were recorded in the death registers of 1871. From time to time I have to announce in my Weekly, Quarterly, and Annual Reports the deaths of persons whose ages *as stated in the registers*, amount to or exceed 100 years. It will not be deemed superfluous by those who take note of the newspaper correspondence which so frequently follows the announcement of a case of extreme longevity, for me to remind the public that the district registrars have no authority, even if they had the means and the leisure for so doing to investigate the truth or otherwise of the statements as to age made by the legal informants of deaths; the informants are alone responsible for the correctness of those statements. As a most able and painstaking writer upon this subject in his recent work remarks: "The Registrar-General has no "alternative but to tell the tale as it is told to him."* In 1871 the deaths of 69 persons were registered at the following ages, *as stated by the informants;* 27 at 100, 17 at 101, 10 at 102, 5 at 103, 3 at 104, 2 at 105, 2 at 106, 1 at 107, 1 at 108, and 1 at 109 years. Of these reputed centenarians 25 were males and 44 females. From 1861 to 1871 inclusive the registered deaths at 100 years of age and upwards have amounted to 855, namely, 231 males, and 625 females; so that on an average 21 men and 57 women go to their graves every year with the renown of centenarianism attaching to their memories. And the Census returns show that about 180 persons out of the entire population would, on enumeration, return themselves as having attained their hundredth year of life; the annual rate of mortality at this advanced stage would therefore be about 43 per cent. By the English Life Table the mortality at the ages 100 and upwards would be 58 per cent., and that implies 116 deaths annually out of 200 living. There is evidence† that it would be unsafe to attempt to draw any precise conclusion as to the limits of the duration of human life from the unverified statements of individuals in the death registers; all that may be said with certainty is that instances such as that of Jacob William Luning, whose death in 1870 at the age of 103 years was clearly established by documentary evidence submitted and published in the Weekly Return, show that the limit of life is not absolute at 100 years, however exceptional may be the cases in which it is exceeded.

It is worthy of note that the experience of Life Assurance Societies in this country supplies only one example of an insured life completing

* "Human Longevity," by W. J. Thoms, F.S.A.

† Mr. Thoms gives examples of 30 cases investigated by him: 4 only of these turned out to be demonstrably centenarians; 4 were doubtful; 22 are either disproved absolutely or are shown to be unsupported by proof.

its hundredth year, namely that of Jacob William Luning above referred to. The difficulties attending an investigation of cases of reputed centenarianism are no doubt considerable, but the question is one of scientific importance.—(34th Annual Report, pp. xviii–xix.)

Mean Age of Population.—The mean age of the English population has remained constantly since 1851 at 26·4 years. This is the same result as is obtained by adding up the ages of every persons living, and dividing by the total number of such persons. The mean age of males was less than the mean age of females by 0·8 of a year, for the mean age of the males was 26·0, of the females 26·8 years. The mean age in England of the people of 20 years and upwards remained also very constant; it was at the three last Censuses 40·4, 40·7, and 40·8 years.

The fact to observe is that the people of England, which calls herself Old, are younger than the people of many other countries, and certainly younger than the people of the countries of stagnation, not because life is shorter, but because the births, instead of remaining stationary, are continually increasing, and infusing youthful blood into the people. The emigration of adults also reduces the mean age of those left.

The mean natural age of the people living, deduced from the Life Table, is actually 32·1 years—of the males 31·77, of the females 32·33. That would be the actual age of the population had there been no migration and had the births remained constant.—(Census Report, 1871, Vol. 4, p. xiii.)

8. Civil or Conjugal Condition.*

Age at Marriage.—Marriage is the institution by which the population is primarily regulated; and while it is the great adjuster of the numbers it is at the same time the guardian and the educator of the generations to come. To the urns of Death all contribute; but with the annual marriages and the births the great mass of the population, the young and the old, have nothing directly to do. These events are under the control of about one fourth part of the population in the prime of life. The fertility of marriages is determined first by nature, and, in the second place, by the age of women at marriage, as is evident, in spite of all controversy. If the marriage age of women become 20, or 30, or 35, the number of years of marriage and of children to a marriage changes; so does the interval between generations, and the probability that the parents will both live to rear and to launch their offspring in the world under favourable auspices.

Men and women intermarry at all ages; but eight in ten of the brides and bridegrooms at their first marriage are between the ages of 20 and 30, when growth is completed and the frame has attained maturity, the mean age of both sexes at their first marriage is 25—the bridegrooms being $25\frac{2}{3}$, the brides $24\frac{3}{10}$, according to the registers. The real disparity is probably about a year.

Mean Age of Persons who Married in 1861–70, above the Age of 15 Years.

Age.	Bachelors.	Widowers.	Bachelors and Widowers.	Spinsters.	Widows.	Spinsters and Widows.
15 and upwards -	25·65	42·40	27·80	24·30	39·10	25·60

* For further extracts bearing upon statistics of marriage, see Part II., pp. 67–83.

MEAN AGE of PERSONS LIVING in 1871, above the Age of 15 Years.

AGE.	Bachelors.	Husbands.	Widowers.	TOTAL MEN.	Spinsters.	Wives.	Widows.	TOTAL WOMEN.
15 & upwards	25·30	43·10	59·95	37·00	26·50	40·60	58·90	37·60

(Census Report, 1871, Vol. 4, p. xviii.)

Duration of Married Life.—The mean time that a couple of such lives survives can be calculated; it is 27 years; that is the probable duration of married life, during which children enjoy the protection of both parents; who may, therefore, both expect to see their first surviving child attain the mean age of marriage. But there is the further mean life-time of the surviving parent, which in the case of the father is 9·44 years, of the mother 11·31. The duration of the longest life is 47·84, during which both parents, or one, may be expected to survive, and to look after the interests of their children.

The proportions of the married couples to the widowers and widows would be expressed by the above numbers; there would be to 27 married couples 9 widowers and 11 widows; whereas in consequence of re-marriage the actual number of widowers is less than 3, of widows 6, to 27 married couples. This disruption of families by the death of one parent and by the survival of another, and the reparation by re-marriage, is of so much social importance that by way of further illustration it may be mentioned that to 2,940,782 couples first married at the same ages as now rule, if there were no re-marriages there would be living 1,024,769 widowers and 1,227,769 widows; but in the actual distribution such large numbers lose these titles by re-marriage that the existing widowers are 398,202, the widows 879,173, and the married couples, represented by wives living, 3,948,527, the latter including, therefore, large numbers of re-married widows.

The mean age of the married population is 41·85 years, and the mean age at marriage being 26·70 years, the mean term of existing married life is 15·15 years. Upon an average husbands and wives have lived so long together. This term is reduced by the increase of marriages raising the proportion of the younger married couples to the whole; for the mean age of the married at the above ages by the English Life Table would be 44·33 and the mean term of existing unions 17·63 years. —(Census Report, 1871, Vol. 4, pp. xviii–xix.)

Effect of Alteration in the Age at Marriage.—The age of marriage being of prime importance, it may be interesting to show what the effect of any great alteration would be, such for instance, as Aristotle, one of the greatest naturalists that ever lived, proposed: for certain reasons he lays it down that the man should marry at 37, the woman at 18. The effect of this would be to reduce the joint mean marriage life-time to 24 years, while the widowers would be 4, the widows 18, to 24 married couples; so the proportion of widows would be augmented to an extraordinary extent, and orphans, and still more fatherless children, would be multiplied. This would seriously affect the nurture of the offspring of such marriages, especially among free workmen and artizans. All late marriages increase the proportional number of orphans. It is evident then that the problem is much more complex than those economists who take the people to task for marrying early imagine; and on the theory of the survival of the fittest it is probable that nature's many solutions of the problem as to the most suitable age to marry yield, if not the best, at least as good results as Aristotle's. Plato in his Republic asserts that the citizens should be the offspring of women of 20–40, of men of 25–55, which is in close accordance with existing facts. (Census Report, 1871, Vol. 4, p. xix.)

Proportions of Married Males and Females at different ages.—Without the sanction of the laws of physiology, or of common sense, a girl may—but in the present day rarely does—marry at the age of 12, a boy at the age of 14, under the existing laws of England; but the consent of parents and guardians is required in certain cases where either party has not attained the age of twenty-one; and the proportional numbers of either boys or girls who marry under the age 20 is happily small. The mean age at which marriages are *first* contracted in England and Wales is 25·8 years for males, and 24·6 years for females; while 54 in every *hundred* brides, and 54 in every *hundred* bridegrooms, are 20 and under 25 years of age. As the marriages subsist on an average about 27 years, the numbers and proportions of persons in the married state increase as age advances, until they are reduced by the rapid dissolution of marriages by death. Thus, under the age of 20, of 100 youths only 0·4 are married; at 20–25 the proportion amonst men rises to 20; at 25–30 to 54; at 30–35 to 71; at 35–40 to 78; at 40–45 to 80; at 45–50 to 81—in 100 at each age respectively. The proportional number of men in the married state declines after 55 and 60 rather rapidly, so that at the fifth age of 80 and upwards only 37 of 100 men have wives.

With respect to women, the proportions differ from those above; for at 15–20 the married are 2·5 per cent. of the whole number of that age living; at 20–25 the proportions rise to 30 per cent.; at 25–30 to 57; at 30–35 to 70; at 35–40 to 75 per cent., which is the highest proportion ever attained, as among women it never happens that more than 3 in 4 at any age are in the married state, while of men 4 in 5 at the age 40–50 are married.

At the age 40–45, of 100 women 74 are married; and the proportion falls to 52 per cent. at the age 60–65, and to 12 per cent. at the fifth age of 80 and upwards, for then only 12 in *a hundred* women have husbands.

The proportional numbers of the persons in the married state at advanced ages are sustained by remarriages of widowers and widows; and as the widows remarry much less frequently than widowers, the comparison of the relative proportions of the married in both sexes shows that widowers enjoy a portion of the married life of men of 35, and a very considerable proportion of the married life after the age of 55.—(Census Report, 1851; Occupations, Vol. I., p. xxxi.)

Effect of Marriage on Population.—In every part of Great Britain a large number of men and women who live to advanced ages never marry. Of the population at the ages of 20 and upwards, about 1 in *ten* men and 1 in *eight* women may be referred to this category; or in Great Britain *one* in *ten* of the *survivors* of the young men now living, and *one* in *eight* of the survivors of the young women now living, will die as bachelors and spinsters if they live to the age of 60 and upwards; besides the great numbers who die unmarried at younger ages. Celibacy, as well as marriage without children, is therefore to be considered the natural state of a portion of the population; for under no circumstances that can be conceived will the whole of the people marry. Certain duties of the most exalted as well as of the humblest kind in the world are most efficiently performed by these classes; and although the proposition, that "the best works and of greatest merit for the public "have proceeded from the unmarried or childless men" may not be absolutely true, as it is put by Bacon*; they have unquestionably contributed their full share to public works, which often absorb the powers of the mind to an extent that would embarrass him that in "wife and children has given hostages to fortune." There is also evidently a large number of both sexes in this class who from infirmity and diseases, either acquired or hereditary, cannot marry, and some who have a total disinclination to marriage.

The British population contains a great reserve of more than a million unmarried men, and of more than a million unmarried women, in the prime of life, with as many more of younger ages; and if the whole of the population were married the births in Great Britain would be 2·3 times as numerous as they are *if they bore the same proportion to the wives at different ages as they do now.*

From the state of things which the Census discloses it is evident that the strength, the rate of increase, and the colonization now proceeding can be sustained by the marriages of only a part of the population; hence it follows, that if by any judicious means the increase of the incurably criminal, idle, insane, idiotic, or unhappily organized parts of the population can be without cruelty repressed, under a system of religious discipline, to a greater extent than it is at present by the selection that pervades, more or less, the whole system of English marriages,—the character and good qualities of the race will be immeasurably improved, without checking the tide of population or the increase of numbers. Hitherto the flower of the British youth have been in ignorance sent to the alluvial lands of the tropics, where our race cannot live, or where it inevitably degenerates; while, in defiance of the principles of physiology, and of the doctrines that are inculcated on the breeders of the inferior animals by the Royal Agricultural Society,—convicts have been thrown broadcast over some of the healthiest colonies in the world, and may now, without due precaution, multiply at home, like the *forçats* in France, and prove a leaven of social disorder and disorganization.

The proportion of children to a marriage, and consequently the population, are regulated, not so much or so immediately by the numbers of the people who marry as by the *age at which marriage is contracted.* The mothers and fathers of nearly half of the children now born are under 30 years of age; and if all the women who attain the age of 30 should marry, and none should marry before that age is attained, the births would decline to about two-thirds, and if the marriage age were postponed to 35 the births would fall to one-third part of their present number: so the population would rapidly decline; firstly, because the number of births to each generation would grow less; and, secondly, because, as the interval between the *births* of successive generations would increase, and the duration of life by hypothesis remain the same, the numbers living contemporaneously, in other words, the population, would be further diminished. The age at which *first* marriages take place necessarily varies according to circumstances in different populations and in different classes of the same population; in the eldest and youngest sons of noble families; in the various rising or declining professions; among skilled artizans, and labourers.—(Census Report, 1851; Occupations, Vol. I., pp. xliv–vii.)

* Bacon's Essay—VIII. On Marriage and Single Life.

9.—Occupations.

Census Inquiry and Classification.—In 1801, at the first Census, this branch of inquiry was very simple. The total population of England and Wales, exclusive of army, navy, and merchant seamen, was simply classed under three heads, after excluding 443,235 not returned as of any occupation; namely, 1,713,289 *persons* chiefly employed in agriculture; 1,843,353 *persons* chiefly employed in trade, manufacture, or handicraft; and 4,873,103 *persons* not employed in either of the preceding ways, including probably children and indefinite numbers of women.

In 1811-21-31 for *persons* families were substituted: thus in 1821 it appeared that 847,957 *families* were returned as chiefly employed in agriculture, 1,159,975 as chiefly employed in trade, manufacture, or handicraft, and 485,491 as not comprised in either of the two great classes. In 1831 a further important step was taken in the right direction; the defective character of the classification by families grew evident; so the several occupations of males of 20 years of age and upwards employed in retail trade or in handicraft, as master or workmen, were separately returned.

In 1841 the name, age, sex, &c., and occupation were returned as a "each man's description of himself," and the results were published in Alphabetical Tables, with a synopsis under a few heads, showing the number of males and females under 20 and above 20 years of age.

In 1851 special instructions were given to the enumerators; these were extended again in 1861 and 1871, so as to guard against mistakes and vagueness; and in the three Reports the two sexes have been classified under their respective occupations, with distinctions of age.

The classification by families is of some use in simple populations, where labour is not much divided; but in England the members of the same family,—the husband, wife, and children—are often engaged in different occupations, even when the children are at home. Our classification is in principle a *classification of each individual under his principal occupation on the Census day.* The distinction of age enables us to compare the number living in each well-defined occupation with the number dying registered at the corresponding ages; and thus to determine the influence of employment on health and life. The age is important in another way, as showing whether the persons employed in any particular manufacture, or trade, or profession, are children, young men or old; and by the relative numbers at early or advanced ages, at what period professions are entered, or whether they are increasing or decreasing. It thus increases the value of the return of occupations tenfold; yet singularly enough, England is the only country where this attempt at a complete classification of the population according to occupations and age has been carried into effect. This is probably in part due to the mechanical difficulties of the analysis, which can only be executed adequately by a number of well-trained clerks. In France the population was for some time classed in large groups, as formerly in England, showing the number of individuals living directly or indirectly by the several professions. This is no doubt an interesting view of a population, but to carry it out would be a matter of no ordinary difficulty in England, where it would not be easy for either man or woman to return the precise number of individuals living on his professional earnings. And there would necessarily be many men, women, and children living on the earnings of more than one individual of more than one profession; so that they would often be returned twice.

Interesting as this information might be, if it could be obtained with tolerable accuracy, it is of infinitely less value than a return of the individuals in each separate occupation. Thus, in the return in question, the force of the army would not be shown, inasmuch as the wives and children would be confounded with the soldiers and officers on whom the country relies for its defence. This defect has been felt in France, and in the last Census the persons directly engaged in the several professions are distinguished from their so-called families. But to obtain this information the ages of the people in the several professions have to be sacrificed.—(Census Report, 1871, Vol. IV., pp. xxxviii–ix.)

Double occupations.—Double occupations are as great a source of difficulty as the varying degrees of the subdivision of labour in the manufacturing and other districts. The same person is a member of parliament, a magistrate, a landed proprietor, and an occupier of land; in a lower circle, an innkeeper and a farmer; a maltster and a brewer; a fisherman in the season, a farmer or a labourer in the rest of the year. The enumerators were instructed to this effect, that "a person following "more than one distinct trade may insert his occupations in the *order* "*of their importance;*" and in the classification the first occupation was generally taken.

The whole population had to be passed in review, and every man had to be referred to some one head, although his time might be passed in two occupations; but if a class thus sometimes obtains more constituents than it deserves, it on the other hand often sustains counterbalancing losses.

The first and most obvious distribution of the population is into the two great groups of (1) those who work, and of (2) those who professedly have no definite occupation. After a due correction has been made for the persons who are infirm or who have retired in advanced age from their trades or professions, the number of the latter class in this country will not be found to be numerous.

It would be out of place here to insert a disquisition on the principles of classification; to attempt to show the impracticable nature or the imperfections of other classifications; and to vindicate in all its details the arrangement that has been adopted. But this arrangement possesses one advantage that should not be overlooked: it is not a mere arrangement on paper such as that of the people into producers, distributors, and consumers; but an arrangement in which it has been found practicable to find a place for every one of the twenty-one millions of people in Great Britain, and in which we can pass them rapidly and distinctly in review. (Census Report, 1851, Occupations, Vol. I., pp. lxxxii–iii.)

Industrial Census.—A Census in the most extended sense, and as it has been understood in some countries, embraces an enumeration of the visible property and of the annual produce; it includes, therefore, industrial and agricultural statistics. The present Census was restricted by the Act to an enumeration of the population, and of certain circumstances illustrative of their condition and occupations. No attempt could therefore be made to enumerate the number of manufactories, shops, or separate properties in the country; but in connexion with occupation it was thought desirable to distinguish masters from men, and for this purpose to ask the masters in trade and manufacture to so distinguish themselves by writing "master" after the names of their respective occupations, and by adding the *number of men* on the Census day in their employ. Farmers, who are *masters* of a particular occupation, were requested to state *how many acres* of *land* they occupied, and *how many labourers* they employed, with a view of giving a definite idea of the term "farmer," and of laying the foundation of a further inquiry.

This information can evidently only be made perfectly accurate by a careful and laborious revision on the spot; but, in the absence of this revision, the returns furnish information of so much interest on a matter so imperfectly understood, that it was thought proper in 1851 to construct tables showing the size of farms in each county, together with the number of labourers that were employed.

The return of the masters in trades is imperfect; all the masters have not so returned themselves; and it can only be rendered complete in the event of the Census being extended to an Inquiry into the Industry of the country. (Census Report, 1861, Vol. 3, p. 29.)

10. Infirmities.

Census enumeration of Infirmities.—An inquiry into the numbers of the Blind and of the Deaf-and-Dumb in Great Britain was instituted for the first time at the Census of 1851. Notwithstanding the great interest attaching to these classes, both in a social and a physiological point of view, the statistics of blindness and deaf-muteism in this country have not hitherto advanced beyond estimates and conjectures founded chiefly upon returns obtained in foreign states, or the limited experience of a few public institutions. Great disadvantages have resulted from this entire absence of authentic information, not only to society at large, but more especially to these afflicted persons, on whose behalf the appeals and efforts of philanthropy, unsupported by a reference to facts illustrative of their numbers and condition, have lost much of their intended effect.

Before noticing the chief results of the inquiry, it may be proper to state the mode in which the information was acquired. The plan adopted was the very simple one of including in the "Householder's "Schedule" left at every house to be filled up with the required particulars relating to its inmates, a column in which was to be written the word "Blind" or "Deaf-and-Dumb" against the name of any member of the family so afflicted. In the performance of his duties, the enumerator was required to use the utmost care to prevent omissions, and when such were detected he was to supply the defective information, either from his own knowledge or the statements of credible persons, as far as he might be able. Owing to the difficulty of ascertaining the existence of dumbness in extreme infancy, the number of cases returned under that head must necessarily be slightly deficient; but as no motives are apparent to induce an intentional suppression of facts usually well known beyond the limits of the household, it may be presumed that the returns of the Blind and Deaf-and-Dumb, although subject in common with the other branches of the inquiry, to accidental omissions, are on the whole tolerably complete.

It was not thought desirable to divert the attention of the persons making and collecting the Census returns from the great and essential points of the general enumeration by any attempt to obtain, with respect to these special classes, information as to the circumstances of their affliction—such as whether it was congenital or acquired; nor was it found practicable at a later period to enter upon a further investigation of the cases in reference to these and other questions of undoubted interest. In Ireland, the Census Commissioners had fortunately no difficulty in pursuing the subject to its full extent. By means of that admirably organized body, the Constabulary force, and eminently aided by the experience of the Assistant Commissioner, Mr. Wilde, who has paid great attention to the subject, they were enabled successfully to follow up each case; and they have embodied the results in a Report, recently presented to Parliament, which forms an extremely valuable contribution on a branch of vital statistics hitherto comparatively unexplored.* (Census Report, 1851, Occupations, Vol. I., pp. cviii–ix.)

The Blind.—In Great Britain and the Islands of the British Seas there are 21,487 persons—11,273 males and 10,214 females—returned as totally blind. The number in England and Wales is 18,306 of both sexes; in Scotland, 3,010; and in the Islands of the British Seas, 171 persons. These numbers furnish a proportion relatively to the whole population of 1 blind in every 975 persons in Great Britain, 1 in every 979 in England and Wales, 1 in 960 in Scotland, and 1 in 837 in the Channel Islands and the Isle of Man.

These results admit of favourable comparison with the relative numbers in Ireland, which, according to the Census, are 1 in every 864 inhabitants. In the level portions of Europe, comprising Belgium, Hanover, parts of Germany, and the plains of Lombardy and Denmark, the proportion is stated to be 1 blind in every 950 inhabitants—but slightly differing from the average of Great Britain. In more elevated regions the proportion is considerably lower; but in Norway it is found to be 1 in every 482 inhabitants.†

In reviewing the distribution of the Blind over the different parts of Great Britain, it should be remembered that the institutions which have been established for the reception and instruction of persons deprived of sight are located in the principal cities and towns. Where, however, the towns are very large, the inmates of these establishments only slightly affect the proportion which the Blind bear to the general population. Thus in London, notwithstanding the number of cases brought from other parts, the proportion is 1 blind in every 1,025 inhabitants. Other large towns present the following results:—

Manchester -	1	blind in	every	1,107	inhabitants.
Liverpool -	1	,,	,,	999	,,
Birmingham -	1	,,	,,	1,181	,,
Leeds - -	1	,,	,,	1,203	,,
Sheffield - -	1	,,	,,	1,141	,,

It has been generally considered, and is no doubt to a certain extent true, that crowded dwellings and other circumstances attendant upon dense populations, by inducing diseases of the organs of sight, have caused a greater amount of blindness in towns than in rural localities. It has also been thought that blindness has been increased by many of the employments followed in populous manufacturing towns. But whatever may be the influences prevailing in towns, it is clear from the returns that a much larger proportion of blind persons is found in agricultural than in manufacturing and mining counties. For example, in Wilts, Dorset, Devon, Cornwall, and Somerset there is an average of 1 blind in every 758 inhabitants; in Essex, Suffolk, and Norfolk, 1 in 888; and in the northern counties of Scotland, which include the Highlands, 1 in 823. The highest proportion, 1 in 665, is observed in Herefordshire.

* The Report is entitled,—"Census of Ireland for the Year 1851.—Part III. Report on the Status of Disease."

† Census of Ireland.—Report on the Status of Disease, p. 41.

In striking contrast with these are the following manufacturing or mining counties:—

Yorkshire, West Riding	-	1 blind in every		1,231	inhabitants.
Cheshire and Lancashire	-	1	„ „	1,167	„
Durham - -	-	1	„ „	1,163	„
Staffordshire -	-	1	„ „	1,082	„

Conclusions unfavourable to the rural districts should not, however, be deduced from a mere comparison of the Blind to the population living at all ages. Blindness is a common infirmity of extreme old age, and an examination of the ages of the Blind shows that nearly one-half of the persons deprived of sight are above 60 years of age. It follows, therefore, that in those localities in which the largest numbers of old men and women are living, the largest proportion of the Blind will be found. In the great seats of manufacturing industry the population generally is much younger than in most of the agricultural counties, where, as shown in a former section of this Report, persons in large numbers, and especially females, are living, in circumstances favourable to longevity, at very advanced ages. Thus, in the counties presenting the highest and lowest proportions of blind persons, the influence of age is sufficiently apparent:—

Counties.	Proportion per Cent. of Population aged 60 Years and upwards.	Proportion per Cent. of Blind aged 60 Years and upwards.	Population at all ages to One Blind.
Hereford - - - - -	10·5	61·1	665
Wilts, Dorset, Devon, Cornwall, and Somerset - - - - -	9·0	53·7	758
Essex, Suffolk, and Norfolk - -	8·8	50·1	888
Northern Counties of Scotland -	9·3	54·7	823
Yorkshire, West Riding - - -	6·1	43·1	1,231
Cheshire and Lancashire - -	5·4	31·8	1,167
Durham - - - - -	6·3	52·8	1,163
Staffordshire - - - -	6·0	42·0	1,082

The proportion of the Blind aged 60 and upwards to the persons *living* who have attained that age, shows how close a connexion exists between blindness and advanced years:—

PROPORTION of BLIND PERSONS to 100,000 *living*.

Counties.	Blind. To 100,000 *living* at		
	All Ages.	60 to 80.	80 and upwards.
Hereford - - -	150	748	2,019
Cornwall - - - -	137	596	3,120
Devon - - - - -	136	609	2,942
Dorset - - - - - -	132	608	2,800
Somerset - - - - -	129	618	1,887
Wilts - - - - - -	121	643	1,705
Yorkshire, West Riding - -	81	475	2,002

So, in other counties, according to the proportion of old and young persons living, a greater or less amount of blindness is generally observed. But, while the question of age is of great importance in investigating the distribution of blindness, it will not explain all the variations presented in the returns, as in some localities other influences are doubtless at work.

In the early years of life the numbers of the Blind are not large. Of the 21,487 blind persons in Great Britain, only 2,929, or less than 14 per cent., are under 20 years of age—a circumstance tending to show that cases of blindness at birth are not very common. Between 20 and 60 years of age there are 8,456 persons, or about 39 per cent. of the whole number; while 10,102 persons, or 47 per cent., are at the advanced ages above 60. These facts point to the conclusion that blindness in many cases may have arisen as a natural infirmity attendant upon old age.

Of the persons in Great Britain returned as blind 11,273 are males and 10,214 females. Accidents and diseases resulting in loss of sight are more likely to arise in the employments followed by males than in those of females. The proportions are 110 males to 100 females in Great Britain, and 113 males to 100 females in England and Wales. In Scotland the females returned differ but slightly from the males, a result probably traceable to the preponderance of aged women in that country. Compared with the general population, we find to every 10,000 living in Great Britain 11·0 males and 9·5 females blind. In England the proportion is nearly the same. To every 10,000 inhabitants of Scotland there are 10·7 males and 10·2 females blind. The males generally exceed the females until 70 years of age is attained; from that period of life the blind women are much more numerous. The disproportion of females at all ages is greatest in Monmouthshire, Devon, Cornwall, Hereford, and Huntingdon. The Irish returns show a proportion of the sexes the converse of that observed in Great Britain, namely, 111 females to 100 males. (Census Report, 1851, Occupations, Vol. I., pp. cix–xii.)

Occupations of the Blind.—The returns do not admit of a rigid distinction between the employments followed by the Blind and those subsequently acquired by them. Instances are common of blind persons being engaged in pursuits apparently quite incompatible with loss of vision. The employments taught in the institutions for the Blind are usually basket-making, sack and net making, knitting, and music. Most of the other occupations detailed in the Tables must be regarded as those followed *previous* to blindness.

The present or previous occupations of the Blind have been classified in Tables for each sex, distinguishing the ages in quinquennial periods.* This affliction, it will be seen, is not confined chiefly to particular classes and trades, but exists amongst all ranks, and in a great variety of employments. None of the great branches of manufacturing industry seem to be peculiarly liable to it; indeed the small numbers returned against cotton, linen, silk, woollen-cloth, iron, and earthenware are remarkable, when the immense amount of labour employed in these manufactures is considered. Factory workers are, however, mostly young persons; and none would be employed in the midst of machinery with any defect of vision.

Amongst the items which present the largest numbers in the classification of employments are Agricultural Labourers, of whom there are 907; Labourers not otherwise described, 512; Chelsea Pensioners and Soldiers, 586; Greenwich Pensioners, 70; Farmers, 505; Domestic

* See Summary Tables, Census Report, 1851, pp. cccii–cccix.

Servants (chiefly females), 438: Weavers, 295; Coal-miners, 195; Copper and Lead miners, 68; Stone and Limestone quarrier, 51. Of the class described as "Annuitants" and "Living on Alms" there are 1,062; and 2,833 blind Paupers are returned in workhouses without any statement as to previous occupation. Of the Blind following employments presumed to have been acquired after loss of sight there are—musicians and teachers of music, 535; mat, sacking, and net makers, 127; and knitters, 92. With respect to 2,853 males and 5,960 females, no returns respecting their actual or previous pursuits are made. (Census Report, 1851, Occupations, Vol. I., p. cxii.)

Distribution of Blindness.—Blindness it is supposed becomes gradually more prevalent as the equator is approached from the poles, and fixed ratios of the blind to the sighted have even been assigned to different parallels of latitude. No sufficient data exist, however, for any certain conclusions of this nature; and although the prevalence of blindness in tropical countries is well known, we believe the fact may be ascribed to causes which exercise a more powerful influence than climate. In countries where the masses of the people are badly fed and lodged, where sanitary laws are disregarded, and where there is little knowledge of ophthalmic surgery, blindness will always be common, and it will be little modified by the circumstances of mere geographical position. In the subjoined Table we give the latest statistics accessible to us relating to foreign countries and to a few of our colonial possessions. It will be observed that in Norway the ratio is as high as 1 blind

RATIO to POPULATION of the BLIND in the undermentioned Countries. (From the Report on the Status of Disease in Ireland, 1861.)

Countries.	Ratio to Population.	Countries.	Ratio to Population.
Norway	1 in 540	Newfoundland	1 in 1,426
Ireland	1 „ 864	Wurtemberg	1 „ 1,436
Savoy	1 „ 884	Denmark	1 „ 1,523
Piedmont	1 „ 887	Hanover	1 „ 1,579
France	1 „ 938	Holland	1 „ 1,663
Scotland	1 „ 960	Oldenburgh	1 „ 1,720
England and Wales	1 „ 979	Prussia	1 „ 1,738
United Kingdom	1 „ 994	Nova Scotia	1 „ 1,788
Hesse Darmstadt	1 „ 1,231	Prince Edward's Islands	1 „ 1,880
Belgium	1 „ 1,233	Bavaria	1 „ 1,986
Saxony	1 „ 1,386	United States	1 „ 2,470
Sweden	1 „ 1,419		

to every 540 inhabitants, or nearly two to one as compared with Great Britain. In the American States the ratio of blind to the whole population is 1 in 2,470, and of blind slaves to all slaves, 1 in 2,616; in several of the southern states between 26 and 33 degrees of latitude the proportion is much lower, tending to show that climate has here had little or no direct influence. But it must be borne in mind that in the United States, and in several of our own colonies, where the people are largely recruited by the immigration of young and healthy persons, the blind will naturally be in a low ratio to the rest of the population. Persons labouring under deprivation of sight, like the sick, the maimed, and the decrepit, rarely emigrate; and, apart from this circumstance, the comparatively small proportion of aged persons in the population of these countries will sufficiently account for the inconsiderable numbers of the blind.

With regard to the distribution of the blind in different parts of England, the recent returns lead to the same conclusion as those of 1851, namely, that this affliction is more common in the rural districts than in those chiefly devoted to manufacturing, mining, and commercial industry. For example, in the south-western counties, comprising Wilts, Dorset, Devon, and Cornwall, the average proportion is 1 blind in 793 inhabitants; in the eastern counties (Essex, Suffolk, and Norfolk) it is 1 in 902, and in North Wales 1 in 880; these parts of the country being for the most part agricultural and pastoral. On the other hand in the north-western counties (Cheshire and Lancashire) the ratio falls to 1 in 1,253; in York, West Riding, it is 1 in 1,296; in Durham 1 in 1,252; and in Bedfordshire, where young persons are largely employed in the straw-plait manufacture, 1 in 1,325. But to whatever causes the high ratios in the agricultural counties are due, it is certain that the crowded dwellings and defective sanitary arrangements of large towns, combined with the occupations usually carried on amongst dense masses of people, are extremely conducive to diseases resulting in loss of sight. The lower proportions observed in the manufacturing and mining districts must therefore be mainly ascribed to immigration, and the comparative youthfulness of the population in those localities. Loss of sight being greatly influenced by age, part of the excess of blind persons in the rural districts is owing to the fact that they contain a larger proportionate number of persons in advanced life than the towns and manufacturing districts; while the immigrants into the latter are chiefly young persons who labour under no physical disability to interfere with their employment in the factories, in domestic service, or in trade as apprentices and work-people. (Census Report, 1861, Vol. 3, pp. 43–4.)

Causes of Blindness.—The mode of procedure adopted in taking the Census precluded the enumerators from pausing in the performance of their appointed task for the purpose of making special inquiries, which would be of great interest if they could be efficiently carried out, in reference to the blind; such as the causes of their infirmity and the period of life at which it commenced, their circumstances with regard to instruction, and their means of support. An attempt was made, for the first time, upon this occasion, to ascertain the extent of congenital blindness, by means of an instruction in the Householder's Schedule, to the effect that persons *blind from birth* were to be so described; but whether the information thus obtained may be regarded as tolerably complete and satisfactory we are not prepared to say. It appears that the term "born blind" is often applied to children losing their sight in the early years of life as well as to those actually blind from birth; and no doubt the difference is slight between those who never beheld the light and those who lost the faculty of vision before they had used it long enough to acquire permanent impressions. To what extent the vague employment of this term, thus sanctioned by popular usage and similarity of condition, has affected the value of the statistics of the born blind, we are unable to state; but it is not improbable that while some of the persons making the returns would use the words in a popular sense others would restrict them to their literal meaning, and that imperfect information would be the result.

Small-pox has undoubtedly been one of the most prolific causes of blindness in England. Of 1,456 pupils received into the Liverpool School from 1791 to 1860, no less than 250, or more than one-sixth, are said to have been blinded by small-pox; and of the pupils admitted to the London asylum a large proportion had been deprived of sight by the same disease. Purulent ophthalmia, with which the new-born infant is frequently attacked a few days after birth, is a disease quickly destructive of sight unless arrested by careful treatment. Many other forms of disease result in this calamity; but happily the great advances made in the knowledge of the anatomy of the eye have enabled surgeons to treat successfully many of the structural causes of blindness, and to restore sight in cases which, not many years ago, would have been considered hopeless. If all diseases of the eye cannot be traced to their origin, there can be no doubt that the bulk of them, when not attributable to advanced age, are induced by the unhealthiness of dwellings, the want of cleanliness, bad or insufficient food, and other well-known causes of physical deterioration, as well as by every description of overwork involving a considerable strain on the organs of vision, whether that of the student, the needlewoman, or the mechanic. To these undoubted causes of blindness must be added the various accidents to which all classes, and the labouring classes in particular, are constantly exposed. (Census Report, 1861, vol. 3, pp. 44–5.)

The Deaf and Dumb.—In Great Britain 12,553 persons (6,884 males and 5,669 females) are returned as Deaf-and-Dumb. Of this number, 10,314 are in England, 2,155 in Scotland, and 84 in the Islands in the British Seas. The proportion which the Deaf-and-Dumb bear to the general population in Great Britian, is 1 in every 1,670, in England 1 in 1,738, in Scotland 1 in 1,340, and in the Islands 1 in 1,704. These numbers and proportions would be slightly increased if allowance were made for the omission of infants, with respect to whom, owing to the difficulty of ascertaining the existence of deafness and consequent muteism in the first years of life, the returns are unavoidably imperfect. The above numbers will therefore be received as an under-statement of the actual state of Deaf-dumbness. But as the same defect of necessity exists in the returns of other countries, no erroneous conclusions will be formed from using them for the purposes of comparison.

According to the most recent returns, the average proportion of the Deaf-and-Dumb to the population of Europe generally is found to be 1 in every 1,593 persons.* In Holland, Belgium, and other states presenting chiefly a flat surface, the proportion is much smaller than in Norway and Switzerland; indeed, in some of the Swiss cantons, where cretinism is prevalent amongst the mountain passes, there is 1 Deaf-mute in every 206 inhabitants. In Ireland, the average is 1 in 1,380 persons; and in the United States of America, where however, the returns are admitted to be very defective, 1 in 2,366.

* RATIO to POPULATION of the DEAF and DUMB in the under-mentioned Countries. (From the Report on the Status of Disease in Ireland, 1861.)

Countries.	Ratio to Population.	Countries.	Ratio to Population.
Savoy - - -	1 in 443	Hanover - - -	1 in 1,450
Piedmont - - -	1 „ 563	Saxony - - -	1 „ 1,629
Wurtemburg - -	1 „ 901	England and Wales -	1 „ 1,640
Ireland - - -	1 „ 1,026	France - - -	1 „ 1,671
Norway - - -	1 „ 1,200	Bavaria - - -	1 „ 1,774
Scotland - -	1 „ 1,311	Denmark - - -	1 „ 1,920
Prussia - - -	1 „ 1,334	Belgium - - -	1 „ 2,277
Sweden - - -	1 „ 1,360	Holland - - -	1 „ 2,714
United Kingdom -	1 „ 1,432		

Looking at the distribution of the Deaf-and-Dumb over the face of Great Britain, we find them to be more common in the agricultural and pastoral districts, especially where the country is hilly, than in those containing a large amount of town population. The Northern Counties of Scotland, which include the wild and mountainous region of the Highlands, present the highest average,—1 in 1,156 of the population; then the South-Western Division of England, with 1 in 1,393; followed by the Southern Counties of Scotland, 1 in 1,480; and the Welsh Division, 1 in 1,542. We have already seen that the South-Western and Welsh Divisions of England and the Northern Counties of Scotland contain the largest proportional number of blind persons.

Cretins, most of whom are Deaf-mutes, are found in some of these localities; the disease of cretinism is also accompanied by mental imbecility in a greater or less degree.

The proportion of Deaf-mutes is lowest in the Northern Division of England—1 in 2,058 inhabitants; and in the North-Western Division (Cheshire and Lancashire), where a nearly similar average prevails—1 in 2,014.

Although as a general principle a greater degree of prevalency of Deaf-dumbness seems to exist in rural and hilly localities than amidst urban and manufacturing populations, yet exceptions are remarked on applying this test to the counties, and the smaller sub-divisions composing them. The following English counties, for example, present widely different results, scarcely to be explained by a reference to their physical or geographical peculiarities:—

Yorkshire, East Riding.	1	deaf-and-dumb	in	every	2,231	inhabitants.
Monmouthshire -	1	"	"		2,300	"
Kent (*Extra-Metropolitan*).	1	"	"		2,343	"
Durham - -	1	"	"		2,480	"
Huntingdon - -	1	"	"		3,016	"
Hereford - -	1	Deaf-and-Dumb	in	every	1,054	inhabitants.
Worcester - -	1	"	"		1,160	"
Derby - -	1	"	"		1,272	"
Cornwall - -	1	"	"		1,278	"

The relative numbers of the sexes are in all countries much more disproportionate amongst the Deaf-and-Dumb than amongst the Blind. In Great Britain and in England and Wales there are 121 male Deaf-mutes to 100 females; in Scotland the inequality is somewhat greater, namely, 125 to 100 females; in the Islands in the British Seas there are 121 males to 100 females. The Irish Returns give the reversed proportion of 111 females to 100 males.

In every 10,000 of the general population of each sex in Great Britain, 6·7 males and 5·3 females are Deaf-and-Dumb. But while the returns for the whole country exhibit a larger proportion of males, the reverse obtains in some localities; thus in Berks, Bedford, Salop, Derby, and Monmouth, more females are returned than males relatively to the numbers living of each sex.

Of the 12,553 Deaf-mutes, only 783, or 6·2 per cent., had reached 60 years of age,—a fact showing the unfavourable position of this class as regards length of life; while those under 20 years of age, although the numbers are unquestionably deficient, amounted to 47 per cent. The incompleteness of the returns for the years of early life, arising from the uncertainty which must exist with respect to infants, and the natural indisposition of parents to form a painful conclusion on the subject while the slightest grounds for doubt exist, has already been adverted to. A rough estimate of the omissions from this cause may be made by assuming the Deaf-mutes under 5 years of age to bear the same proportion to the general population of the same age as the persons aged 5 years and upwards bear to the residue of the population. There were in Great Britain, of 5 years of age and upwards, 18,222,518 persons, of whom 11,993 were deaf-and-dumb. If a like proportion existed amongst the population under 5 years of age (2,736,959 persons), 1,801 Deaf-mutes, instead of 560, would have been returned under the first quinquennial period of age. The addition of 1,241 cases would raise the percentage of those under 20 years of age to 52, and that of the ages above 20 to 48; but as the omissions would not be so frequent in the fourth and fifth years of age as in the earlier years, the supposed number to be added is probably too large. (Census Report, 1851, Occupations, Vol. 1, pp. cxiii–xv.)

Congenital mutism.—Very little success attended the attempt to ascertain at the Census the number of congenital cases of Deaf-mutism, by means of an instruction in the householders' schedule to the effect that persons deaf-and-dumb "from birth" should be so described. In many instances the fact was duly noted, but it was evident that in many others the instruction had escaped notice, or the person filling up the return was unable to give the information. Even the schedules of more than one institution for the class under consideration were altogether silent on this point. As incomplete statistics would be of no value, we considered the partial information not worth the labour of extracting. In Ireland, where a further investigation of every case of Deaf-dumbness returned at the Census was made by the constabulary and police, much difficulty was experienced in ascertaining whether the individuals were born deaf or not. From a large number of facts derived from the experience of various institutions in Europe and America, collected with much labour by Mr. D. Buxton, Principal of the Liverpool School for the Deaf-and-Dumb, that gentleman has arrived at the conclusion that it is hopeless at present to expect to establish any fixed ratio between cases of congenital deafness and those which have resulted from accident or from disease acquired after birth. Another writer, who is connected with the London School for the Deaf-and-Dumb, states that out of 3,050 well-authenticated cases within his own knowledge, 2,241 were *born deaf*, 759 resulted from various diseases, and with respect to 50 no positive information could be obtained; and adding to these the results of 2,805 other cases in different institutions and countries, he concludes that the actual preponderance is about 60 per cent. on the side of the *congenitally deaf*, while 40 per cent. are *accidentally deaf.*

The causes of congenital mutism have engaged the attention of eminent physiologists and pathologists, but they are still enveloped in much obscurity. One thing appears certain, that the organic defect which results in real deafness from birth is always incurable. Among the most common causes assigned for the appearance of congenital deafness in families are fright and morbid mental impressions on the part of the mother during gestation, consanguinity of the parents, and the transmission of the defect itself, or of the predisposition to it, from parents to their offspring. (Census Report, 1861, Vol. 3, pp. 56–7.)

Blindness and deaf mutism at groups of ages.—On comparing the ages of the Deaf-and-Dumb and of the Blind with those of the general population, the most opposite results are shown with respect to these two classes. In the case of the Blind, the numbers *increase* at each period from infancy to old age, after 55 very rapidly, and nearly in the same ratio as the general mortality. Of the deaf-and-dumb, the highest proportions are at the periods of age ranging between 5 and 25 years, and the numbers then gradually *diminish* as the ages advance.

PROPORTION of the BLIND and the DEAF-AND-DUMB at DIFFERENT AGES to the MALE and FEMALE POPULATION in 1861.

YEARS of AGE.	To every 100,000 living at each age, the proportion of			
	BLIND.		DEAF-AND-DUMB.	
	Males.	Females.	Males.	Females.
ALL AGES.	104·8	88·5	70·0	52·4
0-	21·6	17·5	21·9	19·2
5-	27·8	23·4	85·2	66·1
10-	41·8	31·3	98·4	70·8
15-	49·7	36·5	83·6	59·9
25-	74·7	42·2	73·3	52·6
35-	104·0	62·7	68·1	47·1
45-	148·8	101·4	67·2	54·8
55-	263·4	216·6	64·7	54·6
65-	558·3	504·3	59·9	49·4
75-	1216·6	1233·4	55·6	43·2
85 and upwards	2468·5	2321·9	61·5	63·1

The increase in the proportion of the Blind at the higher ages is the result of the additional numbers every year becoming blind. And the rate of increase after puberty is governed by the same law as that which governs other sickness. The facts relating to deaf-and-dumb children under the age of 5 are from their nature imperfectly recorded. The diminution of the proportion of the Deaf-and-Dumb after the age of 15 can only be accounted for by their mortality being at a higher rate than that of the general population. (Census Report, 1861, Vol. 3, p. 58.)

11. ECONOMIC VALUE OF POPULATION.*

Various attempts have been made to estimate the amount and the increase of the capital of the United Kingdom. The most recent attempt of the kind has been made by the chief of the statistical department of the Board of Trade. The value of the most important part of the capital of the United Kingdom and its increase have yet to be determined; I mean the economic value of the population itself. To this I propose to call attention briefly.

As lands, houses, railways, and the other catagories in the income tax schedules are of value, because they yield annual returns; so, for the same reason, and on the same principle, the income of the population derived from pay of every kind for professional or other services and wages can be capitalized; not precisely, it is true, unless the income of every person living were returned at least as nearly as the incomes subject to income tax; but sufficiently near to the true value to show

* See also "Cost, and the Present and Future Economic Value of Man", pp. 531–7.

that the value of the population itself is the most important factor in the wealth of the country.

It will be sufficient to state here that the capitalization of personal incomes always proceeds upon the determination of the present value at any age of the *future annual earnings* at that and all future ages; hence the value of future wages rises from the date of birth, when it is a notable quantity; is highest in the labouring classes at the age of 25; and declines as age advances, until in extreme age, when no wages are earned, it disappears. The living by the Life Table are most numerous in childhood, and gradually fall off till they are all extinct; and so in the population enumerated at the Census the numbers decline from the first year to the ultimate year of age. While the rates of wages rise rapidly from birth to the age of manhood, and afterwards decline, the numbers living constantly decline. Taking a series of observations on the wages of agricultural labourers* some years ago at different ages; determining their value by a Life Table at five per cent. rate of interest for each age; and multiplying the numbers living by these values, it is found that the mean gross value at all ages is 349*l.* But the mean value of the subsistence of the labourer as child and man, determined by the same method, is about 199*l.*; and deducting this sum from 349*l.*, there remain 150*l.* as the mean net value of the male population, estimated by this standard of the *agricultural labourer*. To extend the value to the whole population, including females, the standard might be lowered from 150*l.* to 110*l.* a head.

Then multiplying the population of the United Kingdom by 110 we have as the aggregate value £3,640 million; this including only as much of the income as approximates in annual amount to the wages of agricultural labourers. Only a small part of it is subject to assessment under the income tax schedules. The gross assessment under the income tax affords the means of estimating the value of incomes exceeding 100*l.* a year under Schedules D. and E.; excluding companies, mines, and works, these profits and salaries amounts to £214 million a year, to which about £92 million a year may be added for incomes above 30*l.* and below 100*l.* a year; thus making the aggregate of such incomes £306 million a year; which when the assessments of B. (farmers') are added becomes £373 million a year. Deduct the *half* of this revenue as due to external capital, and as required for the necessary sustenance of farmers, tradesmen, and professional men and there remain £186½ million a year as pure profit; which cannot be capitalized as a perpetuity inasmuch as the interest is limited by the lives of the producers, but taking life contingencies into account may be capitalized at ten years' purchase. This makes the value of these incomes £1,865 million. Allowing £255 million for the part of the incomes of about a million people paying the income tax previously valued in the £3,640 million, and for other deductions, £1,610 million remain, which, added to the £3,640 million already obtained, make £5,250 million.†

Thus by capitalizing the earnings, fees, salaries, wages of the professional, mercantile, trading, and working classes, £5,250 million are obtained as an approximation to the value which is inherent in the people, and may be fairly added to the capital in land, houses, cattle or

* See Journal of the Statistical Society, Vol. xvi., pp. 42–43 Extracts from this paper will be found on pp. 531–7 of this volume.

† Mr. Giffen makes the value of the capital in other forms £8,500 million; making with the value of the population itself, £13,750 million. See Journal of the Statistical Society, Vol. xli., pp. 1–31.

stock, and other investments. The amount would be increased by taking into account the rise of wages, and the income omitted in the returns of Schedule D. With an industrial Census an accurate estimate can be made of this most important part of the capital of the country.

The minimum value of the population of the United Kingdom, men, women, and children, is 159*l.* a head; that is the value inherent in them as a productive, money-earning race. The incomes chiefly under schedules D., E., and B., raise the mean value from 110*l.* to 150*l.* (see above).

Again, it must be borne in mind that the value under Schedule A. is dependent upon the population; where there is little population land itself is of little value. The increase of the value of house property is directly due to the increased numbers and earnings of the inhabitants. The railways yield no profit where there is no population. The profits of quarries, mines, ironworks (Schedule D.), and other concerns are mainly due to the skill and industry of the masters and men who work them. Upon the other hand the products of human industry are multiplied a hundredfold by the tools, machinery, steam power, and all the appliances which capital commands and represents. Should the population of a country decay, the value of its capital might sink to the vanishing point.

What I wish further to point out is that during the 39½ years this office has existed there have been added to the population of the United Kingdom 7,619,759 people who, valued as land is valued by the annual yield of net profit, constitute an addition of £1,212 million to the wealth of the nation.

The value of labour—that is of working men—varies, and is greatest where there is the greatest facility for profitable use, and where it is in greatest demand. Thus a large stream of the population of England flows to the Metropolis; and England is to the United Kingdom what the Metropolis is to England. So the populations of Ireland and Scotland flow into England, where they find more profitable employment, and are of more value than they are at home.

For the same and other reasons large armies of the population of the United Kingdom passed into the colonies and the United States; during the thirty-nine and a half years (1837–76) the excess of births over deaths was nearly 16 millions, of which nearly 8 millions augmented the ranks of the population at home, and more than 8 millions settled in other lands; chiefly in the midst of the old English stock of the United States and in the Colonies extending from Canada in America, to Africa and to Australasia.

Of the 8,013,267 people who must have left the country, only about 6,580,000 are accounted for by the Emigration Commissioners, whose returns were imperfect in two ways; they neither included the whole of the emigrants nor recognised emigrants returning recently in large numbers.*

The emigrants are chiefly adults married and unmarried; the men greatly exceeding the women in number. A few infants accompany their parents. Valuing the emigrants as the agricultural labourers have been valued at home—taking age and service into account—the value of emigrants in 1876 was 175*l.* per head.

If we may venture to apply this standard to the whole period it will follow that the money value of the 8,000,000 people that left England, Scotland, and Ireland in the years 1837–76 was £1400 million, or on an

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* See Census Report, 1871, where this was first demonstrated; and Emigration Report, 1877.

average about 35,000,000*l*. a year. In round numbers taking into account their aptitude to earn wages in future years at the home rates the annual industrial army that went out was worth at starting 35,000,000*l*. Many of the emigrants are skilled artizans, and considerable numbers are returned as farmers, gentlemen, professional men, and merchants; some of whom no doubt carried away a certain amount of capital which is not here brought into account.

The policy of the people of this country has thus been a policy of progress; instead of resting as they were in 1837, they have added since that year on an average of 192,873 souls annually to the population at home, and sent 202,868 sons and daughters to seek their fortune abroad in other fields of labour. The women, instead of to 644,214 children, who would just replace the population removed by deaths, have given birth to 1,039,987 annually, at a certain loss of their own lives with intermingled sorrows and joys such as befall mothers in rearing children: while the men instead of expending the whole of their gains on themselves have devoted a large share to their wives and families; besides that, as we have seen, the external wealth of the country has increased, as the nation has, without conquering territory or levying heavy contributions on its European neighbours.

The value of men varies with their earnings, which differ considerably in the colonies from the earnings of agricultural labourers at home; and on the whole before the civil war the emigrants to the United States got higher wages, and at the same time gave a higher value to the territory.

It may be contended that emigration is a loss to the mother country. It seems so. It is like the export of precious goods for which there is no return. But experience proves that simultaneously with this emigration there has been a prodigious increase of the capital of the country, especially in recent years. Wages have risen, and the value of the labourer has risen in proportion. In Norfolk, where wages are intermediate between the rates in the north and south, the rise has apparently been about 20 per cent.; so a fifth may be added to the estimated value of the workman. When the man leaves the village where he was born and bred, he leaves the market open to his fellows; he removes to a field where his work is in demand, and carries his fortune with him. It is the same when he emigrates to the colonies. His parents in rearing him have expended their gains in the way most agreeable to themselves. They have on an average five children, instead of two or three, or none. Taking a wider view, the emigrants create articles of primary use with which in exchange they supply the mother country; they have sent to England in the 39 years wheat, cotton, wool, gold to the value of hundreds of millions. What is of still more vital importance, they grow into new nations; they multiply discoveries; by confederation they will be to the Anglo-Saxon race outposts of strength across the Atlantic, in the Pacific, in South Africa, and in Australasia on the flank of India. And, moreover, to all it is an advantage to speak a wide spread language, and thus to be in social, literary, and scientific communion with millions of the same race. The increasing numbers enable them, advanced as they are in the arts, in the sciences, and in civil government, to do more for the good of kindred races; and to endow them with advantages which could not be attained in other ways for centuries. They govern India.

The economic value of a population depends very much on their command over the powers of nature; which they acquire by education. Put barbarians in possession of the land, the mines, the manufactures, the machines, the ships, the triumphant position of these islands on the sea between two continents, and what would be the result? Another Asia Minor, Egypt, or Syria? The better educated the English people become, the more skilful they will become, and the more valuable in an economic sense they will be. The clever artisan is worth more than the rude labourer. Now the art of reading and writing their own language is by no means proof of complete education, or of any technical training, but it is a proof that men in possession of it are preparing to enter on the heritage of thought, and knowledge, and sentiment, which men of all ages have bequeathed to mankind, and which is enshrined in the writers of an admirable language.

In 1837 not more than 58 in 100 men and women possessed this art; but there has been progress, and I have year by year assiduously noted the increase of their numbers in the 39 years, so that I am now able to report, that instead of 58, *eighty-one* in a hundred write their names in the marriage registers.

It is evident that there are other elements on which the economic value of the working population depends; and foremost among them stand health and long life. The longer men live, and the stronger they are, the more work they can do. Epidemic diseases in rendering life, render wages, insecure. These diseases are most fatal in cities whither the population—to secure all the advantages of the division of labour—have been congregating every year in increased numbers: villages have become populous or have grown into towns; so the population has been growing denser. And that by a definite law, other things being equal, tends to increase weakness, sickness, and mortality. There have been counteracting agencies in operation in the *thirty-nine* years. Asiatic cholera was epidemic in England in 1831–2; influenza followed at intervals in 1833, 1837, and 1847; and laid thousands of the population low; in 1848–9 the cholera epidemic in England and Wales alone was fatal to *fifty-three thousand people*;* its ravages in every corner of the kingdom were described; the conditions of its diffusion and fatality were brought to light, and the further investigations of the slighter epidemics of 1854 and 1866 prove that this plague is under the control of science. Other epidemics have since been fatal especially to children, and fever has struck at princes and peers as well as peasants; but upon the whole the great zymotic diseases have been quelled. Plague in its various forms has been kept at bay by a series of defences based upon minute precautions. In some epidemics I found it necessary to publish daily particulars respecting deaths in the Metropolis. By pursuing such inquiries, year after year, not only many of the causes that induce sickness and destroy life have been discovered, but observations of the same kind have shown that their removal has been followed by health and longer, more vigorous life. The economic value of the population of several towns has been increased by sanitary measures. The truths established, the facts ascertained, the remedies discovered in the thirty-nine years past await their full administrative applications in the years to follow; and the savings of time wasted in sickness, as well as of precious lives prematurely lost in youth and manhood, will enhance the value of the population to an incalculable extent. The famines so fatal in Ireland are not likely to recur; part of the population has emigrated to England or to America, and the intelligent landowners of Ireland, through the extension of the Poor Law, now insure their countrymen against death by starvation. The same beneficient law has in the thirty-nine years been extended to the Highlands of Scotland. Every improvement in health recorded makes it clearer and clearer that the

* Registrar General's Report on Mortality of Cholera in 1848–9.

gloom of sickness and premature death flies away before sanitary measures; and when the qualified health officers whom the Universities are offering to examine, are in suitable positions under enlightened local authorities all over the country they will no doubt prove as efficient in preventing as their medical brethren are in treating sickness. The result on human happiness cannot be calculated; but a future Industrial Census will show in a very definite shape its effect in raising the economic value of the population. The mean lifetime by the English Life Table is 40·86 years; by the Healthy Life Table it is 49·0 years, which is attainable in every well organized State. It is fair to assume that if a fifth part be added to the mean lifetime, at least a fifth part will be added to the worth of a living and labouring population. Upon this estimate £1,050 million will be added to the economic value of the population of the kingdom. Its value will increase with its numbers, and so will the value of its emigrating thousands.—(39th Annual Report, pp. vi–x.)

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OF

PART II.—MARRIAGES.

PART II.—MARRIAGES.

Introduction.

Marriage statistics possess value and interest from several points of view. Apart from their relation to and influence upon the birth-rate, and their influence upon the increase of population,* these statistics throw useful light upon various social and political problems. Marriage-rates directly afford a trustworthy test of our national well-being. Dr. Farr called them a barometer of national prosperity; and indirectly the Marriage Register supplies the most reliable measure of the progress of Elementary Education.

Although, as appears from some of the following extracts from Reports written by Dr. Farr, statistics based upon more or less reliable returns have been constructed for earlier periods, marriage statistics of a really trustworthy character date, in England, from the passing of the Civil Registration Act in 1837. The Registrar-General's Annual Reports contain tolerably uniform statistics relating to the 46 years 1838–83, and there is no good ground for doubting that the registration of marriages has been fairly complete throughout that period. The marriage-rate, that is the proportion of persons married in England and Wales, during these 46 years has ranged between 17·9 per 1,000 persons living in 1853, and 14·4 in 1879; the mean annual rate in the whole period being 16·3 per 1,000. A careful consideration of this long series of annual rates fully justifies Dr. Farr's description of the marriage rate as the barometer of national prosperity. Periods of commercial prosperity or inflation are consistently marked by high marriage rates, and those of depression as consistently by low rates. The relation, however, between the price of wheat and the marriage-rate has not been so persistently maintained in recent years, and it has been pointed out in the later Annual Reports of the Registrar-General that the marriage-rate in England moves in far more constant relation with the amount and value of British exports.

The simple proportion of persons married to the total population, while it affords a fairly accurate measure of the marriage-rate in any nation or community in a series of years, cannot be trusted as a means for comparing the respective marriage-rates in different nations or communities in which the proportions of sex, age, and conjugal condition may present very wide differences. In order to obviate the effect of this disturbing influence, marriage-rates for comparative purposes should be based upon the estimated numbers of bachelors, spinsters, widowers, and widows respectively living at different groups of ages. Examples of the methods adopted by Dr. Farr for this purpose will be found on pp. 78–80. The Census Report for 1881 shows the required numbers enumerated in counties, and in each of the urban sanitary districts having at the date of the Census a population exceeding

* On pages 20–21 and 44–47 of Part I., dealing with the Statistics of Population, will be found several extracts bearing upon the influence of marriage on the increase of population, and dealing generally with the statistics of its civil or conjugal condition.

50,000 persons. For smaller populations the calculation of detailed marriage statistics would be useless labour. The age proportions of a population, and also the proportions of the single and the married, change so slowly (except in rare cases), that for all practical purposes it may safely be assumed that during a current intercensal period such proportions remain the same as those found to prevail at the last Census. The amount of error involved in such an assumption would be too small to seriously detract from the value of marriage rates based upon numbers estimated by this method.

One of the most unsatisfactory features in the marriage statistics published by the Registrar-General is the still incomplete return of the ages of persons married. It appears from the last published Annual Report relating to the year 1883, that in 29,582, or 14·3 per cent. of the 206,384 marriages recorded during that year the age of one or both of the persons was omitted from the register by the officiating minister, the information in the age column being only "minor," or "full age," as the case might be. Such a description of the age is unfortunately indirectly sanctioned by the Registration Act, and so long as this is the case it is to be feared that the return of ages will be incomplete. The omissions are practically confined to Church of England marriages, and no difficulty arises in obtaining this desirable information in all cases (with rare exceptions) recorded by the civil registrars of marriages in dissenting places of worship and in register offices.

The last few extracts in this section bear upon the changing proportional relations between the Church of England and other religious denominations, as exemplified by the marriage returns, and by the registers of certified places of worship and of places certified for marriages.

The educational statistics based upon the signatures in the Marriage Register will be found in Part VI., at pp. 517–22.—(EDITOR.)

1.—MARRIAGE AND PROSPERITY.

Causes of Fluctuations in the Marriage-rate.—The number of marriages in a nation perhaps fluctuates independently of external causes, but it is a fair deduction from the facts that the Marriage Returns in England point out periods of prosperity little less distinctly than the funds measure the hopes and fears of the money market. If the one is the barometer of credit, the other is the barometer of prosperity, present in part, but future, expected, anticipated, in still greater part.

(1.) As a war diminishes the marriages by engaging great numbers of men at the marriageable age, an excess of marriages naturally follows peace, when the militia, soldiers, and sailors, with small pensions, are discharged. This is seen in the peace of Paris, the peace of Amiens, and the peace at the close of the last war. Manufactures and commerce in England have hitherto entered into renewed activity on the cessation of wars : markets are thrown open, and great numbers of people obtain employment, which has more to do with the increase of marriages than the mere discharge of great numbers of men from the public service and pay.

(2.) The growth of domestic animals is affected by comparatively few vicissitudes; and there is little fluctuation in the supply of meat. But the crops of grain in a country vary largely; the prices vary still more; while the wages of the bulk of the population have a limited range. Years of plenty are years of prosperity for the people; and the marriages increase, with a few exceptions, when provisions are cheap. As abundance is one of the causes that multiply, dearth is one of those that diminish the number of marriages.

(3.) The establishment of new, or the extension of old, employments promotes marriages: the cotton manufactures, the canals of the last century, the railways of the present day, are examples. In fact, an increase in their incomes is taken by the generality of people for the beginning of perennial prosperity, and is followed by a multitude of marriages.

(4.) The periodical epidemics of speculation are accompanied by an increase of marriages. Great numbers of people, of all classes, fancy themselves growing wealthy while shares are rising; and in the gambling transactions of the Stock Exchange, if some are ruined, others are enriched. The apparent improvement in the position of the small capitalists, the increased wages of the working classes, where the speculation involves the employment of labour, and perhaps the spirit of speculation itself, lead many to embark in matrimony.

(5.) The nation is sometimes extraordinarily sanguine. A statesman of genius, like Lord Chatham, at the head of affairs, produces the same confidence in a country as the presence of a Cæsar, Napoleon, or Wellington, on an army. Great victories, the joy of peace, large financial or political measures, new discoveries in science, new applications of the powers of nature, the opening of kingdoms and continents to commerce, raise public feeling to a state of exaltation long before the slightest improvement in the material condition of the population is realized by those measures that are likely to have ultimately that effect. Such periods of public exaltation are almost invariably accompanied by an increase in the number of marriages.

In fine, the great fluctuations in the marriages of England are the results of peace after war, abundance after dearth, high wages after want of employment, speculation after languid enterprise, confidence after distrust, national triumphs after national disasters.

The causes that increase and the causes that diminish marriage differ in energy; they admit of various combinations; they sometimes neutralize each other; and the marriages express the result of all those forces on the public conduct of the people.

I shall now inquire very briefly into the value of the Marriage Returns, and of other measures of public prosperity. An increase in the consumption of malt, hops, wine, spirits, coffee, tea, sugar, and tobacco, from which about 28,000,000*l.* of the revenue of the country are derived, implies an increase in the expenditure and wages of the working people; as an increase in the imports of raw silk, cotton, wool, tallow, and timber, is an evidence generally of more active manufacturing enterprise. The Marriage Returns express the same facts. Now it is invariably observed, that any extraordinary increase of marriages, or any augmentation in the consumption either of the comforts, stimulants, or necessaries of life, not always within the reach of the great mass of the population, is followed by a corresponding falling off. The ship raised on the crest of the wave is not surer to plunge than this prosperity to subside. "Eating and drinking, marrying and giving in marriage," preceded a great historical catastrophe; and it is evident from the facts already adduced, that though a nation may be rising, it never behoves the wise and sober to be more on their guard, more alert, or more liberal in giving good counsels, than when thousands of the people are setting up in business, establishing families (for every marriage is the foundation of a family), and consuming an unusual amount of luxuries. This "prosperity" may be the dawn of progress, or the riotous forerunner of ruin. To distinguish the two kinds of "prosperity" is difficult, but not impossible; and in the national life they are always intermingled in different proportions at different times. The usual course in the crisis appears to be this. Capital accumulates until the outlay of the surplus in the ordinary business of the country yields little profit. The thrifty grocer, the farmer, the cotton-spinner, or the merchant, with his routine system and limited market, finds that his business will bear no more capital. Ingenuity is taxed to discover new sources of employment and production. The discovery, after many failures, is made. The capital, invested in the new mines, factories, cultivation, commerce, yields large profits. This gets noised abroad. More capital is invested in similar undertakings, or undertakings suggested by the new principle. Capital is then drawn from all employments at low profits. Expectations are raised. Tradesmen and merchants take capital from their usual business to embark for the new El Dorado. Professional men and annuitants anticipate and invest part of their incomes. The public enthusiasm is fanned by unprincipled sharpers. Scrip and paper money afford extraordinary facilities for speculation. Men with no capital buy and sell shares; men with little capital go beyond their limits; and men of large capital undertake responsibilities to which no capital is equal. Large numbers of people are employed. Wages, salaries, fees, fly about in every direction. "Eating and drinking, marrying and giving in marriage," go on at an accelerated rate. All this series of facts is in the rough party estimates of debate confounded with substantial progress under the name of "prosperity." It is evident, however, that the new source of production remains through all; that the first investments are exceedingly profitable; and that in the end the speculation becomes a pure destruction of capital; for a nation, like an individual, can run through its property by the waste of the holders, their want of prudence, their improvidence in paying wages which the profits of production will not repay, or by the extravagant expenditure of wars, the only great speculations in which governments have hitherto engaged. The farmer may be running out his land, the grocer reducing his stock, the cotton-spinner letting his machinery fall to pieces for want of repairs, the carpenter selling his tools, while there is an increase in their expenditure, or even their income, if by this term is understood the surplus of the cash receipts over the outgoings of ordinary business in any given year. The capital of a country—its fertile soil—its horses, cattle, and provisions—its machinery and tools—its houses, ships, buildings, furniture, goods, merchandize, silver, gold—the slow accumulations of a thousand years, each "bearing fruit in its kind," with skill and labour eternally renewing and extending itself—may be wasted year by year, brought low, and destroyed; and while the destruction is going on, the expenditure of the nation may be increasing instead of diminishing. The prodigal is converting its estate into an annuity for a short term.

The reason of the depression that invariably follows a period of prosperity is in the nature of things. Wealth may be suddenly destroyed; but a sudden creation of wealth is impossible; for it is the produce of skill and labour, and though skill moves *per saltum* in inventions, human labour advances slowly, as generation follows generation. Where a new force like steam is placed at man's disposal, its introduction to profitable uses is slow. But in the crisis of "prosperity" a nation believes itself rich that the year before found it a hard thing to live; and on this high pitch regulates its expenditure. For man's course is determined by opinion; and opinion uninformed by science is full of delusions, wayward, and prone to exaggeration. The happy agriculturist has been known to be disturbed by the fertility of Egypt, shake before the rustle of the wheat waving over the plains of Hungary or Russia, and be overwhelmed in imagination by the endless produce of the vast valleys of the Mississippi. The "commercial mind," on the other hand, full of imagination, is excited by the sudden opening of great territories to trade: witness the effect of the treaty with France in 1787; the opening, as it is called, of the Continent of Europe, at the peace of Amiens, and the peace of 1814; the opening of South America by Mr. Canning in 1823–5; the opening of Asia recently through the Indus and China. Commerce sees these vast continents covered with customers; sets hands to work, freights her ships, and, as she expects, finds millions in want of her wares, and quite willing to accept them; but without anything of value that they are able or willing to give in exchange for the new untried commodities; men, whether civilized or savage, having generally ways enough to dispose of their income, and little left to experiment in new pleasures. The merchandize becomes a drug. It is sold for a fraction of its cost price, or given away; and in perishing often feeds the germs of a distant future trade. Some native commodity is displaced, or the industry of the population is stimulated to produce exchangeable articles for a profitable commerce.

In the invariable decline following an increase of marriages they have never fallen back to the original numbers. Population has increased faster than the marriages. The same may probably be said of the energies and productive powers of the country. And if it is true that depression always follows "prosperity," the converse is equally true. The agriculture of England, by improvements in its methods, and its extension in breadth to lands before uncultivated, has, through good and bad seasons, dearth and abundance, steadily advanced. Manufactures, aided by new powers and machines, have made still more progress; and commerce, through periods of languor and paroxysms of speculation, has increased, enlightened by science, having at command multiplied facilities of receiving information, as well as new agents of intercommunication with the world. And thus England has hitherto held on her way through ages: sometimes prosperity has shone on her, and all the winds have been favourable; then heaven has been clouded, or the gulf-streams of time have carried her aside, or adversity has hung over her; but, amidst all the vicissitudes and chances of the voyage, her true onward glorious course has still been held.

Mr. Pitt, in 1786, estimated the population of England and France at 8 millions and 24 millions. The power and wealth at the disposal of both countries has increased in a faster ratio than their population. The population of the United Kingdom was about 16 millions, of France 27 millions, in 1801. In 1846 the population of the United Kingdom was

MARRIAGE RATE in ENGLAND, 1796–1845.

Years.	Annual Marriages to 100000 Females living.	Living to One Annual Marriage.			Ages of Women.	Annual Marriages to 100 Women living.		Women living to One Annual Marriage.	
		Males.	Fem.	Persons.		1816 to 1825	1836 to 1845	1816 to 1825	1836 to 1845
1836–1845	1533	63·1	65·2	128·3					
1826–1835	1588	60·9	63·0	123·9					
1816–1825	1607	60·8	62·2	123·0					
1806–1815	1637	60·7	61·1	121·8	15–45	3·596	3·277	27·8	30·5
1796–1805	1716	57·2	58·3	115·5	20–50	4·168	3·722	24·0	26·9

about 28½ millions; of France about 35 millions. The increase in the relative strength of this empire, from the time of Chatham and Pitt, when England had to hire Hessians or other mercenaries, is immense. At the present time there are not less than 7 millions of men in these islands; and 5 millions of men well able to bear arms.

It is a fact well worthy of attention that the proportion of marriages to the female population has progressively diminished from 1·716 per cent. in the 10 years 1796–1805, to 1·533 per cent. in the 10 years 1836–45. The proportion of marriages to the population in each period of 10 years is shown in the accompanying Table. While the marriages increase in prosperity, it is a general rule that the proportion of marriages to the population decreases as the mortality decreases; and that marriage takes place later as life becomes longer. (8th Annual Report, pp. 26–30.)

Marriage-rate, Form of Marriage, and Commercial Prosperity.—The marriages after banns were as *five* to every *one* by licence. The proportion of marriages after banns to those by licence is less than it has ever been in any year, except 1847, since 1841; and it is evident that the pressure of the high prices of provisions, and of other circumstances, depressed the poorer classes of society more than the classes who usually marry by licence. Upon comparing the proportional numbers of marriages by licence and after banns, it appears that when the price of wheat is low or moderate the proportion of marriages by banns preponderates to the greatest extent.

It may be assumed that the marriages by licence represent the marriages of the higher and middle classes of society, and that those after banns represent the marriages amongst artizans and labourers.

If the facts for the 14 years are arranged in the order of the prices of wheat, it is seen that the marriages among the higher classes were relatively rather more frequent in the five years when the prices were highest than in the five years when the prices were lowest; while the marriages were most frequent among the classes who marry by banns, when the prices of wheat were low; and as these classes are the most numerous, they regulate the general result.

There is less fluctuation in the marriages of the rich than in the marriages of the poor, and the rise has hitherto not been simultaneous in the two classes; so that the difference in the proportion of marriages by banns and marriages by licence is a very sensitive test of the condition of the lower classes.

The cost of the marriage licence is on an average about 50*s*., while the usual fee for the publication of banns is *one* shilling; and the other marriage fees vary in the same direction, but not in the same proportion. If we exclude the persons married "not according to the rites of the "Established Church,"—who are sufficiently well represented in respect of wealth by those who are married in the church by licence, and after banns—the population is thus voluntarily divided into two great classes, (1) those who are willing to pay 50*s*. for a licence, and (2) those who marry after banns; the numbers of the two classes on an average of 14 years being to each other as *one* to 5·35. These facts afford some guide in estimating the relative numbers of two great classes of society, which are well marked, but are not divided by specific names. The licences cost about 54,000*l*., the publications of banns not less than 5,400*l*. in the year. (17th Annual Report, pp. ii–iv.)

High prices of wheat depress marriage among the classes (five out of six) who marry by banns, to a greater extent than they depress marriage among the remaining sixth of the people marrying by licence. Consequently, as the annual average price of wheat was higher (74*s.* 8*d.*) in 1855 than it was in any of the 15 years since 1841, the proportion of marriages by *banns* to the marriages by *licence* should be lower than it was in any of those years. This is found to be the case, and the proportion was 4·883 marriages by banns, to 1 marriage by licence in 1855. The principle that was announced in the last report, is thus confirmed by the experience of another year. (18th Annual Report, p. iii.)

The proportion of marriages by banns to those by licence was 5·24 to one. Wheat was at an average price of 53*s.* 3*d.*, which may be termed "intermediate." By comparing groups of years, distinguished as dear, cheap, and moderate, it will be seen that those when moderate prices ruled were most favourable in the general opinion of the unmarried for laying the foundation of domestic establishments. The year 1860 helped to confirm that result. If *licence* and *banns* be taken as the respective badges of capital and labour, it may be shown that in years of middle and low prices marriage was most frequent in the working classes; in years of high prices it was most frequent in the middle and upper classes; but in the "intermediate" priced year of 1860 the marriage-rate was remarkably well maintained amongst rich and poor alike. (23rd Annual Report, p. v.)

Depression of the Marriage-rate by the Cotton Famine.—In Lancashire the marriages, which were 6,315 and 6,127 in the third quarter of 1860–1 respectively, declined to 5,475 in that of last year. The following are some of the more important districts in that county, with the number of marriages in the quarter ending 30th September of each of the last three years:—

	1860.	1861.	1862.
Bolton	287	301	236
Bury	229	185	167
Chorlton	142	128	140
Salford	161	154	141
Manchester	1,194	1,157	1,018
Ashton	350	365	220
Oldham	243	221	184
Rochdale	218	221	158
Burnley	204	184	175
Blackburn	338	306	243
Preston	298	257	249

The marriages in Stockport, in Cheshire, show a clear decrease in 1862; they were 291, 301, and 204. It has been stated that Ashton-under-Lyne stands at the top of the scale of pauperism; and if marriages are expected to be fewest where distress is greatest, the returns fully justify that expectation. In Ashton the decrease on the two previous summers was no less than 38 per cent. Next in respect of decrease is Stockport, where it was 31 per cent. The marriages of Rochdale decreased 28 per cent.; of Chorley 28; of Leigh 24; of Blackburn 25; of Oldham 21; of Bolton 20; of Bury 19; of Manchester 13; of Salford and of Haslingden 11 per cent. In Preston and Burnley they decreased 10 per cent., and in Wigan the decrease was 9 per cent.

Chorlton showed a slight increase. When the marriage returns for the year are completed, they may be compared with the amount of pauperism, namely, the proportion which the persons relieved from the local rates and the funds of Relief Committees bore to the whole population. (25th Annual Report, pp. xxix–xxx.)

Summary of Fluctuations of the Marriage-rate, 1839–77.—Some of the general causes which have contributed to the fluctuation in the number of marriages in England and Wales during the past thirty-nine years may be referred to.

In the ten years, 1839–48, preceding the period when the Act relating to free trade came into operation the average price of wheat was high, 58*s*. 7*d*. per quarter, and there were great fluctuations in the marriage rate.

In the first five years of the decade the average price of wheat fell gradually from 70*s*. 8*d*. per quarter in 1839 to 50*s*. 1*d*. per quarter in 1843; but the hopes and prospects of the people were depressed, so the marriage-rate declined from 15·9 in 1839 to 15·2 in 1843. The most noteworthy events of the period were the Chartist riots in 1839, and the turn-out of cotton spinners and great general distress in 1842, when the depression reached a crisis and expressed itself in the lowest marriage-rate (14·7) recorded since the commencement of civil registration. Previously to 1842 the country had suffered from four successive bad harvests.

In the second half of the decade (1844–48) the marriage-rate rose, but the potato disease in England and Ireland, and three deficient harvests in 1845, 1846, and 1848, together with a commercial panic, brought the rate down to 15·8 in 1847, the year when 10,000,000*l*. were voted for the relief of the Irish who were suffering from famine. During these ten years just reviewed (1839–48) the quantity of wheat imported into the United Kingdom, and retained for home consumption, never exceeded 12,000,000 cwts.

In the five years 1849–53 the mean marriage-rate was high; it increased from 16·2 in 1849 to 17·5 in 1852, and notwithstanding the very deficient harvest in 1853, the rate rose to 17·9 in that year. This is the highest marriage-rate on record. During this period (1849–53) the duty on corn was reduced to 1*s*. per quarter; gold was discovered in Australia, the great exhibition was opened, and owing to free trade the quantity of foreign wheat imported began to increase; in 1853 it reached 20,913,000 cwts.; the average price of wheat was low, and in 1851 reached a minimum price of 38*s*. 6*d*. per quarter.

The five years 1854–8 witnessed some events of great importance; in 1854 there was an extremely good harvest, but war was declared against Russia, and the year 1857 was memorable for the Indian mutiny and for a great commercial panic; all these events had a depressing effect on the prospects of the community, and the marriage-rate declined from 17·2 in 1854 to 16·5 in 1857 and (notwithstanding a good harvest) to 16·0 in 1858.

In the decade 1859–68 the annual marriage-rate was 16·8. In the first five years of this period, although provisions were cheap, the mariage-rate fell to 16·3 in 1861, and to 16·1 in 1862, when great distress prevailed in the cotton districts of Lancashire, owing to the temporary disruption of the United States; in both these years the harvest was deficient. For the first three years (1864–6) of the second lustre, the marriage-rate was high, and the price of wheat comparatively low, but the effects of the rinderpest which broke out in 1865, and was not stamped out as an epidemic until about the middle of 1867, and the great monetary panic in London in 1866, soon made their impression on the rate, and it fell from 17·5 in 1866 to 16·5 in 1867, and to 16·1 in 1868, the year of the Abyssinian war. The year 1866 was memorable as the commencement of a period of commercial depression which lasted until the end of 1870. From the year 1868, owing to the ravages of the cattle plague, both beef and mutton rose considerably in price. In each of the three years 1865–7 the harvest was deficient.

The next five years, 1869–73, comprised two (1869–70), when trade was dull and the marriage-rate was low. In 1869 the duty on corn ceased, but in this and the following four years the harvest was deficient. In the last three years (1871–3) of this lustre the country revived; the year 1871 witnessed a remarkable rise in prices and in the wages of labour, and commerce and manufactures recovered from the languor of the previous five years; but a year or two afterwards a reaction set in, wages were greatly reduced, and these three years of prosperity were followed by four years (1874–77) of commercial difficulties and stagnation in trade. There was an abundant harvest in 1874, but in 1875–7 the harvests were unsatisfactory, trade was depressed, strikes were prevalent, and commercial failures were experienced. All this was expressed in the marriage-rate of the country, which rose from 15·9 in 1869 and 16·1 in 1870 to 16·7 in 1871, 17·5 in 1872, 17·6 in 1873, and fell to 17·1 in 1874, to 16·8 in 1875, to 16·7 in 1876, and to 15·8 in 1877. The marriages in the last ten years experienced nearly as great fluctuations as they did in the decade previously to the introduction of free trade.

The gradual increase in the supply of foreign wheat, a few years after the duty on corn was reduced, is remarkable. Thus the number of cwts. of wheat imported into the United Kingdom to every 100 of population in the five years 1854–8 was 54, whereas in the five years 1859–63 the proportional number was 94.

In the four years 1863–6 when the price of wheat was low, there was a considerable reduction in the quantity imported, but in 1867 when the price rose to 64*s.* 5*d.* per quarter, after two or three deficient harvests, a new impetus was given to the importation of corn, and the foreign supply still further increased; the average number of cwts. imported in the five years 1869–73, to every 100 of population, was 121, and in 1874–7 it was 144.

In 1877 the number of cwts. imported for home consumption was no less than 53,347,482 or 159 cwts. to every 100 of population, an enormous increase compared with the quantity in 1846 (8,592,458 cwts.) immediately before free trade was in operation.—(40th Annual Report, pp. xii–xiii.)

2.—Marriages in Successive Generations.

It may be of interest to mention that there is a complete series of Returns of English marriages from the year 1755 down to the present day; and it appears (1) that on an average of the 5 years of which 1758 is the middle year, 52,666 men and the same number of women married annually; (2) that on an average of the 5 years, of which 1791 is the middle year, 72,347 men and as many women married annually; (3) that in the 5 years of which 1824 is the middle, 104,180 men and the same number of women married; while (4) in the 5 years 1855–9 the marriages rose to 158,868. Taking these intervals of 33 years to represent the intervals between the marriages of successive generations, it will be noticed, that the numbers run in such proportions that each couple married in the first generation left two couples of marrying grandchildren and three couples of marrying great-grand-children. Thus 52,666 fathers left to marry 72,347 sons, 104,180 grandsons, and 158,868 great-grandsons, consequently the great-grandfathers were only equal in number to one-third part of the number of their direct male descendants in the third degree. This happens only in increasing populations, and it is probable that in the four generations preceding the year 1756 no such inequality existed. An increase of population implies a profound social modification.—(28th Annual Report, p. v.)

3.—Marriage Seasons.

Unlike birth and death, marriage is a voluntary act, and if men so will, all the marriages of a country may be celebrated in any single month of the year. But human will is influenced by motives, and these appear to operate all through the seasons of the year with variable force. In London the close of the season among the higher classes is a matrimonial epoch; among the working classes the festivals of Whitsuntide and Christmas, and the season of Lent exert some influence, so do the terms of service, which vary in different counties. The geniality of spring is perceptible; but Lincolnshire is the only county in which the spring weddings exceed the autumn weddings in number. The accumulations of autumn supply a store of food and the harvest wages of the young swains in agricultural districts are often wisely invested in the furniture of a cottage: it has already been shown that workpeople are influenced in marriage by economic conditions and prospects.

It might be supposed that marriages take place indifferently on any day of the week. But it is not so. Few marriages are celebrated on a Friday. Now Friday was in former times the day which would be especially devoted to these celebrations, as is implied by the names *Dies Veneris* of the Latins; and Friday, the day of the Saxon goddess Friga.

This day was chosen by the early church, perhaps partly in opposition to Paganism, as a day for carnal mortification; it was the day of the crucifixion of Christ; and hence the festive Friday of the Saxons, and the day especially under the star which astrologers held was most fortunate, fell into the category of "unlucky days." Seamen will not sail, women will not wed, on a Friday so willingly as on others days of the week. The Sun, Moon, and Saturn have gained by this silly superstition. Half the weddings are celebrated on Sunday and Monday; Saturday has more than its average number, and in the southern as well as the northern counties the Saturday marriages are the most numerous. Economy of time is an alleged motive for Sunday weddings. (27th Annual Report, pp. xiv–v.)

4.—Ages at Marriage.

Statement of Ages in the Marriage Register.—The marriage registers ought in all cases to show the precise age of the parties married, but in 55,098 out of the 190,112 marriages registered in 1871 the age column was filled in with the words "of full age," "minor," or "under age." By law the clergy are required to register marriages according to the form of the Schedule annexed to the Act (6 & 7 W. 4. c. 86), in which form the example given, instead of stating the precise age of one or both of the parties, describes the man as "of full age" and the woman as "minor" only. And in the earlier years of registration the clergy were perhaps not unnaturally disposed to content themselves with a bare conformation to the letter of the law without regard to the requirements of statistical and legal investigation which needed a more liberal interpretation of the spirit of that law to satisfy. It is gratifying, however, to find that whereas in 1851 the proportion of cases in which the precise ages of the parties married were not stated amounted to 63 per cent. of the total marriages registered, ten years later it had fallen to 37 per cent., in 1867–70 to 32 per cent., and in 1871 to 29 per cent. Instances of unwillingness on the part of bride or bridegroom to divulge their ages must of course be anticipated, but it may be hoped that gradually they will cease to occur as common sense gets the better of a vain wish to hide that which is already probably no secret to the clergyman or registration officer, whose avocations, moreover, would most likely predispose them to regard all such matters of detail from a general point of view rather than as affecting any particular individual. Furthermore, if clergymen and registrars made it a rule to put the question as to age in the form "What was your age last "birthday?" instead of "Are you of full age?" the marriage returns would soon exhibit a diminution in the number of cases of unspecified age. The importance of complete statistics of the age at marriage in determining the relative fecundity of population is obvious.—(34th Annual Report, p. x.)

If all the ages were returned, it would afford the means of determining with greater accuracy the mean age at marriage in England, the probable duration of the joint lives of husband and wife, the annual rate of marriage at different ages, and many other important social questions.

The returns are less imperfect now than they were in 1855, when the ages of both parties were not returned in 42 per cent. of the total marriages, whereas in 1874, 26 per cent. was the proportional number of cases of imperfect returns.

Yorkshire supplied the greatest proportional number of perfect returns, but even in this county the ages of both parties were not stated in the marriage register in 11 instances out of every 100 marriages. In Wales, and in the Northern counties of Durham, Northumberland, Cumberland, and Westmorland, the proportion per cent. of imperfect returns was 15, in Lancashire and Cheshire 18 per cent. The groups of counties furnishing very imperfect returns were the South Midland, 31 per cent., the South-eastern, Eastern, and South-western, 28 per cent. But it is in London that the returns were most imperfect, for there the ages were omitted by the Officiating Minister or Registrar of marriages to the extent of 53 per cent.—(37th Annual Report, pp. xi–xii.)

Marriage of Minors.—It is necessary to bear in mind that the mere fact that the proportion of marriages under age is higher in one population than in another absolutely proves that the disposition to early marriage differs only when the proportional numbers of unmarried women under and above 21 years of age is the same; for the real relative tendency to early marriage is measured in two populations, by dividing the annual marriages of minors in those populations by the numbers living unmarried at the corresponding ages.—(19th Annual Report, p. vi.)

The proportion of children to a marriage is, to a great extent, dependent on the age at which marriage is contracted, and the marriage registers of a nation furnish the means of determining this age. In

England and Wales of 201,267 marriages registered in 1872 the ages of both parties were specified in 145,507 instances, about five-sevenths of the total number. The mean age at marriage of these 145,507, including the re-married, was 27·9 years for men, and 25·7 years for women.

The proportion of young people who marry has never been so high as it was in 1872, and the proportion has been gradually increasing since the commencement of registration. In 1851 in every 100 marriages 5·02 men and 15·75 women were under 21 years of age, while in 1872, 8·00 of the men and 22·32 of the women were minors, but this increasing tendency to early marriage has not affected the mean age at marriage to any appreciable extent, for while the mean age of bachelors in 1851 was 25·8 years, and of spinsters 24·6 years, the ages in 1872 were nearly the same, viz., 25·7 and 24·3 years.

By means of the Census returns relating to the ages and conjugal condition of the people, I am enabled to show the annual rate of marriage at each year of age under 21, in each of the three periods 1850–52, 1860–62, and 1870–72.

MARRIAGE-RATES of BACHELORS, WIDOWERS, SPINSTERS, and WIDOWS, AGED UNDER 21, in 1850–2, in 1860–2, and in 1870–2.

AGES.	PROPORTION MARRIED TO 100 LIVING.					
	Bachelors.	Widowers.	Total Men.	Spinsters.	Widows.	Total Women.
	ANNUALLY IN THE 3 YEARS 1850–52.					
Total aged 15 and under 21	—	—	·763	—	—	2·427
	ANNUALLY IN THE 3 YEARS 1860–62.					
Total aged 15 and under 21	·946	4·255	·946	2·959	7·452	2·962
15—	—	—	—	·017	—	·017
16—	·003	—	·003	·136	—	·136
17—	·031	—	·031	·789	2·941	·790
18—	·320	—	·320	3·041	1·220	3·040
19—	1·539	—	1·539	6·096	5·714	6·096
20 and under 21	4·256	7·273	4·258	9·618	10·204	9·620
	ANNUALLY IN THE 3 YEARS 1870–72.					
Total aged 15 and under 21	1·177	3·390	1·177	3·405	6·710	3·408
15—	—	—	—	·018	—	·018
16—	·002	—	·002	·153	—	·153
17—	·041	—	·041	·933	—	·933
18—	·404	—	·404	3·640	1·282	3·639
19—	2·034	2·083	2·034	7·246	6·857	7·246
20 and under 21	5·298	4·698	5·298	10·590	8·333	10·584

Note.—The Population at the above Ages has been deduced from the graduated Tables showing the estimated numbers living at each year of age, published in each of the Census Reports of 1851, 1861, and 1871. In a certain number of cases the Age at Marriage is not returned; for example: the average annual number of Minors married in the 3 years 1870–72 was 14,888 Men and 41,978 Women, but an abstract of the instances in which the ages of both parties were stated only produced 13,681 Men and 35,732 Women; the ages of one or both of the couples married in the other cases being distinguished in the marriage registers by the terms "Minor," "Under Age, &c." The numbers of Men and Women whose ages were not stated have been proportionally distributed over the different periods of age.

To ascertain the increased disposition to early marriage more accurately the number of unmarried women living under 21 years of age at different periods must be taken into account. This has been done in the above table, and by dividing the average annual marriages of minors by the numbers unmarried at corresponding ages, the result shows that, among men under 21 years of age, marriage was contracted by 7·6 in 1,000 living in 1850–52, by 9·5 in 1860–62, and by 11·8 in 1870–72; and that early alliances among women under 21 years of age were contracted by 24·3 in 1,000 in 1850–52, by 29·6 in 1860–62, and by 34·1 in 1870–72.

There is therefore, beyond doubt, an increasing tendency to early marriage among the young people of this country.—(35th Annual Report, pp. xi–xiii.)

Marriage-rates of Bachelors, Spinsters, Widowers, and Widows.—A new table is introduced below, in which the number of marriages of bachelors, of spinsters, of widowers, and of widows respectively is compared with the numbers of the four classes enumerated at the Census in 1851. This table supplies a more satisfactory measure of the rate of marriage than the ordinary comparison of the marriages with the population, including a variable proportion of children. Thus of 1,000 bachelors in England, 58 married, and the proportions ranged in the counties from 82 in the Surrey portion of London to 36 in Herefordshire, and to 32 in Cumberland. Of 1,000 spinsters in England 61 married, and the proportions ranged from 82 in Staffordshire to 36 in Cumberland. It appears that the marriages in London are in a high proportion to the marriageable part of the population, and that the proportion in the surrounding counties of Surrey, Middlesex, and Essex, is conversely below the average. A certain proportion of the marriages of the country people are apparently contracted in the towns; and in the north of England, it was shown in the last report, that great numbers of the population of the northern countries marry, or pretend to marry, over the borders in Scotland, where the law of marriage is still in a loose and unsatisfactory state.

ANNUAL MARRIAGE-RATE in 1851 of BACHELORS, SPINSTERS, WIDOWERS, and WIDOWS, at DIFFERENT AGES, to 100 enumerated in 1851.

Ages.	Bachelors.	Spinsters.	Widowers.	Widows.
Total.	5·773	6·085	6·457	2·096
15-	·464	2·183	—	5·000
20-	11·209	12·672	30·766	19·649
25-	12·209	9·503	35·790	14·906
30-	7·851	6·025	28·627	11·611
35-	4·558	3·780	20·313	7·253
40-	2·798	2·501	14·075	4·333
45-	1·448	1·418	8·858	2·672
50-	·705	·599	5·711	1·298
55-	·349	·311	3·201	·731
60-	·152	·085	1·745	·241
65-	·146	·026	·862	·068
70-	·031	—	·316	·025
75-	·059	—	·100	·015
80 and upwards	—	·044	·067	·011

Note.—Of the 154,206 marriages solemnized in 1851 the ages of both parties were stated in only 56,347 cases. For this table the marriages in which the ages were not stated have been distributed to the various ages, in the proportion shown in the stated cases.

The accompanying Table shows, for the first time approximately the rate of marriage at different ages, and will admit of many useful applications in the solution of questions of population, as well as in the calculation of rates of insurance under certain contingencies. It will be noticed that 127 per 1,000 of the spinsters of the age of 20–25 married in the year: and that marriage was contracted by 3 in 1,000 spinsters of the advanced age of 55–60.—(14th Annual Report, pp. 6–8.)

Widowers are more inclined to marry than bachelors. By the annexed table, showing the average annual rate of marriage in the three years 1870–72 at each of 14 periods of age, it will be observed that this disparity of disposition is most remarkable in old widowers and old bachelors. At ages 35–40, to every bachelor who married 4 widowers remarried; at ages 40–45, 5 widowers remarried to every bachelor who married. As age advances this disparity increases, and at ages 50–55 the relative proportions were 1 bachelor to 7 widowers; at 60–65, 1 bachelor to 8 widowers; and at 65–70, to every bachelor who married 8 widowers remarried. These are marriages out of equal numbers.

Annual Marriage-rate of Bachelors, Spinsters, Widowers, and Widows at Different Ages, in the Three Years 1870–72.

Ages.	Bachelors.	Spinsters.	Widowers.	Widows.
Total.	6·175	6·313	6·575	2·110
15–	·468	2·252	1·149	4·235
20–	12·352	13·785	22·917	17·064
25–	13·821	10·418	30·296	15·678
30–	8·604	5·997	27·943	10·806
35–	5·343	3·698	21·872	7·116
40–	3·051	2·400	15·337	4·459
45–	1·968	1·581	10·739	2·809
50–	1·060	·806	7·323	1·513
55–	·610	·395	4·519	·820
60–	·334	·165	2·735	·393
65–	·146	·057	1·185	·133
70–	·075	·022	·538	·047
75–	·083	—	·190	·013
80 and upwards	—	—	·061	·002

Note.—Of the average annual number of marriages (191,011) in the three years 1870–72 the ages of both parties were stated in 135,854 cases. For this table the marriages in which the ages were not stated have been distributed to the various ages in the proportion shown in the stated cases.

Widows also marry in higher proportions than spinsters; thus at ages 15–20, to every spinster who married 2 widows remarried; at ages 20–25 and 25–30 the disparity was not so great, but at ages 30–35, and up to 65, the relative proportions were about the same as at ages 15–20, for to every spinster who married 2 widows remarried.—(35th Annual Report, pp. xii–xiii.)

5. Marriages and Religious Worship.

It will be observed that the marriages in registered places increased from 2,976 to 15,249, or fivefold in 13 years; within the last 7 years the marriages in Roman Catholic chapels increased from 2,280 to 5,623, and in a more rapid ratio than the marriages in other registered places of worship.

From returns which were procured at the last Census, it was estimated that on Sunday, March 31st, 1851, the total number of persons who attended places of public worship was 7,261,032.* Upon comparing the marriages with the number of attendants at different places of religious worship, this general result is obtained:—That among the Roman Catholics the persons who married were in the proportion of one to every 28 attendants, while among the members of the Church of England and of other religious denominations, except Jews and Quakers, there was one marriage to every 25 attendants. The facts stand thus:

—	Persons married in 1850.	Attendants at Places of Public Worship on March 30th 1851.	Proportional Numbers.
Church of England and other Christian bodies (exclusive of Quakers and Roman Catholics)	281,170	6,913,690	1 to 25
Roman Catholics -	11,246	305,393	1 to 28

If we divide the Protestants into two classes a very different result is obtained:

—	Persons married in 1850.	Attendants at Places of Public Worship on March 30th 1851.	Proportional Numbers.
Church of England -	261,918	3,773,474	1 to 14
Other Christian bodies (exclusive of Quakers and Roman Catholics)	19,252	3,140,216	1 to 163

The number of persons married in 1850 at the churches was to the number of attendants on the Census Sunday as 1 to 14; while the number of persons married at the chapels was to the number of attendants as 1 to 164. The whole of this discrepancy can scarcely be accounted for by the attendance of members of the Church of England at the chapels, or by the marriage of members of dissenting congregations according to the rites of the Church of England: but it admits of no doubt that from the influence of long custom, of opinion, or of a preference for the judicious, admirable, and well-established marriage service of the Church of England, vast numbers of the people who habitually attend other places of worship resort to the churches to marry.

* Census of Great Britain 1851. Religious Worship, p. clvi.

The dissenters also complain, with justice, that in marrying according to their own rites they are subject to restrictions and unnecessary annoyances; the notices of their marriages are read before boards of poor law guardians, and their marriages in the register offices have often to be performed in the workhouses, which, it must be admitted, as they offer no pleasant associations, open no very inviting avenue to the temple of Hymen.

The Quakers attended to the number of 18,172 at their 371 places of worship, containing 91,559 sittings, on the Census Sunday (March 30th, 1851); but in the year 1850 only 138 of the Friends married according to their own forms, so that there is still an unusual reluctance to marry among the male or female members of this remarkable sect, which, if it is neither sustained by hereditary accessions nor proselytes, will eventually decline in England.

The Jews present quite a different aspect; they marry in considerable numbers (520 were married in 1850); but the number who attended their synagogues on Saturday was only 4,150; so that there was one Jew married to every 8 who attended. Marriage appears to be common, but polygamy, though it is allowed by the law of Moses, is, I am informed, not practised by the Jews in any country of Europe except Turkey. (13th Annual Report, pp. iii–iv.)

6. Certified Places of Worship.

The Toleration Act of 1688 gave Protestants freedom of meeting for religious worship at certified places; in 1791 the same advantages were extended to Roman Catholics; in 1812 it was enacted that no Protestant congregation of more than 20 persons should meet unless the place of meeting had been certified to the bishop, archdeacon, or the quarter sessions; and in 1852 the certificates were directed to be sent to the Registrar-General. The Act 18 & 19 Vict. c. 81, only enacts that "all "places of religious worship, not being churches or chapels of the "Established Church, should, if the congregation should desire, but not "otherwise, be certified to the Registrar-General." Thus the certification is no longer indispensable, and the intolerant restrictions on religious worship are now entirely abolished in England.

Certain legal advantages attach to the registration of places of religious worship, for it places them under the especial protection of the law; and it is indispensable to the solemnization of any marriages, except those in Established Churches or in Register Offices.

A return was procured by this office of all the places that had ever been certified since the passing of the Toleration Act in 1688 to 30th June 1852, so far as existing documents supplied the information; and from that return it appeared that 54,804 places had been certified in the 164 years. In the first years, down to the end of 1690, 939 places were certified; 143 as permanent, 796 as temporary buildings. Of these 239 belonged to Quakers, 108 permanent and 131 temporary buildings. The places of Wesleyan Methodists first appear in 1741–50 in small numbers and as temporary buildings; but increase rapidly in 1791–1800, and then go on until their numbers in the end amount to 3,901, of which 2,035 were chapels or permanent structures. The other buildings are registered chiefly as belonging to Protestant Dissenters, consisting no doubt of Presbyterians (including Unitarians), Independents, and Baptists. Of 13,950 the particular denomination is not specified.

The following summary table gives the principal results :—

PLACES of WORSHIP returned as having been CERTIFIED in each DECENNIAL PERIOD from 1688 to 30th June 1852.

Decennial Periods.	Places described as		Total Number of Places certified in each Decennial Period.
	Houses, Dwelling-houses, Rooms, or otherwise as Temporary Buildings.	Chapels, Buildings, Meeting-houses, or otherwise as Permanent Buildings.	
TOTAL - -	39,817	14,987	54,804
1688—1690 - - -	796	143	939
1691—1700 - -	1,247	32	1,279
1701—1710 - - -	1,219	41	1,260
1711—1720 - -	875	21	896
1721—1730 - - -	448	27	475
1731—1740 - -	424	24	448
1741—1750 - - -	502	27	529
1751—1760 - -	703	55	758
1761—1770 - - -	701	85	786
1771—1780 - -	978	158	1,136
1781—1790 - - -	1,154	316	1,470
1791—1800 - -	3,479	915	4,394
1801—1810 - - -	3,975	1,485	5,460
1811—1820 - -	7,497	2,664	10,161
1821—1830 - - -	7,675	2,910	10,585
1831—1840 - -	4,550	2,872	7,422
1841—1850 - - -	3,090	2,720	5,810
1851—1852 - -	504	492	996

There appears to have been no means of striking any of the 54,804 certified places off the record; but great numbers of them disappeared in the progress of time; and at the Census of 1851 returns as to accommodation and attendance were obtained from 20,400 places of worship then existing and not belonging to the Established Church of England; 17,000 were returned as separate buildings. Of these separate buildings only 3,228 were on the marriage registers of 31st December of that year. The number registered for marriages on the last day of the year 1865 was 5,352; and at that date 16,819 places were on the register of places for religious worship. The Quakers and Jews are not required to register their places of worship as such. (28th Annual Report, pp. vii–viii.)

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OF

PART III.—BIRTHS.

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INTRODUCTION.

BIRTH statistics are important mainly on account of the influence of the birth-rate upon the increase, and upon the sex and age distribution of the population. Population, marriage, birth, and death statistics are, indeed, so interdependent, that no one of these branches of vital statistics can be efficiently handled without a full acquaintance with the main principles and bearings of them all. Birth statistics, including those of illegitimacy, moreover, possess a social interest apart from their more purely statistical value arising from the relation they bear to population.

Prior to the operation of the Civil Registration Act of 1837, no trustworthy birth statistics existed; indeed, they were not possible, since no machinery for their collection existed. From 1837 we possess, however, fairly complete national birth statistics, which there is good ground for believing to be increasingly accurate year by year. In the earlier years of registration a considerable, but unknown, number of births were not recorded, and Dr. Farr estimated (see p. 89) that this deficiency averaged five per cent. of the births occurring during the 39½ years ending with 1876, on the assumption that the actual mean annual birth-rate during that period was not lower than 36 per 1,000 of the population. The Births and Deaths Registration Act of 1874 first made the registration of births compulsory, and, without taking too sanguine a view of the present condition of birth registration, there is no good reason to doubt that the proportion of unrecorded births is now not only much smaller than the five per cent. estimated by Dr. Farr prior to 1876, but absolutely very small. It is probable that the births which now remain unregistered are for the most part illegitimate. The recent steady decline in the proportion of registered births out of wedlock is, however, probably, due to other causes, and should not be attributed to increasing deficiency in the registration of such births, as there are trustworthy grounds for believing that as with legitimate, so with illegitimate births, the proportion unregistered is considerably smaller than was the case in the early days of civil registration.

The birth-rate calculated by the usual method, that is the proportion of registered births to the population at all ages, is a sufficient approximation to a true birth-rate to answer most of the statistical purposes for which a birth-rate is applied. This crude birth-rate is, indeed, sufficiently trustworthy when the object is to compare the rates prevailing during a series of years in the same population. When, however, it is desired to compare the birth-rates in two or more communities, in which the sex and age distribution of the population may present considerable differences, it is necessary to calculate the rates by a method which eliminates the disturbing influence of those differences. This may be effected by calculating the proportion of registered births to the number of women aged 15 to 45 (the ages at which most children are born) estimated to be living in the community of which it is desired to ascertain the birth-rate. The Census Report for 1881 shows the number of females aged 15 to 45 enumerated in that year in each urban and rural sanitary district as well as in each registration county, district, and sub-district. The age and sex proportion of a population changes very slowly, and, except in those cases where the rate of increase of population by immigration is very abnormal, it may for all practical purposes be assumed that those proportions remain constant during a current intercensal period. On the basis, therefore, of the age and sex proportions prevailing at the last Census the number of females living between the ages of 15 and 45 may be estimated for each year between two enumerations; and upon this number a birth-rate, trustworthy for comparative purposes, may be calculated.

If the birth-rate among married and unmarried women, respectively, be required, it will be necessary to estimate, in a similar manner from the more recent Census information, the numbers of married and unmarried females living at these ages in the population to be dealt with. The proportion of legitimate births to married women, and of illegitimate births to unmarried women, will thus give true legitimate and illegitimate birth-rates. It is obvious, however, that such detailed statistics could not be trusted for comparative purposes unless they related to a population sufficiently large to avoid the inevitable accidental fluctuations incidental to all small numbers. As a matter of fact, moreover, the Census Report does not give the necessary information for estimating the number of married and unmarried women, except for registration counties, and for all urban sanitary districts having at the time of the last Census a population exceeding 50,000 persons.

The number of births to a marriage affords a fairly trustworthy test of the fecundity of a nation or community. It is patent, however, that this test can only be usefully applied when the population to be dealt with is sufficiently large to yield trustworthy results, and when both marriage and birth statistics are available for a fairly long series of years. The law regulating the registration of marriages, moreover, is unfavourable to the collection of accurate marriage statistics for any area of which the boundaries do not correspond with those of registration districts. Practically speaking, therefore, trustworthy statistics of fecundity cannot be calculated for smaller areas of England and Wales than registration counties. This, however, is the less to be regretted, as the main use of fecundity statistics, that is, of the proportion of children to a marriage, is for international comparison, and for detecting any change in the degree of prolificness prevailing in a nation in a long series of years.

In the sub-division of this Part dealing specially with illegitimacy (it was found impossible to exclude all reference to this subject in the sub-division "Birth Registration and Birth-rates"), some valuable extracts will be found dealing with the influence of early marriages, of the proportion of spinsters in the population, and of elementary education, upon the proportion of illegitimate births. Some of these extracts, although necessarily fragmentary, are as valuable for what they suggest as for the information they contain. Extracts bearing upon the mortality of illegitimate children will be found in the section dealing with infant and child mortality.

The last three sub-divisions deal briefly with Sex Proportion at Birth, Defects of the Birth Register, Statistics of First Born, and with Still Births.—(EDITOR).

1.—BIRTH REGISTRATION AND BIRTH-RATES.

Birth Registration, 1837–76.—I propose now to give a brief account of the registered additions to the population since 1st July 1837, when civil registration began; and to determine as nearly as I am able how far the number of children registered falls short of the number of children born alive. The facts prove that the defects were diminishing before the law was enforced by penalties; and now with due vigilance the registration of births as well as of deaths will, I believe, be in England as complete as it is in any other country in Europe.

Looking back from the first complete year of registration to the last, the annual births were 463,787 in 1838 and 887,968 in 1876; and the new births actually recorded from 1st July 1837 on the national registers were 26,129,906. There were in the first year 30·3 births registered to every 1,000 inhabitants, in the last year 36·6; and after allowing for any natural increase of the rate in the interval, or any deficiency of registration in the last year of all, I am inclined to think the actual birth-rate of living children was 36 per 1,000 during the 39½ years of civil registration. At this rate besides the 26,129,906 births registered, 1,441,603 births remained unregistered, or about 5 in 100.

The births were diminished by 17,079,018 deaths, which after subtraction left an excess in the numbers added to the population of 10,492,491; about 1,200,609 more than the increase of the home population determined from the Censuses. The 1,200,609 must have left England by emigration in excess of immigration. There were in *England and Wales* in the middle of 1837 about 15,103,778 people; and at the end of 1876 more by 9,291,882 new comers, making in the aggregate 24,395,660 inhabitants on 31st December 1876.

The emigration from Scotland and Ireland has been in proportion to their population more extensive than the emigration from England; and certain numbers of the population of England are of Scotch or Irish birth or descent. Consequently as the population in Ireland—not the Irish people—decreased, the increase of the population in the UNITED KINGDOM was less than the increase of the population during the same time in England and Wales. The increase of population in the UNITED KINGDOM, exclusive of the islands in the British seas, in the 39·5 years was 7,619,759. I leave out of account here the numbers of the army, navy, and merchant seamen abroad, the English, Scotch, and Irish residing in other countries, as well as the immense number of living emigrants and their descendants in the Colonies and in the United States.

The population of the UNITED KINGDOM increased in the 39 years 1837–1876 at the rate of 29 per cent.; and in the last ten years at the rate of 10 per cent. The increase in the last ten years was at the rate of 0·94 per cent. per annum. It was 0·66 per annum during the whole 39 years.—(39th Annual Report, pp. v–vi.)

Birth-rates among Married Women, 1851.—The mothers of all the children that are born in the country are between the ages of 15 and 55; and the greater part of them are between the ages of 20 and 40. The English schedule is defective, as it does not show the age of the father and mother at the birth of the child; but it may be inferred from the Swedish returns that not more than 1 in 8 women who bear children is under the age of 20 or above the age of 40.

It appears that in 1851 there were in England and Wales 2,553,894 married women under the age of 55, and that the children born alive in wedlock were 573,865; so that 22 in 100 bore living children. The number of unmarried women,—spinsters and widows inclusive,—of the same age (15–55) was 2,449,669; and as the number of children born out of wedlock was 42,000, it would appear that to 100 of them 1·7 children were born. The proportion of children to 100 married women under the age of 55 ranges between 19·73 in Herefordshire and 25·56 in Durham; the proportion of children to 100 unmarried women (age 15–55) ranges between 1·12 in Devon and 2·83 in Norfolk.

BIRTHS in WEDLOCK, registered in 1851 to 100 Married Women, aged 15–55, in Registration Counties.

Counties in order of their Birth-rates.	Birth-rate to 100 Married Women.	Counties in order of their Birth-rates.	Birth-rate to 100 Married Women.
Herefordshire - -	19·7	Monmouthshire - -	22·4
Shropshire - - -	20·0		
London - - -	20·4	ENGLAND AND WALES -	22·5
Middlesex - - -	20·4		
Norfolk - - -	20·7	Northamptonshire - -	22·5
Surrey - - - -	20·8	North Riding - -	22·6
Devonshire - -	20·9	Buckinghamshire - -	22·6
Gloucestershire - - -	21·0	Cheshire - - -	22·7
East Riding (with York) -	21·0	Hertfordshire - - -	22·7
North Wales - - -	21·1	Kent - - -	22·8
Somersetshire - -	21·5	Dorsetshire - - -	22·8
Hampshire - - -	21·5	Warwickshire - -	22·9
Nottinghamshire - -	21·5	South Wales - - -	23·1
Berkshire - - - -	21·7	Huntingdonshire - -	23·2
Worcestershire - -	21·8	Leicestershire - - -	23·5
Essex - - - -	21·9	Cumberland - -	23·5
Sussex - - -	21·9	Westmorland - - -	23·5
Suffolk - - - -	22·0	Northumberland - -	23·7
Rutland - - -	22·0	Bedfordshire - - -	23·7
Derbyshire - - -	22·1	Cornwall - - -	24·2
Wiltshire - - -	22·1	Lancashire - - -	24·3
Oxfordshire - - -	22·2	West Riding - -	24·4
Lincolnshire - -	22·3	Staffordshire - - -	25·0
Cambridgeshire - -	22·4	Durham - - -	25·6

The number of women of the age (20–40) in England and Wales at the time of the Census, was 2,856,398; of whom 1,248,182 were unmarried, 1,608,216 were married. And if 11·967 per cent. of the children are deducted, belonging as it may be inferred, to the women under 20 and above 40, it will follow that to every 100 women of the age 20–40 about 18·981 children are born annually, to every 100 unmarried women 2·962, and to every 100 married women 31·413 children.

These facts may well calm the apprehensions of those who entertain any dread of the depopulation of the kingdom; and they present in an encouraging aspect the great resources of the English population for colonization or for war.—(14th Annual Report, p. xiii.)

Birth-rates among Married and Unmarried Women, 1841–57.—In forming an estimate either of the prolificness or of the state of public morals in a country, the number of children born in wedlock must be compared with the number of married women at childbearing ages; and in like manner the number of children *born out of wedlock* must be compared with the number of unmarried women of the same ages.

I have hitherto shown the proportion of births in and out of wedlock to the population of the several counties; and the birth-rate has been found to differ considerably. But that rate is evidently regulated to a large extent, firstly by the proportional number of women in the several counties between the ages of 15 and 55, and secondly by the numbers living in the marriage state at those ages.

In consequence of the arrangements made at the last Census, the ratio of legitimate births to married women, and of illegitimate births to unmarried women, can now be definitely determined for each county, from the returns of thirteen years, including six years before and six years after the Census year.

ANNUAL BIRTHS in WEDLOCK, registered during the 13 Years 1845–57, to 100 Married Women aged 15–55, in Registration Counties.

Counties in order of their Birth-rates.	Birth-rate to 100 Married Women.	Counties in order of their Birth-rates.	Birth-rate to 100 Married Women.
Norfolk - - -	19·6	Leicestershire - -	21·6
Shropshire - -	20·0	Cambridgeshire - -	21·6
Devonshire - -	20·2	Oxfordshire - -	21·6
Herefordshire - -	20·2	Derbyshire - -	21·9
London - -	20·4	Worcestershire - -	21·9
Gloucestershire - -	20·7		
Middlesex - - -	20·7	ENGLAND AND WALES -	22·0
North Wales - -	20·8		
Suffolk - - -	20·9	Kent - - -	22·1
Sussex - - -	20·9	Northamptonshire -	22·1
East Riding (with York) -	20·9	Huntingdonshire - -	22·1
Berkshire - - -	20·9	Warwickshire - -	22·4
Somersetshire - -	21·0	Cumberland - -	22·5
Surrey - - -	21·0	Bedfordshire - -	22·5
Hampshire - -	21·1	North Riding - -	22·6
Wiltshire - - -	21·2	Monmouthshire - -	22·6
Dorsetshire - -	21·2	Northumberland - -	22·9
Essex - - -	21·3	Westmorland - -	22·9
Nottinghamshire - -	21·3	West Riding - -	23·5
Rutlandshire - -	21·3	South Wales - -	23·5
Hertfordshire - -	21·4	Cornwall - - -	23·8
Cheshire - - -	21·5	Lancashire - -	24·0
Buckinghamshire - -	21·5	Staffordshire - -	25·2
Lincolnshire - -	21·6	Durham - - -	25·2

The proportion of women of the puerperal age differs much in the manufacturing, mining, and agricultural counties; and while the proportion of women living *married* at the age of 20–40, to *ten unmarried*, is *ten* in *two* counties (Middlesex, *extra*-metropolitan, and Westmorland), and only *eleven* in North Wales, Devon, Surrey, Gloucester, Somerset, Salop, Hereford, Cumberland, the proportion in four counties, Monmouth, Durham, Stafford, and Huntingdon, is *nineteen* married women of the age 20–40 to *ten* unmarried women of the same age.

The number of unmarried women of the age of 15 and under the age of 55 may be divided into nearly two equal portions; the one of women of the age of 20 and under 40, the other of women above or below that period; and the Swedish returns show that the mothers of the great majority of children are 20 and under 40 years of age. I have, therefore, to determine the relative birth-rates, compared the births respectively (1) with the number of women of the age of 15–55, and (2) with the number of women of the age 20–40. The counties, arranged in the two orders, stand in nearly the same relative positions.

Thus in Devonshire *one* child in *eighteen* born alive is illegitimate; while in Norfolk *one* in every *nine* children born alive is illegitimate; and in Devon *eleven unmarried women* out of 1,000 of the age 15–55 bore children annually; while in Norfolk *twenty-five* out of 1,000 unmarried women of the same age bore living children annually. If the illegitimate children had been the children exclusively of women of the age 20–40, then the proportion of such women must have been 21 annually in Devon and 50 in Norfolk out of every 1,000; in nine counties less than 30; in twenty counties 30 and less than 40; in fifteen counties 40 and less than 50 women.

The mining counties Stafford and Durham, the border counties, Hereford, Salop, and Cumberland, the Danish counties, Norfolk, Suffolk, Nottingham, Derby, Leicester, and the manufacturing counties in a less degree, Bedford, York, Chester, and Lancaster, have an excess of women unmarried, yet prolific; while all the Celtic population occupy an intermediate place; and the population south of the Thames has the smallest proportion of unmarried women bearing children.

ANNUAL BIRTHS out of WEDLOCK, registered during the 13 years 1845-57 to 100 Unmarried Women, aged 15–55, in Registration Counties.

Counties in order of their Birth-rate.	Birth-rate to 100 Unmarried Women.	Counties in order of their Birth-rate.	Birth-rate to 100 Unmarried Women.
London	0·80	Northamptonshire	1·80
Middlesex	1·01	Northumberland	1·82
Devonshire	1·09	Berkshire	1·82
Surrey	1·20	Hertfordshire	1·83
Gloucestershire	1·22	Lancashire	1·88
Cornwall	1·24	Buckinghamshire	1·88
Somersetshire	1·35	Oxford	1·90
Rutlandshire	1·41	Cambridgeshire	1·93
Hampshire	1·45	Westmorland	1·93
Sussex	1·49	Lincolnshire	1·96
Dorsetshire	1·51	Cheshire	1·99
Kent	1·52	West Riding	2·00
Warwickshire	1·56	Durham	2·01
Huntingdonshire	1·60	Bedfordshire	2·01
Monmouthshire	1·61	Derbyshire	2·10
		Leicestershire	2·10
ENGLAND AND WALES	1·64	North Riding	2·14
		Shropshire	2·15
Worcestershire	1·70	Suffolk	2·21
North Wales	1·73	Herefordshire	2·23
Essex	1·73	Staffordshire	2·30
Wiltshire	1·74	Nottinghamshire	2·31
East Riding (with York)	1·75	Cumberland	2·37
South Wales	1·76	Norfolk	2·52

These tables deserve to be studied by persons living in the several localities in connexion with all the circumstances; as there can be no doubt generally of the unhappiness of the children born out of wedlock, any more than there can of the derangements produced in families by profligacy.

Why, it may be inquired, do *twenty-five* in Norfolk, and *eleven* in Devon, bear children annually out of the same number of unmarried women; and what are the consequences to the population of the two counties, distinguished in such different ways.

The proportion of legitimate children borne by women of all ages annually to 1,000 married women living of the ages under 40 is 392 in Cornwall, 321 in Norfolk, which is thus also in another way remarkable.

For all England 1,000 married women of the age 15–55 have 220 children annually; 1,000 unmarried women have 16 children annually, or one in *fourteen* of them is exposed to the same chance of bearing children as married women.—(20th Annual Report, pp. xiv–xvi.)

Birth-rates among married and unmarried Women, 1872.—The recent Census returns confirm previous deductions, and show that counties with a high proportion of married women at the child-bearing ages have the highest birth-rate; thus of every 100 women living at the ages 15–45 in Durham, 59·9 were married, and in Stafford 56·3, while in Devon the proportion was only 45·2, in Dorset 47·0, and in Hereford 47·3. Of every 100 women living in England and Wales, at the ages 15–45, 49·6, nearly half the number, were married.

The Appendix to the Census Report of 1871 contains some interesting results bearing upon this point,* and shows that in the counties containing the agricultural districts the birth-rate is generally low, while in those counties where the great mining industries of the country are carried on the birth-rate is high; thus the proportional number of legitimate births annually in the ten years 1861–70, to every 100 married women aged 15–55, in the counties of Durham and Stafford, was 25·3 and 24·8 respectively, while in the counties of Devon, Dorset, and Hereford, the proportions were only 21·2, 21·7, and 19·7 respectively.

If the ratio of *illegitimate births* to spinsters and widows aged 15–55 be compared in these counties, the results are nearly equally striking; the average annual number of illegitimate births to every 100 unmarried women being 2·2 in Durham and 2·4 in Stafford, while in Devon, Dorset, and Hereford, the proportions were 1·3, 1·5, and 2·0 per cent.—(35th Annual Report, p. xvi.)

2. Fecundity of Marriage.

Births to a marriage, England and Scotland, 1856–60.—The marriages in a calendar year give rise to births which are registered year after year for 20 years. The births to the 167,723 marriages in the year 1859 could only be determined by following the families and counting all the children unto the end. The division of the sum of the children by the marriages would accurately express the fecundity, as it has been called, of marriages. If the annual marriages do not increase or decrease in number through a series of years, the division of the annual births by the annual marriages of the same years expresses the fecundity pretty accurately; but the marriages in England are increasing rapidly; consequently the 740,275 births registered in the year 1864 must be divided by the marriages of some earlier year to get an approximation to the fecundity. As the age of the mothers is unfortunately not recorded, the interval in England is unknown which intervenes between the mean age of marriage and the mean age of the mothers when their children are born; otherwise that interval would indicate the calendar years with which the births of the year 1864 should be compared.

* See Vol. IV. Census of England and Wales, 1871.—General Report, Table 81, p. 68.

But the interval in Sweden between the mean age of mothers at marriage (25·8 years) and their mean age at the births of their children (31·7) is six years; and the interval in England cannot differ much from six years. Hence, if the legitimate births of given years are divided by the marriages of six years earlier date, the quotient will be the proportion of children to a marriage within close limits. In England the births thus determined to a marriage were 4·255, 4·301, 4·304 in the years 1862, 1863, and 1864. In Scotland the births in 1862 to the average marriages of six years earlier date (1855, 1856, and 1857) were 4·694. The number of children to a marriage thus appears to be greater in Scotland than in England, and this is held to be a proof that married women are more prolific in Scotland than in England.

Proceeding upon another basis the annual number of legitimate children registered in England was 626,506 in the five years 1856–60; when the average number of wives of the age 15–55, determined directly from the Census returns of 1851 and 1861, was 2,843,374; consequently 100 wives bore 22·0 children annually. In like manner it is found that 100 unmarried women bore on an average 1·7 illegitimate children; that is 17 children to 1,000 women. 100 women, including the married and the unmarried, bear 12·3 children annually on an average.*

In Scotland, during the same years, the following proportions were found to exist: 100 wives bore 24·8 children annually, 100 spinsters or widows bore 1·9 illegitimate children; and 100 women bore 12·0 children legitimate or illegitimate.

The wives of Scotland, as well as the spinsters, are apparently more prolific than the corresponding classes in England; and yet taken collectively the women of England are more prolific than the women of Scotland. 1,000 English women (age 15–55) bear 123 registered children annually; while 1,000 Scotch women bear 120 children. The difference is slight, but it is in favour of the English women.

This appears, at first sight, to be contradictory and paradoxical. It is explained by the circumstance that the proportion of recognized wives in the population is much lower in proportion in Scotland than it is in England, and as the fecundity of wives is to that of spinsters as 13 to 1, a slight difference in the proportions alters the birth-rates of the two populations. The difference in this respect between England and Scotland is great: in England 52 in 100 women of the age 15–55 are wives, 48 only are spinsters and widows; in Scotland the proportions are reversedly 44 recognized wives to 56 spinsters and widows.

1856–60.—Wives and Spinsters and Widows, aged 15–55, in England and Scotland.

—	Number of Married and of Unmarried Women.		Proportional Number of Married and Unmarried Women.	
	England.	Scotland.	England.	Scotland.
Women	5,437,769	867,062	100·00	100·00
Wives	2,843,374	383,271	52·29	44·20
Spinsters and Widows	2,594,395	483,791	47·71	55·80

* The proportions are slightly different in the years 1862 and 1864; but the argument remains unaffected. The same remark applies to the proportions of births to women of age 20–40.

By altering the proportions in Scotland, for instance, by transferring 57,608 women from the ranks of the unmarried to the married women, and by transferring 2,130 children from the ranks of the illegitimate to the legitimate children, the fecundity of women—of the wives and of the spinsters—of Scotland, becomes the same as the fecundity of the corresponding classes in England, namely, wives having children 22·034 per cent., spinsters and widows 1·676; instead of 24·790 and 1·916 per cent.; and when the transfer is made, the proportions remaining still show a less excess of women living in the state of marriage in Scotland than in England. Let us push this inquiry a little further.

COMPARATIVE FECUNDITY of ENGLISH and SCOTCH WOMEN of the Ages 15–55.

YEARS.	BIRTHS.					
	To 100 WOMEN.		To 100 WIVES.		To 100 SPINSTERS AND WIDOWS.	
	England.	Scotland.	England.	Scotland.	England.	Scotland.
Average in the 5 years 1856–60	12·321	12·027	22·034	24·790	1·676	1·916
1856	12·373	11·851	22·276	24·672	1·670	1·805
1857	12·337	11·982	22·137	24·861	1·671	1·835
1858	12·056	11·997	21·535	24·700	1·669	1·933
1859	12·543	12·232	22·361	25·073	1·711	2·004
1860	12·295	12·072	21·870	24·643	1·658	2·004

"There is an important distinction between the law of Scotland and that of England upon the point of legitimation by marriage, the former *legitimating all the children of the parties born before* the marriage, the latter legitimating only those who were born after the marriage. * * *

"It has been an established rule and principle of the law of Scotland for some centuries that *when a man and a woman are once lawfully married all the children born of such parents, whether born before the public celebration or open declaration of such marriage, or after it, are equally to be esteemed their legitimate children.* * * *

"It is generally stated in Scotch authorities to rest on a presumption or fiction, by which it is held *that there was from the beginning of the intercourse of the parties, or at the time when the child was begotten, a consent to matrimonial union interposed, notwithstanding that the contract was not formally completed or avowed to the world* [at the Census, for example] *until a later period.*"*

The legitimation of children born out of wedlock by subsequent marriage is somewhat different in France; it depends on the decision of

* Shelford, Law of Marriage, pp. 783–4. In a note he adds: "Legitimation *per subsequens matrimonium* is admitted, with different modifications, not only by the law of *Scotland*, but in *France*, *Spain*, *Portugal*, *Germany*, and *most other countries in Europe*. It prevails in the *Isle of Man* (*Lex Scripta of the Isle of Man*, p. 70–75), *Guernsey*, and *Jersey*, *Lower Canada*, *Saint Lucia*, *Trinidad*, *Demerara*, *Berbice*, the *Cape of Good Hope*, *Ceylon*, and the *Mauritius*. It is not admitted by the law of England, or of her other possessions in the West Indies and North America, or by the law of Ireland. It prevails in the States of *Vermont*, *Maryland*, *Virginia*, *Georgia*, *Alabama*, *Mississippi*, *Louisiana*, *Kentucky*, *Missouri*, *Indiana*, and *Ohio*, but *not* in the *other States* of America.—1 Burge on Foreign Law, 101."

the parents under the Code Napoleon, which nearly expresses the state of the law on the continent of Europe since the time of the Romans.

"Les enfans nés hors mariage autres que ceux nés d'un commerce incestueuz ou adultérin *pourront être légitimés par le mariage subséquent de leurs père et mère, lorsque ceux-ci les auront légalement reconnus avant leur mariage ou qu'ils les reconnaitront dans l'acte même de celebration.*"—Code Civile, livre i. section 331.

England stands almost alone among the civilized nations of Europe in refusing legitimation, even at the wish of the parents, to offspring born out of wedlock: and changes of the law might be demanded not only in kindness but in justice to the children, if there were no great countervailing advantages on the side of English law. Such advantages are believed to exist.

Out of 1,000 children whose births are registered in England 65 are illegitimate; out of 1,000 registered in Scotland 89 are illegitimate (1856–60); the proportion of bastards in an equal number of children of the two countries is as 3 in England to 4 in Scotland. Is this to be ascribed to the greater ignorance of Scotch women? By no means. Is it due to differences of religious belief or zeal? No one pretends that in this respect the people of Scotland are at all inferior to the people of England. We are thus driven back for an explanation to differences of the laws.

It is quite certain that many of the children registered as illegitimate in Scotland will be legitimated by the subsequent marriage of their mothers; the number is not always recorded as the mere fact of marriage regular or irregular legitimates offspring; but assume the numbers to be 2,130 out of 9,272 illegitimate births, then it follows that an indefinite number of the women returned at the Census as spinsters in Scotland are living in a state of quasi-marriage described in the books, and fairly expecting if they have children to see those children legitimated by subsequent marriage; they are kept in an uncertain state, hovering between concubinage and marriage, to which there is nothing corresponding in England, and they would nearly all, if they lived under the English law, be explicitly married. If the numbers of these women are taken at 57,608, as has been before explained, and added to the wives of Scotland (age 15–55), the numbers of wives *de præsenti* and wives *de futuro* will be 440,879, giving birth to 97,143 children annually, leaving 426,183 spinsters and widows corresponding to the same class in England, and giving birth to the same proportion of illegitimate children.*

* Let the fecundity of wives age 15—55 in England be thus expressed by—

$$\frac{\text{legitimate children in a year}}{\text{wives living in a year}} = f;$$

and that of unmarried women by $\frac{\text{illegitimate children}}{\text{spinsters and widows}} = \phi$.

And for Scotland put l = legitimate births in corresponding year, borne by w wives of age 15—55; also i = illegitimate births by s spinsters and widows of same age.

Then to obtain the proportion (y) of spinsters to be transferred to wives, and of illegitimate births (x) to be transferred to the legitimate, in order to make the fecundity of the corresponding classes equal to those of England, we have these Equations of Condition:

$$(1) \quad \frac{l + xi}{w + ys} = f = \cdot 22034$$

$$(2) \text{ and } \frac{i - xi}{s - ys} = \phi = \cdot 01676$$

$$\therefore \quad x = \frac{\phi f(s + w) - (\phi l + fi)}{i(\phi - f)}$$

$$y = \frac{fw + \phi s - (l + i)}{s(\phi - f)}$$

As a class these women in the prenuptial stage have comparatively few children, for the fruitful marry, and the unfruitful as a rule remain unmarried.

Other explanations are conceivable, but under this hypothesis it is not necessary to assume that there is any essential difference in the organization, the fecundity, or the virtue of the women living north and south of the Tweed. The laws are different. The result seems to tell in favour of the English marriage law, and against legitimation by subsequent marriage, inasmuch as the benefit to existing illegitimate children is purchased by multiplication of their numbers, uncertain connexions between the sexes, and extensive disorganization of family life.—(27th Annual Report, pp. xx–xxiv.)

Births to a marriage, 1864 *and* 1874.—Assuming that the interval between the mean age of marriage and the mean age of the mothers in England is 6 years, then the legitimate births in 1874 divided by the average number of marriages in the three years 1867–9 will give the average number of births to a marriage—4·57. In the year 1864 the proportional number was 4·30, so to every 100 marriages in England there are now 457 births, whereas ten years ago there were 430, or 27 less. This is no doubt owing to some improvement in the registration of births. The annual number of legitimate births to every 100 married women aged 15 and under 55, in the 10 years 1861–70, was 22·35. —(37th Annual Report, p. xiv.)

Birth-rates and Fecundity in European States.—The births registered in England are, in proportion to the population, one-seventh part more numerous than in France, and one-seventh part less than in Prussia. To 3,525 inhabitants 100 births are annually registered in France, 113 in England, 133 in Prussia, 136 in Austria, 151 in Russia. The small number of births in France is not accounted for by any difference in the proportion of the persons married, who are in fact more numerous in France than in any other country from which I have been able to procure returns. It appears that 100 French wives had 14 children, 100 Prussian wives 21 children yearly; or, in other terms, 717 wives bore annually 100 children in France, 152 children in Prussia. If the births are divided by the annual marriages that took place seven years before, there were 3·33 births (in wedlock) to a marriage in France, 4·05 to a marriage in Prussia, and 4·34 to a marriage in Austria; 4·26 to a marriage in England, and, if a correction be made for first marriages, 4·79 to every *two* persons married. The total annual births in England, divided by the persons married seven years before, give on an average 5·12 children to every two persons married; and, as many illegitimate children are the offspring of married persons before, during, or after marriage, the number of children to every two persons married in England must be between 4·79 and 5·12, or little short of *five*, about three of which attain the age of marriage to replace the two parents and those who have no offspring; the surplus swelling the number of the existing inhabitants of the island, or flowing off in emigration.—(6th Annual Report, p. xxx.)

Fecundity of married women in European States.—Through the courtesy of the superintendents presiding over the statistical departments of the respective European States, I am enabled to publish for the year 1876 some approximate results, showing the comparative fecundity of married women in the different States.

I pointed out in the 27th Annual Report,* that to ascertain the number of births to a marriage (unless the marriage-rate is stationary) the annual births should be divided by the annual marriages of some previous year. In the following results it has been assumed, in the absence of more precise information, that the interval between the mean age of mothers at marriage, and the mean age at the births of their children, is the same in England and in other countries, as it is in Sweden, viz., about six years. The legitimate births in 1876 have therefore been divided by the marriages of six years earlier date. Thus in Sweden the number of legitimate births in the year 1876, to the *average* annual number of marriages in six years earlier date (1869, 1870, 1871) was 4·84, so the number of children to a marriage in Sweden appears to be nearly the same as the number in England, viz., 4·63.

In Italy the proportional number of births to a marriage was apparently highest, 5·15; but this is probably owing to the fact that all the marriages are not at present registered. Prussia stands next in order of greatest fecundity, and the proportional number was 4·92. In the Netherlands it was 4·83, nearly the same as it was in Sweden. In Belgium it was 4·48, nearly the same as it was in Spain; in Denmark it was low (4·24), and in Austria still lower (3·73), while it was lowest in France, viz., 3·42.

COMPARATIVE FECUNDITY in different EUROPEAN STATES.

YEARS.	European States.	Births to a Marriage.
1876	Italy - -	5·15
,,	Prussia - -	4·92
,,	Sweden -	4·84
,,	Netherlands -	4·83
,,	England - -	4·63
,,	Belgium - -	4·48
1870	Spain - -	4·47
1876	Denmark -	4·24
,,	Austria - -	3·73
,,	France - -	3·42

(40th Annual Report, p. xxxvii.)

Fecundity in France.—In France, according to the last returns of 1863-69, the proportion of children born annually to 100 wives of 15–55 was 15.

COUNTRY.	YEARS.	AGES 15-55.		AGES 20-40.	
		Legitimate Births to 100 married Women.	Illegitimate Births to 100 unmarried Women.	Legitimate Births to 100 married Women.	Illegitimate Births to 100 unmarried Women.
ENGLAND AND WALES.	(1861-70)	22·35	1·64	35·87	3·34
FRANCE - -	(1863-69)	15·10	1·62	26·39	3·33

* p. xx.

Thus, at the French rate, the English wives would have borne annually in 1861–70 only 475,948 children, whereas their lawful children actually registered were 704,309.* 475,948 births would not have replaced the 479,450 annual English deaths in the period, so the population, without any emigration, would have declined. In France more women marry than in England, and though they have fewer children to a family, the population is not sensibly declining.

This is a question of numbers which are not much swayed either way by the direct action of the wealthy, the scientific, or the highly cultivated. It involves the sustained systematic policy of two masses of people,—of the Catholic peasant proprietors and of the artizans of France, with few settled colonies, on the one hand; of the Protestant workmen, labourers, miners, artizans, and mariners of England, with vast colonial possessions, on the other. The social policy in both cases may perhaps be considered open to censure, and yet may not be without vindication in the circumstances of the two nations. If the French parent asks how many of his children have a chance of a livelihood on a parcel of the dear land he loves so well, and regulates his family accordingly, he appears to have the sanction of the school of economists founded by an Englishman: while on the English side we contend, with the facts revealed by the Census in our hands, that the English people have instinctively pursued a great and wise policy: they have increased at variable rates; by increasing rapidly since the last century they have exalted England to a height overtopped by no other power; they have peopled colonies; they have planted wide in perpetuity the English race; and they have exercised a great part in the government of the finest regions of the earth. That they have done under great discouragements and at great sacrifices. Malthus told them at the beginning of the century that by the principle of population they were increasing in geometrical progression; that they were thus perpetually pressing upon the means of subsistence, which increased in arithmetical progression; that this was the inevitable cause of misery, of which the only mitigations were destructive diseases cutting down their numbers, or the diminution of marriages and births by prudence.—(Census Report, 1871, Vol. 4, pp. xvi–vii.)

Possible increase of Fecundity and of the Birth-rate.—To 100 married women aged 15–55, 22·47 living children are born annually, and to 100 unmarried women 1·7 living children are annually born. Upon the hypothesis that as many unmarried women must *cæteris paribus*, be living irregularly to every child born out of wedlock as there are wives to *every child* born in wedlock, then 186,920, or 1 in 13 of the unmarried women, must be living so as to contribute as much to the births as an equal number of married women. A certain class of cases countenances the belief that the numbers and proportions are understated—others, that they are overstated—by such a hypothesis. But as the mothers of so many as probably 7 in 8 children are of the second age (20–40) when 100 married women have 31 children annually, it will follow that 42,000 children out of wedlock may be borne by about 136,728 women of that age (20–40), or by about 9 (exactly 9·129) in every 100 of the 1,248,182 unmarried women. Nearly 1 in 11 may be struck off the list of spinsters by this estimate, which appears, on the whole, to be of the two the nearest approximation to the truth; thus leaving, out of 1,248,182 unmarried women 1,111,454 living in celibacy

* The Average Annual *legitimate* births in England 1861–70 were 704,309, whilst at the French birth-rates the English married women aged 15–55 would have borne 475,948 children.

in the prime of life (20–40), against 1,744,944 women, namely 1,608,216 wives and 136,728 women who are not wives, who bear children. Now, some conception of the voluntary control that is exercised over the numbers of the population may be obtained by considering that the births are proportional to the number of married women, who at this age may be raised in the proportion of 2 to 3 by the simple transfer to their ranks of a portion of the 1,111,454 unmarried; and, further, that an increase of the actual births by one third part or by one half would certainly double the rate at which the population has increased for the last half century. For the sake of simplifying the statement, the whole of the births have been here referred to the women of the age of 20–40; but it is well known that in America great numbers of women marry and bear children at the ages under 20, when in Great Britain only 25,607 are wives, and more than a *million young women* are spinsters. (Census Report, 1851; Occupations, vol. I, p. xliv.)

3. Illegitimate Births.

Registration of Illegitimate Births, 1842.—The Abstracts have been extended, and present Returns of the first marriages, to which I have already adverted, and the annual number of illegitimate children registered,—upon which I proceed to offer a few remarks. The first attempt to ascertain the number of illegitimate children in England was, I believe, made at the Census of 1831, when Mr. Rickman obtained, from the officiating ministers of churches and chapels in England and Wales, Returns of illegitimate children born in their parishes or chapelries during the year 1830. The total number returned was 20,039, of whom 10,147 were males, 9,892 females. Mr. Rickman was of opinion that this return was accurate; but, from want of uniformity in making the Return, many of the officiating ministers merely stating the numbers *baptised* in their churches and chapels, instead of recording, as requested, the number *born* according to the best information they could obtain, I think no great reliance can be placed on the correctness of these Returns. In which opinion I am confirmed, on referring to a Return of illegitimate children whose baptisms were registered by the clergymen in the several parishes of Lancashire, the West Riding of Yorkshire, Norfolk, Surrey, and Herefordshire, during the year 1831, presented to the House of Commoms in March 1843. No specific reference is made to illegitimate children in the Registration Act; and, as it is not stated on the face of the Register of Births whether the children registered are or are not born in wedlock, the attempt to determine this point cannot always be successful; but great care has been taken in framing this Abstract, and in every doubtful case the child being classed as legitimate, I am confident that the Abstract now submitted to you cannot in any view be conceived to overstate the number of illegitimate children born in England. In the country districts I see no reason to suppose that illegitimate children escape registration in greater proportion than children born in wedlock; but, when the facilities in populous districts for the concealment of births from the registrars, and the impunity with which a woman may suppose she can assume a name, or give the name of a father, are considered in connexion with the relatively small number of illegitimate children registered in the Metropolis, Liverpool, and some other large cities, I fear that we must set down the number of illegitimate children in the Abstract as an under-statement. The attention of the registrars has been specially directed to these points, and they are required to acquaint every informant that any false statement wilfully made by her respecting any particular to be recorded in the register, will render her liable to the pains and penalties of perjury; they are also instructed to discourage the entry of the names of putative fathers in the Register Books of Births.

The number of illegitimate children registered in 1842 amounted to 34,796, which is 14,757—or 74 per cent.—more than the numbers in Mr. Rickman's Returns of 1830. The population increased only 17 per cent. in the 12 years. I am disposed to consider Mr. Rickman's Returns as deficient to a much greater extent than they were supposed to be at the period of their publication; but, with a correction for the increase of population, the numbers in the Abstract for 1842 would only have exceeded those in Mr. Rickman's Returns for 1830 by 11,300 instead of 14,757. This difference may, perhaps, among other causes, be ascribed to an actual increase in the proportion of illegitimate children during the operation of that important change in the Poor Law, which threw the charge of maintaining their illegitimate offspring upon the mothers. But to whatever cause the increase may be ascribed, the relative numbers of legitimate and illegitimate births and baptisms returned in 1830 and 1842, show in the latter year a relative as well as an absolute excess of illegitimate children. (6th Annual Report, pp. xxx.-xxxi.)

Registration of Illegitimate Births, 1871.—Illegitimate births to the number of 44,775 were registered in 1871, amounting to 5·6 per cent. of the total births registered. Twenty years ago they were close upon 7 per cent. of the total births; in the 10 years 1851–60 they averaged 6·5 per cent.; in the following 10 years 6·1 per cent.; so that from whatever cause there has been a gradual and uninterrupted falling off in these evidences of human frailty. I have no grounds for supposing that the general diminution in the illegitimate birth-rate is caused by any increase in the omissions to register, on the contrary, I think that as in those elements of registration which we have the means of accurately observing, undoubted progress in the direction of greater completeness has taken place, it is fair to assume with respect to the registration of illegitimate births that at any rate no more of them are lost sight of now than in former years. In London little or no variation in the rate of illegitimate birth has taken place in 20 years; it amounts to about 4 per cent. of all the births, which is markedly less than the average for the whole country, partly for reasons, no doubt, which will be sufficiently obvious to all who are familiar with life in great cities, but which do not lie within my province to discuss. (34th Annual Report, p. xvi.)

True measure of Illegitimacy.—In seven counties, exclusive of the metropolitan counties, the proportion of births out of wedlock is less than 6 in 100 births; namely, 5·3 in Monmouth, 5·4 in Devon, 5·5 in Cornwall, 5·7 in Durham, 5·8 in the Extra-metropolitan part of Middlesex, 5·8 in Huntingdon, 5·9 in Warwick; in six counties the proportion of illegitimate births exceeds 9 in 100 births, namely, 9·1 in Westmorland, 9·5 in Nottingham, 9·9 in Shropshire, 10·2 in Herefordshire, 10·5 in Cumberland, and 11·1 in Norfolk; so that in Norfolk 1 in 9 of the children, and in Devon 1 in 19, are born out of wedlock.

These returns show that great differences exist in the manners of different counties; and they undoubtedly imply varieties in the state of the family relations, in the social education of children, and in the morals of the people. But it must not be immediately assumed, as has been sometimes done, in comparing the counties of England and Wales, any more than in comparing the results of our returns with those of other countries, that the relative morality of the population is expressed by these numbers.

The relative proportions of the unmarried women who gave birth to children in the year 1851 are shown in the annexed Table.

BIRTHS out of WEDLOCK, registered in 1851, to 100 Unmarried Women, aged 15–55, in Registration Counties.

COUNTIES, in order of their Birth-rate.	Birth-rate to 100 unmarried Women.	Percentage of married women who signed by marks, 1851.	COUNTIES, in order of their Birth-rate.	Birth-rate to 100 unmarried Women.	Percentage of married women who signed by marks, 1851.
London - -	0·82	23	Lancashire - -	1·90	63
Devonshire - -	1·12	36	Northumberland -	1·95	38
Middlesex - -	1·17	30	Essex - -	1·95	45
Gloucestershire -	1·27	37	Bedfordshire - -	1·97	59
Surrey - -	1·35	29	Westmorland -	1·97	29
Cornwall - -	1·36	52	Cambridgeshire -	2·01	46
Hampshire - -	1·46	34	Durham - -	2·02	48
Somersetshire -	1·51	43	Lincolnshire -	2·04	39
Dorsetshire - -	1·52	38	Buckinghamshire -	2·06	50
Sussex - -	1·54	29	West Riding -	2·09	59
Rutlandshire -	1·59	32	North Riding -	2·09	36
East Riding (with York)	1·62	39	Cheshire - -	2·12	55
			Oxfordshire - -	2·13	39
Warwickshire -	1·65	43	Derbyshire - -	2·14	42
Kent - -	1·62	34	Northamptonshire -	2·15	45
Monmouthshire -	1·68	61	Hertfordshire -	2·15	51
England and Wales -	1·72	45	Shropshire - -	2·17	47
			Herefordshire -	2·20	41
Worcestershire -	1·79	48	Leicestershire -	2·32	43
South Wales -	1·80	67	Staffordshire -	2·40	60
Berkshire - -	1·80	35	Cumberland -	2·44	30
North Wales -	1·82	66	Suffolk - -	2·45	46
Wiltshire - -	1·85	47	Nottinghamshire -	2·46	48
Huntingdonshire -	1·89	47	Norfolk - -	2·83	44

Excluding London from view, as the returns are probably imperfect, it may be inferred that generally the unmarried women in the counties south of the Thames, comprising the descendants of the old Saxon population, have few illegitimate children: Wales stands next in the scale: the West Midland, the North Western, and the South Midland counties, covering the area of the ancient Mercia, present less favourable results; while in Yorkshire, the Northern counties, the North Midland counties, and particularly the Eastern counties, covering the area of the ancient Danish population, the number of illegitimate children is excessively great.

The women of the counties in which there are fewest illegitimate children appear to be the best mothers and housewives, as, other things being equal, they lose fewer of their children in infancy than the women of counties where many children are born out of wedlock.

With the facts in these tables before them, it will be for the clergy and for other moral inquirers in each county to investigate the causes of the discrepancies which they disclose, and to ascertain how the existing evils can be most efficaciously and successfully treated. To facilitate such inquiries, which should be elaborate and not be confined to a single class of causes, the counties are arranged in the above Table in the order that the proportion of mothers of illegitimate children of the age 20–40 bear to 100 unmarried women of the same age; commencing with the counties in which the proportion is lowest. A column is added showing the state of elementary education among the women who married, these throwing indirect light on the state of education of the unmarried women in each county. (14th Annual Report, pp. xiii–xiv.)

Illegitimacy and Early Marriage.—The average annual number of children born out of wedlock in the 10 years 1846–55, to every 100 spinsters aged 15 and under 45, was 1·89. In the 10 years 1866–75 the proportional number fell to 1·79, showing a decrease of 5·3 per cent.

The increasing number of early marriages does not appear to account for the decreasing rate of illegitimacy in England.

As an illustration in confirmation of this, take the four counties of Cumberland, Norfolk, Salop, and Westmorland, which had the highest proportions per cent. of children born out of wedlock in the 10 years 1865–74; the mean annual rate of illegitimacy in these four counties was 9·6, and the mean proportional number who married under age to 100 marriages in 1865–74 was 5·7 for men, and 17·5 for women; whereas in the counties or parts of counties of Middlesex (extra-metropolitan), Surrey (extra-metropolitan), London, and Monmouth, where the proportion per cent. of children born out of wedlock was lowest—4·1 per cent., the proportional number who married under age to 100 marriages in 1865–74 was 5·0 for men, and 18·2 for women. (38th Annual Report, p. xxvii.)

Proportion of Illegitimate Births and of Spinsters to Females aged 20–40.—The relation between the illegitimate births and the proportional number of spinsters in different counties is strikingly exhibited if the counties are arranged in groups in the order of the rate cf illegitimacy.

Groups of Registration Counties.	Children born out of Wedlock to every 100 Births. 1876.	Proportion of Spinsters aged 20–40 to every 100 Women living at the same Age in 1871.
1st Group of Ten - -	3·9	36·1
2nd Group of Ten - -	4·6	37·9
3rd Group of Ten - -	5·0	39·1
4th Group of Ten - -	5·9	38·6
5th Group of Six - -	8·0	41·3

[A useful table in the 39th Report (on page xxv) shows the proportion of illegitimacy in each English county in the ten years 1856–65, in the ten years 1866–75, and in the year 1876, also the decrease per cent. in 1876 compared with the mean proportion in 1866–75; and the proportion of spinsters aged 20–40 to females of the same ages in 1871.] (39th Annual Report, p. xxvi.)

Decrease of Illegitimacy.—A great reduction in the rate of illegitimacy has taken place during the last 16½ years (reckoning from the middle of each of the periods 1855–64 and 1875–7): the reduction per cent. reached 39 in Leicestershire, 35 in Cheshire and Nottinghamshire, 34 in

Derbyshire and the North Riding of York, 33 in Essex and Lancashire, 32 in South Wales and Wiltshire, 31 in Berkshire, and 30 in Durham. Indeed, in the whole of England and Wales the fall in the 16½ years was not less than 27 per cent. (40th Annual Report, p. xxiii.)

4. Sex Proportion at Birth.

Sex proportion at Birth, 1841.—I showed in the Fourth Annual Report that the proportion of boys to girls born in England was 10,486 to 10,000. The mathematical questions connected with the proportion of the sexes born have been investigated by Laplace, Poisson, Babbage, and other distinguished philosophers; and one of the results which has attracted most attention and created most speculation is, that the proportion of boys is greatest among legitimate children. In France, for instance, the boys are to the girls born as 106·4 to 100·0; but among illegitimate children the proportion is 104·4 to 100·0. The present Return gives a result exactly the reverse; of the legitimate births the boys are to to the girls as 105·4 to 100·0; of illegitimate births the boys are 108· to 100·; and, small as the numbers are, the ratio differs little in the two quarters. It is, I believe, assumed in the French Returns that foundling children are illegitimate. If it be true, as is stated by those acquainted with the matter, that many of the children sent to the foundling hospitals in France are the offspring of married people, who probably abandon a greater proportion of girls than boys, it will follow (1), that the proportion of children born out of wedlock is nearly the same in England as in France; and (2), that the inference from the Returns of Continental States having foundling hospitals as to the relative predominance of females among natural children is fallacious. (5th Annual Report, pp. 10–11.)

Sex Proportion at Birth, 1838–83.—More boys than girls are born every year in England and Wales. In 1877 the boys were in the proportion of 103·6 to every 100 girls. The proportions of the sexes are perhaps regulated by some natural law in operation immediately preceding, or at some early stage of, intra-uterine life; probably several other causes also exert their influence, such as the social status and relative ages of the parents at marriage. The excess in the births of males over those of females is believed to be greater among first-born children than it is among those born afterwards.

To whatever influences the relative proportion of the sexes at birth is due, it is well known that an excess in the number of boys born prevails not only in England but among all European races.

Dr. Bertillon and others have collected facts which throw some light on this interesting subject. In the meantime I wish to draw attention to the remarkable fact that this excess in the proportional number of boys born to girls born in England and Wales is less than it was, as will be seen by the subjoined table.

Proportional Number of Males born to Females born.

Years.	Males born to every 100 Females born.
In the 10 Years 1838–47 -	105·0
„ „ 1848–57 -	104·6
„ „ 1858–67 -	104·4
„ „ 1868–77 -	103·9
„ 6 Years 1878–83 -	103·8

(40th Annual Report, p. xxi.)

5.—Defects of Birth Register; Statistics of First Born.

Two grave defects in the registers of the United Kingdom deprive them of much of their utility as pedigrees, and as records of facts for the solution of the great problems of population. Neither the age of mothers at the births of each of their children, nor the order of birth, is recorded; so that the number of children borne by women at different ages, and in the course of their lives, cannot be ascertained. This defect was supplied in the first schedule of the Scotch Act, but the important parts of the schedule were unfortunately discontinued after 1855. Dr. Stark turned some of the precious results of that year's registration to account; and so has Dr. Duncan in his valuable work on Fecundity. Dr. Duncan proves from various sources that the mortality in the first pregnancy is to that in subsequent pregnancies nearly as two to one; and from the data he has collected it may be assumed, until further observations are made, that about 1 wife in 8 or 10 is sterile.

How can we determine the number of firstborn children in England annually? It must evidently bear some relation to the marriages. Now the annual number of legitimate children in the six years 1862–67 was 695,597, and the annual marriages in the six years 1856–61, with which they may be fairly compared, were 162,681, of which 147,804 were marriages of spinsters: so that the births to a marriage are 4·276; the births to each woman married are 4·706. The births to each procreant wife—if only 133,024, or *nine* in *ten* wives, have living children—must be 5·229. Consequently as families consist of one, two, three, four, up to ten or more children, and every family has one first-born child, it is evident that the first-born children in wedlock will be to the total children so born as 133,024 to 695,597; or as 1 to 5·229. We can from these proportions infer that about 19 per cent. of the children in wedlock are first-born, but to get the number of women bearing first children, the mothers of the children born out of wedlock must be brought into account, and some corrections must be made. This being done, it will be found that the 3,600 annual deaths in childbirth during the six years 1862–67 imply about 48 deaths to 10,000 delivered; and if, as is found by other observations, the mortality in first deliveries is proportionally to the mortality in subsequent deliveries as 2 to 1, the mortality among English mothers will be 80 in 10,000 for first children and 40 for subsequent deliveries, taken in the aggregate.

Statistics of Firstborn.

To get the number of *firstborn* children by *mother* from the total number of children c born in wedlock to w wives: let 0·9 or any fraction s be the co-efficient of fertility, then it is evident that $sw = w' =$ number of procreant wives out of w wives. $\frac{c}{w'} = \frac{c}{sw} = f = \frac{695,597}{133,024} =$ average number of children in the family of a fertile mother, made up of families compounded variously of one, two, three ... n children; unless the wife has before marriage borne children every family thus constituted has necessarily one *firstborn* child to mother: and the number of *firstborns* in the legitimate births of a year are thus determinable, as they $= w' = \frac{c}{f}$.

Let *d* include the mothers either married or single dying in childbirth. Then to complete the estimate of the firstborn the children born out of wedlock must be brought into account; their average numbers in the six years were 46,181. What numbers of children in the aggregate do these mothers bear out of wedlock? Not *two* probably on an average; and if the proportion of the firstborn among the children is taken at *two* in *three* it will imply that two such women bear on an average three illegitimate children; that two-thirds of the illegitimate are firstborn.

ENGLAND.

Annual marriages in the 6 years 1856-61 -	162,682
Husbands marrying for first time -	139,930
Widowers - - - -	22,752
Wives marrying for first time -	147,805
Widows - - - -	14,877
Children born annually, 1862-67 - -	741,778
In wedlock - - - -	695,597
Out of wedlock - - - -	46,181
(*d*) Annual deaths of mothers by childbearing in the 6 years 1862-67 - - -	3,600

ANNUAL BIRTHS IN ENGLAND IN THE SIX YEARS 1862-67.

——	Total Children born.	First-born.	Second-born and others.
——	$(a + b)$	(a)	(b)
Children born - -	741,778	163,812	577,966
Legitimate - -	695,597	133,024	562,573
Illegitimate - -	46,181	30,788 ?	15,393 ?

To determine from the English returns the mortality from childbirth, on the assumption that the first child-bearing is twice as fatal as those following, we have this equation:

$$2\,xa + xb = d = \text{deaths by childbirth}$$
$$\therefore x = \frac{d}{2\,a + b} = \cdot 003975 = \frac{3{,}600}{905{,}590}$$

where $2x$ represents the rate of mortality in the first pregnancy, a represents the number of such childbirths in the given year, and b = the childbirths of all other orders from second to last inclusive.

The above reasoning supplies us with the means of answering this question approximately: What is the proportion of firstborn to mothers in the population? Among the portion of the population born in wedlock nearly 1 in 5, or 19 in 100, are firstborn. This proportion could only be disturbed to any extent by emigration or by a difference between the rate of mortality among the firstborn and the subsequent born children of families. The proportions among the children not born in wedlock would be very different; and there is reason to believe that the casualties of infancy cut down their numbers.

The number of men exceeds the number of women who marry more than once; hence the proportion of firstborn children to total children of fathers is less than the proportion of firstborn children to mothers. Thus the mean annual number of children born in wedlock in England (1862–67) was 695,597; the mean annual number of marriages (1856–61) was 162,682; that is 162,682 men married 162,682 women in those years; now if we divide 695,597 by the annual number of husbands marrying one or more times in their lives, namely, about 139,930, the mean number of legitimate children by one wife or more to each husband is 4·971.

Thus, if the fathers marrying at 28, aged 34 when their children are born, divide their property equally among their legitimate children, and nine in ten fathers have children, the nine fathers will have on an average 5·52 children, and will leave at death, taken at the age of 64, about 3 children, so the property will be divided into 3 parcels on an average. This is exclusive of the sub-divisions of the property of childless fathers.

In France the proportions of children are much lower; to each husband only 3·637 children are born to his one or more marriages; and, taking nine in ten as fertile, the average family will consist of 4·041 children; so, taking the proportions to survive as the same, the property will only be divided into *two* parcels.

The firstborn to fathers in 100 of the population will be 18 in England, 25 in France; *one* in *five* or *six* in England, *one* in *four* in France, is a firstborn child.

Second-born children are fewer in number than firstborn: and firstborn = last-born children. (30th Annual Report, pp. 222–6.)

6. Still Births.

In the case of children born alive—or who breathe—both the birth and death are registered, but still-born children are not registered in England.

Under the provisions of the new Registration Act no still-born children, however, should be buried without a *certificate*, stating that they were still-born, signed either by the registered medical practitioner who was in attendance at the birth, or by one who had examined the body. In the absence of a registered medical practitioner a declaration has to be made by the midwife or some other person qualified to give such information, stating that the child was not born alive.

Still-born children, therefore, are by the new law *certified* as such, although they are not registered. In England the proportion of still-born children to total births is supposed to be about 4 per cent., but this is uncertain.

In France, under the provisions of the Code Napoleon, children who die (either after or before birth) before registration, are recorded as still-born. Dr. Bertillon estimates that 22 in 100 of the children registered in France as still-born breathed, and such children in England would be registered among the births and deaths.

The number of deaths registered in France in the year 1875, exclusive of so-called still-born, was 845,062, and the death-rate was 23·1 per 1000 of population.

The number of still-born children registered under the provisions of the Code in the same year was 43,834, a deduction of 22 per cent. (9643) from which, represents the corrected number of still-born children in France in 1875, viz., 34,191.

Including the estimated number of live-born children (9643) the deaths in France in 1875 were 854,705, instead of 845,062, and the corrected death-rate, therefore, was 23·4 instead of 23·1 per 1000.

In France in 1875, the corrected proportion of still-born children to every 100 live-born children was 3·6. In Belgium the proportion in the years 1860–65 was 3·7. (38th Annual Report, pp. xxv—vi.)

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PART IV.—DEATHS.

Introduction.

It may confidently be assumed that the most important branch of vital statistics is that which deals with deaths and rates of mortality. This is not only the most complex branch of the subject, therefore demanding the more careful study, but the influence of health on the human race is so powerful for good or evil that statistics of deaths and rates of mortality acquire their greatest value from their acceptation as trustworthy indications of public health.

The public confidence in the use of death-rates as a test of health or sanitary condition may be fairly attributed to the educational influence of Dr. Farr's statistical work, published during a long series of years in the Registrar-General's Weekly, Quarterly, and Annual Reports. By the death-rate here alluded to is meant the proportion of annual deaths (at all ages and from all causes) to the population at all ages. Attempts have, it is true, been made at various times during the past 15 years to decry or depreciate the value of what has been called the "national system" of death-rates. The opposition to this system may be said to have culminated when the late Dr. Letheby, then President of the Metropolitan Health Officers' Association, made, in one of his Presidential Addresses, his notorious attack on the system of mortality statistics initiated by Dr. Farr, and adopted by the Registrar-General in his reports. Dr. Letheby, with more or less justification, claimed as his supporters in this attack on Dr. Farr's system, Dr. Rumsey, Dr. Ransome, Dr. E. J. Wilson, Dr. Syson, Mr. W. Royston, and Mr. Andrew Watt. In this Presidential Address, Dr. Letheby went so far as to deny that a high death-rate was necessarily an evil, and said that "an increase in the rate of mortality is often a sign of "prosperity, for a high death-rate means a high birth-rate, and a "high birth-rate is the invariable concomitant of prosperity." The main ground of Dr. Letheby's attack was an entire misconception of the relations between birth-rates and death-rates. It is well known that the recorded death-rates in populations having high birth-rates are almost invariably higher than those prevailing in populations in which the birth-rates are low. From this observed fact Dr. Letheby and others assumed that the high death-rates were due to the high birth-rates, by causing an undue proportion of young children in the population; young children being inevitably liable to a high rate of mortality. Dr. Farr had again and again pointed out the fallacy of this assumption, and shown that populations having high birth-rates should, sanitary conditions being equal, have lower death-rates than populations having low birth-rates. An apology is now almost necessary for re-stating that this is due to the following facts. A high birth-rate implies an exceptionally large proportion of young adults in a population, and consequently an unduly small proportion of elderly persons; it therefore implies an age distribution of the population which is exceedingly favourable to the death-rate. A low birth-rate, on the other hand, implies an unduly small proportion of young adults, and necessarily a large proportion of adult persons; the age distribution of such a population is, therefore, very unfavourable to the death-rate. In explication of the fact that high birth-rates are generally found co-existent with high death-rates, it is only necessary to point out that the aggregation of young adults which produces high birth-rates only takes place in urban districts; and that it is the urban aggregation, and not the high birth-rate that results from it, which causes the high death-rate. The fallacy involved in the assumption that high birth-rates cause high death-rates appears still to have lingering attractions for some medical officers of health, anxious to account for excessive mortality in urban districts, but it has never been authoritatively put forward since the discomfiture of Dr. Letheby's attack. The controversy is now matter of history, but those interested in the subject will find Dr. Letheby's paper in the Transactions of the Metropolitan Health Officers Association, and a reply thereto, in a paper read by the Editor of this volume before the Statistical Society, in Vol. 37 of the Journal of that Society.

In the first sub-division of this Part will be found a selection from Dr. Farr's writings bearing upon the significance of death-rates, and upon the various disturbing influences that militate against the value of the crude death-rate as an accurate test either of mortality or of health condition. From what has been written above it may be assumed that rural death-rates, by the national system, are somewhat over-stated, and that urban rates by the same system are under-stated. Consequently, a comparison of rural and urban death-rates, unless the rates be corrected for the differences of age-constitution in the two populations, considerably understates the excess of mortality due to urban aggregation and insanitary condition.

The necessity for such corrections and some of the methods by which they may be made, are dealt with in many of the extracts in the following pages. Before proceeding to correct death-rates for differences of sex and age proportions it is necessary to fix upon some standard with which useful comparison may be made. The Life Table is the only method that gives true rates of mortality, from which all disturbing influences of sex and age proportions have been eliminated. It therefore appears desirable to use life table death-rates as the standard for comparison. The rates of mortality given by Dr. Farr's English Life Table, No. 3, and by his Healthy District Life Table, supplies two such standards; the former if the mean death-rate in England and Wales during the 17 years 1838–54 be the desired standard; and the latter if the higher standard, based on the mortality in 63 selected healthy districts, should recommend itself for adoption. The application of these standard life table death-rates of males and of females at the several age-periods to the proportional numbers living at the same age-periods of each sex will show the number of deaths that would occur in any given population if such life table rates prevailed at the several age-periods. The aggregate number of deaths calculated by this method, divided by the population at all ages, would give what may be called the normal death-rate, in accordance with any standard adopted for the purpose of comparison. The difference between such normal rates and the recorded death-rates show how much the recorded death-rates differ from the standard of comparison, after due allowance has been made for variations of sex and age proportions. This method was adopted in the paper, referred to above, which was read before the Statistical Society in answer to Dr. Letheby's attack upon

Dr. Farr's system of mortality statistics in December 1874.* In the more recent paper, read before the same Society in April 1883*, will be found the outline of another Life Table based upon the mortality experience in England and Wales during the five years 1876–80, when, under the influence of improved sanitary organization, and increased public interest in health matters, due in great measure to the Public Health Acts of 1872 and 1875, a well-marked decline in the national death-rate had fully set in. This affords yet another standard for the calculation of corrected rates. In the Registrar-General's Decennial Supplement to the 45th Annual Report, dealing with the mortality statistics of the ten years 1871–80, yet another standard for comparison is adopted by Dr. Ogle, the successor of Dr. Farr. This standard is based upon the mean death-rates in England and Wales, at 12 groups of ages, during the 10 years 1871–80, these rates being used in this report for the construction of a Life Table, the results of which are there compared with those of Dr. Farr's English Life Table, No. 3, based upon the mortality in the 17 years 1838–54.

The second sub-division of this Part is devoted to those selections dealing specially with rural and urban mortality, and with the excess of urban rates due to aggregation or density of population in towns. Dr. Farr was probably the first vital statistician to discover and precisely to point out the remarkably constant relation between density of population and mortality. Indeed, he found the relation so constant that he styled it a law of mortality, a term, however, open to some objection, since it may easily be proved that it is possible for a high degree of density of population to prevail, without its producing the excess of mortality which the word "law" suggests is the inevitable result of such density. One of the main objections urged by the opponents of the "national system" to the "use of death-rates as a test of sanitary "condition is that they take no cognisance of varying density of "population, of the quality of house accommodation, of occupation, of "social condition, &c., in different populations. As if, forsooth, these "were not the main causes of the varying health-conditions of popu- "lations, of which the death-rate has been so generally accepted as "a trustworthy test. Sanitary authorities of towns in which the "density of population is great, the streets and courts narrow, crowded, "and ill-ventilated, and in which large proportions of the population "follow unhealthy occupations and belong to the poorest classes of society, "are heavily handicapped in their health responsibilities, but the "death-rate of such towns do not on that account afford less accurate "numerical tests of their health condition."†

The effect of density upon the death-rate is, however, beyond dispute, and the prevention of such aggregation and over-crowding in towns as is detrimental to health is at the same time one of the most important and most difficult problems, the solution of which is being diligently sought by the development of sanitary science and organisation. It should always be borne in mind that the death-rates in urban populations at all ages, as has been explained above, unless corrected for differences of age distribution, invariably understate their real mortality, while for the same reasons the death-rates in rural districts, unless corrected, overstate their true mortality.

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* The Value of Death-rates as a Test of Sanitary Condition, Journal of Statistical Society, Vol. xxxvii., p. 437–71; and the Recent Decline in the English Death-rate, and its effect upon the Duration of Life, Journal of the Statistical Society, Vol. xlvi., pp. 189–213. Both these papers were contributed by the Editor of this volume.

† See paper read, by the Editor of this volume, at the Birmingham Congress of the National Association for the Promotion of Social Science, September 1884.

While, however, the uncorrected death-rate at all ages is, for comparative purposes, open to objections, some of which have been above referred to, death-rates at groups of ages are practically free from such objections. The proportions of deaths under five years of age, to persons living at those ages, or, as they are usually and correctly called, the death-rates of children under five years of age, whether in urban or in rural districts, are trustworthy for comparative purposes, as are the death-rates at other groups of ages. Several of the extracts in the following pages deal with this subject, and point out the importance of supplementing the death-rate at all ages by death-rates at groups of ages. No health officer's report should be deemed complete without rates of mortality at groups of ages, namely, the proportions of deaths at such groups of ages to the estimated numbers living at the same groups of ages. Here it may be noticed that there are two false methods by which many health officers seek to show the varying rates of mortality in their districts at different age-periods. The first of these false methods is the calculation of the proportion of deaths at various age-periods to the deaths at all ages. The second is the calculation of the proportion of the deaths at various age-periods to the population at all ages. The results of both these false methods are liable in a still greater degree to all the disturbing influences of variations of age-distribution, which depreciate the value of uncorrected death-rates at all ages for comparative purposes. The results by these two methods depend far more upon the proportions of persons living at the various age-periods than upon the rate of mortality prevailing at such age-periods, and are therefore valueless as tests of true mortality. The number of age-periods which it is desirable to adopt in health reports, with a view to throw light upon the sanitary condition of any population, must mainly depend upon the amount of population to be dealt with. If the population be small, five age-periods would be sufficient, as too great a subdivision of the population would affect the value of the rates for comparative purposes. These age-periods might, therefore, vary from five to the twelve adopted by the Registrar-General for all England, and its several counties, according to the population of the district to be dealt with. As has previously been stated, the Census Report for 1881 gives, in vol. 3, the ages of the enumerated population of each urban and rural sanitary district, as constituted in 1881, in twenty quinquennial periods. As, for all practical purposes, it may be assumed that the proportional age distribution that prevailed at the last Census has since been maintained, no real difficulty stands in the way of estimating the number of persons living at any age-period in any sanitary district in any year, or of calculating the annual rate of mortality at any age-period. This method of analysing a death-rate at all ages is absolutely necessary in order that true and indisputable inferences may be drawn therefrom as to the sanitary condition of the population.

As tests of sanitary condition the death-rates of infants under one year, and of children under five years of age, are more important than the rates at any other groups of ages. The rate of mortality of infants under one year of age may be measured either by the proportion of recorded deaths at this age to the estimated number of infants living at the same age, or by the proportion of deaths under one year to the registered births. Investigation has shown, beyond doubt, that the ages of young children are very incorrectly returned at the Census enumeration, owing to the general and indiscriminate use of two methods for describing age. At the Census enumerations the numbers of infants under one year of age are certainly under-stated, for there is good ground for believing that many infants in their first year of age are returned as aged one year; that a smaller number in their second year of age are returned as aged two years, and so on. Some have sought to explain the deficiency of infants returned at the Census to omissions in the enumeration; but Dr. Farr, on grounds which are fully described in the extracts on pp. 206–9, attributed the deficiency to confusion between the current year of age and the completed years of life rather than to actual omissions. The probability of the truth of this assumption is supported by the fact that, so far as can be ascertained by investigation, the deficiency under one year is practically balanced by the excess of the numbers enumerated at the succeeding ages, two, three, and four years, inasmuch as there appear to be no good grounds for supposing that the total number of children enumerated under five years of age is deficient. On account of this deficiency in the Census numbers of infants under one year of age, the mortality of those infants is measured in a more trustworthy manner by the proportion of deaths under one year to registered births than by the method of estimating the numbers living at this age from the enumerated numbers. The correct application of this method is to divide the deaths under one year of age in a given year by the mean number of births registered in that and the preceding year. As, however, the numbers of births in a population do not vary very considerably from year to year, the simpler and very usually adopted method is to use the proportion of deaths under one year to registered births in the same year as a measure of infant mortality; and for all practical purposes this simple method gives results which are sufficiently trustworthy.

The death-rate of children under five years of age should invariably be calculated upon the estimated number of children living at these ages. This death-rate of children affords an invaluable test of the sanitary condition of a population, and is for this purpose more important than the death-rate at any subsequent age-period. As has already been pointed out, all attempts to judge of the mortality of children by the proportion of deaths of children to total deaths, or even by the proportion of deaths of children to the population at all ages, can only tend to fallacious inferences.

In all cases in which the population dealt with is sufficiently large to yield trustworthy results, the death-rates of males and of females should be calculated separately, not only at all ages (which rates should be given in all reports), but at five or more groups of ages. The relative mortality of the two sexes often throws light upon the causes of fluctuations in rates of mortality, and whenever the relative mortality of the two sexes shows abnormal proportions it is desirable further to analyse the mortality by calculating rates for males and for females at various age-periods. Several of the extracts in the third section of this Part (*see* pp. 179–88) afford valuable information bearing upon the mortality of males and of females at different ages.

The fifth and sixth sections of this Part deals with causes of death, as returned for the purposes of the national death register, by medical practitioners and by coroners. Causes of death in the death register are necessarily little more than the more or less trustworthy guesses of a large body of more or less skilled observers, except in the small proportion of cases in which these guesses are corroborated or modified by *post mortem* examinations. Statistics of causes of death should therefore be compiled with caution, and without any attempt at over elaboration of detail. Still greater caution should be used in drawing inferences and deductions from a comparison of the results for a series of years. Changes of nomenclature and of classification add materially to the difficulties in the way of useful comparison of such statistics for different periods of years. There is no reason to doubt that the quality of the material placed at the disposal of the Registrar General year by year by medical practitioners and coroners for national statistical purposes is steadily improving, and if due caution be observed in the use of the statistics compiled from this material they may be made to render valuable service in facilitating the solution of the many important problems bearing upon the fluctuations of mortality that still await solution. One of the most necessary qualifications for successful statistical work is a correct and strictly impartial estimation of the value of the materials available as the basis of calculation. The rejection of all materials that are not beyond all suspicion would fatally restrict the field of statistical research, while, on the other hand, the progress of statistical service is hindered rather than advanced by the too confident use of materials inherently and fatally defective. Much valuable work may be done with defective materials if their defects be kept steadily in view, both in the calculation of results and in making deductions therefrom. The materials with which Dr. Farr had to work nearly fifty years ago were defective enough to have discouraged a less sanguine and indefatigable statistician; but while he was able from time to time to improve the quality of his materials, few will venture to deny the value of the results he derived from such defective materials, even in the early years of his service in the Statistical Department of the General Register Office, which dated from 1838. In vital statistics all students must learn to use imperfect materials and yet to guard, as far as possible, against fallacious results. It is at all times important not to conceal the imperfections of materials dealt with, but rather to draw attention to them in such manner as to promote the acceleration of their removal.

The extracts in this section range over a wide field, and necessarily include a considerable number that, after the lapse of years, are more valuable for their suggestiveness than for the actual facts they set forth. The statistics of mortality from the several zymotic and epidemic diseases are valuable, however, for reference purposes. The selections from Dr. Farr's Cholera Reports form important contributions to the history of epidemic disease in England, and could not have been omitted from this volume, although they are not all strictly statistical.

The concluding pages of this Part are devoted to selections bearing upon class and occupational mortality, meteorology and mortality, mortality in institutions, and the influence of marriage on mortality.

(EDITOR.)

1. DEATH-RATES, THEIR CONSTITUTION, AND THEIR SIGNIFICANCE AS TESTS OF HEALTH AND HEALTH PROGRESS.

Life and Death in England.—How the people of England live is one of the most important questions that can be considered; and how—of what causes, and at what ages—they die is scarcely of less account; for it is the complement of the primary question teaching men how to live a longer, healthier, and happier life.

The vital units to be specially dealt with are persons living and persons dying in the ten years 1861–70, only distinguishing them into units representing males and females of different ages and occupations, losing life year after year by various causes, in about 627 districts extending from the borders of Scotland to the English Channel and from the Irish Sea to the German Ocean. The deaths in the several classes have to be compared with the population enumerated at three decennial censuses, in corresponding groups.

The long series of Tables offers a retrospect extending over the ten years, and is in continuation of a series embracing the previous ten years, with which it is compared.

The primary object is to determine what the death-toll* is at the several ages, and what the causes of the loss of life are, under different circumstances. The importance of this determination will become apparent by enumerating some of the relations the mortality bears to other orders of facts. There is a relation betwixt death and sickness; and to every death from every cause there is an average number of attacks of sickness, and a specific number of persons incapacitated for work. Death is the extinction of pain. There is a relation betwixt death, health, and energy of body and mind. There is a relation betwixt death, birth, and marriage. There is a relation betwixt death and national primacy: numbers turn the tide in the struggle of populations, and the most mortal die out. There is a relation betwixt the forms of death and moral excellence or infamy; men destroy themselves directly or their fellows under the most varied mental conditions; they may die by indulgence in excesses, by idleness, or by improvidence. Death is met especially in primeval races not only in conflicts with each other, but in conflicts with other races of animals—directly with great carnivorous quadrupeds or creeping poisonous serpents, and indirectly with four-footed animals, winged birds, and multitudinous insects, blighting or consuming food. Death is also wrought by low but organised parasites in the body. It is still more frequently the result of elementary molecules (zymads) which, though of no recognised form, evidently thrive, propagate, die in the bodies of men, disintegrating or devitalizing their tissues.

There is finally a relation betwixt death and the mean lifetime of man; if a life passing through a given time is represented by a line, death is the point of termination as birth is the point of origin. And a generation of men born together is represented by an indefinite number of such lines of life. The natural lifetime of man is a century; that age under ordinary conditions is, as the Etruscans remarked, attained by at least *one* in every considerable generation, and they made it their sæculum; as in that time are passed through all the phases of childhood, youth, manhood, maturity, and monumental age.† The mean lifetime in the healthiest districts of England—and in the healthiest ranks—is 49 years; and we have no evidence that under the most favourable conditions it exceeds 50 years. Actually individual life varies in duration from a second to a century. And the relation to be shown here is between the dying by different causes and the living at every stage of the march of a generation through time. The mean lifetime of a generation may be the same, and yet the several lifetimes of the individuals of which it is composed may vary infinitely; under the actual laws of mortality, great numbers die in infancy, few in adolescence, more in manhood, and, after infancy, the greatest number by the English Table at the age of *seventy-three*, the numbers born having fallen in the proportion of ten born alive to two then surviving. It is evident that an entire revolution in the life of the human race would follow if every person born lived the average lifetime of fifty years, or if half the deaths happened in infancy and the other half at the end of 100 years or at any very advanced age. What we observe actually is that in certain conditions the mean lifetime sinks to half its standard length; and that

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* This compound of Saxon words appears to be preferable to "death-rate" or "death-tax;" it is equivalent to "rate of mortality."

† See Census Report of 1851, Vol. I., p. xv.

this is the result of the high mortality in the first five years, of the reduced mortality in adolescence, and of the increasing mortality in manhood up to the ultimate term of life; few old people surviving and few dying therefore after four score years, especially in such unfavourable conditions as exist in Liverpool.

Under the existing state of things, of the constituent lives of every generation a certain number dies at every age of causes to be investigated under two heads:—direct and organical, including diseases and injuries; and remote and indirect, namely, the causes of those diseases and injuries. Before entering upon the investigation two preliminary questions have to be discussed. (Supplement to 35th Annual Report, pp. 3–4.)

Decennial Mortality Reports.—The determination of the law of mortality requires an extensive area of observation, both in space and time, to eliminate accidental perturbations. And the causes affecting the life of children, of adults, and of old people,—of males and females,—of persons in different occupations, are so various that we can only hope to unravel their influence by a general analysis of the phenomena in different places through a series of years.

As helps towards this analysis several series of Tables have appeared in the Appendices to the Annual Reports.

The division of the country for registration purposes is based upon the Poor Law Unions which have towns in their centre, and our calculations have gone generally to show the mortality in the districts of England and Wales. The Ninth Report showed the rates of mortality of males and females at each of seventeen periods of life, and at all ages, in the eleven Divisions, in 40 counties of England; the three ridings of Yorkshire; in North and South Wales; and in 324 groups of districts. The calculations were founded upon the living at ages enumerated at the Census of 1841, and upon the deaths at the same ages in the seven years 1838–44.

Again, the Sixteenth Report contains Tables of the density of the population, and of the annual mortality, during the ten years 1841–1851. The rates of mortality are deduced from the registered deaths in the ten years 1841–50, and from the populations enumerated at the Censuses of 1841 and 1851. The facts are printed in detail in the Thirteenth Report. The corresponding facts for the years 1851–60 will be found in the Twenty-third Report.

The present volume shows the annual rate of mortality per 1000 in all the districts, counties, and divisions of England during each of the decenniads 1841–50 and 1851–60. It also exhibits in an elaborate series of Tables the deaths and the rate of mortality among males and females of the age under 5 years, 5–10, 10–15, 15–20, 20–25, 25–35, 35–45, 45–55, 55–65, 65–75, 75–85, 85 and upwards; as well as the causes of death at all ages.

It is shown in the Introduction to the English Life Table that the mean of the populations at the beginning and end of a period is somewhat above the mean numbers living through the period, when the population of a district increases in geometrical progression, and that consequently when the deaths of such a district are divided by the living thus determined the quotient is rather too small; so the rate of mortality in the present series of Tables is slightly understated in the districts increasing in a geometrical ratio. The labour of obtaining the years of life by integration would have been beyond the compass of the force at our disposal; and such errors as have been mentioned are of little practical importance in dealing with the limited numbers of even large districts, subject to various local disturbances from migration and other causes, and only yielding results approximating more or less to settled averages. Some inaccuracies in the statement of the ages also interfere with the results, but to a less extent than might at first be supposed; and they will not interfere essentially with the comparisons to be drawn between the rates of mortality in the various town and country districts of the kingdom. (Supplement to 25th Annual Report.)

Local Death-rates.—The death-rate for England (in 1864), as has been stated, was 2·386 per cent.; but while this is shown by the Tables to be the rate for the whole kingdom, it may not be precisely that which ruled in any assignable part of it. Density of population, purity and impurity of earth, water, and air, wealth and poverty, the geological structure of a district,—these and other elements of health and sickness, in their manifold combinations, depressed the mortality in one place, raised it in another. The following rates in different *counties* may be selected, though these, as must be obvious, are derived from populations living each in circumstances almost as diversified as those of the country in its whole extent, and therefore do not furnish the extreme examples that distinguish the busy town from the hamlet. But the differences are nevertheless very considerable in some instances: Westmorland supplied, amongst all the English counties, the best example of healthy condition, the rate of mortality in it having been 1·820; for in the Table, it should be mentioned, the Welsh counties are not distinguished, but are formed in two groups, North and South Wales. The next lowest rate was 1·902, which prevailed in the extra-metropolitan portion of Surrey.—(27th Annual Report, pp. xxx–i.)

History of Death-rates.—The history of death-rates in the various towns and districts of England has been recorded in the annual reports for a period extending over 36 years, and from time to time it has been pointed out that the variations from such disturbing causes as sex and age are confined within comparatively narrow limits—especially the elements of sex, and do not affect the general mortality of *persons at all ages* to such an extent as to interfere with its value as a sure indicator of the prevalence of conditions prejudicial to life; and recent investigations have confirmed this, and shown that the ratio of deaths to population *at all ages* may be taken, as a fair indication of the sanitary condition of the population. Wherever the general mortality is high, agencies are to be found at work unfavorable to health, and the town or district requires the attention of the medical officer of health, but statists have long considered the general death-rate as only a preliminary test, to be followed up by further research relating to the mortality of children and adults at different ages, and by different diseases.—(36th Annual Report, pp. xiii–xiv.)

The Law of Mortality and Death-rates at all Ages.—In a population rapidly increasing, disturbed by immigration or emigration, and liable to fluctuations in the rate of mortality, the law of mortality, and consequently the duration of life, or the expectation of life at different ages, can only be deduced with any approach to accuracy from two series of facts; (1), the population existing at annual, quinquennial, or decennial periods of life, and (2), the deaths at the corresponding ages. —(4th Annual Report, p. 17.)

The mortality of the various populations of the world is generally stated as one in so many, or as so many per cent. or per 1,000 per annum. The latter result is the ratio of the deaths at all ages to the living at all ages.

Now it is evident that the proportion of deaths to a given number living varies to a great extent with the ages of the living; in the first five years of age the mortality is at the rate of 7·243 per cent. for boys, at the age of 10–15 it is 0·488, at 55–65 it is 3·085, at 75–85 it is 14·667 per cent. The mortality of the two sexes also varies, so that, independently of other causes of variation, the mortality of different populations will differ according as they consist of numbers in various proportions at the ages at which the mortality is high or low.

When the population is sustained by an uniform annual number of births, the number living at each age is regulated solely by the law of mortality, reducing the numbers year by year, until each annual generation is extinguished.

The laws of mortality may vary infinitely, it is conceivable, so as to yield the same mean lifetime, and the same rate of mortality. Thus by the English Life Table 1,000,000 children born alive die off so as to leave survivors in every year of age up to the 109th, when the last of the generation dies off; the mean lifetime is 40·858, and 1 in 40·858, or 2·447 per cent. of the population so constituted die annually. If every one of the 1,000,000 children lived 40·858 years, and died at the end of the term, the mean lifetime would be 40·858 years, and it will be evident that the mortality would be at the rate of 1 in 40·858, or 2·447 per cent. per annum. Yet how different are all the circumstances? How different are the conditions of existence? How different is the law of mortality?

The rate of mortality in England was not 2·447, but 2·245 per cent. per annum, during the period when the facts were collected upon which the Table is based. Thus 1 in 44·54 died; while the mean lifetime was 40·858.

Assuming the prevalence of the same law of mortality, the rate calculated on the mean population, and the deaths at all ages, is lower in a rapidly increasing population than it is in a stationary population, because the mortality at all ages from about 4 to 54 is lower than the mean mortality of the whole normal population; and while a regular increase of population has the effect of increasing the proportion of children under 4 years of age, who die off quickly, it has also the effect of still further increasing the proportion of the living at the ages 4 to 54, and of diminishing the proportions of the old people, whose rate of mortality is high.

In the healthy districts of England the normal mortality is 2·059 for males, and 2·022 for females by the Life Table; while it is 1·772 for males and 1·733 for females, as deduced from the ratio of deaths at all ages to the living at all ages. This is the rate of 17 deaths per 1,000 of the population, which is so often and so fairly quoted, as a standard of comparison applicable to increasing populations.

There is another disturbance of the proportions living at ages more or less mortal, by immigration and by emigration. Thus the general effect of immigration into towns is to reduce their rates of mortality, by increasing the proportion of the living at ages of less than the mean mortality of the people of the place. The bulk of the emigrants to towns from the country are probably in good health, but a certain number of sick resort to the town hospitals; upon the other hand, of the emigrants, some are comsumptive, seeking health in the country and abroad, or returning home to die; but the emigrants are less numerous in the aggregate than immigrants, and so far have less effect on the mortality.—(Supplement to 25th Annual Report, p. xxv.)

Significance of Death-rates.—The rates of mortality published in the Weekly Returns having been misunderstood in some quarters, it may be useful once more to explain what the general death-rates of a population imply.

The rate of mortality differs in a generation as it passes through different ages. It is in infancy very high, in boyhood very low, through manhood it increases, and as men descend into the vale of years is rapidly accelerated by the wearing away of vital force. The mean rate in England has been for some years 22 annual deaths to 1,000 living of all ages. The rate for males is 183 in 1,000 *in the first year of life;* only 18 in the fifth, 6 in the tenth, 5 in the sixteenth, 8 in the twenty-first year of life; 13 in the forty-first year, 19 in the fifty-first year; 33 in the sixty-first, 70 in the seventy-first, 153 in the eighty-first year, 307 in the ninety-first year of life. Infants and boys under 4 years of age experince a *mortality above the average rate*, and so *do men of the age of* 54 *and upwards;* while boys and men of 5 years of age and below 54, *die at less than the average rate.* In the country and in cities, under the same sanitary conditions this universal law prevails; infants and old people die off more rapidly; boys and girls as well as men and women in the prime of life, less rapidly than the average rates imply.

The general rates of mortality, as they are usually given, may differ therefore in two populations, merely because the one contains more of the population under 5 and above 55 than the other. When the births exceed the deaths, the effect is to increase the number of children under 5 years of age; and it is conceivable that a novice in these inquiries may rush to the conclusion, that the effect of an excess of births is to increase the general rate of mortality; whereas it is found by observation to have the contrary effect. The mortality of a population with an excess of births over deaths is lower than the mortality of a stationary population where the births and deaths are equal. And the reason on reflection is obvious. The births take place steadily year by year in a city; and if they are in excess of the deaths, they throw into it not only additional children under 5 years of age, but also children and adults above that age; and hence there is *less than the due proportion of old people* in the whole population; hence also the mortality appears below what it would be in the same population, under the same sanitary conditions, if the births and deaths were equal. In all England the births are to the deaths as 3 to 2; and this has the effect of reducing the rate of mortality to 22 in 1,000. By the English Life Table, in which the people of different ages are distributed as they would be if the births and deaths were constantly equal, the correct rate is found to be 24 in 1,000. In Liverpool when the rate of mortality was 34, the corrected rate was 39; in the same year the rate for London was 24, the corrected rate 27.

Immigration has the effect of reducing the general rate of mortality; as it swells the excess of persons at ages of low mortality.

The rates of mortality as they are generally cited, when the population is accurately determined, are for all the cities in the weekly tables below the true rates; and when the differences in the rate in two cities are great, it is certain that this cannot be explained by any differences of the ages of the two populations.

A sustained rate of mortality above 17 in 1,000 always implies unfavourable sanitary conditions: the London rate of 24 is moderately good; any rate above 30 implies sanitary conditions highly destructive to human life.

When any city experiences a higher rate than the average, it should always be a matter of serious inquiry and concern to its citizens.

As to the significance of weekly rates of mortality the following propositions may be laid down:

1. These rates calculated in the usual way express facts; and higher rates than usual in a town show that from some cause or other the deaths are frequent, and *vice versâ.*
2. These rates are below the true rates in all the towns of the United Kingdom, in consequence of the great excess of births over deaths; which has the effect of increasing the proportion of the population living at ages when the mortality is below the average.
3. The excess of immigration over emigration operates in the same direction.
4. An excess of females in a town reduces its general rate of mortality.
5. There is an influx of patients into Hospitals in towns, but this is probably more than counterbalanced by the retirement of consumptive immigrants into the counties of their birth to die.
6. A sudden and large addition of births in a single year would have the effect of slightly raising the general mortality in that year; but the supposition of such an addition in English cities is baseless: the law here is a constant excess of births over deaths, which keeps up a constant excess of young and middle-aged lives.
7. A Life Table constructed in the usual way shows the true average rate of mortality, and the mean duration of life; the two facts being indissolubly connected. The correct mortality of our worst cities was 1 in 25, in our healthiest districts it was 1 in 50; the duration of life was 25 and 50 years under the same circumstances.
8. A comparison of the true rates with the rates calculated in the usual way will show that the latter rates exhibit the relative fatality of different cities with sufficient accuracy for all ordinary purposes. They have no fallacious meaning.
9. Instead of reducing the death-rate of towns, on the ground that their birth-rate is high, the reverse should be done to get the corrected death-rate.
10. The true death-rate in all England lies between the death-rate and the birth-rate calculated in the usual way; a sixth of the difference added to the death-rate is nearly its proper correction.
11. The causes of the differences of the rates of mortality are various, and in every case demand careful investigation on the spot by the town authorities.—(Weekly Return, No. 12, 1870.)

The significance of the death-rate has been frequently explained, but as it is not yet apparently understood by all who employ it, a few words on the subject may be of use.

The parish clerks of London, at the instance probably of Elizabeth's government, began the weekly bills of christenings and burials in 1593, and the series was continued uninterruptedly from the year 1603. At first the plague was distinguished, and then other diseases and casualties. The average deaths being known the mere rise or fall of the weekly numbers gave a good indication of the varying mortality of the people, without any reference whatever to the population.

The Registrar General in the year 1840 took up the traditional London Weekly Bill, extended it, and has since made it complete by including with London 20 more great towns of the United Kingdom, the whole inhabited by nearly eight million people. By persevering applications the returns have at length been procured weekly from the principal cities of Europe, India, and America. As the cities and towns vary in population, to make comparison possible it was necessary to show not only the number of deaths, but the proportion the deaths bore to a fixed number of the living, for convenience made 1,000; and, further, as in the calculation of simple interest, to show not what the rate is per week, but per annum. This is the death-rate as it appears in the present publication.

It is evident in the first place that if the weekly deaths are correctly recorded, their fluctuations in a town will show its varying states of mortality; and if the populations of towns, which seldom fluctuate much, can be calculated approximately as the rates of increase vary little, the death-rate will show as a matter of fact how much the mortality of a town varies from the mortality of other towns in any particular week. The Census is only taken every ten years; but the local authorities have it always in their power to determine whether the town is increasing or decreasing at the usual rate, so that no error of any magnitude need be committed in the estimate of the population, especially where the population is large. Thus in London before the Census of 1871 was taken, the population was estimated by the Registrar General at 3,247,631, and it was found by enumeration at the Census to be actually 3,254,260.

The death-rate is a fact; anything beyond this is an inference. In deciding whether the mortality is much greater than it should be, and whether the average mortality of one town is greater than the mortality of another town differing from it but little, all the resources of statistical science have to be brought into requisition. The distribution of the population according to age and sex may be different, and this has to be taken into account. The deaths of males and females have to be compared with the corresponding mean population living at different periods of life; and from the death-rates varying in each period, the variations of the law of mortality with age can be determined. This being done, a Life Table for the population of the place can be constructed, showing the mean lifetime from which the normal mortality of the people can be determined. The same table shows the population living at each year of age to a given number born, and the mean age of the living.

Population, Deaths, and Mortality per 1,000 at Twelve different Periods of Age, in London and in England, 1861–70.

Ages.	London. Mean Population, 1861–1871.		London. Annual Deaths in 10 Years 1861–70.		London. Annual Mortality per 1,000 living during the Years 1861–70.		England. Annual Mortality per 1,000 living during the Years 1861–70.	
	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.
All Ages -	1,415,466	1,613,659	37,581	36,053	26·55	22·34	23·61	21·28
0—	195,963	196,500	17,032	14,997	86·91	76·32	73·16	63·43
5—	161,151	163,821	1,509	1,449	9·37	8·85	8·15	7·76
10—	141,969	145,035	603	590	4·24	4·07	4·46	4·48
15—	131,585	151,530	766	773	5·82	5·10	6·16	6·62
20—	133,185	166,302	1,096	1,034	8·23	6·22	8·45	7·96
25—	233,714	280,674	2,538	2,470	10·86	8·80	9·90	9·69
35—	178,860	206,826	3,066	2,656	17·14	12·84	13·46	12·03
45—	124,417	144,530	3,195	2,676	25·68	18·52	19·17	15·56
55—	71,145	90,739	3,120	3,035	43·85	33·45	33·00	27·77
65—	33,097	49,021	2,741	3,296	82·83	67·23	66·90	58·80
75—	9,325	16,338	1,576	2,394	169·02	146·54	146·58	134·43
85 & upds.	1,055	2,343	339	683	321·42	291·42	313·57	283·64

The *preceding* table shows the mean mortality of the population of London at 12 ages, in the ten years 1861–70, compared with the rate in England and Wales.

Disturbing elements have to be considered: thus a certain number of patients sent from the country to London for medical advice die either in private houses, workhouses, or hospitals, and a certain number of unmarried young consumptive people return home to the country to die; these two currents probably neutralize each other, and it would be unsafe to attempt a correction either way on this account.

The chief disturbing element in the country is the excess of births over deaths, which has the effect of increasing the mass of young people living at ages when the mortality is low; and in addition to excess of births in towns, the immigrants at early ages have the same effect. The death-rate true in itself is below what the death-rate would be in the same population normally constituted as regards age.

But the disturbances from these and from all other intrinsic causes acting on the death-rate, so far as is yet known, are not great; thus in all England the crude annual death-rate for 35 years is 22·4 per 1,000, while the corrected rate by the Life Table is 24·5. The crude death-rate in towns understates the mortality. But as far as we know the underrating does not exceed 3 or 4 per 1,000; and this is not considerable when we find the average death-rates of 30 years (1841–70) varying from 15 in Glendale (Northumberland), to 24 in London, 27 in Birmingham district, and 36 in Liverpool. Add 2 to Glendale, 3 to London, 3 to Birmingham, and 3 to Liverpool, and the mortality, corrected approximatively so as to make it the mortality of a population normally constituted as to age and sex, becomes 17, 27, 30, and 39.

It will be observed that the correction alters the relative less than the absolute mortality, and that for immediate practical purposes the relative crude mortality is a satisfactory guide.

In deciding on the exact relative mortality of these towns the observations should extend over about ten years, so as to get an average not much disturbed by epidemics. The rates of mortality and the causes of death at convenient intervals of age should also be determined, and be made the basis of the Life Tables.

And if it is desirable to investigate the causes of any differences in the mortality, the density of population, the water-supply, the drainage, and the occupations will naturally be taken into account.

A volume is now in preparation showing for the males and females of 622 districts of England and Wales the rates of mortality, at the same ages as are shown for London.

It may thus be summarily stated that:

1. The crude rate of mortality, which is the proportion the deaths bear to the population, is a definite fact, and shows the variations in the mortality of London or of any other town, from week to week, year to year.
2. The true rate of mortality and the mean lifetime of a people living in a town or a country can only be determined by means of a Life Table, such as that which has been constructed for England and Wales.
3. As the population of England is increasing by the excess of births over deaths (3 births to 2 deaths), and the increase is still greater in towns by the excess of their immigration over emigration, the number of people is in excess at ages when the mortality is low, so the death-rate is below what it would be if the numbers of population at different periods of life were in the same proportion as they would be if the births equalled the deaths in number.

4. The absolute mortality, as derived from a Life Table properly constructed, is higher in England, where the population is increasing, than the crude death rate, to which 2, 3, or 4 per 1,000 should be added in the several districts to get the absolute mortality.
5. The death-rate, which is a safe guide in judging of the varying mortality of the same place, is also a safe guide in judging of the *relative mortality* of towns. Wherever the mortality exceeds 17 in 1,000 there is much sanitary work to be done.

(Weekly Return, No. 43, 1874.)

Relation between Birth-rates and Death-rates.—The natural term of human life appears to be *a hundred years*; and out of the annual generations successively born in England and Wales a few solitary individuals attain that limiting age, the rest dropping off year by year as age advances; so that the mean lifetime is at present only 41 years.

If every person born lived 100 years, and the annual births were equal year after year, the mortality would be at the annual rate of 1 in 100, or of 10 in 1,000; and if every person lived 41 years, it is obvious that, the births being equal, the mortality would be at the rate of 1 death annually in 41 living, or rather more than 24 deaths in 1,000 living.

If the births constantly exceed the deaths in number, upon this hypothesis, the mortality remaining the same, although the mean duration of life remains 41 years, the mean mortality will be below 1 in 41—below 24 in 1,000. And the same proportion is true, though the lifetimes of individuals vary from 0 to 100 years: thus though the mean lifetime is 41, the births exceeding the deaths and increasing, the mortality in England and Wales is 1 in 45, or rather more than 22 annual deaths in 1,000 living.

The rate of mortality among children and among men and women of different ages, varies; so that the mortality (73 in 1,000) of children under 5 years of age is at nearly three times the average rate of the whole population, while among boys and girls of the age (10–15), the mortality is at the rate of 5 in 1,000, or only one-fourth or one-fifth of the general rate; and the mortality remains below the average until the age of 55, but becomes after that age much above the average. The population in which the annual number of births increases, contains an undue proportion of children, of youths, and of persons of middle age; and the result is, that the rate of mortality is *less* than it would be if the population was in the proportions that would arise from an equal number of annual births.

The deaths to 1,000 living in different districts will, therefore, vary to some extent, according as the population is constituted of more or less of the children or adults at the ages that experience a relatively high or a low rate of mortality.

But allowing for the circumstance that the annual deaths to 1,000 living in England should be less than they would be if the births did not increase, the mortality of different districts varies with the different degrees of health in the population. (16th Annual Report, p. xiv.)

Arranging the districts of England in the order of their mortality, it is found that the annual mortality in the various groups ranges from the rate of 15 to 39 per 1,000; the birth-rate from 29 to 40 per 1000; and it is seen that, in the next Table, as the death-rate increases, the birth-rate increases, so that in all the districts with a mortality under 25 per 1,000 the natural increase of population is very constant. The mortality increases with the density of the population; and thus every additional death is met by an additional birth.

DENSITY of POPULATION, DEATH-RATE, BIRTH-RATE, EXCESS of BIRTHS over DEATHS, and INCREASE of POPULATION per 1,000 PERSONS LIVING, in Seven Groups of Districts arranged in the Order of Mortality.

Number of *Districts.*	Range of Mortality: Rates per 1,000 Living.	Persons to a Square Mile.	1861–70. To 1,000 PERSONS LIVING. Average Annual Deaths.	Average Annual Births.	Average Annual Excess of Births over Deaths.	Average Annual Increase of Population in middle of period.
ENGLAND & WALES 619	15–39	367	22·4	35·1	12·6	12·4
54	15–17	171	16·7*	30·1*	13·4	15·8
349	18–20	195	19·2	32·2	13·0	8·8
142	21–23	447	22·0	35·6	13·6	16·2
56	24–26	2,185	25·1	38·1	13·0	15·3
16	27–30	6,871	27·8	39·1	11·3	8·9
1	32	12,172	32·5	37·3	4·8	3·2
1	39	65,834	38·6	37·6	−1·0	−12·3

* These rates are obtained by dividing the aggregate deaths and births in the districts having an average annual mortality ranging from 15 to 17 per 1,000, by the aggregate population of thos districts $\left(\frac{D}{P}\right)$. Each group is treated in the same manner.

In the first stage of the scale, that is in the 54 healthy districts, the death-rate is 16·7, the birth-rate 30·1; in the second stage the death-rate is 19·2, the birth-rate 32·2; in the third stage the death-rate is 22·0, the birth-rate 35·6; in the fourth stage the death-rate is 25·1, the birth-rate is 38·1. The natural increase of population in each of these four stages ranges from 13·0 to 13·6, or is severally 13·4, 13·0, 13·6, 13·0. When the mortality reaches the *fifth stage* the death-rate is 27·8, the birth-rate 39·1; and after that point, while the death-rate increases to 32·5 in Manchester and 38·6 in Liverpool, the birth-rate recedes to 37·3 and 37·6, and there is a decrease of indigenous population, which if it should go on might end in a decrease of population in geometrical progression.

Should the deaths in the districts where the mortality is 22·0 per 1000 be reduced by sanitary measures to the same level as in the districts where the mortality is 19·2, the births might be reduced in the same or a greater degree, namely, from 35·6 to 32·2; and should the death-rate be brought down to 16·7, the birth-rate might be reduced, as in the healthiest districts, to 30·1; the deaths falling 5·3, the births actually fell 5·5 per 1,000, as shown in the table. The fall of the birth rate is observed in the existing circumstances of this country; it maintains an uniform increase in districts under different laws of mortality, but it is not a necessary consequence of a reduced death-rate, and if, in the opinion of the parties concerned, their prospects are good, they marry and procreate children at the same rate as before; in that case the population increases faster; whereas in a depressed condition the births fall off until the population becomes stationary, or declines.

Thus there is no inevitable connection between the gradual reduction of the mortality of the whole kingdom to the rate of 17 per 1,000 and the more rapid increase of population; because the birth-rate may of itself fall to the level of that now prevailing in the healthiest districts and leave the increase of population as it was. Statesmen are not then, by alarming cries of increase of population in a faster geometrical progression, to be deterred from the noblest work in which they can engage; for it is certain that population as it improves in England will not increase faster than the requirements of industry in all its forms at home or the new openings of colonial enterprise abroad. (Supplement to 35th Annual Report, pp. xii–xiv.)

True Death-rates and the Probability of Dying.—If on an average of years out of 1,000 children born simultaneously, 149 die in the twelve months following the date of birth, the probability of dying is expressed by the fraction 0·149: that is the ***death-chance*** of a new-born infant under the given law of mortality. As 851 of them survive, 0·851 is the fraction to express the probability of living; it is the ***life-chance.*** Now ·851+·149=1=life-chance+death-chance.

This probability is often expressed thus: the chances are 851 to 149 that a new-born child will live a year. The value of £1 payable if the child should live a year is 17*s.* (£·851); the value of £1 payable on the death of the child is 3*s.* (£·149); the chances in favour of life being greater than the chances in favour of death.

The lives may be looked at with a view to determine the persistency of the life-force; which is such in the present case, that 851 live out of 1,000 during one revolution of the earth; at the age of 20 it is such that 992 out of 1,000 men live a year. The proportions vary under varying conditions, but these variations do not accurately denote the vital force, which is only correctly measured on the ***scale of mortality.***

The mortality is determined by the ratio which the deaths bear to the years of life. "The men living, and the time expressed in years, "multiplied into each other, produce the years of life with which the "deaths are compared. A year of life is the lifetime unit."* It is represented by one person living through a year; or by two persons living through half a year. A regiment of an average strength of 1,000 men during three years represents 3,000 years of life; and if the deaths in the three years are 60, the rate of mortality is thus expressed:

$m = \frac{60}{3000} = \cdot 02$; or the mortality is said to be at the rate of 2 per cent. per annum. The 100 years of life are a fixed quantity; and as it is found that under various circumstances, and at different ages, the rate varies from 1 to 2, 3, 4, 5 up to 50, this scale serves to measure the life-force, or the complementary death-force, in the same way as the centigrade scale of the thermometer serves to measure heat.

A thermometer is not a convenient measure of heat unless at all temperatures it contains the same quantity of mercury, and unless each degree measures equal expansions of the mercury. If the mercury escapes, a correction is required to give the expansion of equal quantities of mercury at every degree of temperature. In observing with the barometer, the measure is adjusted at both ends, so as to give the exact height of the column above the mercury in its well.

* See Introduction to English Life Table, pp. xiv to xx; extracts from which will be found on pp. 485–8.

So, to determine the rate of mortality on a strength of 1,000 men joined by no recruits, it is necessary to take their mean strength during the whole period of observation; for if one man dies at the end of a week, 999 only remain afterwards exposed to risk, and if the numbers are reduced at variable intervals to 990, to 985, to 911, to 700, to 600, and so on, it is evident that the years of life in the same time will be less than the years of life in a regiment which obtains a recruit for every casualty. All that is required in such cases is to take the observations so as to give the true years of life; and the ratio which these years of life bear to the deaths is the exact measure of the mortality. It is evident, on the other hand, that such a measure is not supplied by a comparison of the deaths in a year, for example, to the living at the beginning of that year. The results by this method are only strictly comparable when the deaths are in the same proportion and occur in the same periods of the year.

By the English Life Table 1,000 infants followed through their first year of age yield nearly 903 years of life; and the mortality is at the rate of $\frac{149}{903}$, or, more correctly, $\frac{149{,}493}{902{,}781} = \cdot 16{,}559$. It is $16 \cdot 559$ per cent. per annum. The probability of dying is $\cdot 149{,}493$; and upon the erroneous assumption that this is the rate of mortality it would be $14 \cdot 949$ per cent. per annum; less by $1 \cdot 610$ than the true rate, with which it should never be confounded.

At other ages than the first year the rate of mortality serves to give the probability of living a year, and thus supplies the fundamental elements of a Life Table. The difference between the rate of mortality (m), and the probability of dying (p), becomes less in proportion as the two fractions diminish; for upon the hypothesis that the deaths in a year occur at equal intervals in the year, the relation of p and m is thus expressed:

$$p = \frac{1 - \frac{1}{2} m}{1 + \frac{1}{2} m} = \frac{2 - m.}{2 + m.}$$

(Supplement to 25th Annual Report, pp. iv–v.)

Method for comparing Local with Standard Death-rates.—We have no means of ascertaining what the rate of mortality would be among men living in the most favourable sanitary conditions; otherwise observations for a term of years on a considerable number of such persons would supply a standard rate with which other rates could be compared.

In the absence of such a standard, the districts of England in which the mortality rate did not exceed 17 annual deaths in 1,000 living, have been selected as the basis of a new life table which will shortly be published, as the nearest approximation we can obtain to a table representing the human race in the normal state.

The 5th column in the annexed table shows the rates of mortality at 12 different ages in the districts of England which we call, for the sake of distinction, healthy. The sanitary conditions are often defective, but the defects are counterbalanced; so that the districts being much less unhealthy than the average, may be so designated.

It will be observed that if the population (2,373,983) be multiplied by 17, and the product be divided by 1,000, the resulting number (40,358) will represent the annual deaths that would take place in London if the mortality were at the rate of 17 in 1,000 annually. The actual rate of mortality in those districts was $17 \cdot 72$ in 1,000 males, and $17 \cdot 33$ in 1,000 females.

METHOD for comparing the RATES of MORTALITY in the HEALTHY DISTRICTS of ENGLAND, with the Rates prevailing in other Districts; LONDON given as an example.

LONDON.

AGES. 1	Population estimated to the middle of 1851. 2	Average Annual Deaths in the 5 Years 1849-53. 3	Average Annual Rate of Mortality in the 5 Years 1849-53. 4	Average Annual Mortality in Healthy Districts (1849-53). 5	Average Annual Deaths which would have occurred if the Mortality had been the same as in Healthy Districts. 6
			MALES.		
0—	147390	12156	·08247	·04348	6367
5—	121977	1274	·01045	·00674	817
10—	107745	569	·00528	·00384	412
15—	208028	1669	·00802	·00691	1432
25—	195983	2178	·01111	·00818	1596
35—	145165	2504	·01725	·00928	1341
45—	96559	2542	·02632	·01273	1223
55—	54479	2396	·04398	·02294	1243
65—	26514	2299	·08670	·05486	1446
75—	7387	1294	·17522	·12817	942
85—	794	272	·34247	·28350	225
95 and upwards -	48	19	·40047	·40000	19
All Ages -	1112069	29172	·02623	*·01534	17063
			FEMALES.		
0—	147969	10635	·07187	·03720	5473
5—	123082	1220	·00991	·00702	859
10—	109701	540	·00492	·00480	524
15—	248763	1619	·00651	·00765	1896
25—	233846	2213	·00947	·00894	2082
35—	165265	2345	·01419	·00998	1642
45—	113007	2241	·01983	·01192	1338
55—	69308	2460	·03549	·02162	1487
65—	36496	2645	·07247	·04992	1809
75—	12582	1936	·15384	·11866	1483
85—	1793	514	·28685	·26711	477
95 and upwards.	102	42	·41611	·45000	46
All Ages -	1261914	28410	·02251	*·01515	19116
Persons -	2,373,983	57,582	·02425	*·01524	36,179

* This is the rate of mortality that would prevail in the healthy districts at *all ages* if the distribution of the ages were the same as they were in London in 1851.

But the population experienced very different rates of mortality at different ages, and the proportional numbers living in London at the various periods of life is not the same as it is in the country districts, which send out emigrants. London is supported partly by immigrants and partly by births. It has hence an excessive number of people in the prime of life. Accordingly, it is found that with the population as it was distributed in 1851 the annual deaths in London would not exceed 36,179, or the annual mortality would be 15 in 1,000 if the rates of mortality at each of the 12 periods of life were the same as those prevailing in the healthy districts.

Example: The number of boys under 5 years of age was 147,390; the annual rate of mortality in the healthy districts was ·04348; and multiplying these two fractions together, 147,390 × ·04348 = 6367 deaths which would have happened in London had the mortality been at the same rate as it was in the healthy districts.

By continuing the process, the numbers in column 6 are obtained, amounting in the aggregate to 36,179; the mortality in London should therefore have been $\frac{36,179}{2,373,983} = \cdot 0152$ or 15 in 1,000.

All towns like Liverpool, Glasgow, and Manchester, have an excess of that part of the population which experiences, on account of age, less than the average rate of mortality. A part of the mortality of the towns is therefore marked by this circumstance.

And the effect of a correction for age such as has been employed in the Registrar General's reports shows that the number of *unnatural deaths* is always understated by comparing the total deaths with the deaths which would take place at the rate of 17 in 1,000.

It is shown in the table that, on an average, 57,582 persons died in London annually during the five years 1849–53, whereas the deaths should not, at rates of mortality then prevailing in certain districts of England, have exceeded 36,179; consequently 21,403 unnatural deaths took place every year in London. It will be the office of the Boards of Works to reduce this dreadful sacrifice of life to the lowest point, and thus to deserve well of their country.

In Liverpool, by the same method, it is found that 6,418 lives were lost in the year 1857, in excess of the deaths at the healthy rates. In Manchester the sickness and mortality are also excessive. (20th Annual Report, pp. 174–6.)

Progress of Public Health possible.—Malthus maintained at one time that attempts to prevent the ravages of epidemical diseases are hopeless, inasmuch as the population always presses on the means of subsistence. Now population is dependent on two factors, the yearly births of children and the number of years the children live; and if subsistence is limited, population is also limited. The population of England may be less, but can never be greater, than the subsistence it can command. It is not, however, necessary that the subsistence itself should be produced in England; other products of the same exchangeable value can in the present state of transport in the world always be converted into subsistence. Manchester lives as well as a county consisting of farmers and agricultural labourers. A nation then is not "cabined, cribbed, confined," by its acres; it can create on one acre of land produce worth the agricultural products of a thousand acres. Subsistence is a limited but not a fixed quantity. Its extension may keep pace with the extension of population. Then the births of the present day suffice to sustain a population much larger than the population existing; and yet the births might be increased by one-third, as will be evident when it is considered that more than 2,000,000 women of the age of 15–55 are unmarried, and that the 3,000,000 women of that age married, "or otherwise to the same extent as married women "bearing children," bear on an average only 22 children annually to every 100 women. The reproductive power of the nation is thus under "restraint," as Mr. Malthus called it, and the experience of France implies that without diminishing the number of persons in the married state the annual births may here fall very considerably below the present numbers. Then there is the great opening of emigration. Vast regions of America, Australia, Asia, and Africa, are unpeopled, or are peopled by unsettled unproductive savages. Colonial settlements, plantations as Bacon calls them, are the glory of England. Other races have transiently conquered the nations of the earth; England has planted

Englishmen on continents from which time cannot dislodge them These plantations call perpetually for recruits.

To dread, therefore, any ill consequences from arresting epidemics, or to argue on *a priori* grounds that it is impossible in opposition to nature to save life, to prolong life, to strengthen, and in every respect to improve the English race, is illogical; for give them health, and if the increased numbers cannot be sustained on subsistence by their industry within the shores of those islands, the births will naturally decline; but the natural remedies are increased industry to command produce from abroad, and emigration to seek after subsistence on the vast trans-oceanic territories.

Then the very conditions which diminish the numbers killed in the battle of life diminish the numbers of wounded; and as every single death by violence implies the injury or mutilation of survivors, so nearly all the zymotic diseases leave irreparable traces in the blind, the deaf, the weak in body or brain. By removing the discovered causes of death you at the same time remove conditions which prevent the progress towards perfection of the English race. We have, therefore, everything to hope, and nothing to dread from measures of public health and of public safety. (30th Annual Report, pp. 210–11.)

Probable Decrease of Mortality.—There are many obstacles to the sanitary progress of a nation, and it is evident that at present they can only be overcome in part; but there is no ground for despair. There has been progress. The mean lifetime of sovereigns and peers is prolonged; it was in past ages much shorter than the lifetime of the unhealthy labourers in the cities of to-day. The mortality of the city of London was at the rate of 80 per 1,000 in the latter half of the seventeenth century, 50 in the eighteenth, against 24 in the present day. The mortality in the liberties of the city of London within and without the walls was in the four plague years 1593, 1625, 1636, 1665, at the rate of 24, 31, 13, and 43 per cent. In the city alone 90,472 persons died of plague in the four epidemics, and 55,604 of other diseases. The enumerated population of the city was 130,178 in 1631. In the cholera epidemic year of 1849 the mortality from all causes in the metropolis was only 3 per cent. And in the last two epidemics there was a further decline. Thus it is as certain that the high mortality can be reduced by hygienic appliances down to a certain limit as it is that human life can be sacrificed.

The analysis of the causes of the mortality renders it still further certain that the actual mortality of the country can be reduced. Many of the destroyers are visible, and can be controlled by individuals, by companies, and by corporate bodies, such as explosions in coal mines, drowning in crazy ships, railway collisions, poisonings, impurities of water, pernicious dirts, floating dusts, zymotic contagions, crowdings in lodgings, mismanagements of children, neglects of the sick, and abandonments of the helpless or of the aged poor.

Furthermore, including the London district of Hampstead, there are fifty-four large tracts of England and Wales which actually experience a mortality at the rate of only seventeen per 1,000—less by *five* than the average mortality per 1,000 of the whole country, less by *ten* than in nine districts, and less by *twenty-two* than the mortality reigning for ten years in Liverpool. Now the healthy districts have a salubrious soil, and supply the inhabitants with waters generally free from organic impurities. The people are by no means wealthy; the great mass of them are labourers and workpeople on low wages, whose families get few luxuries, and very rarely taste animal food. Their cottages are clean, but are sometimes crowded, and impurities abound; the sanitary shortcomings are palpable.

It will not, therefore, be pitching the standard of health too high to assert that any excess of mortality in English districts over *17 annual deaths* to every 1,000 living is an excess not due to the mortality incident to human nature, but to foreign causes to be repelled, and by hygienic expedients conquered.

It is right to state that the real is greater than the apparent mortality of these districts; they are increasing, and contain an undue proportion of population at the younger healthiest ages, so that a correction for this makes the mortality *20* instead of *17*. That is the rate of their stationary mortality if the population were stationary, if births equalled deaths, and there were no migration.

The mean annual deaths at the rate of 22·4 in the ten years 1861–70 were 479,450 in England; and had the rate of mortality been 17 the annual deaths would not have exceeded 363,617; so the overplus due to the operation of causes existing, but less destructive in the healthier districts was 115,833. The hope of saving any number of these 115,833 lives annually by hygienic measures is enough to fire the ambition of every good man who believes in human progress. (Supplement to 35th Annual Report, pp. viii–ix.)

Possibilities and Difficulties of extending Human Life.—The laws of life are of the highest possible interest, even if the knowledge of those laws gave men no more power over the course of human existence than the meteorologist wields over the storms of the atmosphere, or the astronomer over the revolutions of the heavens. But all human laws proceed on the belief that the lives of individuals and of communities can, within certain limits, be regulated for good or for evil; and as latterly this has been questioned, it becomes necessary to discuss the problem—can lifetime be prolonged by a knowledge of the causes that cut it short, or by any means within a nation's power?

To live long is a natural aspiration, and in the early years of the marvellous science of chemistry the alchemists sought with as much ardour as they sought the philosopher's stone for an *elixir vitæ* to confer on man perpetual prime; they promised him, by its discovery, immortality upon earth. The possibility of this seems to have been an ancient belief, for in one of the oldest legends man had been told that he should not die—that he should live for ever. And it had in it some grounds, or it could never have led the first Bacon, Descartes, Franklin, and Condorcet to intimate that human life might be prolonged indefinitely. The forces, as well as the constituents of the body, are in truth indestructible; but they are fugitive, and are perpetually passing out of the men of existing generations into other forms: the flame of consciousness shines in one life only for a while. But the alchemists were right when they saw virtues in minerals and trees to prolong as well as to shorten life; to check disease and to set the body free; for if mercury, arsenic, antimony, iron, potash, soda, magnesia, phosphorus, chlorine, iodine, sulphur, in their various salts and acids; if strychnia, quinine, opium, chloroform, æther, ipecacuanha, camphor, and alcohol, will kill, they will also cure in the hands of the skilful. Surgery too has its great triumphs. Therapeutics is not a delusion, the Healer is a reality. But no drug can do more than prolong life for a time; the man raised from the grave dies in the end. Life can be lengthened by regimen—by dietetics, which Celsus says engaged in his day the most eminent professors of medicine in Rome, because it is the most potent and philosophical, dealing in regimen of mind and body, and medicinally controlling aliment, air, sleep, and exercise. The influence of the external world of air, water, soil, and climate on health and length of life was placed beyond doubt by the great treatise of Hippocrates. And Moses had before inculcated the exclusion of the sick by zymotic diseases from the Congregation. In these latter days science has gone further, and shown under what conditions the lifetime is long or short; and the science of life, yet only in its infancy, will make further progress, and solve many problems hitherto held to be insoluble, when hygiene is cultivated in all the medical schools. The genius of agriculture, of engineering, of industry, and of commerce is growing every year, and handling new power in new machines, is supplying new means of existence, and banishing fatal impurities.

Descent is easy, and onward motion over a level road is not difficult; but every step upwards to a higher state encounters obstacles; and so it is in the improvements of the human race. Of this a few examples are instructive:—small-pox is a fatal disease, and after it had been learnt that a milder type could be induced artificially, fatal to few of the inoculated, the practice was introduced in London, and was publicly performed in the years 1746–63 on 3434 persons at the small-pox hospital; only 60 of whom it is said died of the disease.* The mortality varied in different places, but it was nowhere considerable. What appeared so well fitted to justify Lady Mary Wortley Montague's exultation when she learnt in Turkey that "ingrafting" rendered small-pox harmless? "I am patriot enough," she wrote in 1718, "to take pains to bring this "useful invention into fashion in England." But it was found after it was brought that the deaths from small-pox in London, compared with the deaths from all other causes, and also the absolute mortality, increased considerably when inoculation became common. Large numbers of children and adults remained unprotected, and inoculation kept the *variolads* alive in an artificial nursery. Inoculation is now made illegal. Again, hospitals were opened to receive people attacked by this dreadful disease, and to afford them the advantages of watchful attendance and skilful advice. This was carried out in London; but the mortality of the patients in the hospital was double the mortality by the disease outside.† Here was another apparent failure. But vaccination was a great advance on inoculation; the danger of the operation was quite inconsiderable, and cowpox, unlike small-pox, never scattered abroad the seeds of disease. In 1771–80 small-pox in London was the cause of 100 in every 1000 deaths, in 1831–5 of 27, in 1861–70 of 11, and in the absolute mortality by this disease there was a large reduction. In the last two decenniads, 1851–70, the mortality per 100,000 by small-pox remained stationary in London at 28. In all England the mortality per 100,000 by small-pox declined from 22 to 16, or to the extent of 6; but population growing denser the mortality by scarlet fever rose from 88 to 97, thus increasing 9, or one and half times as much as the mortality by small-pox decreased. The mortality by measles, diphtheria, and whooping-cough also increased. Vaccination diminished the chances of taking small-pox, and though it did not afford absolute security, it reduced the danger of its attacks. But, density of population increasing, other zymotic principles appeared to find in its absence freer scope for

* Duvillard cites Dr. Jurin, who prepared a table showing that out of 447 inoculated with effect 9 died; Dr. Monro inoculated 5554 persons, of whom 72 died; Dr. Gregory set down the mortality at 3 in 1000. By natural small-pox the mortality per 1000 attacked ranges from 150 to 300.

† The mortality in the Small-pox Hospital was at the rate of 25 per cent. in 1746–63, for 1634 of 6456 patients died. For later returns see Letter to the Registrar General in Appendix to 34th Annual Report.

their destructive operations. In quenching the flames at one point the good work is begun but it is not ended. Can zymotic diseases of all kinds never be quenched?

Out of pity for poor children Foundling hospitals were erected, but the babies nearly all perished, and a greater number than ever were abandoned. Had these hospitals succeeded the race of child-abandoning men must have been multiplied.

Another example is offered by the drainage of towns. In London the fatal refuse which had been retained in the houses was conveyed by water into the drains and into the Thames; and this was an advance on the previous state of things; but the sewers were charged with impurities; they put houses by their effluvia in communication with each other, and poured zymotic elements into the waters which were distributed by companies to the houses of both the wealthy and the indigent. And even at the present hour the sewage is pumped into the Thames, which it pollutes and obstructs, instead of being distributed over the land to which it belongs. The same difficulty in disposing of sewage is encountered in all English towns.

In the early ages the English population was scattered in slight dwellings over woods, meads, and undrained marshland, where they suffered from agues, rheumatisms, and famine fevers; as the people multiplied they assembled in cities and partook of a few of the advantages of civilization; but the increase of density brought new dangers, and, as the proximity of houses exposed towns to conflagrations, it laid their inhabitants open to devastating maladies, and to destructive pestilences. The people flocked in numbers to London in the reigns of Henry VIII., of Elizabeth, and of James, and the sweating sickness and fevers and the oriental plague decimated the population. The Restoration brought country families to the metropolis, and the plague made its ever-memorable swoop. The manufactures, the mines, and the great works that create subsistence for thousands, collect workmen in towns as ill-provided with sanitary appliances as ill-organised camps; and thus Lancashire, Yorkshire, Durham, South Wales, are still in a high degree insalubrious. Until the Legislature, led by Lord Shaftesbury, intervened, the lives of young children and mothers were barbarously sacrified in the factories and mines. Here is seen again the success with which evil poisons the healing springs of industry.

The low wages of large numbers of artisans in towns deprived them of the means of healthy life; latterly wages have risen, and they had the command of those means to a larger extent, but unfortunately the consumption of spirits and other stimulants absorbed their wages to the no small detriment of health. To sweep out the dusty and close workshops they are apt to be made draughty, so difficult is it to improve the health of artisans.

In the last twenty years the towns of England have increased from five hundred and eighty to nine hundred and thirty-eight; their population from nine to fourteen millions; and the health of the whole population of the country has remained stationary.

Breeders reject weakly animals from their stock, and thus achieve success. By the care now taken of the humblest member of the human race the weakly, it is said, survive; they marry and propagate, and thus, as some contend, the proportion of inferior organizations is raised. The imbecile, the drunkard, the lunatic, the criminal, the idle, and all tainted natures were once allowed to perish in fields, asylums, or gaols, if they were not directly put to death, but these classes and their offspring now figure in large numbers in the population. (Supplement to 35th Annual Report, pp. v–viii.)

Progress of Mankind in Health.—Turgot, Price, Priestley, Godwin, had written on the perfectibility of man, but Condorcet put this doctrine forward with new force in the remarkable work he wrote while he was under the ban of proscription in the last bloody days of the French Revolution.* Any Secretary of the French Academy of Sciences is not only distinguished by eminence in one branch of learning, but by a general acquaintance with the whole circle of the sciences; in writing on human perfectibility, Condorcet, therefore, did not write in ignorance. He knew the greatness of the conception; and had sounded all its depths. His argument is an induction drawn from the progress of nations through nine historical epochs in science, art, literature and civilisation; and from the gradual rise to heights higher and higher, as well as from the intrinsic energy of their animating principle, he predicts in the last chapter not only an indefinite development of the sciences, of the arts, and of institutions, but of man himself in all his faculties. He foresees new discoveries in all the sciences, and in the arts, reacting on each other; improvements in the theory and practice of life; completing the faculties by placing more powerful instruments at their disposal; and by their own development. All classes by education, by free trade, by cheap law, by simpler manners, will be raised to a higher level; the classes dependent on labour, and men having a little capital, by insurance, and by co-operation, will enjoy advantages now only possessed by great capitalists. Progress will be accelerated by new methods in the sciences; by new notations; by the application of calculation to all branches of human affairs; and by simplifications of processes in the arts. Teaching both the sciences and the arts will be facilitated; men and women will alike cultivate the fields of nature. At present not a fiftieth part of the people endowed with talents obtain the education required for their development.

What Condorcet in 1794 sketched of the progress of the arts and sciences has already been fulfilled. The sketch was a prophecy. But he is equally confident that as plants and animals have been developed, so man, already richly endowed, is susceptible of organic perfectibility. The English and French are as much in advance of the Saxons and Franks as the cattle and horses of to-day are ahead of theirs. The senses will grow finer, the forces more vigorous, the intellectual faculties inconceivably superior to what is seen in the present average of the race; man may be indeed a "little lower than the angels." Who can doubt, he asks, that the progress of *conservative medicine*,† the use of healthy aliment and lodging, a regimen which will develope energy by exercise without wasting it by excesses; the removal of the most potent causes of degradation, abject poverty and superfluous wealth; will prolong the lifetime of men, insure more constant health, and more robust constitutions. It is clear that conservative medicine, rendered more efficacious by reason and social institutions, must in the long run banish transmissible and contagious diseases, as well as maladies due to climate, diet, occupation; nay, the hope of relief may be extended to all other diseases whose remote causes may probably be recognised. Now, is it absurd to assume that this perfectibility of man will go on

* Esquisse d'un Tableau Historique des Progrès de l'Esprit Humain. Ouvrage Posthume de Condorcet; 3rd edition, 1797. Condorcet, born 17th September 1743, died on 8th April 1794. In early life he co-operated with Turgot; and was for many years the Perpetual Secretary of the French Academy of Sciences. He wrote in favour of free trade and against the slave trade when prohibition and slavery were recognised institutions.

† *Médicine conservatrice* is the expression of Corvisart; it will bear transplantation into English. He also uses the term *médicine préservatrice*. Either is better than "preventive medicine."

indefinitely through endless ages? So argued Condorcet. Malthus, to confute his doctrine, advanced the principle of population under which mankind multiplies, he contends, so fast in geometrical, while subsistence increases in arithmetical progression, that the numbers are necessarily kept down by "misery." This principle of population—the "wedded "love" that Milton hailed—is the inexhaustible source of human wretchedness! The irony is terrible.

Condorcet, one of the eminent band of mathematicians then existing in France, would have smiled at the hypothesis that men increased in geometrical and subsistence in arithmetical progression, when it happens that the plants and animals on which men feed can all increase or decrease in geometrical progression at faster rates than man. The law is the same. He anticipated the objection from an indefinite increase, and suggested how it may be overcome.*

Mr. Darwin, accepting the law of the increase of animals in geometrical progression, instead of viewing it as a reason for an eternal stand-still of misery, traces to the consequent struggle for existence, and the survival of the fittest, the progressive development of creation from its lowest to its highest forms. He contends that living matter in the past was perfectible; and this is an argument for the indefinite perfectibility of men through future ages.

The great source of the misery of mankind is not their numbers, but their imperfections, and the want of control over the conditions in which they live. Without embarrassing ourselves with the difficulties the vast theories of life present, there is a definite task before us—to determine, from observation, the sources of health, and the direct causes of death in the two sexes at different ages and under different conditions. The exact determination of evils is the first step towards their remedies.—(Supplement to 35th Annual Report, pp. xix–xx.)

Sanitary Work, and Decline of Mortality.—There are many districts in England where the good effects of the sanitary administration of the last 20 or 30 years can be distinctly traced. Those in the annexed table may be cited as examples of such improvement.

DISTRICTS of ENGLAND and WALES showing some IMPROVEMENT in the ANNUAL RATE of MORTALITY in the THREE DECADES 1841–50, 1851–60, and 1861–70.

Number of District.	Name of District.	Registration County.	Enumerated Population.		Average Annual Mortality. Deaths to 1,000 Living.		
			1861.	1871.	1841–50.	1851–60.	1861–70.
182	North Witchford -	Cambridge -	14,791	15,585	27	21	20
183	Whittlesey - -	Cambridge -	6,966	7,002	25	23	21
184	Wisbech - -	Cambridge -	33,309	34,209	25	22	20
189	Orsett - -	Essex - -	11,595	13,172	24	21	18
254	Salisbury* - -	Wilts - -	9,039	9,212	28	24	20
279	Stoke Damerel -	Devon - -	50,440	49,449	26	23	21
372	Wolverhampton -	Stafford -	126,902	136,053	27	28	24
393	Coventry - -	Warwick -	41,647	40,113	27	25	21
446	Macclesfield -	Chester - -	61,543	59,339	26	25	23
520	Hull - -	York - -	56,888	68,316	31	25	26
582	Newport - -	Monmouth -	51,412	61,252	24	22	21
585	Merthyr Tydfil -	Glamorgan -	93,008	104,239	28	29	25
605	Crickhowell -	Brecknock -	22,457	20,147	27	25	23

* The District of Salisbury was abolished, and the sub-district of Salisbury transferred to the District of Alderbury, in the year 1869.

* Condorcet, Esquisse, pp. 362–4.

The district of North Witchford affords a striking instance of the important results that can be attained through health administration. The average annual mortality fell from 27 per 1,000 in 1841–50, to 21 in 1851–60, and to 20 in 1861–70: in the four years 1871–4, the results are still more remarkable, the mortality being reduced to 17 per 1,000.

In Whittlesey, a steady improvement in the mortality is also discernable from 25 to 1,000 in 1841–50, and 23 per 1,000 in 1851–60, to 21 per 1,000 in 1861–70; in 1871–4 the rate fell to 19 per 1,000.

In Wisbech sanitary supervision commenced soon after the cholera epidemic of 1854. In 1866 the town was supplied with pure water, and extensive sewerage works are now completed. The annual death-rate of this district has been reduced from 25 per 1,000 in 1841–50 to 19 per 1,000 in 1871–4.

The great land drainage works have had great influence in improving the health of the inhabitants of the Isle of Ely. By their means the atmosphere has been purified and dried, and the returns for Wisbech show a marked diminution in the death-rate from phthisis, the average annual mortality per 1,000 living in the 10 years 1851–60, being 2·0, whereas in the ten years 1861–70 it was reduced to 1·6.

In Orsett the remarkable reduction in the death-rate during the 30 years 1841–70 is partly due to sanitary improvements, but mainly to the drainage of the land and consequent dryness of the soil. In the four years 1871–4 the mortality was only 17 per 1,000. The annual rate of mortality from phthisis decreased from 2·8 per 1,000 in 1851–60, to 1·9 per 1,000 in 1861–70.

Reference has already been made in some of my previous reports to the good effects of drainage and water supply in the district of Salisbury. Before any improvements were made, the annual death-rate in 1841–50 was 28 per 1,000, but by the year 1855 an excellent system of drainage was in operation, and the district was supplied with pure water, so the annual rate was reduced in 1851–60 to 24 per 1,000, and in the following decade it was still further reduced to 20 per 1,000. The *city* of Salisbury, with a population in 1871 of 12,903, appears to be in a good sanitary condition, the annual mortality in the four years 1871–4 being at the rate of 21 per 1,000.

In Wolverhampton the annual mortality has fallen from 28 per 1,000 in the 10 years 1851–60 to 24 in the four years 1871–4. Dr. Love, the Medical Officer of Health, attributes this reduction to various sanitary improvements carried out since 1858. In 1865 the town was entirely re-sewered, and a more wholesome water supply obtained, but much still remains to be done to put Wolverhampton in a good hygienic state.

The cause of the great improvement in the health of Coventry is attributed by Dr. Fenton to the progress of sanitary works. Such improvements have been the means of reducing the annual death-rate from 27 per 1,000 in the 10 years 1841–50, to 25 per 1,000 in the 10 years 1851–60, and to 21 per 1,000 in the 10 years 1861–70. In the four years 1871–4 the mortality rose to 24 per 1,000. This was owing to an epidemic of small-pox in 1871–2, and of scarlet fever among children in 1873–4.

Previously to any sanitary improvements in Macclesfield the mortality of this district, in 1841–50, was at the annual rate of 26 per 1,000. In 1853–6, sewerage works were executed; in 1851–2, the town was provided with an improved water supply, and various other sanitary measures were adopted, but the condition of Macclesfield was far from satisfactory, for the mortality of the district, in 1851–60, was 25 per

1,000. In the following decade, however, 1861–70, it fell to 23 per 1,000.

Kingston-upon-Hull presents another example of the good effects of sanitary measures. Mr. Holden, the Medical Officer of Health, states that cholera was appallingly fatal in 1849; in proportion to population, it suffered more from cholera than any district in the kingdom. The annual rate of mortality, from all causes, in the 10 years 1841–50, was 31 per 1,000. An investigation showed that the drainage was bad, and the water—derived entirely from the river Hull—received the sewage of such places as Driffield and Beverley. The Local Board of Health, incorporated in 1851, began to carry out sanitary improvements, and in the 10 years 1851–60, the mortality was reduced to 25 per 1,000. In 1864 the river water was abandoned, and the town received a constant supply of pure water from the springs rising out of the chalk wolds at Derringham. What has been effected is encouraging, but the mortality of Hull may be still further diminished, for in the 10 years 1861–70 the mortality was 26 per 1,000, and during the four years 1871–4 it was 25 per 1,000.

The improvement in the health of Newport is attributed by Dr. Davies to the extensive and complete system of drainage executed chiefly between 1851 and 1860, by means of which the sewage was swept into a tidal river about three miles from its mouth. The effect of the drainage has also been attended with the beneficial result of lowering the subsoil water. The town now receives a constant supply of good water. The mortality declined from 24 in 1841–50, and 22 in 1851–60, to 21 in 1861–70.

The mortality of the district of Merthyr Tydfil—the great centre of the iron manufactures of South Wales—in 1841–50, and in 1851–60, was at the high average annual rates of 28 and 29 per 1,000 respectively. This was attributed by Mr. Dyke, the medical officer of health, to deficient drainage, to the absence of any system of scavenging, and to a scanty and impure water supply. In the year 1866 the drainage was completed, and a plentiful supply of pure water obtained, so that the annual rate in 1861–70 averaged only 25 per 1,000. The sanitary state of the town, however, was not satisfactory, for the mortality in the four years 1871–4 rose to 27 per 1,000, owing to the prevalence of small-pox in 1872, of enteric fever in 1873, and of contagious fevers in 1874.

The improvement in Crickhowell is mainly due to sanitary arrangements in the urban district of Brynmaur, which has been thoroughly drained and provided with an ample supply of pure water. Sanitary improvements are in progress, however, in various parts of Crickhowell. The mortality in the 10 years 1841–50 was at the annual rate of 27 per 1,000; in the following decade, 1851–60, it fell to 25 per 1,000, and in 1861–70 there was a further reduction to 23 per 1,000, at which rate it continued during the four years 1871–4.—(37th Annual Report, pp. ix–xxi.)

Mortality and High prices of Wheat.—The close of the 16th century was marked by the commencement of two important series of statistical observations,—the Record of the prices of Wheat in the Eton Books, and the London Bills of Mortality,—which were continued, with scarcely any interruption, through the 17th and 18th centuries. The character and nature of these returns are well known. The London Bills did not include all the deaths,—parishes were gradually added, and the population of the metropolis at any time before 1801 is unknown, so that the absolute mortality cannot be determined. The

Windsor prices, taken only twice a year, do not give the real average prices of wheat all the year through in London. A comparison with the averages drawn up by the Receiver of Corn Returns, however, exhibits a general agreement, which places them beyond the reach of the disparaging criticism in the Report of one of the Parliamentary Committees.

In comparing the two series of observations, with a view of ascertaining whether there is any connexion between the prices of wheat and the mortality, I have taken periods of 10 years, from 1601 to 1610, 1611 to 1620, &c., up to 1800, and have arranged the years in the order of the prices, beginning with the highest, as in the annexed example.

EXAMPLE.

Year.	Price of Wheat Per Quarter. *s.*	*d.*	Burials in London, according to the London Bills.	Year.	Price of Wheat Per Quarter. *s.*	*d.*	Burials in London, according to the London Bills.
1741	47	0	32,169	1750	32	6	23,727
1746	39	0	28,157	1742	32	0	27,483
1748	37	0	23,869	1745	27	4	21,296
1749	37	0	25,516	1743	24	11	25,200
1747	34	10	25,494	1744	24	10	20,606

The deaths in the 5 years of highest prices are then compared with the deaths in the 5 years of lowest prices in the Table, and the general result is, that in the twenty decennial periods, the deaths were 1,971,076 in the 98 years of highest prices, and 1,830,835 in the 98 years of lowest prices. The excess of deaths in the years of highest prices was 140,241. The method, by taking several short equal periods, contains in itself corrections of all the errors arising from the increase of population, or progressive improvements in the metropolis, and resting only on the relative number of deaths, yields results entirely independent of the absolute mortality.

The causes of a high mortality are various; but the greater number of known causes may be referred to five heads: 1, excessive cold or heat; 2, privation of food; 3, effluvial poisons generated in marshes, foul prisons, camps, cities; and epidemic diseases, such as typhus, plague, small pox, and other zymotic diseases; 4, mechanical and chemical injuries; 5, spontaneous disorders to which the structure of the human organization renders it liable. The three first classes of independent causes vary in intensity from year to year; and as *each* will separately produce the effect which we are investigating, namely, an increase of deaths, it must be evident that this effect will not always vary as privation or as *any one* of the class of causes. For instance, the sweating sickness, said to have broken out in Richmond's camp, spread through England, and destroyed great numbers. It was a poison in the air, and like other poisons, its fatal action was not stopped by abundance of food, although its ravages, if aided by famine, might have been rendered more deadly. So of the black death in 1348, the plague in 1665, the cholera in 1832.

Then, low prices do not always denote plenty, nor high prices scarcity. And if high prices increase the mortality, any great mortality has a tendency to reduce the price of provisions. Thus in 1349 "the price of every kind of cattle was much reduced; they wandered about in herds without herdsmen. Corn of all kinds was so abundant that no one cared to gather it." Workmen were scarce, a "great part" of them having been destroyed, and demanded high wages.—See against the years 1348–9, Henry de Knyghton, Rymer's Fœdera, Walsingham, J. Barnes, Holinshed.

Those great disturbing causes and the imperfections of the returns require for the elimination of their effects a series of observations extending through a century. The concurrent evidence of the 17th and 18th centuries appears to me to justify the inference that high prices of wheat—I mean relatively high—irrespective of the other necessaries of life, had then a tendency to increase the mortality in London.

Mr. Tooke, in his valuable work on Prices, has reviewed all the years of scarcity and high prices in the 18th and 19th centuries. Mr. Tooke had no theory to support on this subject which did not fall within the scope of his work. I therefore take the periods upon which he has fixed to test the effects of dearth. He mentions *seven* periods of various degrees of dearth in the 18th century, exclusive of 1800, which is connected by 1801 with the 19th century: 1709 and 1710 were years of "great dearth;" in 1727, 1728, 1729, "some degree of dearth" was felt; 1740 was "felt as a year of dearth;" "thousands of acres remained unsown in 1756"—there was "a scarcity of corn and a high price of provisions;" in 1766 there was "dearness of provisions;" the quartern loaf in London was at one time as high as 18*d.*; [at Windsor prices were highest in 1767;] the five years 1770–4 are said to have had "unproductive harvests*." A table presents a comparative view of the deaths reported in the London bills before and after the years mentioned by Mr. Tooke. The correspondence, as might be excepted, between the high and low prices, and high and low rates of mortality is only general.

Mr. Rickman procured from the clergy, returns of the burials at the Established Churches for each year from 1780 to 1830. The returns are incomplete, but they serve to show the relative mortality all over the country in consecutive years. Thus we find that the "partial deficiency" of the harvest of 1794 was followed by scarcity and an increase of deaths in 1795. The harvest was favourable in 1793. The prices in 1794 were 53*s.* 4*d.* per imperial quarter; the burials, 197,740. In 1794 there was a partial deficiency. Prices in 1795 were 76*s.* 6*d.* per imperial quarter; burials rose to 210,339.

In 1799 and 1800 the seasons were "bad," and the dearth of 1800 and 1801 produced great distress. Committees of both Houses of Parliament were appointed to inquire into the means of supplying the people with food; and with the scarcity a typhus epidemic took its rise concurrently, which was inquired into by a Committee of the House of Commons. The prices and burials returned during the five years 1798–1802 were—

	Average Prices of the Winchester Quarter of Wheat. Windsor Prices.		Corn Returns.		Burials in England.
	s.	*d.*	*s.*	*d.*	
1798	54	0	50	3	187,531
1799	75	8	67	6	189,586
1800	127	0	113	7	208,063
1801	128	6	118	3	204,434
1802	67	3	67	5	199,889

* "The King's Speeches," "Corn Tracts," and other original authorities, are cited by Mr. Tooke. A little confusion in the dates is apparently caused by the earlier writers making their year terminate in March. Thus the *winter* of 1709, new style, is the winter of 1708, old style.

Up to 1837 the registers of deaths were imperfect. The rate of mortality could only be obtained approximately. The registration under the new system is complete; and with the Censuses of 1831 and 1841, enables us to calculate the proportion of deaths to the increasing population of each year. Taking the three first and the three last years, which are the years of highest and lowest prices, it will be found that the mortality in Yorkshire, Cheshire, Lancashire, and all England, was highest when the prices of wheat were highest.

	Average annual Deaths to 100,000 of the Population in the three years when the prices of Wheat were	
	Highest.	Lowest.
Yorkshire	2239	2147
Lancashire and Cheshire	2789	2468
England	2270	2110

The difference in these rates implies a difference of many thousands in the deaths of the whole country. Out of the same population in Lancashire and Cheshire, for every ***seven*** deaths in the years of low prices ***eight persons died*** in the years of high prices. The mortality was higher in the agricultural counties in the three years when the average price of wheat was high, than in the years when the price of wheat was allowed to fall nearer the natural average which prevailed through the two preceding centuries. For all England, out of the same population, the funerals in the three years of high prices, were 14 to every 13 in the three years of lower prices, approaching the natural standard. (Journal of Statistical Society, Vol. IX., pp. 163–7.)

Cotton Famine and mortality in Lancashire 1862. A few of the registrars witnessing a reduction of the mortality with the distress that prevailed in their districts at the same time have been tempted to speculate on the facts, and as those officers in the course of their duties are in frequent communication with the labouring classes their opinions may be quoted. The registrar of Wigan states that more freedom to breathe the fresh air, inability to indulge in spirituous liquors, and better nursing of children, are believed to have improved the public health. The registrar of Little Bolton holds that the decrease of deaths is mainly due to a greater amount of domestic superintendence. The registrar of Hulme thinks that the even temperature of the weather and increased attention paid to young children have caused the decrease. The registrar of Knott Lanes (Ashton) attributes the result to absence of epidemics, mildness of the weather, out-door exercise, maternal care; also to parish relief and charitable contributions, by means of which food has been obtained not sufficient for health but enough to mitigate distress and prevent hitherto an increase of mortality. The registrar of Preston sub-district also refers to the good effect of fresh air, nursing, and mildness of the weather, and he adds: "In the weeks ending " August 2nd, 9th, 16th, 23rd, and 30th, I registered 30, 25, 29, 24, " and 37 deaths, but in the corresponding weeks of 1861 when work " was more plentiful and people in better circumstances they were 50, " 40, 50, 42, and 57. The peaceful and dignified conduct of the " operatives entitles them to the warmest sympathy and support of all " classes." The registrar of Ancoats (Manchester) is convinced that the low rate of mortality in his sub-district was due to the coldness of the summer, in consequence of which diarrhœa did not prevail.

It has been recently asked whether starvation is good for the health, and attempts have been made with indifferent success to solve a difficulty which has not arisen. Nobody will seriously contend that inadequate supplies of food are conducive too health ; it is too well known that famine has often slain its thousands ; but it is right at the present time to guard against deductions from the returns of mortality which they do not justify. It has been assumed as obvious that if the death-rate in the distressed districts does not exceed or falls below that which has prevailed in times of prosperity, the relief obtained by the unemployed from public and private sources has sufficed to maintain them in health. The allowances may or may not have been sufficient in amount, but the returns of mortality furnish no evidence of the fact ; they only show that extreme consequences of famine have not yet been manifested. Recreation in the open air, moderation in meat and drink, and the due administration of domestic offices are beneficial to health, but if they have been compensation for the loss of wages the tables above quoted are silent on the point. These tables prove that under circumstances favourable to human life the mortality in England was reduced last quarter, and that the districts of the cotton manufacture were not prevented by the distress from participating in the benefit, they cannot show that if Lancashire had been prosperous the health of its people would not have been still better and a further reduction of mortality obtained. It is a matter not of speculation but fact that winter approaches, and that the cold of winter swells the bills of mortality by attacking the old, the young, and the infirm of middle age, and it needs not the gift of prophecy to predict that if cold and want, prolonged and embittered, attack a population with combined force, it must fall as if under an armed host. To avert or mitigate such a result, food, clothing, bedding, and firing must be dispensed by a public or private charity that can rise to the greatness of the occasion. (25th Annual Report, pp. xxxii-iii.)

Mortality and Water Supply: London.—No observations exist embracing the whole of the phenomena of the life of these numbers of both sexes and of different ages extending over a century, and severally varying in strength, in morality, in intellect, in industry, in health, in occupation, in effectual production and consumption.

But we have now before us the results of observations on a certain class of phenomena. The births, the deaths, and the causes of death are recorded shortly after they occur, and an analysis of the registers has been published weekly for twenty-one years.

The results are as valuable as an experimental philosopher could have deduced from his experiments if he had had the power to expose the population to great vicissitudes of heat and cold, of dampness and dryness ; to the changes incidental to differences in the prices of food ; to air and water of different degrees of impurity ; and to destructive epidemics.

Some of these results were pointed out at the time when the facts were first observed, or in the annual reports, and others will undoubtedly be elicited by future investigations.

Thus we learn that in the same circumstances the same number of people die at the same ages of the same diseases, year after year ; organized bodies being governed by laws as fixed as those which govern the stars in their courses.

Certain changes of condition, within given limits, produce no appreciable effects ; but beyond those limits the effects are in some regulated proportion to the intensity of the causes ; varying, however, also with the state of the bodies submitted to their action, as is evident by studying the effects on the two sexes at different ages.

Thus excessive heat and cold injure health, and increase the mortality in the former case, by giving rise to diarrhœa, in the latter to diseases of the respiratory organs; the effect generally being greatest in infancy and old age, and varying with age at rates regulated by laws.

The human body consists principally of water, in combination with some organic compounds and salts; and this compound of oxygen and hydrogen is in constant use for drink, ablution, and daily use, so that water is the life-blood of cities. Without water they cannot exist, and on its quality their salubrity depends to an extent which the observations of twenty-one years have determined.

The supply of water in London is derived from shallow wells, from deep wells, from the New River, and from the River Thames, or its tributaries the Lea and the Ravensbourne. The well waters are foul, and nearly all of them have in solution organic matter derived from cesspools. The Thames has during this period been the great sewer of London, and in the years of the cholera epidemic was found charged with organic matter of unquestionable origin. The Lambeth Water Company, the Southwark, and the Chelsea, in the first epidemic (1849), supplied the South and West Districts of London with Thames water, from the part of the river extending from Hungerford to some distance above Vauxhall Bridge, and the cholera was then fatal, as the table shows, to 14,125 persons in London, and it was equally fatal in the houses of the same districts and streets that were indiscriminately supplied by the Lambeth Company, which pumped its water from the foulest part of the Thames at Hungerford, and by the Southwark and Vauxhall Company, which took its water higher up the river, but within the tidal range.

It was shown in the Cholera report (1849), that, in 10,000 inhabitants living in the districts supplied with water taken from the Thames at Kew and Hammersmith, 15 died of cholera; that 48 died of cholera in districts supplied with the waters of the Amwell, the Lea, and the Ravensbourne; and that 123 out of the same number died of cholera in the districts supplied with waters taken from the foul part of the Thames between Battersea and Waterloo Bridge. "*One*, *three*, and *eight*," it was added in the report, "express the relative virulence of the epidemic "in the three conditions."*

The Lambeth Company, in January 1852, wisely removed its source of supply at once up to a part of the Thames above Teddington Lock; another company lingered on its old site; and the epidemic cholera of 1854, therefore, found parts of the population of London on the south side of the river in very different conditions; the one supplied with very impure water by the Southwark Company; the other supplied with water much less impure provided by the Lambeth Company. The companies had been in competition, and they often supplied the same streets and districts, so their customers were nearly in all respects in the same sanitary conditions, with one exception; a gallon of the Southwark water contained 3·5 grains, of the Lambeth water 1·4 grains of organic matter. The dejections of the cholera patients of London were in the Southwark water in small quantities, but in quantities sufficient to augment the mortality week after week in every district; and in five weeks 2,284 persons died of cholera in 40,046 houses supplied with the Southwark water, while 294 had died in 26,107 houses supplied with the water taken higher up the Thames. †

The previous deduction was thus confirmed, and the subsequent investigation by a committee appointed by the Board of Health, to inquire into the deaths in every house supplied by the two companies, placed it

* Report to Registrar General on Cholera in England 1848–9; *see* Extracts on pp. 333–51.

† Appendix to Registrar General's 17th Report; *see* Extracts on pp. 357–63.

beyond a doubt that the mortality of cholera in London was augmented by the impure water with which the population was supplied.

It will be remarked that the *quantity* of organic matter which was so evidently deleterious in the Southwark water amounted, according to the best existing methods of chemical analysis, to *two* grains in a gallon in excess of that in the Lambeth water; that is, 2 grains in 70,000 grains, or one part in 35,000. A person who *drank* a *quart* of the water would take only a grain of organic matter, and still less of the fatal ferment.

Animalcules and muscular fibre have been found in water containing minute quantities of organic matter; it is evident, therefore, that this fluid in rivers, which receive the sewage of towns, must often contain the elements of zymotic diseases, and can never be circulated through a population for any length of time with entire impunity. And water companies may be assured that the purest water is the most salubrious, and that which is likely to retain the firmest hold on the market.

It is therefore of the utmost importance to keep strict watch and ward over the quality of this fluid, which is now supplied to the inhabitants of London by companies enjoying a virtual monopoly under an Act of Parliament, which bound them to alter the sources of supply, or to improve the quality of the water, after the following dates:—

Grand Junction - -	1855, August 31.
Southwark and Vauxhall -	1855, August 31.
West Middlesex - - -	1855, August 31.
Chelsea - - - -	1856, August 31.
East London - - -	1856, August 31.
New River - - -	1857, June 30.

And this is done much more effectually than it could be by any vexatious inspection of their works, through a careful periodical analysis of the water as it is delivered, by one of the most eminent chemical analysts of the day. The publication of the results of the analysis in the Weekly Tables is perhaps of more utility than the publication of meteorological phenomena, over which public companies have no control.

The improvement in the water supply of London within the period is great and decisive; and it coincides with the reduction of the mortality. After the Census the data will exist for comparing the rates of mortality in the several districts of London supplied by wells and by the several water companies, with the mortality in towns where the waters are softer and purer.

From the twelve monthly analyses of the waters of each company by Dr. R. D. Thomson in 1860, it will be observed that the quantities of organic matter in the waters supplied by the Chelsea, Lambeth, West Middlesex, and New River Companies are nearly equal (1·67 to 1·69); the Grand Junction and the Southwark waters contain a little more impurity (1·74); the East London still more (1·90): the Kent water is, however, the worst, and contained 1·99 grains. A marked improvement will be observed in all since 1851, when their fatal effects in aggravating the mortality of cholera were first disclosed. (23rd Annual Report, pp. xxxiv–vii.

Area, Elevation, and Water Supply: London.—Eight companies supplied the population with water, the life-blood of cities, from the Thames, and from its tributary the Lea, supplemented by wells. Their supply to London and its environs, according to the returns of the companies, amounted to 453,857 cubic metres daily, making a ton to every house inhabited or uninhabited: correcting for the supplies to factories and to streets, the domestic supply is equivalent to 12 decalitres (26 gallons) daily to each person. The water drawn from the wells of London is now inconsiderable in quantity. Dr. Frankland's careful analyses show the composition of the waters. The Thames, unlike the yellow Tiber and the turbid Arno rushing down from the Appenines, is justly called "clear" in ordinary seasons, but it overflows, and its basin was heavily flooded during winter all down its lowest levels. Drought followed in summer, hence the composition of its waters varied largely.

The manure of fields, with the sewage of cities, was washed into the waters. On 60 trials, *five* in each month, the water was clear in 35 instances, slightly turbid in 10, turbid in 8, and very turbid in 7 instances, when drawn from the pipes of the five Thames companies. It deserves note, that the waters of the West Middlesex company were in all the 12 trials found clear and transparent; and that the New River water was only twice found slightly turbid. The matters rendering the waters turbid are in suspension. Dr. Frankland's analyses deal with the matter in solution. He found the solid impurity dissolved in the Thames water ranged from 23 to 39 parts in 100,000, in the Lea water from 21 to 36 parts. In the summer months the waters attained an unusual degree of purity. Upon Dr. Frankland's scale the sewage contamination was much less in 1868 than in 1867; the West Middlesex and the East London companies both stood well. (35th Annual Report, p. lxv.)

Male and Female Mortality in London, 1862.—Not only the births of males are in excess of those of females, but also the deaths of males almost invariably exceed those of females, and last year the proportion in London showed 104 deaths of males to 100 of females, which is nearly the average proportion in England. Maitland, who published his History of London in 1739, speculated on this twofold result, which he was enabled to deduce from the christenings and burials of the seventeenth and eighteenth centuries; and he drew the conclusion, which undoubtedly was erroneous in those times, as it would be in the present day, that the population within the bills of mortality contained a majority of males. He writes: "Having the bills of mortality now "before me, I think it will not be amiss to undeceive the public in these "particulars: 1. Much the greatest part of mankind are of opinion that "there are two females to one male of the human species, but that this "is a palpable error is manifest from the accounts of christenings and "burials from the year 1657 to that of 1738, during which time of "eighty years there appears to have been christened 619,187 males and "585,334 females, and buried 994,656 males and 965,298 females, which "in the christenings amount to 33,853 more males than females, which "is 5½ per cent. in favour of the former, and in the burials, 29,358, "which is likewise 3 per cent. in favour of the males. This is a double "demonstration that there are considerably more males than females." He adds, that "the majority in favour of the males is by our naturalists "said to be designed by nature for the support of that part of the "human species which is more liable to be destroyed by war than the "other. But as war is only casual, and not perpetual, I am of opinion "that this supernumerary supply is designed by nature as a constant "remedy against incessant contingencies which the males are more "obnoxious to both by land and water than the females." The second prevailing opinion which he undertakes to refute is, that "not one "person in a thousand lives to the age of seventy or eighty." (25th Annual Report, pp. xliii–iv.)

Relative Mortality of Males and Females at Seven Age Periods, in Eight Groups of Districts, 1861–70.—The following Table affords valuable evidence of the varying incidence of the effect of density of population and of insanitary conditions upon males and females living at seven age periods, in various groups of districts in which the annual rate of mortality, during the 10 years, 1861–70, ranged from 15 to 39 per 1,000. The rates prevailing at each age period, in each sex, are compared with the rates that ruled in the 53 healthy districts in order to show the relative excess at each age period, and of each sex, in the more unhealthy districts.

Mortality Range - -			15–17	18–20	21–23	24	24–26	27–30	32	39
Persons to one square mile - - -			166	186	379	25,671	1,718	4,499	12,357	65,823
			DEATHS OF MALES AND FEMALES, out of Numbers living.							
AGES.	SEX.	Numbers living.	In 53 Healthy Districts.	In 345 Districts.	In 137 Districts.	In London.	In 47 Districts.	In 9 Districts.	In Manchester District.	In Liverpool District.
ALL AGES	Males -	5,692	100	112	130	151	149	172	201	233
	Females	6,131	100	114	128	137	144	158	187	223
0–5	Males -	2,411	100	124	164	210	212	244	284	349
	Females	2,931	100	128	170	224	223	260	310	394
5–10	Males -	17,825	100	109	141	167	168	196	250	294
	Females	18,416	100	111	139	163	164	183	212	279
25–35	Males -	12,063	100	106	118	131	117	159	177	241
	Females	11,919	100	111	123	105	123	123	156	208
35–45	Males -	10,030	100	103	123	172	137	181	233	302
	Females	10,081	100	105	119	129	127	142	194	243
45–55	Males -	7,386	100	104	127	190	152	199	255	323
	Females	8,432	100	104	119	156	139	167	242	312
55–65	Males -	4,211	100	106	130	185	161	186	253	299
	Females	4,662	100	103	120	156	146	167	235	269
65–75	Males -	1,834	100	103	122	152	144	163	199	219
	Females	1,975	100	101	114	133	132	146	186	189

Out of 2411 Male Children living under 5 years of age 100 die annually in the Healthy Districts, ... 284 in the Manchester District, and 349 in the District of Liverpool.

(Supplement to 35th Annual Report, p. clxii.)

2. RURAL AND URBAN MORTALITY.

Low Death-rates and Healthy Districts, 1841–50.—Upon examining the tables it was found that in three districts (*Rothbury* and *Glendale* in Northumberland, *Eastbourne* in Sussex,) the annual mortality was at the rate of 15 deaths in 1,000 living.

The annual rate of mortality was 16 in 1,000 living in the fourteen following districts; Holsworthy (Devon), Battle, Cuckfield (Sussex), Reigate (Surrey), Haltwhistle, Easthampstead, Guisborough, Bootle, Christchurch, Hambledon, Okehampton, Garstang, Builth, and Steyning.

The annual mortality was at the rate of 17 in 1,000 in Hendon (comprising Harrow), Belford, Southwell, Dorking; and in all forty-seven districts.

Upon going over these districts it will be found that the health and the circumstances of the population by no means approach any ideal standard of perfection. Nature, however, does much for the inhabitants. The fresh air dilutes the emanations from their nuisances; and infectious diseases are not easily transmitted from person to person in detached houses. Still the health of the people in those districts admits of improvement; and it may be assumed with certainty, that the mortality of the English people, in very variable but generally favourable conditions, dces *not* exceed 17 in 1,000 deaths.

The deaths of 17 persons in 1,000 may therefore be considered, in our present imperfect state, natural deaths; and all the deaths above that number may be referred to artificial causes.

It will greatly facilitate sanitary inquiry if a convenient scale can be framed for measuring the degrees of damage, and the loss of life, which each district sustains from the various causes of insalubrity. The most accurate scale is supplied by the Life Table; which can only be constructed by expending a considerable amount of labour on the returns of each district. A much simpler scale is derived from the rates of mortality. Thus the mortality in the districts of England ranged from 15, 16, and 17 to 36 in 1,000.

If, as has been proposed, 17 is taken as the point above which all the mortality is excessive, 17 will be the zero of this new scale; and in England the scale will range up to 19 or 20 degrees. There are 87 districts experiencing *one* death in excess of 17 annually; 96 have *two* deaths, and 111 have *three* deaths; and 18 have *eleven* or *more* deaths in excess annually. It may be observed that the mortality increases as the density of the population, or the nearness of the people to each other. —(16th Annual Report, pp. xv–xvi.)

Healthy District Mortality.—The proportion of the deaths in a given time to a given population is not an exact measure of its vitality; the mortality being very different at different ages, and the proportional numbers of young and old being disturbed by excesses of births over deaths, and by emigration, the deaths in two equal populations may vary from differences in their composition as to age, without implying any real differences in the vitality. A disturbance may also be produced from disproportions in the sexes. Under ordinary circumstances the annual rate of mortality, however, at all ages, serves as a sufficiently accurate measure of the relative sanitary condition of the population; and where this is insufficient, the mortality at quinquennial or decennial periods of life may be separately determined.

The mortality of England and Wales in 1857 has been compared with the mortality of England and Wales in the ten previous years, and it may be compared with the mortality (22·36 per 1,000) in the 19 years 1838–56. It is below that average. But is that average itself, it may be asked, the true standard? What is the natural rate of mortality among Englishmen, under favourable sanitary conditions? Under such conditions how long do they live? How many of them die annually? No direct answer can be given to these questions. No large body of Englishmen is breathing pure air, living on a perfectly sound diet, free from all defilement, and free from vice, exercising duly the mind and body generation after generation. We can point to no model city—to no model caste; we can discover no model parish in the country. In the matter of health we are all very ignorant or desperately negligent. What courses then remain open to the inquirer? One only. The mortality of the districts of England in which the sanitary conditions are the least unfavourable, can be employed as the standard measure until happier times supply the real standard of vitality. Sixty-four districts in various parts of the country are found where the mortality of the people ranged on an average extending over ten years from *fifteen* to *seventeen* deaths in 1,000 living. This is not an accidental event; the mortality only fluctuates in such places slightly from year to year, and the death rate under the same circumstances will not be exceeded. The people dwell in sixty-four districts extending over 4,797,315 acres, and their number at the last Census was 973,070. Undoubtedly the sanitary conditions in which they live are in many respects favourable. They generally follow agricultural pursuits; and they are scattered thinly over an open country, often on high ground, so that the impurities which they produce are dispersed and diluted in the air and water. They do not breathe each other's exhalations in theatres and churches. They do not drink water sullied by impurities. They do not drink poison in gin palaces. Their minds are not overwrought by dissipation, passion, intellectual effort. But visit their dwellings, and amidst much that is most commendable you will discover many sources of insalubrity. The bed-rooms are often small, close, crowded; personal cleanliness is not much studied; the dirty pig and the filth of various kinds lie here in close proximity to the house; the land there is imperfectly drained; in the winter, clothing, fuel, and food are scantily enjoyed in all large or improvident families; ignorance yields its baneful fruits; medical advice is ill supplied or unskilful. Yet the annual mortality per 1,000 of this million men, women, and children, year after year, does not exceed 17. Is it not evident that under more favourable auspices the death rate would be still lighter? Under such sanitary conditions as are known, and with all the mechanical appliances existing, can we not imagine a community living a healthier life than these isolated people?

Without affirming on physiological grounds that man was created to live a destined number of years, or go through a series of changes which are only completed in eighty, ninety, or a hundred years, experience furnishes us with a standard which can only be said to be too high. 17 in 1,000 is supplied as a standard by experience. Here we stand upon the actual. Any deaths in a people exceeding 17 in 1,000 annually are unnatural deaths. If the people were shot, drowned, burnt, poisoned by strychnine, their deaths would not be more unnatural than the deaths wrought clandestinely by disease in excess of the quota of natural death; that is, in excess of *seventeen* deaths in 1,000 living.

But it may be said that this standard cannot fairly be applied to determine the excessive mortality of large towns, which can never become so healthy as the country. How healthy towns may become we do not know. It is only proved that the population of parts of many towns experiences a mortality little above the natural standard; and that the prevalent diseases are referable to causes which evidently from their nature admit of removal. The question, however, is not, Does the excessive mortality admit of removal? but, does it exist?—and these two questions have no logical connection. The existence of the excess is established by comparing the actual mortality with the standard. Then the chief causes of the excessive mortality are now ascertained; and if the people have done all they can to remove them, the residual excess may be held to be inevitable. But what is inevitable at one time and in one place is not inevitable at other times and in other places. It is therefore of the utmost importance to keep steadily in view all the excessive mortality over and above that which is implied in the great decree: "It is appointed unto man once to die." In London during the sixteenth century the population lived about twenty years on an average, and 50 died out of 1,000 living; consequently the excess over 17 was 33. That this excess was not inevitable is now demonstrated; for, with a great increase in number, the population now lives about 37 years, and the mortality has fallen to 25 in 1,000. Is the excess of 8 deaths a year among every 1,000 living inevitable? This cannot be admitted for a moment, if we regard only the imperfect state of those sanitary arrangements which the public authorities of London have within their power. Nor can it be admitted that the excess of 5 deaths—or 22 deaths instead of 17—a year in every 1,000 living is inevitable in England and Wales, with evidence before our eyes of the same violations of the laws of nature in every district.

Whether the causes admit or do not admit of removal, the fact, then, is incontestable, and must not be lost sight of, that the excess of deaths in England and Wales over those from causes which exist in sixty-four districts was 91,652 in the year 1857; for 419,815 persons died in that year, and only about 328,163 persons would have died had the mortality not exceeded the standard of 17 deaths in 1,000 living.—(20th Annual Report, pp. xxxv—xl.)

Exceptionally Healthy Districts, 1841–70.—There are two districts in England exceptionally healthy; Glendale and Rothbury.* Their annual mortality during the 30 years 1841–70 was at the low average rate of 15 per 1,000.

In Rothbury, a third of the population is employed in healthy occupations connected with agriculture. The remarkable low death-rates, ruling at the different ages, are shown in the subjoined table, where they are compared with the rates in the healthiest parts of England:

AGES.	ROTHBURY DISTRICT.			HEALTHY DISTRICTS of ENGLAND.	DIVISION II. SOUTH EASTERN COUNTIES.
	MEAN POPULATION, 1861–71.	DEATHS in the 10 years, 1861–70.	ANNUAL MORTALITY. — DEATHS to 1,000 LIVING.	ANNUAL MORTALITY. — DEATHS TO 1,000 LIVING. 1849–53.	1861–70.
All Ages - -	7,114	1,105	15·5	17·5	19·1
0–	931	270	29·0	40·4	51·1
5–	834	56	6·7	6·9	6·5
10–	751	34	4·5	4·3	3·9
15–	1,316	60	4·6	7·3	6·6
25–	956	69	7·2	8·6	9·3
35–	768	74	9·6	9·6	11·9
45–	627	65	10·4	12·3	15·1
55–	486	101	20·8	22·3	25·7
65–	293	150	51·2	52·3	56·1
75 and upwards	152	226	148·7	145·3	151·5

* In the Rothbury district the village of Harbottle has 120 inhabitants, and Dr. Frank Richardson states that among them are 37 children under 14 years of age. During the last 20 years no child has died. He gives another instance of the vitality of children in the parish. "A farmer and his three shepherds, who have "occupied their present situations nearly 30 years, have among them 47 children, "and not a single death has occurred in these families. The inhabitants have "abundance of plain substantial food, excellent water, good residences as a rule, "and regular but not severe work in a pure bracing atmosphere; they are highly "intelligent and generally abstemious. I am indebted to the Rev. A. Proctor, who "has been upwards of 40 years the esteemed vicar, for the corroboration of the "statistics of this parish which I have now given you."

Such exceptional cases are well worthy of study; and our young health officers may learn a useful lesson of hygiene from these farmers and shepherds living on the southern slopes of the Cheviot Hills. Dr. Benjamin Richardson can scarcely hope that the mothers of his Hygiea will be more successful in rearing children—their lambs—than these shepherds' wives.

The district of Rothbury contains several very large ancient parishes. That of Alwinton on the southern slopes of the Cheviots extends over 46,681 acres, and comprises 16 townships. The population of this parish decreased from 1,325 in 1861 to 1,205 in 1871, when 39 births and only 9 deaths were registered, so the birth-rate of the parish in 1871 was 32·4 per 1,000 of population, whereas the death-rate was but 7·5 per 1,000.

The nine deaths registered during that year included two of infants under one of age, one of a person 25 years, three aged 50 and under 60, one aged 68 years, and another aged 92 years.

In the year 1874 only six deaths were registered, and, assuming the population to have been stationary since 1871, the mortality was at the rate of only 5 per 1,000.—(37th Annual Report, pp. xxi–xxii.)

Healthy and Unhealthy Districts of England, 1838–44.—Although no regular Registers of Deaths were kept before the Reformation, the chronicles show clearly enough that England has been periodically devastated by famines and plagues from the earliest times. A large proportion of the population of the island has been more than once swept away by these visitations. The great plagues of the sixth and seventh centuries—which destroyed, according to some estimates, half the inhabitants of the Eastern empire—extended to Britain. Besides the Black Death in the fourteenth century, the sweating sickness of the sixteenth century, and the plagues of the seventeenth century, terminating in the plague of 1665, described in detail by the historians—a long catalogue of famines and epidemics may be given, which, though briefly and imperfectly noticed in the chronicles, were perhaps not much less fatal.

After the Revolution the great plagues ceased; but the mortality was kept up by typhus, small-pox, influenza, and other zymotic diseases. The writings of Mead, Pringle, Lind, Blane, Jackson, Price, and Priestley,—the sanitary improvements in the navy, the army, and the prisons,—as well as the discovery of vaccination by Jenner,—all conduced to the diffusion of the sound doctrines of public health, and had a practical effect, which, with the improved condition of the poorer classes, led to a greatly reduced mortality in the present century. Since 1816 the returns indicate a retrograde movement. The mortality has apparently increased. Influenza has been several times epidemic, and the Asiatic cholera reached England, and cut off several thousands of the inhabitants in 1832. It reappeared and prevailed again, as we have seen, with no mitigated violence, in 1849.

The health of all parts of the kingdom is not equally bad. Some districts are infested by epidemics constantly recurring; the people are immersed in an atmosphere that weakens their powers, troubles their functions, and shortens their lives. Other localities are so favourably circumstanced that great numbers attain old age in the enjoyment of all their faculties, and suffer rarely from epidemics. The variations in the mortality are seen in the tables of the Ninth Annual Report. The rate of mortality is calculated on 2,436,648 deaths in the 7 years 1838-44; and on the population taken at the Census of 1841, in the middle of the period. On tracing over 324 sub-divisions of the country, the force of death in males and females of different ages, the most remarkable differences are discovered. Here of 1,000 young children under 5 years of age *forty* die, there a *hundred and twenty* die annually; here, of 1,000 men of mature age (35–45) *nine* die, there *nineteen* die yearly; of 1,000 men of 45–55 years of age *twelve* die in one district, *thirty* in another; at the more advanced ages of the next decennium (55–65) *twenty-four* die annually in one, *fifty* in another district: of 1,000 females of all ages without distinction, 14 die annually in three districts, 15 die in eighteen districts, 17 (or less) in forty-eight districts. And in strong contrast, 23 in 1,000 females die in twenty districts, 26 in 1,000 in three districts, 27 in seven districts, 31 in two districts.

The mortality at all ages, without distinction, differs much less than the mortality of children, and less even than the mortality of men and women of the age of 35 and upwards in the several parts of the country. The population from the age of 15 to 35 is unsettled; at that age the emigration of servants and artizans from the country to the towns takes place; and as consumption, the disease then most fatal, is slow in its course, its victims in many cases retreat from the towns to their parents' homes in the villages to die. And the death is registered where it happens, not where the fatal disease began, so that, on comparison, it is told twice in favour of the towns; once in being withdrawn from the town register, and a second time in being added to the country register, to which it does not properly belong.

Independently of external causes, and by the force of a natural law, the mortality varies at different periods of life; so that the rate of dying in two mixed populations may differ according to the varying proportions of children, young persons, or old people. The series of tables shows the rate of mortality at six periods of life, under five years, at 10–15, 35–45, 45–55, 55–65, and 65–75. It is shown in the extreme cases, that when the general mortality is either high or low, the mortality at nearly all these ages is high or low; and a collation of the whole leaves little doubt on the question of the relative insalubrity of the various parts of the country.

Upon looking generally at the health of the population, it will be found that people suffer most in the great town districts. Liverpool and Manchester are the places of highest mortality, then follow some of the districts of London, Merthyr Tydfil, Bristol, South Shields, Macclesfield, Hull, several districts of Lancashire, Sheffield, Nottingham, Leicester, Stoke-upon-Trent, Wolstanton and Burslem, Leeds, Newcastle-on-Tyne, Birmingham, Coventry, Wolverhampton, Newcastle-under-Lyme, Derby, Salisbury, Northampton, Bradford, Gateshead, Shrewsbury, Walsall, Norwich, Colchester, Sunderland, Exeter, Worcester, Bedford, Dudley, Bath, Ipswich, Carlisle, Lancaster, Cambridge, Aylesbury, Maidstone, Canterbury, Wycombe, Gloucester, Wakefield, and Reading.

The mortality is not increased equally at every age in these districts. And it varies considerably in the two sexes; the returns for childhood, manhood, and old age, males and females, conspire in proving the prevalence of general causes of insalubrity operating with different degrees of intensity, but with much greater force than in other parts of the country.

It is probable that under any circumstances a certain number of children born will never reach maturity; that in a numerous population there will every year be deaths at all ages, from internal or external causes. In the present state of mankind it is impossible to say how small the inevitable loss by death is, as in every place, and among all classes of people, certain known sources of insalubrity exist, which unquestionably account for a part of the prevalent mortality. The annual mortality of males and females of all ages in England is at the rate of 22 in 1,000; in Glendale, Bellingham, and Haltwhistle, three districts of Northumberland, the mortality in the same seven years was 14 in 1,000. Not to take an extreme case, a group of 21 statistical districts has been formed, and a table of the mean mortality has been deduced from the whole; which, as it represents the lowest rates of mortality hitherto observed, over a period of seven years in a considerable population, may for the present be called the mortality of man from natural causes. The excess of mortality over this standard may be unhesitatingly referred to artificial, unnecessary causes, in such tables as the following, showing the waste of life and health in 40 town and city districts. An equal population (100,000) is taken at six ages; and it will be observed that the insalubrity tells with most effect against childhood: the mortality under 5 years of age is raised 124 per cent.; in manhood it is raised 77, 83, 70 per cent. at three ages, and in puberty and old age 45 per cent. Out of *a given number of men*, at different ages, the deaths by unnatural causes increase every year; for the table shows that to 100,000 living in each period, the deaths are 700 by unnatural causes at the age of 35–45; and 1,060 at 45–55; 1,682 at 55–65. The rate of mortality is raised in a less ratio, but to a much greater extent in old than in middle age, for the natural mortality in old age is high. The absolute number of deaths is greatest in infancy, as the number of old persons living is small compared with the number of children living in every population; so that whether the ratio of increase on the natural rate of mortality, the actual increase in the rate of mortality, or the number of deaths be regarded, children are the most cruelly treated by the destroyer. Yet of every 17 men who die in towns, 7 die by unnatural causes; and of 1,000 living at the age of 40, *seven* die; at the age of 50, *eleven* die; at the age of 60, *seventeen* die; at the age of 70, *twenty-six* die every year from causes evidently external and unnatural. Women escape with the least loss; yet five in every fifteen annual deaths would not happen in healthy places.

ANNUAL Rate of Mortality per CENT. [or per 100,000] in Healthy and Unhealthy Districts, also the Excess of Mortality due to Unhealthiness.

MALES.				FEMALES.		
Age.	Low.	High.	Excess.	Low.	High.	Excess.
0—5	4·323	9·678	5·355	3·660	8·405	4·745
10–15	·393	·572	·179	·460	·603	·143
35–45	·913	1·613	·700	·992	1·411	·419
45–55	1·276	2·336	1·060	1·172	1·895	·723
55–65	2·396	4·078	1·682	2·131	3·323	1·192
65–75	5·657	8·224	2·567	4·799	6·964	2·165

The table may be read thus without reference to decimal points. Of 100,000 boys living, 4,323 die in comparatively healthy places, and 9,678 in unhealthy places, the excess of deaths chargeable on the latter is 5,355.

It often happens that unhealthy and healthy villages, streets, parishes, and towns are in immediate juxtaposition; and constitute parts of the same district. The effect of this admixture on the results is, that the unhealthy districts are *less unhealthy*, and experience a lower rate of mortality than they would if all the healthy parts were eliminated. Upon the other hand, the healthy districts are made to appear less healthy than they would if they consisted only of healthy places, inhabited by people in good circumstances, under a proper course of diet, discipline, and exercise. The difference in the mortality of the two classes of districts is therefore understated. (Cholera Report, 1849; pp. v–vi.)

Excessive Mortality in Towns.—The influence of air, water, food, and temperature on health and of the other conditions with which the Health of Towns Bill deals, was emphatically stated 60 years ago by Dr. Price, no mere theorist in this matter, but the scientific founder of the Equitable Insurance Society. After showing, from a comparison of the duration of life in London and Holy Cross, Stockholm and Sweden, Manchester and the parts around, that human life is shorter by almost one half in cities than in the country, he adds:—

"From this comparison it appears with how much truth great cities have been called the graves of mankind. It must also convince all who consider it, that, according to the observation at the end of the Second Essay, it is by no means strictly proper to consider our diseases as the original intention of nature. They are, without doubt, in general, our own creation. Were there a country where the inhabitants led lives entirely natural and virtuous, few of them would die without measuring out the whole period of the present existence allotted them; and death would come upon them like a sleep, in consequence of no other cause than gradual and unavoidable decay. Let us, then, instead of charging our Maker with our miseries, learn more to accuse and reproach ourselves.

"The reasons of the baneful influence of great towns, as it has been now exhibited, are plainly—First, the irregular modes of life, the luxuries, debaucheries, and pernicious customs, which prevail more in towns than in the country. Secondly, the foulness of the air in towns, occasioned by uncleanliness, smoke, the perspiration and breath of the inhabitants, and putrid streams from drains, churchyards, kennels, and common sewers."

This induction, drawn with great sagacity from a limited number of facts, gradually acquired strength; the experiments in prisons and the navy confirmed it; Mr. Milne, after Dr. Price, demonstrated the high mortality of towns, and of marsh lands; and Mr. Edmonds in the *Lancet*, proved from the Census and the returns, imperfect as they were, of the parish registers for six towns of England, for London, and the several counties, as well as from correct returns for Glasgow, that the mortality at all ages was from about 2·8 to 3·0 per cent. in towns—nearly 2·1 per cent. in all England, and as low as 1·7 or 1·8 in some counties. Mr. Edmonds also showed that the mortality bears a certain relation to sickness at each age. For every annual death, two persons are constantly suffering from sickness, of a severity that disables labouring men from work. According to Mr. Neison's recent observations, there are 2·5 constantly sick in Friendly Societies to one death under 60; the recorded sickness after 60 is greater; the sickness in infancy is unknown. But if we assume that 2·5 are sick to one death—and this proportion certainly does not include slight illness, or all for which people take physic—the numbers constantly sick in London were 122,000, and the annual attacks of sickness more than 1,220,000, during the seven years 1838–44; the number of annual attacks would have been at least 350,000 less, and the number constantly sick would have been 35,000 less, if the health of London had been as good even as that of Lewisham, one of the districts within its own limits. This view, and all the principal facts known in connexion with the public health of England are discussed in the article Vital Statistics, of McCulloch's Statistical Account of the British Empire, which appeared in 1837. The cholera epidemic, followed by an influenza in 1837, more fatal than cholera, and an epidemic of typhus, had drawn attention to the state of public health; the Registration Bill was brought into operation; Dr. Arnott, Dr. Kay (now Kay Shuttleworth), and Dr. Southwood Smith, were appointed by the Poor Law Commissioners to inquire into the causes of fever in parts of London in 1838; Mr. Chadwick conducted an inquiry into the health of many towns of the kingdom in 1839; subsequently, a Committee of the House of Commons, of which Mr. Slaney was chairman, collected evidence and drew up a report in 1840; and in 1843, a Royal Commission was appointed to inquire into the whole subject. The reports of the Commission appeared in 1844 and 1845.—(10th Annual Report, pp. xiii–xiv.)

Excessive Urban Mortality, London, 1838–44.—The English system of registration, however imperfect it may still be, has realised the expectation held out in the opening speech of the minister who introduced the measure to parliament, in so far as "it enables the Government to acquire a general knowledge of the state of the population of the country."* In successive Reports the births, deaths, and marriages have been compared with the population of different districts; the prevalence of diseases has been traced in various parts; and the irrefragable proofs of the high mortality in towns induced the late Government to appoint a commission of inquiry, which resulted in a Bill submitted to Parliament by Lord Lincoln and Sir James Graham. A new bill for improving the health of towns has been prepared and brought in by the Viscount Morpeth, Lord John Russell, and Sir George Grey. As this Bill is likely to occupy the attention of Parliament in the present session, it may be useful to introduce here some extracts from a series of calculations, based on the Census returns of 1841, and the deaths registered during the seven years 1838–44. The facts and methods of calculation are given at length in the Ninth Annual Report, 8vo.; in the mean time it will be sufficient to observe that the object of the investigation is to exhibit the mortality at different periods of life in the divisions, counties, towns, and groups of country districts into which England and Wales have been divided. From these results the duration of life can be deduced. Corrections have been made for the increase of population, deaths in hospitals, and other disturbing causes.

The mortality in Liverpool, Manchester, and some other places has been before adverted to. The tables show the mortality of all the districts now included in the London tables of mortality. They afford ample materials for reasoning; but I shall here only direct attention to a few of the points bearing more immediately on the great question of the health of towns. London contained 1,950,000 inhabitants in the middle of the year 1841; and 342,565 deaths were registered within its limits in the septennial period of which 1841 was the middle year. The deaths on an average were 48,938 annually. To 1,000 females living at all ages 23 died, while to 1,000 males living at all ages 27 died yearly. The mortality of females in the neighbouring counties, during the same seven years, was from 18 to 20; of males 19 to 21 in the 1,000; the mortality of females in London was 5, of males 8 in the 1,000 more than in the healthiest county. Out of an equal number of males living, there were 3 deaths in London for every 2 in the healthy counties. Out of 1,000 boys under 5 years of age in Surrey, and 1,000 in Sussex, 48 and 50 died annually; out of 1,000 in London, 93 died annually. The mortality of children under 5 years of age is twice as great in London as in the adjacent counties, including several towns.

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* See speech of Lord John Russell on bringing forward the Bill for the Registration of Births, Deaths, and Marriages.—*Mirror of Parliament*, 1836, *p.* 131.

—	Annual Deaths at all Ages to		Annual Deaths under 5 Years of Age to	
	1,000 Females living.	1,000 Males living.	1,000 Girls living.	1,000 Boys living.
Surrey - - -	18	19	41	48
Sussex - -	18	19	42	50
Hampshire - - -	18	20	44	52
Kent - - -	19	21	48	57
Berkshire - - -	20	20	46	53
London - -	23	27	80	93

The excess of deaths in London is not the result of climate, for the climate differs little from that of surrounding counties; and some of the London districts are not more unhealthy than many country districts. Take Lewisham, for instance, comprising Blackheath, Sydenham, Eltham, and Lewisham itself. The annual mortality of females was 16; of males, 18 in 1,000.

The deaths registered in London during the 7 years 1838–44 were - - - - -	342,000
If the mortality during the period had not been greater than in Lewisham, the deaths of London would have been about - - -	244,128
Excess of deaths in London -	97,872

Here are 97,000 deaths in 7 years from causes peculiar to London. Other districts may be taken in the place of Lewisham, but the result would be the same.

A considerable part of the population of London is recruited from the country, immigrants entering chiefly at the ages 15 to 35, in a state of good health. The sick and weakly probably remain at home; many of the new comers, too, unmarried, when attacked in London by slow consumption—the most fatal disease at the ages 15 to 35—return to their parents' houses to die; so that the mortality of the great city is made to appear in the returns lower at those ages than it is. If we take children under 5 years of age, where neither these disturbing causes nor occupation interferes, the deleterious influence on health of London in its present state will appear undisguised in all its magnitude.

The deaths registered in London (1838–44) under 5 years of age were - - - -	139,612
The deaths, if the mortality had not been higher than in Lewisham, would have been - -	80,632
Excess of deaths in London among children -	58,980

Here are more than 58,000 children destroyed in London within 7 of the last 10 years.

In these plain and appalling facts—in the detailed statements that follow of the mortality at each age of life in the several districts—or in the circumstances of the several parts of the population, it is difficult to discover any valid reasons for excluding London from the operation of the measure of Her Majesty's Government for "improving the Health "of Towns in England."

There are, however, circumstances peculiar to the metropolis, which present difficulties, and which must be taken into account. The Health of Towns Bill—with the Improvement Clauses—proposes to enable the mayor, aldermen, and burgesses of corporate towns to prepare plans and maps of their respective jurisdictions; to lay out, pave, improve, cleanse streets; provide market-places and slaughter-houses; remove nuisances and dangerous buildings; regulate lodging-houses; secure the ventilation of public buildings; prevent smoke and extinguish fires; lay down sewers and drain houses; procure supplies of pure water and artificial light. It proposes to give the same powers to Town Commissioners, two-thirds of whom are to be elected by the rate-payers—one-third to be appointed by Her Majesty—in unincorporated towns. It provides the constituted authorities with qualified officers. The Town Councils or Town Commissioners are to appoint surveyors. The First Commissioner of Her Majesty's Woods and Forests, and three others, are to be "The Commissioners of Health and Public Works" to carry out the Bill—appoint Officers of Health, Inspectors, Auditors, to advise and to aid the Local Authorities. The Bill gives the "Commissioners "of Health and Public Works" power to enforce few or no improvements; they can only suggest them; nothing can be done without their knowledge; some things require their approval. The peculiarity of London consists in this, that of its 1,950,000 inhabitants, in 1841, dwelling in 263,000 houses, valued at a rental of nearly 11,000,000*l.** and standing on 115 square miles of land†—only 124,915 men, women, and children, dwelling in 15,727 houses, valued at 1,399,128*l.*, standing on an area of less than a single square mile north of the Thames—have the advantage of Municipal Institutions. The rest of the Metropolis is governed by innumerable Vestries, Paving Boards, Sewers' Commissions, Water Companies, Gas Companies, and other bodies, which escape observation, and, to a certain extent, responsibility. The Commissioners appointed to inquire into Municipal Corporations in 1837, reported that in 1831 the assessed taxes paid by the City were 205,476*l.*; by the rest of the Metropolis included in the Parliamentary Boroughs, 1,022,131*l.* "With respect," they say, "to the nature of the population, it is well "known that, on the one hand, the City contains by far the most active "commercial district of the metropolis, and that it forms the northern "bank of the highest part of the Thames accessible to large vessels; "and, on the other, that it does not contain either the Courts of Law, "the Houses of Parliament, or Government Offices, or, generally "speaking, the residences of the higher or more opulent classes." The "Corporation Reform Act," in other cities, brought all the parts that would popularly be termed the town within the scope of the municipal authority. Having "pointed out how small a proportion of the metro-"polis is comprehended within the municipal boundary," they profess themselves "unable to discover any circumstance justifying the present "distinction of this particular district from the rest, except that in fact "it is, and had long been so distinguished."‡ The Health of Towns Bill, without raising the question of Municipal Reform, proposes to deal tenderly, but impartially with London; it leaves the City in possession of all its privileges, and will apparently give to it the same powers under the Act, and subject it to the same inspection as the Reformed Municipal Corporations; while the rest of the metropolis is to be dealt

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* Derived from the Return of Real Property assessed to the Property and Income Tax, for the Year ending April 5th, 1843. The annual value of property in London rated for the relief of the poor in 1841 was 7,810,216*l.*

† The area of the Thames in London is not included in this statement.

‡ *See* extract from the Commissioners' Report, p. 14.

with on the same general principal as unincorporated towns, the Act being put in execution by "Town Commissioners, possessed of real or "personal estates to the amount of 5,000*l*., or rated to the relief of the "poor upon the annual value of not less than 50*l*., of whom one-"third shall be from time to time appointed by Her Majesty, and the "remaining two-thirds shall be elected by the rate-payers of the several "parishes or places included within such district." Such is a brief outline of the important measure which has been proposed by Her Majesty's Government to improve the Health of London, as well as of the other Towns of the Kingdom, and so to put a stop if possible to the sickness, suffering, and loss of life brought to light by the Registration Returns.

Instead of the inhabitants of London "measuring out the whole "period of the present existence allotted them," it is found that, in 7 years, 139,612 perished in infancy (under 5 years of age); 40,830 in youth (5 to 25); 109,145 in manhood (25–65); and that only 52,464 attained the age of 65 and upwards. Instead of "death coming upon "them like a sleep," when the faculties are dulled by age and slow decay,—it convulses tender infancy, falls with burning fevers upon man in his prime, snatches away the mother with the babe still upon her breast. But not to take an extreme view, nor to be too sanguine—and, above all, to avoid any exaggeration—let us set down here the deaths in London and the deaths which would have happened at different ages if the mortality had not been higher than it was in Lewisham, where any one who will take the trouble may ascertain that many obvious and easily removed causes of insalubrity still exist.

Age.	Deaths in London.	Deaths that would have happened if the Mortality had been the same as in Lewisham.	Excess of Deaths in 7 years by causes peculiar to London.
0—5	139,612	80,632	58,980
5—25	40,830	35,706	5,124
25—65	109,145	83,447	25,698
65 and upwards	52,464	44,343	8,121
All specified Ages	342,051	244,128	97,923

Such is the excess of mortality. The excess of sickness must have been still greater.

At the two or three meetings held to oppose the Government Bill for improving the Health of Towns, by bodies holding local trusts, no reference was made to the loss of life constantly going on in London. It appears to have been unknown to the speakers, or to have been taken for granted because the mortality is little more than half as high in the present as it was in the 17th century, that the health of the metropolis is perfect; that plague having been expelled, typhus and consumption may be tolerated. Now the plain truth is that one day with another 134 persons die daily in London; that the great majority are untimely deaths,—children, fathers, mothers, in the prime of life; and that at least 38 die daily in excess of the rate of mortality which actually prevails in the immediate neighbourhood. 38 persons are destroyed every day in London by local causes. If these deaths took place on London Bridge or at Newgate, would any sensible man in the city oppose any reasonable measure devised by a Minister of the Crown to put a stop to the frightful sacrifice of life? The city has consented to see Newgate partly free from fever—inspected by an Officer of the Crown. Why is the disease cast out of criminals to be allowed to enter and destroy the labouring multitudes? Are their lives of less value? But the city itself, it is said, is as healthy as it can be; the authorities have done everything that can be done. A minister of health can suggest nothing which the City of London has not already accomplished. Has the Lord Mayor ascertained this by personal inspection? He has the conservancy of the swans and fish of the Thames: and so weighty has this duty been held that the first magistrate attended by the civic authorities proceeds periodically to hold courts of inspection and to ascertain the condition of these creatures. If some time after having been

To Thames's banks which fragrant breezes fill,

and seen the white swans on the river and the fishes glide through the clear waters, on landing from his barge below Temple Bar he would place himself under the guidance of Dr. Lynch, a medical officer, and Mr. Hutchinson,* a surgeon and registrar of the city, they could lead the procession on the way to Newgate, Smithfield Market, Houndsditch, and the Tower, through alleys, and lanes, and up courts inhabited by citizens of London, presenting a far different aspect; they would pass through streets on which the sun rarely shines, houses saturated with pestilential vapours—and breezes fanning sewers and excremental matter—the most fatal field of fever in the metropolis. They would see disease gleaming in the eyes of children, wasting the bodies of women, prostrating the strength of men. If they called for the registers of death for the City without the walls, they would find in them 13,637 names enrolled in seven years—five thousand of which would have had no place there if the "deliberate conviction" of the Commission of Sewers were well founded that the "City of London for health, clean-" liness, effective drainage, lighting, and for supply of water to its" inhabitants, cannot be surpassed." (10th Annual Report, pp. ix–xvi.)

Area, Elevation, and Density of London, 1868.—The area of London is 122 square miles, equal to a square of a little more than 11 miles, 18 kilometres to the side. The Thames and the tides unite the great city to the sea. The ground rises to an elevation higher than the hills of ancient Rome, but a considerable part of the population on the south side of the river is living below or at the level of the Trinity high-water mark. The average elevation of the ground at which the population lives is 12 metres (=13 yards). The points below high-water mark on the north side of the Thames are in Fulham, Pimlico, Westminster, and the Isle of Dogs; on the south side in Battersea, Kennington, Camberwell, Bermondsey, and Rotherhithe. The Plumstead marsh has the lowest surface, from 5 to 11 feet *below* high water mark. The highest elevations are at Hampstead (429 feet = 131 metres) in the north, and Shooters Hill (411 feet) and Sydenham Hill (360 feet) in the south. The site of the capital of the empire is an eliptical river basin round the dome of St. Paul's cathedral. The population is unequally distributed, dense in the centre, less dense in the outside districts. The mean density is expressed by nearly 100 people living to a hectare, 40 to an acre; the population density of the capital is 100 times the density of the United Kingdom. The people live in 400,778 houses; the streets are irregular and often narrow, but the elevation of the houses is not often so lofty as to cover the streets with unhealthy shadows. The annual value under county rate assessment exceeded 15,000,000*l*. (31st Annual Report, pp. lxiv–v.)

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* See Mr. Hutchinson's accurate account of the wretched state of parts of the West London District, 5th Annual Report, 8vo., p. 537.

Excessive Urban Mortality; Manchester compared with Surrey, 1838–44.—" The Seventh Annual Report, 8vo. edition (pp, 330–338), contains some calculations which set in a striking light the extent to which human life and health have hitherto been sacrificed. The calculations have been made with care; they are based upon the returns of deaths for the seven years 1838–44, and the Census taken in 1841, the middle of the period. It appears—to give a few examples of the results—that the annual deaths in the town districts of Manchester to 1,000 males living are 37, in the extra-metropolitan parts of Surrey 19 in 1000. To take particular ages, the annual mortality of boys under five years of age is 48 in Surrey, 148 in Manchester, to 1,000 living.

" Of men of the age of 35 and under 45, the annual mortality is 11 in Surrey, 21 in Manchester to 1,000 living. The enormous difference will be rendered more obvious to some by the simple facts:—

		Deaths registered in the 7 Years 1838–44.
" Population of the Town Sub-Districts of Manchester in 1841 - - -	163,856	39,922
" Population of the Extra-Metropolitan Districts of Surrey - - -	187,868	23,777
	Difference -	16,145

" The population of Surrey exceeded that of Manchester, yet in 7 years 16,000 persons died in Manchester over and above the deaths in Surrey, the mortality in which from the poverty of the labourer, and slighter degrees of the influences so fatal in Manchester, is higher than it should be. There were 23,523 children under 5 years of age in Surrey, and the deaths of children of that age were 7,364; the children in Manchester were 21,152, the deaths 20,726. In the 7 years, 13,362 children in Manchester alone fell a sacrifice to known causes, which it is believed may be removed to a great extent and the victims in Liverpool were not less numerous. Other parts, and particularly the *towns* of England, are similarly afflicted.

"It is found from the returns of the 7 years 1838–44, that the mortality of Liverpool and Manchester, and the worst parts of other towns, is nearly double the mortality of tolerably salubrious districts.

" It is well known that the decaying matters of marshes give rise to agues, dysenteries, and fevers; and it is proved satisfactorily by the facts collected under the Registration Act that the excessive mortality from diseases of the zymotic and other classes, observed in towns, is occasioned by animal or vegetable poisons, with which the atmosphere is charged, in different degrees of concentration, depending on accumulated filth, crowding in dwellings and workshops, the closeness of courts, imperfect supplies of water, and the want of efficient sewers. The high temperature of the summer of 1846, in which the mean temperature ranged from 0°2 to 7°7 above the average during 10 weeks out of 13, accelerated the decomposition, and increased the virulence of these effluvial poisons as well as of the diseases which they promote. Once grown epidemic, the diseases continued to rage during the rest of the year. Thus the mortality of 1846 may be accounted for. If it took place in obedience to any cyclical law, or to a general cause acting simultaneously in Asia and Europe, the great fact remains, that the deaths were nearly twice as numerous in ill-constructed towns, where the poison is concentrated, as in the country, where it is diluted and destroyed by the fresh air.

"The precise degree of influence which the various agencies have in causing the high mortality of towns is not easily determined. Opinions differ as to what fraction of the suffering and death is to be set down to the want of water or of sewerage; crowded lodgings, narrow streets, ill-ventilated workshops; the destitution of skilful medical advice; the neglect of children; doses of opium and inroads of quackery; slaughter-houses and rank churchyards."—(9th Annual Report, pp. 26–36.)

Loss of Life in large Towns, 1851–60.—The population was so distributed in the thirty town districts, that at the rates of mortality prevailing in the healthy districts at eleven different ages the annual deaths would have been 38,459 in the ten years 1851–60, when the mean population was 2,541,630. The annual rate of mortality in the two sexes would have been 15·13 per 1,000. With the same distribution of population in respect to age and sex as existed in the healthy districts, the mortality would have been at the rate of 17·53 per 1,000; while the rate of a normally constituted population under the same law of mortality would have been 20·41 per 1,000.

The *actual* mortality deduced from the deaths and the population of the thirty districts was at the rate of 28·01 in 1,000; and the corrected mortality would exceed this number.

In comparing the mortality of town and country districts together, without distinction of age, it must be borne in mind that the method is comparatively favourable to the towns, as the proportion of the masked mortality is in them greater than it is in the country districts.

DEATHS in 30 LARGE TOWN DISTRICTS in the 10 Years 1851–60; and also the DEATHS which would have occurred if the MORTALITY had been at the same Rate as prevailed in the 63 HEALTHY DISTRICTS (1849–53).

AGES.	Deaths in 10 Years 1851–60.	Deaths which would have occurred in the 10 Years at Healthy District Rates.	Excess of Actual Deaths in 10 Years over Deaths at Healthy District Rates.
All Ages	711,944	384,590	327,354
0–	338,990	135,470	203,520
5–	31,319	19,290	12,029
10–	14,240	11,020	3,220
15–	43,807	37,550	6,257
25–	48,625	36,150	12,475
35–	50,071	30,320	19,751
45–	49,638	26,680	22,958
55–	49,763	27,020	22,743
65–	47,445	31,510	15,935
75–	30,583	22,920	7,663
85 and upwards	7,463	6,660	803

The loss of life in the ten years under the sanitary arrangements existing is illustrated in the above Table. Thus, at the rates prevailing at the several ages in the healthy districts, the annual deaths would have amounted in the thirty town districts to 38,459; but the actual average number of deaths was 71,191; there was consequently an annual excess of 32,735 deaths, which may be justly ascribed to the unfavourable sanitary conditions in which the people live and die.—(Supplement to 25th Annual Report, pp. xxvi–vii.)

Causes of Excessive Urban Mortality.—The atmosphere, besides oxygen and nitrogen, contains carbonic acid and aqueous vapour. The mean proportion of carbonic acid is 49 volumes in 100,000 volumes of air, according to the younger Saussure; who also states that it varies from 37 to 62 volumes. Mr. Coathoupe has estimated the quantity of air which passes through the lungs of a man of ordinary size in 24 hours at 267 cubic feet, of which nearly 8 per cent. by volume, or 21 feet, are exchanged for carbonic acid;* the bulk would be equivalent to a cube of 6·4 feet. If, for a mere illustration, we assume that on an average 16 cubic feet of the gas are thrown off from the skin and lungs of each person, 30 million cubic feet will be exhaled daily by the population of the metropolis, distributed over an area of about 1,951 million square feet. Add the amount of the same gas formed by animals of every kind,—fires, lamps—and multiply the sum by 100, inasmuch as respiration for several hours in air which contains 1 or 2 per cent. of carbonic acid has been found to produce alarming effects (Broughton), and it will be seen that without effectual means of dispersion the amount of air vitiated in the metropolis, by this element alone, would be by no means inconsiderable.

Is the excessive mortality, then, in towns, to be ascribed to the accumulation of carbonic acid, or of any similar gas, which is so rare as to be innoxious in open districts? It was natural, when it had been discovered that carbonic acid mixed in air destroyed animals, and after many accidents in mines and closed chambers had been traced to this agent, to ascribe the excessive mortality of towns to the same cause. Further investigation must show, I think, that it has but a small share in raising the mortality of towns, the provision for its dispersion is so complete.

The velocity with which the air rushes into a vacuum is the same as that of a body that has fallen from a height of about 26,000 feet (nearly five miles); or, according to the Torricellian theorem, putting v for velocity, g for the velocity acquired in one second by a body falling freely, and h for the height of the homogeneous gaseous column, $v = \sqrt{2gh}$. As $g = 32{\cdot}19$ feet, and $h = 26{,}000$, the velocity is 1,296 feet in a second.† But the height of the column is inversely proportional to the density of the gas; the reciprocal of d (= the density) must therefore be put under the radical, in applying the formula to any other gas besides atmospheric air, which is taken as unity. The density of carbonic acid is $d = 1{\cdot}524$; and $v = \sqrt{2gh\frac{1}{d}} = 1{,}049$. The velocity with which carbonic acid rushes into a vacuum is 1,049 feet a second. In applying the formula to different gases, $2gh$ might remain invariable; d (= the density of the respective gases) would vary, and the relation of v (the velocity) to d (the density) is such that v would vary as the square root of the reciprocal of d. The density of hydrogen is ·069, and its diffusive velocity is 4,920 feet a second, or 3·8 times the diffusive velocity of atmospheric air, 4·7 times that of carbonic acid; the diffusive velocity of carbonic acid is eight-tenths that of air.

Dalton discovered that carbonic acid entered the space occupied by hydrogen in the same proportion as if no hydrogen had been present.

* Graham's Chemistry, p. 1016.

† Poisson estimates the height of the atmospheric column at the temperature of zero, pressure 0·76 metre, to be 7950 metres.

He inferred that gases do not, like liquids, exclude each other, and this is now admitted. So that if an air-tight chamber full of carbonic acid communicate with the external air, the same quantity of air will find its way into the chamber as if no carbonic acid gas were present; and if water were introduced, the same amount of aqueous vapour would occupy the space as if neither gas were present. The elasticity and density of the atmosphere of the chamber would be the sum of the densities and elasticities of all the gases and vapours. It has been assumed here, to simplify the statement, that while the atmospheric air entered the carbonic acid gas remained; but it would in fact go out, for the same reason that the air entered in order to set the gases without and within in equilibrium.

Professor Graham has investigated the rates at which gases are diffused through small apertures and porous substances. To understand the law of these movements, let us assume that two large equal spaces, A and B, 1,000 feet long, are separated by a partition; that the one (B) is a vacuum, the other (A) filled with carbonic acid gas; we know that if the partition were removed the gas would rush into the empty chamber with a velocity of 1,049 feet a second. If the partition were permeable the gas would enter, but at a slower rate, and different gases would enter at different rates. If the partition were of stucco (dry), and A were filled with hydrogen, B with air, the hydrogen and air would both pass through the stucco, and if the quantities of air on one side, and hydrogen on the other, were collected as they escaped, it would be found that the volume of hydrogen that passed in a second was to that of air as 3·8 to 1. Professor Graham ascertained experimentally the relative proportions transmitted—which he called *diffusion volumes*—of these and other gases, and discovered that the "diffusion volumes" were as the reciprocals of the square roots of the densities of the several gases. The "diffusion volume" is evidently the measure of the velocity; 3·8 : 1 is the relative velocity with which hydrogen and air rush into a vacuum; and while the interposition of a porous substance equally retards the velocities of gases, it leaves the ratio of these velocities, which is as the square roots of their densities, unaltered. Graham's experimental method has the same relation to the movements of gases as Galileo's inclined plane to the fall of solid bodies; it is not only a discovery but an instrument.

The Professor remarks that the result of diffusion is, that gases enter space in the same quantities ultimately as if no other gas existed in the space: but that "the diffusive process takes place in different gases "with very different degrees of rapidity. Thus, the external air "penetrates into a 'diffusion tube' with velocities denoted by the "following numbers, 1277, 622, 302, according as the diffusion tube is "filled with hydrogen, with carbonic acid, or with chlorine gas."* This is quite in conformity with Dalton's doctrine, that "the resistance which "the particles of one gas offer to those of another is of a very imperfect "kind, to be *compared to the resistance which stones in the channel of a* "*stream oppose to the flow of running water*."† One gas does not pass through another with the same velocity as it would through space; and the various retardations of the velocity of its passage through different gases is no more a deviation from the law than the fact mentioned by Professor Graham,—that the gases go more slowly through cork than through stucco. That the presence of air retards the diffusion of vapour is evident from Leslie's experiment for freezing water under the air-pump, in which the air is removed to facilitate the passage of vapour,

* Graham's Elements of Chemistry, pp. 75, 76.
† Graham's Elements, and Manchester Memoirs, vol. v.

from the surface of the water to the sulphuric acid. All the phenomena of evaporation into the atmosphere establish the same fact. The pouring of carbonic acid from one vessel into another proves equally well that the velocity of its diffusion is retarded.

To form an idea of the dispersion of the carbonic acid gas generated in towns, according to the law in pneumatics, assume that 1,000 cubic feet are formed per second; it will be equal to a cube of 10 feet. Now if this volume of carbonic acid were in the centre of a vacuum it would disperse in every direction at a velocity of 1,049 feet a second. It is nearly the velocity of sound. A particle would fly a mile in 5 seconds, 12 miles in a minute. The velocity of a "high wind" is 50 feet a second, "a hurricane that tears up trees" 147 feet a second—one-seventh of the velocity with which carbonic acid rushes into a vacuum. If the gaseous film evolved every second over the area of the metropolis were pure air, it would only move slowly away, by the impulse with which it was thrown off, and because it was lighter than the atmosphere; but as it is carbonic acid, the surrounding atmosphere is a vacuum, into which its rush is opposed only by the small quantity of carbonic acid gas existing, and the sluggishness of the aerial particles. The rapid removal of this gas from cities is effected by a force much greater and altogether independent of the winds. It is carried rapidly through the air, until it is fixed again by vegetation and exchanged for oxygen, which flows into the atmosphere of cities, according to the same law, to replace the oxygen consumed.

These results are confirmed by chemical analysis of the air. The differences in the quantity of carbonic acid in winter and summer, night and day, are ascribed by Dumas to more of the gas being absorbed, retained, and brought down by rain in cold than in warm weather. They are meteorological changes extending over all the atmosphere. Chemists have hitherto failed to detect any excess of carbonic acid gas in cities. A commission is now sitting in Paris, engaged in the analysis of the atmosphere by Dumas's method, which is held to yield the most accurate results. I am not aware that the air of any place in England has been analyzed by the new method, but the observations in other countries show no diminution of oxygen in the city air. Thus the oxygen was to the nitrogen in the air of Paris as 230·0 to 770·0 (by weight); and on Faulhorn, in Switzerland, 8767 feet above the level of the sea, as 229·7 oxygen to 770·3 nitrogen.*

* The proportions in the subjoined table are by weight; the aqueous vapour and carbonic acid were abstracted. They are all the analyses that have yet appeared in the *Comptes Rendus* of the French Institut.

	Oxygen.	Nitrogen.	Chemists.
Paris - - - -	230·0	770·0	Dumas.
Brussels - - -	230·6	769·4	Stas.
Geneva - - - -	229·8	770·2	Marignac.
Berne - - -	229·5	770·5	Brunner.
Faulhorn - - - -	229·7	770·3	Dumas.
Gröningen - - -	229·9	770·1	Verver.
Copenhagen - - - -	230·1	769·9	Lewy.
North Sea - - -	226·0	774·0	Id.
North Sea - - - -	231·2	768·8	Id.
Elsinore - - -	230·4	769·6	Id.
Guadeloupe - - - -	226·8	773·2	Id.
Guadeloupe - - -	231·4	768·6	Id.

Recherches sur l'Air, by M. Lewy, Copenhagen. Comptes Rendus, t. 17. Aug. 1843, p. 235.

Carburetted hydrogen and sulphuretted hydrogen arising from graves are less dense, and are dispersed more rapidly than carbonic acid: scarcely a trace of them can be detected.

Carbonic acid and other noxious gases can, as is well known, be confined for a time in well-closed apartments, and oxygen can be excluded, but the dispersive force is so great, that chemists have seldom succeeded in detecting any difference in the proportions of the gases, even in the air of crowded hospitals. If any difference exist it must be small, and might have a slight effect on health, but, as the experience of our collieries proves, would not raise the mortality to anything beyond a fraction of 40 per cent.; besides, the country is exposed as well as the town population to the influence of deleterious gases in the close chambers of small cottages.

It is, then, to matters suspended in the atmosphere of cities that the excessive mortality must be referred. Smoke is heated gas, carrying with it unburnt particles in suspension; the carbonic acid is scattered immediately by its diffusive velocity, and the particles of solid matter, carried up by the heated air into the sky, disperse, become invisible, and fall around insensibly, in a clear atmosphere, or at a distance when there is any wind. If watery vesicles are also suspended in the air, the column of smoke ascends but a little, carbonic acid is absorbed, the carbon imbibes water and air, it mixes with the watery cloud, and all the phenomena of a London fog are produced. These fogs form apparently when the temperature of the Thames is higher than the temperature of the air,* which is calm (or if there be any wind it is nearly saturated), the fogs generally disappearing as the temperature of the air is raised by the sun.

That the smoke is irritating to the air-passages, injurious to health, and one of the causes of death, to which the inhabitants of towns are more exposed than the inhabitants of the country, is probable; but if the effect were very considerable it would be most evident in the dense fogs, when the atmosphere is loaded with smoke, and is breathed for several consecutive hours by the population—men, women, and children. Now we have never observed any connexion between the increase of the mortality and the London fogs. The diseases, again, caused by smoke must be of a mechanical nature, and affect the lungs and air-passages; it may increase the pulmonary diseases, but will assuredly not produce scarlatina, measles, typhus, and other diseases which prevail in towns.

"It may be stated in general," says Dr. Price, "that whereas in great towns the proportion of inhabitants, dying annually, is from 1 in 19 to 1 in 22 or 23, and in moderate towns from 1 in 24 to 1 in 28; in country parishes and villages, on the contrary, this proportion seldom exceeds 1 in 40 to 50."†

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* I believe that no comparative observations have hitherto been made in London on the temperature of the air and river; but Professor Fournet has shown, from the observations of four years at Lyons, on the confluence of the Rhone and Saône, that the temperature of the rivers, from November to March, is considerably higher than the mean temperature of the air. The fogs set in in November. *Météorologie de Kaemtz.*—(Note by French translator, *Ch. Martins*, p. 111.) Kaemtz remarks (p. 113) that "50 lbs. of incandescent carbon, exposed in the open air, will weigh "from 105 to 107 lbs. in the course of a few days; a fact well known in powder-"mills. Hence the particles of carbon in escaping from the chimney absorb air and "become heavier. Nevertheless, the wind may carry them to a distance; but if the "air be calm and humid, the specific gravity of the particles augments rapidly, they "mingle in the fog, and spread over the neighbourhood."

† First Additional Essay, 1775. Works by Morgan. Seventh edition, vol. ii. p. 218.

The terms "great towns," "moderate towns," and "villages," are not sufficiently specific for our present purpose; but the general principle announced by Dr. Price is correct,—that the mortality of towns has a tendency to increase at the same time as they extend. It is a particular case of the law of density. The displacement of the atmosphere of towns is effected by ascending columns and by circumfusion; it must diminish as the proportion of the surrounding to the enclosed houses decreases. The four sides of a solitary house are exposed to the currents of the atmosphere; of 16 houses built on equal squares, in the form of a square, 12 face the open country, 4 are completely enclosed. Of 10,000 houses on a square area, 9,604 are enclosed; a city of 250,000 houses built on equal squares, and in the form of a square, would be surrounded by only 1,996 houses facing the country. The ratio of the total to the exterior houses built on a square area, if n express the number on a side, will always be $\frac{4(n-1)}{n^2}$; and the proportion of the exterior houses will diminish rapidly as n increase in all other polygonal forms as well as squares. That this disadvantage and that of density can be counterbalanced is seen by the fact that while the population of English towns has increased the mortality has fallen in the largest, below the standard fixed by Dr. Price for moderate towns.

It is proved beyond doubt that, if the population be the same in other respects, an increase of density implies an increase of mortality; and that the ratio of increase in the mortality is as certain roots of the density. If a further and more extended inquiry, into which I have not time now to enter, should confirm the principle that the mortality in towns* is as the 6th roots of the density of the population, it will be time enough to ask why this should be the particular ratio. But the chemists must first discover means of determining the density of the atmosphere of organic matter, which may be called the *zymotic atmosphere*, in different districts. The density of population is no strict measure of the density of the zymotic atmosphere; nor, admitting that the matter is a poison, does the relative density of the population express the relative quantities inhaled in a given time; if it did, it is improbable, and contrary to all analogy, that the mortality should increase in the simple ratio of the dose. The exact effect of increasing doses of poison has not been accurately determined; but it is well known that small quantities of all poisons are taken with impunity, and that the dose of arsenic, opium, or prussic acid may be increased up to a given point, at which the disease produced is severe or fatal. Four drops of prussic acid, diluted, may be taken with safety, when four drops more would kill a certain number of persons. How large, or, rather, how small, the dose of matter may be which will produce a zymotic disease it is impossible to say; but if a minute diluted charge of *vaccinine* (vaccine lymph) produced cow-pox, say one time in 100, it would be an interesting problem to determine, by doubling the quantity, in what ratio the proportions infected increased. (5th Annual Report, pp. 411–24.)

The density of the population in the town districts was such in 1851 that 384 persons lived on a *hundred* acres, while in the country districts 28 lived on the same ground; so that 14 were living in the same space in towns as was occupied by one in the country. It was shown in the Sixteenth Report that under our present imperfect sanitary regimen the

* I say "towns," because the application of the formula must have a limit.

mortality of the population increases in proportion as the population increases in density; and there must consequently be some relation between these elements.

The matter of which living beings consist is undergoing perpetual changes; it advances from the stages of water, air, salts, earth, and compounds of the other elements, into the vegetable and animal organizations of nature, where it exhibits all the phenomena of life. In this highest state every beat of the heart, every movement of the limbs, every sensation along the nerves, every emotion of the soul, every effort of the intellect, discharges a certain number of atoms from their places to escape in the breath and the secretions; at length the whole body dies; and as its elements ascended through various degrees to the highest life, so they descend gradually after death through various transformations to simpler states. In several of these stages the decaying matter has, in the air, in the water, and in contact with the skin, the power to harm the living; it has a tendency to impress its own action on their organs; and under certain circumstances the foul matter is the breath of the noisome pestilence. In the air it is poison; under the earth from which it came, it goes through its final stage of disintegration, and rises, by the quickening force of seeds, again life-giving into the light.

In conformity with a law of nature the organic refuse in the atmosphere is converted by oxygen in a peculiar state into carbonic acid, or it assumes the form of volatile ammonia and of other compounds, which are dispersed; the velocity of the conversion and of the dispersion bearing a certain proportion to the quantity of such matter, the agitation of the air, and the temperature. The refuse in water is subject to similar changes under similar conditions.

Men then are always surrounded, in air and water, by an atmosphere of decaying matter, which is given off from their own bodies and from the animals by which they are surrounded; the quantity is in the same conditions proportional to their numbers; but the quantity of this matter in a noxious state is reduced to insignificance when a small number of men live on a large area, when their dwellings are on high ground, and when all the refuse is laid every day as it is produced under the disinfecting earth from which it sprang. (19th Annual Report, pp. xxv–vi.)

Diseases of Town and Country.—Different classes of the population experience very different rates of mortality, and suffer different kinds of diseases. The principal causes of these differences, besides the sex, age, and hereditary organization, must be sought in three sources—exercise in the ordinary occupations of life—the adequate or inadequate supply of warmth and of food—and the differennt degrees of exposure to poisonous effluvia and to destructive agencies.

The concentration of the population in cities doubles the deaths from zymotic diseases and diseases of the nervous system; the ratio of deaths having been as 1 to 2·11, and 1 to 2·13; and upon reference to individual diseases, it will be observed that the augmentation in the latter class occurs principally in convulsions and hydrocephalus:—Deaths by convulsions, counties 1,347, cities 3,723, ratio 1 : 2·76; by hydrocephalus, counties 559, cities 1,540, ratio 1 : 2·75. It has already been intimated that convulsion is a frequent intercurrent symptom in diarrhœa and diseases of the epidemic class in infants; it may exist, however, as an independent affection, and in that case has clearly, as well as hydrocephalus, with which it is allied, an epidemic character. A similar remark will apply to pneumonia and bronchitis, of which

1,209 cases were registered in the counties, 2,865 in the cities; ratio 1 : 2·37. The pulmonary inflammation was, in many cases, developed in the course of measles, influenza, and other diseases of the first class. The three following diseases, which principally affect adults between the ages of 15 and 65, show that unhealthy places augment the fatality of diseases in different degrees.

	Counties.	Cities.	Increase per cent. in Cities.
Deaths by consumption -	5,857	8,125	39
" childbirth -	217	372	71
" typhus - -	1,564	3,456	221

This gives the classification a peculiar property. Wherever the absolute mortality is low, the number of deaths in the epidemic class is less than the number in the pulmonary class; and, on the contrary, wherever the deaths in the first class exceed or equal those in the third, it may be affirmed that the absolute mortality is high.

The occupations in cities are not more laborious than agriculture, and the great mass of the town population have constant exercise and employment; their wages are higher, their dwellings as good, their clothing as warm, and their food certainly as substantial as that of the agricultural labourer. The Poor Law Inquiry, and successive Parliamentary Committees, have shown that the families of agricultural labourers subsist upon a minimum of animal food, and an inadequate supply of bread and potatoes. The source of the higher mortality in cities is, therefore, in the insalubrity of the atmosphere. Every human being expires about 666 cubic feet of gas daily, which if collected in a receiver, would destroy other animals; and is constantly producing, in a variety of ways, the decomposition of animal and vegetable matter, yielding poisonous emanations in houses, workshops, dirty streets, and bad sewers. The smoke of fires, and the products of combustion are also poisonous. All gases and effluvia, like odours, are diffusible; they have a certain force of diffusion, which Professor Graham has expressed numerically; and all the emanations from human habitations in the open country mingle, almost as soon as they escape, in the currents of the atmosphere. But locate, instead of one individual to a square mile of land (the supposed density of population in the uncultivated forests of America and the steppes of Asia), 200,000 individuals upon a square mile, as soldiers in a camp, and the poison will be concentrated 200,000 fold; intersect the space in every direction by 10,000 high walls, which overhang the narrow street, shut out the sunlight, and intercept the movements of the atmosphere; let the rejected vegetables, the offal of slaughtered animals, the filth produced in every way decay in the houses and courts, or stagnate in the wet streets; bury the dead in the midst of the living; and the atmosphere will be an active poison, which will destroy, as it did in London formerly, and as it does in Constantinople now, 5·7 per cent. of the inhabitants annually, and generate, when the temperature is high, recurring plagues, in which a fourth part of the entire population will perish. But the health will be a little more impaired by residence upon 1 than upon 100 square miles, if means can be devised for supplying the 200,000 individuals with 200,000,000 cubic feet of pure air daily, and for removing the principal sources of poisonous exhalations. The latter object is partly accomplished by paved, even streets, by the scavenger, by an abundant supply of water, by large well-constructed trapped sewers, and by domestic habits of cleanliness; but it is difficult to perceive how volatile impurities can be removed, and how a stream of uncontaminated air can be supplied where the sun cannot heat the earth and air, where there are no open squares, or the streets are narrow, or the houses are only separated by courts, or built in *cul de sac.* It will be found, *cæteris paribus*, that the mortality increases as the density of the population increases; and where the density and the affluence are the same, that the rate of mortality depends upon the efficiency of the ventilation, and of the means which are employed for the removal of impurities. The next step in the argument is to establish these two facts; which will be done by showing that in 32 districts of one large city the mortality increases with the intensity, and falls with the diminution of the causes, to which the excessive mortality has just been ascribed. The necessary deduction from the series of facts, then, is that the mortality has a tendency to increase as the density of the population increases, but that the unhealthful tendency can be counteracted by artificial agencies. In other terms, the mortality of cities in England and Wales is high, but it may be immeasurably reduced. A good, general system of sewers; the intersection of the dense, crowded districts of the metropolis by a few spacious streets; and a park in the East end of London would probably diminish the annual deaths by several thousands, prevent many years of sickness, and add several years to the lives of the entire population. Similar improvements would have the same effects in the other cities of the empire. The poorer classes would be benefited by these measures, and the poor-rates would be reduced; but all classes of the community are directly interested in their adoption, for the epidemics, whether influenza, typhus, or cholera,—small-pox, scarlatina, or measles, which arise in the east end of the town, do not stay there; they travel to the west end, and prove fatal in wide streets and squares. The registers show this; they trace diseases from unhealthy to healthy quarters, and follow them from the centres of cities to the surrounding villages and remote dwellings. (1st Annual Report, pp. 108–16.)

In 1831 the city population enumerated was 3,079,292, the country population 3,255,479; with the corrections which have been suggested, as the population increases faster in cities than in the country, the population in 1838 would be about 3,726,221 in the city districts, and about 3,539,908 in the counties. The city was probably to the rural population as 1·053 to 1·000; and to this extent (5 per cent.) the deaths in the counties should be augmented, to render the mortality strictly comparable.

DEATHS by Twelve Classes of Fatal Diseases, in City and in Rural Districts.

—		City Districts.	Rural Districts.
Estimated population, June 30, 1838		3,726,221	3,539,908
1. Epidemic, Endemic, and Contagious Diseases		23,655	13,685
2.	Sporadic Diseases. Of the Nervous System	15,651	8,177
3.	Of the Respiratory Organs	28,973	18,508
4.	Of the Organs of Circulation	1,301	712
5.	Of the Digestive Organs	6,505	3,361
6.	Of the Urinary Organs	417	373
7.	Of the Organs of Generation	984	547
8.	Of the Organs of Locomotion	653	354
9.	Of the Integumentary System	144	66
10.	Of Uncertain Seat	10,447	10,529
11. Age		7,374	8,874
12. Violent Deaths		3,104	2,516
Causes not Specified		1,811	2,708
Total Deaths		101,019	70,410

Besides the 70,410 persons who died equally in the dense and in the more scattered populations, there was an exces in the cities of 30,609 deaths; 9,970 from diseases of the epidemic class, 7,474 from diseases of the nervous system, 10,465 from diseases of the respiratory organs, and 3,144 from diseases of the digestive organs. The annual rate of mortality in the cities was 2·7, in the counties 2·0 per cent.; and the mortality in the cities 1·36 to 1·00 in the counties. The mean duration of life in the two sets of circumstances would differ nearly in the ratio of 37 years and 50 years.

In examining the special causes of death, three classes may be distinguished; one class which was exaggerated in cities to the highest pitch, a third class in which the mortality was nearly the same or in excess in the counties, and an intermediate class. To 1·00 death in the counties the deaths out of the *same amount of population* in the cities were by asthma, 3·80;* erysipelas, 2·71; convulsions and teething, 2·57; cephalitis and hydrocephalus, 2·41; hydrophobia, 2·37; pneumonia, bronchitis, and pleurisy, 1·99; delirium tremens, 1·98; typhus, 1·88; small-pox, 1·73; heart disease, 1·73; child-birth, 1·63; syphilis, 1·59; rheumatism, 1·58; gout, 1·55; hernia, 1·48; purpura, 1·46; sudden deaths, 1·45; liver disease, 1·45; hepatitis, 1·35; tetanus, 1·32. The excess of mortality in cities was less in the following cases: by consumption 1·24; croup, 1·23; violent deaths, 1·17; stone, 1·11; mortification, 1·10; malformations, 1·07; apoplexy, 1·07; hæmorrhage, 1·02. The mortality by the third class of causes was greater in the counties than in the cities: for the mortality to 1·00 in the counties was in the cities, by paralysis, ·99; dropsy, ·99; jaundice, ·99; diabetes, ·97; cancer, ·92; hydro-thorax, ·88; hematemesis, ·79; debility (frequently premature birth), ·75; atrophy, ·75; scrofula, ·46. It will be useful to compare all the other diseases, but, in doing so, it must be borne in mind that the diseases in the epidemic class fluctuate from year to year; that when the number of cases is considerable the relative mortality is most correctly expressed, and that slight differences deserve little attention.

The fatality of scrofula, purpura, cancer, stone, jaundice, diabetes,—chronic diseases—in which there are new deposits, new formations, or new secretions, is as great in the country as in cities; dropsy comes under the same head. Their exciting causes are common to the two classes of population.

It has been proved that the same injuries and diseases are more deadly in cities than in the country; which may account for the higher mortality from violent death, hernia, and some other causes. Parturition is as frequent in the country as in town; where it is nevertheless so often followed by puerperal fever as to be 63 per cent. more fatal.

If the mortality in the counties has been taken for unity, and all above it has been termed excess, it must not be understood to imply that less than 70,410 deaths may not be expected to occur out of a population of 3,539,908. The population of the counties, which have been held to represent the country, included the inhabitants of several cities. The mines of Cornwall caused many deaths; and anyone who has visited the ill-ventilated dwellings of the poor, and is acquainted with their limited command of clothing, firing, and substantial food in agricultural districts, cannot come to that conclusion. The minimum degree of sickness which a well-educated, affluent people would

* The 2629 deaths in the cities from asthma were to 658 as 4·00 to 1·00; but the population in the two cases was as 1·053 to 1·000; divide, therefore, 4·00 by 1·053, to obtain the true relative mortality. It was, as is stated in the text, 3·80 to 1·00.

experience, and the years which they would number in the circumstances most favourable to health, are unknown; for the majority of the rich and middle classes whose lives have been observed, live principally in ill-constructed cities, and are exposed to the epidemics generated among their unhappier neighbours. It will be prudent, therefore, not to speculate upon a state of things of which the registers afford no examples, as it may sound paradoxical to fix more than fifty-five years for the average duration of human life; and it would not be practicable to suggest any means for improving by immediate measures the health of agricultural districts more effectual than the improvement of the cities in their centres, from which so many diseases radiate.

Is the excessive mortality of cities inevitable? It has not long been established to the public satisfaction that the mortality in dense populations is excessive. The simple process of comparing the deaths in a given time out of a given number living is a modern discovery; and as some individuals died at all ages in the healthiest, or attained the highest ages in the unhealthiest classes, and epidemics desolated the country as well as towns, though to less extent, the unaided reason was baffled in its attempts to unravel the intricate facts, and to draw conclusions which could justify, or stimulate public interference. If the law of nature had been, that all the inhabitants of an unhealthy place attained the age of 40 years, and of a healthy place the age of 50 years, and then invariably died, the difference would have been perceived in two or three generations: but the law of nature was different; in both cases infants died at the breast, men perished in the prime of life, and old men grew gray with age; the proportions only varied, and the difference was in the average duration of life, which varied from 20 to 50 years, and yet remained undetermined. It was probably not generally known before the publication of the first Report, that the mean duration of life was from 25 to 30 years in the east districts, and from 40 to 50 years in the north and west districts of the metropolis; it is not therefore surprising, that the relative mortality of remote districts remained so long undiscovered.

The first writers who established satisfactorily the high mortality of cities took a gloomy and perhaps a fanatical view of the question. Cities were declared vortices of vice, misery, disease, and death; they were proclaimed "the graves of mankind." The population of the country, it was said, was drawn to them to be sacrificed; and those who entered left all hope behind, for no prospect of health in cities was beheld. Happily the further application of the methods which those eminent writers employed, and the facts which the registers furnish, enable us to analyze the causes of death in cities; and to show that while the mortality is increased as much as they stated, the apprehensions into which they were betrayed were ill-founded when applied to the future. There is reason to believe that the aggregation of mankind in towns is not inevitably disastrous. Health and life may be preserved in a dense population, provided the density be not carried beyond certain limits. Of this the nature of the causes to which the mortality is due, as well as the rapid improvement in the health of London within the last two centuries, is presumptive proof; and the favourable condition of several districts of the metropolis leaves little room for doubt on the subject. The city population of England is greater than that of any other country of Europe, and it increases more rapidly than the population of the rural districts. In this there is nothing to regret; for if the general progress of civilization compensated the loss of life in the cities of the ancient world and of the middle ages, the advantages of cities are not less evident in the present time. (2nd Annual Report, pp. 80–98.)

The general principles connected with this subject have been discussed in the Appendices to former Reports; and the circumstances were pointed out, which, it is believed, increase the mortality in towns, cities, and dense populations of every kind. The number of deaths by different causes in the metropolis, and 24 of the principal town or city districts, are now contrasted with the deaths from the same causes in counties containing a less dense population, chiefly engaged in agriculture. The following table shows the annual mortality of 1,000,000 living, and the relative excess in the town districts. The way in which the population, in the middle of the two years (January 1, 1839), was estimated, has been already explained. The population enumerated in 1831 was assumed to have increased at the same rate as in the 10 years 1821–31.

—	Area in Square Miles.	Estimated Population, Jan. 1, 1839.	Deaths Registered in Two Years.	Inhabitants to One Square Mile.	Annual Mortality per Cent.
Country Districts -	17,254	3,559,323	129,628	206	1·821
Town Districts - -	747	3,769,002	197,474	5,045	2·620

The density of the country districts was to that of the towns as 10 to 245, the mortality as 100 to 144. The mean duration of life in the two classes of districts differs nearly 17 years; it is in the proportion of 55 years (country) to 38 years (towns). The difference is greater than was given in the calculation founded on the facts observed in 1838, when the deaths in Bristol, Clifton, and Norwich were (by error) not subtracted from the deaths in the counties of Gloucestershire and Norfolk. The mortality in the town districts, however, declined in 1839 more than the mortality in the country districts. As the population increases faster in the town than in the country districts, the difference in the mortality was greater than it is represented to be by these numbers.

The diseases chiefly incidental to childhood are twice as fatal in the town districts as they are in the country.

The deaths by several diseases of old age were almost equally numerous in the towns and the country. Asthma is, however, an exception.

It must be borne in mind that the number of children and old people *living* in the towns is less than in the country districts; while the number of persons in the middle of life is proportionally greater in the towns than in the country.

The following diseases, occurring generally between the ages of 15 and 60, were from 25 to 50 per cent. more fatal in the town than in the country districts.

—	Deaths Registered in the		Deaths to 1,000,000 Living in the		Excess.
	Country Districts.	Town Districts.	Country.	Towns.	
Typhus - - -	6,462	10,852	941	1,461	55 per cent.
Consumption - - -	24,094	32,436	3,508	4,367	24 "
Hepatitis and Diseases of Liver - - -	1,085	1,623	158	219	38 "
Diseases of Childbearing -	909	1,560	132	210	59 "
Rheumatism - - -	324	531	47	71	52 "
Paramenia - - -	19	35	3	5	70 "

The tendency to consumption was increased 24 per cent., to typhus 55 per cent., in the town districts; but as the absolute mortality from consumption is three times as great as from typhus in towns, and nearly four times (3·73) as great in the country, the excess of deaths by consumption, caused by the insalubrity of towns, is greater than the excess of deaths by typhus—a fact which has hitherto been overlooked. Thus, 24,094 deaths from consumption occurred in the country, 32,436 in the town districts; the excess amounted to 8,342 deaths; 6,402 deaths from typhus occurred in the country, 10,852 in the town districts; the excess amounted to 4,450 deaths. The difference is more correctly exhibited by a comparison of the mortality from the two diseases.

The facts show the propriety of the ordinary medical advice to place persons of a consumptive habit in a pure atmosphere; but they militate against sending them to reside in the continental towns, in many of which the mortality is as high as it is in Bethnal Green and Whitechapel. Paramenia (mismenstruation), though rarely fatal, is a very common disease, and one which greatly embarrasses the medical practitioner. The facts in the table point out the utility of the country watering-places to patients afflicted with the complaint in cities. The excess of deaths by childbirth in the town districts is striking. Out of nearly the same number of deliveries, 909 mothers died in the country, 1,560 in the town districts.

The causes of the excessive mortality of towns are well known; and it cannot be too frequently repeated, that they admit of removal to a great extent.

The mortality increases, *cæteris paribus*, as the density of the effluvial poison generated in cities, and not strictly as the density of the population. The indigence of the inhabitants, or an insufficiency of proper food—even when not carried to the extent of starvation or famine—has also a decided effect on the production of effluvial poisons, as well as on the tendency to diseases of every kind. Hence the mortality is not always greatest in the densest parts of cities.

This principle explains the facts that, although the mortality is increased 44 per cent. by the present condition of the towns in England,—where the proportion of town population is greater than in any other country in Europe, except Belgium,—the mortality of the nation has been much below the average during the whole of the present century; and, up to the present day, the expectation of life remains higher in England than in the rest of Europe. The industry and intelligence that have created flourishing towns have ameliorated, though not so rapidly as they might have done, the sanitary condition of the people. (3rd Annual Report, 98–101.)

Relation between Density of Population and Death-rate.—It is well established that the mortality of the populations of cities is generally higher than the mortality of people in the country. And it has been shown in the annual Reports that there is a constant relation between the density of the population and the mortality. This has been further tested by arranging all the districts in the order of their mortality during the ten years, and then determining the density of their population. A Table presents a summary view of the results.

The general mortality of the 631 districts ranged from a rate of 14 to 33 deaths in 1,000 living. If the facts are arranged in five great groups, the following result is obtained:—

1. Where the mortality was 14, 15, or 16, the population was in the proportion of 86 persons to 1 square mile.
2. Where the mortality was 17, 18, or 19, the population was 172 persons to a square mile.

3. Where the mortality was 20, 21, or 22, the population was of the density expressed by 255 to a square mile.
4. Where the mortality was at the rate of 23, 24, or 25, the population was of the density expressed by 1,128 to a square mile.
5. And where the rate of mortality was 26 and upwards, the average density was expressed by 3,399 persons to a square mile.

Thus in these five groups there is a constant increase of mortality running parallel with the increase of density.

Not only is that the case in great groups, but the same law reigns over the two series of ratios—the ratio of deaths to the living and the ratio of the living to the area of land on which they dwell—when the groups are multiplied and the facts are subdivided so as to give rise to some disturbance; which almost invariably admits of explanation. For it happens when there is a discrepancy that the population is lodged on a small portion of the area of a wide district, and in that case the density of the part in which the people dwell is not accurately expressed by the method here employed. When the groups are larger, the effects of these perturbations are less visible, as the disturbing causes neutralize each other to some extent.

The population of the denser districts differs in many respects from that of the thinly peopled districts of the country; but there can be no doubt that mere proximity of the dwellings of the people does not necessarily involve a high rate of mortality. When any zymotic matter, such as varioline, scarlatinine, or typhine finds its way into a village or street, it is more likely to pass from house to house than it is where the people are brought less frequently into contact. The exhalations into the air are thicker. But if an adequate water supply, and sufficient arrangements for drainage and cleansing are secured, as they can be by combination in towns, the evils which now make dense districts so fatal may be mitigated. Indeed, some of the dense districts of cities are in the present day comparatively salubrious. (Supplement to the 25th Annual Report, pp. xxxiii–v.)

Effects of Density of Population on Health.—The term town implies municipal government and industrial organisation. But it will be convenient to discard for the moment every other consideration except the density of the population. This is shown by dividing the population by the square miles of area on which they are living. This has been done; and there is found to be a general relation between the mortality and the density of the population. Thus, in the healthy districts, during 1861–70, there were 166 persons to a square mile; in all England, 367; in Liverpool, 65,823. And this implies that the mean proximity of person to person in the three groups was 147, 99, and 7 yards; the proximity being as the square root of the density.*

The density of population as usually calculated assumes that the numbers are distributed evenly over the area; but this is scarcely ever the case; for the English towns and districts include open spaces unbuilt on, which conduce to the free aeration of the place, but in very different degrees. In some districts the greater part of the population is crowded on a portion, while the rest is thinly scattered over the remainder of their area. Thus the density of the population of London is expressed by 25,671 persons to a square mile; but the density of the Central

* p = proximity in yards $= \dfrac{2^{\frac{1}{2}}}{3^{\frac{1}{4}}} \times \dfrac{1760}{D^{\frac{1}{2}}}$ (where D = population to a square mile.)

See extract on pp. 35–36.

districts is 107,729; of Westminster 153,976. In one sub-district of Westminster, Berwick Street, the density is 278,587, while in Hampstead it is 7,315. The proximity in London is 11·8 yards; and of the densest sub-district of London (Berwick Street) 3·6 yards. The Manchester district besides the dense parts contains much open country. Upon the other hand, Liverpool, Birmingham, and Bristol districts comprise the densest parts of the towns of those names; the towns being more extensive. The local divisions of the kingdom have grown up; they are multiplied unnecessarily; they are so conflicting and the names are so confusing that it is difficult to use them without creating misapprehension. We may hope to see a remedy some day applied to this state of things. In the meantime the readers of the Registrar General's Reports will bear in mind, that *districts* conterminous with unions are referred to unless the contrary is stated.

In the years 1861–70 the population of an average district was 34,555; the annual births 1,212; the deaths 775; the excess of births 437.

To investigate more exactly the relation between density of population and the mortality, which we know increases in some proportion to density, the districts have been grouped in the order of the mortality at all ages. The groups are eighteen; commencing with a mortality at 15, and ascending to 39.

The area, population, births, deaths, and mortality of each group have been determined; and are shown in the Tables. The irregularities that are encountered in dealing with single districts are in part effaced; and the general result is that in all the large groups the density and the mortality follow the same order.

In the Appendix to the Fifth Report I endeavoured to show that within certain limits there was a definite relation between density of population and mortality. And it was found that the mortality of districts did not increase as their density, but as the 6th root of their density. Thus the female mortality of St. James Westminster district was ·02145; its density was 145,059 persons to a square mile; the density of St. George Hanover-square being 39,018. What was the mortality? By calculation from the density it should have been ·0172, and it was ·0171.* The same relation existed between the mortality and the density of population in other districts of London.

A larger basis is now supplied by the facts of 10 years recorded in all the districts of England and Wales. They have been arranged in the Tables; and with this result, that in every group the mortality increases with the density, but happily not in the direct proportion of the density. London has been excluded in the following calculations. Thus in the 345 districts with a mortality of 19·2 the density was 186 persons to a square mile; in the 9 districts with a density of 4,499 what was the mortality? In the first place it was not expressed by the proportion 186 : 4,499 :: 19·2 : x but by this proportion nearly—

$$(186)^{0\cdot12} : (4499)^{0\cdot12} :: 19\cdot2 : x = 28\cdot1$$

The accompanying Table shows a comparison between the actual and the calculated mortality.

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* *See* Registrar General's Fifth Report, Appendix, pp. 420–424. The constitution of the above two districts has since been changed. *See* Extracts on pp. 161–5.

ANNUAL RATE of MORTALITY per 1,000, in Seven Groups of Districts of England and Wales (exclusive of London), and the Mortality deduced from the Densities of Population in those Groups.

Number of Group.	Number of Districts in each Group.	RANGE of MORTALITY.	DENSITY—Persons to a Square Mile.	PROXIMITY in Yards.	OBSERVED MORTALITY.	CALCULATED MORTALITY.
Columns -	1.	2.	3.	4.	5.	6.
ENGLAND & WALES (exclusive of LONDON) -	593	15-39	315	107	22·00	20·41
I.	53	15-17	166	147	16·75	18·90
II.	345	18-20	186	139	19·16	19·16
III.	137	21-23	379	97	21·88	20·87
IV.	47	24-26	1,718	46	24·90	25·02
V.	9	27-30	4,499	28	28·08	28·08
VI.	Manchester District	32	12,357	17	32·49	37·70
VII.	Liverpool District	39	65,823	7	38·62	38·74

FORMULA.—m being the mortality in any group and m' being the higher mortality at any other group, D and D′ being the density of population in the two groups, then

$$m' = m\left(\frac{D'}{D}\right)^{n} = m\left(\frac{D'}{D}\right)^{0\cdot11998}$$

The mortality of districts is nearly as the 12th root of their densities.

The starting point being 19·16, the calculated rates (see col. 6) in the other groups are deduced by the formula from the densities as given in column 3; or taking the above value of n, and p and p' as the mean proximity of person to person, we have $m' = m\left(\frac{p}{p'}\right)^{2n.}$ So the mortality of districts is nearly as the 6th root of the proximities.

The table may be read thus:—In 47 districts having a density of 1,718 persons to a square mile, a proximity of 46 yards, the annual mortality (1861–70) ranged from 24 to 26—the exact mortality was 24·90—per 1,000. The mortality calculated from that of the 345 districts having a mortality of 19·16, a density of 186 persons to a square mile, was 25·02, thus differing from the actual mortality by only 0·12.

It will be noticed that there is not much difference in the density of groups I. and II., and yet the mortality in group I. is much lower than the mortality in group II. It may therefore be inferred that there are many more small towns in group II. than in group I., and in those small towns the effects of a higher density are felt, whereas in group I. the population is more evenly distributed over the area. Were the population aggregated to the same extent as it is in group II., it is probable that the mortality would approximate to 18·90.

The districts being grouped in the order of the mortality the density of population is always found to increase with the mortality, but more rapidly. The greater the proximity of man to man the greater is the mortality. To show how far the effect of the causes of mortality varies in dense and open districts at different ages in the two sexes the following Tables have been framed. The 593 districts are arranged in seven groups; under which the mortality of males and females is given at 12 ages. Only the London districts have been excluded, and that on account of the difficulty of distributing the deaths at different ages in hospitals over the districts to which they properly belong.

The mortality per 1,000 *under* the age of *five years* is in the seven groups—

No. of group - -	I.	II.	III.	IV.	V.	VI.	VII.
For females - - -	34	44	58	76	89	106	134
„ males - - -	41	51	68	88	101	118	145
Excessive mortality of males -	7	7	10	12	12	12	11
Mean of males and females -	38	48	63	82	95	112	140

It will be noticed that the groups are numbered in the order of their density, No. I. being the least dense and No. VII. the most dense.

After examining the mortality at the various ages in the seven groups of different densities, this general law may be deduced from the facts. As the mortality of males and females increases at all ages with the density of population, so it increases at every group of ages, but in very different proportions; most in early childhood (0–5); least at the two quinquennial ages 15–20 and 20–25, when immigrants enter towns; another maximum being attained at the ages 45–65, immediately after reproduction ceases. At the ages of 65 and upwards the effect of density in increasing the mortality diminishes. The effect is not considerable at any age after 35 in the 345 districts (group II.), having a density of 186 persons to a square mile; there the chief effect is produced in childhood.

In the 137 districts, having a density of 379, the effect of density after the age of 15 remains nearly uniform, and increases the mortality by about one-fifth part.

In the 47 districts, having a density of 1,718, the mortality is doubled in childhood; and is raised by about a half at the ages 45–65.

London, though with a density of 25,671 persons to a square mile, follows for childhood the same law as the 47 districts; the mortality is doubled; then at the ages 45–65 it is still higher than in the 47 districts, for the mortality being increased by nearly three-fourths approaches the mortality of the 9 districts. But London presents this exceptional fact; the mortality at the ages 15–20 and 20–25 is below the mortality in the healthiest districts. The cause of this will be discussed hereafter.

INCREASE of MORTALITY at each of Twelve Age-Periods in Seven Groups of Districts experiencing different Rates of Mortality at all Ages.

Annual Rates of Mortality per 1,000 Persons living at all Ages, 1861-70	Range 18-20 Mean - 19	21-23 22	24	24—26 25	27—30 28·5	32	39
Number of Districts at the above rates of Mortality	345	137	London.	47	9	Manchester District.	Liverpool District.
INCREASE *per cent.* ON THE RATES OF THE FIFTY-THREE HEALTHY DISTRICTS.							
ALL AGES -	13·2	29·3	44·3	46·5	65·4	94·3	128·3
Under 5 - -	25·7	66·8	115·9	117·2	151·4	196·0	269·1
5- - - - -	10·1	39·9	65·0	66·1	89·3	131·3	186·4
10- - -	11·0	30·7	14·9	40·9	40·3	69·9	77·1
15- - - - -	8·4	23·4	−2·7	27·3	42·1	49·7	51·9
20- - -	9·2	18·5	−4·5	15·6	23·9	40·2	66·7
25- - - - -	8·5	20·1	17·9	20·3	41·2	66·4	124·7
35- - - - -	3·7	20·6	50·7	32·3	61·5	113·7	172·2
45- - -	3·9	23·1	74·0	46·1	84·3	149·3	217·9
55- - - - -	4·8	25·4	71·0	53·7	77·0	144·4	184·4
65- - -	2·1	18·0	42·7	38·1	54·8	93·0	104·2
75- - - - -	1·7	9·5	22·3	24·1	32·1	48·3	38·6
85 and upwards -	9·8	11·8	10·6	16·1	15·6	22·9	−·7

This Table of the increase of mortality may be read thus:—In *345 Districts* having a mortality at all ages of *18—20 per 1,000*, the mortality at the *ages under five years* shows an excess of 25·7 per cent. on the rate at that group of ages in the 53 Healthy Districts; *in 137 Districts* having a mortality at all ages of 21—23 it is 66·8 per cent. in excess;......in Liverpool it is 269·1 per cent. in excess, or out of the same numbers of Children living, the deaths are between three and four times as many in Liverpool as they are in the Healthy Districts.

The accompanying Table shows, in a comparative view, how differently the various causes of mortality operate at different ages in the eight groups of districts. This is mainly due to the varying powers of resistance.

The exposure of children, of men and women in the prime of life, and of old people to causes of death, varies in different circumstances; but it is evident, after every allowance has been made, that the power of resisting the noxious influences at work in the thickest peopled districts is greatest at puberty, least in childhood and in manhood.

The following Table shows this more clearly; for it shows at each age out of what numbers living there are 100 deaths in the healthy districts; and then in other columns how many die in the seven other groups of districts out of the same numbers living. Thus to 10,050 persons living of the age of 35–45 only 100 die annually in the healthy districts; and 104, 121, 132, 162, 214, and 272 in six other groups of districts. In London the deaths out of the same numbers are 151.

RELATIVE MORTALITY, 1861–70, at each of Twelve Age-Periods in Eight Groups of Districts, the Deaths at each Age in the 53 Healthy Districts being represented by 100.

Annual Rate of Mortality per 1,000		15-17	18-20	21-23	24	24-26	27-30	32	39
Persons to one sq. mile		166	186	379	25,671	1,718	4,499	12,357	65,823
		DEATHS, OUT OF NUMBER OF PERSONS as given in Column 2.							
AGES.	Persons living.	In 53 Healthy Districts.	In 345 Districts.	In 137 Districts.	In London.	In 47 Districts.	In 9 Districts.	In Manchester District.	In Liverpool District.
ALL AGES -	5,903	100	113	129	144	146	165	194	228
0-	2,646	100	126	167	216	217	251	296	369
5-	18,116	100	110	140	165	166	189	231	286
10-	27,624	100	111	131	115	141	140	170	177
15-	17,825	100	108	123	97	127	142	150	152
20-	13,210	100	109	118	95	116	124	140	167
25-	11,990	100	109	120	118	120	141	166	225
35-	10,050	100	104	121	151	132	162	214	272
45-	7,874	100	104	123	174	146	184	249	318
55-	4,425	100	105	125	171	154	177	244	284
65-	1,902	100	102	118	143	138	155	193	204
75-	775	100	102	110	122	124	132	148	139
85 & upwards	361	100	110	112	111	116	116	123	99
Columns -	1	2	3	4	5	6	7	8	9

The Table may be read thus:—Out of 2,646 Children living under five years of age, 100 die annually in the Healthy Districts; 126 in 345 Districts having rates of mortality of 18 to 20; ......296 in Manchester District; and 369 in Liverpool District.

Female children with a lower absolute mortality than males under five years of age suffer relatively in every group more than males in the denser districts. At 5–10 the mortality of males is but slightly in excess and at all other ages the males are the greatest sufferers from the unsanitary conditions. Their occupations come into play.—(Supplement to 35th Annual Report, pp. xxiii–v.)

Improvement of Health in Towns.—Although the time may be distant when cities will be as healthful as rural districts, or the inferiority which our English poet ascribed to "the town" as the handiwork of man become much less apparent in point of salubrity than it is at present, it cannot be questioned that large populations have even now advantages of a nature favourable to health which villages do not possess. The highest attainable health is probably to be sought in a happy combination of both states—*rus in urbe*. The words of an excellent popular writer may prove to be no dream, but a well-founded expectation; he believes that we shall ultimately obtain "a complete interpenetration of city and "country, a complete fusion of their different modes of life, and a "combination of the advantages of both, such as no country in the "world has ever seen."* But it may be asked, whether it is forbidden by this last expression to accept as a perfect model even Nebuchadnezzar's Babylon, which the distinguished writer himself has extolled. (23rd Annual Report, p. xxi.)

* Charles Kingsley's Miscellanies: Great Cities.

3. Mortality at Different Ages.

Census Ages, and Ages in Death Registers.—With respect to the subdivision of the first year, it must be observed that more than a fifth of the whole number of deaths registered in the year ending June 30, 1838, namely, 71,888, out of 335,956, are under 1 year of age; that the distinction of months at that early period will exhibit circumstances more important with respect to the expectation of life, than that of years at later periods; and that the expectation of life on the day of birth differs greatly from that at six, three or even one month old. It appeared to me, therefore, that such distinctions ought not to be overlooked; and that the abstract should be framed rather with reference to the ascertained ratios of mortality than to an equal division of the periods of age. After the first year, the ratio of mortality rapidly declines; and this decrease is shewn by the enumeration of deaths for each of the four following years. It may, perhaps, be thought that this subdivision ought to have been rendered more minute, and that I have passed too abruptly from the six-fold division of the first year to the exhibition of whole years immediately afterwards. But I must state in reply to any such objections that the Registers do not enable me to divide the years after the expiration of the first. In cases of death under 1 year of age, the number of months, and often of days, is stated with precision; but where the age of the child has exceeded 12 months, "One year" is often the only entry in the column headed "Age," leaving it doubtful to what period between the end of the twelfth and of the twenty-fourth month the death is to be referred. The same observation is still more extensively applicable to deaths after the second year.

After the fifth year, I have combined the ages in quinquennial periods, a system which, after much consideration, I deemed preferable to that adopted in the abstracts for the first year of registration, namely, of stating the number of deaths at each successive year of age.

To the statement of deaths at each successive year, it might be objected that it was delusive, and assumed an appearance of minute accuracy which was not founded on truth. This objection is not applicable to the reported ages of children. Their recent births are fresh in the recollection of their parents or guardians, and their age is stated with sufficient accuracy. But it is not so with respect to the ages of persons far advanced in life; many of whom, especially among the poorer classes, are ignorant of their exact age, and when they die, leave no record which enables their surviving relatives to state their ages with precision. An evidence of the vagueness attending statements of age is "the tendency to speak in round numbers" noticed in the preface to the Abstract of the Population for 1831, a tendency causing a great apparent excess of mortality in the decennary periods at 30 and upwards, and of which the following remarkable instances may be found in the Abstract of Ages published in the preface to the Population Abstract for 1831, extracted from burial registers in England and Wales for 18 years:—

Ages.		Ages.		Ages.		Ages.		Ages.	
29	26,630	39	23,778	49	23,689	59	25,782	69	33,038
30	31,027	40	33,513	50	33,527	60	43,273	70	53,953
31	22,301	41	20,989	51	20,911	61	26,084	71	32,162

Experience has shown that this incorrectness also exists in the statements of ages in the registration of deaths, as will appear upon reference to the abstracts for the year ending June 30, 1838.

An abstract of deaths at every successive year of age is, therefore, confessedly incorrect; and, in stating this, I am stating a strong reason against its continuance; for by exhibiting such an abstract, I should commit a fault which I deem it most important to avoid,—that of assuming the delusive appearance of more minute accuracy than actually exists. By combining the deaths at different ages, after the fifth year, in quinquennial divisions, not only are errors and irregularities materially diminished, but the abstracts are rendered in a form more useful, more conducive to the fulfilment of those practical objects for which such abstracts are principally compiled. (2nd Annual Report, pp. 12–13.)

Age Constitution of the Population.—The deaths in the ten years amounted to 55 hourly on an average, or to nine deaths every ten minutes;* but it is not so much with these deaths in themselves that the inquiry is concerned as with the numbers living at every moment of the decenniad. Upon the state of the twenty-one millions living the mortality depends; out of them the minutely death flows. Now the population increased; and this increase, which is a continuation of the process that has been going on for a century at variable rates, has produced large alterations in the proportions of the 21,389,245 living at different ages. This must be so. There were 7,636,233 births in the ten years 1861–70, of which the children under the age of ten enumerated at the beginning of 1871 were the survivors. But at the same Census 507,522 persons of the age of 70–80 existed; and they were the survivors of the children born in the ten years 1791–1800, which, it is pretty certain, did not exceed 2,988,439 in number. Had the children born then been as many as in 1861–70, the living at 70–80 would have been raised in that proportion to 1,296,850. And so of other ages. Now similar but not the same alterations in the proportions have taken place in every district of the kingdom. How can this difficulty in instituting just comparisons be obviated?†

As the mortality—and the fatal diseases—vary with age it is evident that the population and the deaths must be divided into a certain number of corresponding groups in order to determine the mortality and the fatal diseases of each group; we can then proceed to compare the rates of mortality and of disease in the several districts of the country. (Supplement to 35th Annual Report, p. xx.)

Mortality at groups of ages in England, Carlisle, Belgium, and Sweden.—The deaths at different ages are so closely connected with health and with the great apparent changes in the diseases of this country, that we shall here present a comparative view of the rate of mortality that prevailed in England, Carlisle, Belgium, and Sweden, from an article in the ***British Medical Almanac*** for 1836.

Here it appears that the mortality of the whole English population, between the ages of 20 and 40, was higher than in Belgium and Sweden, while the mortality in early life was much lower; and if the Carlisle observations ever approximately represented the mortality of England, the waste of life in the five years of infancy has almost diminished one-half during the last 100 years. Other observations support this probability.

Contrary to the Swedish observations, the mortality of females between the ages of 10 and 40, is higher than that of males: it is only in childhood, and after the 50th year, that the mortality of females is lower than that of males. (McCulloch's Account of the British Empire, article Vital Statistics, Vol. 2, pp. 543–4.)

* The hourly births were 86; or 14 every ten minutes.

† See a paper on "The Value of Death-rates; by Mr. Noel A. Humphreys."—Journal of Statistical Society, vol. xxxvii.

DEATH-RATES per 1,000 PERSONS living in ENGLAND, SWEDEN, and BELGIUM, at 13 Age-periods.

Ages.	England and Wales. 18 Years, 1813–30. Males.	England and Wales. 18 Years, 1813–30. Females.	Carlisle. 9 Years. 1779–87. Persons.	Belgium. 1829. Persons.	Sweden. 21 Years, 1755–75. Persons.	Sweden. 20 Years, 1776–95. Persons.
0—	53·5	46·0	82·3	65·8	90·1	85·0
5—	7·2	6·7	10·2	8·7	14·2	13·6
10—	5·0	5·2	5·0	5·4	6·6	6·2
15—	7·2	7·6	6·8	6·6	7·6	7·0
20—	10·1	10·4	7·5	9·1	9·2	8·9
30—	11·4	12·4	10·6	10·0	12·2	11·6
40—	14·9	14·9	14·3	13·6	17·4	16·1
50—	23·4	21·6	18·3	21·7	26·4	23·9
60—	45·3	41·2	41·2	38·5	48·1	49·3
70—	101·2	90·9	83·0	90·9	102·3	104·1
80—	227·1	214·6	175·6	178·8	207·8	197·4
90—	370·1	371·9	284·4	304·7	394·1	351·3
Above 90	611·1	560·6	—	—	—	—
All ages	21·7	20·7	25·0	22·7	28·9	26·8

Mortality of Males and of Females at Groups of Ages, 1838–44. —The following table is valuable as showing the rate of mortality of each sex, at 17 groups of ages, during the first seven years of Civil Registration in England and Wales. The figures are especially useful for comparison with the rates prevailing in more recent periods.

Ages.	POPULATION 1841. (Estimated to the Middle of the Year.) Males.	POPULATION 1841. Females.	DEATHS in Seven Years. Males.	DEATHS in Seven Years. Females.	Annual Rate of Mortality per Cent. Males.	Annual Rate of Mortality per Cent. Females.
0—	210,341	218,851	301,378	236,261	20·510	15·440
1—	215,322	214,250	100,874	95,764	6·706	6·393
2—	218,035	219,006	53,785	53,449	3·531	3·490
3—	203,492	206,368	35,826	35,802	2·520	2·481
4—	201,080	200,263	26,034	25,634	1·853	1·831
0—	1,048,270	1,058,738	517,897	446,910	7·072	6·037
5—	953,235	952,450	61,659	59,903	·926	·900
10—	880,907	852,517	31,028	32,662	·504	·548
15—	1,507,944	1,633,939	84,833	95,152	·805	·833
25—	1,178,131	1,275,849	79,703	89,967	·968	1·009
35—	871,845	902,863	76,093	78,431	1·249	1·242
45—	621,142	653,065	77,047	70,680	1·776	1·548
55—	398,937	433,202	87,539	84,275	3·141	2·782
65—	224,863	259,283	103,873	106,692	6·613	5·885
75—	86,736	103,707	87,218	95,723	14·394	13·201
85—	12,635	17,906	26,167	34,497	29·646	27·553
95 and upwards -	579	1,091	1,727	3,112	42·697	40·795
All ages specified	7,785,224	8,144,610	1,234,784	1,198,004	—	—
Not specified -	—	—	2,505	1,355	—	—
All ages - -	7,785,224	8,144,610	1,237,289	1,199,359	2·270	2·104

NOTE.—The mortality was not disturbed by any great epidemics in these years, and it believed that they will serve well as the basis of Tables for use by Life Offices.

(20th Annual Report, p. 204.)

Mortality of Males and Females at various Age-periods, 1838–62.—We have from the three Censuses of 1841, 1851, and 1861, in which the ages of the population were enumerated, the means of determining very nearly the numbers living in each of the twenty-five years (1838–62) during which the registration of deaths has been in operation.

The specification of the numbers living at each separate year of age is, except as a matter of curiosity, utterly useless, for in the first place great numbers of the people do not know their exact age within a year or two, and in the second place the actual numbers at each year of age fluctuate considerably from various causes, and an annual Census alone could supply the true numbers living for each year. By collecting together all the numbers returned in each five years of age under fifteen, and in each ten years after that age, groups of population are obtained at the Censuses, of sufficient magnitude to allow us to determine the years of life, and the rate of mortality at each important period of life in each of the twenty-five years. The weight of the results is increased by the extended area of observation, which covers the whole of England and Wales, for a quarter of a century.

The deaths vary considerably in number in the various groups; thus under the age of 5 the number of boys dying ranged from 70,000 to 100,000 annually; at the age 10 and under 15, the deaths of boys ranged from 4,200 to 6,100; while at each of the decennial periods afterwards, from 15 to 85, the number of deaths ranged from 10,000 to 21,000; in the decennium, from 85 to 95, the numbers fell to 4,000 or 5,000; and for 95 and upwards are about 200 to 300 men, and twice as many women.

The mortality of the two sexes differs considerably at different ages; thus in the first five years of life the excess of mortality among boys over that of girls is in the ratio of 7·216 and 6·216, or 1·000 per cent.; in the next period it is only slightly in excess; but from the age of 10 to 25 and 35, the young women die in a greater proportion than young men, the cause of which it is important to investigate; at the age of 45 and upwards, the women die at a lower rate, and live longer afterwards than men.

The mean mortality among boys of 10–15 is at the rate of 5 in 1,000; of young men in the next ten years (15–25) the mortality is somewhat less than 8 in 1,000, and in the following decennial periods the numbers dying per 1,000 run up to 10, 13, 18, 31, and 67 (at the age 70=65–75), 147, 303, and 436, which is the rate carrying off the old men of 95 and upwards.

The mortality among women goes through similar variations.

It will be observed that the mortality at the same periods of life fluctuated. Thus while the mean mortality of boys under five years of age was 7·216, their mortality in the year 1846 was as high as 7·781, and in 1845 as low as 6·683 per cent. The one was ·565 above, the other ·533 below the average, making the total range in the rate 1·098.

Generally at all ages, from 5 to 65, the mortality was highest in the year of the great cholera epidemic (1849), and lowest in the years 1856, 1860, and 1861.

The mortality rate never falls so much below the mean mortality as it is raised above it by epidemics especially, and while the absolute difference of the rates is naturally greatest at the advanced ages, when the rates themselves are high, the relative rise and fall is greatest in childhood after the age of 5 years and under 15, when the zymotic diseases of that age are most prevalent. Women of the age of 15 and under 45 were cut off in great numbers in the cholera years.

The following are examples of the fluctuations of the rates of mortality in the twenty-five years.

The mean annual mortality of men of the age 25–35 was ·975, but the mortality of men of that age in 1849 was 1·236, and in 1850 it was as low as ·877 per cent. The range was ·359; in the one case it was more than 26 per cent. above ·975, and in the other 10 per cent. below that mortality rate.

The mean annual mortality of men of 55–65 was 3·136, but in 1849 the rate was 3·653, in 1850 it was 2·979; thus the range was ·674 in the twenty-five years.

An insurance office upon a large number of these lives of 55–65 would pay at the rate of 31 policies in 1,000 during ordinary years, but it may pay on 37 or 30 deaths in years of high or low mortality. The relative fluctuation is greater when small numbers are concerned.—(25th Annual Report, pp. xvi–xviii.)

Mortality of Males and Females at Groups of Ages, 1838–71.—The most important deductions in this Report are drawn from a comparison of the registered facts with the population enumerated; and having now determined by the analysis of the Census returns not only the numbers living, but their ages, I am able to show the mortality of persons of both sexes at 12 different groups of ages for each of the 34 years 1838–1871. This is one of the most important series of facts relating to the life of a nation ever published; and it is worthy of remark that the mortality at the several ages for the 34 years differs little from the mortality of the 17 years, 1838–54. The mortality of males at all ages was 2·33 per cent. in 1838–54, and 2·33 per cent. in 1838–71; of females for the same periods, 2·16 and 2·15.

ANNUAL MORTALITY per Cent. of Males and Females in England and Wales.

Ages.	Males.		Females.		Ages.
	1838–54. (17 Years.)	1838–71. (34 Years.)	1838–54. (17 Years.)	1838–71. (34 Years.)	
ALL AGES -	2·33	2·33	2·17	2·15	ALL AGES.
0—	7·25	7·26	6·23	6·27	0—
5—	·92	·87	·91	·85	5—
10—	·52	·49	·54	·50	10—
15—	·82	·78	·85	·80	15—
25—	1·00	·99	1·06	1·01	25—
35—	1·28	1·30	1·27	1·23	35—
45—	1·85	1·85	1·59	1·56	45—
55—	3·18	3·20	2·82	2·80	55—
65—	6·69	6·71	6·00	5·89	65—
75—	14·76	14·71	13·44	13·43	75—
85—	30·14	30·55	27·92	27·95	85—
95 & upwards	44·03	44·11	43·22	43·04	95 & upwards

Note.—The Table may be read thus:—Of Males of the Age 25 and under 35 the rate of mortality *per cent.* was 1·00 in 17 years 1838–54; and ·99 in 34 years 1838–71, and so for other ages. The rates of mortality for 1838–54 are taken from the English Life Table, pp. xviii–xx; the rates for 1838–71 are the arithemetical means of the several rates for each of the 34 years.

The coincidence between the rates of mortality at the ages when insurance is effected are equally remarkable. This is a descisive proof of the solid foundation of the English Life Table, which was calculated on the population living at two Censuses, and on 6,470,720 deaths; for the rates are in complete accord with the rates deduced from the living at four Censuses, and from 14,330,919 deaths, distinguishing the numbers living at 12 ages into which human life is divided in our tables, science being no longer contented with the seven ages of the old times.

The mean lifetime of the English people is by the table 40·86 years. That is the average number of years children born in England live.

It is gratifying to me at the end of 34 years to be able to say that one of the objects for which registration was established has been accomplished, and that the expectations held out in the following passage of the first Report from this office have been realised:—

"The recommendation of the Report" [of the Select Committee of the House of Commons on Friendly Societies in 1827, pointing out the insufficiency of the data hitherto collected, and the contradictory nature of the several Life Tables founded on them], "that measures be adopted " for making 'an accurate and extensive collection of facts,' whereby " may be facilitated 'the solution of all questions depending upon the " 'duration of human life,' is at length carried into effect; ample " materials, thus conducing to ameliorate the condition of the working " classes, are now afforded in the certified copies of registers deposited " in the General Register Office, and each year's accumulation will " increase the value of such records, by augmenting the number of " facts upon which calculation may be brought to bear."*

The National Table is, it will be seen, a safe basis for the insurance of lives, as it includes all the population; and in the degree that persons living in unfavourable conditions, or labouring under diseases are excluded, will be the proportion of profits dependent on the mortality.—(34th Annual Report, pp. v-vi.)

Proportional Mortality at different Age-Periods.—If we take the general mortality of the population from the English Life Table, it is at the rate of 24·47 per 1,000 of the living at all ages; and the mortality is made up of deaths occurring at the ages shown in the annexed table; that is 6·44 at the age 0–5, 2·52 at the age 5–25, and 6·62 at the age 65–85.

As the births increase every year in England, the population and the deaths in the earlier ages are in undue proportion; thus the general mortality, instead of 24·47 per 1,000, becomes 22·45 for years 1838–54; but for ten years 1851–60 it was 22·17, and of the 22·17 deaths not less than 8·98 are children under 5 years of age, while only 3·70 are of the ages 65–85.

The general mortality, without distinction of age, is to a considerable extent made up of children's deaths, and its variation in different districts depends largely upon this element.

In the healthy districts, where the general mortality was at the rate of 17·53 deaths in 1,000 living, 5·29 of the said deaths were of children under five years of age.

In thirty large town districts the general mortality was at the rate of 28·01 deaths to 1,000 living; and 13·34 of the deaths were those of children under 5 years of age.

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* First Report of Registrar General for year ending 30th June 1838, p. 16.

PROPORTION OF DEATHS at different Ages to 1,000 Living at all Ages.

AGES.	English Life Table (1838–54).	England (1851–60).	30 Large Town Districts (1851–60).	63 Healthy Districts (1849–53).
ALL AGES - -	24·47	22·17	28·01	17·53
0– - - -	6·44	8·98	13·34	5·29
5– - -	2·52	3·00	3·52	2·65
25– - - -	3·20	2·90	3·88	2·22
45– - -	4·75	3·07	3·91	2·46
65– - - -	6·62	3·70	3 07	4·14
85 and upwards	·94	·52	·29	·77

The total difference between the rates of mortality, in the Large Town and Healthy Districts, is 10·48; of which 8·05 is accounted for by the deaths under 5 years of age. Of all England, and the healthy districts, the difference in the mortality is 22·17—17·53=4·64; of which the children's deaths account for 3·69 =8·98—5·29.

This principle must be borne in mind, as well as the disturbances which are produced by the increase of births, and by migration, by hospitals and by lunatic asylums, in studying the series of Tables exhibiting for each district the density of the population, and the rates of mortality per 1,000 during each of the ten years 1841–50 and 1851–60; or the mean rate in the twenty years 1841–60.

The two long periods, each of ten years, and the size of the districts, justify us in instituting a comparison between their rates of mortality.

In the whole kingdom the mortality was near the same rate in each of the decennia.—(Supplement to 25th Annual Report, p. xxvii.)

Mortality of Males and of Females at various Age Periods, 1861–70. —The vitality is measured either by the years of life out of which *one* death occurs, or by the death out of a *unit* of lifetime. Thus in England, according to the life table, 1 in 41 living dies annually. The death out of a unit of lifetime is ·02447. As this implies that 2·447 die in a year out of 100 living, the mortality is said to be 2·447 per cent. annually; or, to speak in round numbers, 24 in 1,000. Make the numbers living constantly sustained 1,000, then if 24 die in a year the mean interval between each death is 15 days; and if a death occur out of the 1,000 every 24 days the rate of mortality will be retarded, as it is in inverse proportion to the interval between each death. The faster people die in a city the greater is its mortality. Thus any two of three variables being fixed, the vitality is measured by the variation of the third.

For the *rate of mortality*—expressed briefly by *the mortality*—involves three elements—time, numbers living, numbers dying; the time being fixed at a year, and the living through that time at 1—which may be called a year of life—the rate of mortality is a fraction, easily convertible into a whole number by multiplying this fraction into 1,000, or any greater number. Here the rate at different ages is expressed as the mortality of the living at those ages. Thus, taking the boys of England (1861–70) under five years of age in one group, it is found that the mortality was at the rate of 7·316 per cent. per annum; then boys of the age of 5 and under 10 die at the lower rate of ·815*; and

* By a mere change of the place of the decimal point to the right this may of course be read as 8·15 per 1,000.

boys of 10–15 as they enter puberty die at the still lower rate of ·446. In the next five years of age the mortality of youth rises; and at 20–25 the mortality is ·845, nearly the same as that of boys 15 years younger; through manhood the mortality rises slowly up to 3·300 at the age 55–65; and as age advances still more until at 85 and upwards it is at the rate of 31·357. The mortality of females goes through a similar cycle; descending to a minimum at the first great change of formative energy in puberty, and then ascending with age until subsiding life is converted into the other forces of nature. The law implies first an increasing and then a continually decreasing power of sustaining vitality.

But the law varies with the conditions of existence; and though these conditions vary infinitely—some being favourable and others unfavourable to life—there are large masses of the population, whole regions and cities, where the results of all the agencies in operation differ widely.

Take for example the group of 51 districts called healthy for the sake of distinction, and here it is found that the annual mortality per cent. of boys under five years of age was 4·246, of girls 3·501. Turn to the district of Liverpool*: the mortality of boys was 14·475, of girls 13·429. Here it is evident that some pregnant exceptional causes of death are in operation in this second city of England. What are these causes? Do they admit of removal? If they do admit of removal, is this destruction of life to be allowed to go on indefinitely? It is found that of 10,000 children born alive in Liverpool 5,396 live five years; a number that in the healthy districts could be provided by 6,544 annual births. This procreation of children to perish so soon—the sufferings of the little victims—the sorrows and expenses of their parents—are as deplorable as they are wasteful. In Liverpool the death of children is so frequent and dreadful, that a special system of insurance has been devised to provide them with coffins and burial ceremonies. The mother when she looks at her baby is asked to think of its death, and to provide by insurance not for its clothes but for its shroud and other cerements. There are cases where a wretched parent has insured the life of her baby, and realised money by the transaction; but there is no statistical evidence to show that this is a systematic trade; rather the reverse; all that is certain is that the children are bred in such unfavourable and unnatural conditions that they perish in excessive numbers. The extent to which the several causes contribute to their destruction requires further investigation; but enough is known to justify the belief that such causes may be to a considerable extent removed.

Then the sacrifice of the lives of men at the most productive ages, from 35 to 55, is almost equally great; the deaths out of the same numbers living are as *three* in the Liverpool district to every *one* in the natural state of the working population of extensive districts of the kingdom.

The thousands of families of the Liverpool district are of various grades, and live in very different sanitary conditions; some may be as healthy as groups of families anywhere else, and others may suffer to the extremest extent; but the general result is seen in the Table, which may for the moment represent the unhealthy classes, as the other Table represents the healthy classes, of the nation. Every great city has in it a bit of Liverpool. Between the extremes of mortality, high and low, lies a series of intermediate rates, and the aggregate of the whole mass is expressed in the rates for all England.

* The *Borough* of Liverpool extends over a part of West Derby. The *District* is co-extensive with the *parish*.

AVERAGE ANNUAL RATE of MORTALITY per Cent., 1861–70, at different AGES in FIFTY-ONE HEALTHY DISTRICTS, in the whole of ENGLAND and WALES, in LONDON, and in MANCHESTER and LIVERPOOL DISTRICTS respectively.

Ages.	MALES.					FEMALES.				
	Fifty-one* Healthy Districts.	England and Wales.	London.	Manchester District.	Liverpool District.	Fifty-one* Healthy Districts.	England and Wales.	London.	Manchester District.	Liverpool District.
All ages -	1·756	2·361	2·655	3·538	4·097	1·623	2·128	2·234	3·046	3·636
0–	4·246	7·316	8·691	11·790	14·475	3·501	6·343	7·632	10·590	13·429
5–	·566	·815	·937	1·401	1·647	·562	·776	·885	1·152	1·514
10–	·346	·446	·424	·651	·668	·390	·448	·407	·579	·614
15–	·483	·616	·582	·939	·945	·628	·662	·510	·740	·758
20–	·738	·845	·823	1·167	1·422	·734	·796	·622	·955	1·102
25–	·824	·990	1·086	1·469	1·998	·807	·968	·880	1·307	1·749
35–	1·007	1·346	1·714	2·325	3·007	·975	1·203	1·284	1·926	2·408
45–	1·346	1·916	2·568	3·455	4·372	1·176	1·555	1·852	2·876	3·701
55–	2·372	3·300	4·385	6·017	7·095	2·114	2·777	3·345	5·031	5·760
65–	5·456	6·669	8·283	10·876	11·918	4·995	5·880	6·723	9·426	9·564
75–	13·128	14·658	16·902	20·978	19·488	12·378	13·443	14·654	17·300	16·281
85 & upwds.	28·492	31·357	32·142	40·714	29·600	26·400	28·364	29·142	27·387	25·446

* In this Table two districts are excluded from the *fifty-three* Healthy Districts shown in other Tables, namely, Barnet and King's Norton, ou account of their proximity, the former to London and the latter to Birmingham.

The above table exhibits the rates of mortality of males and females respectively, at 12 groups of ages, in London, contrasted with the rates at the same groups of ages in 51 Healthy districts, in all England, in the district of Manchester, and in the district of Liverpool. Arranged in the order of mortality at all ages, as in the Table, it will be noted that London ranks next to all England, Manchester following, and Liverpool standing last, with the high rate of 4·097 deaths per cent. of males and 3·636 of females.

If we take 15 great town districts in different parts of the kingdom—including Manchester—and compare the rates of mortality at different ages with the mortality at the same ages of the 17 great town districts, including, besides the 15 districts preceding, Liverpool and London, the rates will be found to differ but little, and that is through London being included in the 17 towns which contain on the average of the ten years 1861–71 no less than 4,981,258 inhabitants, or nearly a fourth of the population of England and Wales. The rates very fairly represent the death-tax which the great city populations of England now pay.

The causes that make the rates of mortality vary may be considered under two heads—

(1.) Causes inherent in the population itself, such, for example, as *sex* and *age*.

(2.) Causes outside the population, such as air, water, food, clothing, dwellings, or such groups of causes as are involved in residence, and relation of the several parts to each other in time and space.

Mere inspection of the Tables 49, 50, 51, establishes under the first head two things; (*a*) that the mortality of males everywhere exceeds the mortality of females at nearly all ages; (*b*) that the mortality is at a minimum at the age 10–15; and increases in two directions, as we approach birth, and as we recede to lengthening age.

Under the second head it is established by the facts that the mortality in all the great towns is high at nearly all ages; and also that the rates of mortality of the populations in mass under all the local conditions vary generally in the same direction as the mortality at their several periods of life. In fact the causes of insalubrity affect people of all ages; but it will be shown hereafter that their effects differ in degree at different ages.—(Supplement to 35th Annual Report, pp. xxi–ii.)

4. Infant and Child Mortality.

Mortality of Children.—It must also be borne in mind that the proportions of the deaths of children, though showing a high mortality in some places as compared with that of others, must not be regarded as true criterions of the comparative mortality, unless the proportions of living children to living adults were in those different places the same. Neither must it be supposed that the proportion of children dying out of 1,000 deaths at all ages, whether given for the whole or for any part of England and Wales, will afford the means of expressing correctly the proportion of such deaths to the living population. This would not be the case unless the population were stationary, the deaths being equal to the births; but in England and Wales the number of births greatly exceeds that of the deaths, as will appear from the following abstracts. Even though the registration of births is still deficient (and there is reason to believe that the number registered in every one of the 25 divisions falls short of the actual number), yet, even with this admitted probable deficiency, the number of births, if applied as an element of calculation, will show a mortality much less than it appears in the Comparative Table of Deaths. Neither of these, however, can be accepted as correct; and even the proportion of deaths under 1 year to 1,000 registered births is a little higher than the truth. —(2nd Annual Report, p. 16.)

Mortality of Infants.—As there are difficulties in determining the ages of the oldest people in the population, so there are great difficulties in determining the rate of mortality among infants, from the want of exactly observed facts. The infants in the first year of life are to some extent mixed up with infants in the second year of age; and their numbers fluctuate from year to year, owing to fluctuations in the births, and the mortality from zymotic and other diseases, so that the years of infant life cannot be accurately deduced from decennial enumerations of the infants living at the date of the Census. Again, the mortality diminishes so rapidly after the date of birth, and at such various rates under different conditions, that it is necessary to subdivide the first year into months, and even days, to get results exactly comparable. The still-born children in England are not registered; and a certain number of infants that breathe for a short time are, it is believed, to save the burial fees, interred as the still-born are buried, and so escape registration. Upon the other hand, the deaths of premature children born alive are registered; and they amounted to 45,814 out of 626,340 deaths of infants under 1 year of age in the six years (1858–63) that they have been distinguished from infants dying of debility. The recognised proportion is 7·315 per cent., so that to obtain the rate of mortality among children *born at the full term* of *nine months*, the premature children, if we had the means, should be struck out of the account both of the living and dying. This is impossible in the present state of statistical observation. But it happens that these deaths of premature children serve as probably more than a sufficient set-off against the infants of full term dying soon and escaping registration.

The age of man is reckoned from the date of birth; but before that date the fœtus has lived its intra-uterine life, and the instant in which the sperm-cell and germ-cell intermingle is the true time of the embryo's origin. Respecting the rate of embryonic mortality there is little definite information; but it is probable that as the mortality in the first year of breathing life rapidly increases as we proceed backwards from the twelfth to the third, second, and first month, the same law prevails during embryonic life, until we arrive at the destruction of an immense proportion of the spermatozoa and ova which are provided to secure the continuation of the species. This question well deserves the attention of the Obstetric Society, and is intimately connected with abortions, miscarriages, and still-births.*

ENGLISH LIFE TABLE for each Month of the First Year of Age, and Annual Rate of Mortality per cent. of Children in each Month under 1 Year of Age.

AGE.	LIVING at 0 and at the end of each Month of Age. $l_{\frac{x}{12}}$			DEATHS in each Month of Age. $d_{\frac{x}{12}}$			ANNUAL RATE of MORTALITY per Cent. in each Month under 1 Year of Age. $m_{\frac{x}{12}}$			AGE.
$\frac{x}{12}$ (Months.)	Both Sexes.	Boys.	Girls.	Both Sexes.	Boys.	Girls	Both Sexes.	Boys.	Girls.	$\frac{x}{12}$ (Months.)
0	1,000,000	511,745	488,255	46,503	26,787	19,716	57·132	64·501	49·455	0—
1	953,497	484,958	468,539	17,195	9,640	7,555	21·837	24·093	19·507	1—
2	936,302	475,318	460,984	12,178	6,758	5,420	15·710	17·184	14·192	2—
3	924,124	468,560	455,564	10,100	5,598	4,502	13·187	14·423	11·918	3—
4	914,024	462,962	451,062	9,550	5,320	4,230	12·604	13·869	11·306	4—
5	904,474	457,642	446,832	9,033	5,044	3,989	12·050	13·299	10·761	5—
6	895,441	452,598	442,843	8,547	4,771	3,776	11·509	12·717	10·276	6—
7	886,894	447,827	439,067	8,087	4,498	3,589	10·992	12·114	9·849	7—
8	878,807	443,329	435,478	7,657	4,229	3,428	10·501	11·502	9·484	8—
9	871,150	439,100	432,050	7,253	3,959	3,294	10·033	10·868	9·184	9—
10	863,897	435,141	428,756	6,872	3,691	3,181	9·584	10·222	8·936	10—
11	857,025	431,450	425,575	6,518	3,424	3,094	9·161	9·561	8·756	11—12
12	850,507	428,026	422,481	—	—	—	—	—	—	—

NOTE.—This Table was calculated from the Corrected Births and from the Deaths registered in the 17 Years 1838–1854 under 3 months, at 3 and under 6 months, and at 6 months and under 1 year (see Note to Table VII., p. xxiii of English Life Table). Of 1,000,000 persons born, 953,497 were living at the end of the first month of age, 46,503 having died in the interval, of whom 26,787 were Males and 19,716 were Females; 936,302 were living at the end of the second month, and the deaths in that months were 17,195, of whom 9,640 were Males and 7,555 were Females. The *Annual* Rate of Mortality per cent. of infants under 1 month was 57·132, viz., Males 64·501, Females 49·455, and so on for other ages.

The annexed Table from the English Life Table shows the estimated numbers of males and females surviving each month, and the annual rates of mortality in each month. It will be observed that the rate of mortality rapidly declines month by month; and that the mortality of boys in every month exceeds that of girls, so that at the end of the first year the number of boys does not greatly exceed the number of girls.

The mortality of infants in France was such in the first year as to reduce 1,000,000 to 820,065, according to the experience acquired by following the births in 1856–60 for the 12 months following. The deaths were 179,935, and the probability of dying 0.179935.

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* Dr. Granville has the merit of having called attention to the importance of the subject. In his *Report of the Practice of Midwifery at the Westminster General Dispensary*, for 1818, he showed that of 400 pregnant married women who applied at the Dispensary 128 had miscarried within the previous ten years one time or more; in all 305 times. The 128 women had given birth during the same term of years to 556 live children, 305 dead embryos. 272 of the women had not miscarried at all; and Dr. Granville does not say to how many living children they had given birth. Of the 305 miscarriages, 185 occurred in the first 3 months of pregnancy, 65 in 3–6 months, and 55 in 6–8 months. (pp. 39–48.)

The French returns show the deaths in the first week of life; and by the returns of 1856 the mortality was at the rate of 154 per cent. per annum in the first seven days, 120 in the second seven days, and 54 in the sixteen days following. The mean births were 927,226; the deaths in the three periods were 27,002, 20,517, and 20,618, making 68,137 deaths in the first month of life. So out of 1,000,000 births 29,121 die in the first week, 22,128 in the second week, and 22,236 in the sixteen days following.

In England and Wales the deaths of 2,374,379 infants in the first year of age were registered in the 26 years 1838–63; and of the number 1,329,287 were boys, 1,045,092 were girls. The deaths at the same age registered in the ten years 1851–60 were 996,630; of boys 557,213, and of girls 439,417. Nearly 100,000 infants died annually; in the proportion of about 56 boys to 44 girls. (Supplement to 25th Annual Report, pp. v–vi.)

Mortality of Infants under one year, and its causes.—The high rate of infant mortality continues to occupy the earnest attention of medical statists. The death-rate of infants* in England and Wales, in 1875, was 158 per 1,000, or 4 per 1,000 above the average rate in the 10 years 1861–70. This implies that the mortality among infants is increasing.

The subjoined Table shows the death-rate of infants from all causes in 18 large towns. The highest rates in 1875 prevailed in

MORTALITY OF CHILDREN under ONE YEAR OF AGE from All Causes in Eighteen Large Towns, 1870–75.

BOROUGHS, &c.	PROPORTIONAL NUMBER of DEATHS under One Year to every 1,000 Births registered in 52 or 53 Weeks in each Year.						
	1870.	1871.	1872.	1873.	1874.	Average Number in the 5 Years 1870–74.	1875.
Portsmouth - -	160	144	146	139	151	148	133
London - -	163	171	159	159	155	161	162
Bristol - - -	196	165	151	157	153	164	166
Wolverhampton -	163	185	176	175	169	174	161
Sunderland -	150	222	177	163	166	176	169
Oldham - -	—	188	178	169	190	181	177
Birmingham -	181	190	166	180	180	179	196
Hull - -	176	177	204	174	172	181	191
Sheffield - -	180	208	185	180	188	188	176
Nottingham -	186	187	207	172	195	189	199
Salford - -	191	221	173	185	189	192	178
Norwich - -	221	200	210	159	177	193	210
Newcastle-on-Tyne	183	223	177	186	198	193	187
Bradford - -	208	209	197	206	189	202	200
Manchester -	203	221	191	198	197	202	184
Leeds - - -	217	205	212	192	200	205	197
Leicester - -	235	241	228	213	215	226	245
Liverpool - -	259	269	222	213	233	239	210

* By the death-rate of infants throughout this Report, is meant the proportional number of deaths of children under one year of age to every 1,000 births. "Death-rate" under 1 is used for its shortness instead of the more correct term "probability

Leicester, 245 per 1,000, Liverpool 210, Norwich 210, Bradford 200, Nottingham 199, Leeds 197, Birmingham 196, and Hull 191. Portsmouth had the lowest rate, 133 per 1,000.

What are the causes of such high death-rates of infants in large towns? This is a question of vital importance, and to assist in giving a satisfactory answer, the average annual death-rates of infants from each of eleven causes, in the three years 1873–5, have been calculated for 15 large towns. The results are shown in the subjoined table.

MORTALITY of CHILDREN under ONE YEAR of AGE from different CAUSES in ENGLAND, in SCOTLAND, and in FIFTEEN LARGE TOWNS, 1873–5.*

BOROUGHS, &c.	ANNUAL NUMBER of DEATHS of CHILDREN under One Year of Age in the three years 1873-5, to every 1,000 BIRTHS.												
	All Causes.	The Eleven Causes.	Measles.	Scarlet fever.	Whooping-cough.	Teething.	Diarrhœa.	Convulsions.	Lung Diseases.	Tubercular Diseases.	Atrophy.	Premature Birth.	Suffocation.
ENGLAND† -	152·7	131·6	2·2	1·4	5·9	2·9	17·1	25·1	26·3	9·8	26·7	12·8	1·4
SCOTLAND‡ -	125·7	94·3	2·2	1·9	6·4	3·4	7·0	5·5	25·2	11·1	30·7		·9
Portsmouth -	145·9	130·9	2·8	·3	5·3	3·0	32·2	21·5	24·2	11·7	22·7	6·1	1·1
London - -	159·1	135·6	3·1	1·1	8·3	3·6	20·4	18·5	31·9	13·8	20·5	10·4	4·0
Wolverhampton -	166·0	140·9	2·4	1·5	5·9	1·1	22·0	30·4	31·2	9·4	26·4	10·2	·4
Sunderland - -	167·6	147·5	1·5	·6	7·3	3·2	21·3	28·2	25·4	6·4	39·4	13·6	·6
Oldham - -	180·1	150·9	3·0	1·6	7·5	4·8	16·4	26·0	36·2	11·8	27·3	16·3	—
Norwich - -	183·4	161·8	·6	—	9·8	2·0	27·2	22·9	20·8	6·9	63·0	8·6	—
Salford - -	183·9	151·7	7·0	1·7	4·2	2·2	31·5	25·0	27·7	9·1	32·4	10·3	·6
Sheffield - -	186·1	148·8	1·6	3·2	6·5	5·2	31·0	33·0	36·9	8·0	10·4	12·5	·5
Birmingham -	187·0	160·0	2·0	2·4	7·5	1·6	33·9	13·4	28·3	7·1	39·7	14·1	10·0
Newcastle-upon-Tyne - -	190·6	164·5	2·0	2·7	5·2	2·6	24·4	37·7	24·5	13·9	37·9	12·0	1·6
Manchester -	192·9	157·4	3·1	2·1	6·5	2·9	28·7	28·1	31·3	9·0	33·9	11·1	·7
Nottingham -	199·5	184·8	3·9	1·9	5·3	2·7	33·7	32·1	25·4	15·4	47·0	16·8	·6
Leeds - - -	201·1	162·7	2·0	2·6	5·5	3·5	30·9	26·2	32·4	9·8	32·2	16·6	1·0
Leicester - -	217·3	203·1	2·8	1·1	6·0	4·1	54·5	31·6	23·1	11·8	50·7	16·6	·8
Liverpool - -	218·9	191·2	6·1	4·9	9·0	2·2	31·9	28·6	39·4	12·6	37·7	10·6	8·2
Mean - -	185·3	159·5	2·9	1·8	6·7	3·0	29·3	26·9	29·3	10·4	34·8	12·4	2·0

* The results for the fifteen large towns are deduced from returns supplied by the Medical Officers of Health. As far as practicable differences in nomenclature have been adjusted.

† In England, in the three years 1873-5, the causes of death of 5,354 infants (1·4 per cent.) were no stated.

‡ The results for Scotland are for the three years 1870-2. The causes of death of 2,894 infants (6·6 per cent.) were not stated in those three years. Dr. Robertson, the Superintendent of the Statistical Department of the General Register Office, Edinburgh, states that it cannot be assumed that the popular but utterly unscientific term "bowel hives" is now used by informants in any large proportion of these 2,894 cases; the term being rarely observed in the certificates of death.

"of dying under the age of 1." The births, out of which the deaths under 1 year of age occurred in the year 1875, were those registered in the two years 1874 and 1875. To obtain the proportional number of deaths (0–1) to births, the deaths (0–1) should be divided by $\left(\frac{B_{74} + B_{75}}{2}\right)$ the mean number of births in 1874–75; but as the *mean* number differed so little from the annual number, the births in the year 1875 were used in obtaining the results relating to infant mortality. In calculating the death-rates of infants, it has been found more accurate to apply the number of *births* to the deaths under one year of age, than the numbers *enumerated at the Census*, as it is believed these were not always accurately returned. The practice sometimes being to put down children in the first, second, and third years of age as 1, 2, 3, instead of 0, 1, 2, a certain number of children in the first year of age, who should have been returned as 0–1, were returned as 1–2.

The table deserves careful study, for the agencies which destroy infant life are many, and they vary in different localities. Some of the principal causes are improper and insufficient food, bad management, use of opiates, neglect, early marriages, and debility of mothers; but whatever may be the special agencies at work which are so prejudicial to infant life, it must be borne in mind that a high death-rate is in a great measure also due to bad sanitary arrangements.

In towns such as Sunderland, Wolverhampton, and Newcastle-upon-Tyne, where the iron and coal mining industries prosper, and where the marriages of minors are in excess, mismanagement through ignorance is probably one of the causes of a high infant death-rate, while in towns such as Oldham, Norwich, Salford, Nottingham, Leeds, Leicester, and Manchester, where the women are more or less employed away from home in the manufacture of textile fabrics, it is probable that one of the causes of the high rates of infant mortality is maternal neglect. In the hardware manufacturing towns, such as Sheffield and Birmingham, comparitively few women are employed in the factories.

As regards illegitimate infants, the chief causes of the high mortality are no doubt improper food and neglect; but the death-rate of children born out of wedlock will be discussed further on.

The causes of death which are more directly the result of neglect and mismanagement, are convulsions, diarrhœa, and atrophy.

In Scotland, infant mortality is not so high as it is in England. In the 10 years 1861–70, the average annual death-rate was 154 per 1,000 in England, and 121 in Scotland, and it is remarkable that the excess in the number of deaths from convulsions, diarrhœa, atrophy, and premature birth, accounts for nearly the whole of the difference in the high rate of infant mortality in England, compared with that of Scotland. The number of deaths of infants in England, in the 10 years 1861–70, from convulsions, was 208,320, and from diarrhœa, 119,430. In Scotland the respective numbers were 5,801 and 6,156. The births registered during the same period in England were 7,500,096, and in Scotland 1,120,791. Thus the average annual death-rate of infants in 1861–70, in England, from convulsions, was 27·8, and from diarrhœa 15·9 per 1,000, whereas in Scotland the respective death-rates were only 5·2 and 5·5 per 1,000. In the above table, average annual rates of infant mortality in England and Scotland are shown from each of eleven causes of death.

The cause of this high mortality of infants from convulsions and diarrhœa in England, compared with Scotland, is supposed to be due to bad feeding.*

Compared with the fifteen English towns the mortality of infants from all causes in the city of Glasgow in the three years 1873–75, was comparatively low, viz., 163·3 per 1,000 births. Only Portsmouth and London have a lower rate of infant mortality. The death-rates per 1,000 in the city of Glasgow from each of several causes were as follows: measles 4·3, scarlet fever 3·4, whooping-cough 8·9, diarrhœal diseases 12·1, lung diseases 37·7, atrophy and debility 23·5, premature birth 14·9, fever 0·5, small-pox 1·0, croup and diphtheria 2·3, consumption 2·3, nervous diseases 25·4, and from other causes 27·0.

The mortality in the mining and manufacturing towns of England from convulsions, diarrhœa, atrophy, and premature birth together, was 86 per 1,000 in Oldham, in Sheffield 87, Wolverhampton 89, Salford 99, Birmingham 101, Manchester 102, Sunderland 103,

* See Paper by Dr. Stark, M.D., F.R.S.E., as to treatment of infants in Scotland, in Vol. XXIX. of the Journal of the Statistical Society, pp. 13–17.

Leeds 106, Newcastle-upon-Tyne 112, Norwich 122, Nottingham 130, and Leicester 153.

No comparison, however, of infant mortality, in different towns should be made without looking to the occupations of the women.

In seven of these fifteen towns, women are employed in greater or less numbers, at the mills and factories, in textile manufactures. In Oldham, these four causes of death (convulsions, diarrhœa, atrophy, and premature birth) represented only 48 per cent. of the total mortality of infants. In Salford, the proportion was 54 per cent., in Manchester 53, and in Leeds 53. In Norwich, Nottingham, and Leicester respectively, these four causes represented 66, 65, and 71 per cent. of the total mortality of infants.

Turning to the mining, and hardware manufacturing towns, these four causes represented 47 per cent. of the total mortality in Sheffield, and 54 in Wolverhampton and Birmingham. In Newcastle-upon-Tyne and Sunderland the respective proportions were higher, viz., 59 and 61 per cent.

In Oldham, the rate of infant mortality was high, viz., 180 per 1,000: the excess is no doubt partly owing to the mothers being employed at the mills. About three weeks or a month is the average time they remain at home after the birth of a child. Dr. Sutton recommends the establishment of day nurseries for the better protection of infants during the hours they are deprived of maternal care. It is remarkable that, although the proportion of women, aged 20 years and upwards, employed in textile manufactures was highest in this town, 346 per 1,000, yet the rate of infant mortality was relatively lower than in any of the other six textile manufacturing towns. The mortality from lung diseases was excessively high in Oldham.

In Norwich, the death-rate of infants was higher than in Oldham, being 183 per 1,000. The proportion of women employed in textile manufactures was lower in this town than in any of the others; it was 58 per 1,000 living. Dr. Crosse reports that much ignorance prevails among the poorer classes as to the proper way of rearing infants, and this appears to be borne out by the results, for the mortality from atrophy was at the high rate of 63 per 1,000; it is the highest rate from this cause in any of the fifteen large towns.

In Salford, the rate of infant mortality differed from that in Manchester. In the former the rate was 184; in the latter it was 193 per 1,000. The proportion of women employed in the textile manufactures, in these two towns, was 152 per 1,000. In Salford, Dr. Tatham reports that the high death-rate was chiefly due to the mothers leaving their offspring soon after birth, in order to work at the cotton mills: their infants, thus neglected, soon fell an easy prey to the first disorder that attacked them.

In Salford, the mortality from diarrhœa, and in Manchester from convulsions and lung diseases, was higher than the mean for the fifteen towns.

In Nottingham, the mortality of infants reached the high rate of 200 per 1,000. The proportion of women engaged in textile manufactures was also high, viz., 249 per 1,000. Dr. Seaton states that although the death-rate of infants was unduly augmented by married women being thus employed, he is of opinion that infants were not deprived of maternal care in Nottingham to the same extent as they were in some other so-called textile manufacturing towns. Of the

6,758 women thus employed, 1,487 were engaged in hosiery manufacture. The death-rate from atrophy was excessively high in Nottingham, viz., 47 per 1,000.

NUMBER, and PROPORTION per 1,000, of FEMALES 20 YEARS of AGE and UPWARDS employed (1) in TEXTILE MANUFACTURES and (2) in HOUSEHOLD DUTIES, according to the Census of 1871; together with the rate of INFANT MORTALITY 1873–5; in the SEVEN FACTORY TOWNS, and in PORTSMOUTH, and LONDON, arranged in the order indicated by the Results in Col. 4.

TOWNS.	Females 20 Years of Age and upwards in 1871.					Infant Mortality, 1873–75.
	Females enumerated 20 Years of Age and upwards.	Number engaged in		To every 1,000 living the proportion employed in		Death-rate per 1,000 Births.
		Textile Manufactures.	Household Duties.*	Textile Manufactures.	Household Duties.*	
Cols. - - -	1.	2.	3.	4.	5.	6.
Oldham - - -	32,343	11,178	15,961	346	493	180
Nottingham - -	27,171	6,758	12,429	249	457	200
Manchester and Salford	150,019	22,750	81,245	152	542	188
Leicester - - -	27,677	3,368	15,017	122	543	217
Leeds - - - -	72,719	6,776	47,873	93	658	201
Norwich - - -	25,684	1,478	13,847	58	539	183
Portsmouth - -	31,504	—	21,460	—	681	146
London - - -	1,022,419	—	585,506	—	573	159

* The results in this column represent the number of women *at home*; generally engaged in household duties, but in certain cases assisting in their husbands' business.

In Leeds, the rate of infant mortality was as high as 201 per 1,000. The proportion of women employed in textile manufactures was 93 per 1,000.

In Leicester, infant mortality was greatly in excess, being at the rate of 217 per 1,000. The proportion of women employed in textile manfactures was 122 per 1,000. Of the 3,368 women working in these fabrics, 1,840 were engaged in hosiery manufacture. The rate of infant mortality from diarrhœa and atrophy in Leicester was excessively high, viz., 54·5 and 50·7 per 1,000 births.

Infant mortality was lowest in Portsmouth, and the death-rate from *each* of the eleven causes in this town was lower than the mean for the fifteen towns, except from teething, the mortality from which was the same as the mean; from diarrhœa, and from tubercular diseases, the mortality exceeded the mean.

In Liverpool, the death-rate from lung diseases was excessive, 39·4 per 1,000, or 10·1 per 1,000 above the mean. The mortality from lung diseases was also very high in Sheffield, Oldham, Leeds, London, Manchester, and Wolverhampton.

The high mortality from suffocation in Birmingham and Liverpool demands the attention of the coroners.

In the factory towns of Nottingham, Leeds, Leicester, and Oldham, the mortality from premature birth was excessively high.

CAUSES of INFANT MORTALITY in Towns in the Three Years 1873–5.

CAUSES OF DEATH.	Mean Death-rate per 1,000 in 15 Towns. (*See* Table on p. 191.)	PORTSMOUTH		LIVERPOOL.		LONDON.	The Seven Textile Manufacturing Towns, *see* p. 194.	
		Death-rate per 1,000.	In defect or excess of the MEAN.	Death-rate per 1,000.	In excess or defect of the MEAN.	Death-rate per 1,000.	Death-rate per 1,000.	In excess or defect of LONDON.
Cols.	1.	2.	3.	4.	5.	6.	7.	8.
ALL CAUSES - -	185·3	145·9	−39·4	218·9	+33·6	159·1	194·0	+34·9
The 11 subjoined Causes	159·5	130·9	−28·6	191·2	+31·7	135·6	167·5	+31·9
Measles - - -	2·9	2·8	− 0·1	6·1	+ 3·2	3·1	3·2	+ 0·1
Scartlet Fever - -	1·8	·3	− 1·5	4·9	+ 3·1	1·1	1·6	+ 0·5
Whooping-cough -	6·7	5·3	+ 1·4	9·0	+ 2·3	8·3	6·4	− 1·9
Teething - - -	3·0	3·0	0·0	2·2	− 0·8	3·6	3·2	− 0·4
Diarrhœa - -	29·3	32·2	+ 2·9	31·9	+ 2·6	20·4	31·9	+11·5
Convulsions - -	26·9	21·5	− 5·4	28·6	+ 1·7	18·5	27·4	+ 8·9
Lung Diseases - -	29·3	24·2	− 5·1	39·4	+10·1	31·9	28·1	− 3·8
Tubercular Diseases -	10·4	11·7	+ 1·3	12·6	+ 2·2	13 8	10·5	− 3·3
Atrophy and Debility	34·8	22·7	−12·1	37·7	+ 2·9	20·5	40·9	+20·4
Premature Birth -	12·4	6·1	− 6·3	10·6	− 1·8	10·4	13·8	+ 3·4
Suffocation - -	2·0	1·1	− 0·9	8·2	+ 6·2	4·0	0·5	− 3·5

In the above table (cols. 6, 7, and 8) the death-rates from each of the eleven causes in these seven textile manufacturing towns in the aggregate are compared with those in London, and the results indicate in a striking manner that—over and above a certain proportion of the mortality which may be attributable to indifferent sanitary arrangements —the causes most fatal to infant life in factory towns, and which are inseparable from bad nursing and feeding, are diarrhœa, convulsions, and atrophy. The mortality from premature birth was also in excess. Thus the respective death-rates of infants in London, and in the seven factory towns, were, from diarrhœa 20·4 and 31·9, from convulsions 18·5 and 27·4, from atrophy 20·5 and 40·9, from premature birth 10·4 and 13·8 per 1,000.

The death-rates in the seven factory towns from whooping-cough, teething, lung-diseases, tubercular diseases, and suffocation, were lower than those in London. (38th Annual Report, pp. xl–xlvi.)

Child Mortality in London, 1730–1830.—The method pursued in obtaining the following results is unexceptionable, and demonstrates that for the last century the mortality of children in London has constantly been on the decline.

BIRTHS and the DEATHS under 5 Years of Age, according to the "London Bills of Mortality," for 100 years, in 5 Periods of 20 Years each; and the NUMBER DYING under 5 Years out of 100 born.*

	1730–49.	1750–69.	1770–89.	1790–1809.	1810–29.
Total Births - -	315,456	307,395	349,477	386,393	477,910
Total Deaths under 5 Years - -	235,087	193,694	180,058	159,571	151,794
Dying per Cent. under 5 Years -	74·5	63·0	51·5	41·3	31·8

* On the diminution of the mortality of infants in England, by T. R. Edmonds, Esq.—*Lancet*, Vol. I., 1835–36.

In the 20 years, 1730–49, out of 100 born, 74·5 died under the age of 5 years. During the 20 years, 1810–29, only 31·8 died out of the same number. This table is from a paper of Mr. Edmonds, to whose investigations of the English population returns we shall have frequently to refer.

If half the children formerly cut off at an early age in England be now reared, and form part of the adult population; while the annual deaths between 20 and 30, instead of being 7·6, or 9·1, or 8·9 per 1,000, as in Carlisle, Belgium, and Sweden, are 10·1; it will appear that a vast number of weakly children are every year introduced into the English population, and that, unless proper means be taken to fortify the constitution in manhood, the relative vigour will not increase in the same ratio as the population. (McCulloch's Account of the British Empire, Article Vital Statistics, Vol. 2, pp. 543–4.)

Mortality of Illegitimate Infants.—As the law of bastardy was essentially altered by the new poor law, has been again amended in one of its most important principles, and has latterly attracted a good deal of public attention, I have thought it right to submit to you a general Abstract of the number of illegitimate children registered in England, and to point out some of the particulars to be attended to in drawing inferences from results collected under a great variety of circumstances. But the most important matter, in a political point of view, is the condition of the illegitimate children themselves. If the mortality were not greater among them than among legitimate children, every fifteenth person in England must be of illegitimate extraction. But the mortality of illegitimate children is, as in other countries, no doubt greatly above the average; for, without any crime whatever of his own, the illegitimate child is often exposed to dangers, hardships, and ignominy from his infancy; the law pronounces him *filius nullius*; he, nevertheless, escapes in England the tender mercies of the Foreign Foundling Hospital, and in our great towns and colonies has probably a better chance of attaining the station to which his personal conduct may entitle him than in any other country in Europe.

To make the statistical information respecting illegitimate children as complete as it might be, the age and occupation of the mothers should be ascertained, as well as the proportion of children who are formally recognised by the fathers. I conclude my remarks upon this subject with the judicious observations of one of the ablest statistical writers of the present day. "The proportion of illegitimate children "cannot serve as a standard of morality; nevertheless a remarkable "frequency of such children is without doubt in many respects a great "evil. The invariable fact that the mortality among the illegitimate "is far greater than among the legitimate, and that many more of them "are still-born, shows clearly enough how much more unfavourable "their position is from the first. Who can doubt that their bringing "up is much harder and more difficult? that the existence of a class "of men, bound to society by few or no family ties, is not a matter of "indifference to the State? The great majority of foundlings are "illegitimate, which of itself shows how little, as a general rule, the "mothers can or will care for these children. It is beyond doubt that "fewer illegitimate children grow up to maturity; that they get "through the world with more trouble than children born in wedlock; "that more of them are poor; and that therefore more of them become "criminals. Illegitimacy is in itself an evil to a man; and the State "should seek to diminish the number of these births, and carefully "inquire to what circumstances any increase is to be ascribed."* (6th Annual Report, pp. xxxvii–viii.)

In the five years 1871–5, infant mortality was excessively high in the districts of Leicester, Liverpool, and Preston, where the respective rates were 229, 223, and 222 per 1,000, and as the death-rate among illegitimate infants is known to be higher than it is among legitimate infants, it was believed that the rate of illegitimacy in 1871–5 (the number of children born out of wedlock to every 1,000 births) would bear some relation to infant mortality, but such is not the case, the rate of illegitimacy in Leicester and in Liverpool being 44 per 1,000, while in Preston it was 71 per 1,000.

DEATH-RATES of LEGITIMATE, and of ILLEGITIMATE INFANTS; Percentage of MARRIAGES of MINORS to TOTAL MARRIAGES, and ILLEGITIMATE BIRTHS to 1,000 BIRTHS, in twenty-four districts, in five years 1871–5.

Name of District.	DEATHS OF: Legitimate and Illegitimate Infants to 1,000 Births.	DEATHS OF: Legitimate and Illegitimate Infants to 1,000 Births.	DEATHS OF: Legitimate Infants to 1,000 Legitimate Births.	DEATHS OF: Illegitimate Infants to 1,000 Illegitimate Births.	Percentage of Marriages of Minors to Total Marriages, 1871–75.		Children born out of Wedlock to every 1,000 Births, 1871–75.
	In 1871–75.	In 1875.			Men.	Women.	
TWELVE DISTRICTS with HIGH RATES of INFANT MORTALITY.							
Leicester - -	229	245	239	386	16·2	29·3	44
Liverpool - -	223	214	205	418	6·8	24·3	44
Preston - - -	222	230	214	448	13·5	22·0	71
Radford - -	196	204	187	547	17·3	31·2	54
Nottingham - -	193	202	191	365	12·1	24·8	65
Goole - -	175	196	192	257	8·3	30·2	58
Keighley - -	175	181	175	325	9·8	20·2	51
Guisborough -	174	206	202	292	8·5	34·2	44
Mansfield - -	174	189	180	324	17·3	34·3	80
Haslingden - -	174	189	181	355	13·8	24·1	44
Driffield - -	172	206	168	596	6·5	26·9	116
Basford - - -	170	179	169	341	20·1	38·4	64
Mean - -	190	203	192	388	12·5	28·3	61
TWELVE DISTRICTS with LOW RATES of INFANT MORTALITY.							
Ledbury - -	96	102	94	222	4·9	17·5	74
Reeth - -	100	107	106	118	2·4	25·9	89
Kendal - - -	103	105	91	329	6·3	20·7	67
Stratford-on-Avon	106	83	69	293	5·1	16·6	55
Leominster -	108	104	95	240	2·6	12·5	72
Easingwold - -	109	97	84	227	5·6	21·2	95
Wetherby - -	112	104	99	182	4·8	15·8	66
Shipston-on-Stour	113	120	112	237	6·9	18·5	73
Helmsley - -	114	87	75	184	7·5	23·9	133
Richmond - -	117	122	114	231	3·8	19·4	75
Hereford - -	119	128	114	313	3·4	13·9	75
Market Harborough	120	121	116	286	5·8	13·9	50
Mean - -	110	107	97	239	4·9	18·3	77

* Handbuch der Populationistik von D. Chr. Bernoulli, pp. 130–1.

The results in the preceding Table show that the rate of illegitimacy bears no relation to the death-rate of infants, and it is remarkable that the districts with a high rate of infant mortality are generally those with a comparatively low rate of illegitimacy, and *vice versâ*. Thus in the twelve urban districts with a high mean death-rate among infants, in 1871–5, of 190 per 1,000, the rate of illegitimacy was 61 per 1,000, while in the twelve rural districts, with a comparatively low mean death-rate among infants of 110 per 1,000, the rate of illegitimacy was 77 per 1,000.

It is not improbable that a certain number of illegitimate children are registered as legitimate in towns, while in the country they are correctly registered as illegitimate, the circumstances connected with their birth being too well-known to allow of any false representation being made : some illegitimate births have no doubt escaped registration altogether.

For each of the 24 districts in the Table, the number of *deaths of illegitimate infants* were abstracted from the death registers for the year 1875. The results are instructive ; and I hope at some future time to publish similar facts for each of the 631 registration districts in England and Wales.

Twenty-four *districts* have been selected as examples, out of 631, viz., twelve with a high rate of infant mortality, and twelve with a comparatively low rate. Had a selection been made from the 2,194 *sub-districts*, it is probable that death-rates could have been reviewed exceeding even those in Leicester, Liverpool, and Preston.

Turning to these results in the Table it will be seen that the death-rate, in 1875, among illegitimate infants in Liverpool, was 418 per 1,000, and in Preston 448 per 1,000 ; double the rates among the legitimate infants, which were 205 and 214 respectively. The mean death-rates in the twelve urban districts, among the legitimate, and illegitimate, were 192 and 388 respectively.

In the urban district of Radford the mortality among legitimate infants was 187 per 1,000, whereas among the illegitimate it was 547 per 1,000 ! or nearly three times as high, and in Driffield the respective rates were 168 and 596 per 1,000 !

In the rural districts, where the death-rates of infants were not so high, the mean mortality of the illegitimate was rather more than double that of the legitimate. The mean death-rates in the twelve rural districts, in the year 1875, were 97 per 1,000 among the legitimate, and 239 per 1,000 among the illegitimate. In Kendal the mortality among legitimate infants was only 91 per 1,000, while among illegitimate infants it was 329 per 1,000, or nearly four times as high ; and in Stratford-on-Avon the respective rates were 69 and 293 per 1,000.

It will be observed in the Table that in the districts where there was an excess of early marriages, the mortality of infants born in wedlock was comparatively high. Thus the mean infant mortality in the twelve urban districts, in the year 1875, was 192 per 1,000, and the mean proportion of girls who married under age to 100 marriages in these districts was 28, whereas in the twelve rural districts, where the mean infant mortality was 97 per 1,000, the proportion was only 18.

Dr. Russell, the Medical Health Officer of the city of Glasgow, has furnished the particulars, relating to the death-rate among legitimate and illegitimate infants for that city, which I subjoin, and which confirm the results observed in the 24 districts in England.

MORTALITY of LEGITIMATE and ILLEGITIMATE INFANTS in the CITY OF GLASGOW, 1873–5.

YEARS.	LEGITIMATE INFANTS.		ILLEGITIMATE INFANTS.		DEATHS	
	Births.	Deaths under 1 year.	Births.	Deaths under 1 year.	Of Legitimate Infants to every 1,000 Legitimate Births.	Of Illegitimate Infants to every 1,000 Illegitimate Births.
1873	18,416	2,845	1,786	523	154	293
1874	19,178	2,863	1,785	495	149	277
1875	19,104	2,905	1,714	491	152	286
1873-5	56,698	8,613	5,285	1,509	152	286

The number of legitimate births in England and Wales, in 1875, was 809,794: the number of illegitimate births was 40,813, so the total number of children born was 850,607, and the mortality in their first year of age was 158 per 1,000.

Since it has been ascertained that the mortality among illegitimate infants is about double that among the legitimate, then from the mean proportions observed in the twelve urban and in the twelve rural districts, it follows that the lives of 7,020 illegitimate infants were sacrificed through neglect and improper food in the year 1875. This is on the assumption that the death-rate among illegitimate infants should be the same as that which prevailed among legitimate infants, viz., 148 per 1,000.

But the general death-rate of infants, instead of being 158 per 1,000, should at least be as low as that in some of the healthiest parts of England. By the healthy district life table it was only 111 per 1,000. If 111 per 1,000 be taken as a standard rate, for the present, which is 47 per 1,000 less than the rate for all England, then no less than 40,197 deaths of infants occurred in 1875, in excess of the number that would have been registered at the rate that prevailed in the healthy districts. (38th Annual Report, pp. xlvi–viii.)

Mortality of Infants at each Month of the first year of Age; England, Healthy Districts, and Liverpool.—According to the life table, of 100,000 children born in the healthy districts of England, 96,339 are alive at the end of the first month, 3,661 having died in the interval. Of the same number born in Liverpool, only 94,551 are alive at the end of the first month, 5,449 having died in the interval.

At the end of the second month, 95,178 are alive in the healthy districts, 1,161 having died in that month; in Liverpool 92,088 are living, 2,463 having died in the month; and so on until at the age of seven months the numbers living are reduced to 91,932 in the healthy districts, and to 84,373 in Liverpool.

In the healthy districts, the mortality rapidly decreases, month by month. Thus the rate was 448 per 1000 living under one month of age, 145 at one month of age, 102 at two months, 76 at five months, 71 at six months, and 53 at 11 months of age.

LIFE TABLE and ANNUAL DEATH-RATE for EACH MONTH of the FIRST YEAR of AGE, in the HEALTHY DISTRICTS of ENGLAND AND WALES; in ENGLAND AND WALES generally; and in the DISTRICT of LIVERPOOL.

AGE. $\frac{x}{12}$ MONTHS.	LIVING at 0 and at the end of each Month of Age. $l_{\frac{x}{12}}$			DEATHS in each Month of Age. $d_{\frac{x}{12}}$			ANNUAL RATE OF MORTALITY per cent. at each Month of Age. $m_{\frac{x}{12}}$		
	In Healthy Districts.	By English Life Table.	In Liverpool District.	In Healthy Districts.	By English Life Table.	In Liverpool District.	In Healthy Districts.	By English Life Table.*	In Liverpool District.
0	100,000	100,000	100,000	3,661	4,650	5,449	44·751	57·132	67·219
1	96,339	95,350	94,551	1,161	1,720	2,463	14·549	21·837	31·672
2	95,178	93,630	92,088	806	1,218	1,724	10·205	15·710	22·678
3	94,372	92,412	90,364	683	1,010	1,563	8·716	13·187	20·937
4	93,689	91,402	88,801	631	955	1,506	8·109	12·604	20·525
5	93,058	90,447	87,295	584	903	1,469	7·554	12·050	20·365
6	92,474	89,544	85,826	542	855	1,453	7·054	11·509	20·489
7	91,932	88,689	84,373	504	808	1,458	6·597	10·992	20·917
8	91,428	87,881	82,915	470	766	1,482	6·185	10·501	21·642
9	90,958	87,115	81,433	441	725	1,528	5·832	10·033	22·730
10	90,517	86,390	79,905	416	687	1,594	5·528	9·584	24·180
11	90,101	85,703	78,311	396	652	1,680	5·286	9·161	26·023
12	89,705	85,051	76,631	—	—	—	—	—	—

NOTE.—By moving the decimal one place to the right in each of the last three columns, the results will represent the annual rate of mortality per 1000.

* See Supplement to Registrar General's 25th Annual Report, p. vii.

In Liverpool the mortality was 672 per 1000 under one month of age, 317 at one month, 227 at two months, and 204 at five months, after which age, the mortality, instead of decreasing, as in the healthy districts, increases to 205 at six months, 216 at eight months, 242 at ten months, and 260 at eleven months of age.

So unfavourable to infant life are the unsanitary conditions of large towns—especially Liverpool—that not only is the mortality at some months of age twice as high as it is in the healthy districts, but at 7 months of age and upwards it is three times as high. The mortality of infants by lung diseases is higher in Liverpool than in any other large town.

The mortality of children under one year of age is 111 per 1000 in the healthy districts of England, and 229 in Liverpool, but the rate at each month of age differs considerably, decreasing rapidly from birth, as will be seen by reference to the above Table.

The subjoined Table shows in a striking manner how much depends, at the starting point of life, whether infants breathe the poisoned air of large towns, or the fresh pure atmosphere of healthy districts.

NUMBER and PROPORTION of DEATHS at DIFFERENT MONTHS of AGE to 1000 BIRTHS in the HEALTHY DISTRICTS and in LIVERPOOL in the Eight Years 1839–46.

MONTHS.	DEATHS.		PROPORTION of DEATHS at each Month of Age to 1000 BIRTHS.		Excess in Liverpool.
	In 63 Healthy Districts.	In Liverpool.	In 63 Healthy Districts.	In Liverpool.	
Total under 1 year -	52,833	16,133	110·5	228·9	118·4
0 - - -	18,790	3,762	39·3	53·4	14·1
1 - - -	5,956	1,700	12·5	24·1	11·6
2 - - -	4,135	1,190	8·6	16·9	8·3
3 - - -	3,505	1,079	7·3	15·3	8·0
4 - - -	3,239	1,040	6·8	14·7	7·9
5 - - -	2,997	1,014	6·3	14·4	8·1
6 - - -	2,781	1,003	5·8	14·2	8·4
7 - - -	2,586	1,007	5·4	14·3	8·9
8 - - -	2,411	1,023	5·0	14·5	9·5
9 - - -	2,264	1,055	4·7	15·0	10·3
10 - - -	2,136	1,100	4·5	15·6	11·1
11 - - -	2,033	1,160	4·3	16·5	12·2

NOTE.—The total births in the eight years 1839–46 were 478,048 in the Healthy Districts, and 70,491 in Liverpool.

Thus in Liverpool the mortality of children under one year of age was at the rate of 229 deaths per 1000, 53 of which deaths were of infants under one month of age, 24 of one month of age, and so on for each month of age in the Table.

In the healthy districts the mortality of children under one year of age was at the rate of 111 deaths per 1000, 39 of which deaths were of infants under one month of age, and 13 of one month of age.

The difference, therefore, in the rate of mortality of children under one year of age in Liverpool, and in the healthy districts, was 118, of which, 14 were by deaths under one month of age, 8 by deaths at two months of age, and so on. (38th Annual Report, pp. xlviii–l.)

Mortality of Children (0–5) *in Registration Districts* 1851–60.—Death in childhood is an unnatural event, inasmuch as the regular series of development of the human structure from the germ-cell to the perfect man in his prime, and in his last declining stage of existence, is interrupted. But life at all ages depends upon so many conditions, and is exposed to so many risks, that out of given numbers living some die at every age, and we can only take for a practical standard the lowest authenticated rates of mortality.

Thus in the 63 Healthy Districts of England the annual mortality of boys under five years of age was at the rate of 4·348, and of girls 3·720 per cent.; the mean being 4·034.

Twenty-eight districts have been selected, showing the low annual rate of mortality 3·348 for the mean of the rates of the two sexes: the boys dying at the rate 3·576, the girls at the rate 3·120.

The twenty-eight districts are found in all the regions of England and Wales, from the northern limits of Northumberland to the New Forest on the Southampton Waters.

The mortality was at the annual rate of 2·317 in Bellingham; 2·593 for boys, 2·040 for girls. This rate is only slightly exceeded in the adjoining district of Rothbury, also on the border of Northumberland; and in Bootle north of the Duddon on the coast of Cumberland.

The mortality among the families of the British Peerage has been investigated with much care and ability by Mr. A. H. Bailey and Mr. A. Day.* They confined their investigations to the peers, the children of peers, and the children of the eldest sons of peers living in the present century. The numbers existing on December 31, 1855, were 4,282; 2,283 males, and 1,999 females.

The mortality of peers' children under five years of age was at the rate of 2·069 per cent.; among boys under five years of age 2·227, girls 1·882.

The number of facts for the peerage is small; as the deaths of boys were 274, of girls 196; or 470 in the aggregate. For Bellingham the deaths of boys in ten years were only 112, of girls 82; 194 in the aggregate. The districts of the lowest mortality are very thinly peopled, but there is no reason to suspect that any of the deaths are unregistered. And the mortality only proceeds gradually step by step up to 3·500 in many other districts.

Dr. Joseph John Fox, in a valuable paper on the vital statistics of the Society of Friends, found that by the returns in the "Annual Monitor" the mortality under five years of age in 1842–52 was at the rate for boys of 3·190, of girls 2·383.† This mortality differs little from the mortality of the peerage. Another return makes the mortality of the boys of Friends 5·598, of the girls 4·733.

The mortality of 1,087 children of the clergy has been investigated by the Rev. John Hodgson, M.A., who procured returns in 1829 and 1858 from the parents; the mortality of the boys was at the rate of 3·729, of the girls at the rate of 2·302 in the years under observation; making the mean mortality of the sexes 3·027.‡

Very different are the rates of mortality among children in one hundred and fifty-one districts; where the lowest mortality among boys is at the rate of 7·084, and the highest at the rate of 13·741 per cent. annually. The mean mortality of the districts was for boys 8·593, for girls 7·432, for both sexes 8·013.

These mean rates are obtained by adding up the district rates, and dividing by the number of districts.

The population of children in the one hundred and fifty-one districts was 1,391,420 in 1861; and the annual deaths at the rate (3·348) of twenty-eight healthy districts would be 46,585; while at the mean rate (8·013) it would be 111,494. Thus there is an annual sacrifice of about 64,909 children's lives by various causes in one hundred and fifty-one districts of the kingdom.

The mean annual mortality of children under five years of age was 10·022 per cent. in Sheffield, 10·149 in East London (City), 10·203 in Coventry, 10·219 in Nottingham, 10·246 in Whitechapel, 10·277 in

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* Assurance Magazine, vol. ix., pp. 305–326.

† Journal of Stat. Society, vol. xxii., p. 219 and p. 220. Dr. Fox says this rate "is obviously much too low," and on that ground suspects that the returns are defective.

‡ Observations on the duration of life among the clergy by the Rev. John Hodgson, M.A., Table 4, p. 36.

Leeds, 10·480 in Wolverhampton, 10·852 in St. Giles (London), 11·725 in Manchester District, and 13·198 in Liverpool District.

There is no doubt great negligence on the part of the parents, great ignorance of the conditions on which health depends, and great privation among the masses of the poor, but there is no reason to suspect that any great number of the infants in these districts fall victims to deliberate crime; yet the children of the idolatrous tribe who passed them through the fire to Moloch scarcely incurred more danger than is incurred by the children born in several districts of our large cities.

A strict investigation of all the circumstances of these children's lives might lead to important discoveries, and may suggest remedies for evils of which it is difficult to exaggerate the magnitude.

The weaklier lives, it is said, are, under this state of things, cut off; but it must also be borne in mind that many of the strongest children are wounded and are left weakly for life.—(Supplement to 25th Annual Report, pp. ix–xiii.)

Mortality of Children (0–5), 1861–70.—The first thing to observe is, that the fatality children encounter is primarily due to the changes in themselves. Thus 1,000,000 children just born are alive, but some of them have been born prematurely; they are feeble; they are unfinished; the molecules and fibres of brain, muscle, bone are loosely strung together; the heart and the blood, on which life depends, have undergone a complete revolution; the lungs are only just called into play. The baby is helpless; for his food and all his wants he depends on others. It is not surprising then that a certain number of infants should die; but in England the actual deaths in the first year of age are 149,493, including premature births, deaths by debility and atrophy; diseases of the nervous system 30,637, and of the respiratory organs 21,995. To convulsions, diarrhœa, pneumonia, bronchitis, their deaths are chiefly ascribed; little is positively known; and this implies little more than that the brain and spinal marrow, nerves, muscles, lungs, and bowels fail to execute their functions with the exact rhythm of life. The first two are said by pathologists to be often rather symptoms of diseases unknown than diseases in themselves. The total dying by miasmatic diseases is 31,266; but it is quite possible that several of the children dying of convulsions die in the early stages of some unrevealed zymotic disease, whose symptoms have not had time for development. Convulsion is a frequent precursor in children of measles, whooping-cough, scarlet-fever, fever: indeed, Dr. C. B. Radcliffe well remarks "in the fevers of infancy and early childhood, especially in the "exanthematous forms of these disorders, convulsions not unfrequently "takes the place occupied by rigor in the fevers of youth and riper "years."* Many of the cases of pneumonia may also in like manner be whooping-coughs and other latent zymotic diseases. In the second year of life pneumonia, bronchitis, and convulsions are still the prevalent, and most fatal diseases; many also die then of measles, whooping-cough, scarlatina, and diarrhœa. Scarlet fever asserts its supremacy in the second, third, fourth, and fifth years of age. Whooping-cough is at its maximum in the first year, measles in the second, scarlatina in the third and fourth years. Thus these diseases take up their attacks on life in succession and follow it onwards.

The deaths from all causes under the age of five years are 263,182. The number ascribed to infanticide is very few; but the deaths by suffocation (overlaying) &c., are more numerous; and so are the

* A system of Medicine by Reynolds, vol. 2, p. 593. Article on Diseases of Spinal Cord.

deaths directly referred to the "want of breast-milk." The total deaths by burns, injuries, drowning, and all other kinds of violence, are 5,175.

By a physiological law 511,745 boys are born in England to 488,255 girls; and by another law 141,387 boys and 121,795 girls die in the first five years of life; so that at the end of five years the original disparity in the numbers of the two sexes is so much reduced that at the age of five years the boys only slightly exceed the girls in number. The greater mortality of boys is due to difference of organisation, for the external conditions are substantially the same in which boys and girls are placed.

Great as is the influence of organization itself, the difference of external circumstances and sanitary condition exercise a very real influence on life, disease, and death in childhood.

Thus, even in the healthy districts of the country, out of 1,000,000 born, 175,410 children die in the first five years of life; but in Liverpool District, which serves to represent the most unfavourable sanitary conditions, out of the same number born, 460,370, nearly half the number born, die in the five years following their birth. This is 284,960 in excess of the deaths in the healthy districts.

Of 1,000,000 CHILDREN BORN ALIVE in the HEALTHY DISTRICTS in ALL ENGLAND, and in the DISTRICT of LIVERPOOL, the NUMBERS dying under Five Years of Age from NINETEEN GROUPS of CAUSES.

——	HEALTHY DISTRICTS.	ENGLAND.	LIVERPOOL DISTRICT.
DEATHS FROM ALL CAUSES - -	175,410	263,182	460,370
TOTAL ZYMOTIC DISEASES - -	49,761	87,099	171,009
Small-pox - - -	602	3,331	5,175
Measles - - - -	5,257	11,507	25,514
Scarlatina - - -	11,373	17,959	26,818
Diphtheria - - - -	4,184	2,425	3,395
Whooping-cough - - -	9,650	14,424	32,551
Fever (Typhus, Enteric, and Simple) -	2,807	5,401	9,297
Diarrhœa and Dysentery - -	9,354	20,344	51,911
Cholera - - - -	399	1,129	4,255
Other Zymotic Diseases - -	6,135	10,579	12,093
Cancer - - - -	110	71	62
Scrofula and Tabes Mesenterica -	5,335	8,115	11,694
Phthisis - - - -	2,656	4,469	5,116
Hydrocephalus - - - -	6,604	9,296	14,972
Diseases of the Brain - -	22,692	40,065	49,840
Diseases of the Heart, and Dropsy -	1,304	1,507	2,038
Diseases of the Lungs - -	27,884	41,476	79,893
Diseases of the Stomach and Liver -	4,431	4,778	4,874
Violent Deaths - - -	4,232	5,175	17,107
OTHER CAUSES - - -	50,401	61,131	103,765

The above Table shows how many children die from the several groups of causes (1) in the healthy districts, (2) in all England, and (3) in the Liverpool District. There is a greater increase in Liverpool from small-pox and measles than from scarlet-fever; and diphtheria was more fatal in the healthy districts than in all England. Diarrhœa and cholera were greatly aggravated in the other districts of England;

so were whooping-cough, and fever, under which were registered typhus, typhoid, infantile remittent, and relapsing fever. The diseases of the lungs are more fatal to children in Liverpool than diseases of the brain.

The children of Norway fare better than the children of sunny Italy; to which it may well be still an *officina gentium*. Out of 100 children born alive the deaths in the first five years of life are in Norway 17, Denmark 20, Sweden 20, England 26, Belgium 27, France 29, Prussia 32, Holland 33, Austria 36, Spain 36, Russia 38, Italy 39. Russia is almost as fatal to her children as Italy.

In a paper* read before the Statistical Society the methods of determining the rates of mortality were described, and I collected information as to the treatment and management of children in Scotland, Norway, Sweden, France, and Austria. The subject was taken up in England by the Obstetrical Society, who published an able report based on returns, on the birth and treatment of English children.† I have not yet received papers from Russia or Italy.

The mortality of infants evidently depends, to some extent, on the midwifery of a country; on the way the children are fed by the mothers; on the water; and on the cleanliness observed, as well as the other sanitary conditions.—(Supplement to 35th Annual Report, pp. xxviii–xxx.)

Mortality of Children in European States.—In the first place, let us ask how many children out of 1,000,000 born alive see their fifth birthday—live five years?

In the north, there is the fine free population of Norway, scattered over the habitable parts of a large well-watered territory, in some parts fruitful or covered with pine forests, in other parts sterile: in addition to fish in their waters and agricultural produce, they derive profits from timber, mines, and ships. The climate is severe, but on the western Atlantic slope the severity is softened by the Gulf Stream. In some of its features we are reminded of Scotland.

Out of 100 children born in Norway, 83 attain the age of 5 years; in Sweden 80; in Denmark 80, including Schleswig and Holstein down to the Elbe, the country of the Angles of old; in England 74; in Belgium 73; in France 71; in Prussia 68; in Holland 67; in Austria 64; in Spain 64; in Russia 62; in Italy 61.

Thus the chance is always in favour of the life; but here it is 8 to 2, there only 3 to 2.

What is the proportion of *deaths* under the age of 5 out of 100 children that see the light? In Norway 17; Denmark 20; Sweden 20; England 26; Belgium 27; France 29; Prussia 32; Holland 33; Austria 36; Spain 36; Russia 38; Italy 39.

Thus Death, drawing lots for the lives of children, has in one part of Europe 2, in another 4 out of 10 in his favour.

Out of 100 children born in addition to the number 17 dying in Norway, 3 die in Denmark, 3 in Sweden, 9 in England, 10 in Belgium, 12 in France, 15 in Prussia, 16 in Holland, 19 in Austria, 19 in Spain, 21 in Russia, 22 in Italy. Thus in the sunny climate of the south, death carries off two children from Italians for every one he takes in high latitudes from Norwegians.

In all England 26 children under 5 years of age die out of 100 born; but in her healthy districts she loses only 18, nearly the same number

* Mortality of Children in the Principal States of Europe, in the Journal of Statistical Society, vol. xxix., pp. 1–35.

† Republished in the Appendix to the Registrar General's 34th Report, pp. 225–9.

as Norway; while in her thirty large town districts,* 36 perish. There is the same contrast between the country and the city as there is between Norway and Italy. In France I find contrasts of the same sort in the departments.

If we turn to particular classes the mortality presents still larger contrasts: according to the peerage records, out of 100 children born alive, 90 survive; 10 die in the first 5 years of age. The deaths among the children of the clergy are nearly in the same proportion.†

The proportions have been reversed in some foundling hospitals.

For reasons which I have explained, the rate of mortality is only exactly determined by comparing the average numbers living with the deaths in a given time. That we can do for eleven of the States of Europe.

We are able in some States to marshal our little troops in three regiments, the first of babes under 1, the second of children of 1—3, the third of children of 3—5.

By the English Life Table, of 100 children born, 15 die in the first year, 5 in the second, 3 in the third year, 2 in the fourth, and 1 in the fifth; making 26 in the 5 years of age. Of the 15 who die in the first year, 5 die in the first month of life, 2 in the second, and 1 in the third.

The *annual* rate of mortality in the first week of life in France is 154 per cent.; and the greater the mortality in any country generally, the greater is its excess in the first days of life.—(Journal of Statistical Society, Vol. xxix., pp. 3–5.)

Infant Mortality, and Census Enumeration of Children.—A few preliminary observations are necessary in reference to the facts, to the mode of their record, and to the trustworthiness of the evidence of their observers. The facts themselves are sufficiently obvious: the birth, and the death, and the existence of a child admit, except in the rarest instances, of the easiest possible verification. With regard to the designation of age, that is a different affair; on an average nearly 2,000 children are born daily in England and Wales; 14 every 10 minutes—more than *one* per *minute*. Hence if for the sake of great scientific precision, the age of infants in their first year had to be expressed in minutes, we should have them of all ages—from *one* minute to 525,949 minutes. Mothers state the age in weeks or months, up to twelve or twenty-four months, and after the age of *one* year, people are generally satisfied with the age stated in years. Unfortunately among the highest class of authorities, there are two different common modes of expressing the approximate age; and two different ages are expressed by the same numbers. Thus, a person of the age 31 and 360 days, is set down as 32 at an insurance office, and as 31 at an office for the sale of annuities. He is 31 *or* in his 32nd year in ordinary language: his nearest age in years is 32 years, as he would be called if fractions of years were expressed decimally, and decimals were dropped. Thus it is the rule to write 31·4 in round numbers 31, and 31·5 is written 32. The ordinary practice is to call a man 31 until he is 32; and it is usually assumed, with sufficient accuracy, that of a body of men so called, the mean age is 31½ years. There is, however, another mode in use; thus a child of two years and 11 months, is in some places, and by some

* Comprising St. Giles, Holborn, East London, St. George-in-the-East, St. Saviour, Southwark; St. Olave, Southwark; St. George, Southwark; Southampton, Yarmouth, Norwich, Salisbury, Exeter, Bristol, Wolverhampton, Birmingham, Leicester, Nottingham, Derby, Liverpool, Wigan, Bolton, Salford, Manchester, Ashton-under-Lyne, Preston, Leeds, Sheffield, Hull, Newcastle-upon-Tyne, and Merthyr Tydfil.

† See authorities cited in Supplement to Registrar-General's Twenty-fifth Report, p. xii.; reprinted in this Vol. on p. 202.

classes, called a child in its *third year of age.* They write its age as 3 years in figures, whereas, according to the other mode of expression, the child's age is 2 years.

The mode of stating age among statists is by no means settled: our life and population tables now begin with *zero*, thus:—

Age.	Living.	Dying.	Population.
0 - -	1,000	149	903
1 - -	851	54	818
2 - -	797	28	781

The table is read thus; of 1,000 children born simultaneously, 851 live one year, 149 die in the first year of age, and 903 will, on an average, be found living at a Census in the first year of their age.

Instead of ages 0, 1, and 2, Halley wrote 1, 2, 3. Again, the ages grouped in decennial periods are differently expressed by different writers; thus in France, Sweden, England, and other countries, they write—

0 and under 5 = 0—5.
20 „ 30 = 20—30.

The same facts as to age are expressed by Mr. Neison and by some other actuaries, thus: 0 to 4; 20 to 29. This is not a little puzzling; it is not exact; and it would be well if all could agree upon one system of expressing age, so as to avoid ambiguity. In our reports I find it convenient to write the age of the last birthday, and when the *interval* of age in a group of persons exceeds 1 year, to write the series of ages according to the same analogy in figures followed by a dash:—

Age.	
0— - - - -	787
5— - - -	643
10— - - - -	511
15— - - -	473

Note.—The table is read thus: 643 persons are of the age 5 and under the age 10, &c.

With so much variation in the expression of the time a man has lived—called age—we can scarcely feel surprised to find in the various censuses of Europe errors in the statements of age directly traceable to ambiguities of language. In the early years of life these mistakes demand attention, otherwise they may lead us into such grave mistakes as we have to notice.

The ages of the population were enumerated in England in the year 1841 for each year of age under 15; and the following is the series of children returned and classified by the Census Commissioners:—

Age.	Children at each Year of Age under 5 as returned at the Census of 1841.
0— - - -	427,601
1— - - -	427,966
2— - - -	435,413
3— - - -	408,332
4— - - -	399,840

You will observe that not only the children of 1 and under 2, but also the children of 2 and under 3 years of age are returned as more numerous than the children in the first year of age (0—1); which, looking at the increase and great regularity of the births, as well as at the great number of deaths in the first two years of life, is impossible. In reflecting upon this, it appeared evident to me that this discrepancy in the ages arose from a certain number of the children in the *first year* of age, who should all have been placed against zero (0), having been carried on to 1; while children in the *second year* of age, who should have been set down against 1 year of age, were carried on to 2; where the excess was at a maximum; the errors afterwards more nearly counterbalancing each other. We despaired in 1851 of being able entirely to overcome the difficulty of getting the ages of young children exactly stated; and the ages of that Census were all given in quinquennial periods, as we had better methods of getting the numbers at the early ages; and I foresaw that, if the uncorrected facts were published, they could, for various reasons, be of little use, and might mislead some unlucky person into an attempt to determine the mortality of infants by such data.

All the children under 1 year of age on 8th April 1861, must have been born in the preceding twelve months, when the births registered were 673,801. If we knew the precise number of births, the deaths out of that number, as well as the inflow and the outflow of migration in those twelve months, we should obtain the precise number of infants living under 1 year of age on the Census day. Such precise knowledge is not within our reach—the majority of the births are registered within the first six weeks after their occurrence, and the infants' deaths of a year include the deaths of infants born within that year and the year preceding it. But an approximation to the numbers surviving can be obtained sufficiently near for the purposes of our argument, from the mean births of 1860–61, and the deaths under 1 year of age in 1861. If the number of annual births remain constant, the number of infants living in any year must lie between the annual number of births and that number diminished by the deaths under the first year of age. It would be nearer the latter than the former number, on account of the excess of deaths in the first months of life.

The average annual births in the two years 1860–61 were 690,227. Let us deal, for the sake of simplification, with 1,000 *daily* births, then of the 1,000 born on the first day of a year a certain number die day by day through the year; and as every day a fresh wave of 1,000 lives emerges to die off at the same or at a similar rate, you will find by enumeration decreasing numbers one day, two days, three days . . . . . 365 days old in your population. The 365,000 under 1 year of age are reduced to 329,515 by death. By the English Life Table the numbers surviving out of 1,000,000 births at the end of every month of the first year of age are shown; and if it were necessary, the numbers for each day could be interpolated. From this table carried on the numbers maintained in the first, second, third, and succeeding years of life are readily deduced.

The births increase variously in England and Wales, and the deaths fluctuate; but by taking the mean births in 1856–57 we get an annual number of births out of which it may be assumed the deaths in the first year of age occur in 1857, the deaths in the *second year* of age occur in 1858, the deaths in the *third year* of age occur in 1859, the deaths in the fourth year of age occur in 1860, and the deaths in the fifth year of age occur in 1861. By subtracting the deaths in each year of age from the births we get the survivors. The births of 1857–58 are treated in the same manner.

We thus obtain numbers living at each year of age which will serve for comparison with the numbers enumerated at the corresponding ages in the Census year.

Now, if the ages of the children have been at all mis-stated, according to our hypothesis, the Census numbers of children will be understated against the ages 0 and 1; but after that age the Census numbers will be somewhat in excess of the calculated. That, you will observe, is the case. The Census numbers under five years of age are actually in excess of the calculated numbers.

The variation in the practice of returning the ages of children is great in different towns; and so is necessarily any defect in the registration of births. And furthermore it is impossible to pass by one general ratio from the births in a town to the numbers surviving at a Census; as the deaths in infancy are differently distributed in every town and year, according as this or that form of disease is prevalent: convulsions kill the infant of the first month; measles, scarlatina, whooping cough, kill him later, or in the tenth, eleventh, and twelfth month. The ages at which the deaths occur affect the numbers to be enumerated; thus, if 200 infants die out of 1,000 in the first hour of their birth, the Census will find only 800 living under 1 year of age; if they die on the last hour of the year 1,000 will be enumerated; and under the prevailing laws of mortality the actual numbers will range between these extremes from 800 to 850, 900, 920, and so on. In particular towns there will be a greater range of variations between the numbers of infants living deduced by one formula from the births, or the deaths under 1 year, and the numbers actually living on a given day under 1 year of age. — (Journal of Statistical Society, Vol. xxviii., pp. 125–137.)

5. CAUSES of DEATH (GENERAL); their NOMENCLATURE, CLASSIFICATION, and MORTALITY.

Importance of Registration of Causes of Death.—Long before the commencement of Registration, my attention was turned towards an object admitted to be of great importance to the improvement of medical science, namely,—to obtain a faithful statement of the *cause of Death* in the column of the Register set apart for that purpose. It is obvious that such statements, in order to obtain due credit, ought to be derived, whenever it is possible, from the medical attendant of the deceased person, and that therefore it was only from the co-operation and assistance of the practising members of the medical profession that a satisfactory attainment of this important object could be expected. I, therefore, in the spring of 1837, communicated on this subject with the President and Fellows of the Royal College of Physicians, the President and Members of the Royal College of Surgeons, and the Master and Members of the Society of Apothecaries, and obtained the concurrence of those bodies, signified by the signatures of their respective Presidents and Master appended to a joint circular address, pledging themselves, in every instance which may fall under their care, to give an authentic name of the fatal disease, entreating all authorised practitioners throughout the country to follow their example, and to assist in establishing a better Registration, and inviting them for that purpose to attend to a subjoined explanatory statement, wherein they would see set forth the provisions of the recent statute, and the means whereby the important object so recommended might most effectually be obtained. The "Explanatory Statement" which I had submitted to these corporate bodies, and which thus received their combined approval, after stating who are the persons who, according to the Act for Registering Births, Deaths, and Marriages, in England, must give information to the Registrar on being requested so to do, "earnestly recommended that "every practising member of any branch of the medical profession "who may have been present at the death, or in attendance during the "last illness of any person, shall, immediately after such death, place in "the hands of such other persons as were in attendance, of the occupier "of the house in which the death occurred, and of some inmate who "may probably be required to give information, written statements of "the cause of death, which such persons may show to the Registrar, "and give as their information on that subject." Having done this, I caused copies of the circular address, with the subjoined explanatory statement, to be sent to all authorised practitioners of medicine and surgery throughout England and Wales, whose names and addresses I was able to obtain. I have the satisfaction of stating that the measures thus adopted have been eminently successful, and that even in this first year of registration—the commencement of a new system—the result is such as will not disappoint the expectations of those who hope to derive, eventually, from that source, materials of vast importance to the advancement of the science of Vital Statistics.

In order that these materials should be available for such beneficial purposes, it was obviously essential that they should be duly arranged. The execution of this task, for the first and second quarters, has been committed by me to Dr. Farr, a gentleman of the medical profession, whose scientific knowledge and intimate acquaintance with statistical inquiries were ample pledges of his peculiar fitness, and whose letter, including Abstracts of the Causes of Death, and explaining the classification which has been adopted, I have the honour to lay before your Lordship in the Appendix to this Report. (1st Annual Report, pp. 11–12.)

[The above extract from the First Annual Report of the first Registrar General, Mr. T. H. Lister, is inserted because it refers to the appointment of Dr. Farr to the superintendence of the Statistical Department of the General Register Office, and because it throws light upon the history of registered causes of death. The circular address above referred to is printed as the next extract.—EDITOR.]

With reference to the registration of Causes of Death, the following paper was circulated in May, 1837 :—

"We, the undersigned, President of the Royal College of Physicians, President of the Royal College of Surgeons, and Master of the Worshipful Society of Apothecaries, having authority from the several bodies whom we represent, to resolve to fulfil the intentions of the Legislature in procuring a better Registration of the Causes of Death, being convinced that such an improved Registration cannot fail to lead to a more accurate statistical account of the prevalence of particular diseases from time to time.

We pledge ourselves, therefore, to give, in every instance which may fall under our care, an authentic name of the fatal disease.

And we entreat all authorised practitioners throughout the country to follow our example, and adopt the same practice, and so assist in establishing a better Registration, in future, throughout England; for which purpose we invite them to attend to the subjoined explanatory statement, in which they will see set forth the provisions of the recent statute, and the means whereby the important object we have recommended may most effectually be attained.

(Signed) HENRY HALFORD,
President of the Royal College of Physicians.
(Signed) ASTLEY COOPER,
President of the Royal College of Surgeons.
(Signed) J. HINGESTON,
Master of the Society of Apothecaries.

1*st May*, 1837.

Registration of Causes of Death : Explanatory statement.—The recent Act for registering Births, Deaths, and Marriages in England, presents an opportunity for obtaining that great *desideratum* in medical statistics, a more exact statement of *the causes of death*, in the case of every registered death throughout the whole of England and Wales, after the month of June next ensuing.

The Register-Books in which all deaths are to be registered after the last day of June, 1837, contain columns wherein may be inserted the *cause of death*, in juxtaposition with those other important illustrative circumstances, the *sex*, the *age*, and the *profession* or calling of the deceased person. Each Register-Book will also be assigned to a particular district of small extent, and will thus show in what part of the kingdom each death has occurred. If, therefore, the cause of death be correctly inserted, there will exist thenceforward public documents, from whence may be derived a more accurate knowledge, not only of the comparative prevalence of various mortal diseases, as regards the whole of England and Wales, but also of the *localities* in which they respectively prevail, and the *sex*, *age*, and *condition of life* which each principally affects.

For the attainment of this object, it is necessary to ensure, as far as it is possible, the correct insertion of the "*cause of death.*" It is obvious that on this subject the requisite information can seldom be given to the Registrar, except by the medical attendant of the deceased person; and that even if the Registrar be a medical practitioner (which in many instances will be the case), yet will he often be unable to ascertain the truth in this respect if he is to depend solely on the reports of persons ignorant of medicine and of the names and nature of diseases; and it cannot be expected that from his own knowledge he will be able so far to correct their errors as to ensure a statement worthy of credit. The requisite information must therefore be supplied either *directly* or *indirectly* by the medical attendant of the deceased person;—that is to say, if such medical attendant is not applied to by the Registrar, he must afford the requisite information to those other persons to whom the Registrar must apply.

The persons who, according to the Act for Registering Births, Deaths, and Marriages in England, must give information to the Registrar on being requested so to do, are "some person *present at the death*, or *in* " *attendance* during the last illness," or " in case of the death, illness, " inability, or default of all such persons, the *occupier* of the house or " tenement; or, if the occupier be the person who shall have died, some " *inmate* of the house or tenement in which such death shall have " happened." It is also provided that, "for the purposes of this Act, " the master or keeper of every gaol, prison, or house of correction, " or workhouse, hospital, or lunatic asylum, or public or charitable " institution, shall be deemed the *occupier* thereof."

It is therefore earnestly recommended that every practising member of any branch of the medical profession who may have been present at the death, or in attendance during the last illness, of any person, shall, immediately after such death, place in the hands of such other persons as were in attendance, of the occupier of the house in which the death occurred, or of some inmate who may probably be required to give information, *written statements* of *the cause of death*, which such persons may show to the Registrar, and give as their information on that subject.

It is desirable that such statement should be very short, the column in the Register Book in which it is to be inserted being not more than sufficient for the insertion of about 10 words of moderate length. It should therefore contain only the name of the disease which was considered to be the cause of death, and not a *detailed* account either of antecedent symptoms or of the appearances which may have presented themselves after death. It is also desirable that such statements should exhibit the popular or common name of the disease, in preference to such as is known only to medical men, whenever the popular name will denote the cause of death with sufficient precision."

The returns procured in the first year were on the whole tolerably satisfactory; but, as might have been expected, some of the entries were incorrect; the information in many instances had not been furnished directly by medical men, and had been furnished in ill-defined words, such as *decline*, *fit*, *inflammation*, *visceral disease*, *cold*, *long illness*. Local terms were employed, which appear to denote different diseases in different parts of the country. In many cases where inquests were held, no attempt had been made to inquire into the direct cause of death.

It appeared, therefore, necessary to suggest, as far as was practicable, the use of a uniform intelligible nomenclature. The following remarks were made in the Appendix to the First Report; and a classification was adopted which has been followed in the subsequent Reports:—

"The advantages of a uniform statistical nomenclature, however imperfect, are so obvious, that it is surprising no attention has been paid to its enforcement in bills of mortality. Each disease has in many instances been denoted by three or four terms, and each term has been applied to as many different diseases; vague, inconvenient names have been employed, or complications have been registered, instead of primary diseases. The nomenclature is of as much importance in this department of inquiry as weights and measures in the physical sciences, and should be settled without delay.

"In order to render the Register as correct as possible, it is desirable that the cause of death should be directly certified in every instance by the medical attendant, who might either leave the certificate with the informant, or give it upon application to the Registrar. When the medical attendant is the informant, he will of course sign the register, as directed by the Act. The certificates of the cause of death might be in one of the subjoined forms, which present examples of some of the more common cases.

"The duration of the fatal disease should be stated, when known, in hours, days, or years; which would supersede the words 'sudden,' 'acute,' 'chronic,' &c., and in the end furnish many highly important results."

Further experience has confirmed these remarks; and it has been deemed desirable to revise the nomenclature, and to make such alterations and additions as the rapid progress of medical science required.—(4th Annual Report, pp. 144–6.)

Practical Utility of Registered Causes of Death.—The registration of births and deaths proves the connection of families, facilitates the legal distribution of property, and answers several other public purposes which sufficiently establish its utility; but in the performance of the duty with which you have been pleased to intrust me, I have to examine the registration under a different point of view, and with different objects, which will perhaps ultimately prove of not less importance. The deaths and causes of death are scientific facts which admit of numerical analysis; and science has nothing to offer more inviting in speculation than the laws of vitality, the variations of those laws in the two sexes at different ages, and the influence of civilization, occupation, locality, seasons, and other physical agencies, either in generating diseases and inducing death, or in improving the public health.

One of the many obvious applications of the facts will be to the promotion of practical medicine. The extent to which epidemics vary in different localities, seasons, and classes of society, will be indicated by the registered diseases; and the experienced practitioner, wherever he may be placed, will learn to administer remedies with discrimination, and with due reference to the circumstances of the population. He will discover that the characters of diseases change, and will not treat a pneumonia in the same way in Whitechapel and in Westmorland, if it appear, from the causes of death, that the diseases and constitution of the population present striking discrepancies. The modifications in the character of diseases, and in the medical treatment, are indicated perhaps more accurately by the prevailing epidemics than by either the temperature, the hygrometricity, or any other appreciable condition of the atmosphere; and it was Sydenham's doctrine that the treatment of acute diseases should have a reference not only to the immediate symptoms, and to the seasons, but also to the epidemic constitutions of the year and place. A national system of Registration like the present can alone indicate the characters of the diseases in every district; and determine how far the practice taught in the schools, or illustrated in crowded hospitals, and in the unhealthy parts of the metropolis, among the destitute poor, may require modification among other classes of society, and in other localities.

The registration of the diseases of the several districts will furnish medical men with a series of valuable remedial agents. It will designate the localities where disease is most rife, and where there is the least tendency to particular classes of sickness and infirmity. In recommending a residence to patients the physician will find the registered causes of death an indispensable directory; and the utility of a sanitary map of the country, such as the returns will furnish, cannot fail to be felt in England, where a part of the population is constantly migrating from place to place in search of health. Much information has been collected respecting the influence of the English climate; but the facts will bring to light many salubrious spots hitherto unknown, and disclose the dangers which infest others unsuspected. Invalids resort to some unhealthy places; families carry their children in the autumn into districts where small-pox and measles are often epidemical, or go into parts of the country where, as the registration shows, bowel complaints and fevers are extraordinarily fatal.

The registration of the causes of death, besides contributing to practical medicine, will give greater precision to the principles of physic. Medicine, like the other natural sciences, is beginning to abandon vague conjecture where facts can be accurately determined by observation; and to substitute numerical expressions for uncertain assertions. The advantages of this change are evident. The prevalence of a disease, for instance, is expressed by the deaths in a given time out of a given number living with as much accuracy as the temperature is indicated by a thermometer; so that when the mean population of the district is known, the rise and decline of epidemics may be traced exactly, and it will then be possible to solve the problem, whether certain tribes of epidemic disorders constantly follow others, in one determined series or cycle. Loose phrases are still current, for which numerical formulæ will be substituted. Sydenham, one of the most accurate of medical writers, in speaking of small-pox, employed such terms as these: (1661) "It prevailed a little, but disappeared again."— (1667–9) "The small-pox was more prevalent in town for the first two "years of this constitution than I ever remember it to have been."— (1670–2) "The small-pox arose; yielded to the dysentery; returned," &c., &c. These terms admit of no strict comparison with each other; for it is difficult to say in which year the small-pox was most fatal, and impossible to compare Sydenham's experience thus expressed with the experience of other writers in other places and other ages; for "prevailed a little," "raged with violence," and similar terms, may imply either that small-pox destroyed 1, or 2, or 5, or 10 per cent. of the population. The superior precision of numerical expressions is illustrated by a comparison of Sydenham's phrases with the London bills of mortality in the same years.

DEATHS from SMALL-POX in London.

Years.	Deaths.	Years.	Deaths.	Years.	Deaths.	Years.	Deaths.
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1663	411	1668	1,987	1673	1,116	1678	1,798
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1665	655	1670	1,465	1675	2,507	1680	689

The 1,987 deaths from small-pox in 1668, and the 951 deaths from that disease in the year following, express the relative intensity of small-pox in distinct terms. The method of the parish clerks, although imperfectly carried out, was the best. Sydenham guessed the quantity with sagacity, and called it great or small; the parish clerks measured it, and stated the results in figures. The present Registers will furnish medical science with an unbroken series of observations expressed numerically.

Only a limited number of facts fall under the notice of a single observer. His opinions, when they are the results of his own experience, are stated in general terms, and are often adopted by others in entirely different circumstances. Notwithstanding the constancy of nature, this leads to serious practical errors. Hippocrates wrote his immortal works in Asia Minor and Greece, in a particular climate, stage of culture, and civilization; yet all his precepts were taken for the guide of his successors in England, France, and Germany. The therapeutic doctrines of Sydenham, who lived in Pall Mall, and practised principally in Westminster, spread through Europe. The celebrated Broussais' theory of irritation and *gastro-enterite* originated in the French camps. The physicians of this country, when the causes of death are universally recorded, and recorded accurately, will be saved from the fallacies of partial generalization; and, with the results of the registry before them, will be enabled to obtain extended views of the nature, courses, and modifications of diseases. They will have, as a basis for deduction

their own observations, and those of every medical practitioner in England and Wales, in all places, and in all times; for the national Registration goes on in winter and summer, in spring and autumn; and it extends to all parts of the kingdom and to all classes of society.

The works of Huxham, Haygarth, Short, Heysham, Heberden, Willan, Bateman, and many recent medical writers, present illustrations of all these propositions; although they rarely had access to sources more authentic than the Bills of Mortality.

Any improvement in the treatment of disease, and any addition to medical science, will tend ultimately to the diminution of human suffering; but the registration of the causes of death is calculated to exercise a still more direct influence upon public health. Diseases are more easily prevented than cured, and the first step to their prevention is the discovery of their exciting causes. The Registry will show the agency of these causes by numerical facts, and measure the intensity of their influence. The annual rate of mortality in some districts will be found to be 4 per cent., in others 2 per cent.; in other words, the people in one set of circumstances live 50 years, while in another set of circumstances, which the Registration will indicate, they do not live more than 25 years. In these wretched districts, nearly 8 per cent. are constantly sick, and the energy of the whole population is withered to the roots. Their arms are weak, their bodies wasted, and their sensations embittered by privation and suffering. Half the life is passed in infancy, sickness, and dependent helplessness. In exhibiting the high mortality, the diseases by which it is occasioned, and the exciting causes of disease, the abstract of the Registers will prove, that while a part of the sickness is inevitable, and a part can only be expected to disappear before progressive social amelioration, a considerable proportion of the sickness and deaths may be suppressed by the general adoption of hygienic measures which are in actual but partial operation. It may be affirmed, without great risk of exaggeration, that it is possible to reduce the annual deaths in England and Wales by 30,000, and to increase the vigour (may I not add the industry and wealth?) of the population in an equal proportion; for diseases are the iron index of misery, which recedes before strength, health, and happiness, as the mortality declines.—(1st Annual Report, pp. 86–9.)

Analysis of Causes of Death.—To avoid confusion, I must state in what sense the term "cause of death" is here understood. A man falls from a height, and breaks his neck; a woman takes arsenic, which corrodes the coats of the stomach, and in both cases death is the result. The arsenic and the fall, or the fracture of the neck and the corrosion of the stomach, may be viewed as the causes of death. Both should be registered, and both may be separately considered. A person swallows prussic acid, and although the prussic acid be discernible, no evident material alteration of structure may be discovered. The second cause of death cannot be ascertained. When an inflammation or a cancer proves a cause of death, the material change in the organization is sufficiently apparent; but there is no connexion with any external element; or a connexion, if it exists, cannot be traced with anything equivalent to the primary cause in the cases of violent death. Deaths may, therefore, be divided into two classes, passing into each other, but as distinct as day and night; the first class comprising all that can be referred to external violence, suffocation, poison, lightning, and fire; the second, such as under certain circumstances spring up spontaneously in the organization, and are represented by inflammation, cancer, and rheumatism. A reader, unacquainted with medicine, may conceive the

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1663	411	1668	1,987	1673	1,116	1678	1,798
1664	1,233	1669	951	1674	853	1679	1,967
1665	655	1670	1,465	1675	2,507	1680	689

The 1,987 deaths from small-pox in 1668, and the 951 deaths from that disease in the year following, express the relative intensity of small-pox in distinct terms. The method of the parish clerks, although imperfectly carried out, was the best. Sydenham guessed the quantity with sagacity, and called it great or small ; the parish clerks measured it, and stated the results in figures. The present Registers will furnish medical science with an unbroken series of observations expressed numerically.

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nature of the latter class of causes by reflecting, that if a watch or a machine is destroyed by dashing it upon the ground, or throwing it into the fire, its motion may also be arrested by internal causes, having their source in its own mechanism ; particularly if he bear in mind that there are innumerable processes going on in the body which are not mechanical, a change in which will destroy life, as the acid fermentation destroys milk or wine, without any mechanical agency.

Independently of external injury, the human body has a tendency to death ; but the tendency to life is stronger in almost every instant of existence. Let the liability to death be expressed by the deaths out of 100 living a year at the ages 20–30, then the chance of dying in the year is but 1, and the opposite tendency, or the chance of living, is 99. The probability of living, and the probability of dying, vary at different ages, and in different circumstances : but how much soever the two probabilities vary in their relations, they may always be conceived as existing.

If the human frame have in itself the principles of death, they possess very diversified characters. Particular classes of diseases reign in different regions and seasons, but cases appear to occur in all climates, to demonstrate that every kind of malady can arise where man can subsist. This tendency to diseases—the morbid diathesis—is seen in families that are surrounded by the same external circumstances ; where some suffer from asthma, some from gout, some from insanity, some from phthisis. There must, it is evident, be here a predisposition to disease, or it would not be stronger in one than in another, and different families would not be peculiarly subject to this or that form of malady, this or that kind of death. The human race, and every large section of the race, may then be considered as having hereditary predispositions to the pathological phenomena designated diseases, in such a way that children are not generally born with disease, but in the successive changes which they undergo, from the first throb of life to their final evolution, there is besides the upward, onward impulse, a principle which draws a certain number within the sphere of disease and mortality.

The analysis of disease is still imperfect ; and at first its multitudinous species were, like other natural objects, only separated into large groups. Plagues were the first diseases distinguished. They destroyed a great number of lives in a short time and at uncertain intervals, and inspired the people with wonder and terror. Neither the Jews, Greeks, nor Romans, however, described with precision the plagues which they witnessed. All kinds of epidemics were designated by the generic term pestilence ; and the characteristic symptoms escaped even the classical historians. It is still undecided whether the plague of Athens, described elaborately by Thucydides, was small-pox ; and it is absolutely impossible to identify the numerous plagues which Livy has recorded. This should excite little surprise. When an object falls under a writer's notice for the first time he seizes its striking features and effects, and frequently overlooks the characteristic traits, which can be learned only by a careful, frequent comparison with other kindred objects. Linnæus has defined in two lines many plants and animals, which eminent travellers have failed to characterize in several pages of description. By studying each kind of plague, analysing its symptoms, and noting the order of their succession, nosologists have found that while all plagues agree in destroying great numbers in a short time, at uncertain intervals, they differ essentially in the symptoms, duration, and fatality ; in the numbers and classes that they attack ; and in the mode and rapidity of their diffusion. Inquirers have succeeded, in the course of several centuries, in analysing plague, and distinguishing under that generic designation several diseases. The early historians recorded the occurrence of plague, painted its ravages, and in their narratives seldom seized the characteristic symptoms. Hippocrates, Galen, and the Greek physicians, gave accurate descriptions of several species, but confounded or divided erroneously, or did not delineate others, partly through ignorance of anatomy, partly from oversight, but principally from the law which makes the analysis of diseases, like every other department of medicine, a progressive process.

Besides plagues, the tempests of the atmosphere of life, there is another vast, noiseless legion of diseases, marching at an even pace, neither exhibiting aggravation, nor creating sudden desolation, but never halting day nor night, and less under the control of external circumstances than epidemics. They are named *sporadic* diseases by medical writers, and are the ordinary maladies of every day occurrence. It is left for the registration to decide whether they participate at all in the fluctuations of epidemics. The line of demarcation between them and plagues is sufficiently broad; but as epidemics approach ordinary diseases, prevail sporadically, and only break out epidemically at intervals, it is not unlikely that certain sporadic diseases take a colour of the plague character.

Sporadic diseases are found to differ from each other in their symptoms, course, termination; and in the organs which they affect. A part wastes (atrophy), or grows too large (hypertrophy); is infested by a new formation (carcinoma, melanoma), or is irritated and destroyed by a morbid deposit (tubercles). The phenomena of inflammation, hæmorrhage, dropsy, mortification, gout, rheumatism, diabetes, mark distinct species. Again, the body is an aggregate of organs and systems, each of which performs its offices separately, but in singular harmony with the whole frame: the organs and functions then form another ground of subdivision; and as inflammations of the brain, of the lungs, and of the kidneys, present different trains of symptoms, they are considered separate species. Two or three diseases, as thus distinguished, may co-exist; they give place one to the other, run into various complications, and present irregularities, which sometimes render the diagnosis difficult. But this does not ordinarily happen. If the nature of a disease be not detected at once by a practised eye, its history, causes, and termination dissipate the obscurity.* Pathological anatomy, chemistry, the stethoscope, and other instruments of investigation, have greatly facilitated the analysis of diseases. They have led to the formation of new species, and to the more accurate definition of known species; they have also shown that symptoms of the same organic alteration were often mistaken by the early writers for distinct diseases. Sauvages described 300 genera and innumerable species of diseases in his Nosology. The interminable catalogue appears to have appalled M. de Ratte, who exclaims, in his eulogy of Sauvages, *Quel nombre prodigieux d'ennemis!* The genera, in Cullen's Nosology, amount to 151; Good has 137 genera in his Nosology, and 490 species, besides varieties. Exclusive of malformations the species amount to 465, of which 234 may, perhaps, be fatal at one time or another. The diseases enumerated in the first London Bills of Mortality did not exceed 65 in number; 199 occur in the Bill of Mortality for Philadelphia (1836). The extent to which the analysis of diseases is carried must depend upon circumstances; and for statistical purposes, although the

* Distinctionem morborum aliquando difficilem esse, fatentur omnes; possibilem autem in plerisque, fateri etiam oportet; nam si quis hoc negaverit, idem fecerit, ac si nullam esse artem dixisset.—Cullen's *Synopsis Nosologiæ Methodicæ*, t. 2. p. xv.

individuality of the facts should, as for as possible, be preserved, the distinctions must not be too subtle or too fine, otherwise there will be more distinctions in the tables than in the original observations. And this should never be; for when two or three diseases are confounded by any considerable number of observers, it is better, although they may be distinguished by others, to refer them to one head in a statistical table. The heart, for instance, is liable to several forms of disease; it may be enlarged, wasted, ulcerated, dilated, softened, or ossified; its valves may be destroyed or contracted; its action may be impaired in various ways. The practitioner and the scientific writer endeavour to seize all these distinctions; but in the present state of medicine many heart diseases are necessarily confounded, so that it is useless to separate them in a tabular analysis.—(1st Annual Report, pp. 89–92.)

Registration of Causes of Death; Defects and Imperfections.—Registered causes of death are subject to two kinds of imperfection, which it is necessary to distinguish.

The first is the consequence of the imperfection of medical science itself, and will only diminish as that science advances. And the second arises from the imperfect practical application of existing science: only a portion of the population has the advantage of consulting the most skilful physicians or surgeons of the day, who are conversant with the newest discoveries in physic; and in the remoter parts of Wales, as well as in some English counties, the medical man lives so remote as to be absolutely beyond the reach of large numbers of the people; many young children, many long afflicted men and women, many old people, die without being seen for weeks before death by a surgeon. Many men die of hernia, many women in childbed, who might be saved by surgical skill. Yet the medical attendance of the population is, I believe, better in England than it is in any other state of Europe; and the Poor Law does much to extend its advantages to the lowest classes. Where surgeons are not found in attendance on the sick they should be supplied in some way; and if this were done, science might well be employed to inquire into the causes of deaths which it had endeavoured to prevent.

To resume: thousands of deaths occur without any scientific inquiry into the cause of death; and in thousands of other cases medical science seeks in vain to unravel the mystery which enshrouds the extinction of life.

The coroner often simply returns "natural death." As one of the great ends of Government is the protection of life, the inquiry, however, in such cases is not without its use, as the negative finding of a jury is a satisfaction to the public mind, and suffices sometimes to relieve the innocent from suspicion. At the same time it often deters the tempted man from crimes which he feels are likely to be discovered.

In the earliest dawn of the nation the English inquired into the causes of death with a view to discovery and prevention. The protection of life was a fundamental principle of their laws. It was as much an object of their political organization as national defence or war. And the dead body, it was held, called for the coroner's inquest whenever death was sudden or violent or in prison; that is, whenever it was the result, or appeared to be the result, of any discoverable cause. The plagues of the sixteenth century proved that human life is exposed to invisible enemies more deadly than the mechanical forces of nature, the ferocity of animals, or the malignity of manslayers; and towards the end of Queen Elizabeth's reign the London Bills of Mortality were commenced (1592). It was part of the general measures of her able government, by which abstracts of burials, baptisms, and marriages were directed to be compiled in each parish; and persons were appointed to view the bodies of all that died before they were suffered to be buried, and to certify of what probable disease each individual died, in statements of which it was the duty of the minister to make a weekly return. The deaths by plague and by all other diseases in the aggregate were published in the London bills so early as 1603; and in 1629 the several casualties were set forth weekly. Graunt gives a complete return for the year 1632 of the causes of 9,535 deaths in London, whereof 8 were of the plague.* He says, that though not published, "the original entries in the *Hall-books* were as exact in the very first "year as to all particulars as now; and the specifying of casualties and "diseases was probably more."

Graunt thus describes the mechanism by which the observations in this remarkable series of Tables were collected:—

"When any one dies, then, either by tolling or ringing of a bell, or by bespeaking of a grave of the *sexton*, the same is known to the *searchers*, corresponding with the said *sexton*.

"The *searchers* hereupon (who are ancient matrons sworn to their office) repair to the place where the dead corpse lies, and *by view of the same*, and by other enquiries, they examine by what *disease* or *casualty* the corpse died. Hereupon they make their report to the *parish clerk*, and he, every *Tuesday* night, carries in an accompt of all the *burials* and christenings happening that week to the Clerk of the Hall. On Wednesday the general accompt is made up and printed, and on Thursday published and dispersed to the several families who will pay four shillings *per annum* for it."

Graunt discusses the value of the bills, and shows what "corrections "upon the, perhaps, ignorant and careless *searchers'* reports," were required; at the same time he says, as "many of the casualties were "but matter of sense," the searchers' reports might be sufficient in such cases. In many of the more intricate cases "the *searchers* are "able to report the opinion of the *physician* who was with the patient, "as they receive the same from the friends of the defunct;" and in very many cases, such as drowning, small-pox, dropsy, falling sickness, palsy, ague, rickets, their own senses were, in his opinion, sufficient.

Many of Graunt's judicious observations on the casualties of the bills are applicable to the reported casualties of the remotest parts of the country in the present day; for some districts still represent the ignorance of the cities of ages gone by. And Graunt was essentially right, for there can be no doubt of the value of even the imperfect reports of facts in the early bills directly concerning the life and death of Englishmen. They had on them in Graunt's book the approving stamp of the Royal Society. Sydenham, it is evident, had the London bills before him in writing his imperishable commentaries. Arbuthnot used them in an argument on Divine Providence and in the interests of morality.† Heberden in a masterly paper illustrated the use of the weekly observations, and deduced from them an important law.‡ Simpson and Price constructed life tables from the London bills.

The parish clerks of London deserve our gratitude for their perseverance in publishing the bills, which the citizens took in weekly for "no other reason" that Graunt could discover than curiosity about

* Natural and political observations upon the London Bills of Mortality. By Capt. John Graunt, Fellow of the Royal Society. Tuesday, June 20, 1665. At a meeting of the Council of the Royal Society ordered to be printed. 5th ed. 1676.

† An argument for Divine Providence taken from the constant regularity in the births of both sexes. By Dr. John Arbuthnot, Trans. of Royal Society. Vol. xxvii. p. 186. He shows by the London bills that males always exceed females in the yearly births, but that external accidents make a great havoc among males. He concludes that "Polygamy is contrary to the law of nature and justice."

‡ *See* Influence of Cold upon Health. By W. Heberden, junior, M.D., Phil. Trans., 1796, p. 279.

increase and decrease of burials or rare casualties, "so as they might "take the same as a text to talk upon in the next company;" and in the plague-time, "that so the rich might judge of the necessity of "their removal, and that tradesmen might conjecture what doings they "were like to have in their respective dealings." Similar bills were commenced in some other English and continental cities, but they were allowed to drop, leaving the series incomplete.

While medical science advanced, the weekly bills remained stationary; their interest was not kept up by eruptions of plague; Dissenters' burials were not included; and the clerks of many parishes made no returns, or only made them irregularly. And even when complete, the bills gave no information about the population of the towns and counties of the whole kingdom.

It was only in 1837, five years after the first epidemic of cholera, that under the Registration Act provision was made for the inquiry into the cause of nearly every person's death. The column of the schedule headed "Cause of Death" was introduced in the House of Lords. There have then since July 1st, 1837, been two kinds of inquests into the cause of death,—the Coroner's Inquest and Registration Inquiry.

The latter measure appears to have been looked upon as experimental. There was no view of the body, no arrangement for obtaining evidence, no machinery for instituting inquiry; and where there had been no medical attendant, or where the medical attendant refused to supply the information in his possession, no means of getting the required facts, except by making the medical man the legal informant. The imperfect information of the coroners was expressed in rude, vague, antiquated language, and was less satisfactory than that supplied from other sources. The heads of the medical profession supported the Registrar General's efforts to overcome the first difficulties; you circulated medical certificate books with a *Nosology* freely among the profession all over the country. You addressed coroners, and since the office has been strengthened by the Act authorising the payment of medical witnesses, their information is much more valuable than it ever was before. The result is apparent in the returns of the present year. You succeeded in providing in medical men frequent substitutes for uninstructed jurymen and "ancient matrons sworn." Under the present administrative arrangements little further progress can be made.

It is notorious that the registration of the cause of death in its present form has contributed to bring crime to light, and has facilitated the conviction of the guilty. The trials of Palmer, Pritchard, and other criminals afford illustrations. Enough has been done since the passing of the Registration Act to establish the utility of general inquiry into the causes of all deaths, and to justify the employment of the machinery necessary to make the inquiry as complete as possible for accuracy of record, for protection of life, and for the furtherance of medical science.

It will be borne in mind that the coroner and his jury can only conduct the inquiry on view of the body (super visum corporis); by the first statute (4 Ed. 1. stat. 2. A.D. 1276) it is enacted, that on being commanded by the King's bailiff or other honest men of the country the coroner of our Lord the King "*shall go to the* PLACES *where any* "*be slain, or suddenly dead or wounded* * * * and shall forth- "with command four of the next towns, or five or six, to appear before "him in such a place." The coroner inquired upon oath, and his information was based upon actual examination of the body, the place, and the surrounding persons. The searchers of the London bills were also instructed "to repair to *the place where* the dead corpse lies, and "*by view of the same*, and by other inquiries, to examine by what "disease or casualty death was caused." The registry of burial in the Established Church is a public act; the coffin and several witnesses are before the clerical registrar; but the identification of the body in the place of death is lost. And in a large city anybody may be buried under any name. By the Code Napoleon the Registrar is bound to *see the body*, and to register the death on the information of two men of full age (21), and without his certificate the body cannot be interred. (Code Civil, Livre I. tit. I. s. 77.)

S. 77. "Aucune inhumation ne sera faite sans une autorisation, sur papier libre et sans frais, de l'officier de l'état civil, qui ne pourra la délivrer qu'après s'être transporté auprès de la personne décédée, pour s'assurer du décès, et que vingt-quatre heures après le décès, hors les cas prévus par les règlemens de police." See also s. 37.

Should any signs of death by violence be discovered, or any suspicions be aroused, the body can only be buried after the circumstances of the death have been inquired into and reported on by a police officer, aided by a physician or surgeon. (s. 81.)

This is the spirit of the registration law on the continent. The inspector of the dead in Austria is called *Todbeschauer*. In Brussels notice of every death is sent to the Town Hall, with the address, and a medical inspector inquires into the circumstances and registers every death.*

In England, under the Act 6 & 7 Will. 4. c. 86. death registration is a simpler process. A person *present* at the death, or *in attendance during the last illness*, of the deceased person, goes to or sends for the Registrar of the district in which the death happens, gives the requisite information,† and signs the register book as the informant either in writing or by mark. The qualification implies that the informant has seen the deceased person alive during the last illness, but beyond that there is no restriction in the act as to capacity, character, sex, or age.

The informant and the Registrar are usually alone during the act of registration; no witness is required; and, if present, no witness is allowed to sign the book.‡ If the persons qualified to give information do not come to the Registrar, he is directed to go to the house where the death occurred, "or *wherever* such person *qualified* to give informa-"tion can be found, and ask for it." When found, informants "by "refusal to give information, and to sign the register books, render "themselves liable to be indicted for a misdemeanor." The inducement to take the initiative turns on the use of the Registrar's certificate, which given after registration is authority for the burial of the body. Any person burying a dead body without the certificate of the Registrar or the Coroner, and neglecting to give notice of the burial within seven days, incurs a penalty not exceeding 10*l.* for every such offence.

Registration is thus performed without any expense to the parties, and with as little trouble and expense to the public as possible. Copies of the entries in the register books made by the Registrars, and verified

* Early one morning, after the annual fêtes in which the Belgians so much delight, I accompanied Dr. Verstraten on his pilgrimage to the chambers of the dead scattered over the city, and it was a very striking and varied spectacle. At one hour we stood in the midst of lights and incense by the body of a lady of rank, at another in a wretched attic by the corpse of a father of a family of sleeping children, and finally, after traversing many streets, finished our course at the Lying-in-Hospital. He inquired into the circumstances and causes of every death.

† In default of the qualified informants as above described, it is incumbent on the *occupier of the house* to give information, upon being requested so to do by the Registrar. Of the occupier's death an inmate may be the informant.

‡ See Regulation for Duties of Registrars, and Act 6 & 7 Will. 4. c. 86. 1836.

by the Superintendent Registrars, are sent every three months to the General Register Office, where they serve for statistical and other important purposes. A certified copy of an entry, sealed at the General Register Office, says the Act, shall be received as evidence of the death to which the same relates, without any further or other proof of such entry.

The Registrars, appointed generally by Boards of Guardians, before their appointment is confirmed, answer questions in writing, and their competency is proved by their copies sent to the office, and by the state of their registers which are periodically examined by Inspectors. The Registrars are a highly respectable body of men of all the various classes of society, and as they are only paid small fees they are necessarily engaged in other professions, in trades, or in some branch or other of industry. The work requires integrity, accuracy, sound sense, good writing, and close attention to all the minute provisions of the Act and of the Regulations. The clerical part of their duty is checked by the Inspectors, by the Superintendents, and by the central Record department; but there is at present no means of checking the registered facts, or of determining the degree of accuracy with which informants report and Registrars record the particulars of each entry. Where the informant is educated and interested, he naturally reads before signing the entry, and thus to some extent checks the work. Unfortunately it happens that in a large proportion of cases the Informants sign by a mark, and as they cannot write their names they cannot read the record which they sign alone in the presence of the Registrar. They cannot check the record. This has given occasion to cases of fraud which could scarcely have been anticipated. In the course of twenty-nine years, out of a body of 2,200 officers, four, for the sake of the shilling an entry, inserted long series of fictitious entries of deaths which never occurred. They invented all the particulars of hundreds of deaths. The first case was that of a Registrar of All Souls, Marylebone, who died before the discovery; he served under a most acute Superintendent Registrar. The second case was that of a Registrar of Howard Street Sub-district, Liverpool, of respectable connexions, who for fictitious entries was dismissed, convicted of felony, and sentenced to six months imprisonment with hard labour. These two cases, and another at South Shields, are referred to in the 9th and 13th Annual Reports,* and the required corrections are made in the calculations of the mortality of Marylebone, of South Shields, and of Liverpool. This offence, it may be mentioned, was first distinctly defined in the Forgery Act of 1861 (24th & 25th Victoria), under which the wilful insertion of any "false entry of any matter relating "to any death" renders the offender liable, on conviction, to penal servitude for life (s. 36.); yet a Registrar of Howden, who began registering fictitious entries about ten years ago, continued the practice up to a recent date under the eye of his Superintendent, and subject to the periodical visitation of intelligent Inspectors. The causes of death were copied, with slight variations, from medical certificates, and his imaginary informants were represented as signing with marks. This a man of ordinary capacity dared and was able to do, because while there is a check on the handwriting and the form of entry, there is no check whatever on the accuracy of record, or on the veracity of informants. The facility of signing with marks of single informants tempted four men into the commission of these extraordinary crimes for

* See Report IX., pp. 177 and 258–9. Report XIII, p. 294.

the sake of small sums of money. For money the same criminals might, it is to be feared, with the hope of impunity before them, have falsified the record of important facts affecting vast amounts of property in insurances and successions. Fictitious entries embarrass statistical inquirers, and they were first brought to light in this office by the exorbitancy of the results. The Howden fraud was kept within narrower limits; it was discovered through the clergyman of a parish where the mortality was exaggerated.

It is deplorable that a single case of fictitious entry by a Registrar, or of deliberate fraud by informants, should have occurred during twenty-seven years; but it must be borne in mind that few registrars among many thousands, and few informants among many millions exposed to temptation, have criminally falsified the public records. The wilful falsifications are insignificant in number in comparison with the errors in 11,011,291 entries on the death registers.

I have referred to such defects of Registration as vitiate the evidence that the registers afford affecting property, and the use of the records for scientific induction. I have now to refer to the imperfect security afforded by incomplete as compared with complete registration against murder and attempts on life. The following death was thus registered :—

" Died 11th June 1848 at Wix (Manningtree) William Constable,
" aged 38 years, labourer, decline (3 months). *Not certified.*

" × The mark of Mary Faint, present at the death, Wix."

This was one of the Essex poisonings. The man it was afterwards discovered, was poisoned with arsenic by his half-sister Mary May, aged 28. She was tried at Chelmsford, found guilty, and executed.

The facility of registration in this easy way does not discourage the criminals. They go on with greater confidence. And this was only the first discovered case of a series of similar murders of husbands and children by wives and others, who could make their marks and administer arsenic in the Essex villages of Wix, Bradfield, Ramsay, Dovercourt, Tendring, Thorpe, Kirby, Mistley, Great Oakley, and Great Holland.* Sir James Graham in the House of Commons, in June 1846, referring to another series—the Norfolk poisonings,—said: " There was reason to believe that in the county of Norfolk no fewer " than twenty persons had died from poison administered by one " individual, and in none of these cases had an inquest been held." I may cite other instances.† One murder successfully registered without detection led to the commission of more murders, and murder became epidemic by imitation. It is probable that the number of such cases was exaggerated, but the terror they inspire is in itself an evil, and by crimes of the kind the country is dishonoured in the eyes of the world.

* These cases are well described in the letter of a barrister in the Morning Chronicle, April 11th, 1849.

† In one case it happened that Mr. Hitchins, who was coroner for Kesteven and Parts of Lindsey, was also a Registrar of Deaths in Lincoln. He assigned the following reasons for wishing to retain the latter office :—" My object in desiring to " retain office is not for the emolument, but because I have found it to assist me " essentially in my office of coroner. By its means of information three murderers, " and one for manslaughter, have been transported; and at the present time two " murderers, and one for manslaughter, are for trial at the next assizes, from being " unable to obtain certificates."—*Letter, dated Lincoln, 3d February* 1849. The murderers in another district might have escaped, as the deaths might have been registered without a certificate.

These deaths occurred in country villages among ignorant people, but in towns the detection of crime is rendered in certain cases much more difficult than it is in the country. The body can be buried in any churchyard or cemetery without a Registrar's certificate; and the clergyman or burying officer, though bound to give the Registrar notice (which he sometimes forgets), can only give such particulars as the parties conducting the funeral supply. The notice, if written, may be addressed to the wrong Registrar, or be so vague or perhaps erroneous that the Registrar of a large district, like Islington in London, cannot find the house in which the death occurred. Bodies are sometimes removed unregistered to other districts for burial, and all traces of them are lost. As still-born children are not registered at all, and are buried with little difficulty, there is a great temptation to inter the bodies of children living only a short time as still-born. This opens another gate to crime.

By forbidding, as in France, the burial of any body without the Registrar's certificate, the latter class of evils will be obviated; and although inconvenience must occasionally arise from the absolute prohibition of the burial of the uncertified dead, that inconvenience should be encountered for the sake of many compensating advantages.

There is another defect in the Act: some old women and men, like hermits of old, live in solitary dwellings; in their last illness terminating suddenly they may have no person in attendance, and no witness present at their death. In these cases there is no legally qualified informant, and the deaths are not registered; the causes of death remain for ever unknown. The coroners are now paid by fixed salaries, and in many cases of violent deaths they do not hold inquests, unless they are led to suspect crime. This saves the county expense, but it has resulted in the absolute non-registration of deaths.

Such are some of the defects by which the registration of the causes of deaths, and of the fact of death itself, is rendered less useful than it might be made for the purposes of science, for sanitary administration, for evidence affecting successions of property, and for the protection of life. To remedy these defects, amendments of the Act are required; families must take more trouble to find qualified informants, and the country must consent to pay the necessary expenses of fuller inquiry.

It is now sufficient to send to the register office one informant, such as a nurse, and although a medical certificate is asked for, it is not indispensable by law, and is often not produced. That is all the trouble families are put to in registering their dead; and the Registrar gets *a shilling* from the poor rate for recording, and making copies of the entry to be transmitted to the central office. The Superintendent Registrar gets 2*d*. for examining the copy of the entry with the original entry. Each death costs the country *twenty pence* for registration, including pay of officers, cost of books, ink, copying, custody of records (which it is expected will last for centuries), indexing, analysing statistically, and administration.

The inquiry into the cause of death might be made sufficient for all its great and useful purposes by a simple extension of the system of medical certificates which you introduced, and which has for many years been in partial use. And as I am not disposed, in imitation of foreign practice, to relinquish the principle of confidence in the medical attendants on families, I submit that having been in attendance up to the date of death, their certificates should still be received, provided they *have seen the deceased on the day of death, or have seen the body* *subsequently for identification.* It would be undesirable to enforce the grant of the certificate by any penalty; and under this arrangement the medical attendant should charge the family a fee in proportion to his ordinary charges. For pauper patients the Poor Law medical officer should be entitled for the certificate of death to a fee fixed by the Commissioners.

Under these circumstances many deaths which are now "certified" would be "uncertified" by medical attendants, as the friends of out-patients of hospitals and dispensaries, as well as others often get certificates to which they are not entitled through the kindness of the medical officers, who have sometimes no means of identification or verification. In all such cases, and in every case of death without medical attendance up to the date of death in which the certificate could not be obtained from a legally qualified medical attendant,—an informant, or the occupier of the house, or in his default an inmate, should be bound to give notice to a medical officer specially appointed for the duty in each of the districts of the kingdom. This *registration medical officer* would thereupon visit the body, and if all was clear, and admitted of satisfactory determination, send his medical certificate of the probable cause of death by the informant or by post to the Registrar, who would upon its receipt register the death, and issue his certificate for burial in the usual course. The *registration medical officer* would, if the case was enveloped in any suspicion or obscurity, refuse his certificate until an inquest had been held or refused by the Coroner, whose inquiry should by no means be superseded. The *registration medical officer* should be specially qualified to conduct *post mortem* examination, and, on being summoned, might appear as the medical witness at the inquest. By practice he would acquire aptitude in the investigation of the obscurer causes of death, and in the detection of crime. Under this system every death, and the cause of every death, would be certified; and poisonings and criminal attempts on the life of children or adults would be less frequent, as they would with difficulty escape detection. Expected impunity would not invite men or women into the commission of fearful crimes. And human life would be under a new safeguard.

The Registrar should invariably write "certified by" in his Register Book, adding the name and title, and if out of the district the address of the medical attendant or of the registration medical officer, as the case may be. The Registrar to file the certificates, and to produce them for examination with the certified copies by the Superintendent Registrar, who would certify the accuracy of the copied entry of the cause of death.

It would increase the value of the evidence if the certifying physician himself signed the entry in the register. But this would be a complication; it would increase the expense, give much trouble, and produce delay, so that I do not propose it. It was tried in the case of the coroners, and failed.

The advantages of the proposed amendments may be briefly enumerated:

(1.) The *cause of death* would in all cases be certified by one professional witness, and would be recorded as correctly as is practicable in the present state of science.

(2.) The fact that a given person died at a given place would be attested by the informant as at present, and the evidence would be enormously strengthened by an educated witness. While so large a portion of our informants cannot even write their names, this is of great importance.

(3.) Secret murders and attempts on life, and deaths of children, or of old people, from neglect, could rarely escape detection; they would, other things being equal, be less frequent than they have been in past times. Life would become more secure. The public solicitude, like a Providence watching over all, would cherish the reverence of all classes for human life.

(4.) The frauds of informants would be less common, and no Registrar would again manufacture fictitious entries, thereby throwing discredit on the whole of the *national registers.*

(5.) Much trouble would be saved to the public, who are now put to expense in getting corroborative certificates, as it is felt that the present certified copy of an entry is most imperfect evidence of the death and identity of deceased persons.

(6.) The registration medical officer visiting the dwellings of people in unfavourable sanitary conditions would discover and point out the consequences of those conditions to the families themselves, and to the authorities in seasons of cholera, of fever, or other epidemics. The authorities would find it convenient to make him the health officer of the district; and often where such an officer already exists, he might discharge the medical registration duties. The Post Office would employ the registration medical officer in insurance business, and so would insurance offices, to whom he could render essential service in putting a stop to the numerous frauds which are every day committed at their expense.

Two *Inspectors* are appointed with great advantage, as they instruct Registrars, and inspect the books on the spot in periodical visits. But they proceed no further than the books; and, unless the books themselves supply evidence of inaccuracy, no inaccuracy is discovered. They do not institute any comparison between the actual or the ascertainable facts and the records of those facts. Here many errors must occur. At this office no important work is allowed to pass unchecked; and after selecting the clearest headed men, the calculations are all made in duplicate, and carefully compared. Experience has shown that this is necessary to ensure accuracy. It provides against errors of human fallibility, and errors of negligence. Now the registration records need not be made in duplicate by two separate officers and compared; but by periodical inquiries into the actual facts of *cases where the informants sign with marks* every Registrar would work under a sense of responsibility, and would do his work better than he does it now. I beg to suggest that an Inspector should be appointed for special employment on this duty, and a Medical Inspector should be especially employed in looking after the registration of the causes of deaths.

Medical men have to learn the difficult duty of returning fatal diseases on a uniform system and under the same names. Their attention might be called to any imperfections in their returns.* This is found to work well in Geneva, where it was performed for many years by my friend Dr. Marc d'Espine with the best possible result, both in the interests of science and of justice.

This improvement in our system of registration would be quite in accordance with English habits, which must ever be religiously respected in a matter so solemn as death. The public medical officer would only intervene when the family had no physician in attendance, and wherever he attended it would be confidentially, for the comfort and satisfaction alike of friends and of the community.

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* Circular letters are now addressed to certifying medical practitioners whose certificates do not supply the necessary information for satisfactory classification.—EDITOR.

This system, I submit, would be more efficacious than the registration now in use in France, where the death can be registered by declaration, without assigning the cause of death. The inspection of the body by the *Officier de l'état civil* would be superseded by the certificate of the medical attendant, or of the registration medical officer; the inquiry into the cause of death would be universal; and the evidence of the certificate of registry would be valid. The French explicitly reject women as informants,* and thus must in many cases forego the best possible testimony. Women are almost always, except on the field of battle, in attendance or present at death. The wife does not forsake the husband, the mother the child, in the last moments. In marriage and in birth, the two great acts of registration, the woman is indissolubly associated with the other sex, and from men in death they are not divided. On what ground then is the woman rejected peremptorily as a witness? The French principle is inapplicable to English women. But in England we may well avoid rushing to the other extreme. Why should a majority of the informants of some districts be ignorant women who sign the registers with marks, and cannot read and check the entry to which their signature is attached in the national records?† The medical certificate is indispensable under such circumstances.

* Code Civil, livre 1. sec. 37. : Les témoins produits aux actes de l'état civil ne pourront être que du sexe masculin agés de vingt-un au moins et ils seront choisis par les personnes interessées.

† NUMBER and PROPORTIONS per Cent. of Persons who were Informants of Deaths, and of Persons married, who signed the Register with Marks, in eleven Districts or Sub-Districts of England and Wales in a portion of the Year 1864.

——	INFORMANTS AT DEATH (exclusive of Coroners and Informants in Institutions).			PERSONS MARRIED.		
	Total Number of Deaths.	Informants signing with Marks.	Proportion per Cent. signing with Marks.	Total Number.	Number signing with Marks.	Proportion per Cent. signing with Marks.
PERSONS -	3,196	1,537	48	10,864	2,902	27
Males -	1,208	312	26	5,432	1,142	21
Females -	1,988	1,225	62	5,432	1,760	32

The facts are compiled from the Registers of the districts of Chelsea, Reading, Peterborough, Romford, Highworth, Rugby, Derby, Halifax, Durham, and Carnarvon, and the sub-district of St. Martin, Liverpool.

Of 100 informants 38 were males and 62 were females.

NOTE.—Exclusive of coroners and informants of institutions, of 1,217 informants at death in the county of Northampton 181 were men of whom 52 signed with marks, and 1,036 were women of whom 784 signed with marks. Of 1,843 persons married 447 men and 499 women signed with marks, or of 100 *informants at death* 69 *signed with marks*, and of 100 persons married 26 *signed with marks*. The ignorance of the informants at death was to the ignorance of the ordinary run of people marrying in Northamptonshire as 69 to 26. Of 100 informants 15 were males and 85 were females.

The improvements in registration cannot be carried out without expense. The medical certificate will cost the public from *a florin* to *a guinea* an entry; only the portion of the pay for the registration medical officer and for inspectors will come out of poor rate and out of consolidated fund. It is desirable to make the fee of the registration officer sufficiently high to command the services of a good class of the profession; and the tariff must, therefore, necessarily vary in country and town districts with the distances to be travelled, and the variable local medical charges. The fixing of the fee might be left to you, subject to the approval of the Treasury. The cost of registration medical officers and of inspectors would not exceed in the aggregate 50,000*l.**

If we compare this sum, and the value of the services for which it is to be paid, with the cost of inquests and the cost of funerals, it does not appear to be great or extravagant.

The cost of registering the particulars and the causes of the deaths of the 495,531 persons who died in England and Wales was about 41,350*l.* in the year 1864; in 1867 under the improved plan it would be about 91,350*l.* Instead of 20*d.* it would be about 44*d.* on each death. This sum would be amply recouped in the additional security to life and property. It is computed from the legacy duty returns on 495,531 deaths that about 93,500,000*l.* passes by death to successors. On this sum 92,000*l.* is less than a farthing in the 1*l.*

The coroners of counties and boroughs held inquests on 24,787 bodies at a total cost, including coroners' salaries, travelling expenses, and medical witnesses, of 72,598*l.* This sum is paid out of the rates. It amounts on an average to 2*l.* 18*s.* 7*d.* on each inquest. The jurymen are not paid for their services, but they are summoned, and if they do not attend render themselves liable to a penalty. The value of their time cannot be estimated at less than 25*s.* 5*d.* This will make the cost of an inquest 4 guineas, or 24,787 inquests cost 104,105*l.* in the year. The value of this ancient institution cannot be questioned, but the inconvenience and cost to families left out of account in this estimate is not inconsiderable.

If the inquiry by inquest had been extended to the whole of the deaths, the cost in coroners and in medical witnesses only in the year 1864 would have amounted to 1,451,345*l.*, without allowing anything for the time lost by jurymen, and for the inconvenience of families.

The cost of 66,748 funerals in the metropolis was estimated by Mr. Chadwick† for the year 1839 at 626,604*l.*; and his "proximate "estimate of the expense for the total number of funerals in England "and Wales," was 4,871,493*l.* He shows that the expense of pauper funerals in London was 13*s.*, of artizans 5*l.*, tradesmen of second class &c., 27*l.* 10*s.*, tradesmen of 1st class 50*l.*, gentry and the higher classes of people 100*l.*; while the expenditure on the funerals of children under 10 years of age of the corresponding classes, excluding paupers, ranged from 30*s.* to 30*l.* The average cost of funerals of persons of every rank above paupers in London he takes at 14*l.* 19*s.* 9*d.*, and including paupers at rather less than 10*l.* I am aware that the cost of funerals of persons of rank runs up to 1,000*l.* or 1,500*l.*, and that workmen's clubs pay commonly 10*l.* for burial, but I am disposed to think that Mr. Chadwick's

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* Take the annual deaths at 500,000, and the uncertified cases in the proportions above given as 17 per cent., then 85,000 cases would be visited annually. The cases would be almost exclusively in the poorer classes, and at 10*s.* each the cost would be 42,500*l.*

† Supplementary Report on the Results of a Special Inquiry into the Practice of Interment in Towns, by Edwin Chadwick, C.B., pp. 70–1.

estimate is too high for the whole population, in town and country. Instead of his figures I take the average cost at 6*l*., and then the amount that the nation expends annually on the burial of its dead is 2,973,186*l*. This includes only expenses that figure in undertakers' bills. It neither comprises the extra cost of mourning, nor the expenditure in memory of the dead on monuments, or friable stones, which will be obliterated or crumbled into dust long ere the national lists of the dead in the custody of the State have perished.

It is well to attach solemnity to funerals, but no one can doubt that it would be wiser on the part of the nation to give a florin or a guinea as a fee to a registration medical officer for the benefit of the living and of generations to come than to squander guineas lavishly on stones, or on lids of feathers, rich silk bands, porters, pages, feathermen, and mutes.

The registration medical officer would stand in nearly the same relation to the Registrar-General, who directs the inquiry into the cause of death for the purposes of registration, as the medical witness stands (under 6 & 7 Will 4. c. 89.) to the coroner, but it might be desirable to leave his first appointment and pay to the same bodies as appoint the Registrars and Superintendent Registrars.

Satisfaction in good work was pronounced by the inventor of the word "statistics" to be characteristic of the English workman,* and I trust that I may without presumption say that while the department of which you are the chief shares the feeling it is anxious to deserve Achenwall's praise of the English workman.

The following is an analysis of the particulars of which evidence is found in the death registers. I take the example given in the schedule :

1. That a person is dead.
2. That the name of that person is—*William Green*.
3. That the said person died at a certain date,—*at 5 o'clock 4th February* 1865.
4. That the said person died in a certain place,—31 *Strand, London*.
5. That the said person was by profession—*a carpenter*.

Note.—All these particulars are recorded on the evidence of the informant, who, if he has witnessed the death, bears direct testimony to particulars 1, 3, 4; the testimony as to 2 and 5 may be direct or indirect. If he was merely in attendance, and has not seen the body, all the evidence is indirect. He gets it at second hand.

6. That the said person was a male or female—*Male*.
7. That the said person was of the age—43.

Of the *sex* and *age* the evidence is always indirect; it would be strengthened, as would all the other evidence, by the production of the certificate of birth at the time of the registry of death.

8. That the *cause of death* of said person was *small-pox*.

Note.—Sometimes the cause of death is easily distinguished by unskilled observers; in others it can be discovered after death by a skilful inspector from the testimony of surrounding persons; in others it can only be distinguished by medical men who have observed the symptoms during life. In many obscure cases inspection of internal organs (autopsy) and

* "The Englishman is the best workman in the world, for he works so as to satisfy his own mind, and always gives his work that degree of perfection which he has once learnt to appreciate and attain; and as the Frenchman seeks to enhance the value of his manufactures by all kinds of external ornament, so the Englishman seeks to give his productions in exactitude, usefulness, and durability a less fleeting worth." (Statsverfassung der heutigen vornehmsten Europäischen Reiche und Völker im Grundrisse von Gottfried Achenwall Weyland Hofrath und Professor der Rechte und der Politik zu Göttingen. 1781. p. 324.)

chemical analysis are required to enable the medical expert to divine the cause of death. In some cases, particularly of infants and old people, the cause of death cannot be discovered in the present state of medical science.

9. That the signature, description, and residence of informant was—*Rebecca Green, Widow*, 17 *North Street, Marylebone.*

   Note.—Under "Description," when *in attendance* is added, it would be well to add "nurse," wife," "mother," &c. &c., and the profession of informant. So also when "present at death." This concludes the information; the two other columns relate to the Registrar.

10. That the Registrar registered the said particulars on a given day—*5th February.*
11. Witness, his name and title, *John Cox, Registrar.*

I found on trial that in London many particulars respecting the great majority of the deceased, except in public institutions, are known to the people around them at death.* The following is one among many instances. It is a specimen of what I held then and still think would be a complete schedule. If it be ever adopted it will be necessary to pay the Registrar 1*s.* 6*d.* instead of 1*s.* 0*d.* an entry, and the Superintendent 3*d.* instead of 2*d.* for examination, as the labour will be increased. It is evident that the additional particulars as to birthplace, residence in district, parents' names, marriage, and issue would have the same value as some of the particulars now registered; they would depend on indirect evidence, and, if required, every year such evidence would increase in value:—

District, *Poplar.—William Canty, male, age 62, died 28th February, at half-past six o'clock a.m., at 16 Cottage Row, of pneumonia, 2 months, as certified by H. Bloomfield. M.D.; born in Cork, Ireland; 36 years in Poplar; father Timothy Canty, deceased, mother Mary Canty, maiden name Nicolas, deceased; married in Scrill parish, Ireland, at age 22, to Honora M'Carty; left issue Timothy, age 31, William 30, Mary 20, John deceased, aged 27 in 1846, Catherine deceased, aged 1 in 1820, Stephen 21;* witness, *Honora Canty* her × mark, *widow,* Informant; *Mary Canty, daughter,* witness; *T. W. Gagen,* Registrar, *March 3, 1847.*

I do not venture to complicate the proposal as to the medical registration certificate with these or any other alterations of the schedule and the Act.

To secure the registration of the causes of death it would be necessary to alter some clauses of the Act (6 & 7 W. 4. c. 86.), and to insert a new clause to the following effect. It is slightly altered from the Registration Act for Ireland (26 Vict. c. 11. s. 46.)

"Medical Certificate of Death.

"Whereas it is expedient to establish an authentic registration of the "causes of death: Be it therefore enacted, the Registrar shall furnish "from time to time, *gratis*, to every duly qualified medical practitioner "within his district the necessary forms of certificates of death in the "form (—) hereunto annexed, which certificates the Registrar General "shall cause to be printed and forwarded from time to time to every "Registrar for that purpose; and the medical practitioner who shall "have been in attendance during the last illness and until the death of "any person dying after the 31st December 1866 shall within three "days after the death of such person transmit to the Registrar of the

* See Journal of Statistical Society, Vol. XI., "Report of Registration Committee "to the Council of the Statistical Society," pp. 282–5.

"district in which the death occurred, or deliver to the relatives of the
"deceased, or to a person legally qualified to sign the Register as
"informant of the death, a certificate of the cause of death in the form
"mentioned, the particulars of which shall be entered by the Registrar
"in the register. In case such certificate shall not be so transmitted
"or delivered, the Registrar shall give notice of the death to the
"registration medical officer, who shall within two days after the receipt
"thereof return a certificate duly filled up to such Registrar, who shall
"enter the particulars relating to the cause of death in the proper
"column of the death register; provided that the registration medical
"officer shall, if he see fit, refuse to give his certificate until an inquest
"has been held."

Certain amendments would be required in the Act to secure the complete registration of deaths. The task of giving notice of death to the Registrar, and in the case of deaths without medical attendance to the registration medical officer, should be enforced by penalty (see sect. 38 of 17 & 18 Vict. cap. 80., Scotch Act,) so as to make it the duty of the parties concerned to procure from the medical attendant, or in his default forthwith from the registration medical officer, the certificate of the cause of death authorizing the issue of the burial certificate by the Registrar. It is evident that if the body can be interred before the inquiry it will open a door to crime by rendering detection difficult if not impossible. The body is seen at once and is often buried in France on the second day; in England the people cling to the presence of their dead, and thus inquiry is easier. Decent dead-houses should be provided for poor families in towns.

Still-born children should be seen by the registration medical officer, whose certificate to the effect that they were still-born would authorize their burial without funeral rights. They would be entered in his books, and would not appear in the Registrar's accounts, which should embrace only all those born alive.—(27th Annual Report, pp. 175–191.)

[Many of the imperfections and defects in the English Registration system, here pointed out by Dr. Farr, were removed by the Births and Deaths Registration Act of 1874, which came into operation nearly ten years after the 27th Annual Report was written. The suggestions, however, as they were written, form an interesting contribution to the history of Civil Registration, and some of them, notably that relating to the appointment of a registration medical officer for inquiry concerning uncertified and unsatisfactory causes of death, are still under discussion. —EDITOR.]

Statistical Nosology.—Several Nosologies have been framed, and partially adopted. The *Nosologia Methodica* of Sauvages was the first important work of the kind; his successors, Linnæus, Vogel, Sagar, Selle, Ploquet, Crichton, Macbride, and Darwin, either made few innovations or few improvements, and the system of Sauvages would perhaps have continued current, if Cullen had not offered a Nosology, which his popularity as a teacher and a writer, as well as its simplicity and its merits, contributed to establish in Great Britain. The principal modern Nosologies are by Pinel, Richerand, Bichat, Parr, Young, and Mason Good. Diseases may be classified *anatomically*, or according to the parts affected; and the anatomical arrangement may be founded upon the locality proceeding *a capite ad calcem;* upon the organs and systems of organs; or upon the different tissues, whether serous, mucous, adipose, muscular, nervous, bony, or parenchymatous. The anatomical arrangement is followed by some London lecturers.

Vicq-d'Azyr, Richerand, Bichat, and Mason Good classified diseases physiologically, or after the *functions* involved in disease. Mason Good divided diseases into six classes; those affecting the digestive, the respiratory, the sanguineous, the nervous, the sexual, and the excernent functions; and a seventh class of fortuitous lesions and deformities. By writers upon diagnosis diseases have generally been considered topographically; for the purposes of prognosis they have been divided into acute and chronic, slight and fatal: and in practical therapeutics a division exists into medical and surgical diseases. Diseases have also been divided into diseases of children, adults and old people. Dupuytren remarked at the beginning of the present century, that such classifications are not founded upon the essential nature of the pathological processes or products themselves; and considered abstractedly, they are inferior to the symptomatological classifications. A classification founded upon the elementary phenomena, and the products of disease, such as has been indicated by Professor Carswell,* would probably lead to important numerical results, if it could be realised in the present state of medical observation. If the relative frequency of inflammation, tubercles, carcinoma, &c., and the organs which they especially affect at different ages and in different circumstances, were determined by direct observation, and expressed numerically, it could not fail to throw light on medicine. This has been attempted in an arrangement of fatal diseases occurring in the Equitable Society, at Carlisle, and in Philadephia. The same diseases have also been classified according to the organs affected at different ages.† Dr. Heysham classed the Carlisle observations according to Cullen's Nosology. In the London, Swedish, Philadelphian, and other tables of mortality, the causes of death are arranged alphabetically. Cullen's Nosology is in general use in the public services; but pathological anatomy has made great progress since the time of Cullen, and his Nosology no longer presents diseases in their presumed natural relations. It is not suited to statistical purposes, and has been properly abandoned in the statistical report on the diseases of the army, although Cullen's Nosology has been used in the army medical returns down to a late period.

The primary divisions of a *Statistical Nosology* should evidently be founded upon the mode in which diseases affect the population: whether they are generated and prevail only in particular localities (endemics), extend like cholera over nations (epidemics), or are propagated by contagion; whether they arise in an isolated manner (sporadically) from ordinary causes, and sources existing in the organization itself; or whether they are caused by violent means. The first class will embrace all diseases, like ague, fever, small-pox, and cholera, that prevail endemically or epidemically, together with hydrophobia and such maladies as are communicated by inoculation. This great class of maladies is the index of salubrity; it is this class which varies to the greatest extent in different climates and seasons; it is this class that has latterly been so much diminished in England, and that constitutes the principal difference between the health of different populations and different periods; for fearful and destructive as epidemics are in their strength, sweeping mankind of every age before them, like an irresistible conflagration, they can be controlled and almost always admit of prevention or mitigation. Of the utility of keeping this class of diseases distinct in a practical sanitary report there can be no question. The ancient division of plagues and sporadic diseases has therefore been retained.

* Illustrations of the Elementary Forms of Disease.

† Art., Vital Statistics, MacCulloch's Statistics of the British Empire.

Classification is another name for generalization, and successive generalizations constitute the laws of the natural sciences. But it is obvious that the classification must depend not absolutely upon the facts considered in their essential nature, but also upon the form, character, and accuracy of the observations. And this renders necessary a brief reference to the mode in which the causes of death have been recorded.

Diseases are not always easily distinguished: the symptoms of different species appear simultaneously and are confounded; the nature of the affection is sometimes known, while many of the organs involved are concealed; or the part affected is recognised when the precise nature of the lesion can only be discovered by *post mortem* examination. These obstacles to the accurate determination of disease are inherent in the subject; other sources of inaccuracy may be traced to the incompetency and negligence of the observers. The result so far as it affects the registration is the same. It is generally less difficult, however, to determine from the external symptoms the part affected, whether it be the brain, lungs, heart, or intestines, than to ascertain whether the lesion be inflammation, tubercles, carcinoma, or ulcer; and there are consequently in the returns numerous entries, such as "disease of the "heart," "disease of the chest," "disease of the brain," "disease of the "liver," the nature of the disease having been apparently unknown and unspecified. To classify these entries, which may be reduced, but are in the present state of medical science and of the registration inevitable, —sporadic diseases have been grouped according to the systems and organs affected. The first group of diseases of the brain, spinal marrow, and nerves, shows that this classification possesses several advantages; bringing together diseases which have considerable affinity, and which are easily confounded with or run into each other, and so correcting errors and discrepancies in nomenclature, besides reducing the phenomena of fatal diseases to natural families. In fixing the tabular list of diseases the following principles have been attended to:—

1. Diseases distinctly specified in the returns, although not of frequent occurrence, like diabetes, have each a place in the tabular form; so that the facts thus fully laid before the public may be separately compared, and classified in any way likely to lead to useful results. Where a particular disease occurred very rarely, it was classed under a general head, and referred to in notes.

2. The number of groups has, however, been diminished, because no general principles can be deduced from small numbers, accidental irregularities destroying the results, according to the well-known doctrines of probabilities. Besides it was useless to keep up distinct heads, which, although distinguished in some, were confounded in other returns.

3. When after whooping-cough it was stated that the patient died of pneumonia, the case has been referred to the primary disease; and the same principle has been adhered to in similar instances.

4. The list of diseases has been drawn up with direct reference to the returns. It was, however, necessarily fixed before the Abstract was made.

Objections will perhaps be brought against the condensation of the list in the abstract, and the confusion of diseases essentially distinct in their nature and seat; but a more extended catalogue in the present stage of registration would lead to deceptive results, and present an air of minute exactness which has not been obtained. Several of the groups may be subdivided at a future time, if it should be deemed advantageous.

The tabular arrangement exhibits the greater number of the causes of death under names which will be found convenient in practice, and sufficiently precise for statistical purposes. The common English name has always been adopted, except in a few obvious instances; but where no *one* English name existed, and where the disease is popularly expressed by periphrasis, the common medical term has been adopted. Pneumonia is used, for instance, and not inflammation of the lungs. The Latin or English synonyme will render the tables intelligible on the one hand to foreigners, and on the other to the general reader. If the causes of death were uniformly registered under the same names, and each cause of death designated by one word, it would increase the accuracy of the Abstract, and diminish the labour of framing it very considerably, perhaps one-half, as much time is necessarily lost in calling over three or four hundred thousand long words, such as, "inflammation "of the membranes of the brain," and still more in determining precisely what many of the equivocal local terms mean.

In different circumstances, and in other countries, it would be necessary to have a distinct head for remittent fever, yellow fever, plague, &c.; but it will be found that if they occurred, they produced so few deaths as scarcely to affect the high mortality from typhus in England. The same remark applies to other heads, including distinct diseases.

The advantages of a uniform statistical nomenclature, however imperfect, are so obvious, that it is surprising no attention has been paid to its enforcement in Bills of Mortality. Each disease has in many instances been denoted by three or four terms, and each term has been applied to as many different diseases; vague, inconvenient names have been employed, or complications have been registered instead of primary diseases. The nomenclature is of as much importance in this department of inquiry as weights and measures in the physical sciences, and should be settled without delay. (1st Annual Report, pp. 92–5.)

*Analysis of Morbid Phenomena—Nomenclature.**—It will be observed that the Alphabetical List contains more diseases than the Nosology, and the Nosology more than the Abstracts; to explain this, and to show how the list of the causes of death may be legitimately extended or contracted, it will be useful to inquire how diseases have been named, or upon what principles morbid phenomena have been grouped and subdivided. I shall therefore pass rapidly in review the elementary phenomena of disease, and consider more particularly how the numerous and in some instances apparently arbitrary species have been distinguished by original and systematic writers; for without admitting the assertion repeated by Cullen, that "species are created by nature, genera by the human mind,"†—as our ideas both of species and genera are creations of external nature *and* of the percipient mind,—the determination of these primary elements of generalization is unquestionably more important than the subsequent steps in the process, because an error here will be irreparable. The species in the statistical Nosology occur in the registers as well as in all the systematic medical works; and my object is not so much to propose anything new, either in the names or the species, (it

* The medical reader who takes an interest in this subject, is requested to refer to the article "Nosology" in the Appendix to the First Report. I say "medical" reader, because it is impossible to discuss a subject so purely technical as Nosology without assuming a knowledge of facts and principles which can only be familiar to medical men; who it is quite certain will be called upon to exercise all their professional sagacity in returning the "causes of death" with the necessary degree of accuracy.

† A natura vero, species solum datæ sunt; et generum constitutio est mentis humanæ excogitatio.—*Cullen*—Synopsis Nosol. Meth. Even in natural history it would perhaps be more correct to say "individuals" than species.

being the very nature of an arrangement of the facts observed by all the practitioners of a country to follow, as the observers themselves follow, the discoveries of pathology), as to point out some of the principles which have guided us in the distinction of species, and in the formation of the other divisions of the classification.

The human body consists of atoms of various kinds in certain degrees of proximity—in a polarity—and in relative positions—which probably determine the properties of the organization, considered in reference to its various parts, and to the external world; from which it is constantly receiving, and to which it is incessantly rendering, its elements. The constituent atoms of oxygen, hydrogen, carbon, nitrogen, phosphorus, sulphur, iron, calcium, magnesium, potassium, and sodium, exist in fluid or solid compounds—the result of a long series of metamorphoses in the earth, atmosphere, plants, and inferior animals. The fluid compounds are blood. The solids, which, according to a recent theory, consist of cells, may be divided into cellular, mucous, fibrous, horny, cartilaginous, osseous, muscular, vascular, nervous tissues; and the blood, apparently a homogeneous liquid, perpetually undergoing transformations, readily separates out of the vessels into a clot of fibrine entangling globules, and into serum, containing dissolved albumen, with carbonates, phosphates, muriates, and sulphates of potash and soda in solution. Fibrin and albumen contain the same elements in the same proportions; with a red colouring compound of iron they form the globules. The blood also contains peculiar fatty bodies, and the earth of bone in small quantities. All the *tissues* are formed out of the blood, and they form the parts, organs, and systems of which the aggregate is the organization.

The body in the whole, and in its parts, undergoes innumerable alterations, but these deviations from the normal type may be reduced to certain general heads:—(1.) increase or diminution of density, weight, volume, cohesion, elasticity, colour, number (of parts),—of which the following are examples—induration, softening, dilatation, contraction, atrophy, hypertrophy, anæmia, plethora, albinism, fracture, hæmorrhage: (2.) displacement; examples—transposition of viscera, hernia, dislocations, passive congestion, dropsy: (3) heterologous* products; examples —pus, tubercle, cancer, melanosis: (4.) disorganization; examples— ulceration, mortification. The secretions—the products of transformations of the blood and tissues—saliva, intestinal juice, pancreatic fluid, bile (poured into the intestinal canal), milk, urine (liquids), perspiration, breath (generally in a state of vapour)—may all be excessive (flux), altered in composition (discharge), or deficient (suppression); examples —diuresis, ischuria, diabetes, albuminuria, stone (of uric acid, oxalate of lime, phosphate of lime, the triple phosphates). As the urine, which affords peculiar facilities for chemical investigation, has been found to vary in all its constituents, and to contain either matters derived from the blood, as albumen—or, as in jaundice, secreted by remote organs—or new (heterologous) compounds, such as diabetic sugar, oxalate of lime, free uric acid,—the existence of similar changes may be inferred in the other secretions, and in the blood.

Besides the physical and chemical alterations which may be detected after as well as before death, derangements of the dynamic phenomena of life are observed, which may be referred to the heads of heat, refrigeration, spasm, paralysis, pain, coma, mania, amentia; as we see them, for instance, in ague, the exanthemata, typhus, inflammation, cholera, tetanus, epilepsy, palpitation, paraplegia, gastrodynia, apoplexy, insanity.

* Lænnec proposed to call tubercle, melanosis, and cancer, which have no analogues in the organization, heterologous products.

The elementary phenomena of disease admit of infinite combinations: and none is of more frequent occurrence, or of greater importance, than inflammation; the symptoms of which are "*redness* and *swelling*, with *heat* and *pain*."* The redness and swelling denote an excess of blood in the part; the heat a chemical reaction of the blood and tissue, the result of which is interruption of the function, and generally the effusion of lymph, the formation of pus, or gangrene. If the hypothesis be adopted, that heat is formed by the combustion of organic matter, and is proportional to the amount of oxygen consumed, we can easily understand how heat is generated, and becomes sensible in inflammation. The heat, accompanied by quick pulse (increased action of the heart), is called inflammatory fever; but fever itself is the result of a great variety of morbid processes, in which the disengagement of heat and the waste of flesh is rapid.

If we now inquire how the species of disease have been distinguished, and whence their characters have been derived, it will be found to have been generally from the morbid processes or products, the parts affected, the pain, the perceptibility of phenomena, their duration, their individuality, frequency, and fatality.

The parts affected, and their functions, stand next in importance to the morbid processes, actions, or products. The body is an aggregate of organs, each consisting of a variety of tissues, and performing special offices. The eye, for instance, is an organ consisting of a lens, of humours, membranes, blood-vessels, muscles, nerves, the optic nerve: its function is vision; and though all the deviations of its apparatus from the normal state are morbid, interference with vision stamps them with importance, and entitles them to names. The most important organs are the brain, spinal marrow, nerves, senses, constituting the nervous system; *function*—sensation, volition, motion: the heart, arteries, veins, —the vascular system; *function*—circulation of the blood. The nervous and vascular systems pervade, and their derangement may directly disturb, all the parts of the body. The functions of the absorbent, respiratory, digestive, urinary, generative, locomotive, integumentary, and cellular systems, will be denoted by their names. Each system is composed of many parts, forming subordinate organs; thus, the hand is an organ of prehension, the mouth of mastication, the pharynx of deglutition. Some parts are more easily observed than others, and will be found to have not perhaps more disease, but a greater number of specified diseases. The influence of function and of perceptibility on nosological nomenclature will be seen by comparing in systematic works the diseases of the ear and hand with the long list of diseases of the eye; the diseases of the mucous membrane with the diseases of the skin; the inflammations distinguished by the ancients, with the serous, mucous, parenchymatous inflammations of modern pathologists, armed with new instruments of diagnosis, and facilities for examining bodies after death. Where particular parts of organs are liable to attacks, and present characteristic symptoms under the attack, or where the products of pathological processes are distinct; wherever, in fact, important pathological states and phenomena are isolated, and can be individualized, they have been made species of disease. Pleurisy, pneumonia, and catarrh (bronchitis), were distinguished at an early period, and their independent existence has been confirmed by pathological anatomists; they differ in the symptoms, site, and fatality; and occurring together, but often alone, are examples of the way in which diseases of different parts of an organ have been divided into species.

* Notæ vero inflammationis sunt quatuor, rubor et tumor cum calore et dolore. *Celsus*, lib. 3, sect. 10.

In the constitution of species, more attention is now justly paid to structural than to functional changes; the former are often the proximate causes of the latter, but some pathologists, led astray by a principle of classification applicable to natural history,* or pre-occupied by their anatomical studies, and the recent discoveries in morbid anatomy, have denied the existence of dynamic disease, and, by a violent and improbable hypothesis, have assumed that every case, for instance, of insanity, convulsion, or syncope, is the *symptom* of a congestion, inflammation, or some other evident anatomical lesion. It would be as reasonable to assume that the needle of the mariner's compass never loses its magnetic properties but by evident oxidation.

Upon an examination of the registers of the fatal diseases in the first years of registration, made, as is evident, from the instructions, without any preconceived notions on classification, it was found that, exclusive of epidemic diseases, a majority of the cases had been referred to particular organs, which were named or unequivocally indicated by the nature of the lesion. In other cases, such as hæmorrhage, dropsy, abscess, mortification, and cancer, the seat of the disease was seldom mentioned. The first class was arranged in groups, as sporadic diseases of the nervous, circulating, respiratory, digestive, urinary, generative, locomotive, and integumentary systems; the second as diseases of uncertain seat (*de incertis sedibus*).† This mode of viewing the facts is common in England; it has been adopted in the treatises on the practice of physic which are most generally in the hands of practitioners, and, what is of more importance, by the authors who have devoted themselves successfully to research, and have naturally contributed most to the formation of the reigning medical opinions. The Library of Practical Medicine has followed this arrangement, and we have the original works of Abercrombie and Marshall Hall, on the Diseases of the Nervous System; Hope, on the Diseases of the Circulating System; Williams, on the Diseases of the Chest; Abercrombie, on Diseases of the Stomach and Intestines; Prout and Sir Benjamin Brodie, on the Diseases of the Urinary Organs; Willan and Bateman, on Cutaneous Diseases, not to mention others, and the treatises on midwifery, or the surgical treatises on the diseases of the joints and bones. Upon the other hand, there are essays and papers by Carswell, Watson, Sir James Clark, Mueller, Carmichael, and Walshe, on hæmorrhage, dropsy, tubercle, cancer, with a subordinate reference to the parts affected. The French writers, Lænnec, Andral, Chomel, Rostan, Lallemand, and Louis, from whom we derived so much, have cast their practical works in the same mould. This mode of grouping and considering the different types of sporadic disease appears to be practically the best—to involve few errors in carrying it out, to lead to useful results, and to be in conformity with the general principles upon which diseases have been constituted and named.

It will be observed that the different heads in the statistical Nosology are numbered and sometimes subdivided. They may be called species,

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* Pour que chaque être puisse *toujours se reconnaître dans ce catalogue*, il faut qu'il porte son caractère avec lui : on ne peut donc prendre les caractères dans des propriétés ou dans des habitudes dont l'exercice soit momentanée mais ils doivent être tirés de la conformation : *Cuvier*—Règne Animal, tome i. p. 7. The problem in natural history is or *was*—Given one of many thousands or millions of individuals, what is its name and place in the "catalogue?" As the specimen is often dead, or, as in fossils, has been only partially preserved, the superior importance of characters derived from the most permanent structures of the organisation is obvious. Recognition is not a main object of any classification of diseases; and the most expert anatomist would, in numberless instances, find it is impossible to divine from the after-death appearances the previous pathological phenomena.

† Celsus.

provided the term be not understood in the strict sense it bears in natural history,* with the technicalities of which medical science should not be encumbered, as it has principles of its own, and can derive more advantage from the methods of chemistry and natural philosophy.

To commence with the diseases of uncertain or variable seat. *Hæmorrhage* is essentially the *loss of blood;* blood may escape from any of the vessels in any part; and the difference and susceptibility of the part has given eight names to the affection. Hæmorrhage is periodical in females, and hereditary in some families; epistaxis is a type of simple hæmorrhage. The extensive loss of blood in phthisis, stone, cancer, ulcer, wounds, &c., is an important and sometimes fatal complication, but the *combination* of lesions may be described ("phthisis, hæmoptysis," &c.), and does not require a name. Hæmorrhage in the brain is one of the causes of apoplexy; in the lungs, one of the causes of asphyxia. Dropsy, the effusion of serum in the cellular tissue, the brain, chest, pericardium, peritoneum, tunica albuginea, has received distinct names. It is frequently an effect of retarded circulation, is a sequela of scarlatina, is observed in famines, and is the cause, consequence, or concomitant of Bright's disease of the kidneys (nephria). Abscess, or purulent deposit, is a secondary disease; *psoas abscess* (almost invariably scrofulous) has been distinguished, ulcer is generally scrofulous, scorbutic, syphilitic, cancerous, or varicose, and is further described by the addition of the part affected. Scrofula, characterized by the deposit of a matter allied to, if not identical with, the tuberculous matter of phthisis, so frequently affects the lymphatic glands, that their chronic enlargement or inflammation (adenitis) is almost always considered scrofulous; the deposit of tuberculous matter in the mesenteric glands has a name (*tabes mesenterica*), as it is frequent in children. Tubercle may be deposited in every part, and is found in the bodies of those who die of other diseases, it affects the glands and brain chiefly in children, the lungs in adults. Cancer differs from tuberculous matter in its tendency to assume an imperfect form of organization, it presents several varieties, but as it invades many parts simultaneously or successively, it has not received special names from the organs notwithstanding the variety of specific symptoms to which it gives rise. It is unnecessary to extend these remarks; they will apply with little variation to all the diseases in the class. By following all the possible combinations of the few elementary lesions here fixed upon, through all the organs, considering each a separate disease, and giving it a name, the number of species would become very great, but the number has been limited by their infrequency, imperceptibility, indistinctness, or indestructiveness.

If it were agreed to use the prefixes—hæm-a, hydr-o, py-o, helc-o, choir-a, carcin-o, necr-o, hyper, par—to designate the ten principal lesions in the class, by prefixing them to only ten of the principal parts (and they may be prefixed to a hundred), 100 species would be formed. Thus, as we have *hydro-cephalus*, serum infused in the brain (including its membranes); we should have *hæmencephalus*, blood effused in the brain; *pyencephalus*, pus (abscess) in the brain; *helcencephalus*, ulceration of the brain; *choirencephalus*, tubercles in the brain; *necrencephalus*, ramolissement of the brain; *hyperencephalus*, hypertrophy of the brain; *parencephalus*, malformation of the brain; and *carcinen-*

* La génération étant le seul moyen de connaître les limites auxquelles les variétés peuvent s'étendre, on doit définir *l'espèce la réunion des individus déscendus l'un de l'autre ou de parents communs*, et de ceux qui leur ressemblent autant qu'ils se ressemblent entre eux.—*Cuvier*, R.A., tome i. p. 17. With this definition before our eyes, we cannot confound the species and genera of natural history with those of diseases.

cephalus, cancer of the brain; *carcinocardia*, cancer of the heart; *carcinopneumon*, cancer of the lung; *carcinohepar*, cancer of the liver; *carcinogaster*, cancer of the stomach; *carcinentera*, cancer of the intestines; *carcinephrus*, cancer of the kidney; *carcinocystis*, cancer of the bladder; *carcinohystera*, cancer of the uterus; *carcimamma*, cancer of the breast. *Carcinosteon* is designated osteosarcoma in surgical works. All these lesions are the source of special phenomena; (hæmencephalus, carcinencephalus, and carcimamma, for example, are attended by very different effects); and they have been enumerated because a comparison of these and other possible combinations of lesions and symptoms affords a good illustration of the way in which diseases have been constituted; but the new names have not been introduced into the Nosology, because it could have led to uniformity only at the expense of old names,* and because the primary fatal diseases of several in the class are not numerous, and others, as has been already stated, in which there are organised or unorganised deposits, affect several organs before they prove fatal. Hæmencephalus, necrencephalus, hyperencephalus, hypercardia, may however be advantageously adopted. In other cases it will be simpler to write, as has been recommended in the Nosology, "cancer of the breast, liver, brain," than three compound names; and more convenient to describe the disease by the addition of the locality affected, as cancer of the tongue," "œsophagus," "stomach," "colon," &c., than to invent specific names, which are only required in the place of descriptions when the things or facts have to be frequently considered and mentioned.

Redness, swelling, heat, and pain are diagnostic symptoms of inflammation, but they cannot be satisfactorily observed except in external parts; the fever is common to all acute inflammations; though the vascular injection, and other traces of inflammation might be found after death, they are rarely observed, as the internal parts are seldom inspected; so that practically the perversion or abolition of function is the most striking phenomenon in the inflammations of the organs which are considered sufficiently important to form distinct diseases. Hence the parts affected, with the suffix "*itis*," gives names to thirty or forty diseases; a subdivision of phenomena which, if it is not always justified, and is unnecessary for statistical purposes, admits of explanation, and throws light upon the principles already advanced. Inflammation may exist wherever there are blood and capillaries; its species are limited by the importance of the parts affected. Inflammation of the membranes and medullary matter of the brain have been designated meningitis and encephalitis; of the spinal marrow and its membranes, myelitis. Besides these inflammations, which sometimes exist apart, and can sometimes be distinguished during life, writers have described arachnitis, cerebritis, cerebellitis, &c., from the appearances after death. Cullen designated by the old term phrenitis the inflammations of the brain, spinal marrow, and membranes; and although the chief distinctions of modern pathologists should be attended to, where it is practicable, in assigning the causes of death, it would be unwise to carry the division further, or to preserve more than the one head, cephalitis, in the abstracts. Ophthalmia is now subdivided, and minute oculists describe "conjunctivitis, sclerotitis, iritis, choroiditis, retinitis, and "hyaloiditis." Auscultation has facilitated the diagnosis of affections of the chest; and the inflammations of the internal and external membranes have been separated from those of the parenchyma

* Helcosteon and chirosteon for caries, psoas abscess, and white-swelling; necrosteon for necrosis, hyperosteon for exostosis and node, choirentera for tabes mesenterica, hæmentera for melæna, hæmahystera for menorrhagia, hydroperitoneum for ascites, &c.

of the heart and lungs; besides pleuritis, bronchitis, and pneumonitis, practical writers now treat of pericariditis, endocarditis, carditis. The inflammations of the two surfaces and parenchyma of other organs are generally designated by one word—glossitis, parotitis, hepatitis, pancreatitis, splenitis, nephritis, cystitis, orchitis. If it were of the least utility, the triple subdivision might be extended to these organs; and hepatitis, for example, might be made choledocitis, perihepatitis, hepatitis. Inflammation of the intestinal tract has received several names; stomatitis, tonsillitis, pharyngitis, œsophagitis, gastritis, enteritis, (under which term I include duodenitis, jejunitis, ileitis, cœcitis, colitis, rectitis, proctitis). These terms are held to designate especially inflammation of the mucous and submucous coats of the canal; which is invested after it enters the abdomen by the peritoneum: inflammation of this serous membrane is named peritonitis. A question has arisen whether inflammation of the part of the peritoneum, investing the stomach, small and large intestine, liver, uterus, bladder &c., should not be specifically designated gastritis, hepatitis, &c.? It will be much more convenient to designate inflammation of every part of the peritoneum—peritonitis: but the serous and subserous coats of the peritoneum derive blood from the vessels of the subjacent organs; and, when secondarily involved, their inflammation is necessarily included in our idea of inflammation of those organs. Inflammation of the liver, causing adhesions of the peritoneum, is essentially hepatitis; the inflammation, from perforation of the intestine, of the investing membrane of the liver, and of the other viscera, although their functions are all violently deranged, is essentially peritonitis. Ileus is ascribed to inflammation of the muscular coat of the intestine by Dr. Abercrombie, who considers it "established that a result of inflammation in muscular fibre "is gangrene."* Dothinenteritis has been applied to inflammation of the mucous follicles. The inflammations of the respiratory tract are—coryza (schneideritis ?), laryngitis, tracheitis, bronchitis, pneumonitis; of the urinary tract—urethritis, cystitis, ureteritis, pyelitis. The bones, ligaments, joints, (synovial membranes), bursæ, tendons, muscles, nerves, veins, arteries, lymyhatics, and glands, described by anatomists, are very numerous; the bones, for instance, are reckoned at 246, and every one may be the seat of inflammation, similar in its kind, however different in its effects; so to avoid an endless multiplication of names, which would be rarely or never used, inflammation of the veins (of one or of all) has been called phlebitis, and the inflammations of the other parts have been named in the same way, arteritis, adenitis, neuritis, myositis, arthritis (synovitis, chondritis, *syndesmitis*), ostitis, (endostitis, periostitis,) *fascitis, tendinitis.* In registering this class of cases it will be most convenient to write "Inflammation of ——," the particular part; or "Arthritis (knee)," &c.

Inflammations are *acute* or *chronic*; but the duration may be more accurately expressed by the ordinary measures of time.

Inflammations may be divided into pure inflammations—*idio*-inflammations—or those which supervene in a normal state of the blood and tissue; and inflammations which are developed in cachexies, and in the course of other diseases. The distinction is of such fundamental importance, that it should be explicitly expressed in the names; which might be effected by restricting the use of the termination "itis" to idio inflammations, and applying the termination "*ia*" to complicated inflammations. Simple inflammation of the lungs would be designated

* Researches on the Diseases of the Stomach, the Intestinal Canal, the Liver, and other Viscera of the Abdomen. By J. Abercrombie, M.D., &c. Third edition, p. 6.

pneumon*itis;* the inflammation of the lungs occurring in small-pox "pneumon*ia*." Upon the same principle ophthalm*itis;* and purulent ophthalm*ia*, may be distinguished; the visceral inflammations in typhus and remittent fever would not be cephal*itis*, &c., but cephalia, pulmonia, gasteria, enteria, hepatia. The inflammation of the brain in scrofulous children has a specific name—hydrocephalus; and peritonitis, with tubercular deposition, is qualified by "tubercular;" the adoption of the two terminations would be a useful extension of the analogy, with which dysenter*ia* is in strict conformity.

The systems of organs in the body are liable to functional derangements which cannot be ascribed to inflammations. Neither the inflammation nor the dynamic derangement exists independently of the organs; the two series of phenomena often co-exist; and it is not clear that they can be advantageously separated in statistical abstracts of the causes of death. They were grouped together under the principal systems in the first abstracts, and the arrangement has been retained: for the organ determines the character of the disease, as the grafted branch determines the quality of the fruit.

The brain, spinal marrow, and nerves are the organs of sensation, volition, and (with the muscles) of motion. The muscles are of two kinds; (1) the voluntary muscles, which are attached to the bony levers of the skeleton, and by contracting at the bidding of the will, produce the various movements which we witness of the whole or a part of the body; and (2) the involuntary muscles of the hollow organs, for the retention, circulation, ingestion, and expulsion of fluids; some of which such as the heart and intestinal canal, are independent of the wili, while others, like the respiratory muscles, are excited by the brain and by the spinal marrow—by the stimulus of volition and of contact—reflected along the nerves. Spasm is in general the excess, paralysis the abolition or diminution, of muscular action; the voluntary muscles, in spasm, contract spontaneously, despite of the will; in paralysis the will has no effect upon them, or does not produce harmonized contractions; the involuntary muscles in the same circumstances contract violently and irregularly, or cease to contract upon the application of the accustomed stimuli. As volition implies consciousness, the muscles which are exclusively excited by volition are inactive (paralysed ?) in sleep, coma, and apoplexy—which, in its simple form, appears to be a modification of deep sleep. In tetanus, croup, epilepsy, catalepsy, hysterics, convulsions, chorea, tremor, paralysis, apoplexy, the voluntary and partly voluntary motor system is principally deranged, with or without loss of consciousness; but the spasms or paralysis may originate in the muscles, the nerves, or the spinal marrow: and after Dr. Marshall Hall's ingenious hypothesis, supported by many facts and experiments, the true spinal system, in this sense, may be considered the seat of the spasm, which, as well as paralysis, may affect any muscle to which motor nerves are distributed, as pain may be felt in any part from which sentient nerves proceed. Pain accompanies nearly all diseases; when it is the sole or principal phenomena, it has been designated neuralgia—or cephalalgia, odontalgia, cardialgia, gastralgia, enteralgia, &c., by suffixing algia, from ἀλγος, pain. Odynia is used precisely in the same sense (as in gastrodynia); and headache, toothache, heartache, bellyache, stomachache, are translations of the Greek compounds. Tic douloureux is a convulsive pain. The spasms and paralysis of parts may be designated in the same manner as their pains, by terminations (cardiasm may denote spasm, cardialysis paralysis of the heart): hemiplegia and paraplegia are in general use; trismus, opisthotonos, emprosthotonos, pleurosthotonos, are scarcely required to denote transitory forms of tetanus. The modifications of muscular force, contraction, and rhythm, as well as their combinations with pain, loss of consciousness, and functional derangements, are numberless; it will be sufficient to mention a few from the Nosologies, as as they are either physiological, and not primary independent affections, or seldom shorten life: trembling, shivering, languor, lassitude, hiccup, sobbing, sneezing, coughing, puffing, snoring, yawning, twitching, twinkling, squinting, stammering. (Linnæus, Mason Good, &c.)

The modifications of the senses, and of their organs, are equally numerous: the names of disorders of the feelings, passions, intellect, occupy no inconsiderable space in the lexicons of all languages. Mania, monomania, and dementia—a termination of mania—may be distinguished in the registers.

When the brain, spinal marrow, and nerves of persons affected with the lesions that have been called dynamic are examined after death, traces of inflammation are often found: congestion, softening, effusion of serum, hæmorrhage, tubercles, tumours, produce paralysis or apoplexy. The connexion between the anatomical lesions and derangements of function requires further investigation; it is not constant.

It was necessary to point out the dependence of visceral pains, spasms, and paralysis on the brain and spinal marrow; which, in their various states of excitement, depression or derangement, influence even the involuntary muscles. The heart, for instance, beats violently or intermittingly under various states of mental excitement, and beats heavily and slowly in apoplexy: but as palpitation, spasm, fainting, cardialgia, &c., are frequent symptons of heart disease, and as their source in idiopathic cases may be in the heart itself, they have been classed with its inflammations and organic diseases. The same principle has been acted on in dealing with the neuroses of other organs, and with affections of the brain originating in the diseases of the heart and kidneys. The organic diseases of the vascular system—hypertrophy, atrophy, ossification, diseased valves, aneurism—which are now detected by auscultation, can often, but not always, be traced to inflammation.

Laryngismus stridulus, and asthma, appear to be the only neuroses of the respiratory system which require a separate head in a classification of fatal diseases. Deposits of tubercle have so frequently their seat in the lungs, that the phenomena to which they give rise have been called phthisis pulmonalis; and on this ground, as well as the supposed uncertainty of diagnosis, where auscultation is not used, phthisis was classed with the diseases of the lungs in the first Abstracts. It does not, however, appear to be governed by the same laws as the pulmonary diseases, and will probably require, with the progress of registration, to be classed in the Abstracts under a separate head, or with the other tuberculous diseases.

Hernia (strangulated) and intussusception are inflammations of the intestine, caused by pressure; in the former preceded by the escape, in the latter by violent muscular action, of the bowel, and generally terminating in mortification, with the symptoms of ileus. Constipation may be either the effect of inaction (torpor), or of spasmodic constriction (colic) of a portion of the intestinal tube: stricture is a contraction of the submucous coat, either from previous inflammation, ulceration, or heterologous deposits; and the symptons vary according as the stricture may be situate in the œsophagus, pylorus, ileum, rectum, &c., and may consequently interrupt the ingestion of food or the passage of fæces. As the canals of the organs of the body transmit fluids, obstructions and retentions form an important class of their derangements; thus, besides the stricture of the intestine, there are obstructions of the gall-ducts, of the ureters, urethra, heart-valves, arteries, veins, trachea, all of which may be fatal. The reduction of aliment is the special function of the stomach and intestine; it is inferred that this is imperfectly performed when there is nausea, heartburn, disengagement of gas, or of acrid fluids; hence the designation, dyspepsia. Little is known of the diseases and functions of the pancreas and spleen. Liebeg has rendered it probable that the bile is absorbed from the intestine; may not disorders of nutrition, therefore, which put a stop to its destruction (combustion) in the blood, lead to its deposit in the cellular tissue, or secretion in the urine? Jaundice is, however, generally connected with the diseases of the liver, and is always referred to the liver as its source. The fatty degeneration of the liver occurs frequently in phthisis; cirrhosis is an atrophy of the liver produced by the pressure of the contractile tissue, developed in the capsule of Glisson.—(*Carswell.*) The compression of the portal vein leads to venous effusion, and almost invariably constitutes the disease which was called by the ancients ascites.

Ischuria, diuresis, albuminuria, diabetes, stone, are the principal functional diseases of the urinary system; the three first, though often symptons (as subordinate phenomena are sometimes called) of nephritis and other diseases, appear to have sometimes an independent existence. As the sugar of diabetes is found in the blood and in the stomach, it has been considered essentially a dyspepsia, and been classified with the stomach diseases, as bile in the urine has been referred to the liver; but we have custom, with the unquestionable, invariable existence of sugar in the urinary secretion, on one side, and only a probable hypothesis on the other. A secretion may be modified as well by a change of the fluids, from which it is made directly or indirectly, as by a change in the secretory organ; and the oxalic acid, uric acid, triple phosphate, albumen, as well as sugar in the urine, may often be considered the exponents of changes in the chemical processes of remote organs. The same may be said of mismenstruation. All the diseases incidental to *childbirth* are connected together by this function, and their seat in the reproductive organs.

Besides inflammation, the osseous system may be the seat of all the diseases of uncertain seat: brittleness and softening appear to depend upon the excess or deficiency of bone-earth in the gelatinous tissue. Skin diseases require no comment here: the innumerable varieties depend apparently as much on the complicated structure of the integumentary system, and its free exposure to the oxygen of the air, as on the specific nature of the morbid processes.

Two or more diseases frequently coexist: pleuripneumonia, paraplexia, and gastro-enteritis are examples of the compound names by which these combinations have been designated. If two morbid states invariably coexist, or two parts are simultaneously affected, and the one affection imply the other, a single name is sufficient; if the coincidence be rare, a new name will be unnecessary; and, as a general rule, it will be better in such cases to write the names of the separate diseases consecutively, whether they arise from the same cause, or stand to each other in the relation of effects and causes.

The phenomena of all the diseases which have hitherto been considered had reference to the nature of the morbid processes, or the systems of functions and organs: two classes remain to be reviewed—the class of epidemic, endemic, contagious diseases, and the class of poisons, asphyxia, or injuries, in which the cause is the fundamental fact around which the phenomena are naturally grouped.

One person dies of corrosion of the stomach and hematemesis, another of palsy of the heart, another of tetanic spasms of the respiratory muscles, another of pure narcotism, another of a combination of these phenomena which have in them something peculiar, and differ from the spontaneous diseases with which they have been compared. All the sufferers have been poisoned by oxalic acid, in various degrees of dilution. To what single disease in the Nosologies can these affections be referred? Verdigris produces a variety of symptoms—vomiting, cutting pains in the bowels, jaundice, violent headache, cramps in the legs, convulsions, palsy, insensibility,—and the poison itself is the predominating fact; the nature of the morbid processes, and the lesion of the parts or functions being of secondary importance, differing according to the dose, the individual, and many accidental circumstances, but possessing altogether, in connexion with each other, order of succession, intensity, and result, a certain individuality of character, which distinguishes poisoning by copper from poisoning by other substances, and from other diseases. The diseases that poisons, such as oxalic acid and the salts of copper or lead, occasion in the body, should evidently be named, now that the diseases have been ably investigated and described though they are not so well understood as their exciters. The idea of the metal, lead, is represented by the word "lead;" and as this name is required for the purposes of speech, a name for the series of phenomena caused by lead, or the salts of lead, in the human body, appears to be equally indispensable in medical science. It is as necessary to distinguish the effects of a lead poison in the body, from the lead poison itself, as to distinguish a "burn" from the fire by which it is produced; for lead, or arsenic, or any substance of the kind, proves a cause of death only when it produces certain changes (diseases) in the organization, and those changes are logically the direct cause of death. A *burn* or *arsenicia* may be the cause of death; but fire and arsenic are only causes of death by producing burn and arsenicia. Catharsis, narcotism, intoxication, salivation, burn (blister, eschar), asphyxia, fracture, contusion, wound, dislocation, are names that have already been adopted to designate the pathological effects of chemical or mechanical agents. Catharsis is produced by colocynth, scammony, jalap, rhubarb, aloes, senna, castor oil, croton oil, elaterium, salts of soda, potash, magnesia, and a hundred other substances; in the effects of which careful observation might detect peculiarities, slight in some cases, but as broad and obvious in others as the differences in the chemical composition of the cathartics. In strict conformity, nevertheless, with the correct principles of nomenclature, catharsis and hypercatharsis serve to express the actions of the greater number of purgatives; yet it must not be forgotten that these actions are of a peculiar nature, sometimes affecting the whole organization, and constituting specific diseases, of which catharsis is a leading symptom. Opium, hyoscyamus, hemlock, hydrocyanic acid, tobacco, belladona, digitalis, fungi, cause narcotism, and the term narcotism designates sufficiently well the effects of some of the common narcotics; but it would be absurd to confound the diseases excited by opium and hydrocyanic acid, digitalis and poisonous fungi, under a general designation. Catharsis, narcotism, intoxication, and burn present nearly all the elementary phenomena of poisoning; but the number of combinations of elementary phenomena, and degrees of intensity, like their chemical causes, are innumerable.

"Miasm, properly so called, causes disease without being itself "reproduced. Carbonic acid and sulphuretted hydrogen, which are "frequently evolved from the earth, in cellars, mines, wells, sewers, "and other places, are amongst the most pernicious miasms." (*Liebig.*)

Miasms produce diseases like ague, without being propagated by contagion; but the poisons—carbonic acid, sulphurretted hydrogen, and other gases, which are given off by organic matter in putrefaction, afford an illustration of their action. The miasm which excites intermittent fever may be designated *pyretine;* and if it were not probable that modifications of the marsh miasm induce, in certain circumstances, remittent and yellow fever, specific names should be found for their principles. Rheumatic fever is apparently caused by a miasm.* Its changes of seat can scarcely be accounted for on the hypothesis that it is a local inflammation of the fibrous tissue.

Certain matters which have not yet been analyzed produce small-pox, glanders, hydrophobia, syphilis, measles, scarlatina, and other diseases; and as it was before proposed to give names to the well-defined diseases produced by poisons, so, for the purposes of reasoning, it will be equally useful to name these specific matters or transformations of matter by which diseases are propagated either by inoculation and contact (contagion), or by inhalation (infection). The following list exhibits the popular and scientific names of diseases in juxtaposition with the proposed names of their exciters; and it may be assumed hypothetically, that in the blood corresponding bodies exist, which are destroyed, and by the transformation of which the exciters are generated or reproduced. The names in the second column terminate in *a*, except a few in *s*. Lyssa (from λυσσα, rabies), the old Greek term, has been restored by Mason Good; I propose, for the sake of uniformity, to call puerperal fever *metria;* mumps, *parotia*; reserving parotitis for simple inflammation of the parotids; croup, *tracheia;* and the disease from puncture in dissection, *necusia*, (νεκυς the dead body).

Diseases.		Zymotic Principles.
Small-pox - -	variola.	varioline.
Cow-pox - -	vaccinia.	vaccinine.
Glanders - -	equinia.	equinine.
Hydrophobia - -	lyssa.	lyssine.
Syphilis - -	syphil*is*	syphiline.
Infection in dissecting	necusia.	necusine.
Erysipelas - -	erysipel*as*.	erysipeline.
Puerperal fever -	metria.	metrine.
Measles - -	rubeola.	rubeoline.
Scarlet fever - -	scarlatina.	scarlatinine.
Whooping cough -	pertuss*is*	pertussine.
Dysentery - -	dysenteria.	enterine.
Diarrhœa - -	diarrhœa.	
Cholera - -	cholera.	cholerine.
Influenza - -	influenza.	influenzine.
Typhus - - -	typh*us*.	typhine.
Plague - -	pest*is*.	pestine.

The existence of gangrenine, ergotine, ophthalmine, tetanine, miliarine diphtherine, parotine, aphthine, tracheine, may also be admitted. It is maintained by some pathologists, that the same specific poison produces several of these diseases—erysipelas, necusia, and metria, for instance; but while the diseases are described as distinct, it will be most

* The exciting cause of intermittent fevers, rheumatism, and [rheumatic] neuralgia is generally admitted (?) to be *malaria;* and if viewed abstractedly, and with reference to their specific nature, *it is probable that malaria is the only exciting cause of these diseases.—Prout on Stomach and Urinary Diseases*, p. 80.

convenient to consider their exciters as distinct, although they may be convertible into each other, and be as nearly related as varioline and vaccinine.

The chemical composition of these principles is at present unknown; but as salts are distinguished from each other by their relations to other bodies, and, though they may have the same appearance in solution, are found to differ by the compounds which they form with other bodies in solution, so the existence is demonstrated by the effect, of the matter here called "*lyssine*," on animals, although it cannot be detected by the rough analysis of artificial chemistry. The smallest quantity imaginable of *lyssine* inserted under the skin of a dog produces hydrophobia; and the bites of the infected dog will throw other dogs, and even human beings, into a state similar to that of the dog from which the charge of lyssine originally came. Varioline in the same manner produces small-pox, if the patient has not previously undergone its influence, or the influence of vaccinine—a modification of varioline. The diseases of this class have been frequently spoken of as fermentations; and Liebig has now opened the way to the explanation of their nature by a reference to the phenomena attending the transformations of organic compounds, excited by the action of other compounds simultaneously undergoing analogous transformations. Thus yeast, which is gluten in a state of transformation, added to wort, which contains gluten and sugar, converts the gluten of the wort into yeast, and at the same time the sugar into alcohol and carbonic acid, the two transformations going on together, and the latter ceasing when the former ends. The yeast reproduces yeast, if gluten, from which it was originally derived, be present; and if the temperature and circumstances be favourable, fermentation may be spontaneous.*

It must be admitted, with respect to all the forms of these diseases, that the body, in the cycle of external circumstances through which it passes, may run into them spontaneously (in this they differ from the class of diseases referred to external causes); for it is impossible to trace them invariably to infectious sources; it is not *a priori* more improbable that they than that other diseases should arise spontaneously; and it is impossible to account for their existence in the world upon any other principle than that of spontaneous origin. Still the property of communicating their action, and affecting analogous transformations in other bodies, is as important as it is characteristic in these diseases, which it is proposed therefore to call, in this sense, zymotic.† A single word, such as *Zymotics*, is required to replace in composition the long periphrasis "epidemic, endemic, and contagious "diseases;" with a new name, and a definition of the kind of pathological process which the name is intended to indicate, persons who have not made themselves acquainted with the researches of modern chemistry can scarcely fall into the gross error of considering this peculiar kind of diseased action and vinous fermentation absolutely identical, or of considering that others entertain that opinion. Liebig

* *See* Liebig's luminous exposition of the doctrines of fermentation, in his Chemistry of Agriculture, Physiology, and Pathology: two vols.

† From ζυμοω, I ferment: zymosis fermentation, and zyma ferment, may also be employed in English, *not in the sense* which they have in Greek, but as general designations of the morbid processes and their exciters. *Zymosis*, and the verb from which it is derived, occur in Hippocrates. See a good note and quotation from Galen, by Fœsius, in the *Œconomia Hippocratis*, appended to the Geneva edition (1662) of the works of Hippocrates. *Coction* appears to have been used by the father of medicine with the same qualification as ebullition and fermentation by Sydenham. See his Treatise on Ancient Medicine, vol. i., Œuvres complètes d'Hippocrate, par E. Littré, 1839.

draws a distinction between fermentation and putrefaction: the reasons are more urgent for distinguishing the pathological transformations from fermentation or putrefaction, while it is admitted that they are of a chemical nature, and analogous to fermentation; by which they are moreover to a certain extent explained, although so little is known of the series of chemical changes and products in any single zymotic malady, or of the chemical reactions of the living forces and organs. Small-pox is by hypothesis the transformation of varioline, and certain unknown concomitant chemical changes in the blood and skin: manifesting the important symptoms which fall under direct observation.

Some of the morbific principles are fixed; others are volatile; but the greater part of them are fixed and volatile in different circumstances. Necusine, pestine, syphiline, lyssine, equinine, and vaccinine are the most frequently fixed; they give rise, when placed on the skin, particularly where the epidermis is removed, to their peculiar diseases; but contagion is not invariably the result of their contact; indeed, in several of them it is the exception rather than the rule. Either there is no matter in the organization susceptible of transformation, or the specific transformation is overpowered by the vital energies; for in every case, if the morbific principle (zymine) tends to impart its movement to the organisation, the organisation, animated by the natural forces, has a tendency to continue its own processes, and to impart its conservative movements to all the organic matters which are brought within its sphere.

Varioline is converted in the cow (as Mr. Ceeley has shown) into vaccinine and cow-pox affords an interesting illustration of the modifications which diseases undergo, and which may be imparted to them by changes in their exciters. Vaccinine taken from the cow effects the transformation of the *materies morbi* in man almost as completely as varioline; but it reproduces vaccinine; and in the process is never fatal, never produces the variolous fever, and its vapour is never infectious, like that of varioline. The mild form of small-pox which appears in persons modified by previous vaccination, or which follows small-pox inoculation, is an equally good example of the changes induced in diseases by the actual constitution of the individual, and the mode of infection.

Syphilis, erysipelas, necusia, metria, rubeola, scarlatina, and the other zymotic diseases, also put on different forms, which may be referred to the state of the exciter, the mode of its application, the matter on which the exciter acts, or the vitality of the patient. A modification of cholerine, or of enterine, probably produces diarrhœa. Louis considers dothinenteria (his *fièvre typhoide*) a different disease from the typhus of this country, and points out the ulcerations, particularly of the glands of Peyer, with the correlative phenomena, and the rose-spots disappearing under pressure, as establishing its distinct character.* The differences in certain cases are unquestionable, and may be expressed by dothinenteria and typhus; but the two forms of the disease occur in this country; the characters are frequently mixed; and they are not greater than are observed in scarlatina simplex, and scarlatina maligna, with black incrustations, and gangrenous inflammation of the throat, in the erythema and phlegmonous erysipelas of Mr. Lawrence, or in the varieties of other diseases.

The blood, which pervades the whole system, is the primary seat of zymotic diseases; but this does not diminish the importance of the local phenomena with which they commence, proceed, or terminate; for

* Louis, Fièvre typhcide, vol. ii., p. 311.

they affect (as poisons do) particular organs more extensively and frequently than others, give rise to specific pathological formations or secretions, and derive their character from the lesions and affected organs.

The heat disengaged in these diseases suggested the term fever, derived from ferveo, as fermentum is from fervimentum.

Some zymotic diseases recur, others only happen once in life, or if they happen twice, it is the exception: this has been explained on the hypothesis that some but not all kinds of matter (zymin) are reproduced in the organization after they have been destroyed by transformation (zymosis) in attacks of disease.

The tendency of zymotic diseases to increase and decline in activity, is one of their most remarkable properties; and the suddenness of their outbreaks, with the great mortality of which they were the cause, excited at an early period the attention and solicitude of mankind. This tendency is indicated by the terms epidemic and endemic; the latter serving to designate diseases which are excited by miasmata, and prevail in proportion to the quantity of miasm developed; the former, epidemic, denoting the diseases transmitted by man to man, independently of locality, or only dependent on locality, temperature, and moisture as adventitious circumstances. For statistical purposes, the epidemic, endemic, and contagious diseases have been classed under one head, as they may all be excited by organic matter in a state of pathological transformation. Ague is not contagious, and is apt to recur; it therefore apparently approaches the class of toxical diseases; but I feel inclined rather to consider it a zymotic disease, in which, to use the language of Liebig, the exciter is destroyed as soon as it is reproduced; and this view is confirmed by the analogies of remittent fever, or yellow fever, so intimately allied in some respects with ague, in others with plague, and apparently contagious (though this is disputed) in certain circumstances. Scurvy is a transformation induced by the want or inadequate supply of vegetable food. It formerly decimated the English navy, and is now met with in certain prisons. Scabies and porrigo (both contagious diseases) are ascribed to an insect (*acarus scabiei*) and a low form of independent organization. The mode in which zymotic diseases are propagated has afforded the ground of an interesting comparison between their diffusion, blight of vegetables, and the generation of animalculæ.

Sydenham referred, in the following passage, to zymotic diseases which were so rife in London formerly as to divert attention from pure inflammations; and, as they approach nearer than other diseases to the definition of species in natural history,* justify the comparison which he has instituted:—

"If the humours are retained in the body beyond the due time, either (1) because nature cannot digest and afterwards expel them, or (2) from their having contracted a morbific taint from a particular constitution of the air, or (3) lastly from their being infected with some poison: by these, I say, and the like causes, these humours are worked up into a substantial form or species, that discovers itself by particular symptoms, agreeable to its peculiar essence; and these symptoms, notwithstanding they may, for want of attention, seem to arise either from the nature of the part in which the humour is lodged, or from the humour itself, before it assumed this species, are in reality disorders that proceed from the essence of the species newly raised to this pitch [zym*ine*]; so that every specific disease arises from some specific exaltation or peculiar quality of some humour [zym*in*] contained

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* See note, page 24, of 4th Annual Report.

in a living body. Under this kind may be comprehended most diseases which have a certain form or appearance; nature, in fact, observing the same uniform method in producing and bringing diseases to a height or crisis as she does in the production or growth of plants or animals; for as every plant or animal is possessed of peculiar properties, so is it likewise in every exaltation of any humour, after its being come to a species or disease. We have a clear proof of this every day, in those kinds of excrescences that grow on trees and shrubs (occasioned by the ill quality of the nutritious juice, or other causes), in the form of moss, mistletoe, mushrooms, and the like; all which are manifestly different essences or species from the tree or shrub that bears them."—*Sydenham's Works, trans. by G. Wallis.*

Sydenham's methods of treatment were adopted by him, and recommended as the results of experimental investigation. However their use might have been suggested, their efficacy was determined by their apparent influence on the recovery of patients; but in his exposition of therapeutic principles, he keeps constantly in view his theory of "commotion" (*comotio*); "a general term which he chooses in order to "prevent all fruitless dispute about words that might arise from the use "of fermentation or ebullition (*fermentatio vel ebullitio*), which, "though they may seem harsh and metaphorical to some, are capable of "a commodious interpretation."*

Thus, in speaking of "continued fever," he says, "with regard to this "disease, I judge that the genuine indications are to keep the com- "motion of the blood [zymosis] within such bounds as suit the design "of nature, so as to prevent its rising too high on one side, whence "dangerous symptoms might follow, or sinking too low on the other, "whereby either the exclusion of the morbific matter might be hindered, "or the endeavour of the blood affecting a new state be frustrated."†

The early medical observers have directed attention to the analogies zymotic diseases have with combustion, fermentation, putrefaction, and poisoning. These analogies have been, to a certain extent, confirmed by the researches of modern chemistry; and Liebig has been led by the study of organic transformations—fermentation, putrefaction, decay —to develop a theory invented by the greatest practical physicians to explain the phenomena of zymotic diseases.

Liebig observes, "that physicians had referred formerly to fermen- "tation merely by way of illustration;" from which it is evident that he had not had time to consult the English medical classics on this head, or he would have discovered, not indeed an anticipation of his own admirable generalizations, but a theory very similar to his own—the basis of their pathology—founded upon enlarged views, and well calculated to prepare the way for his researches and the researches of other chemists.

The three great contemporaries, Sydenham, Morton, and Willis, lived in London when plague and epidemic diseases prevailed; and much as they differed, or were mistaken on some points, all announced more or less clearly the zymotic hypothesis. They were not, it must be borne in mind, mere chemiatric theorists; they had studied diseased action as assiduously, and with as much sagacity, as modern chemists have studied fermentation; Willis was a great anatomist; Sydenham and Morton have left original pathological delineations, which have never

* On the continued fever of 1661–4, sect. 1–4. He adds, "But since the terms fermentation and ebullition have prevailed among the modern physicians, I have not scrupled to use them occasionally, meaning only to convey my thoughts more easily thereby."

† *Id.* sect. 5. See also on the regular small-pox, 1677–9, sect. 30–33.

been surpassed, and laid down plans of treatment which are still followed.

Liebig, Dumas, and the chemists of this country, will, we sanguinely hope, not rest satisfied with what has been done, but continue to prosecute their labours with ardour and success; and, from the study of the series of transformations of nitrogenous compounds, proceed to investigate the transformations of the blood, tissues, and secretions which accompany the production of varioline, typhine, and the other zymotic principles. (4th Annual Report, pp. 186–205.)

Report on the Nomenclature and Statistical Classification of Diseases.—Periodical Returns of the fatal diseases and injuries of the population have been published in London since the commencement of the seventeenth century; in the Department of the Seine, since 1809; and in some States the national registers contain a column in which the cause of death is inscribed. Since 1837 the causes of death have been classified and have been published in England in conformity with the principles of a statistical Nosology which is there in use; and at the Census of 1851 the diseases and infirmities of the population of Ireland were returned and classed in the same order as the deaths.

The progress of the natural sciences is greatly promoted, as experience has shown, by the adoption of a nomenclature which can be used in every country, and which leaves but little doubt that the same thing is designated by the same or by strictly synonymous words. The utility of a uniform nomenclature in the registration of the causes of death was so strongly felt at the first Statistical Congress, that the members expressed their opinion in the subjoined resolution; and Dr. Marc d'Espine and I were requested to prepare a report on the ground that we had for several years the practical direction of statistical inquiries on this subject in Geneva and England.

The resolution is to this effect:—

"*Il y a lieu de former une nomenclature uniforme des causes de décès*
"*applicable à tous les pays.* Cette nomenclature, dont l'importance ne
"peut être méconnue, fera l'objet d'études ultérieures, et pourra être
"arrêtée dans un prochain congrès."

Objects of the Record and Tabulation of the Diseases of Mankind.

The state of health among the people differs in different times and in different places; and the principal purpose of the registration of diseases is to determine the degree of their variation in each district, and in each class of the population, as well as the extent to which they are modified by circumstances.

The causes of insalubrity are thus discovered at their source by death itself; and it is found that in many instances these causes admit of removal by sanitary measures.

The deaths that are the direct result in any way of human agency undergo judicial investigation, which is often aided by the purely statistical inquiry.

The difficulties that attend the inquiry into the diseases of a whole population are numerous. They may be referred to several heads. The phenomena are sometimes exceedingly complicated, and those of the greatest importance pass within the human body. Medical science is, notwithstanding all its achievements, still imperfect; the medical observers all over the country are not always familiar with the latest improvements in the practice of their art, and it often happens that they are only called to see their patients in the last days of illness. In parts of our towns, as well as in remote parishes of the country, many young children and old people die without being seen by any medical man.

No perfect record of the diseases of mankind can, therefore, we believe, be obtained in the present state of civilization; but experience justifies us in saying that the record of the ascertained facts, and of the opinions of the existing race of medical practitioners in Europe, is of value, and admits of many practical applications.

The medical man who attends the sick in illness should be called upon in the case of death to give a *certificate* stating the diseases of which the patients died, the duration of disease (when known), and the date of the last visit.

Where any person dies who has not been attended by a qualified medical man, the body should be inspected, and the certificate filled up, when practicable, by a district health officer, or by some specially appointed medical man.

The plan that is pursued in Geneva, in Brussels, in Paris, and in other cities, of appointing a medical officer to visit everybody, and to report independently on the *cause of death* to an appointed health officer, who has thus the opportunity of comparing the certificates from two sources, is calculated to insure accuracy, and deserves to be adopted in towns. But in the country districts *economy* of *skilled labour* is indispensable. If there the sick poor, while alive, are inadequately supplied with medical advice and medicines, it is vain to expect that two skilled officers can be specially employed to find out the causes of death.

The public registers should embody in simple terms the last results of judicial or other investigations into the causes of death.

Notwithstanding the differences of doctrine, there is now a general agreement all over Europe in the designation of diseases, and popular terms can in many instances be employed without risk of inaccuracy.

In each country—that the public register might be intelligible to the people—the common names should be used where they briefly and distinctly designate a disease, except in cases where the vulgar name may be offensive. It is, however, desirable for statistical purposes that the *names* of diseases should be devoid of all ambiguity, and, to facilitate the abstracts, that they should be *single*. Such double names as are used in botany and the other sciences of natural objects would be cumbersome, and are not required.

In the national register we recommend the use of the popular names; substituting for them, however, the ordinary technical name whenever it is necessary for the sake of accuracy or of brevity.

In popular and judicial nomenclature names have been employed expressive of imperfect knowledge of the causes of death, and some of these names must be adopted. Thus, a person dies suddenly at home, and the cause is not discovered; or a man is found dead from home, without evident injury; such cases are returned under "sudden death," or simply "found dead," with the addition of any important circumstance.

A class of names in universal use, such as "dropsy," and frequently occurring in the mortuary registers, is looked upon with little favour by pathologists; some of whom have proposed that such names shall be altogether discarded. And it is undoubtedly true that many cases of dropsy, convulsion, paralysis, and other forms of disease are every day traced to organic lesion of the heart, kidney, brain, or other organ; but can this be done in all cases with all the assistance derived from the autopsy? Can the lesion on which those diseases depend be discovered with certainty where the medical man sees the patient only for a short time under unfavourable circumstances?

The permission to use vague terms in these cases, it is objected, encourages negligence; but the refusal to recognize those terms that express imperfect knowledge has an obvious tendency to encourage reckless conjecture. It appears, therefore, to be a safer course to retain, for the present, terms of this kind, and at the same time to urge observers to refer specifically to the primary organic lesion wherever it can be satisfactorily determined.

Certain deaths occur in birth, in teething, in puberty, in child-bearing, in the climacteric ages, in old age, which can be referred to no definite disease—to no circumstance except the peculiarities of the condition of the organization at those periods; names designating these conditions must, therefore, be recognised.

Latin names might be used in the *National Tables* of the causes of death, which would then be designated in a way everywhere intelligible among scientific men; but the same object will be attained by using strictly synonymous terms in the national idioms.

It is evidently desirable to extend the same system of nomenclature to diseases which, though not fatal, cause disability in the population, and now figure in the tables of the diseases of armies, navies, hospitals, prisons, lunatic asylums, public institutions of every kind, and sickness societies, as well as in the Census of countries like Ireland, where the diseases of all the people are enumerated.

I have therefore included in the general list the greater part of those diseases, such as ulcers, itch, blindness, and infirmities of various kinds, to serve for the classification of the diseases that affect the health, as well as of diseases that are fatal.

These diseases, as well as the diseases that are not prevalent in Europe, are omitted in the Mortuary List.

The causes of death were tabulated in the early Bills of Mortality (*Tables mortuaires*) alphabetically; and this course has the advantage of not raising any of those nice questions in which it is vain to expect physicians and statists to agree unanimously. But statistics is eminently a science of classification; and it is evident, on glancing at the subject cursorily, that any classification that brings together in groups diseases that have considerable affinity, or that are liable to be confounded with each other, is likely to facilitate the deduction of general principles.

Classification is a method of generalization. Several classifications may, therefore, be used with advantage; and the physician, the pathologist, or the jurist, each from his own point of view, may legitimately classify the diseases and the causes of death in the way that he thinks best adapted to facilitate his inquiries, and to yield general results.

The medical practitioner may found his main divisions of diseases on their treatment as medical or surgical; the pathologist, on the nature of the morbid action or product; the anatomist, or the physiologist on the tissues and organs involved; the medical jurist, on the *suddenness* or the *slowness* of the death; and all these points well deserve attention in a statistical classification.

In the eyes of national statists the most important elements are, however, brought into account in the ancient subdivision of diseases into plagues, or epidemics and endemics—into diseases of common occurrence (sporadic diseases), which may be conveniently divided into three classes, and into *injuries* the immediate results of violence or of external causes.

CLASS I.—EPIDEMIC, ENDEMIC, AND CONTAGIOUS DISEASES.

Zymotici [*Morbi populares, vel Demici?*]

This class includes fever, small-pox, plague, influenza, cholera, and the other diseases which have the peculiar character of suddenly attacking great numbers of people at intervals in unfavourable sanitary conditions. The diseases of this class distinguish one country from another—one year from another; they have formed epochs in chronology; and, as Niebuhr has shown, have influenced not only the fate of cities, such as Athens and Florence, but of empires; they decimate armies, disable fleets; they take the lives of criminals that justice has not condemned; they redouble the dangers of crowded hospitals; they infest the habitations of the poor, and strike the artizan in his strength down from comfort into helpless poverty; they carry away the infant from the mother's breast, and the old man at the end of life; but their direst eruptions are excessively fatal to men in the prime and vigour of age.

Pestilence and famine have always obtained the special attention of governments; and epidemical maladies have a special claim now to the attention of the statist, inasmuch as by prophylactic methods, of which vaccination is an example, and by hygienic arrangements, the ravages of epidemics may be greatly diminished. They are more than other diseases under public control, and may be diminished to a large extent by sanitary measures.

The diseases of the class may be referred conveniently to four groups, of which (1) fever, (2) syphilis, (3) scurvy, and (4) worms, are types.

New names are wanted to designate new groups of phenomena, which might perhaps be less equivocally designated by letters of the alphabet; but, to assist the memory, words have been employed which, by their etymology, will suggest the group. We do not, however, in any case accept the etymological sense as a *definition* or a *description* of the group of causes which a name designates. Thus, parts of the body undergo a specific transformation in the diseases of the first class, and they have been designated ZYMOTIC DISEASES (Zymotici) in England, without any intention to imply that these diseases are fermentations.

The list has been drawn up so as to include all the principal diseases which have prevailed as epidemics or endemics; and all those which are communicable either by human contact or by animals in a state of disease, as well as the diseases that result from the scarcity and the deterioration of the necessary kinds of food, or from parasitic animals.

The *Miasmatic diseases* (Order 1) are diffusible through the air or water, and are attended by fevers of various forms; the matter by which they are communicated is derived from the human body (as in small-pox) or from the earth (as in ague). (Types: small-pox, ague.)

The *Enthetic diseases* (Order 2) (from ενθετος, put in, implanted) may be properly called *contagious*, as they are communicated by contact, puncture, or inoculation. (Types: syphilis, glanders). The venom passes through the skin.

The *Dietetic diseases* (Order 3) arise when the blood is supplied with improper or bad food. (Types: scurvy, ergotism.)

The *Parasitic diseases* (Order 4) attack especially dirty populations, and infest the skin, the intestinal canal, and all the structures of the body. They are rarely fatal; and many pathologists contend that the parasitic vegetable or animal products are the accidental consequences of the diseases which they accompany.

The subsequent diseases fall under two great classes, differing most in the property which those of the first class have of pervading several organs at once, or in succession; while the diseases of the other class consist essentially of functional or structural derangements of particular organs of the human body.

CLASS II.—CONSTITUTIONAL DISEASES.—*Cachectici.*

The diseases of this class are sporadic; they are sometimes discovered to be hereditary; they are rarely confined to one part, but before death ensues they affect several organs, in which new morbid products are often deposited.

The *first* order of *Diathetic diseases* includes gout, dropsy, cancer, mortification.

The *second* order of *tubercular* diseases includes scrofula, tabes mesenterica, consumption, and hydrocephalus.

CLASS III.—LOCAL DISEASES—*Monorganici.*

There are sporadic diseases, in which the functions of particular organs or systems are disturbed or obliterated with or without *inflammation* and its products: some of the diseases are hereditary.

The diseases of the brain, spinal marrow, and nerves, form the first order (1), under the designation of the diseases of the nervous system, or, more briefly, brain diseases. The diseases of the organs (2) of circulation, (3) of respiration, (4) of digestion, and (5) of the urinary, (6) reproductive, (7) locomotive, and (8) integumentary systems, constitute eight orders of local diseases.

[The division into general and local diseases is found to work well; as functional disorder is more easily discovered than the precise nature of the lesions of internal organs which are rarely examined after death. The evidence may be sufficient to show that there is disease in the brain, or the chest, or the intestines, but may not enable the observer to determine whether it is or is not the result of inflammation. Such cases are classed as "diseases of the brain," &c.]

CLASS IV.—DEVELOPMENTAL DISEASES.—*Metamorphici.*

The *fœtus in utero*, the infant prematurely born, the infant in the act of birth, or shortly after birth; the child in the first or second teething; the boy or the girl at the age of puberty; the woman in childbirth, or at the critical age when the reproductive function ceases; the person of advanced age—are all liable to peculiar disorders, which in certain instances are causes of death, and are in the common nomenclature designated "still-birth," "premature birth," "infantile debility," "malformation," "teething," "chlorosis," "childbirth," "climacteric disease," "old age." We place all the cases in this class apart, and join with them atrophy or asthenia, and what is sometimes called "premature old age," in which the nutritive process is interrupted, without other evident disease. They are all the incidental attendants on the formative, reproductive, and nutritive processes; or the results of undetected diseases at the periods of life when those processes undergo great changes.

CLASS V.—VIOLENT DEATHS OR DISEASES.—*Thanatici.*

All the preceding diseases are modified, and some are induced, by external agents, but the present class comprises the evident results of physical and chemical forces acting on the organisation. Burns, asphyxias, wounds, poisonings, stings, are types of the several sub orders of the class.

Fire, asphyxia, mechanical forces, poisons, stings, induce specific diseases, which present a regular succession of phenomena, and should in all cases have names. Thus, as it is the "burn" and not the fire that is the cause of death, so it is the disease to which "arsenic" gives rise, rather than the arsenic, that we should register.

Human agency plays so important a part in this class, that it might be made the basis of the division into orders. Thus a man may die (1) a glorious death in battle (*pro patriâ mori*); he may die (2) by an act of homicide (murder, manslaughter); he may die (3) ignominiously on the scaffold (execution); or, (4) abandoning the post in which God has placed him, he may take away his own life (suicide); (5) he may die by a surgical operation; and (6) he may die by *accident*.

If this grouping be adopted, the mode in which death is produced by wounds, chemical injuries, poisons, asphyxias, and mechanical forces, would form secondary heads.

At the instance of the Registrar General, instructions have been prepared under the several heads of the *Nosology*, for the use of medical men and coroners in England. In the several countries of Europe similar instructions would be required, and might be modified so as to meet the peculiar circumstances of each nation.

The most important point to attend to in the instructions is the registration of the *secondary diseases* which intervene in the course of other diseases, and the record of the duration of every fatal disease.

To render the analysis of the *causes* of *death* complete, it will be necessary to subject a certain number of them to a *second analysis*: showing, for example, the various ways in which *childbirth* is fatal, the circumstances in which *fatal accidents* occur, the cases of *measles* that terminate in *bronchitis* or *pneumonia*, of *scarlatina* that pass into *dropsy*, and the *duration* of each fatal case. These analyses would be interesting chiefly to medical statists.

I have thus sketched in outline the classification of diseases from the statistical point of view, and have arranged them all under the five groups of Epidemic diseases (zymotici or demici), Constitutional diseases (cachectici), Local diseases (monorganici), Developmental diseases (metamorphici), and diseases that are the direct result of violence (thanati).

The general statist will gain a notion of the three first classes, by comparing them with the disorders arising in a most elaborate machine —from electrical, magnetic, or chemical action, and from the wear and tear of its particular parts. The fourth class is exemplified by defects of construction and by general decay. The fifth class is represented by the act of breaking the machine to pieces, disintegrating its parts, and putting an end to its movements, which when once stopped cannot be recommenced.

By studying the causes which are injurious and fatal to men in our countries and in our cities, statists will contribute to the removal of evils which shorten human life and to the improvement of the race of men, so that citizens of civilized States may be made to excel barbarians as much in strength as they do in the arts of peace and of war.

In the words of Bacon, "If physicians [and we may add governments] " will learn and use the true approaches and avenues of nature, they may " assume as much as the poet saith—

" *Et quoniam variant morbi, variabimu*
" *Mille mali species, mille salutis erunt*

(16th Annual Report, Ap

Statistical Classification of Registered Causes of Death.—It often happens that certain diseases are followed by other diseases, or that two forms of malady are successively developed and are in intimate connexion. Thus scarlatina is sometimes followed by dropsy, measles and whooping-cough by bronchitis or pneumonia, typhoid fever by perforation of the intestine, phthisis by pneumothorax, hernia by peritonitis, stone by nephritis, childbirth by metria. External causes are frequently fatal, not in a direct way, but by developing phenomena that are recognized as diseases. Thus arsenic induces gastritis (inflammation of the stomach), alcoholic drinks induce delirium tremens, privation leads to scurvy and dropsy, cold to mortification, burns to internal irritative diseases, contusions, fractures, and wounds to erysipelas, tetanus, purulent deposits (pyemia), and, under certain circumstances, to hospital gangrene.

It has been the general rule, in the classification, to refer the secondary affections that supervene in the course of measles, scarlatina, phthisis, and other diseases, to the primary diseases by which they are caused or modified, and the diseases that are the direct result of external causes to those causes. The partial exceptions to these rules occur in the above classes of cases. At some subsequent period it will be right to investigate these double causes.—(13th Annual Report, p. 129.)

What are Causes of Death?—The human organism, although the force with which it is animated is indestructible, dies inevitably under a great variety of conditions. In one instance death is the direct effect of mechanical violence; a mere shock of arrested motion converts the life force into a new form: in another instance blood is lost and the processes of nutrition are stayed: then agents like fire or frost disintegrate the parts, or chemical forces like opium still for ever the living action in sleep. Submersion under water or stoppage of the air-ways shuts out oxygen, and with the cessation of the supply of this element life is extinguished as suddenly as the light of a lamp; so also life slowly goes out when the supply of food is insufficient, as the flame of a lamp dies when oil is withheld.

Adverse living molecular forms too assert their powers over the structure, and, as in small-pox, syphilis, glanders, cholera, and the other zymotic diseases, transform the body into their own substance and habitation, so that it can live no longer its own life, but is transformed first into multitudes of organic particles, and then mayhap, after many transmutations, into air, water, and earth. What was a living nature of the highest form becomes a dull cloud of matter, again after cycles of changes to be incarnated.

The constitution of the tissues undergoes transformations in cancer and tubercle and other analogous diseases as the blood does apparently in diabetes.

The most common form of disease is inflammation and its results in the several organs of which the body is a confederation; and upon taking up these organs singly each is found to have its well characterized diseases: the brain, no longer the seat of intelligence, sensibility, and reason, becomes the seat of madness; the heart loses its wonderful hydraulic precision; the lungs neither drink up nor discharge breath; the stomach transmutes its aliments no longer or transmutes them amiss; the liver and the kidneys fail to supply their specific distillations; the joints decay; the muscular system, once finely adjusted in its movements, is paralysed; the skin loses its fresh colour, and changes into ulcer and leprosy; the formative forces in some cases go wrong, or stop and leave organs unfinished. The reproductive system, too, which creates and perpetuates generations in endless succession, itself kills the parent and the child in one flood,—one throe of agony.

Now, when it is considered how multitudinous and complex the causes are, not of the one phenomenon, but of the many phenomena of death, for death has its many phases as well as life, it can scarcely be surprising to find that out of nearly half a million of deaths no causes were assigned in eight thousand or more instances. In 4,630 cases no causes were specified; in 3,506 cases it is only inferred that the deaths were sudden, as in them inquests were usually held.

Through the co-operation of the medical practitioners of England and Wales the majority of cases are certified on forms supplied by the Registrar General. In London about 93 per cent. of the deaths are certified, as far as the causes are concerned, by the medical attendants, 5 by the coroners, leaving only 2 in 100 uncertified. Out of 1,578 deaths in London recently analysed 26 were uncertified, of which 4 only are recorded where the deceased had no medical attendant. One of the counties, Northampton, taken at hazard, yielded this result; out of every 100 deaths 91 were certified, 7 were uncertified; 2 died without medical attendance. In some few counties many of the people get no qualified medical advice during life, the medical man lives at great distances, or the people, ignorant themselves, apply for relief to irregular practitioners, men sometimes of natural ability, but often possessing no claim to confidence, except that founded on boundless faith in their own nostrums, which perform the same amazing miracles now as were performed in the dark ages by relics, charms, and exorcisms.

It must be stated, moreover, that the causes of death assigned are often inadequate, and frequently erroneous. A person is dead. What was the cause of his death? is the question addressed to the medical attendant. He has all the information to guide him in his answer that he employed during life in the treatment; but that may be insufficient. Some few years ago "dropsy" would have been returned, and was accepted in medical science as a disease, a cause of death. It is still used rightly in some cases. But many cases are traced back further; the dropsy is found (1) to be associated with albuminous urine, and affections of the kidney, such as Bright's disease; or (2) it is the result of retarded circulation from organic disease of the heart; or (3) it is *ascites*, an effusion into the peritoneal sac from obstructed circulation through the liver; or (4) it is hydrocele, perhaps from injury; or (5) it is ovarian dropsy; or (6) it is a consequence of scarlet fever; or (7) it is anæmic; or (8) it comes on suddenly with fever; or (9) it is general and associated with scurvy. Now after the first step is made in defining the seat and source of the "dropsy" we have got at one link of the chain of causes. The dropsy of scurvy, or anæmia, may be traced to famine, or to insufficiency of some elements of diet; that cause is primary. Then the scarlet fever is the cause of the dropsy; but what is the cause of the first disease? how was the dead child infected? Ascites, the cirrhosis of the liver, may be traced to alcoholism as its primary cause; or the heart disease may be derived from rheumatic fever. And the rheumatic fever may be be the result of exposure to malaria of a specific kind. Now in many cases the primary cause can, but in many cases it cannot, be discovered. Yet to be able to prevent death, the primary cause is of first importance, as it sets the rest in motion.

There are affections of the brain, of the chest, and of other internal parts, which can be distinguished by the pathologist on actual inspection, but not otherwise; while other fatal functional derangements cannot, under the most favourable conditions, in some cases be connected with

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organs at once, or in succession; while the diseases of the other class consist essentially of functional or structural derangements of particular organs of the human body.

CLASS II.—CONSTITUTIONAL DISEASES.—*Cachectici.*

The diseases of this class are sporadic; they are sometimes discovered to be hereditary; they are rarely confined to one part, but before death ensues they affect several organs, in which new morbid products are often deposited.

The *first* order of *Diathetic diseases* includes gout, dropsy, cancer, mortification.

The *second* order of *tubercular* diseases includes scrofula, tabes mesenterica, consumption, and hydrocephalus.

CLASS III.—LOCAL DISEASES—*Monorganici.*

There are sporadic diseases, in which the functions of particular organs or systems are disturbed or obliterated with or without *inflammation* and its products: some of the diseases are hereditary.

The diseases of the brain, spinal marrow, and nerves, form the first order (1), under the designation of the diseases of the nervous system, or, more briefly, brain diseases. The diseases of the organs (2) of circulation, (3) of respiration, (4) of digestion, and (5) of the urinary, (6) reproductive, (7) locomotive, and (8) integumentary systems, constitute eight orders of local diseases.

[The division into general and local diseases is found to work well; as functional disorder is more easily discovered than the precise nature of the lesions of internal organs which are rarely examined after death. The evidence may be sufficient to show that there is disease in the brain, or the chest, or the intestines, but may not enable the observer to determine whether it is or is not the result of inflammation. Such cases are classed as "diseases of the brain," &c.]

CLASS IV.—DEVELOPMENTAL DISEASES.—*Metamorphici.*

The *fœtus in utero*, the infant prematurely born, the infant in the act of birth, or shortly after birth; the child in the first or second teething; the boy or the girl at the age of puberty; the woman in childbirth, or at the critical age when the reproductive function ceases; the person of advanced age—are all liable to peculiar disorders, which in certain instances are causes of death, and are in the common nomenclature designated "still-birth," "premature birth," "infantile debility," "malformation," "teething," "chlorosis," "childbirth," "climacteric disease," "old age." We place all the cases in this class apart, and join with them atrophy or asthenia, and what is sometimes called "premature old age," in which the nutritive process is interrupted, without other evident disease. They are all the incidental attendants on the formative, reproductive, and nutritive processes; or the results of undetected diseases at the periods of life when those processes undergo great changes.

CLASS V.—VIOLENT DEATHS OR DISEASES.—*Thanatici.*

All the preceding diseases are modified, and some are induced, by external agents, but the present class comprises the evident results of physical and chemical forces acting on the organisation. Burns, asphyxias, wounds, poisonings, stings, are types of the several sub orders of this class.

Fire, asphyxia, mechanical forces, poisons, stings, induce specific diseases, which present a regular succession of phenomena, and should in all cases have names. Thus, as it is the "burn" and not the fire that is the cause of death, so it is the disease to which "arsenic" gives rise, rather than the arsenic, that we should register.

Human agency plays so important a part in this class, that it might be made the basis of the division into orders. Thus a man may die (1) a glorious death in battle (*pro patriâ mori*); he may die (2) by an act of homicide (murder, manslaughter); he may die (3) ignominiously on the scaffold (execution); or, (4) abandoning the post in which God has placed him, he may take away his own life (suicide); (5) he may die by a surgical operation; and (6) he may die by *accident*.

If this grouping be adopted, the mode in which death is produced by wounds, chemical injuries, poisons, asphyxias, and mechanical forces, would form secondary heads.

At the instance of the Registrar General, instructions have been prepared under the several heads of the *Nosology*, for the use of medical men and coroners in England. In the several countries of Europe similar instructions would be required, and might be modified so as to meet the peculiar circumstances of each nation.

The most important point to attend to in the instructions is the registration of the *secondary diseases* which intervene in the course of other diseases, and the record of the duration of every fatal disease.

To render the analysis of the *causes* of *death* complete, it will be necessary to subject a certain number of them to a *second analysis*: showing, for example, the various ways in which *childbirth* is fatal, the circumstances in which *fatal accidents* occur, the cases of *measles* that terminate in *bronchitis* or *pneumonia*, of *scarlatina* that pass into *dropsy*, and the *duration* of each fatal case. These analyses would be interesting chiefly to medical statists.

I have thus sketched in outline the classification of diseases from the statistical point of view, and have arranged them all under the five groups of Epidemic diseases (zymotici or demici), Constitutional diseases (cachectici), Local diseases (monorganici), Developmental diseases (metamorphici), and diseases that are the direct result of violence (thanati).

The general statist will gain a notion of the three first classes, by comparing them with the disorders arising in a most elaborate machine —from electrical, magnetic, or chemical action, and from the wear and tear of its particular parts. The fourth class is exemplified by defects of construction and by general decay. The fifth class is represented by the act of breaking the machine to pieces, disintegrating its parts, and putting an end to its movements, which when once stopped cannot be recommenced.

By studying the causes which are injurious and fatal to men in our countries and in our cities, statists will contribute to the removal of evils which shorten human life and to the improvement of the race of men, so that citizens of civilized States may be made to excel barbarians as much in strength as they do in the arts of peace and of war.

In the words of Bacon, "If physicians [and we may add governments] " will learn and use the true approaches and avenues of nature, they may " assume as much as the poet saith—

> " *Et quoniam variant morbi, variabimus* [illegible];
> " *Mille mali species, mille salutis erunt.*"

(16th Annual Report, App[illegible], pp. 7[illegible])

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Now, when it is considered how multitudinous and complex the causes are, not of the one phenomenon, but of the many phenomena of death, for death has its many phases as well as life, it can scarcely be surprising to find that out of nearly half a million of deaths no causes were assigned in eight thousand or more instances. In 4,630 cases no causes were specified; in 3,506 cases it is only inferred that the deaths were sudden, as in them inquests were usually held.

Through the co-operation of the medical practitioners of England and Wales the majority of cases are certified on forms supplied by the Registrar General. In London about 93 per cent. of the deaths are certified, as far as the causes are concerned, by the medical attendants, 5 by the coroners, leaving only 2 in 100 uncertified. Out of 1,578 deaths in London recently analysed 26 were uncertified, of which 4 only are recorded where the deceased had no medical attendant. One of the counties, Northampton, taken at hazard, yielded this result; out of every 100 deaths 91 were certified, 7 were uncertified; 2 died without medical attendance. In some few counties many of the people get no qualified medical advice during life, the medical man lives at great distances, or the people, ignorant themselves, apply for relief to irregular practitioners, men sometimes of natural ability, but often possessing no claim to confidence, except that founded on boundless faith in their own nostrums, which perform the same amazing miracles now as were performed in the dark ages by relics, charms, and exorcisms.

It must be stated, moreover, that the causes of death assigned are often inadequate, and frequently erroneous. A person is dead. What was the cause of his death? is the question addressed to the medical attendant. He has all the information to guide him in his answer that he employed during life in the treatment; but that may be insufficient. Some few years ago "dropsy" would have been returned, and was accepted in medical science as a disease, a cause of death. It is still used rightly in some cases. But many cases are traced back further; the dropsy is found (1) to be associated with albuminous urine, and affections of the kidney, such as Bright's disease; or (2) it is the result of retarded circulation from organic disease of the heart; or (3) it is *ascites*, an effusion into the peritoneal sac from obstructed circulation through the liver; or (4) it is hydrocele, perhaps from injury; or (5) it is ovarian dropsy; or (6) it is a consequence of scarlet fever; or (7) it is anæmic; or (8) it comes on suddenly with fever; or (9) it is general and associated with scurvy. Now after the first step is made in defining the seat and source of the "dropsy" we have got at one link of the chain of causes. The dropsy of scurvy, or anæmia, may be traced to famine, or to insufficiency of some elements of diet; that cause is primary. Then the scarlet fever is the cause of the dropsy; but what is the cause of the first disease? how was the dead child infected? Ascites, the cirrhosis of the liver, may be traced to alcoholism as its primary cause; or the heart disease may be derived from rheumatic fever. And the rheumatic fever may be be the result of exposure to malaria of a specific kind. Now in many cases the primary cause can, but in many cases it cannot, be discovered. Yet to be able to prevent death, the primary cause is of first importance, as it sets the rest in motion.

There are affections of the brain, of the chest, and of other internal parts, which can be distinguished by the pathologist on actual inspection, but not otherwise; while other fatal functional derangements cannot, under the most favourable conditions, in some cases be connected with

any changes in the material structure of organs, even with the help of the best available instruments.

Observers, with excellent intentions, are not always competent, or do not devote the required time to their investigations. Their means of observation are sometimes restricted; they only see the patient for a few moments in his last hours; or for a few minutes at a public dispensary; while from children the subjective symptoms cannot be gathered.

Where the organic injury is evident in the dead body, and is the proximate cause of death, the inquiry after the first cause only commences. Thus a man is found dead in the road in blood, with a wound through his head; that was lethal; but with what instrument was the wound inflicted? A pistol. Who fired the pistol? The man now dead, or another man? Himself. Then was it an accident or a suicide? What were the motives of suicide? Another man. Is the manslayer a soldier fighting, or a duellist? or is he guilty of murder, manslaughter, or justifiable homicide? In a railway accident the question "who is "to blame?" involves "what was the cause," what were the circumstances of the overthrow or collision?

On inquiries into the causes of this class the great tribunals of European justice are occupied. To these causes of death by the violence or malice or recklessness of men importance is everywhere attached. But the causes of the whole deaths of a nation partially inquired into everywhere have nowhere been published, except in England. The English returns are at present, it is to be regretted, unique. And while they are avowedly incomplete, as the chain of causes is not always traced, and the true cause is sometimes mistaken, I hope to be able to show that the returns are of use in their imperfect state, that they require improvement in the present day, and that they are of incalculable interest to mankind.

It is true that 48,634 persons died at the age of 75 and upwards in the year, and thus attained advanced ages; 650 lived to the age of 95 and upwards; of whom 70 lived a hundred years and upwards, which is the term of human life. But how fared it with the multitude? 134,187 persons died in ripe manhood at the age of 25 and under 65 years: while 242,325, under the age of 25, were cut off and perished in childhood and youth! Of the total recorded deaths only 392 were referred to homicide; and paramountly important as the deaths from this cause unquestionably are, occupying too so large a portion of our juridical force, and testifying as the reduced number does to law and police efficiency, it brings out with still greater force the magnitude of the sacrifices of life from other agencies. What these agencies are is assuredly well worth careful inquiry. Death is inevitable, but why is life cut short? Why do the people of England live only a mean lifetime of 41 years?

Biology includes in its sphere of research death, which like birth is common to man and to every living thing; so the extension of that science will shed light on the causes of death. The laws of life involve the laws of death; and every forward step of the biologist will open new fields in vital statistics. In the meantime the existing knowledge admits of so many practicable applications as to justify us in asking for its extension by all the means of accurate observation. It places at the disposal of men now an incalculable control over the duration and happiness of their lives; and it opens to the future a prospect of discovering not indeed elixirs of life, not secrets of earthly immortality to any individual, but protection against many of the dangers which beset the human race.

Science will naturally advance, and the extension of skilful practitioners to the remoter parts of the country will supply good observers. To them we must trust. Where death happens in such circumstances as render it impossible to obtain a satisfactory certificate from a medical man in attendance, the cause, I submit, in the interests of science and of human safety should be investigated by a medical officer specially appointed in each registration district.

One important step has been taken by a committee nominated by the Royal College of Physicians, who have drawn up a complete nomenclature of the pathologicial causes of death. This will be distributed among the practitioners of the United Kingdom, and will thus facilitate the identification of that great class of causes. Synonymes are given in the Latin, French, Italian, and German languages.—(30th Annual Report, pp. 207–10.)

History of the Registration and Classification of Causes of Death, 1837–75.—I propose now to state briefly how the causes of death have been returned by the Registrar General, and what changes have been made in their classification since the year 1837. In 1839, when the first Report was written, this was the state of things—The registers had a column headed in conformity with the schedule of the Registration Act "cause of death," which had to be filled up by information supplied by the coroners, and the informants, who were seldom medical men. Upon the application of the Registrar General the Presidents of the Colleges of Physicians and Surgeons and the Master of the Society of Apothecaries pledged themselves to this effect: "to give, in every "instance which may fall under our care, an authentic name of the fatal "disease." They invited all authorised practitioners throughout the country to follow their example; and to attend to an explanatory statement which, among other things, earnestly recommended them "immediately after death" to place in the hands of the qualified informants "written statements of the cause of death," and to use "the "popular or common name of the disease whenever the popular name "will denote the cause of death with sufficient precision." In every case of inquest on any dead body, the Act says "the *jury* shall inquire "of the particulars herein required to be registered concerning the "death, and the *Coroner* shall inform the Registrar of the finding of "the jury, and the Registrar shall make the entry accordingly."

Upon examining the registers for the last half of the year 1837, I found that they contained an ample treasury of facts, recorded more or less in conformity with the instructions. The nomenclature was in an unsettled state; and the knowledge of the "causes of death" was imperfect. To take the inquests first: the juries instead of assigning the causes of death evaded the question; they used such phrases as "accidental death," "visitation of God," "natural causes," and other terms equally vague. They had not the necessary knowledge, in cases of sudden death, to return the cause of death, even where that cause might have been evident enough to the medical jurist; and the coroner could not instruct them. The coroner of the old school was quite unfit for the new duties imposed upon him by the Act. He had little or no knowledge of medical jurisprudence, and where the knowledge was possessed there was a tendency to copy the old language of routine sanctioned by the law books. The causes of violent deaths were carefully studied, and commented on in the Statistical Nosology (1842). In the Sixth Report, the returns of all the violent deaths of the year 1840 were analysed, distinguishing suicides, murders, manslaughters, and executions from deaths called accidental; and further, the deaths by lightning, by poisons, by burns, by asphyxia, by drowning, and by mechanical injuries of various kinds inflicted by animals, carriages, railways, manufactures, and mines. The report was sent by the Registrar General to the Coroners of England with a letter calling their attention to the new duties which had devolved upon them under the Registration Act, and offering suggestions to be submitted to the juries so as to render their findings conformable with the Act. The "questions" it was shown "to be proposed in reference to every case of death ascribable "directly to external causes are threefold: (1) was the death caused "by *human agency*? did the person die by his own hands or by the "hands of other persons? or was his death accidental? (2) What was "the *instrument, force*, or *thing* by which death was caused? (3) What "was the *nature* of the *fatal injury* inflicted upon the body?" The first is essentially the legal, the second the hygienic, the third the medical point of view. The *time* and the *place* have also to be distinguished. Then it is shown by examples that the causes of death cannot always be assigned in a vague word or two; several particulars have to be sought out, and those to be selected which are likely to point to fatal agencies and prevent their recurrence in future. Since that year the causes of violent deaths have been returned, at one time for groups of years but recently every year, in elaborated tables, of which the tables in the present report are examples. Thus much has been done, but much remains to be achieved under an improved organisation of the coroner's inquest.

The other deaths were returned in large numbers by the medical attendants, who as a body entered cordially into the spirit of the circular that was addressed to them by the heads of the profession. But they laboured under some difficulties. They were often called in late when the diagnosis was difficult; and in many remote regions the physician had not visited the sufferers from chronic disease for some days before death. Then there are many cases of disease obscure even where an autopsy has been instituted; and in the great majority of cases this method of verification was denied either by the reluctance of friends or by the indifference to pathology of the older class of practitioners. England is, I believe, the only country in which legal provision is made for qualified medical attendance on the sick poor; but this provision is sometimes neglected, and persons of all ages, more especially children and old people, are not attended at all, or are attended in their last illness by quacks and unqualified practitioners. The state of the returns and the difficulties of nomenclature are referred to in my first letter to the Registrar General, and it is evident that, imperfect as the returns were and as the knowledge was on which they were based, the facts bearing so directly on human life were of incalculable importance.

In the year 1845 the Registrar General supplied all the qualified practitioners of England with books of blank certificates; and he instructed the registrars not to recognise the certificates of men who held no authentic diplomas. There was space for both primary and secondary diseases, against which their duration was also entered in the certificate. The "certified" cases were distinguished in the registers. The introduction of this system of medical certificates had an excellent effect; it improved the whole character of the returns; and since the year 1847* it has been in use with some improvements in its form.

* The causes of death were abstracted for the years 1837-8-9-40-1-2. The improvement due to the certificates was so apparent in 1847 that the new series was commenced at that date. It might not be without some use to abstract at a future time the returns for the years 1843-4-5-6, which preceded the great cholera epidemic of 1848-9.

The grant of the certificates was voluntary. The new Act of 1874 (37 & 38 Vict. cap. 88.) enforces the grant of the medical certificate by penalties. The form of certificate is embodied in the regulations.

The recorded causes of death are exceedingly numerous; and it often happened that the same cause was returned under different names, which will be found in the alphabetical list at the end of the Nosology. Some classification of these causes was necessary, and I at first tried Cullen's classification, and then endeavoured to use Mason Good's, but found that neither of them would work. It was impossible to arrange the diseases as returned under the classes and orders of the existing classifications. In casting about for a classification, it struck me that it should have special reference to the causation and prevention of death; and that would be most effectually accomplished by making three distinct groups of (1) deaths by epidemic, endemic, and contagious diseases; (2) deaths by sporadic diseases; and (3) deaths by evident external causes. This classification was framed, and used in forming the abstracts of causes of death for 1837.

After more than three years experience I discussed the principles of nosological nomenclature, and drew up the statistical nosology on the same basis as before, but with some extensions and improvements.

(1.) The first group of EPIDEMIC, ENDEMIC, AND CONTAGIOUS DISEASES is thus defined: "*This class comprises diseases which have "been observed to be epidemic, endemic, or contagious. The "blood is probably, in the greater number of them, the primary "seat of disease; and they may be considered, by hypothesis, "the results of specific poisons, of organic origin, either derived "from without or generated within the body.*"

(2.) The second group consists of SPORADIC DISEASES OF UNCERTAIN OR VARIABLE SEAT. "*This class consists of diseases of variable "seat, or diseases in which the nature of the morbid product "and action is, as in cancer, of more importance than the part "affected.*"

(3.) SPORADIC DISEASES OF SPECIAL SYSTEMS AND ORGANS form the third group. "*This class* consists of *congestions, inflamma- "tions, the results of inflammations in certain parts, and "mechanical or functional diseases.*" The sub-groups comprise deaths by diseases of the nervous system, of organs of circulation, of respiratory organs, of digestive organs, of urinary organs, of organs of generation, of organs of locomotion, of integumentary system.

(4.) The fourth class consists of deaths directly referable to EXTERNAL CAUSES: POISONING, ASPHYXIA, INJURIES.

This classification was in use with little alteration until I was requested by the International Statistical Congress, in conjunction with Dr. Marc d'Espine, to frame a project based on this resolution, passed at Brussels: "*Il y a lieu de former une nomenclature uniforme des causes de décès applicable à tous les pays.*"* My report was presented to the Congress convened by the French Government at Paris, and appears in the appendix to the Registrar General's 16th Annual Report (published in 1856). Profiting by experience and by criticism, I carefully revised the English classification, and submitted it in proof to the most eminent physicians, surgeons, and statists of England, Scotland, and Ireland, to whom I was indebted for many valuable suggestions. The causes of

* For the classification recommended by the Congress, see Compte Rendu de la deuxième session du Congrès International de Statistique, Première annexe, pp. 349–359, Paris, 1856. (See also pp. 250–5 of this volume.)

death were thus definitively divided into five classes; and the classes were further sub-divided into twenty-three new orders.

The order corresponds with the Family of Natural History. I did not think it desirable to go further so as to follow the Linnæan analogy of double names for genera and species, but to stop for statistical purposes at single names for single diseases, without distinguishing the varieties.

The causes of death were abstracted with distinction of age and sex so early as 1847, and in the 18th Report (pp. 120–123, 150–176) a table is given of the numbers of deaths of males and females in each of the seven years 1848–54 from the several causes classified. The causes of death for England, with the same distinctions, were given for the year 1855; and they were given in every subsequent report. Previously to 1847 the causes of death were given without distinction of age for divisions and for counties or for groups of districts.

During the course of years some changes, and I believe improvements, were made in the classification. The deaths by violence were distributed under the five orders of accident, battle, homicide, suicide, and execution, and under the sub-heads of fractures, gunshot wounds, wounds, burns, poison, drowning, suffocation, and hanging. Some new or newly discovered diseases were introduced, such as diphtheria (separated from scarlet fever in 1855), puerperal fever (separated from childbirth in 1847), want of breast milk (classed before with atrophy and debility); typhus, enteric, and simple continued fever were first distinguished in the returns of 1869, having been previously returned under the head of typhus. The returns necessarily follow the leading of the heads of science at a distance; amd formerly the enteric or typhoid fever was confounded with typhus by many practitioners. Glanders was separated from erysipelas in 1855. Cancrum oris (noma) appears as a separate head in 1847. Some few diseases were transferred from order to order. The 33rd Report gives the series of returns complete for the years 1838–42 and 1847–70 as regards 113 heads, according to the recent classification; and those changes are, when it is necessary, explained in notes which should be consulted by all who have occasion to use the facts for the earlier years.

Besides the 113 diseases and injuries, there are about 153 others quite distinct in their nature, but of rare occurrence; so to facilitate the labour of classifying the 546,453 deaths from 266 causes, under seventeen different ages, the abstract sheets were so arranged that temporarily the rare diseases were written in the margins, and the tick by which the case was denoted was at the same time made in the line devoted to some allied disease, of which the numbers were not much disturbed by the addition. Then at the end of the year the deaths by these extraneous diseases were published in a separate Table. This series appears in the Reports for 1855–74.*

In the present report the diseases all appear in their proper place in one table; and those that have been introduced, printed in italics, are generally bracketed together under the cause with which in the shorter series they are grouped.

Although it has not been deemed right to go to the expense of publishing separately the causes of death for males and females at several ages in every district of England and Wales, the abstracts for each separate district are kept for reference in the library of the General Register Office.—(38th Annual Report, pp. 225–30.)

* This Supplementary List was continued in the Reports till that for 1880 (inclusive), after which the classification was revised, and the Supplemental List was absorbed in an extended list of diseases. A full list of the changes of classification introduced in 1881 will be found in the Registrar-General's 44th Annual Report, pp. xxix–xxxiv. (Editor.)

Medical Certification of Causes of Death.—Under 6 & 7 Will. 4. c. 86. s. 25. the medical attendant of a deceased person in the last illness, is bound to give information, if applied to within eight days, with respect to the cause of death. For the convenience of members of the medical profession, and to promote the accuracy and uniformity of returns, books, consisting of blank forms of certificates were issued in 1845 to all physicians, surgeons, and apothecaries legally qualified, and practising medicine in England. These forms have therefore been in use for fifteen years; and it must be admitted, that the working of the system has, on the whole, been attended with much success.

With a view to ascertain the measure of that success, Tables have been prepared, and appear at the end of this Report, showing the number of cases in the three months ending 31st March 1858 in which the cause of death was certified by the medical attendant or the coroner, or was *not* certified; and the results are exhibited in divisions, registration counties, and sub-districts.

In the quarter of the year, as stated, 125,819 deaths were registered in England and Wales; and of these, 99,040 were certified in respect to the *causes* by medical attendants; 5,023 by the coroner; 7,275 were *not* certified from want of medical attendance; and 14,481 were not certified from neglect, or for some reason the nature of which is seldom indicated in the register. Or, to make the proportions more clear, out of 100 deaths registered 79 were certified by medical attendants, 4 by coroners, 6 were not certified because not attended medically, and 11 not certified, the reason being not usually assigned. For these 11 out of every hundred, certificates would not be received by registrars, in some cases on account of difficulties of communication which many parts of the country present, in some cases in consequence of neglect, in a few on account of that perverseness or contumacy that is peculiar to some individuals. But in an immense majority of instances the medical profession has shown that willing co-operation which might be expected from a highly-educated and public-spirited body of men; and in most of those cases in which the machinery fails, it is at least doubtful whether a more stringent penal enactment would not be inoperative.

In London the working of the system is as successful as could be desired. Out of 100 cases, 92 were certified by medical attendants, 5 by coroners (97 in all); 1 not certified because there was no medical attendance, and 2 not certified for reasons not assigned. Next to the metropolis are the South-eastern and South Midland Divisions, where 90 and 89 respectively were certified by *medical men and coroners.* In the Eastern and North-western, medical and coroners' returns were in the proportion of 85 per cent.; in the West Midland 82; in the South-western 78; in Yorkshire and the Northern Counties 77; in the North Midland 72; and in Monmouthshire and Wales only 61.

In Liverpool and West Derby, out of 3,841 death, 3,558 were certified by medical attendants, 156 by coroners; in all 3,714. In Manchester, out of 1,755 deaths, 1,370 were certified by medical attendants, 87 by coroners; in all 1,457. In Liverpool and West Derby it was stated that in the quarter 58 persons had no medical attendance in their last illness; in Manchester the number of persons deprived of that advantage was so great as 181.

In Yorkshire as many as 10 persons out of a hundred who died had no medical attendance; in the Welsh Division at least, 12 out of the same number were not medically attended.—(21st Annual Report, pp. 212–13.)

Compulsory Medical Certification of Causes of Death.—Hitherto the grant of certificates of the cause of death by the registered medical practitioners of England has been purely voluntary, and the Registrar General has to thank the medical profession for the hearty co-operation he has received from them in the administration of the Act. In the Births and Deaths Registration Act of 1874 (37 & 38 Victoria) the Legislature has inserted the subjoined clauses:

Certificates of Causes of Death.

20. With respect to certificates of the cause of death, the following provisions shall have effect:

(1.) The Registrar General shall from time to time furnish to every registrar printed forms of certificates of cause of death by registered medical practitioners, and every registrar shall furnish such forms gratis to any registered medical practitioners residing or practising in such registrar's sub-district:

(2.) In case of the death of any person who has been attended during his last illness by a registered medical practitioner, that practitioner shall sign and give to some person required by this Act to give information concerning the death a certificate stating to the best of his knowledge and belief the cause of death, and such person shall, upon giving information concerning the death, or giving notice of the death, deliver that certificate to the registrar, and the cause of death as stated in that certificate shall be entered in the register, together with the name of the certifying medical practitioner:

(3) Where an inquest is held on the body of any deceased person a medical certificate of the cause of death need not be given to the registrar, but the certificate of the finding of the jury furnished by the coroner shall be sufficient.

If any person to whom a medical certificate is given by a registered medical practitioner in pursuance of this section fails to deliver that certificate to the registrar, he shall be liable to a penalty not exceeding *forty shillings.*

And under the penalty clause (39) it is enacted that "Every person "who refuses or fails without reasonable excuse to give or send any "certificate in accordance with the provisions of the said Acts (Regis-"tration Acts, 1836 and 1874) shall be liable to a penalty not exceeding "forty shillings for each offence."

Thus under the Amendment Act every registered medical practitioner in England is bound, under penalty for refusal, to give "a certificate "stating to the best of his knowledge and belief the cause of death." This will only bring a salutary pressure to bear on the few practitioners who neglect to give such certificates as have hitherto been given freely by their brethren.

Where the persons deceased have not been attended by registered medical practitioners, and there has been no inquest, there is no provision to secure the certification of the cause of death in the Act; but this defect may be met to some extent, for under clause 44 the Registrar General, with the consent of the Local Government Board, is empowered "to make regulations for prescribing any matters "authorised by this Act to be prescribed, and to revoke and alter such "regulations.

In England every poor person, unable to pay for medical advice, can obtain the services of a poor law medical officer gratuitously, so that the day may not be distant when nearly every person dying will be attended by a registered medical attendant.

At present a certain number of educated practitioners holding good degrees are not on the register; and hitherto their certificates have been received by order of the Registrar General, who did not wish to bring any undue pressure to bear on them. But to comply with the new Act it will be desirable for them to register, as only certificates of *registered* practitioners are recognised under the above clause.

The refusal of certificates from quacks and pretenders will enlighten the public, and distinguish the qualified practitioner from the unqualified.

In several foreign states every dead body is visited by a medical inspector, who inquires into the cause of death, and grants a certificate, without which the burial cannot take place. As a measure of police this has some advanteges. But under the Amendment Act the medical attendant is consulted, and is entrusted by the State with the duty of returning the cause of his patient's death; he performs in death from disease the office which the coroner executes in sudden deaths, or deaths from violence; and this arrangement, while it is most satisfactory to private families, is less costly, is probably most agreeable to the practitioner, and supplies more authentic information than could be procured from any other source.

Sometimes the medical practitioner falls into the error of the coroners of old, and omits some essential fact in the associated links of the cause of death. It is importunt to avoid this mistake. For example, measles is often followed by pneumonia, and other *sequelæ;* now measles is the primary cause of death in such a case, but it is rendered fatal by the supervention of pneumonia, which is one of its developments. The cause of death is, therefore, properly returned "measles, pneumonia." So when scarlet fever is followed by fatal dropsy, the scarlet fever as well as the dropsy is properly returned. By error, death has been by some practitioners ascribed solely to pyæmia, peritonitis, or hæmorrhage, whereas these secondary diseases have sprung from precedent childbirth, which should never be suppressed.*

It is true that the disease of which a person dies is at times unknown; the medical practitioner has had inadequate means of observation; he may be imperfectly skilled in advanced diagnosis; or the symptoms may be indistinct, complicated, and only explicable by autopsy. In such cases the certified cause is vague; but it does not follow that the whole series of returns subject to such imperfections is useless. If the attainable though imperfect knowledge of disease suffices for the purposes of medical practice, it cannot be worthless for medical statistics.—(35th Annual Report, pp. 221–3.)

Causes of Death in Inquest Cases.—The intention of the inquest was to discover crime, with a view to its punishment and prevention; and in the imperfect state of science at that time "sudden death" was fixed on as a prima facie ground for inquiry. Now it is well known that many spontaneous diseases take away life suddenly; and that in some of the most atrocious murders by arsenic, by antimony, and by cruelty, death is slow in its approaches. The mere fact that death is sudden is a ground for medical inspection, but not necessarily for an inquest; and there are many violent deaths of which a medical inspector may ascertain the causes without moving the apparatus of the inquest, there being no more suspicion of crime in such cases than there is in deaths from fever, pleurisy, or consumption.

With the extension the inquest had attained it left the causes of about 466,560 deaths—of 95 per cent. of the total number in the year—unexplored; yet it is now ascertained that vast numbers of these deaths are referable to negligence; or to causes which admit of removal by hygienic treatment, and by sanitary regulation. To take one class of causes only found to prevail with the greatest intensity in the dense population of towns,—it can be shown that with the present distribution

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* *See* note on p. 226. (Editor.)

of population by age, the mortality in many healthy districts is below, and in none above, 17 annual deaths to 1,000 living: and at this rate the deaths in England and Wales would have been 392,151 in the year. The actual deaths registered were 492,265. Hence it follows that at least 100,114 deaths were the results of causes not everywhere,—not necessarily in such fatal operation. The mean lifetime of people living in the least unhealthy districts of the kingdom is 49 years; in all England 41 years; thus life is abridged by full 8 years. The half of an English generation is cut off before the forth-sixth year is attained; and we have seen how small a fraction of the loss of life is the result of intentional homicide. After judicial inquiry, only 125 death are referred to this head, whereas full 100,000 deaths due to violations of natural laws call for inquiry, with the prospect of success in the discovery of causes still prevailing, which are as fatal as the serpents, wild beasts, and savage criminals of past ages.

The attempt to extend the inquiry into the causes of death was made in London in the sixteenth century, after the College of Physicians was founded by Linacre. The fatal plagues impressed the minds of statesmen, but to one of the companies of the city of London is due the credit of publishing the first weekly bills of mortality. It was not, however, until 1837 that the inquiry into the cause of death was instituted in every case of death under the Registration Act. Then the Registrar General engaged the medical colleges to afford him their assistance on the ground of its scientific utility, the "Cause of Death" having been inserted in the schedule of the Bill by the House of Lords, and accepted by the House of Commons, after its importance had been urged by no less a body than the British Association. A Certificate Book first issued by the Registrar General in 1845, to legally qualified medical practitioners, a statistical Nosology, and a letter to the coroners completed the administrative machinery under which the results of the inquiry into the causes of death are recorded.

Without entering into metaphysical disputes on casuation, it is evident, that to be of practical use, the cause of death recorded must be as clearly defined as possible, and that the verdicts of juries should express the exact essential facts, and not vague generalities.

The inquest is a most valuable institution, and, under the intelligent coroners of the country, we may hope to see henceforward the true causes of the deaths into which they inquire set forth in systematic completeness, as under the Act 6 & 7 Will. 4. c. 89. they have the power to call in a medical expert, and to direct him to perform a post-mortem examination, with or without a chemical analysis. The new Registration Act relies entirely on the jury, instructed by the coroner, for a return of the cause of death, whenever an inquest is held.—(35th Annual Report, pp. 220–1.)

Mortality from Phthisis and from Diseases of the Respiratory Organs.—Phthisis differs essentially in its pathological products, in its complications, and in its fluctuations, from bronchitis. For example, the mortality by bronchitis is immediately doubled, or trebled, by a depression of the temperature of the air, while the deaths by phthisis exhibit little variation. But these diseases are often confounded; and the distinction between chronic bronchitis, or the bronchitis of miners, and consumption, was even recently not obvious to many practitioners. Under these circumstances what significance is to be attached to the fact that the mortality per 1,000 by bronchitis ranged from ·822 to ·978 in the three years 1850–2; and from 1·558 to 1·648 in the four years 1860–63; while the mortality by pneumonia and pleurisy slightly declined; and the mortality by phthisis ranged from 2·624 and 2·826 to 2·511 and 2·611? Is it to be inferred that there has been an actual decrease of death by consumption, and an increase of death by bronchitis? Is the effect of the treatment by cod liver oil in phthisis visible in the returns?

If we divide the 14 years into three periods, as in the following Table, it will be observed that the mortality ascribed to phthisis decreased from 2·811 per 1,000 to 2·574; while the mortality by lung diseases increased from 2·769 to 3·309; by phthisis *and* lung diseases the mortality in the two periods ranged from 5·580 to 5·883.

AVERAGE ANNUAL RATE of MORTALITY to 1,000 living from PHTHISIS and LUNG DISEASES in ENGLAND, for the Three Periods 1850–54, 1855–57, and 1858–63.

YEARS.	LUNG DISEASES.	PHTHISIS.	PHTHISIS and LUNG DISEASES.	
			TOTAL.	INCREASE in the PERIODS.
(5 Years.) 1850–54 -	2·769	2·811	5·580	—
(3 Years.) 1855–57 -	3·103	2·683	5·786	0·206
(6 Years.) 1858–63 -	3·809	2·574	5·883	0·097

To carry the analysis further, the ages of the dying from phthisis and bronchitis must be distinguished; and this is done in the next Table, which shows that phthisis reigns from the age of 10 to 55, and after 65 gives place to bronchitis. The mortality per 1,000 by phthisis among males of the age 15–25 was 3·28, 3·12, and 3·10 in the three periods; among females 4·00, 3·93, and 3·76. Again, at the age 25–35 the mortality of males by phthisis was 4·04, 3·93, and 3·94; of females 4·68, 4·51, and 4·46. The decrement is not considerable, but as age advances it becomes greater; it is greater too in the first 5 years of life.

AVERAGE ANNUAL RATE of MORTALITY per 1,000 from PHTHISIS and by BRONCHITIS in ENGLAND and WALES, 1848–63.

AGES.	In the 7 Years 1848–54.		In the 3 Years 1855–57.		In the 6 Years 1858–63.	
	Phthisis.	Bronchitis.	Phthisis.	Bronchitis.	Phthisis.	Bronchitis.
	MALES.					
All Ages -	2·70	1·01	2·54	1·35	2·45	1·58
0–5 - -	1·69	2·65	1·35	3·51	1·07	4·42
5–10 - -	·65	·12	·50	·14	·47	·16
10–15 - -	·87	·04	·75	·05	·67	·05
15–25 - -	3·28	·08	3·12	·09	3·10	·09
25–35 - -	4·04	·17	3·93	·21	3·94	·22
35–45 - -	3·95	·42	3·96	·55	3·92	·59
45–55 - -	3·91	1·07	3·74	1·33	3·72	1·51
55-65 - -	3·59	2·59	3·29	3·33	3·23	3·79
65–75 - -	2·69	5·89	2·44	8·01	2·05	8·76
75–85 - -	1·11	10·27	1·01	14·63	·83	16·14
85–95 - -	·60	13·80	·45	21·05	·53	22·76
95 and upwards	·26	10·47	—	12·63	·44	23·57
	FEMALES.					
All Ages -	2·92	·91	2·75	1·26	2·62	1·46
0–5 - -	1·61	2·26	1·32	3·00	1·05	3·78
5–10 - -	·73	·12	·60	·16	·56	·17
10–15 - -	1·44	·05	1·24	·05	1·21	·05
15–25 - -	4·00	·09	3·93	·09	3·76	·09
25–35 - -	4·68	·16	4·51	·22	4·46	·21
35–45 - -	4·18	·34	4·10	·45	3·98	·50
45–55 - -	3·21	·85	3·07	1·12	2·93	1·26
55–65 - -	2·71	2·18	2·41	3·16	2·16	3·51
65–75 - -	1·94	5·25	1·57	6·97	1·36	8·34
75–85 - -	·93	9·06	·73	13·25	·60	14·79
85–95 - -	·53	11·87	·46	17·65	·32	20·46
95 and upwards	·42	13·51	·33	15·08	·30	21·32

The great increase of the mortality of bronchitis is at the age after 65; but at the age 45–55 the increase is noticeable. The increase in infancy is also considerable.

The mean temperature of the three periods differs little; in the first and last periods it was equal or 49°·4. The year of lowest temperature, 1853, in the first period was 47°·7; in the last period, 1860, it was 47°·0.

AVERAGE ANNUAL RATE of MORTALITY from PHTHISIS and BRONCHITIS in ENGLAND and WALES, 1848–63.

AGES.	AVERAGE ANNUAL RATE OF MORTALITY TO 1,000 LIVING.					
	In the 7 Years 1848–54.	In the 3 Years 1855–57.	In the 6 Years 1858–63.	In the 7 Years 1848–54.	In the 3 Years 1855–57.	In the 6 Years 1858–63.
	MALES.			FEMALES.		
All Ages -	3·71	3·89	4·03	3·83	4·01	4·08
0–5 - -	4·34	4·86	5·49	3·87	4·32	4·83
5–10 - -	·77	·64	·63	·85	·76	·73
10–15 - -	·91	·80	·72	1·49	1·29	1·26
15–25 - -	3·36	3·21	3·19	4·09	4·02	3·85
25–35 - -	4·21	4·14	4·16	4·84	4·73	4 67
35–45 - -	4·37	4·51	4·51	4·52	4·55	4·48
45–55 - -	4·98	5·07	5·23	4·06	4·19	4·19
55–65 - -	6·18	6·62	7·02	4·89	5·57	5·67
65–75 - -	8·58	10·45	10·81	7·19	8·54	9·70
75–85 - -	11·38	15·64	16·97	9·99	13·98	15·39
85–95 - -	14·40	21·50	23·29	12·40	18·11	20·78
95 and upwards	10·73	12·63	24·01	13·93	15·41	21·62

By grouping the deaths from bronchitis and phthisis together, as in the above Table, we obtain this singular result: the mortality at the ages 5–35 declined; at the ages 35–55 the increase of mortality was scarcely perceptible; at all the ages after 65 the increase was considerable.—(26th Annual Report, pp. 186–8.)

Puerperal Mortality, 1847–54.—The word "births" in these reports is used to express the number of children born alive; and as some children are still-born, while others are born two, three, or four in succession, at one childbearing, the "births" do not express exactly the number of childbearings or *accouchements*.

The exact danger of childbirth to the mother is found by dividing the number of mothers who die by the number of childbearings. Now, excluding the still-born, the number of childbearings is obtained by reducing the births in nearly the proportion of 1 to ·9902; but taking the still-born into account the proportion of live-born children must be nearly as 100 to every 102·531 mothers bearing children in the year.*

* In 1852 the single births were 611,829; the twins were 12,072, representing 6,036 childbearings; the triplets were 111, representing 37 childbearings; thus representing 617,902 childbearings in the aggregate. Consequently, to 100 births there were 99 childbearings, or at 100 childbearings 101 children were born. This is exclusive of the *still-born*. In France the births were 1,925,624, or, including the *still-born and those dying before the registration of birth* ("morts nés et morts avant la déclaration de naissance, c'est a dire, dans les trois jours de la naissance), 1,993,891. To every 100 live born there are 3·545 *still-born* or dying before registration; for the above numbers are in the ratio of 1 to 1·03545. But ·9902 × 1·03545 = 1·02531; and if we apply these ratios to the above facts it will follow that every 100 children born alive imply that 102·531 mothers have been delivered of one or more *live-born* or *still-born* children. But a further correction is required for the children born alive who die before registration: the still-born will probably not exceed 3 to 100 live-born.

The subjoined Table shows that in the year 1848 *sixty-one mothers* died to every 10,000 children born alive, and that since that year the mortality has progressively declined to *forty-seven* in 10,000. This is a gratifying result, and there can be no doubt that by further care and skill the annual deaths (3,009) in childbirth may be largely reduced.

DEATHS of WOMEN in CHILDBIRTH in the Eight Years 1847–54.

YEARS.	Number of Deaths from			Deaths of Mothers to 10,000 Children born alive.
	Metria and Childbirth.	Metria.	Accidents of Childbirth.	
1847 - -	3,226	784	2,442	60
1848 - - -	3,445	1,365	2,080	61
1849 - -	3,339	1,165	2,174	58
1850 - - -	3,252	1,113	2,139	55
1851 - -	3,290	1,009	2,281	53
1852 - - -	3,247	972	2,275	52
1853 -	3,060	792	2,268	50
1854 - - -	3,009	954	2,055	47
8 Years, 1847–54 -	25,868	8,154	17,714	54

		Children born alive.	Estimated Number stillborn.	Born alive or dead.
1852	Births - -	624,012	22,122	646,134
	Childbearings	617,902	21,906	639,808

	Aggregate.	Average annually.
The total live-born children in 8 years (1847–54) were	4,761,278	595,160
" " 7 years (1848–54) "	4,221,313	603,045

On an average of 8 years to every 10,000 children born alive 54 mothers died; so about 53 in every 10,000, or nearly 1 in 189, accouchements were fatal.

What is the mortality in England of *women at different ages* by childbirth? This is shown in the subjoined Table, from the observations of seven years, 1848–54.

MORTALITY OF WOMEN BEARING CHILDREN at different Ages, in the Seven Years 1848–1854.

Age of Mother.	Deaths of Mothers to every 100 Childbearings.			Deaths of Mothers in Childbirth to every 100 Women living.			*Deaths to 100 Women living, from Childbirth and from all other Causes.
	By Metria and other Accidents of Child-birth.	By Metria.	By other Accidents of Child-birth.	By Metria and other Accidents of Child-birth.	By Metria.	By other Accidents of Child-birth.	1848–54.
15–25	·668	·277	·391	·041	·017	·024	·861
25–35	·425	·148	·277	·098	·034	·064	1·090
35–45	·633	·154	·479	·098	·024	·074	1·296
45–55	·883	·163	·720	·009	·002	·007	1·622
15–55	·530	·172	·358	·064	·021	·043	1·135
Cols.	1	2	3	4	5	6	7

By disregarding the decimal points, the Table shows the proportion of deaths to every 100,000 : thus,—to every 100,000 *Childbearings* at the age 15–25, 668 women died by metria and other accidents in childbirth; 277 by metria alone; and 391 by other accidents of childbirth; to every 100,000 *Women living* at the same age, 15–25, the proportional number of deaths were 41; namely, 17 from metria, and 24 from other causes. The mortality from Childbirth and from *all other Causes* at that age to every 100,000 females living, was 861.

What is the danger of death by childbirth among women of different ages *who bear children during the year?* This is a different question; which is of practical importance, both in medical science and in the business of life insurance. The defect in the English schedule, which as yet contains no column for the ages of the parents of the children registered, renders it impossible to answer this question with precision. It will, however, be useful to obtain an approximate answer; and this we have been able to give, by determining the probable proportion of women who bear children at each age from the Swedish returns; and by applying the fraction expressive of this proportion to the English women living in 1851 at the corresponding age, the probable number of them who become mothers every year is determined. The total number thus determined for the year 1851 is 609,845; while the actual average number of the births in the seven years by the returns was 603,045. It is thus evident that the estimate differs to no great extent from the facts; and it may be assumed that the births, corrected for twins, triplets, and still-born children, in England, would represent nearly 609,845 child-bearings.

* The mortality from all causes in the 7 years 1848–54 is increased in consequence of the two cholera epidemic years 1849 and 1854 being included in this average.

It will be observed that in seven years 3,232 mothers died annually of childbirth; 1,052 by metria, and 2,180, or twice that number, by other causes. Nearly the whole of the deaths occur among women of the ages 15–45; a few also die of childbirth at more advanced ages.

On comparing the numbers in columns 4 and 7, it will be seen that among women of the age 15-25 the annual rate of mortality per cent. by all causes is ·861, of which the 1-21st part (or ·041) is by childbirth; at the age 25–35, and 35–45, the annual rates of mortality per cent. by *all causes* were 1·090 and 1·296; of which ·098 and again ·098 were wrought by childbirth. Thus at the age 25–35 *one* in 11 deaths from all causes is by childbirth; at the age 35–45 *one* in 13 deaths by all causes is by childbirth. At the age 45–55 when childbearing is rare, the general rate of mortality is 1·622, and the proportion by childbirth is ·009, or one in 180 deaths from all causes.

These numbers are affected not only by the changing rates of mortality in childbirth and in other diseases, but by the various numbers of women at different ages bearing children; thus at the age of 15–25 only one woman in 16 bears a child in the year, and at 45 and upwards the proportion is inconsiderable; while at the age 25–35 *one* in every 4 women bears in the year, and at 35–45 the proportion by the Swedish returns is about *one* in 6. (*See the following Table.*)

CHILDBEARINGS at Four Periods of Life in SWEDEN (1830–35).

Age.	WOMEN living at Two Enumerations 1830 & 1835.	CHILDBEARINGS in Five Years 1831–35.	Proportional Numbers.	
			Of 100 Women living the Numbers bearing Children annually.*	Women living to One Annual Childbearing.
1	2	3	4	5
15–25	515,257	79,225	6·15	16·26
25–35	428,718	248,589	23·19	4·31
35–45	383,771	148,610	15·49	6·46
45–55	298,047	7,189	·96	103·65
15–55	1,625,793	483,613	11·90	8·40

* This column is derived by multiplying the number of childbearings in the five years 1831–5 (col. 3) by 100, and then dividing by $2\frac{1}{2}$ times the women living at the two enumerations 1830 and 1835 (col. 2).

It will be seen by column 2 of the Table (*see* page 271) that the mortality among 100 women in childbirth at the four periods of age is ·668; ·425; ·633; and ·883. Thus the danger of dying in childbirth is greater (·668) at the age 15–25 than it is (·425) at 25–35. It is in this early age that a large number of the *first children* are borne by their mothers; and these first births are for various reasons attended with peculiar hazards. The pregnancy of young women, consequently, in the present state of midwifery, involves the risk of dying expressed by ·668 in 100 cases, while the risk of dying in a year from all other causes at the same age (15–25) is ·820=·861—·041. Now if the woman remain as amenable to other diseases as other women, the mortality rate in her case becomes ·820 +·668=1·488; or is increased in the ratio of 5 to 9.

In the same way it may be inferred, on the same hypothesis, that the rate of mortality from ***childbirth*** and ***all other causes*** within the year is 1·417 at the age 25–35; 1·831 at the age 35–45; and 2·496 at the age 45–55.

The mortality in child-bearing is least (·425) at the age 25–35, when more than half of the annual children are borne by their mothers; it rises to ·633 at the decennial period (35–45), and to ·883 at the last period of all. The rates of mortality at the three periods are in nearly the same ascending ratio as 2, 3, and 4; that is, the ·633 is nearly a half more than ·425, and ·883 is a third more than ·633. The rates of mortality at intermediate years can be interpolated; for the calamitous death of mothers in childbirth is governed by a mathematical law.

It may be probably assumed that the child-bearing women of a population are, in the language of the Insurance Offices, "select lives," at least "select" in a certain sense; but it can only be determined by further researches whether they are less or more liable than other women to be attacked or to die by the diseases not incidental to childbirth. It is only well known that when they are attacked by zymotic diseases, such as cholera and small-pox, they succumb in unusually high proportions.

By taking all these considerations into account, the actuary will now be able to calculate from the foregoing Table the premiums that cover the risk of childbirth at different ages; and the physician will, from the same facts, see how much his art has to accomplish before the 3,000 English mothers who perish annually in giving birth to their offspring can be saved. Natural and adventitious difficulties are in the way, but they may in many cases be overcome; for "in sorrow" and not in death "thou shalt bring forth children," is the law of nature.

The death of young women in child-bearing points to some of the dangers to be guarded against; and many of the remaining dangers would be removed by a class of educated nurses. (17th Annual Report, pp. 72–4.)

Registered Puerperal Mortality, and Mortality in Lying-in-Hospitals.—Childbirth is of course a physiological process, and under favourable conditions, where the mother has been previously taken proper care of, is attended with little danger. Unfortunately English mothers do not escape scatheless; nor can this be expected under existing circumstances; 3875 mothers died during 1870 of the consequences of childbirth. But there is evidence of improvement. In the four years 1847–50 no less than 59 mothers died to every 10,000 children born alive; in the four years 1867–70 the deaths had sunk to 45.

The error of collecting poor lying-in women into hospitals has been discovered, and to some extent discouraged; medical men have adopted wiser measures; they have taken greater precautions against infection, and midwives have been better taught. Still there is great room for improvement.

A large proportion of the mothers of England have been, from time immemorial, attended by midwives: and this is an excellent and natural arrangement, as midwifery is a business for which intelligent women are admirably fitted. Until lately it was assumed that midwives were born not made, their professional education was wholly neglected, or left to chance, and it still rests on an unsatisfactory footing, although efforts have been made to impart systematic instruction in some quarters.

The midwife should be taught all the mechanical part of the art, and be thoroughly initiated into the practice of health-keeping, she would then be in a position to render her sex essential service.

I may be permitted here to make a few observations on the accuracy of the registration returns of deaths in childbearing. It is connected with a controversy, which has been waged with some warmth, and its settlement is of the first importance.

Seeing how destitute of comforts, means, and medical appliances many women are, the thought occurred to some benevolent person that they might be received and delivered in hospitals. It was the extension of the hospital system to midwifery cases, which have some analogy with wounds and injuries for which hospitals have been used from the date of their foundation. Contrary to expectation the advantages these institutions offered were over-balanced by one dread drawback, the mortality of mothers was not diminished, nay, it became in some instances excessive, in other instances appalling. The inscription—*Lasciate ogni speranza voi ch'entrate*—would have been as appropriate over their open doors as it was over the gloomy underworld of the great Italian poet. "I could adduce a mortality of 1 in 3 in a certain period of the " history of a great hospital," says no unfriendly writer that I shall soon quote, who shows that in the Dublin hospital the deaths of mothers are in the proportion of 1 to 100 delivered, which he appears to consider the normal rate. Le Fort, who has assiduously collected the extant statistics, asserts, as the general result of his inquiries, that "the " mortality of women delivered at home is 1 in 212, and that the mor- " tality of women delivered in hospitals is 1 in 29." This a very distinguished physician, Dr. J. Matthews Duncan, M.D., F.R.S.E., pronounces "a terribly erroneous statement," in a book written expressly on the "Mortality of Childbed and Maternity Hospitals."*

Dr. Duncan first criticises Le Fort's statement that 1 of every 29 women delivered in a maternity dies. He does not question the fact that "taking the data of all maternity hospitals together, Le Fort finds " that 1 of every 29 delivered has died." But he questions the value of the fact in the argument. If the maternity of a hospital like La Charité "is so badly managed as to have a mortality of 1 in 7, what does " that show with a view to the question of the mortality of childbed " generally, or in hospitals as compared with that in houses?" asks Dr. Duncan.† For myself I am inclined to attach a much greater importance to these facts than Dr. Duncan does: they at least show that the mortality in the aggregate of lying-in hospitals as hitherto constructed and managed, is as high as 1 death of a mother in 29 delivered, and some of them go the length of justifying Dr. Duncan's statement: "*I dare say an hospital could be so constructed and managed as to " kill all the inmates!*" Dr. Duncan argues that these exceptional cases should be set aside, that only well conditioned maternities should be selected for argument, adding "it is well known that the best mater- " nities are susceptible of vast improvements." So the case against lying-in hospitals is over-stated according to this eminent writer, who then proceeds to demolish the other branch of the argument, namely, that based very much on the English registration returns, according to which only one mother died to 214 children born alive. The chances by these returns in favour of a mother surviving are thus 213 to 1.

The English deaths are not all returned by medical men, but 92 in 100 of them are so returned all over the country, and in London the proportion is 98 in 100, so that practically the facts are certified by the

* Edinburgh, 1870. † Duncan, p. 15.

medical practitioners of the country. The certificate book, with which every legally qualified practioner is supplied, contains this instruction: "*Whenever childbirth has occurred within one month before death,* "*it should be registered in connexion with the cause of death.*"

There may be an indisposition in some cases to record the child-birth as the cause, but there is no reason to believe that practitioners have generally shrunk from the performance of their duty. Dr. Duncan, however, is of a different opinion. "To show what sources of error in "the registrar's reports are hidden from observation, I shall," he says, quote from Dr. Barnes a passage bringing one to light from a single locality.

"It is stated in the Registrar General's report for 1856, that the "mortality in childbirth in England and Wales in 1847 was 1 in 167, "and that it had fallen to 1 in 227 in 1856. Now, having applied to "Dr. Elkington for the puerperal statistics of Birmingham, I learn that "the registrar of that town says, that 'no one ever specifies the deaths "in childbed or from puerperal fever.'" *

Dr. Barnes is one of the ablest physician accoucheurs of the day, and one of the most authoritative writers, it is not therefore surprising that this statement has been repeatedly cited since as decisive of the value of the registration returns by the medical practitioners of the Kingdom. Dr. Duncan, the scientific author of one of the best works on fecundity, stamps the passage with his express approval.

Let us look at this passage, shorn of the halo of authority, and it comes to this, that Dr. Barnes learnt from Dr. Elkington of Birmingham that the registrar of that town said, that "no one ever specifies the "deaths in childbed or from puerperal fever," and this is adduced to "confute a statement in the Registrar General's report for 1856." It is very easy to be accurate, or to verify a plain statement such as the above, but it is, as we all know, still easier to be inaccurate, and to accept a loose random statement as true. Strangely enough we find in the very report quoted this fact, that in the Birmingham district where nearly all the causes of death are returned by the medical practitioners, they returned in the year 1856 *five* deaths from puerperal fever, and *seventeen* from other causes connected with childbirth.†

Thus the reproach on the veracity of the medical certificates of Birmingham is swept away, and the superstructure of argument on this sandy foundation Dr. Duncan himself will probably be contented to "throw aside out of view." It must be admitted that it scarcely bears the light. Than Dr. Barnes and Dr. Duncan no one can better appreciate scientific accuracy, but so pertinacious is error, so extensive has been the circulation of this passage, that unless they themselves consent to call in their false coin it will remain in circulation for an indefinite period. During the year 1870 the births in Birmingham were 8673, and according to the registration returns 36 mothers died of childbirth.

Dr. Duncan draws a proper distinction between deaths *in* childbirth and deaths *of* childbirth. "Deaths *in* childbirth," he says, "are all "deaths, from whatever cause, occurring within the four childbed "weeks, including the period of labour."

This distinction is necessary, and is drawn in the registration abstracts. Pregnant women are subject to diseases like other women; they may be killed by accidents, and may be attacked by small-pox and scarlet fever, which in them almost invariably prove fatal. Women suffering from phthisis or heart disease, or other chronic diseases, bear

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* From Dr. Duncan's Mortality of Childbed and Maternity Hospitals, p. 12.

† *See* p. 190, and p. 168.

children, and in the abstracts the deaths are referred to these fatal causes, to which, rather than to incidental childbirth, their deaths are attributable. Thus, in addition to 3875 deaths from puerperal fever and the various accidents of childbirth, 719 women died soon after childbirth, 231 of small pox or some other zymotic diseases, 138 of phthisis, 101 of heart disease; 41 women who were returned as pregnant, probably in the early states, also died of various diseases.

A certain number of such cases find their way into lying-in hospitals, but not I imagine great numbers, as many of the cases of heart disease, phthisis, and so on will be treated in general hospitals, workhouses, or at home. If we add the 719 to the 3875 the proportion of deaths in childbirth to children born alive is 1 in 172; while the proportion of deaths directly referable to childbirth itself is 1 in 204 in the year 1870.

To ascertain the degree of error in the returns, those made for the London Weekly Tables during six weeks were scrupulously examined; confidential inquiries were made in every doubtful case of the medical attendants, with this result: that only *one* doubtful death by childbirth was not so returned as to be easily distinguishable; 66 were properly returned. All the cases of death from peritonitis, hæmorrhage, and the like diseases in women of the childbearing age were inquired into; only one of these was a death by childbirth, 5 were cases where the women were in the early stages of pregnancy (not admissible into lying-in hospitals), or had miscarried, and the rest were ordinary cases of disease in women not pregnant. The births during the six weeks were 12,814; taking the deaths of mothers corrected at 67 the proportion was one death in London to 191; while taken at 66 it is one death to 194. Stated otherwise, the deaths distinctly returned were in the proportion of 5·15 to 1000 children born alive, whereas by the correction they become 5·25 distinctly referable to childbirth and not to other diseases under which a certain number of pregnant women die.

Dr. Duncan had a careful search made in the Scotch registers of deaths in Edinburgh and Glasgow, and found that 153 mothers died out of 16,393 within six weeks after delivery; or one in 107. He also deduces from certain returns of private practice a rate of mortality among mothers not very different from this. And from all his researches Dr. Duncan draws this inference, that "*not fewer than one in every* 120 *women delivered at or near the full time die within the four weeks of childbed.*"

Upon this I may remark (1.) that this represents the danger of childbearing as much greater than it is according to popular or medical repute; it is at the rate among childbearing mothers of ·833 per cent. per month, or at the rate of 10 per cent. per annum: about 10 times the ordinary rate of female mortality at that age, and equal to the rate among men in the worst climates. This is given as the average of all deliveries; and as Dr. Duncan has well shown that the first delivery is the most dangerous, such a rate, if general, would represent marriage and childbearing as a most perilous ordeal for a young woman to encounter.

(2) Is it not possible that childbirth may be more dangerous in Edinburgh and Glasgow, where the general mortality is high, than it is in all England; and is it by any means certain that the cases of death happening in the six weeks after 16,393 deliveries in these cities are sufficient to represent the experience of those cities, to say nothing of all Scotland, or of all England. It would imply also—differing as it does from the returns of deaths due to childbirth—a degree of inaccuracy in the returns of the causes of death in the two cities for which we are scarcely prepared.

(3.) With regard to the published deaths in the private practice of eminent accoucheurs is it not possible that there may be a natural selection against their success? Eminent accoucheurs are in many instances called in because the case is expected or found to be unusually difficult, dangerous, or requiring the use of instruments. Thus, when Sir James Simpson reports that at a certain time he lost four cases in at most 180 deliveries, we may be sure that this mortality of 1 in 45 is something exceptional. The circumstance that the facts are few is sufficient of itself to suggest selection. Accordingly we find that J. Clarke reports the loss of 22 mothers by death on 3847 deliveries, Dr. Churchill of 16 on 2548.

(4.) By Dr. Le Fort's Tables the death-rate among 934,781 women delivered at home was 1 in 212, or nearly 4·7 per 1000: which differs little from the general English rate.

(5.) While in the 11 large English towns the mortality rate is 4·9, in the 64 healthy country districts it is 4·3 in 1000.

(6.) As a set off against these cases of excessive mortality in the private practice of eminent accoucheurs, I may cite the returns with which I have been favoured by Mr. G. Rigden, M.R.C.S., an able conscientious practitioner in Canterbury, personally known to me, who has kept records of all his cases, and prepares the statistical health reports of that city. The analysis of 4132 consecutive cases in midwifery yields as the result of his observation 9 deaths: 3 from convulsions and coma, 4 from puerperal fever, 1 from heart disease, and one from a cause not stated. He, as a general rule, is a fortnight in attendance, within which period his observations are strictly confined; but he believes that in no instance did any other death occur within the month, as he must have heard of and recorded it.

Upon all these grounds I feel justified in questioning the deduction of Dr. Duncan. I have shown that the anecdote on which he reasons to invalidate the accuracy of the medical certificates of English registration is a fiction; I have shown that in London the returns bear the strictest examination; nor is this direct evidence rebutted by citing evidence as to other classes of facts of a different nature. Where is the logic of reasoning such as this: Drs. A., B., and C. lost in the limited sphere of their practice, a high proportion of mothers delivered by them; in Edinburgh and Glasgow a much higher proportion died in the six weeks after childbirth; *therefore* the normal mortality in childbirth is high, and therefore the English registration certificates are untrue, indeed suppress the fact of the connection of death with delivery in nearly half the cases. Excluding such cases as death by small-pox, phthisis, and other fatal diseases not connected with childbearing, and correcting for defective specification, I am disposed to set down the mortality at present prevailing in England at not more than 5 deaths of the mother to every 1000 deliveries: or of 1 to every 200 deliveries.

Still-born children may occasion death in childbirth, so that a correction should be made for their exclusion, and a correction of another kind is required for the births of twins and triplets to get the exact mortality of women in childbirth. Our tables in their crude form show the proportion of mothers dying to children born alive; the necessary corrections I have discussed in former reports.

If the lying-in institutions have at all suffered by comparison with the national returns, by including deaths not due to childbirth, it is their own fault; they should register the facts, and analyse them more accurately. If that is done I do not conceive that Dr. M'Clintock's figures will be borne out drawn from home practice, representing the deaths among the inmates from non-puerperal diseases as 34 to every 97 from childbirth itself.

Miss Nightingale, in her notes *On Lying-in Institutions,* after discussing the whole question, has given on page 75 a good form of register which the institutions would do well to adopt, as it would supply all the information required for the statistical analysis of their cases. Miss Nightingale's book was evidently suggested by the failure of the effort the committee of the fund made to establish a training school for midwives in King's College Hospital. She shows that, with every care, 27 poor women, or 1 in 29, died out of 781 delivered, and she shows besides the reason why. Her second chapter, on the "Constitution and Management of a Lying-in Institution" and training school for midwives and midwifery nurses, is not only well worth studying but carrying into effect. For so destitute are some poor creatures, that either in such separate institutions, or in workhouses, they must have help; and this necessity may be turned to account in a training midwifery school. (33rd Annual Report, pp. 406–11.)

Puerperal Mortality, and Mortality in Maternity Charities.—In treating of the mortality from childbirth we have to consider several cases. *Two lives* are at risk, and the following are the four possible combinations of their fates:—

(*a.*) The mother (m) and child (c) generally survive - mc
(*b.*) The mother survives (m), the child (c^1) dies - mc^1
(*c.*) The mother dies (m^1), the child (c) lives - - m^1c
(*d.*) The mother dies (m^1), and the child dies (c^1) - m^1c^1*

There is generally one *child* at a birth; but there may be two, three, or more; and they may be still-born, or die immediately after delivery, or die in the first month (called *chrisomes* in the old Bills of Mortality).

The *mother* usually survives; but in a few rare cases she dies during, or soon after, delivery, the child surviving or dying.

The cases of still-born children are not returned to this office, and the registers do not enable us to distinguish the deaths of mothers or children in the three classes (*b., c., d.*). In rare instances the mother dies and the child survives. In the still sadder case mother and child are entered together in the same *black book.*

I have every year specially dwelt on the causes of death in childbirth for two reasons; firstly because the lives themselves are at the most precious age, and secondly because skill can do more here in averting danger and death than in other operations.

In the 30 years (1847–76) no less than 106,565 mothers died in childbirth; that is, 5 to every 1,000 children—*one* to every 200 children—born alive. The proportions varied from year to year; 42

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* From the returns of the Royal Maternity Charity it appears that 9019 ($m + m^1$) mothers were delivered; 8,998 (m) surviving, 21 (m^1) dying; while 9,117 ($c + c^1$) children were born, of whom 8,832 (c) lived, 285 (c^1) died, including 244 still-born, 41 live-born. Then before delivery we have these four probabilities:—

mc ·96648 mother and child will live;
mc′ ·03119 mother will live and child die;
m′c ·00226 mother will die and child survive;
m′c′ ·00007 mother and child will die;

note that $(m + m^1)(c + c^1) = 9019 \times 9117$ is the divisor of the numbers from which the probabilities *mc,* &c. are derived.

Thus the probability that the mother will live, is ·96648 + ·03119 = ·99767; will die, is ·00233. The probability that the mother will live and the child will die is ·03119. The probability that the child will live is ·96874; that it will die is ·03126. Mother and child survive in 966 deliveries out of 1,000; mother lives, child dies in 31; mother dies, child lives in 2 cases; in only ·07 mother and child die. In the case of two or more children, the problem is somewhat more complicated.

mothers died in 1857 and 69 in 1874 to every 10,000 children born alive, and these were the extreme limits. In the year 1876 the mortality of mothers was 47.

This is a deep, dark, and continuous stream of mortality. How can it be accounted for? In the present state of obstetrical science a certain number of deaths from divers causes is inevitable. There are cases which foil the most consummate skill. Then there are difficult cases which defeat the ordinary practitioner, and the instructed midwife. But great numbers of midwives have never been instructed and have never mastered their art so as to deal with intricate cases. The Obstetrical Society of London shows in its valuable Report that in the country villages from 30 to 90 per cent., in the small towns of 10,000 inhabitants 5 to 10 per cent., of the cases are attended by midwives. Perhaps as large a proportion is attended by midwives in the large manufacturing towns as in the villages. In the east end of London also from 30 to 50 women in 100 delivered are attended by midwives; in the west end of London few.*

In answer to the question "Are the women instructed in midwifery," the Committee of the Society on Infant Mortality says, "Answers in "the negative have been received from all parts of the country, with "the exception of Glasgow and Sheffield." From "several districts "the replies indicate not merely a want of any special education, but "gross ignorance and incompetence, and a complete inability to contend "with any difficulty that may occur." The Committee notices that in London many women are practising who have received a certain amount of instruction at various institutions. Thus a very large number of the mothers is attended by midwives; some instructed in practice, others incompetent to deal with ordinary cases of difficulty. A large proportion of the mothers is attended by physicians, surgeons, and apothecaries; some at the head of their art in Europe, and others skilful or unskilful in various degrees. Dr. Pitman, Registrar of the College of Physicians, says, "To the best of my belief the College included "midwifery as one "of the subjects of its examination as early as 1518." The Licentiates of the London Apothecaries Company have been examined in midwifery since 1830.† There appears to have been a general, but not a special, examination in midwifery by the examiners in both the College of Physicians and the Hall; at the College of Surgeons the midwifery license is a distinct qualification from that of membership. It is granted by the college under a clause in the Charter of the 18th of March 1852. The license was conferred for the first time on the 1st of December 1852.

There is no examination in midwifery for the membership.

The midwifery examinations, the nature of which is published by the College, "are still in abeyance arising out of the difficulty in obtaining "examiners." Thus a registered M.R.C.S., without any other qualification, has passed no examination in midwifery. Many are in large and successful widwifery practice; others, it is to be feared, must labour under disqualifications disadvantageous to themselves and their patients.

Under this state of things *four thousand six hundred and ten* mothers died in childbirth annually in the five years 1872–6. What number of these lost lives, have we any reason to believe, would have been saved

* 34th Report of Registrar General, pp. 225–6.

† Mr. Wheeler, the Secretary of the Society of Apothecaries, states that in consequence of a correspondence between the Obstetrical Society, Sir Robert Peel, and the Company in 1829, the next printed regulations enjoined two courses of midwifery during the second year of study.

had all been watched over by skilful midwives acting under skilful physicians?

I must here notice two remarkable institutions which have furnished returns that will enable me to answer this question. The Royal Maternity Charity was, as I have said, founded in 1757. It had in 1876 two physicians and 22 midwives (located in different parts of London) who delivered in that year 3,069 married women at their own homes. The midwives are instructed by the Charity's Lecturer, Dr. J. Hall Davis. 2,952 of the women were "delivered by the midwives themselves;" in 117 cases the physicians were called into consultation, either from complication in the delivery, or from serious illness before or after labour.* The cost was not more than 9*s.* a case. On an average a midwife delivered 134 women in the 365 days; at average intervals of less than 3 days (2·7 days); she may also have private practice. The midwives are superannuated when old. There is an auxiliary fund managed by visiting ladies; who are authorised to expend about 5*s.* in each case of need. "It was painful to hear from the midwives, 'they "report,' of the lamentable and destitute condition in which some of "the patients were found." Others were in better circumstances.

Now the deaths of mothers to 9,019 delivered by the Royal Maternity Charity in the three years 1875–7 were 21. The mortality was at the rate of 2·33 to 1,000 deliveries. Dr. Roper, M.D., one of the physicians of the Charity says, "Our maternal mortality is as correct as possible, "because whenever a patient is taken ill after confinement, her case is "followed up either to recovery or death."†

The Birmingham Lying-in Charity was founded when the *Lying-in Hospital* of that town was broken up, and has similar rules to those of the London Maternity Charity. The mothers are attended at their own homes by four instructed midwives, acting under a Consulting Medical Board. 8,607 mothers were delivered in ten years, of whom 20 died. The mortality was at the rate of 2·32 deaths to 1,000 mothers delivered, or as nearly as possible the same as in the London institution. The midwives are not allowed to practise privately; and they must be fully employed, as each of the four midwives delivered about 215 women annually. The physician was called in one time in sixty. Precautions are taken against the spread of puerperal fever. The Birmingham Charity has the merit of publishing a very interesting statistical report.

At the rate of mortality among the patients of these two charities in London and Birmingham, the annual deaths by childbirth in England and Wales would have been 2,009; the *actual deaths* registered *were* 4,610; so that 2,601 mothers *perish annually through* the want of such an amount of care and skill as the midwives, acting under the consulting physicians of the two charities, bring to bear in their attendance.

Some allowance should be made for the circumstance that these charities only undertake to attend *wives*, and that they have apparently fewer than usual of mothers bearing their first children (*primiparæ*). Upon the other hand, these mothers are often poor; and I have a further careful return of 4,390 cases in the private practice of Mr. G. Rigden, of Canterbury, where the deaths were 9 in 4,390 deliveries, or 2·05 per 1,000.‡ Other private practitioners, keeping equally accurate accounts, could no doubt supply results equally favourable.

Childbirth is not fatal in itself, but by reason of certain supervening diseases or injuries, which should as well as "childbirth" be always

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* Report of Charity for 1876, p. 25.

† Letter dated March 25th, 1878.

‡ *See* Registrar General's 33rd Annual Report, p. 412; an extract from which will be found on p. 277.

stated in the medical certificate of the cause of death in conformity with the instructions in the medical certificate books in the hands of all registered practitioners. In the five years 1872–76, of the 23,051 deaths in childbirth, 10,498 were referred to *metria* (puerperal fever), 8,400 to specified diseases or injuries, and 4,153 to causes not specified, and therefore imperfectly certified.

The number of liveborn children registered in 1876 in the United Kingdom was 1,155,186; of whom about 173,278 belonged to the middle and upper, and 981,908 to the lower, classes of society. Certain additions should be made for the cases of stillborn children. But assuming that 30 per cent. of the mothers registered were attended exclusively by medical men, 687,336 will remain among the lower class to be attended by midwives. In towns a midwife in full practice may attend 100 cases a year, or one every 3 or 4 days on an average; but one case a week (52 in the year) will be a fair average, so at least 10,000 instructed midwives will be required. At the Census of 1871 only 3349 midwives, such as they have been above described, are returned: 31,180 women were returned as nurses.

It has been wisely decided by the University of London to confer the same medical degree on women after the same examination as men. So it is not now a question of sex. The M.B. or M.D. is proved by examination qualified as far as that goes to practise medicine in its obstetric as well as other branches. But we may accept the practical proposal of the Obstetrical Society to license and register midwives not versed in the full knowledge of medicine, but competent to deal with all the ordinary cases of labour. They could follow their calling at a rate of remuneration which it would be well worth the while of the working man to pay; and in cases of complication call in the help of the experienced physician. The local examination by competent boards might be in the large central or county towns. The register could be conveniently kept, with the Registrar-General's sanction, by the Superintendent Registrars; and the licensed midwives would be authorised to certify the births of the children they bring into the world.

What is wanted besides examinations are good local schools, founded on the admirable system now in operation in London and Birmingham. The Royal Maternity Charity was founded in 1757, when, under the administration of a great minister, the population of England took a start which has continued up to the present day. This institution does not appeal to the imagination, but its utility, economy, and simplicity commend it to the minds of practical statesmen. The Duke of Wellington became its President in 1818, the year after the Princess Charlotte died, and remained its President until the year of his death (1852). He was "a liberal contributor to its funds, and a judicious dispenser of its "benefits." The Duke saw its importance; midwifery had given him his Guards. It would have been difficult to get the Duke to preside over some of our sensational societies, but he at once saw that the mothers of workmen and soldiers had claims for skilful help at their homes in the sorrows of labour. It was a plain good thing that appealed to his mind. Who will perfect the work?

Two things are wanted in every great centre; (1) a society to set midwives to work under an obstetrical practitioner charged with their instruction and guidance; to be followed by (2) a Self-supporting Society among the independent third class, who would thus provide themselves all the skilful help in childbirth their means will enable them to command. The results will amply repay the contributions. (39th Annual Report, pp. 241–51.)

Mortality from Alcoholism.—The deaths ascribed to *alcoholism* or to alcoholic drinks deserve close attention ; they are of two kinds, (*a*) deaths by delirium tremens, and, (*b*) deaths ascribed directly under various names* to intemperance. The number of such deaths was 817 in 1849 and 1,120 in 1876. The proportion of deaths from alcoholism to population (*a million*) in the five quinquenniads 1850 to 1874 was 46, 41, 40, 40, 34 *annually;* there was a decided and gradual decline from first to last. The decline was most striking in *delirium tremens* about the nature and cause of which there can be no mistake ; unfortunately in the last two years the old level was attained, not as regards delirium but as regards alcoholism of other kinds. In the three years (1871–3) of high wages in the manufacturing districts the proportion of deaths by alcoholism was low. The deaths by drink rose on the other hand in the three years (1874–6) of depression probably because some sought consolation in drink, because the hours formerly spent in the workshop were spent in the public-house, or because the previous habits then began to bear fatal fruit. The fact remains, independent of any theory, that in three years of hard work and high wages—three years of prosperity—2,230 people died of drink; while in the three years of idleness and reduced wages—three years of adversity—3,316 died of the same causes—delirium tremens and other results of intemperance. This is contrary to a current opinion; and it may be worth while to point out that in the three years of prosperity the annual consumption of spirits in the United Kingdom was less than in the three years of adversity. It was 36 million gallons a year in prosperity, 42 million gallons a year in adversity. The working classes did not throw away their earnings to the extent some have asserted. The savings banks had a capital of 53*l.* million at the beginning of 1871 ; to which 8,610,231*l.* were added in the three years of prosperity, 8,612,236*l.* in the years of adversity, making 70,280,120*l.* held at least to a considerable extent by the working classes.

The ages at which deaths from alcoholism are registered are shown below. They precede the ages at which deaths from insanity are most frequently recorded.

DEATHS from ALCOHOLISM in ENGLAND and WALES, 1871–6.

—		AGES AT DEATH.											
		ALL AGES.	10–	15–	20–	25–	35–	45–	55–	65–	75–	85–	95 and upwds.
3 Years 1871–73 of Prosperity	Males	1,729	–	10	54	337	531	468	248	72	9	–	–
	Females	501	–	–	10	81	153	147	80	24	6	–	–
	Persons	2,230	–	10	64	418	684	615	328	96	15	–	–
3 Years 1874–76 of Adversity	Males	2,484	–	12	81	504	761	610	384	120	12	–	–
	Females	832	–	1	21	138	241	229	137	58	6	1	–
	Persons	3,316	–	13	102	642	1,002	839	521	178	18	1	–

The greatest number of deaths from alcoholism was registered at 35–45, an age when the brain is most active; the greatest number of deaths from insanity at 65–75.

The number of deaths in six years ascribed directly to alcoholism was 5,546, rather more in number than the 5,450 deaths referred directly to insanity. The ages are shown in the following table.

* Alcoholism, intoxication, dipsomania, drunkenness, ebriositas, inebriety, are some of the words occurring in the registers.

DEATHS ASCRIBED to ALCOHOLISM and to INSANITY in ENGLAND and WALES in the 6 Years 1871–76.

AGES.	ALL AGES.	Under 10	10-	15-	20-	25-	35-	45-	55-	65-	75-	85-	95 and upwds.
Deaths from *Alcoholism*	5,546	–	–	23	166	1,030	1,686	1,454	849	274	33	1	–
Deaths from *Insanity* -	5,450	8	5	73	124	473	716	811	1,052	1,295	757	128	8

As insanity induces paralysis, so alcoholism induces diseases to which a certain number of cases of alcoholism are ascribed in the certificates. Cases of delirium tremens are not necessarily fatal, as under judicious treatment many patients recover; and about their diagnosis there is little chance of mistake; for they can only be confounded with rare inflammations of the brain. This distressing disease is thus described in the lectures of Sir Thomas Watson. The picture is true to the life; and should be carefully contemplated.

"Let me remind you in a few words of the peculiar characters of " delirium [tremens]. If you question the patient about his disease, he " answers quite to the purpose; describes, in an agitated manner, his " feelings, puts out his tongue, and does whatever you bid him; but " immediately afterwards he is wandering from the scene around him to " some other that exists only in his imagination. Generally his thoughts " appear to be distressful and anxious; he is giving orders that relate " to his business to persons who are absent; or he is devising plans to " escape from some imaginary enemy. He is haunted by ocular spectra; " fancies that rats, mice, or other reptiles, are running over his bed: " sees spiders crawling on the ceiling, or a horse's head thrust through " the wall of his room. He addresses remarks to strangers whom he " erroneously believes to be present. He looks suspiciously behind the " curtain, or under his pillow, and he is perpetually wanting to get out " of bed; but he is readily induced to lie down again. It is very seldom " that he meditates harm, either to himself or to others; there is rather " a mixture of cowardice and dread with the delirium."*

The few cases of *delirium tremens* induced by shock from injuries, would be referred to those injuries, so that all the deaths under this head in the registers may be accepted as deaths by excessive drinking in some of its various forms.

The effects of great and excessive doses of alcohol are well known; and so are the effects of the excesses of habitual drunkards.

Ramazzini described very clearly the effects of alcohol breathed in small continuous doses in the distilleries of Modena, not in cellars but in open porticoes, where the alcoholic vapour was necessarily diluted. The men who work in this vapour for several months, and generally pass the winter in the distilleries, grow, he says, " lethargic, shrivelled, emaciated, " melancholic, vertiginous with loss of appetite."† The next step leads us to the effects of drinking between meals through the day, which is also injurious, as is shown in the high rates of mortality among publicans and wine merchants. The effect of total abstinence has not yet been studied on a large scale, except so far as to show that no evident evil ensues, and that many under the regimen are perfectly

* *See* Lectures by Dr. Thomas Watson on the Principles and Practice of Physic, Vol. I., p. 407.

† Ramazzini De morbis Artificum, Ed. 1717, Genevae, cap. xx.

healthy. I will show here in contrast the rates of mortality among two classes who differ considerably in habits, but have as a rule, ample supplies of the necessaries of life; namely, the clergy and the publicans and others dealing in alcoholic drinks. Now the publicans, and certainly the wine merchants, are not as a *body* "habitual drunkards;" nor drunkards in any sense. There are drunkards among them, but they are exceptional, marked men; what as a class they suffer from must be "taking a glass" at intervals between meals with customers or in late hours alone. How fatal this tippling is the following Table shows.

ANNUAL RATES of MORTALITY per 1000 at Four Ages among CLERGYMEN and PROTESTANT MINISTERS, and among PUBLICANS and WINE MERCHANTS.

AGES.	Clergymen.	Protestant Ministers.	Publicans Beer-sellers, Wine and Spirit Merchants.
25–35	4·65	5·83	14·49
35–45	6·28	7·30	20·44
45–55	13·24	9·33	28·59
55–65	22·70	24·60	43·03

NOTE.—The facts on which these calculations are based are taken from the Supplement to the Registrar General's 35th Annual Report, pp. clxxii., clxxv.

A few clergymen abstain from alcoholic drinks for various reasons; they have not as a body "taken the pledge," but the temperance of the clergy of the day is beyond question, and neither they nor the well-bred classes of society usually drink spirits or wine without solid food. At the ages in the prime of life, Protestant ministers are nearly as healthy as the clergy of the Anglican church.

I may cite many other classes that drink in moderation, such as carpenters, or again, agricultural labourers who drink beer, but whose means are limited, and who in the country are less exposed to temptation. Their mortality does not at all approach that of the publicans and spirit dealers. All scientific observation goes in favour of temperance in drinks.

A Committee of the House of Lords, the Duke of Westminster in the chair, sat to inquire "into the prevalence of Habits of Intemperance, "and into the manner in which those habits have been affected by "recent legislation, and other causes." The report is valuable in its scientific evidence as giving the results of the most recent research. The opinion that alcohol is always eliminated by the organs unaltered is refuted. Experiments upon animals, and man, as for example, "the experiments of Professor Binz, of Bonn," clearly prove, says Dr. Burdon Sanderson, "that there is no disengagement of alcohol by the breath, "unless the quantity taken is above a certain ill-ascertained limit; that "limit is about *two ounces* [of absolute alcohol]. That is to say, that "an ordinary man may take as much as *two ounces* of alcohol, and the "whole of the alcohol will be oxidised."* Qu. 9384. It is to that

* Reckoning 1 part of sherry as 0·20 of alcohol, there are about 2·4 oz. of alcohol in half a bottle of sherry.

extent food; the oxidation produces some of the forms of force. Dr. Brunton asserts that alcohol in small doses increases the gastric secretion, and thereby aids digestion; it is then absorbed into the blood; it increases the action of the heart, and dilates the fine vessels, so that the warm blood from the interior of the body pours over the surface and gives a feeling of pleasant warmth and comfort. In the end as more blood is at the surface when the external air is extremely cold the person may be chilled down and die in consequence of the cooling. Such is Dr. Brunton's view.* That can only result from excess. It is evident that chemistry and physiological reasoning throw much light on the action of alcohol. But experience, which may be held to be a series of experiments, can alone determine the precise effects of food and drink of different kinds on the forces and health of men. Wine and ale contain different kinds of alcohol, æthers, and other organic compounds; but the predominating spirit is æthylic or common alcohol (C_2 H_6 O). "Pure alcohol gives no taint to the breath, and good "alcoholic liquids only leave that smell which belongs to their ethers."† Some of the alcohols are extremely noxious. The wines are subject to changes, which Pasteur calls diseases of wine, and traces to different kinds of ferments.‡ This explains some of the sad effects of bad spirits and wines on the people who drink them. Dr. Parkes shows in his experiments that good claret up to a pint had no sensible effect on the temperature of the interior of the body, but it raised the pulsations of the heart from 76·3 to 80·5. The psychical effect of the claret is not recorded; but 4 to 8 ounces of alcohol in the 24 hours produced torpor and sleepliness.§

Food (1) nourishes the body, replacing waste denoted by urea, and keeps the blood and all the tissues in a suitable fluid, physical condition; (2) it generates heat, which is in proportion to the amount of oxygen consumed—carbonic acid and vapour exhaled; (3) it sets free muscular force; and (4) finally it acts on the mind or generates psychical force. Water, milk, wheat, oats, rice, fruits, meats of various kinds, suffice for the first three purposes; but under the fourth head these elements are supplemented by coffee, cocoa, tea, tobacco, spices, wines, and spirits. They directly affect the brain and nerves. Grape, hop, and barleycorn thus find a place. Their effects are not learnt from chemistry but from the senses, of which the poets of all ages and philosophers are natural expositors.

I will now state my reasons for believing that the present mixed dietary of wines and ales, in due proportion with vegetable and animal food, while it yields the maximum energy of life, is conducive to its duration.

I will first notice a fallacy in some reasonings on the subject. Alcohol in excessive dozes produces death and its effects are traced through the various organs of the body. On such a basis this is the reasoning. Alcohol in given repeated doses is fatal; therefore in every dose it poisons men quickly or slowly according to circumstances. It is always a poison. Test this argument on the active remedies of the pharmacopœia. Take arsenic; in doses of ten grains it kills a man in

* *See* Evidence before Lords Committee. Qu. 9246–9378. It is borne out by the experiments of Binz in the paper cited below.

† Effects of alcohol on warm-blooded animals. By C. Binz, M.D., Journal of Anatomy and Physiology, vol. viii., pp. 233–41. He shows by experiment, as Todd had, that in fever alcohol reduces the temperature.

‡ *See* Pasteur, Maladies des Vins.

§ *See* Proceedings of Royal Society, vols. 18 and 19.

excruciating agony in a few hours. In small doses has it any injurious effect? None whatever. On the contrary, it restores or preserves health. Fowler's arsenical solution cures ague. Sulphuric acid is according to the dose a corrosive poison, or a remedy for the diarrhœa premonitory of cholera. Opium puts out life or simply soothes and sends sufferers to sleep. Chloroform kills *one* patient in a thousand, but it quells pain in tens of thousands and is otherwise harmless, so it is still administered in surgical operations. Excess in meats of any kind induces indigestion; and over-feeding is probably as fatal as over-drinking; yet no one advocates entire abstinence from food; and only vegetarians abstain from animal food; ascetics justly call fasting *mortification*.

Alcohol has undoubtedly a medicinal effect in many maladies; it stimulates the fainting heart after shocks of every kind. Port wine is a potent remedy in fevers; instead of raising it reduces the burning heat of the blood, and calms the delirium of the brain. Alcohol appears to arrest the action of zymotic diseases; as it prevents weak wines from fermenting. Like camphor, alcohol preserves animal matter; this is not now disputed. But may it not do more? May it not prevent the invasion of some kinds of zymotic diseases? I invite the attention of those who have portrayed the bad effects of alcohol to consider whether it does not prevent the action of various infections on the temperate. The neglect of this side of the question throws a doubt on many of their inferences. The deaths ascribed to zymotic disease in 1876 were 96,660, to alcoholism 1,120; now it is evident that any effect depressing the prevalence of zymotic diseases that kill their tens of thousands will save the lives of thousands: the same sanitary improvements that diminish the prevalence of disease undoubtedly diminish intemperance and feverish thirst.

It is a remarkable fact that the official returns show that the mortality of grocers was at every group of ages much higher in the year 1871, after they had begun to retail spirits, than it was in 1860–61; *see* the following table. The deaths from alcoholism among the other classes in that year were nearly the same as they were in 1860–61.

MORTALITY per Cent. of GROCERS, 1860–1 and 1871.

AGES - .	15—	25—	35—	45—	55—	65—	75 and upwards.
Years 1860–1 -	·531	·840	·923	1·280	2·053	4·334	12·488
1871 - -	·592	1·115	1·021	1·466	2·567	5·461	13·442
Excess in 1871 -	·061	·275	·098	·186	·514	1·127	·954

NOTE.—In 1860 an Act of Parliament was passed by which, for a license of 2*l.* 2*s.* or 3*l.* 3*s.*, according to rental, grocers or dealers in other commodities than wines and spirits might sell *wine* in quart or pint bottles in any quantity less than two gallons not to be consumed on the premises; previous to that year the license was 10*l.* 10*s.*, and the quantity was unrestricted. In 1860 also an Act of Parliament empowered licensed dealers in spirits (grocers among others) to take out a license, additional to the 10*l.* 10*s.* license for spirits, authorising them to sell *foreign liquors* in reputed quart bottles or bottles in which the same may have been imported; while a further Act passed in 1861 allowed the sale of Foreign or British Spirits in any quantity not less than one reputed quart bottle. In 1872 the law compelled retailers of wines or spirits to get a magistrate's certificate prior to the grant of a license.

The clergy of the Church of England are quite justified, without insisting on total abstinence, in endeavouring to promote temperance of which they themselves experience the full benefit. The rate of mortality among publicans of 35 and upwards is 3·94 per cent.; among the English clergy it is 2·96. Their duration of life is shown in the accompanying Table in comparison with that of other classes. The

DURATION OF LIFE in various CLASSES of the COMMUNITY, notably in those of CLERGYMEN and PUBLICANS.*

AGE. (x)	MEAN AFTER-LIFETIME IN YEARS AT AGE x.				
	By English Life Table. (Males.)	By Healthy Districts Life Table (Males.)	Of the Clergy.	Of other Protestant Ministers.	Of Publicans.
15 - -	43·2	47·2	—	—	38·0
25 - -	36·1	39·9	42·1	41·6	31·3
35 - -	29·4	32·9	33·8	33·8	25·4
45 - -	22·8	25·7	25·7	26·0	20·0
55 - -	16·5	18·5	18·6	17·9	14·9
65 - -	10·8	12·0	11·9	11·4	10·3

The Table may be read thus:—At the age of 25 the mean after-lifetime of the Clergy is 42·1 years, of Publicans is 31·3 years, the difference in the two classes being nearly 11 years: thus the future lifetime of the Publican is one-fourth or 25·7 per cent. shorter than that of the Clergyman. The mean after-lifetime at age 25 is 42·1 years among the Clergy, 41·6 years among Protestant ministers, 39·9 years in the Healthy Districts among populations chiefly agricultural, 36·1 years among the whole population, and 31·3 years among Publicans. Clergymen of this age have lived 25 years, and will on an average live 42 years longer, so their mean age at death is 67 years; while Publicans of the same age live on an average only 31 years longer, and their mean age at death is 56. They lose 11 years of life. At the age of 45 the mean after-lifetime of the Clergy is 25·7 years, exactly the same as that of the populations of the Healthy Districts; it is 26·0 years among Protestant Ministers, 22·8 years among the whole population, and 20·0 years among publicans.

NOTE.—The above calculation of the mean after-lifetime is based for the Clergy on 59,084 years of life and 1,105 deaths; for Protestant Ministers on 24,944 years of life and 472 deaths; for Publicans on 228,592 years of life and 7,127 deaths. See Sup. to 35th Report, pp. clxxii–clxxv.

report of the Lords Committee will no doubt be of great practical importance, and may suggest further scientific research to determine the points at which wine loses its natural virtues and becomes a poison. Dr. Parke's careful experiments were made on a soldier not in company, and the effects on his mind were not noted; yet, that is more striking and important than the effect on temperature, and on the secretions. The effect on the brain stands before that on the heart.—(39th Annual Report, pp. 228–37.)

Violent Deaths in London, England, and Foreign Countries prior to 1839.—Whether violent deaths are on the increase is a question of some interest. The London Bills of Mortality, so far as they can be relied upon, furnish data (*see* the following Table) for obtaining some approximation to the proportion of deaths by violence in the Metropolis to the deaths by all causes from the middle of the 17th century.

* *See also* Extracts from Supp. to 35th Annual Report on pp. 398–404.—(Editor.)

TABLE of the Violent Deaths in the London Bills of Mortality.

Years.	Drowned.	Burnt and Scalded.	Suicide.	Killed.	Murdered.	Poisoned.	Smothered and Suffocated.	Executed.	Total.	Found Dead.	Total, including found Dead.	Total Deaths.
1647 to 1700	3,448	419	901	3,520	683	96	108	1,043	10,218	478	10,696	1,054,201
1701 „ 1749	3,943	384	1,978	3,120	419	115	151	681	10,791	1,770	12,561	1,223,343
1750 „ 1799	5,679	744	1,571	3,546	218	76	288	935	13,057	510	13,567	1,043,759
1800 „ 1829	3,635	1,150	1,090	2,632	99	109	216	595	9,526	406	9,932	586,322
1837½ „ 1839	—	—	—	—	—	—	—	—	3,119	—	—	123,098
	Proportion of Deaths by Violence in 10,000 Deaths from all Causes.											
1647 to 1700	32·7	4·0	8·5	33·4	6·5	·9	1·0	9·9	96·9	4·5	101·4	10,000
1701 „ 1749	32·3	3·1	16·2	25·5	3·4	·9	1·2	5·6	88·2	14·5	102·7	10,000
1750 „ 1799	54·4	7·1	15·0	34·0	2·1	·7	2·8	9·0	125·1	4·9	130·0	10,000
1800 „ 1829	62·0	19·6	18·6	44·9	1·7	1·9	3·7	10·1	162·5	6·9	169·4	10,000
1837½ „ 1839	—	—	—	—	—	—	—	—	253·4	—	—	10,000

In the first period (1647–1700) the annual rate of mortality was about 7, in the second 5·2, in the third 5, in the fourth 3, per cent.; whence it may be deduced that, in the 17th century 6·8 in 100,000, in the 18th century 5·4, in the 19th century 5, died violent deaths. Out of a given amount of population the deaths by drowning increased in the latter half of the 18th century; the deaths by scalds and burns were twice as great in 1800–1830 as in the 17th century. The tendency to suicide remained nearly stationary; so did death by poisoning. All the deaths by personal violence rapidly decreased. In a population of 100,000, according to these accounts, about 23 were killed, 4·6 murdered, in the 17th century; in the 19th century about 13 were "killed," and 0·5 were murdered. The chance of being murdered diminished nine-fold. The executions were more frequent in the latter half than in the beginning of the 18th century, compared with the population within the Bills of Mortality, they were not however half so frequent in the first 30 years of the 19th century as in the latter half of the 18th century, when about 7 were executed annually to a population of 10,000. Relatively to the murders the number of executions increased.

The violent deaths in Sweden, Prussia, and France, as given in the official returns, are compared in the following Table with the results of the English returns.

		Mean Population.	Annual Number of			To a Population of 100,000.		
			Ascertained Suicides.	Other Violent Deaths.	Violent Deaths.	Suicides.	Accidental Deaths, &c.	Total Violent Deaths.
Sweden -	- 1810–30	2,616,874	134	1,637	1,771	5·1	62·6	67·7
Prussia -	- 1820–34	12,393,162	1,112	4,912	6,024	9·0	39·6	48·6
France -	- 1839*	34,154,224	2,747	6,402	9,149	8·0	18·7	26·8
England and Wales	1838–9	15,666,800	1,000	10,679	11,679	6·4	68·2	74·5

* The population of France was 33,540,910, in 1836; the annual rate of increase is ·603 per cent.

The Swedish Abstracts appear to be made on the same principles as our own. 378 infants, said to be "suffocated (overlaid) through the "carelessness of nurses," have been excluded, as the number referred to this head in the English (and probably the Prussian and French) Returns is inconsiderable. With the 378 children overlaid, and 27 deaths ascribed to ardent spirits, the violent deaths in Sweden would amount to $1,771 + 405 = 2,176$, or 8·2 in 10,000 annually. The mines and lakes of Sweden make the violent deaths numerous; 947 persons (792 males and 155 females), were drowned every year. The suicides were numerous in Prussia and France; nevertheless the Return made by the police in Prussia is said to be incomplete. If an addition were made to the 1,000 ascertained suicides in England, for the suicides among the 2,400 drowned, the tendency to suicide would, I fear, be found to be quite as great in England as in France or Prussia. The Return of other violent deaths in Prussia is incomplete: for besides the 4,912 given above, and stated to be by "a variety of fatal "accidents," several are probably mixed up under the head "external "causes or injuries," (comprising 7,368 deaths) with phlegmon, mortification, hernia, urinary diseases, and cancerous ulceration. There is no means of separating into its constituent parts this aggregation of miscellaneous cases.*

Neither the Prussian nor French Returns appear to comprise deaths by homicide, which would not, however, affect the results to any great extent. The French Returns are evidently defective; they profess to give all the accidental deaths which came to the knowledge of the Minister of Justice, who is not paid on the same principle as the coroners of this country. If, instead of 27, we admit that, exclusive of homicide, 37 in 100,000 Frenchmen met their deaths by violence in the year, this will make little more than half the mortality by violence in England; where, after every deduction has been made for defects in the foreign Returns, the mortality by violent deaths is greater than in Sweden, Prussia, France, and probably any nation of Europe, in which civil war is not raging.

The reason of this is explained by the preceding analysis, without implying any extraordinary negligence. Relatively to the population of England, few countries have such an extent of coast, rivers, and canals, or so many men employed in navigation; so many fires, furnaces, and chemical processes in operation; medicines and poisons distributed in so many shops; so many mines, manufactures, or buildings; so many horses, carriages, and railways; such a vast amount of force of every description at its disposal. The great number of violent deaths in England may, therefore, be accounted for on the assumption that the danger in the manufactures, mines, and conveyances, is the same as in other countries; but that the frequency of exposure to it is greater.

It must not, nevertheless, be imagined that the number of "accidental" deaths, injuries, and mutilations, cannot be reduced in England. Deaths in ships, manufactures, and mines, are indiscriminately called "acci-"dental;" yet it is well known that fewer lives are lost by shipwreck in Her Majesty's service than in emigrant vessels; that less accidents happen in one factory than in another; and that the men are crushed, burnt, or blown to pieces, much less frequently in the coal mines of certain proprietors, than in those of others. Many "accidental deaths" are, therefore, *indirectly caused* by human agency. Many of the accidents happen from ignorance and carelessness. The knowledge of

* *Medicinischer Zeitung*, Nos. 44, 45, Nov. 1835. Translated by Mr. Deverell in *Transactions of the London Statistical Society*, p. 121.

the accidents to which people are exposed in different occupations may put them more on their guard against danger.—(3rd Annual Report, pp. 85–88.)

Coroners' Returns of Violent Deaths, 1852-6.—In England a special officer has been elected by the people, from the earliest times, to visit the body of every person slain or wounded, and to inquire into the circumstances of each case. The mere fact that the death was sudden, or that the body was found in water, if the coroner was called upon, rendered inquiry imperative; and it is accordingly enjoined in the statute (4 Edward I.) regulating the coroner's office.

The progress of science has created new forces, often fatal, and has produced new substances, of which our forefathers had no knowledge. Machinery is organized on a large scale, so that the lives of numbers of men are liable to be destroyed, not by malicious intent, but by the negligence of other men who have their lives in charge. Thus, great numbers die by railway accidents; many perish in mining operations; children are suffocated in bed or are burnt by "their clothes taking "fire." Poisoning is not mentioned in the act of Edward; but poisoning is now, unhappily, a common cause of death. Poisons are the most insidious instruments which assassins can employ, and they were evidently little known in England before the Reformation; yet the first English legislators directed inquests to be held on the body dying suddenly, because death might possibly even then be the result of secret violence. Persons slain generally die suddenly; hence, it was made the rule to hold inquests in cases of sudden death. Such was the wise provision of the law.

A man is killed; the coroner receives notice, and summons a certain number of men to inquire, under his direction, into the causes of the death, and to pronounce, after hearing the evidence, a preliminary verdict of acquittal or of guilt. The utility of the inquest is evident. It recognized, in barbarous times, the value of human life. No man could be slain without inquiry. It was a simple means of discovering the guilty, and it brought home blame to the negligent; at the same time the innocent were protected against false imprisonment, for "guilty" was not the verdict of a despot, but of a jury of twelve or more ordinary men who fairly represented public opinion. The verdict threw a shield around the innocent, who, without the inquiry might have been falsely suspected: it left no excuse for private vengeance: and, undoubtedly, the coroner and the jury deterred many evil natures from the commission of crimes which they would have perpetrated had not the dread of the inquest interposed. Lives were thus saved, and every man enjoyed a sense of security which the commission of murders with impunity would have destroyed in the great mass of the population. For, without the inquest, assassination would be the death of many men —the dread of all.

The coroner's inquest is entirely a popular institution. The county coroner is elected by the freeholders; and it is one of the great advantages of the inquest that it engages the great body of the people in the administration of justice; public opinion is thus never in favour of a man whom a jury has pronounced guilty. Assassins and *bravoes* have been shielded from discovery by people in foreign lands who have never served on juries. Through inquests the great body of the English people have been taught also, to some extent, the action of general causes, such as nuisances, in destroying life.

Coroners are elected for counties, and in some cases, for sub-divisions of those counties; boroughs and some districts have special coroners.

England and Wales have, apparently, 324 coroners, some of whom appoint deputies; they held, according to Mr. Redgrave's returns, inquests on 21,801* bodies in the year 1856. The total charges amounted to 67,000*l.*, averaging 3*l.* 1*s.* 6*d.* for each death into which inquiry was made. The charges included the coroner's fees (1*l.* 6*s.* 8*d.* on each inquest), and mileage (9*d.* a mile, reckoning only one way, from his usual place of abode to the body); medical fees for evidence, autopsies, and analyses; witnesses' expenses, constables' allowances, and payments to jurymen, and for rooms.

The findings of the juries are classed under the following heads by Mr. Redgrave:—

Injuries from Causes unknown	424		
Homicide - - -	482	Including—Murder - -	205
		Manslaughter -	271
		Justifiable Homicide	6
Suicide - - -	1,314		
Accidental Deaths - -	9,716		
Ascertained Violent Deaths -	11,936		
Natural Deaths - -	7,102		
Found dead - - -	3,183		
Total Dead Bodies on which inquests were held - -	22,221	These numbers are 420 in excess of the true number—owing to duplicate entries.	

It would thus appear that nearly 10,285 of the bodies died of disease, or in ways not positively ascertained to be violent; and that 11,936 died violent deaths, which involved charges of murder, manslaughter, or justifiable homicide in 482 cases. Ultimately 265 persons were, according to the Criminal Returns, committed to trial for homicide (murder 82, manslaughter 183); and 109 were convicted (31 of murder and 78 of manslaughter).† Of the 31 convicted murderers 16 were hanged. This was the ultimate result of 21,801 inquests; 109 men and women were convicted of homicide, and variously punished. It is asked, upon the face of this return, "Whether, under our police system, "such a number of inquests, leading to no results, is necessary?" "No evidence," it is said, "of crime to satisfy a coroner's jury was "found in 21,325 cases; and of the 476 verdicts of murder and "manslaughter only a few were sustained by sifted evidence before the "judges, for only 109 convictions ensued."

It must, however, be recollected that 1,314 suicides are included in the return; and the importance of inquiring into these cases will not be disputed. Murder, moreover, may sometimes be disguised under the appearances of suicide. 3,183 bodies were *found dead;* and the utility of inquiry into all these deaths will scarcely be questioned.

The examination of the whole series of violent deaths shows conclusively that the coroner should sit in every case, for the denunciation of the guilty, for the comfort of the innocent, and for the information of the public, who should be taught the nature and the extent of all the dangers by which they are surrounded: for some of those dangers they will learn to avoid, and many of them can be diminished or entirely removed.

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* These numbers are corrected for duplicate entries in the original Table. The corrections are made on Mr. Redgrave's authority. The details cannot now be corrected.

† Judicial Statistics, 1856.

Whenever a death occurs suddenly it is wisely enacted that an inquest shall be held; and in interpreting the word "sudden" the fact that the deceased has or has not been recently visited by a legally qualified medical practitioner should be taken into account. Under this interpretation a considerable number of inquests is held on persons who die of common diseases, the effects of which, if scrutinised by medical witnesses, leaves little doubt of their nature. The supposition of violence is thus negatived, and this decisive result is ample compensation to society for the expense.

Virtually, it is true that of twenty-one thousand inquiries only a few lead to the committal and conviction of criminals; but the utility of the inquest is not to be proved by the number of *crimes committed*, but by the number of *crimes prevented;* and it is gratifying to find that homicide is comparatively rare in England and Wales. Few countries present so low a proportion of murders. Yet, the instant that the provisions of the law are disregarded, and inquests are not freely held, such homicidal eruptions break out as the poisonings in Essex, the atrocities in Norfolk, which Sir James Graham feared "had resulted "from an interference with the duties of the office of coroner," and the systematic poisonings of Palmer, in Staffordshire, who was executed in the year 1856.* The increase of subtle poisons lying for sale in the shops, the increase of life insurance, and the immense number of violent deaths in England, demand the observance of all the existing safeguards of life.

The legislature, in the year 1837, extended the inquiry under the Registration Act so as to make it embrace the cause of every death in England and Wales. The informant, in registering a death, has to answer the question, What was the cause of death? and in all cases of inquest on any dead body it was enacted (6 & 7 Gul. 4. c. 86. s. 25.), that "*the jury shall inquire of the particulars herein required to be* "*registered concerning the death*, and the coroner shall inform the "registrar of the finding of the jury, and the registrar shall make the "entry accordingly."

In a letter which was published in the Appendix to the third annual Report (1841) I discussed the coroners' returns of violent and sudden deaths. The defects in the "information" were pointed out; and in the year 1845, after further experience, a letter was addressed to coroners, accompanied by observations on the registration of the causes of violent deaths. Your letter to the coroners concluded in these words: "I confidently anticipate that for the future, in all cases in which "inquests shall be held, the finding of the jury, as recorded in the "register book of deaths, will contain all the particulars which it is "desirable to ascertain."

It is gratifying to find that the "cause of death" as returned by the coroners exhibits improvement. The information is still, however, in many cases very imperfectly given. In the case of railway accidents the nature of the accident is not defined in a large number of instances: the deaths in mines are well described: of the deaths by burns, 2,181 are referred to the clothes taking fire in the 5 years 1852–6, and 75 to conflagrations, but in 7,739 cases the circumstances are not distinguished; the poisons are not stated in many cases of death by poisoning; the deaths by drowning are often obscure, but they are evidently

* It was stated before a Committee of the House of Commons in 1851, that the constabulary of Staffordshire were instructed not to furnish "notices" of deaths to the coroners, except when crime was *suspected*. And the coroners were informed, that if they held inquests in such cases their fees would be disallowed. Under these regulations Palmer committed several murders.

imperfectly returned where the cause can be ascertained; we learn that 588 persons were drowned while bathing, 215 by falling from ships and boats, 265 by shipwreck, 4 while sliding and skating, and in the greater part of 11,758 cases of drowning the information is left imperfect. Suffocation was the cause of 1,624 deaths, which were left unclassified. The coroners' returns state that in 1856 the verdict of suicide was returned in 1,314 cases; only 1,182 were distinguished in the registers, owing, it is believed, to obscurities in the verdicts. In 195 cases of suicide, 182 of murder, 257 of manslaughter, 2,402 of accident in the 5 years 1852–6, the means by which death was caused are not expressed; thus, it is impossible to learn the total deaths from poisoning or from drowning, or from any particular agent, through these serious oversights in the coroners' returns. In the calculations it has been necessary to distribute 5,328 cases of violent deaths so as to get approximations to the numbers of deaths by railways, mines, mechanical injuries, chemical injuries, and asphyxia. Yet this classification was expressly made to include the greatest number possible of the facts as they were returned in 1840; and we are scarcely yet prepared for a more minute classification.

The Tables contain, nevertheless, much useful information. The returns for the *five* years 1852, 3, 4, 5, 6, include 68,554 violent deaths. On an average 13,711 such deaths were registered annually; of males 10,057, of females 3,653. Thus to *one* female *three* males die by violence.

On an average 480 deaths are returned as occurring annually by railways; the numbers rose from 391 in 1852 to 548 in 1856. The number of the deaths by violence from these as well as other particular causes is probably understated, as it has been already remarked that the manner in which some accidents occur is not distinguished. Yet these numbers greatly exceed the deaths returned to the Board of Trade. In 1856 the Board received accounts of 232 deaths from railway accidents, whereas 548 deaths were registered as having occurred in connexion with rails, railway carriages, and railway works.

In mines 1,136 persons were killed annually; 985 in coal mines, 151 in copper, tin, lead, and other mines. We hear chiefly of deaths by explosions in coal mines, but accurate registration shows that the deaths by the explosion of fire-damp are 198 to 939 from other causes. The fall of coal, stone, &c. kills 509 persons in mines annually, including the crushed; 157 fall into the pits or shafts. Few women are killed by either railways or mines. The deaths by all other mechanical injuries are 4,157 annually, comprising the deaths of 3,328 males and 829 females. Falls from heights, scaffolds, windows, stairs, ships,—and falls in walking,—kill 1,077 persons annually; of whom 253 are females, falling chiefly from heights, windows, or down stairs. The fall of heavy bodies kills 332 persons annually. 1,107 persons are killed annually by horses and horse conveyances, more than double the number killed by railways. The numbers exposed constantly to accidents of this kind are probably greater than the numbers exposed to accidents on railways. The accidents by horses and horse conveyances make less noise in the world than railway accidents; and it is only when the aggregate results are collected by registration that the truth is revealed. The returns are however defective, for 546 annual deaths are referred simply to fractures, leaving the cause of the fractures unspecified.

584 persons die annually by wounds, 161 by gunshot wounds, 233 by cut throat, and 190 by other wounds. A large number of these deaths are cases of suicide.

3,045 persons died annually of chemical injuries, that is, almost exclusively by burns and scalds. 1,184 females are burnt to death, 815 males. And how is it that so many females die this painful death? The coroners have not yet enabled us to answer the question explicitly. But of the 451 cases where the information is given, 436 were from the clothes taking fire, and only 15 from fires. In the *five years* 1,349 females are stated to have died from the clothes taking fire; 890 were girls under 10 years of age, 173 were of the age 10–25, and the rest were women of higher ages. Of the 832 males who died from their clothes taking fire, 526 were boys under 5 years of age, 226 were boys of the ages 5–10, and only 80 were of the age of 10 years and upwards. At these early ages the boys as well as the girls wear combustible clothes. Of the 3,195 males and the 4,544 females who died of burns, though in what way the returns do not state, a large number undoubtedly died in the same way. The discovery of these appalling facts will, it may be hoped, lead to new precautions against this danger, and probably the clothes will in the end be rendered by some chemical process incombustible. Of scalds by drinking scalding water, 142 males and 88 females, nearly all children under five years of age, are stated to have died. The larynx is closed in these unhappy cases, and the child is suffocated. It will be observed that the young boys are more incautious than the young girls; 125 boys and 79 girls of the ages 1 and under 4 died by drinking scalding water.

The deaths by lightning are so interesting in a scientific point of view that it was thought right to give them in detail. The deaths of males and females at different ages, and in the several divisions and counties, are shown.

401 persons died *annually* of poisoning, and in nearly 113 cases the poison is not specified. Opium is the principal specified poison; by that drug 125 persons are said to have died, namely, 89 by laudanum, 34 by opium, and 2 by morphia. 34 persons were killed annually by prussic acid, including 15 by the essential oil of bitter almonds. Arsenic stands next, and to it 27 annual deaths are referred. The salts of lead kill 23 persons annually, the salts of mercury kill 10, oxalic acid kills 13, sulphuric acid (oil of vitriol) kills 15 persons annually. The deaths from these poisons are understated, as the 113 deaths from unspecified poisons are chiefly caused by them, and in some cases the poisoning is not discovered, and the death is erroneously ascribed to disease.

3,826 annual deaths are the result of interrupted respiration (asphyxia), including 2,566 deaths by drowning. These returns are incomplete. Persons drowned at sea, whose bodies are not washed on the English shores, are not registered; hence large numbers of the marimime population perishing in the sea remain unregistered. Of the dying by drowning 2,044 were males, 522 were females; they were generally adults. Bathing, shipwreck, falls overboard, are the principal assigned circumstances to which drowning is referred, but the circumstances are unassigned in nearly 2,352 cases.

Suffocation is stated to have caused 708 deaths annually; it was referred to choking by food in 57 cases, bedclothes in 183 cases, overlaying in 106 cases, mephitic gas in 16 cases, limekilns in 13 cases, charcoal in 3 cases. But the cause of suffocation was not stated in nearly half the cases.

494 persons die by hanging every year, 384 males and 110 females, and 50 are strangled annually.

Some of the persons executed have not been distinguished in the registers from other persons hanged, instead of 35, the number actually executed in the five years was 45.

I have already referred to the imperfect returns of 195 suicides, 182 murders, 257 manslaughters, 2,402 accidents, 1,684 injuries. Often the way is not ascertained in which infanticide is committed.

1,033 suicides were returned annually so as to be distinguishable in the register, which is probably less by a tenth than the numbers actually distinguished. Hanging is the most common form of suicide; cut-throat and drowning stand next in the order of frequency: eight-tenths of the suicides are committed in one of these three ways.

The inconceivable importance of inquiries by coroners will be evident from the number of the violent deaths, which exceed the deaths in all our wars, and may undoubtedly be prevented to a large extent.

The contentions of the county coroners and the magistrates have already been referred to. The county coroners pay the expenses of inquests, and are afterwards reimbursed out of the county rates. By a decision of the courts of law, the magistrates consider themselves justified in deciding in every case after the inquest has been held whether it was "necessary." If they consider it unnecessary, they stop the coroner's fees. The utility of the coroner's office is greatly impaired by this state of things. The cause of death is sometimes not ascertained. He ceases to be responsible for holding inquests, which are disallowed on no settled principles. Cases occur in which the coroners refuse to hold inquests on the bodies of persons dying by violence, dying suddenly, or found dead; and in other cases they hold inquests for which they are mulcted to the full extent of their fees and allowances. The coroner is thus degraded in the eyes of the country. His is a high judicial office, and yet it is assumed that for the sake of putting a fee in his pocket he will hold an unauthorised useless inquest on a dead body. The censorship is an invidious office, and is as injurious to the magistrates as it is to the coroner. They are appointed by the crown, he is elected by the freeholders. The jurisdictions of the offices are sometimes conflicting. The coroner holds inquests in prisons, and in county lunatic asylums, which are under the control of the magistrates. The magistrates are not elected by the rate-payers, and their limitation of the expenditure on an institution which has the protection of the life of the people for its object is viewed with suspicion. No unseemly disputes appear to have arisen in boroughs where the coroners are paid by the representatives of the ratepayers.

All the expenses of the county coroners are now paid out of the county rates. They were formerly, it is believed, paid out of the poor rates with the exception of the coroner's fees. And more inquests are now required than were necessary formerly, when violent deaths were of rare occurrence. The aim of the magistrates is apparently to keep down the county rates. But it has been seen that all the expenses of inquests amounted to 67,000*l*. This is a small portion of the county rate. The 324 coroners of the whole of England and Wales received 29,068*l*. in fees in the year 1856, or rather less on an average than 90*l*. each. After deducting 91 coroners who held less than ten inquests each in the year, the incomes of the rest was about 123*l*. on an average. The highest income amounted to 1,692*l*. The mileage was fixed in the last century, and is evidently too low in many districts. The coroners pay the salaries of their deputy coroners and clerks out of the above incomes.

Of all judicial officers the coroner appears to be paid on the lowest scale. Yet his office is subordinate to none in importance. Its requirements are high. He should inspire public confidence by his intellectual as well as by his moral qualities. Without a knowledge of medical jurisprudence in its extensive sense, it is impossible to conduct satisfactorily an inquiry into the causes of deaths, often surrounded by unusual obscurity. His duties are by no means attractive. He is liable to be called upon to hold inquests at all times. The inquiries are often protracted. It is his duty to view the dead bodies in all their revolting changes. His mind is conversant chiefly with deadly accidents; with the sudden deaths from which people pray to be delivered; with suicides; with infanticides; with manslaughters; with dismal murders, which no poet's art can turn into tragedies.

It is the men undertaking all these painful duties whose pay is constantly liable to be disputed by the magistrates. And no other judicial officer is paid in the same precarious way. What would be thought of a proposal to make the pay of the county court judges depend on the number of their decisions, and to allow them to adjudicate only in such a number of cases as the county magistrates consider reasonable. The judges are not fined, as the coroner is, when their decisions are reversed. The chief coroner of England, the Lord Chief Justice, is not paid by fees; and instead of a precarious income he enjoys a certain salary, with a vested right in a pension. The coroner is paid by fees, which can be withheld by the justices; his income fluctuates, and when he is old and disabled, he has no pension to retire on.

The subject is so important that it should be inquired into. And the comparative merits of the pay by fees and by salary should be carefully weighed. The unseemly contention between two high classes of the officers of justice should be brought to a close. When the coroners' pay is placed upon a proper footing, several improvements might be introduced into the conduct of the inquest. Certain classes of cases should be laid down in which inquests should invariably be held, and others should be held on the coroner's responsibility. It should be proclaimed that the inquest involves no suspicion, as indeed its most important function is to dissipate unfounded suspicions. Without an examination of the organs of the body, and often without an analysis of their contents, the cause of death cannot be determined, either negatively or affirmatively. And this examination would be most satisfactorily conducted by one medical officer in each district, who would become by experience expert in manipulation, and sagacious in judgment. He might undergo, before his appointment, a special examination in medical jurisprudence, and be very properly the health officer of the district.

While all existing rights are scrupulously respected, and the selection is left in the hands of the freeholders, it would perhaps be found possible to diminish the exorbitant expenses of contested elections, and at the same time to secure adequate acquirements in the coroners. Physicians, surgeons, clergymen, barristers, solicitors, now undergo examinations. Why should not the future candidate for the office of coroner be required to produce a diploma, certifying the possession of a competent knowledge of medical jurisprudence?

These improvements would necessarily raise this important office to its proper dignity, and greatly increase its public utility. The causes of death would be ascertained. New safeguards of human life would be provided. (19th Annual Report, pp. 196-205.)

Violent Deaths in Mines and on Railways, 1863–72.—There are two groups of violent deaths which have been separately distinguished since 1863, the violent deaths in mines, and the violent deaths on railways. These two great branches of industry are carried on under unusual circumstances, and without the utmost vigilance and skill they involve great sacrifices of life.

The mines are of two kinds, the coal mines, and the copper or other metallic mines, each kind involving its peculiar dangers. The danger of the coal miner arises from gaseous explosions and from falls of coal, stone, and other bodies from the roof. The copper miner is free from the danger of explosion but deprived of the advantages of ventilation, he works in impure, heated air, which induces a peculiar form of lung disease, developed after a certain number of years' exposure. Here we have to do only with violent deaths, which are much less common in copper than they are in coal mines.

The mortality by violent deaths in mines and on railways is shown in the two Tables annexed, at the several ages, as calculated on the population living at those ages.

DEATHS from VIOLENCE in ENGLAND AND WALES "connected with RAILWAYS," at several Groups of AGES, in the 10 Years 1863–72; and the ANNUAL DEATH-RATE per 100,000 Persons estimated to be living in the MIDDLE of that PERIOD.

Groups of Ages in Years.	Estimated Population in the Year 1867, taken as the Middle of the Period of the Years 1863-72.		Deaths from Violence "connected with Railways," in the 10 Years 1863-72.		Annual Rate of Mortality per 100,000 Persons Living from Violence "connected with Railways," in the 10 Years 1863-72.	
	Males.	Females.	Males.	Females.	Males.	Females.
All Ages - -	10,557,066	11,120,459	8,316	663	7·9	·6
Under 5 - -	1,465,041	1,459,879	111	52	·8	·4
5— - -	1,278,784	1,280,543	248	57	1·9	·4
10— - - -	1,155,596	1,139,628	434	61	3·8	·5
15— - -	1,953,189	2,074,023	1,969	78	10·1	·4
25— - - -	1,512,774	1,677,922	1,867	82	12·3	·5
35— - -	1,202,007	1,296,129	1,362	77	11·3	·6
45— - - -	916,226	976,513	1,065	101	11·6	1·0
55— - -	610,625	661,846	745	77	12·2	1·2
65— - - -	334,023	387,133	379	57	11·3	1·5
75 and upwards	128,801	166,843	136	21	10·6	1·3

DEATHS from VIOLENCE in MINES in ENGLAND AND WALES in the 10 YEARS 1863–72 at different Groups of AGES, and MEAN ANNUAL RATE of MORTALITY per 100,000 of the MALE POPULATION and of MINERS.

Groups of Ages in Years.	Deaths from Violence in Mines, in the 10 Years 1863-72.			Mean Annual Death-rate by Violence in Mines, in the 10 Years 1863-72.			
	In all Mines.	In Coal Mines.	In all other Mines.	In all Mines to 100,000 of the Male Population.	In all Mines to 100,000 of the Mining Population	In coal Mines to 100,000 Coal Miners living.	In other than Coal Mines to 100,000 Miners other than Coal Miners.
Aged 10 & upwards	11,482	10,167	1,315	14·7	337·5	395·9	157·7
10— - - -	1,559	1,451	108	13·5	425·9	498·6	143 9
15— - -	3,273	2,860	413	16·8	291·4	334·9	153·4
25— - - -	2,590	2,289	301	17·1	322·1	375·3	155·0
35— - -	1,941	1,689	252	16·2	359·6	421·5	181·2
45— - - -	1,283	1,133	150	14·0	392·0	476·9	167·2
55— - -	643	572	71	10·5	387·9	479·6	152·7
65— - - -	169	152	17	5·1	276·1	338·2	104·6
75 and upwards	24	21	3	1·9	166·0	195·5	83·1

The above Table shows the mortality by violent deaths in mines as calculated on the respective mining population, and on the general male population of England and Wales.

With regard to the violent deaths of every kind on railways, either of passengers or railway servants, the mortality has been calculated on the whole population living at several periods of life. This may be compared with the loss of life in mines.

We have no means of determining the mean population exposed to risk on railways, but the number of railway male servants of every kind in 1871 was 84,625, including 13,715 engine drivers and stokers, 22,083 railway officers, clerks, station-masters, and 48,827 railway attendants and servants. This is exclusive of 45,070 railway labourers, platelayers, and navvies.

The number of railway journeys in 1872 was 423,000,000, exclusive of journeys by season ticket holders, making perhaps in the aggregate 500,000,000. Taking each journey as of 9·6 miles and allowing half an hour for its performance, it follows that the average number of passengers exposed to risk through the year does not exceed 30,000. Adding the 30,000 to 84,625 the total number of persons exposed a year to risk, and among whom the deaths on railways may have occurred was 115,000. Now the deaths were 1,160, so the annual rate of mortality was 11 in 10,000.

We have no means in the returns of separating the deaths of passengers from the rest, and there is reason to believe that the companies' returns in which this distinction is made are incomplete.

We do not know the mean ages of railway passengers and railway servants in the aggregate, but dividing the deaths at each age by the living at each age in the whole population, then it is seen that the mortality at seven decennial ages over the age of 15 differs little among men : the loss of life by violence on railways is at a rate slightly above 1 in 10,000 ; it is 1·0 at the age 15–25, 1·2 at the age 25–35.

It will be seen upon comparing the above figures with those made by the companies to the Board of Trade for the corresponding years that the latter were exceedingly defective, and the returns which have been made in these Reports deserve the merit of having called public attention to the excessive number of deaths among the railway staff, as the mortality of that meritorious class of men might be greatly reduced. (25th Annual Report, pp. 228–9.)

International Statistics of Violent Deaths, 1873–6.—English mortality from violence presents a considerable contrast with what is observed in Italy. There the homicides amounted in 1876 to 1504 ;* against 412 recorded in England and Wales during that year. Thus to 1,000,000 of population there were 54 homicides in Italy against 17 in England. If we had the same proportion the homicides would have amounted to 1,309 in England and Wales. In Rome the proportion is much higher : it is 141 in Rome, in Sicily 137.

Although the results in England are so much more favourable as regards homicide than in Italy, it is the reverse with other violent deaths; there the violent deaths in 1876 were 6,656 against 18,358 (exclusive of executions) in England; or 240 in 1,000,000 of population in Italy against 757 in England.

If we deduct the 1,024 suicides and 1,504 homicides, there will remain 4,128 violent deaths in Italy; from which we deduct also 47 deaths from intemperance, and 6 from hydrophobia and bites of vipers, and one by privation. To render them comparable with the English returns we obtain 4,074 which are thus accounted for :—

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* The homicides are thus classified according to the returns made to the "Stato Civile": involuntari 285; voluntari 1,163; infanticide 56. They are little more than half the number given by the Judicial Statistics. There is no coroner's inquest in Italy.

Deaths by Violence in Italy in 1876.

Drowning - - - - - -	1,324
Suffocation - - - - -	137
Explosions - - - - - -	131
Burns - - - - - - -	337
Lightning - - - - - -	147
Falls - - - - - - -	1,109
Crushes from falls of fabrics, trees, earth - -	332
Horse and horse conveyances - - -	167
Railways - - - - - - -	84
Agricultural machinery - - - -	34
Violence of animals - - - - -	68
Avalanches - - - - - -	7
Injection of poisonous substances - - -	34
Unknown and various causes - - -	163
	4,074

Upon comparing these with the English returns the difference is evident. There are no mines in Italy; and the physical forces set in motion by coal are much less than in England and Wales. The railway accidents and burns are less fatal there than in this country. Upon looking back to the state of England in the last century we shall find a state of things very like what is prevalent now in Italy, and our progress in the industrial arts has been accompanied by hecatombs of deaths which it becomes necessary to endeavour to avert by special measures. The genius of the country has been directed to the achievement of certain works, and has never asked at what expense of life. The time has come to ask at what cost? and to consider carefully how life may be saved. For though there are fewer homicides in England and Wales than in Italy, it must be recollected that the lives are equally sacrificed by negligence as if they were taken by the red hand of the murderer. The mine inspectors and the railway inspectors are well employed if they suggest improvements by which life may be saved; and the same analogy would lead us to try how far similar minds may be directed to the suggesting ways of saving life. The medical health officers will be well employed in this direction.

TABLE showing the NUMBER and PROPORTION to a MILLION LIVING of DEATHS from VIOLENCE, in each of the under-mentioned COUNTRIES, in 1876.

COUNTRIES.	Deaths from Violence.	Suicide.	Homicide.	Accident and Negligence.	Proportion to 1,000,000 living.			
					All Causes of Violent Deaths.	Suicide.	Homicide.	Accident and Negligence.
Switzerland - - -	2,550	540	109	1,901	924	196	39	689
United Kingdom - -	25,798	2,052	533	23,213	775	62	16	697
England & Wales -	18,358	1,770	412	16,176	757	73	17	667
Scotland* - - -	2,516	128	4	2,384	720	37	1	682
Ireland - - -	2,083	111	88	1,884	391	21	17	353
Norway* - - -	1,295	126	23	1,146	724	70	13	641
Finland* - - -	1,179	64	66	1,049	626	34	35	557
Sweden - - - -	2,740	409	88	2,243	619	92	20	507
Prussia* - - -	15,815	3,432	547	11,836	616	134	21	461
Bavaria - - - -	2,629	522	198	1,909	519	103	39	377
Belgium - - -	2,577	439	85	2,053	483	82	16	385
Austria - - -	10,150	2,438	—	—	471	113	—	—
Italy - - - -	6,656	1,024	1,504	4,128	240	37	54	149

* The above facts given for Norway are for the year 1873, for Scotland 1875, for Finland 1874, and for Prussia 1875.

It will be seen in the annexed table that the United Kingdom is at the head of every country except Switzerland in the number of violent deaths. The avalanches and falls down precipices no doubt give Switzerland its fatal pre-eminence. (40th Annual Report, pp. 229–30.)

Statistics of Suicide, 1838.—The tendency to suicide is least among persons who carry on occupations out of doors; and greatest among artisans who are weakly from birth, are confined in-doors, have their rest disturbed, or have little muscular exercise.

Taking the numbers as they stand, 1 in 9,332 masons, carpenters, and butchers committed suicide in the year; and 1 in 1,669 tailors, shoemakers, and bakers: the tendency to suicide in the first class was as 1·0 to 5·6 in the second. The corrected mortality from suicide was 1·33 to 10,000 in the first class, and 7·43 to 10,000 in the second class. The requisite correction will be made, without further notice, in the subsequent rates. It does not affect the *relative* mortality of different classes.

A similar result is obtained by comparing the suicides in the class of labourers with those among artisans and tradespeople ; for the tendency to suicide is twice as great among artisans as it is among labourers.

The proportion of suicides in the miscellaneous class, designated by Mr. Rickman, "*capitalists, bankers, professional, and other educated men,*" is very near the average.

Numbers.	Suicides.	Other Violent Deaths.	Suicides in 10,000.
55,853	22	23	4·9

It has been remarked by theoretical writers who appear to have had this class principally in view, that suicide is most prevalent in countries where the greatest number of people are educated ; and M. Brouc, after an elaborate inquiry, lays it down as a "social law," that suicide is most common where education is the most diffused ; that suicides and scholars increase in the same ratio. Modern education and literature, it is said, have led to an increase in the number of suicides.* In England suicide is, in fact, most frequent in the metropolis, the south-eastern counties, and the northern counties, where the greatest number can write; and it is the least frequent in Wales. The intermediate counties range from 62 to 48, who could write, in 100; the suicides from 4·5 to 6·8 in 100,000.

—	Number out of 100 Persons married, who could write their names.	Suicides to 100,000.
Metropolis	82	10·9
Durham, Northumberland, Cumberland, Westmorland	68	6·5
Surrey, Kent, Sussex, Hampshire, Berkshire	62	8·4
Monmouthshire and Wales	41	2·2

There is a general but no constant relation between the state of education thus tested, and the commission of suicide. It may be admitted that there is some relation between the development of the

* Considérations sur les Suicides de nôtre époque.—Par M. Brouc, *Annales d'Hygiène.* Tome 16, p. 223.

intellect and self-destruction; but the connexion must be in a great measure indirect and accidental. In opposition to the arguments derived from agricultural districts, and labourers in towns, there is the fact that suicide is more frequent among several classes of artisans than it is among better educated people. If the progress of civilisation is to be charged with the increase of suicide, we must therefore understand by it the increase of tailors, shoemakers, the small trades, the mechanical occupations, and the incidental evils to which they are exposed, rather than the advancement of truth, science, literature, and the fine arts.

A comparison of the suicides among servants and the preceding class would throw some light on the influence of mental cultivation. But servants, comprising coachmen, cannot be distinguished from street coach-drivers in the registers,—so that the two classes must be referred to one head; standing in point of education, however, nearly on a level.

—	Numbers.	Ascertained Suicides.	Suicides to 10,000.
Servants and Coachmen - - -	20,292	11*	6·7
Capitalists, Professional, and other Educated Men - - -	55,853	22	4·9

In corroboration of this result, it may be stated that about 2·0 in 10,000 persons assured in the Equitable Society, and 7·8 in 10,000 Dragoons and Dragoon Guards, have been ascertained to commit suicide every year.†

Of 26,665 paupers and others not included in the previous classes, 9 committed suicide, or, with the correction, 4 in 10,000. It does not appear from the registers that either poverty or riches have any great disturbing influence on the tendency to suicide. The influences of their attendant evils are nearly equal. The poor man has an average standard of enjoyment which he can scarcely fall below, and is less exposed to cruel reverses than the affluent; who are, on the other hand, assured, by the abundance of their resources, against the frequent fluctuations in the supply of the primary necessaries of life.

Intemperance and suicide, as well as other violent deaths, are found associated in the registers; and the professions peculiarly addicted to drunkenness have more than the due proportion of suicides. Drunkenness leads to this; but drunkenness is a sort of indirect suicide, and both are tendencies of the mind, indulged often from the same motives, and promoted by similar causes.

There is no reason to believe that suicide has been latterly increasing in England. The fact, nevertheless, that 1,000 persons are ascertained to commit suicide yearly, and that nearly as many more are returned as drowned, &c., in which the verdicts do not state whether death was accidental or suicidal, is sufficient to arrest attention on all the relations of the question.

Some plan for discontinuing, by common consent, the detailed, dramatic tales of suicide, murder, and bloodshed in the newspapers is well worthy the attention of their editors. No fact is better established in science

* 5 were registered servants, 1 a waiter, 1 a pot boy, and 4 coachmen.

† Tables of Equitable Society, 1834, p. 29. Army Statistical Reports, 1839, "The United Kingdom," p. 7.

than that suicide (and murder may perhaps be added) is often committed from imitation. A single paragraph may suggest suicide to twenty persons; some particular, chance, but apt expression, seizes the imagination, and the disposition to repeat the act, in a moment of morbid excitement, proves irresistible. Do the advantages of publicity counterbalance the evils attendant on one such death? Why should cases of suicide be recorded at length in the public papers, any more than cases of fever? It would be out of place to refer here to the moral or strictly medical treatment; but it may be remarked, that the artisans most prone to suicide are subject to peculiar visceral congestions—that suicide is most common in unhealthy towns—and that the influence of medicine on the mind, and on the unstable, ungovernable impulses which are often the harbingers of suicide—is incontestable. To place the shoemaker, tailor, baker, or printer in the same favourable circumstances with respect to air and exercise as carpenters and masons would be impossible. But the workshops of all artisans admit of immense improvements in ventilation. Cleanliness is greatly neglected. Neither the men nor all the masters appear to be aware that the respiration of pure air is indispensable; that the body requires as much special care as the tools, instruments, and machines; and that without it, neither the body nor the mind can be preserved in health and vigour. The new parks and public walks will afford the artisan an opportunity of refreshing his exhausted limbs and respiring the fresh air; and the health and temper of the sedentary workman may be much ameliorated by affording facilities in towns for athletic exercises and simple games out of doors, which, while they bring the muscles into play, unbend, excite, and exhilarate the mind. Moral causes, and the regulation of the mind, have perhaps more influence on the educated classes; but all must derive benefit from out-door exercise. (3rd Annual Report, pp. 79–82.)

Manner of Suicide, 1858–63.—The constancy of the death-rates from suicide, not only in the act but in the mode of suicide, has struck statists from the first, and it has been particularly well illustrated by M. Guerry and M. Quetelet.

Under the obscure workings of insanity, and amidst the conflict of the passions, in a great variety of unhappy circumstances, an order is observed, which can be expressed in laws, and men can by means of these laws estimate or predict future events. Thus it is found that 56 persons, 3 women and 53 men, shot themselves dead in the year 1863; and by virtue of the law, if it be assumed that the same number of persons shot themselves in each of the five preceding years, the error will not be considerable; for the numbers were 54, namely, 53 men and 1 woman in the year 1862; and 59, 59, 54, and 60 in the preceding years; making the average annual number 57, from which the deviation is only 3 or 1–19th either way. By virtue of this law any one may predict that, the circumstances remaining the same, 57 persons now living will shoot themselves in the year 1866. In the six years 253 persons killed themselves annually by cutting the throat or stabbing themselves; the numbers ranging in those years from 215 to 276; that is from 38 below to 23 above the average.

Some erroneous inferences are sometimes drawn from these remarkable laws. It has been assumed, for instance, that because numbers expressing events, such as suicide, succeed each other regularly year after year, that those numbers are perfectly correct. Now this does not follow, for it has been found that the same law extends to errors, and it is quite possible, nay probable, that the number of suicides in

England is understated, as some unknown numbers of the persons found drowned are suicides.

It is established as a law, that the same causes or equivalent causes invariably produce the same effects on the minds of men under the same conditions; but it does not follow from this principle that suicide cannot be brought under any control. A certain number of lunatics destroy themselves; anything, therefore, which prevents or cures lunacy diminishes suicide. In some in-door employments, where the conditions of health are disregarded, the tendency to suicide is developed; and by changing the conditions the tendency is diminished. Idleness, as much as strain of mind, predisposes to suicide; change the conditions and the disposition to suicide is changed. Suicide has generally been treated as ignominious crime; but it sometimes puts forward pretensions to heroism and applause; it is therefore influenced by public opinion. In certain states the mind appears to be fascinated —as in the disposition to plunge from a height—by the presence of a fatal instrument, such, for example, as prussic acid, a pistol, a rope, or a razor; and the withdrawal of the means of death suffices to save the life. Diminish the facilities of procuring poison, and you diminish the peculiar kind of suicide. Discontinue the use of a razor in a country, and you diminish the cases of cut-throat.—(26th Annual Report, p. 193.)

Causes of Death in the Metropolis, 1629–1835.—The following table expresses the liability of the living to death by all the great classes of diseases during six periods of the last two centuries. The first and most difficult step here was to determine the absolute rate of mortality in the six periods. The population in the liberties of London, enumerated in 1631, was 130,178; the deaths in the liberties during the eight years, 1628–35, were 54,299, of which 1-24th were still born: excluding these, the annual mortality was 5 per cent. This represents the mortality of years free from pestilence, but not the absolute mortality of the period, which, for the 24 years, 1620–43, was 7 per cent. Column A. shows, therefore, the fatality of diseases in years intercurrent between epidemic years. Column B. is an approximation to the mortality and diseases of London in the middle ages, although it includes 14 years subsequent to the great fire, and to the last epidemic.* The mortality of London in the 17th century did not differ very sensibly, before the French revolution, from the mortality in the

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* The enumeration of 1631 was published by Graunt, in the Appendix to his Observations, under the title "Anno 1631, ann. 7, Caroli I.: The Number of Men, Women, and Children, in the several Wards of London and Liberties, taken in August, 1631, by special Command from the Right Honourable the Lords of his Majesty's Privy Council." The results agree remarkably with the later enumerations, three of which, 1801, 1811, and 1821, make the population of the liberties of London (97 parishes within, and 16 parishes without the walls,) 130,100, including a correction for seamen and strangers. Without correction, the population, in 1831, was 123,683. The enumeration of 1631 has, therefore, been made the basis of these calculations; as it is not probable the population, in the same space, ever exceeded 130,178. The deaths in the 97 + 16 parishes during 31 years, 1616-46, amounted to 279,964; which diminished $\frac{1}{27}$ for the still-born, and divided by the population (130,178) of the intermediate year, give 6·68 as the annual rate of mortality. The fire disturbed the observations in 1666, so that it was more difficult to obtain an approximation to the mortality in the 20 years, 1660–79; but the enumerated deaths in the 10 years, 1670–79, were 94,644; in the 5 years, 1660–4, 483,000; in 1665, the epidemic year, 56,558; whence 237,349 were deduced as the total deaths in the 20 years. Reduced $\frac{1}{37}$ for the still-born, the annual rate of mortality was 8·85 per cent.; but, to avoid the risk of exaggeration, the rate of this period, including the plague year, 1665, has been stated in the table at 8 per cent.

current years 1629–35: the mean expectation of life at birth, 1728–37, was calculated by Mr. Simpson to be 19·2 years; while in the 10 years, 1771–80, it was 19·6 by Dr. Price's 16th Table. Nearly 5·2 and 5·1 deaths happened annually out of 100 persons living. The mortality of London in 1801–10 had considerably diminished and was estimated by Mr. Milne to be 1 in 34·19 annually—2·92 per cent.* The annual deaths in the 18 years, 1813–30, are stated by Mr. Edmonds at 2·82 per cent.; and as the deaths reported in the bills, 1831–5, were 1-8th more than the deaths in the five years preceding, the mortality has been assumed to be 3·2 per cent. in this period including an epidemic year.

Mean Annual Number of Deaths in London from 20 Classes of Disease in 100,000 living.

By	A. 1629–35.	B. 1660–79.	C. 1728–57.	D. 1771–80.	E. 1801–10.	F. 1831–5.
Chrisomes, overlaid, convulsions, worms, teething, mold-shot head, dropsy on the head, inflammation of brain, rickets, livergrown, canker, thrush, croup, whooping-cough - - - -	1,681	1,591	1,827	1,682	789	625
Small-pox - - -	189	417	426	502	204	83
Measles - - -	16	47	37	48	94	86
Scarlet fever - -	—	—	—	—	—	53
Fever - - -	636	785	785	621	264	111
" Spotted - -	45	90	—	—	—	—
Plague - - -	125	1,225	—	—	—	—
Dysentery - - -	221	894	50	17	1	1
Surfeit or cholera - -	63	148	1	—	—	135
Inflammation - -	—	—	10	31	101	307
Pleurisy - - -	14	6	10	5	4	39
Asthma and tisick - -	—	—	112	85	89	136
Consumption - -	1,021	1,255	905	1,121	716	567
King's evil, scrofula - -	14	19	5	5	—	3
Dropsy - - -	146	349	218	225	131	133
Apoplexy and suddenly -	47	30	48	55	49	59
Palsy and lethargy - -	14	17	12	18	19	28
Old age, bedridden - -	370	388	415	324	241	357
Casualties - - -	65	76	85	70	40	57
Childbed and miscarriages -	80	100	43	47	32	43
Unknown causes - -	—	—	—	—	—	88
Other diseases - -	253	565	211	144	146	289
Deaths in 100,000 living -	5,000	8,000	5,200	5,000	2,920	3,200

Remarks.

1. The diseases of London in the 16th century still prevail in unhealthy climates: not only the diseases and the manner of death have changed in this metropolis, but the frequency and fatality of the principal diseases have diminished.

2. The reported cases of *fever*, *plague*, *cholera*, and *dysentery*, constituted 4-10ths (·396) of the diseases: they destroyed annually, on an average, 31 per 1,000 of the inhabitants; five times as many as are now carried off by consumption.

3. *Fever*, *plague*, and *dysentery*, were most fatal to adults; but they of course carried off a considerable number of children. Convulsions, and other diseases of infancy, did not decline till the 18th century. The disease of adults first diminished in violence; and as the state of the city and medical knowledge improved, the diseases of infants decreased.

* Treatise on Annuities, &c., by Mr. Milne, vol. ii. p. 428.

4. *Small-pox* attained its maximum mortality after inoculation was introduced. The annual deaths of small-pox registered 1760–79, were 2,323; in the next 20 years, 1780–99 they declined to 1,740: this disease therefore, began to grow less fatal before vaccination was discovered; indicating, together with the diminution of fever, the general improvement of health then taking place. In 1771–80, not less than 5 in 1,000 died annually of small-pox; in 1801–10 the mortality sank to 2; and in 1831–5 to 0·83.

5. *Measles* became gradually more general in the 18th century; but in 1801–10, after vaccination was introduced, twice as many died of measles as had died of this exanthem in 1771–80. If scarlet fever and measles, however, have somewhat increased in frequency, the mortality of the three diseases, small-pox, measles, scarlet fever, is only half as great as the mortality formerly occasioned by small-pox alone.

6. *Fever*, exclusively of the plague, has progressively subsided since 1771: *fever has declined nearly in the same ratio as small-pox.* In the three latter periods of the table the deaths from fever decreased as 621: 264: 114; from small-pox as 502: 204: 83.

7. *Cholera morbus* was as fatal in 1660–79 as in 1831–5: in 1831–5 out of 1,000, but 1·35 are stated to have died of cholera; in 1660-79, the deaths from this disease were 1·48.*

8. Other *inflammations* besides inflammation of the lungs unquestionably prevailed in London before 1704, when the word found its way into the bills; but its present comparative frequency is not entirely due to a change of nomenclature. Fevers were the reigning diseases, and an impure atmosphere communicated their character to the inflammations; which are still relatively less frequent where fever and dysentery prevail. In Corfu, 1815–21, out of 325 deaths among our troops, 12 were attributed to inflammation, besides 10 to hepatitis; while 223 were ascribed to fever, plague, and dysentery. Sydenham classes pleurisy, bastard pneumonia, rheumatism, erysipelas, and quinsy, together, under the title "intercurrent fevers:" after distinguishing the idiopathic from the symptomatic disease, he says, "I conceive pleurisy "to be only a fever occasioned by a peculiar *inflammation of the blood*, "whereby nature throws off the peccant matter upon the pleura, and "sometimes upon the lungs, whence a pneumonia arises." Fever, then involved in its vortex the comparatively rare inflammations; inflammation (a vague term), now happening more frequently in a pure form, and proved by *post mortem* examinations to prevail very extensively, has apparently recovered, not only its rightful possessions, but several of the unappropriated, unknown diseases, particularly of children.

9. *Consumption* was exceedingly fatal when fevers and dysentery reigned: it is now very fatal among the British troops in the West Indies. Its relative frequency increased down to 1810; in other words, fever and dysentery decreased more rapidly than consumption. The actual proportion of persons destroyed by this disease, as well as other forms of scrofula (rickets and evil), has, except in the anomalous period

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* Sydenham's Works, vol. i. pp. 218–433. "Cholera comes almost as constant at the close of summer, and towards the beginning of autumn, as swallows in the beginning of spring, and cuckows towards midsummer." He closes an accurate description by remarking, that it "often destroyed the patient in 24 hours." Dr. Craigie has demonstrated the antiquity and identity of cholera all over the world; before the last eruption, it had been epidemic in India. He cites a remarkable case from Morton. *Edinburgh Journal*, 1833.

of 1771–80, progressively declined among the mass of the population in London. If asthma and tisik be added, the declension will be little less apparent.

10. *Dropsy* has been latterly proved to depend frequently on diseases of the heart and of the kidneys: its connexion with agues and dysentery, and with diseases of the liver and spleen, is confirmed by the table (McCulloch's Statistical Account of the British Empire, Vol. II., pp. 612–15.)

Causes of death at different ages.—The English Life Table shows how many of a million children born are males, and how many are females; how many of each sex will probably survive year by year until after the age of 100 years the last life is extinguished; how many die in each year of age; and the mean after-lifetime at every age.

The English Life Table is constructed on the numbers enumerated at 12 periods of life in the two Censuses of 1841 and 1851; and the deaths registered at the corresponding ages in the 17 years 1838–54*; since those dates two more Censuses having been taken, and the deaths registered, and abstracted at the several ages down to 1872, I thought that it might be desirable to construct a new Life Table on the basis of the more extended experience. But the mortality at the several ages having been calculated for each of the 34 years 1838–71, the mean of the rates was found to agree so closely with the mean rates on which the Life Table was based that a new construction became unnecessary. The law of mortality had fluctuated from year to year, but had as yet remained constant; so that the persistence of the force of death as it affects different ages is beyond doubt.

ANNUAL MORTALITY per 1,000 of MALES and FEMALES in ENGLAND and WALES.

Ages.	Males.		Females.		Ages.
	1838–54. (17 Years.)	1838–71. (34 Years.)	1838–54. (17 Years.)	1838–71. (34 Years.)	
All Ages	23·3	23·3	21·7	21·5	All Ages.
0—	72·5	72·6	62·3	62·7	0—
5—	9·2	8·7	9·1	8·5	5—
10—	5·2	4·9	5·4	5·0	10—
15—	8·2	7·8	8·5	8·0	15—
25—	10·0	9·9	10·6	10·1	25—
35—	12·8	13·0	12·7	12·3	35—
45—	18·5	18·5	15·9	15·6	45—
55—	31·8	32·0	28·2	28·0	55—
65—	66·9	67·1	60·0	58·9	65—
75—	147·6	147·1	134·4	134·3	75—
85—	301·4	305·5	279·2	279·5	85—
95 & upwards	440·3	441·1	432·2	430·4	95 & upwards.

The Life Table thus gives out of 1,000,000 liveborn children the deaths at each year of age. To determine all the diseases of which they die at each year of age involves an amount of labour beyond our command, if the whole of the distinguishable diseases recorded are taken into

* See Life Table, pp. xviii–xix; Longman, 1864.

account. To reduce the arithmetical labour within an available compass, I have selected certain diseases of which the diagnosis is most certain. The other diseases are thrown into *groups:* the first *group* of all the class of zymotic diseases of the first order not separately dealt with; the second *group* of all except the distinguished maladies. And the several local diseases are grouped according to the affected organs. Suicide and other violent deaths are given in two lines.

The construction of the necessary tables may be thus described. A separate set of tables was formed for males and females, and the numbers dying at each period of life were taken from the Life Table. The deaths are numerous at first, and the numbers in each of the first five years of age are distinguished; then the numbers dying in the quinquennia 5 to 10, 10 to 15, 15 to 20, 20 to 25; and finally the numbers dying in the decennia 25 to 35, 35 to 45, and so on to the end of life.

From the returns of deaths in 1861–70 by different causes in the same divisions of age, the proportions of males per 1,000,000 dying of each of the 25 diseases or groups of diseases at each division of life were determined. For the deaths according to age and sex in the preceding 10 years 1851–60 the same process was repeated; and from the mean of the results of the two decennaids the final table was derived, which served to distribute the deaths of the males of the Life Table proportionally.

Thus, to take an example, in the years 1861-70 the deaths of males at ages 25–35 were 147,734; the deaths of males by small-pox 2037, by fever 10,513; so the proportion to 1,000,000 deaths at those ages was for small-pox 13,788, for fever 71,162. The corresponding proportions in 1851–60 were for small-pox 12,473, for fever 70,266; the mean for the twenty years was for small-pox 13,130, for fever 70,714. Now, by the Life Table the total deaths of males at ages 25–35 are 30,592; so the numbers due to small-pox are 402, to fever 2163; which accordingly find their places in the table. The other groups of causes were treated in the same way. From the separate tables of males and females the tables of persons of both sexes were framed by addition.

Knowing the deaths from each disease at each age period, the sum of all deaths from the same disease at and after each age are obtained by successive additions.

The Table to be complete should give the deaths from each cause in each year of age; but that series is long, and as it can be obtained by interpolation, I reserve it for a subsequent process.

Out of 1,000,000 children 114,417 will die of phthisis. Assume for a moment that at any age the survivors of the 114,417 may be picked out at that age and thrown into a class apart, then a table of the consumptive could be contructed showing their chances of dying at each age, as well as the premium to pay for an insurance on their lives.

Practically it is not possible to select out of a number of persons taken indiscriminately the numbers that will die of consumption; but it is considered possible by taking ancestral descent, temperament, and premonitory symtoms—such as hæmoptysis—into account, to select a class apart, having what is technically called a consumptive tendency, and whose mortality would approximate to that of the persons actually dying of consumption.

And a Life Table of the class dying of consumption can be formed by summing up the deaths by consumption in the Life Table, as in the subjoined example, which might be completed by interpolation.

NUMBERS to die of CONSUMPTION at and after each AGE out of 1,000,000 CHILDREN born.

Age x.	To die.	Age x.	To die.
0	114,417	35	54,290
5	109,948	45	31,886
10	107,809	55	15,418
15	104,283	65	4,973
20	95,209	75	679
25	81,424	85	52

(Supplement to 35th Annual Report, pp. xxv.–vii.)

Ages at Death from different Diseases.—All the deaths referred to premature birth, and the greater part of the deaths from convulsions, teething, atrophy, and debility occur in the first year of life. Upon the other hand many diseases such as cancer, apoplexy, paralysis, and many organic diseases, are fatal chiefly to people of advanced ages. Others, such as phthisis, fever, and childbirth, are most fatal in the middle period of life. The proportional number of the deaths from these several diseases is altered in an increasing population such as that of England; where the proportion of deaths from diseases affecting the young as those above named, for example, is overstated. The true proportions are shown in the Life Table. Thus the proportions in 1000 deaths in the 20 years 1851–70 were by whooping-cough 23·145, by measles 19·134, by scarlatina and diphtheria 48·427; whereas by the Life Table the same diseases for the same period are more correctly given as 15·161; 12·865; 34·966.

The mean ages at death by these diseases were 1·8, 2·7, 5·8 years; and the excess over the numbers of the Life Table is due to the excess of children of these ages in the increasing population of England. Here are some instances:—

MEAN AGE at DEATH of PERSONS DYING from certain CAUSES, 1848–72; also the DEATHS from those CAUSES to 1,000,000 DEATHS from all CAUSES, 1851–70.

Cause of Death.	Mean Age at Death, 1848–72.	Deaths to 1,000,000 Deaths from all Causes at all Ages, deduced from	
		Life Table.	Registered Deaths.
Whooping-cough - -	1·8	15,161	23,145
Measles - - -	2·7	12,865	19,134
Scarlatina and Diphtheria -	5·8	34,966	48,247
Small-pox - - -	11·9	6,521	8,535
Fever - - -	26·0	38,107	40,170
Childbirth and Metria -	31·7	6,921	7,364

MEAN AGE at DEATH of PERSONS DYING from certain CAUSES, 1848–72; and ANNUAL DEATHS, to 1,000,000 living, from those CAUSES, by ENGLISH LIFE TABLE, compared with the recorded MORTALITY, from the same CAUSES, 1851–70.

Cause of Death.	Mean Age at Death, 1848–72.	Annual Rate of Mortality to 1,000,000 Living of all Ages, deduced from	
		Life Table.	Registered Deaths.
Whooping-cough - -	1·8	371	521
Measles - - -	2·7	315	437
Scarlatina and Diphtheria -	5·8	856	1,046
Small-pox - - -	11·9	160	204
Fever - - - -	26·0	933	918
Childbirth and Metria -	31·7	169	168

The deaths by causes such as childbirth occurring in the middle of life, are not deranged; but the proportion of people dying of the diseases of old age is understated.

The births in the United Kingdom now exceed a million a year; and our Life Table shows that a constant number of a million births will, without any increase of births, maintain a population of 40,858,184, if there be no emigration. The actual population of the United Kingdom in 1871 was 31,545,741. The defect is in the adult and advanced ages.

The Annual Report of the Registrar General shows the deaths from each disease to 1,000,000 living of all ages; and as there is an excess of children in the actual population, the mortality deduced from the deaths and the population of all ages by small-pox, scarlatina, measles, whooping-cough, and all the fatal diseases of the young, are overstated; the mortality by fever and childbirth are undisturbed as they occur at ages near the mean age of the living population. The constitution of the population has to be taken into account in comparing the deaths by small-pox in England with the deaths from the same disease in Sweden, France, or countries where the population is nearly stationary. (Supplement to 35th Annual Report, pp. xxxvi–vii.)

Effect of the Extinction of any Disease on the Duration of Life.—Whoever has lost a friend, a brother, a son by any disease will feel that its extinction would be a boon to mankind which no figures can express. Something, however, can be calculated, and that is the effect of the suppression of any disease on the duration of life. Some diseases are fatal to infants, some to youths, some to men in the flower of life, some to fruit-laden patriarchs; and while the three kinds of loss differ in degree, and differ in the economic effects, they differ also in their effects on the mean lifetime.

The mean lifetime, it will be borne in mind, is found from a Life Table, which shows how many of a given number born live through each year of age, and what is the sum of the number of years they live; the sum of these years divided by the lives is their mean lifetime. Thus by the English Life Table 1,000 persons live in the aggregate 40,858 years; and their mean lifetime is 40·858, nearly 41 years. Of their number 503 live to the age of 45; and after that age they live 11,771 years, so their mean *after lifetime* at 45 is 23·4 years. This is often called the *expectation of life.* The given age *plus* the mean after lifetime is the mean age at which they die.

And it is evident that in judging of the effects of the suppression of a single disease three cases have to be considered: (1) The whole of the lives will die of the other diseases in no greater proportion than before; (2) those other diseases, such as scarlet fever and measles, will grow so much more fatal, as to make up by the loss on this head for the gain on the other, say small-pox; (3) the gain by the supercession of one disease will exceed the loss by the increment of others; or the reverse; so as to result in a partial gain or a partial loss.

It will be convenient to consider first the cases to be, by hypothesis, of the first class; where, as for instance, when men are saved from a violent death they live as long as other people, and the rest of the community remain as they were. Then if the diseases suppressed are such as are fatal in the first year of life, for example, such as the debility and atrophy from premature birth or other causes, convulsions, bronchitis, pleurisy, pneumonia, and diarrhœa fatal soon after birth; then instead of 149,493 dying in the first year, 101,147 of that number will live through the year unless they are carried off by other diseases. Assume for a moment that this will result in an addition to the years lived by the million born, of the years lived by 100,000 average lives saved, then the mean lifetime will become instead of 40·9 years, that number of years augmented by a tenth more or 45·0 years.

Now take any other disease in the end fatal to one tenth of the living at the age of 55, and assume that by some expedient, medical art can prevent any death from it after that age, and what will be the effect on the after lifetime? It will evidently only add the years that a number of persons of that age and upwards live when they are subject to no attacks of the suppressed malady. No effect is produced in early life, and no addition is made in this case to the years lived in manhood up to the age of 55, so the expectation at birth is extended, but not greatly; whereas the full effect is felt by the men of the age of 55 and upwards. They have an enemy the less to encounter through the whole of their career to come.

There is a certain number of diseases that medical art hopes, for various reasons, to prevent. Such are small-pox, measles, scarlet fever, diphtheria, whooping-cough: some of these, if not of recent origin, were not recognized by the ancients.

Small-pox is apparently referred to by Gregory of Tours (565–8); and it is believed to have entered Europe through Arabia. The great Rhazes, who died in the year 923, was physician to a hospital in Bagdad; and he first described measles and scarlet fever under distinct names, as Sprengel shows, although the fact that he did so had been overlooked. Avicenna places scarlet fever as a distinct disease between small-pox and measles. Whooping-cough first appeared in France in 1414; and Mezerai says it cost the life of every person it attacked. Something very like syphilis had been known before; but true syphilis broke out in the summer of 1493 almost simultaneously in every part of Europe.*

* Sprengel's Histoire de la Médicine, Ed. Littré, vols. 2, 3. See pages in Index. Rhazes on Small-pox and Measles, translated from the original Arabic by W. A. Greenhill, M.D., 1858. This work of Dr. Greenhill well sustains the reputation of English medical learning. Singularly enough Rhazes himself says that the "excellent Galen" refers to "small-pox" four several times in his work; but Dr. Greenhill makes it probable that Rhazes was misled by an erroneous translation of the Greek term, pp. 141–2.

Leprosy at the same time declined. Diphtheria is apparently of recent birth. No doubt the origin of these diseases, and of others of the kind, is involved in as much obscurity as the origin of species; for they are also propagated in men by low species of organic life. What is certain is that they do not exist in every community; and that when they are introduced among a virgin population they attack great numbers, as in the instance of the small-pox among the Red Indians, the measles in the Fiji Islands quite recently. The exclusion of the zymotic elements, if it be complete, therefore saves free people from invasion.

But these diseases, as a general rule, attack the same person only once in his life; and the great discovery that small-pox, for some reason or other, when induced by art, assumes a milder form, led to the practice of inoculation in the East, from which it reached England. But this inoculated small-pox was sometimes fatal; and it spread the disease by infection, not in the modified, but in the pristine fatal form. To Jenner and to England belongs the immortal honour of guarding mankind against small-pox by cow-pox, which is neither fatal nor infectious.

No sooner had inoculation been introduced, than Daniel Bernoulli (1760), with very imperfect data, undertook the solution of the problem* now in hand: D'Alembert immediately attacked the hypotheses and the arguments of Bernoulli in favour of inoculation: the controversy showed the mathematical difficulties of the problem to be much greater than was suspected. The whole question was discussed by Duvillard in a work still classical in vital statistics, in which he endeavours to supply the defective data by the resources of the higher analysis. He came to the conclusion that vaccination would add 3·5 years to the existing mean lifetime.†

As the mortality from all causes collectively, and from different causes, at the several ages, is known in England, I propose to show here how far the mortality is reduced by deducting from the general mortality the mortality from phthisis, from cancer, and from all miasmatic diseases. And then a Table‡ will show the number of survivors out of a million births, in the absence of the deaths from these three classes of causes. Precisely the same method is applicable to any other class of diseases.

Diseases such as scarlet fever, that are exceedingly infectious, and that attack the same life only once, will have attacked nearly every one attaining the age of 35, and will leave afterwards very few susceptible. Thus very few die at later ages of scarlet fever or measles, and scarcely any of whooping-cough. These diseases have no sensible effect on the expectation of life after young people are of age.

The labour of constructing and graduating Life Tables being considerable, I have, to illustrate this question, employed the short method I introduced in the Appendix to the Registrar-General's Fifth Annual Report. It is sufficiently exact for the purpose in hand.§

The male mortality for the years 1861–70 is used. The subjoined extract shows the rates of mortality inclusive, and exclusive of the mortality by zymotic diseases, by phthisis, and by cancer.

The result is that if none of the males died of any *zymotic disease*—Order I.—the duration of life would be raised, should they remain subject to the existing rates of mortality from all other diseases.

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* Analyse et Tableaux de l'Influence de la Petite Vérole, par E. E. Duvillard. Paris, 1806.

† Duvillard's Table, derived from what he calls the Law of Mortality (in France) in the natural state, makes the mean lifetime 28·763; whereas it would be 32·256 if no one died of small-pox. See page 143, where he states that the cessation of small-pox would raise the population from 28,763,192 to 32,255,775.

‡ See Supplement to 35th Annual Report, p. clxix, Table 60.

§ See extract on pp. 465–7.

Of the 510,622 boys born, no less than 411,350 will live to the age of 5; 403,871 to the age of 10; 343,674 to the age of 35; the mean after lifetime at birth would be raised from 39·68 to 46·77.

Applying the same method to the effect of the suppression of *phthisis*, which produces its maximum effect later, the mean after lifetime at birth is raised to 42·96, at 35 to 30·77.

The suppression of *cancer* would raise the mean after lifetime at birth to 39·88; at the age 35 to 29·01; at the age 55 to 16·25.

The same method will show the effect of the suppression of any other disease.

Small-pox is the only disease which can practically be superseded to a great extent by a disease itself not mortal. But the opponents of vaccination contend, that so far from leaving other diseases as they were it increases their rates of mortality. Of course, as more live more are attacked by other diseases; but this proves nothing, so long as the lives saved from small-pox only die from other diseases in the same proportion as the rest left before small-pox reigned. There can be no doubt that cow-pox is a variety of small-pox, and is induced by transmitting small-pox lymph through the cow. Small-pox, if not fatal, does not exempt any one from measles or scarlet fever. To contend that small-pox in its severe form, if it do not kill the patient, renders him less, while the milder form renders him more, susceptible of other diseases, derives no support from analogy.

Efforts should be made to reduce all the contagious recurrent diseases to a minimum, by placing the whole population in as favourable a sanitary condition as possible, so that these diseases may be taken, as they are then, in the mildest form. The effect of favourable sanitary conditions is seen in the healthy districts, from which neither measles nor scarlet fever are excluded. They are both less fatal.

The LIFE TABLE DEATHS to 1,000,000 CHILDREN born alive are—

——	In Healthy Districts.	In England.	In Liverpool.
From Small-pox - -	2,359	6,521	8,141
" Measles - - -	6,912	12,865	26,973
" Scarlatina - -	21,403	30,021	38,302
" Whooping-cough - -	10,234	15,161	34,021
" Fever (Typhus, Enteric, and Simple) - -	28,146	38,107	76,563

If every child is attacked by scarlatina at some time of life, then there are 1,000,000 cases, and by the English Life Table 30,021 deaths: so the mortality of the cases is 3 per cent. The mortality of cases is at the rate of 2 per cent. in the healthy districts; 4 per cent. in Liverpool. This is the minimum mortality of cases, for thousands die young of other diseases before they can be attacked by scarlatina. By measles, whooping-cough, and fevers (typhus, typhoid, and typhinia) the variation of mortality is still greater in healthy and unhealthy conditions.

Dr. Watt showed that while the sanitary conditions of Glasgow were deplorably defective, the exclusion of small-pox had not the effect of reducing the general mortality ? as in those years the fatality of other diseases increased.* And further observations tend to show that healthy

* See Registrar-General's 30th Annual Report, Appendix, p. 213, and Treatise on Chin-cough, by Robert Watt, M.D. (1813), pp. 375–9.

sanitary condition as to food, drink, and cleanliness of person, house, and city, stands first in importance; after it, but subordinately, come quarantine, vaccination, and other preventives, as means of subduing mortality; for the mere exclusion of one out of many diseases appears to be taken advantage of by those other diseases, just as the extirpation of one weed makes way for other kinds of weeds in a foul garden.

The effect on the lifetime of extinguishing each separate disease in England may be determined by the same method, from Tables giving the deaths of males, and of females, from every cause of death distinguished in the tabular returns for the 25 years 1848–1872.

The effect of the subtraction of the early fatal zymotic diseases, and of phthisis, fatal in middle life, is to leave greater numbers alive at the advanced ages,—greater numbers therefore to die of the diseases attendant on advancing age. As fatal consumption is developed later in life than scarlatina,* so cancer sets in after consumption: thus we find that of a million born in the healthy districts, 21,403 die of scarlet fever, 108,481 of consumption, and 27,495 of cancer: whereas out of the same number in Liverpool, 38,302 die of scarlet fever, 96,676 of phthisis, and 9,992 of cancer. In Liverpool, and in the unhealthy districts, the children do not live to encounter the diseases of old age. As men die everywhere, the great difference consists in this—that in one set of circumstances a small part, in another a large part, of the cycle of life is accomplished. (Supplement to 35th Annual Report, pp. xxxviii–xli.)

Economic effect of Deaths by different Diseases.—Life has a pecuniary value. In its production and education a certain amount of capital is sunk for a longer or shorter time, and that capital, with its interest, as a general rule, reappears in the wages of the labourer, the pay of the officer, and the income of the professional man. At first it is all expenditure, and a certain necessary expenditure goes on to the end to keep life in being, even when its economic results are negative.

The value of any class of lives is determined by valuing first at birth, or at any age, the cost of future maintenance, and then the value of the future earnings. Thus proceeding, I found the value of a Norfolk agricultural labourer to be 246*l.* at the age of 25: the child is by this method worth only 5*l.* at birth, 56*l.* at the age of 5; 117*l.* at the age of 10; the youth 192*l.* at the age of 15; the young man 234*l.* at the age of 20; the man 246*l.* at the age of 25, and 241*l.* at the age of 30, when the value goes on declining to 138*l.* at the age of 55, and only 1*l.* at the age of 70; the cost of maintenance afterwards exceeding the earnings, the value becomes negative; at 80 the value of the cost of maintenance exceeds the value of the earnings by 41*l.* These values may be compared with the former cost of slaves in Rome, in the United States, and in the West Indies.

The amount of capital sunk in the education of professional men is not only greater, but it is probably at greater risk, and it has to remain longer under investment before it is returned. The maximum value of such a man is attained later in life, probably 40; and in the highest orders of the church, law, and politics, where experience and great weight of character are requisite, the life still increases in value at higher ages.

The causes that destroy the greatest number of lives in their prime—and are therefore first in importance—are fever, consumption, violence; plagues, cholera, and war, where they prevail. Small-pox, too, where

* Phthisis and scarlatina are synonyms of consumption and scarlet fever. Scarlatina was used in the Office Tables until the year 1869, when scarlet fever was substituted for it.

there is no vaccination, is fatal to large numbers of grown-up people. Many Englishmen are drowned at sea; and this will be considered hereafter, for it is only one example of the deaths of men resulting from their pursuits, not only in the army and navy, but in civil life.

The greatest occupation of women, as on that the continuance of the human race depends, is at the prime of life,—childbirth, childbreeding; up to that time all their force accumulates. Of a million children born, 488,255 of them being girls, 6,921 will die of childbirth. They die at the average age of 32. If this generation exactly reproduces its own numbers, it gives birth to a million children, neither more nor less; but it does more than this, for the births in that case would be 144 to 1 death from childbirth, whereas the facts show that the mortality in childbirth is in the proportion of 1 mother to 211 children born alive. Consequently the 6,921 deaths of mothers imply that this generation represented in the Table gave birth to 1,458,190 children to constitute the generation to follow. The increase of numbers thus deduced is 4·58 per cent. in 32 years, or 1·18 per cent. annually.

If English women only bore children enough to keep the population stationary, the tabular deaths by childbirth would be 4,746 instead of 6,921; so 2,175 devoted mothers die of what some might call overwork; but it is work by which new nations are founded. And happily it is work the dangers of which can be incalculably diminished by medical art.

Enough has been established to prove the supreme importance of making renewed efforts to save the most precious of precious lives from fever, consumption, cholera, violence in all its forms, and childbirth. (Supplement to 35th Annual Report, pp. xli–ii.)

STATEMENT of the Particulars published from Year to Year in the Registrar General's Annual Reports in connection with the ABSTRACTS of CAUSES of DEATH in ENGLAND and WALES, 1837–75.

No. of Registrar General's Annual Report.	YEAR.	PARTICULARS PUBLISHED.
1st.	1837	Causes of Death of Males and of Females *without distinction of Age* in England and in 25 Territorial Sub-divisions, from 1st July to 31st December. Causes of Death in Town and Rural Districts compared. Deaths from Epidemical Diseases in first and second quarters in Districts where these Diseases principally prevailed.
2nd.	1838	Causes of Death of Males and of Females *without distinction of Age* in England and in 25 Territorial Sub-divisions. Causes of Death in Town and Rural Districts compared. Deaths from Classes of Diseases in 11 Divisions. Causes of Death of *Persons* in 324 *groups* of Districts and in 11 Divisions.
3rd.	1839	Causes of Death of Males and of Females *without distinction of Age* in England and in 25 Territorial Sub-divisions. Causes of Death *at different Ages* (0, 1, 3, 5, 10, 15, 20, and *decennial* Ages up to 100) of Males and of Females in Manchester, Liverpool, and Birmingham. Deaths of Males and of Females from Classes of Diseases in 11 Divisions. Causes of Death of *Persons* in 324 *groups* of Districts and in 11 Divisions.
4th.	1840	Causes of Death of *Persons* in England in each of three years 1838–40. Causes of Death of Males and of Females in England, in 11 Divisions, and in Counties (for *Persons* only in London). Causes of Death of *Persons* in 324 *groups* of Districts. These abstracts are *without distinction of Age.*
5th.	1841	Causes of Death of *Persons*, of Males, and of Females *without distinction of Age* in England and in 11 Divisions (for *Persons* only in London); and of Males and of Females in Counties and in 324 *groups* of Districts. Causes of Death of Males and of Females *in combination with Ages* (0–1, 1–3, 3–5, 5–10, 10–15, 15–20, and *decennial* Ages up to 90 years and upwards), in 24 Town Districts in the year 1840. Deaths from Small-pox, Measles, Scarlatina, and Typhus in each quarter of 1841 in Divisions, Counties, and 324 *groups* of Districts.

STATEMENT of the Particulars published from Year to Year in the Registrar General's Annual Reports in connection with the ABSTRACTS of CAUSES of DEATH in ENGLAND and WALES, 1837–75—*continued.*

No. of Registrar General's Annual Report.	YEAR.	PARTICULARS PUBLISHED.
6th.	1842	Causes of Death of *Persons*, of Males, and of Females *without distinction of Age* in England, and of Males and of Females in 10 Divisions (London not given in this Table), in Counties and in *groups* of Districts. Deaths from Small-pox, Measles, Scarlatina, and Typhus in each quarter for 1842, as in previous Report. Causes of Death in each of the years 1838–42, and Annual Mortality from each Cause to 1,000,000 Persons living. Violent Deaths in 11 Divisions, classified according to Occupations, Nature of Violent Death, and Age.
7th. (a)	1843, 1844	The Causes of Death were not abstracted for England in these Years.
8th.	1845	
9th.	1846	

(*a*) In the 7th Report were published the Causes of Death in each of the years 1838–42, as in previous Report; also Causes of Death of Males and of Females *without distinction of Age* in grouped Districts of Kent; and Causes of Death, *in combination with Ages*, of Males and of Females in the county of Kent (Ages 0, 1, 2, 3, 4, 5, and *quinquennial* Ages up to 100).

No. of Registrar General's Annual Report.	YEAR.	PARTICULARS PUBLISHED.
10th.	1847	Causes of Death of Males and of Females *in combination with Ages* (0, 1, 2, 3, 4, 5, and *quinquennial* Ages up to 95), in England and in 11 Divisions (107 Causes of Death). These are the first Abstracts of *Ages and Diseases* for all England.
11th.	1848	Causes of Death of Males and of Females *without distinction of Age* in England in 11 Divisions, and in Counties.
12th.	1849	Same Tables as in Report for 1848.
13th.	1850	
14th.	1851	
15th.	1852	
16th.	1853	Ditto, and Specimen Table of Causes of Death and *Ages* of Females in England, classified according to the arrangement proposed by Dr. Farr to the Statistical Congress.
17th.	1854	Same Tables as in Report for 1848.
18th.	1855	Causes of Death (107) of Males and of Females, *in combination with Ages* (0, 1, 2, 3, 4, 5–10, 10–15, and *decennial* Ages up to 95), in England. Diseases, *without distinction of Age*, of Males and of Females in England in 11 Divisions and in Counties. Supplementary Table for England of certain Causes of Death of Males and of Females *at different Ages*, classed for sake of abbreviation under some of the 107 heads in the Grand Table, but which are nevertheless distinct Causes of Death, though fatal to few persons. Causes of Death, *in combination with Ages*, of Males and of Females in England in the 7 years 1848–54 and in each of those years (Causes of Death and Ages the same as for 1855).
19th.	1856	Causes of Death of Males and of Females, *in combination with Ages*, in England. Causes of Death *without distinction of Age* in England in 11 Divisions and in Counties. Supplementary Table for England, as in previous Report. The Table of Deaths from several Causes (chiefly zymotic diseases) in Divisions, Counties, and Districts was published for the first time in this Report, and has been continued in all subsequent Reports.
20th–38th.	1857 and 1858–75.	The arrangement adopted in the Report for 1856 has been adhered to up to the present time, excepting that a new classification of Causes of Death was introduced in the 21st Report for 1858; and in that for 1859 the group of Ages 15–25 was divided thus: 15–20, 20–25. The same classification, with slight variations, of Causes of Death in combination with Ages was published in all subsequent Reports, until that for 1880, inclusive. In the Report for 1881 considerable changes in the classification of Diseases were introduced.
—	1869	The new nomenclature of Diseases by the Committee of the College of Physicians was distributed gratis among the legally qualified medical practitioners, and among the registrars, of England and Wales.

STATEMENT of the Particulars published from Year to Year in the Registrar General's Annual Reports in connection with the ABSTRACTS of CAUSES of DEATH in ENGLAND and WALES, 1837–75—*continued.*

No. of Registrar General's Annual Report.	YEAR.	PARTICULARS PUBLISHED.
36th.	1873	A Table was published of the Deaths by different Diseases in England classified according to the new nomenclature. It includes Deaths for the years 1866–73, and the series has since been continued.
38th.	1875	In this Report the Supplementary Table of certain Causes of Death, explained above in connection with the 18th Report for 1855, will be found incorporated with the *Grand Table for England and Wales.* The numerous diseases hitherto forming the Supplementary Table are now generally bracketed with those allied Diseases, the names of which were, for sake of brevity, intended to include them. In the Table of *Divisions and Counties*, however, the classification remains unaltered.

NOTE.—The deaths from scarlet fever and diphtheria were separately returned in 1855, having been previously to that date shown under the heading of scarlatina. The various forms of fever were not distinguished until 1869, but were all included under "typhus." In the Report for that year and in subsequent Reports, the deaths from fever were classified under the three distinct forms of typhus, enteric, and simple continued fever.

LONDON.—STATEMENT of the Particulars published from Year to Year in the Registrar General's Annual Reports in connection with the ABSTRACTS of CAUSES of DEATH in LONDON, 1837–75.

No. of Registrar General's Annual Report.	YEAR.	PARTICULARS PUBLISHED.
1st.	1837	Causes of Death of Males and of Females *without distinction of Age* from 1st July to 31st December. Deaths from Epidemical Diseases in Districts.
2nd.	1838	Causes of Death of Males and of Females *without distinction of Age*, and ditto in Districts. Causes of Death of Males and of Females in London and in rural Counties compared.
3rd.	1839	Causes of Death of Males and of Females *without distinction of Age*, and *in combination with Ages*, for the Hospitals. Table of Causes of Death in each of 52 weeks, 1840, and Table of Causes of Death *in combination with Ages* (0–15, 15–60, 60 and upwards) in each week May 1840 to May 1841 (reprint from Weekly Tables). Causes of Death of *Persons* in Districts.
4th.	1840	Causes of Death of *Persons* in each of the three years 1838–40, from summary of 52 weeks. Causes of Death *and Ages* for Hospitals. Causes of Death of *Persons* in the two years 1840–41, at the *Ages* 0–15, 15–60, 60 and upwards.
5th.	1841	Causes of Death of *Persons* from summary of 52 weeks, adjusted. Causes of Death *and Ages* (0–1, 1–3, 3–5, 5–10, 10–15, 15–20, and *decennial* Ages up to 90) of Males and of Females in each of the four quarters of 1842, and similar Table for the whole year. Causes of Death *at Ages* 0–15, 15–60, 60 and upwards, in the two years 1840–41. Summary of Weekly Tables, 1842.
6th.	1842	Causes of Death of *Persons without distinction of Age.*
7th.	1843	Causes of Death *and Ages* of Males and of Females (Ages 0, 1, 3–5, 5–10, 10–15, 15–20, and *decennial* Ages up to 90).
	1844	Causes of Death of Males and of Females (same *Ages* as in previous Report), 52 weeks.
8th.	1845	Causes of Death of Males and of Females (*Ages* 0, 1, 2, 3, 4, 5, and *quinquennial* Ages up to 95), 52 weeks. Ditto for the year 1846.

LONDON.—STATEMENT of the Particulars published from Year to Year in the Registrar General's Annual Reports in connection with the ABSTRACTS of CAUSES of DEATH in LONDON, 1837-75—*continued.*

No. of Registrar General's Annual Report.	YEAR.	PARTICULARS PUBLISHED.
9th.	1846	Causes of Death of *Persons* without distinction of Age in each quarter of each of the years 1840-47.
10th.	1847	Causes of Death (107) of Males and of Females *in combination with Ages* (0, 1, 2, 3, 4, 5, and *quinquennial* Ages up to 95).
11th.	1848	Same particulars as in Report for 1847.
12th.	1849	
13th.	1850	
14th.	1851	
15th.	1852	
16th.	1853	
17th.	1854	
18th.	1855	Causes of Death (107) of Males and of Females *in combination with Ages* (0, 1, 2, 3, 4, 5-10, 10-15, and *decennial* Ages up to 95).
19th.	1856	Causes of Death of Males and of Females *in combination with Ages.*
20th-38th.	1857 and 1858-75.	The arrangement adopted in the Report for 1856 was adhered to up to 1880, inclusive, excepting that a new classification of Diseases comprising Classes and Orders was introduced in the Report for 1858; and in that for 1859 the group of Ages 15-25 was divided thus: 15-20, 20-25. The same classification, with slight variations, of Diseases in combination with Ages was published in all subsequent Reports up to and inclusive of that for 1880. In the Report for 1881 considerable changes in the classification of Diseases were introduced.

NOTE.—The first Weekly Table for the Metropolis appeared for the week ending Saturday, the 11th January 1840. This publication, with numerous improvements, has been continued ever since. From 1840 to 1850, inclusive, the deaths classified according to *diseases*, were obtained for the Annual Reports from the 52 or 53 weeks of each year; in 1851 and in subsequent years, however, the deaths were abstracted a second time for the Annual Reports.

(38th Annual Report, pp. 272-4.)

6.—CAUSES OF DEATH: EPIDEMIC, INFECTIOUS, AND ZYMOTIC DISEASES.

Laws of Epidemics.—Epidemics appear to be generated at intervals in unhealthy places, spread, go through a regular course, and decline; but of the cause of their evolutions no more is known than of the periodical paroxysms of ague. The body, in its diseases as well as its functions, observes a principle of periodicity; its elements pass through prescribed cycles of changes, and the diseases of nations are subject to similar variations.*

* The hypothesis that the causes of epidemics are generations of minute insects transmitted from one individual to another, through the medium of the atmosphere, has been ingeniously put by Dr. Holland in his "Medical Notes and Reflections." Henle, of Berlin, has supported the theory by new facts and analogies. The diffusion of contagion has a close analogy with fermentation; and Cagnard-Latour and Schwann have shown that fermentation is the decomposition of organic fluids by minute vegetables of the lowest class. Putrefaction is a destruction of organic matter effected by infusoria, and not a mere decomposition into elements. One contagious disease, the muscardine of the silkworm, is known to depend on the development of a vegetable parasite. The germs are innumerable, and spread with the greatest rapidity. In mixtures, certain genera of infusoria appear, and then give

If the latent cause of epidemics cannot be discovered, the mode in which it operates may be investigated. The laws of its action may be determined by observation, as well as the circumstances in which epidemics arise, or by which they may be controlled.

Amidst the apparent irregularities of the epidemic of small-pox, and its eruptions all over the kingdom, it was governed in its progress by certain general laws. The deaths in the early stage of the epidemic were not registered. To avoid circumlocution, it will be convenient to call the ten quarters in which the deaths were registered the ten periods, the first quarter the first period, the second the second period, &c. &c. The mortality increased up to the fourth registered period; the deaths in the first were 2,513, in the second 3,289, in the third 4,242; and it will be perceived at a glance that these numbers increased very nearly at the rate of 30 per cent. For, multiply 2,513 by 1·30 and it will become 3,267; multiply 3,267 by 1·30, and it will become 4,248. The rate of increase is retarded at the end of the third period, and only rises 6 per cent. in the next, where it remains stationary, like a projectile at the summit of the curve which it is destined to describe.

The decline of the epidemic was less rapid than its rise, and the mortality was somewhat greater in the autumns of 1838 and 1839 than in the summers. But by taking the mean of the deaths in the third and fourth period, the mean of the deaths in the fourth and fifth period, &c., &c., a regular series of numbers is produced.

DEATHS observed in the decline of the Epidemic.

1	2	3	4	5	6	7
4,365	4,087	3,767	3,416	2,743	2,019	1,631

DEATHS in a regular series.

1	2	3	4	5	6	7
4,364	4,147	3,767	3,272	2,716	2,156	1,635

The 4,365 may be considered to represent the deaths that happened between the middle of February and the middle of May. The regular series of numbers has been calculated upon the hypothesis that the fall of the mortality took place at a uniformly accelerated rate.

The calculated numbers are sometimes a little too high, and sometimes too low; but, on the whole, the agreement is remarkable. The second number (4,147) is nearly 5 per cent. lower than the first; and the decrease is successively 5, 10, 15, 20, 26, and 32 per cent. The rates of decrease are 1·052, 1·101, 1·152, 1·205, 1·260, 1·318. The division of 4,364 by 1·052 reduces it to 4,147; the division of 4,147, by 1·101 produces 3,767, &c. The mortality decreased at accelerated rates; and the rate of acceleration was 1·046, which, by successive

place to new genera. Individual cases of disease may be caused by one generation of parasites; an epidemic by successive generations. Each epidemic disease has its specific animal contagion, its specific genera of infusoria. Henle has proved the existence of this cause, and the truth of the theory in every way but one; he has never seen the epidemic infusoria. The omission is, no doubt, important; and the more so on the part of Henle, who is justly considered one of the best microscopic observers in Germany. The infusorial hypothesis does not satisfactorily explain the cause of epidemics; it accounts for them by the creation of animalcules, but does not show why the animalcules are created at distant times in swarms. The phenomena of swarms of insects, of blight, and of infusorial generation, may suggest investigation; but in the present state of pathology they cannot supply its place.—*Pathologische Untersuchungen. Von Dr. Henle, Berlin,* 1840. *British and Foreign Medical Review, April,* 1840.

multiplications, will reproduce all the rates, 1·052, 1·101, &c., &c. The rate 1·046 may be called the constant.

The mortality from small-pox was greater in the metropolis than in all the other parts of England: and the rate of increase in the second, third, and fourth periods was 1·50, the deaths having been 506, 753, and 1,145. The rate of increase in the first and second periods was 1·97, the deaths were 257 and 560.

The decline of the epidemic in the metropolis is shown by the following numbers:—

METROPOLIS.

	1	2	3	4	5
1. Mean quarterly Deaths registered - -	1,103	959	611	240	91
2. Calculated series -	1,103	967	611	278	91

The number 1,103, in the upper line, was the mean of the deaths registered in the fourth and fifth periods; 959 was the mean of the deaths in the fifth and sixth periods; the other numbers were obtained in the same manner. The first rate of the calculated series was 1·14, and the other rates were obtained by multiplying 1·14, four times in succession, by 1·39, the constant.

I subjoin one more comparative series, deduced by the same methods:—

WALES and the WESTERN COUNTIES of ENGLAND.

	1	2	3	4	5	6	7	8
1. Mean quarterly Deaths registered	1157	813	621	489	304	194	116	81
2. Calculated series -	1157	858	621	440	304	206	136	88

The first rate was 1·35; the constant, 1·023.

The rates vary with the density of the population, the numbers susceptible of attack, the mortality, and accidental circumstances; so that to obtain the mean rates applicable to the whole population, or to any portion of the population, several epidemics should be investigated. It appears probable, however, that small-pox increases at an accelerated and then a retarded rate; that it declines first at a slightly accelerated, then at a rapidly accelerated, and lastly at a retarded rate, until the disease attains the minimum intensity, and remains stationary. The degrees of acceleration, and certain corrections, have been neglected in the previous calculations, and the neglect of them produced a little discrepancy between the observed and calculated facts; but it may be well to give one example in which all the corrections are made.

The quarterly rate of mortality by small-pox is obtained by dividing the deaths in a quarter by the population existing in the middle of the quarter; by dividing 4364, for instance, by the population of England on the 31st March, 1838. The annual rate of mortality is expressed by four times the quarterly rate ($\cdot00028 \times 4 = \cdot00112$, the annual rate of mortality by small-pox). The quarters vary in length, from 90 to 92 days; their mean duration is 91¼ days; and to be strictly accurate, the mortality of the March quarter must be raised in the proportion of 90·5 to 91·25. The rates of mortality in England in the following table have been corrected in accordance with these principles.

SMALL POX.

———	1838.				1839.	
	March 31.	June 30.	Sept. 30.	Dec. 31.	March 31.	June 30.
Annual rate of mortality per cent. in England (observed)	·114	·105	·096	·086	·070	·051
Annual rate of mortality per cent. (calculated) - -	·114	·105	·096	·086	·070	·050

These two series of numbers exactly agree; the rates of decrease in the six periods were 1·08, 1·09, 1·11, 1·24, and 1·39. The first three were produced by multiplying by 1·011, the two last by 1·12. The first constant 1·011, extended over the year 1838; the second, nearly the tenth power of the first, over the first half of the year 1839.

The small-pox would be disturbed, and sometimes arrested, by vaccination, which protected a part of the population, and by inoculation, which there is reason to believe led to the extension of the epidemic by diffusing the infection artificially.—(2nd Annual Report, pp. 95–8.)

Cause and Effect of Zymotic Disease.—To prevent the ravages of zymotic diseases we have to go beyond their pathological phenomena; and it must be recollected that every death represents several occurrent cases, varying with age, with hygienic condition, and with medical treatment. The exact determination of the factors of mortality in the several types of disease lies at the foundation of therapeutics, yet it has been strangely neglected. The new Clinical Society might well take this in hand. To illustrate what is here meant Dr. Murchison shows that in the ten years, 1848-57, at the London Fever Hospital the mortality of cases of continued fever was at the rate of 10 per cent. at the age of 15–25, and 15 per cent. at the age of 25–35; so to 10 and to 15 deaths at the two ages there were 100 cases of fever. Proceeding further in the analysis of the three forms of such fever he shows that the mortality from typhus at the same two ages is 7 and 16, from enteric fever 18 and 22, from relapsing fever next to nothing. That is in the London Fever Hospital.* The rates vary in private houses according to the condition of those houses; and we may assume that the danger varies under different lines of medical treatment. Here is a wide field for interfering with the operation of pathological causes of death. It is the great function of the medical profession. They arrest, they render zymotic diseases less lethal by drugs, diet, and hygienic regulation. The force Physic has at its command is undetermined, but it will increase as the science and the art increase, and as the distribution and the organisation of the profession are improved.

Intermittent and remittent fevers are known to be generally induced by marshes. Dr. Salisbury endeavours to trace ague to the pollen of a palmella. Whatever the direct agent may be we know that the danger from these diseases is obviated in two ways; (1) by avoiding marshy tracts altogether, and (2) by draining and converting the marshes into cultivated land, as has been done partially in England. On the the undrained lands of the lower valleys of the Thames and of other English rivers, where their waters are slow, sluggish, thrown out of their channels by milldams, thousands of the population suffer from ague, rheumatism, and neuralgia, while many die of these and of other diseases. Drainage of the marsh land, removal of obstructions to rivers, and

* Murchison on Fever, pp. 221, 369, and 531.

engineering improvements of the water channels, will obliterate countless evils.

The mere aggregation of people together in close apartments generates or diffuses the zymotic matter. Thus, place lying-in women in close proximity to each other, or mix them up with the patients of a general hospital and they die of puerperal fever; place many wounded men in a ward where cleanliness is neglected, and erysipelas, pyæmia, gangrene spring up; imprison men within narrow walls, or crowd them in rooms and typhus breaks out. The general and special hospitals of the country have been, until quite recently, erected without any special reference to the dangers accruing from the assemblage of great masses of sick people within the walls of one building, so that the efforts of the most skilful medical officers are frequently defeated; but a better system of hospital construction, with more cubic space, is likely to prevail, with due provision for effective changes of air, and then the evils of agglomeration will be mitigated. It is only recently that the subject has attracted the attention of surgeons,* who will no doubt anxiously watch the results of the new arrangements. Sir Henry Thompson and Sir James Simpson will, we may hope, continue their researches so as to determine accurately the mortality after the various kinds of amputation in hospitals and in private houses.

To limit the operation of zymotic diseases overcrowding in towns must be absolutely prohibited: the mere accumulation of masses of living people within narrow limits either generates or insures the diffusion of epidemic disease. The plague which almost destroyed Athens was aggravated by the policy of Pericles when he brought the outlying country population within the walls. It is now as then a conflict of difficulties; for the question arises, where can the people live if you turn them out of cellars or garrets; and the alternative is in appearance cruel. But as a healthy city of a limited number of inhabitants enjoys life and fulfils the destiny of its race, while a crowded, suffering, sickly, degenerated city of twice the population only drags on a wretched existence in violation of the principles of life and the operations of nature, laws against over-crowding must be rigorously enforced.

SMALL-POX.—To render the body insusceptible of one zymotic disease of a disfiguring and distressing nature is in itself a good thing, and there is no evidence to show, nor is it likely, that pure vaccine lymph induces any other disease than cow-pox. The number of deaths due to vaccination is inconsiderable. It bears no comparison with the number of deaths by natural small-pox. And the opposition to vaccination on any of these grounds is irrational.

It is, however, by no means proved that the general mortality under unfavourable sanitary conditions is much reduced by rendering a child insusceptible of one type, while he remains exposed to all other types of zymotic disease. This was clearly pointed out in a remarkable treatise by Dr. Robert Watt, lecturer on the theory and practice of medicine in Glasgow. The work was dedicated to Sir Gilbert Blane. Dr. Watt

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* Sir Astley Cooper, in his lectures as reported in the *Lancet*, refers to cold and other causes of gangrene, but has no reference, as far as I can find, to its origin in the poison of hospitals. Under erysipelas this passage occurs: "In hospital practice surgeons were "formerly exceedingly afraid to operate in autumn and spring, for it " has often happened that the *stimulating effects of adhesive plaster* have produced " this disease, and have led to the death of the patient. Sometimes it is epidemic " and sometimes contagious." *Lancet*, Vols. I., II., edited by T. Wakley, surgeon, 1826, p. 247. Pyæmia is not referred to specifically by the great surgeon.

found that, in accordance with his own experience, the Glasgow burial registers showed a decisive decline of the deaths by small-pox after the introduction of vaccination. His researches extended over the 30 years 1783–1812,* which he divided into *five* equal periods of six years each. In the first three periods (1783–1800), before "vaccination could have "had any influence," the deaths by small-pox in 100 deaths from all causes were 20, 18, 19; in the fourth period (1801–6), vaccination had nearly reached its maximum, and the deaths by small-pox fell to 9; in the fifth period (1807–12), when vaccination had "been pretty fully "established, perhaps as much so as in any other city in the empire," the proportion fell to 4. This gratifying result was to some extent counterbalanced by a slight increase in the proportion of deaths by whooping-cough, and a great increase in the deaths by measles. What was still more strange, Dr. Watt found that the proportion of deaths under 10 years of age, to the deaths at all ages, was rather greater in the last than in the first 6 years. He does "not see the smallest ground for the "hypothesis that vaccination does positive harm" "by infusing some "peccant . . . humor into the constitution." But in the first period, "when a third of all the deaths under 5 years of age were caused by "small-pox," a child had the best chance of reaching its tenth year. Dr. Watt was far from expecting this result. He had found that "more than 50 per cent. of the human species died before they were "10 years of age," and that 20 out of 100 born, excluding still-born, "perished by this dreadful malady."†

This is an important point in pathology; and it must be admitted that although there were defects in his data Dr. Watt succeeds in showing (1) that small-pox was one of the great causes of death in Glasgow down to the year 1800, (2) that the deaths by small-pox were reduced to a fifth of their original number by vaccination, and (3) that the children died in nearly the same numbers as before, but of other forms of disease.

Glasgow was then rapidly increasing, and it is possible that the births were then increasing, the mortality is therefore less than it appears to be by Dr. Watt's method. But this does not invalidate his induction.

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* Appendix to Treatise on Chincough, by Robert Watt, M.D. (1813), pp. 375–379.

† Dr. Watt describes vividly his astonishment, pp. 334–336:—

"I began to reflect how different the case must be now! In eight years little more than 600 had died of the small-pox; whereas in 1784 the deaths by that disease alone amounted to 425, and in 1791 to 607, which on both occasions exceeded the fourth of the whole deaths in the year.

"To ascertain the real amount of this saving of infantile life, I turned up one of the later years, and by accident that of 1808, when, to my utter astonishment, I found that still a half or more than a half perished before the tenth year of their age; I could hardly believe the testimony of my senses, and therefore began to turn up other years, when I found that in all of them the proportion was less than in 1808; but still in taking an average of several years it amounted to nearly the same thing as at any former period during the last 30 years. This was a discovery I by no means expected, and how it could have come to pass appeared to me inexplicable.

"From every circumstance which had come under my observation, the efficacy of vaccine inoculation appeared certain. The experience of 13 years' pretty extensive practice had confirmed me fully in this opinion. But still the question recurred, how are we to account for the same or nearly the same number of deaths under 10 years of age? As no new disease has appeared, the deficiency occasioned by the want of the small-pox must have been made up by a greater mortality among the other diseases of children. Has it been equally divided among them, or has a greater share fallen to some than to others? ["An inquiry into the relative "mortality of the principal diseases of children in Glasgow. Appendix to Treatise on Chincough, pp. 334–336. By Robert Watt, M.D. (1813)."]

Glasgow has always been famous for its statistics, and these unfortunately show an increase of the mortality of children. Thus in the five years 1821–5 the mortality of boys under five years of age was 8·08, in 1831–5 it was* 9·78. In the year 1865 the mortality of boys in Glasgow was 11·48, of girls 10·36.† These recent returns confirm the principle. Small-pox is no longer so fatal as it was before vaccination was introduced; in Glasgow it caused in the year 1854 no longer 20 but 2 in 100 deaths; only 180 in 6,054 deaths, that is 3 per cent. of the deaths under 5 years of age; yet the mortality of children is certainly as high, probably higher, than it was in the last 18 years of the last century.

The compulsory vaccination in England has reduced further the fatality of small-pox, but since 1853 other diseases have so prevailed as to counterbalance the gain under this head. The mortality of children has not declined in a corresponding degree.

It is singular that Dr. Watt, evidently a practitioner of great sagacity, and a philosophical professor of medicine, does not at all advert to the wretched sanitary condition in which the increasing population of Glasgow lived at the time he was writing. Yet a part of Glasgow, so late as 1841, is thus described by McCulloch.‡ "It consists of a "labyrinth of narrow lanes or wynds, whence numberless entrances lead "off to small squares, courts, or closes, which usually have a dunghill "[human] in the centre. These wynds and courts are formed of "old, ill-ventilated, and mostly dilapidated houses, varying from two "to four stories in height, without water, and let out in stories or flats; "one of the latter often serving for the residence of two or three "families. Frequently, however, the flats are let out in lodgings, as "many as 15 or 20 individuals being occasionally found huddled "together in a single room . . . . Filth, destitution, and misery prevail "to a frightful extent." I cite this passage to show under what circumstances the suppression of a most fatal type of disease did not diminish the mortality in Glasgow. And it is under unfavourable conditions of the same kind, although less in degree, that the mortality is now sustained in England, where the town populations constantly increasing, without equivalent arrangements for drainage and for accommodation in dwellings, are every year exposed to increasing dangers.

There are two diseases, scarlatina and diphtheria itself a new type of disease, which have been exceedingly fatal since the year 1855, when diphtheria was first distinguished in the returns. Up to 1857 it was apparently confounded with cynanche maligna; but in 1858 it became popular, and in that year 4,836 deaths, in 1859 no less than 9,587 deaths were ascribed to diphtheria. In 1858 and 1859 the deaths from scarlatina and diphtheria together were 30,317 and 29,494; in the two years 1863–4 the deaths from the same causes rose to 36,982 and 35,164. The mortality in 1858–9, from small-pox, had fallen to 3·35 and 1·97 annually in 10,000 living, while from scarlatina and diphtheria the mortality had risen in the two years to 15·72 and 15·13. In 1863–4 the mortality from small-pox was 2·93 and 3·73, from scarlatina and diphtheria 18·18 and 17·08. While small-pox dwindled, these two zymotic diseases flourished at the expense of the growing population.

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* M'Culloch; Statistics of British Empire, Vol. II. p. 547. Lancet, 1835–6, No. 12., paper by Mr. Edmonds.

† Report by Dr. Stark, F.R.S.E., 10th Report of Registrar General of Scotland, p. xxxiv.

‡ Geographical Dictionary, Vol. I. pp. 904–5, Art. Glasgow.

Small-pox, as a general rule, occurs only once in life; some children enjoy immunity against attack; they cannot be vaccinated, they cannot be inoculated; others are infected by the slightest exposure; and under infection some take the disease slightly, some malignantly, fatally. So it is with scarlatina, which now sweeps away a family of children, and is then slight or even unperceived in other families during the same epidemic; epidemics, however, varying in intensity and character from time to time, from place to place.*

It is impossible, in the present state of science, to reduce under any simple law the phenomena of disease development; but disease development is evidently associated with the life development of species, and has with it some analogies. It is, for instance, found by the English Life Table that of 1,000 children born alive, 703 live to the end of the tenth year, 297 die in the 10 years of current life; and the deaths, frequent at first, become less frequent as the age of puberty is approached. The deaths run down rapidly from 149 in the first year to 5 in the tenth year of life; and they are the results of many types of disease, springing up in a certain order. The rate of death is, under the same conditions over a series of years, nearly constant. There is a determinable law of morbility, as there is a determined law of mortality.

While the living units of the generation have fallen in the proportion of three tenths, their constituent elements have augmented by growth: thus while, according to the determinations of M. Quetelet, the weight of 703 children of the age of 10 years is 17,702 kilograms,† the weight of 1,000 children at birth is only 3,055 kilograms; and going back to the ova, of which 1,000,000 would not be of the bulk of a cubic inch, or still further to their germ cells and sperm cells, which are microscopic points, we arrive at the elementary units of which these 1,000 live-born children are the survivors. The embryo in its development is subject to casualties which probably increase as we approach its origin. But with this we have nothing to do. It contains in little elements which it has derived from both its parents, and which will or may reproduce their nature, the nature of their ancestors, and what is more immediately to our present purpose, the diseases by which they perished. To explain various phenomena in reproduction hitherto inexplicable, Mr. Darwin advances the theory of Pangenesis, in which he assumes that all the organs of the parent are represented by gemmules in the embryo.‡ It is a species of atomic theory in biology. Adopting the hypothesis for the moment, let us suppose that certain gemmules or corpuscles, or "germinal matters," are, in the system of a child, capable of becoming the small-pox "granulations" of Chaveau, alone or after coalescence with the granulations of a small-pox patient, then it is conceivable that their metamorphosis, having exhausted the material, may leave the system insusceptible of any further invasion. The same reasoning will apply to measles, scarlatina, typhus, and other types of disease not recurrent.§

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* Sydenham describes simple scarlatina distinctly: he does not refer to the throat affections, and says the patient can only die by the doctor's default. Joseph Frank describes the disease now as the most dreadful scourge in Europe. *See* Maladies éteintes et maladies nouvelles, par C. Anglada, 1869, pp. 304–50.

† Quetelet sur l'homme, Vol. II. p. 37, 1 kilogram = 2·2 lbs. avoirdupois.

‡ Animals and Plants under Domestication. Darwin, Vol. II., pp. 357–404.

§ Mr. Darwin gives a correct and succinct account of the current doctrine of the functional independence of the elements of the body:—

"Physiologists agree that the whole organism consists of a multitude of elemental parts, which are to a great extent independent of each other. Each organ, says

The human frame is built up of molecules passing through the evolutions which constitute the various phases of human life. But these molecules are completely deranged by other molecules of lower forms of life, such as the small-pox "granulations," *variolads* as they may be named, which convert variable quantities of the substance of the child's body into their forms, to be finally transferred into pus or into other corpuscles according as the child's life survives or succumbs in the struggle. Each zymotic disease is generated, we may conceive, by species of living molecules, which may be of a twofold nature, bearing some such relation to each other as the germ and sperm plasms of plants and animals, and becoming proliferous after coalescence, give rise to the various forms of epidemic disease. The danger of bringing great numbers of people into close proximity is well known; it evidently increases the chances of the coalescence, propagation, and diffusion of the various active disease molecules.

The life of these zymotic generations is the death of the elemental part of the human organism, and yet their development depends on its existence. This to some extent limits epidemics. The black death destroyed according to some accounts half the population of England; and the very force of its zymotic principle destroyed the pasture on which the death fed; it put an end to a mass of the people living; and to this extent at least it diminished its own mass; it burnt up in a few years its elements in those surviving; and it encountered other organisations, whose career it could not arrest. So every year recent epidemics subside on this ground; or they are limited by the operation of conflicting disease molecules. For if there is a struggle for existence among the visible forms of life, and if the struggle is the severer, the nearer these forms are allied, is there not also the same struggle among the elementary independent particles of life, to which epidemics are due? Theirs is also a struggle for subsistence.*

Claude Bernard, has its proper life, its autonomy; it can develop and reproduce itself independently of the adjoining tissues. The great German authority, Virchow, asserts still more emphatically that each system, as the nervous or osseous system, or the blood, consists of an 'enormous mass of minute centres of action . . . . . 'Every element has its own special action, and even though it derive its stimulus 'to activity from other parts, yet alone effects the actual performance of its duties '. . . . . . Every single epithelial and muscular fibre-cell leads a sort of 'parasitical existence in relation to the rest of the body . . . . . Every single 'bone-corpuscle really possesses conditions of nutrition peculiar to itself.' Each element, as Mr. Paget remarks, lives its appointed time, and then dies, and after being cast off or absorbed, is replaced * * * * Whether each of the innumerable autonomous elements of the body is a cell or the modified product of a cell, is a more doubtful question, even if so wide a definition be given to the term, as to include cell-like bodies without walls and without nuclei. * * * * * Physiologists maintain, as we have seen, that each cell, though to a large extent dependent on others, is likewise, to a certain extent, independent or autonomous. I go one small step further, and assume that each cell casts off a free gemmule, which is capable of reproducing a similar cell. * * * An atom of small-pox matter, so minute as to be borne by the wind, must, multiply itself many thousandfold in a person thus inoculated. It has recently been ascertained that a minute portion of the mucous discharge from an animal affected with rinderpest, if placed in the blood of a healthy ox, increases so fast that in a short space of time 'the whole mass of blood, weighing 'many pounds, is infected, and every small particle of that blood contains enough 'poison to give, within less than 48 hours, the disease to another animal.'" [Animals and Plants under Domestication. By C. Darwin, M.A., F.R.S. Vol. II. pp. 368–9–70–77–78.

* Thucydides notices that during the plague of Athens other diseases declined: "And besides this, none of those diseases to which they were accustomed afflicted "them at that time; or whatever there was ended in this." Hist. L. II. 51. He refers to this twice, and it has been since matter of common observation.

The constituent units of the body, however independent they may be in their action, are not independent in the same sense as infusorial units, but form parts of one whole, of one *microcosm*, on whose life they depend. As the one may be called the corpuscular life the other may be called the cosmical life of the species: and each species has conditions favourable to its own existence, unfavourable to other existences; alter these conditions essentially, and the life of a given species gains or loses its ascendency; the matter of which it disposed, no longer employed in its further development towards perfection, is abstracted and appropriated by other forms of life. The Glasgow victims were gathered together from all quarters, from the Highlands, from Ireland, and from elsewhere; they were lodged in conditions unsuitable to human life; but excessively favourable to the generation of disease molecules, which abounded in the air, water, and food, as well as in their own structures. To render them unassailable by *variolads*—the matter of small-pox—was not enough, for it left them exposed to the other forms of disease. Thus in a garden where the flowers are neglected, to keep off thistle-down merely leaves the ground open to the world of surrounding weeds.

The spread of small-pox, scarlet-fever, and diseases of that kind is analogous to many chemical and natural phenomena. Thus a spark falls, the fire spreads, and a city is in flames. The process of combustion, like a plague, is propagated. Atoms of hydrogen and oxygen combine the instant they touch a kindred flame, and combustion goes on self-sustained so long as those elements are supplied. Water is the product. But the flame may be kindled by other elements in combustion; and water will not generate water; not so with fermentation. A little leaven leavens the whole lump; and the leaven left propagates other leaven. Yeast in wort converts its sugar into alcohol; wines ferment and undergo various changes; so do milk, butter, cheese, and other animal products; each fermentation has at least one specific chemical product, be it alcohol, acetic acid, lactic acid, or butyric acid; and also one ferment. It is the great merit of Pasteur to have established by ingenious and experimental research, that all these ferments consist of organic molecules, propagated from previous molecules of the same kind. He has shown not that spontaneous generation is impossible, on the confines of the three kingdoms, under every possible condition, but that the fermentations in all the cases he examined were set in motion by specific pre-existing germs; multiplying indefinitely by reproduction under given conditions.

Through self-propagating chemical action, as instanced in combustion, we enter the region of fermentations, where there is also chemical combination, but in dependence on the action of living corpuscles on lifeless matter of organic origin.

Again, we find living molecules in living animals inducing series of changes in the cosmical life, as for example in the ox or in the silkworm.* This differs from fermentation; it is a case of strange corpuscles at work in the midst of the constituent corpuscles of a living being. The struggle and the reaction of the conflicting elements produce the phenomena of diseases, such as small-pox. Granules of vaccine lymph, for example, inserted in the arm of a child, give rise to heat, swelling, redness, pustules, maturation, cicatrix; in cows they produce a disease of another form, cow-pox; in horses they give rise to grease. The corpuscles are specific in their nature, as is shown by the reactions, nearly uniform, which follow in the same animals; reproducing them-

* See Pasteur on Silkworm disease.

selves in the same structures; and giving rise to indelible modifications of the corpuscles (biads) of which individuals affected are built up. The diseases of this nature are called zymotic diseases; the peculiar processes zymoses; to distinguish them from fermentations, with which they have more points of contact than they have with combustion, or any common propagated chemical action. This class of diseases may be designated by a letter; or by an arbitrary word invented for the purpose; and so may the process; but it is quite in accordance with English practice to designate a class of phenomena by a name derived from the Greek, without thereby implying that the new name is either limited or defined by the Greek root.*

Each disease has its peculiar germinal matter; which can sometimes be isolated, as in the case of small-pox, cow-pox, syphilis, glanders, purulent ophthalmia, cholera; while in other cases, as in influenza, its existence is assumed by analogy and hypothesis. It is useful for the sake of explanation and discussion to give these various matters names; thus the vaccine lymph is called *vaccinine;* the granulations of Chaveau, *vaccinads;* variola lymph, *varioline;* and its corresponding elements, *variolads.* Instead of cells, globules, germs, granules, gemmules, protoplasm, germinal matter, or other descriptive names which have been given to the organic units, it will be convenient to adopt some such generic word as the "atom" of chemists. Monad has been appropriated in another sense, and "biad" from bios (βίος, life, evidently allied to βία, *force*) the root of biology, may be conveniently employed. The ultimate organic atom of chemists, like the inorganic atom, is beyond the reach of the microscope; but these *biads* may be, or become visible. Physically they are like blood-corpuscles (*hæmads*).

The zymotic elements differ essentially in their powers, but it is not likely that they can all be distinguished by the microscope. They are known by their effects. By them and by other causes out of 1,000 born in Liverpool, 518 children were destroyed in the first ten years of their life; some by small-pox, many by measles, scarlatina, whooping-cough, many by typhus and enteric fever; one disease prevailing in one year, another disease prevailing in another, but still yielding the like fatal results. This represents what Dr. Watt found at Glasgow long ago. Out of 1,000 children born in London, 351 die under 10 years of age by zymotic diseases and other causes; the deaths are less by 167 than the deaths in Liverpool. How much less is the loss of life by these diseases in the healthy districts of England! There, out of 1,000, only 205 children die in the first ten years of life. The enormous difference cannot be ascribed to vaccination, as common in town as in country; the protection of life against small-pox alone leaves it still at the mercy of the other dangerous diseases of the insalubrious city. There the conditions are in favour of disease-life, and in the highest degree unfavourable to human life.

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* Lavoisier called a well-known gas *oxygen,* on the ground that it forms in combination all the acids with which chemists were then acquainted. "Oξος is "sour wine," "vinegar"; and "vinegarmaker" would be a tolerably literal translation of "oxygen," but by no means a good definition of that wonderful element. Some writers have foolishly objected to the name, since the discovery of hydrochloric, and other acids containing no oxygen. So when *zymosis* derived from the Greek root ζύμη, *leaven,* is employed to designate a series of disease processes in men and animals, it is not intended to confound these processes with fermentation. If fermentation expressed the idea, that word would be used. ζύμη is probably drawn by a similar process from ZEΩ, to boil, seethe, bubble; the bubbling of boiling water, and fermentation presenting some points of resemblance; intestine motion and heat.

Protection against small-pox, and against all forms of imported disease, if that were practicable, should not be neglected; the isolation of the invaded individual; the destruction of the secretions by chemical agencies; chlorine, ozone (permanganate of potash), carbolic acid, sulphurous acid, vinegar, camphor, and other substances, found by experience to be destructive, or prejudicial to the zymotic elements, should all be brought into play. These elements are causes of death, but an order of causes lies still higher.

The primary object to aim at, is placing a healthy stock of men in conditions of air, water, warmth, food, dwelling, and work most favourable to their development. The vigour of their own life is the best security men have against the invasion of their organisation by low corpuscular forms of life; for such the propagating matters of zymotic diseases may be held to be. Vaccinate by all means; but at the same time provide streets, spaces, dwellings, water, drainage. Do not leave the dirt in rookeries, in pits, in dunghills. What are municipal bodies, town councillors, aldermen, mayors, provosts, good for, if they cannot by administrative measures displace rookeries by healthy habitations, supply the people with water, and with the means of "cleanliness," which stands proverbially "next to godliness"?

If we ascend from zymotic disease to its generating element, and from this to bad dwellings, bad habits, and bad municipal organisation, causes are often found lying beyond these in bad laws. A city becomes the seat of trade and manufactures, in which many workmen from the country are required: families are brought together, and are crowded in existing houses; and it is found impossible to extend the house accommodation by building new houses, on account of the existing land tenures. The owners, whether corporations or individuals, hold on limited tenures, and as they cannot sell the freehold, or grant leases for long terms of years, the land is unavailable for building purposes. Houses are not built to meet the demand, and the want of decent dwellings is inevitable. To abolish all the rookeries is possible now, with free and cheap locomotion, if the law give facilities to the acquisition of that necessity of healthy life—sites for dwelling houses. A bad land tenure is a cause of death.

Again, as properties are often let on lease for terms of years at stipulated rents, under covenants by tenants to pay rates and taxes, the tenant cannot justly be called upon to pay within his term the cost of permanent improvements, which will pass into the landlord's hands when the lease expires; the landlord should by law pay the capital, the tenant the interest.

The study of the causes of death in the zymotic class enables us to lay down some rules for the limitation of their ravages.

1. This is a primary rule: place the population in the sanitary conditions found by experience to be most favourable to health. Without this preliminary, all the other measures are futile. The elements of the body fall into decay and degeneracy of themselves, under unfavourable conditions, without any external infection.

2. Fortify the body by a mild disease, if any such is known, against a severe disease. Vaccination, or even inoculation, if vaccination had not been discovered, is properly practised under this rule. But it should be universal to be really successful. The inoculation of a few spreads small-pox among the many. To operate on the mortality, protection against *every one of the fatal zymotic diseases is required;* otherwise the suppression of one disease-element opens the way to others.

3. The suppression of zymotic action by specific applications in the earliest stage of invasion is sometimes possible as in the diarrhœal

stage of cholera. Careful experiments on this matter are required; for the prodromal stage is not always detected, and treatment is either not tried, or, if successful, the existence of the disease itself is questioned.

4. The suppression of the generating beds of disease in unhealthy populations can scarcely fail to be efficacious. To suppress plague, suppress the wretched sanitary conditions of Egypt; to suppress yellow fever, go to St. Thomas, New Orleans, and its other breeding grounds; to put a stop to pandemic outbreaks of cholera, cleanse the waters of India, and improve the condition of the population; to extinguish enteric fever and typhus in our cities, extinguish the rookeries.

5. Syphilis is dealt with on this principle under the Contagious Diseases Act. The forcible detention of infecting women in hospitals is humane and justifiable; but why is the principle not extended to both sexes? Here, to be successful, all the ascertainable sources must be stopped.

6. The destruction of the zymotic germs by chemical agents, by fire, and by disinfectants should in all cases be enforced.

7. Water in rivers charged with sewage, or shallow wells, conveys the germs unchanged (zymads) of some zymotic diseases, as it conveys animalcules and the ova of worms. The pure water of the hills is the safest.

8. The diffusion of several zymotic diseases, among them small-pox, measles, and scarlet fever, is probably effected by detached flakes floating in the air. This danger is lessened by some such treatment as Dr. W. Budd has suggested.*

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* The following is a summary of the precautions recommended by Dr. W. Budd:

1. The room [in which the patient is detached] is dismantled of all needless woollen or other draperies which might possibly serve to harbour the poison.

1*. Thorough ventilation of the room to be maintained by an open fire and other means added.

2. A basin, charged with chloride or carbolate of lime or some other convenient disinfectant, is kept constantly on the bed for the patient to spit into.

3 A large vessel, containing water impregnated with chlorides or with Condy's fluid, always stands in the room for the reception of all bed and body linen immediately on its removal from the person of the patient.

4. Pocket-handkerchiefs are proscribed, and small pieces of rag are used instead for wiping the mouth and nose. Each piece, after being once used, is immediately burnt.

5. As the hands of nurses of necessity become frequently soiled by the specific excreta, a good supply of towels and two basins, one containing water with Condy's fluid or chlorides, and another plain soap and water, are always at hand for the immediate removal of the taint.

6. All glasses, cups, or other vessels used by or about the patient are scrupulously cleaned before being used by others.

7. The discharges from the bowel and kidney are received *on their very issue from the body* into vessels charged with disinfectants.

8. About the fourth day of the eruption the surface of the body, scalp included, to be anointed *twice a day* with olive oil slightly impregnated with camphor; the oiling to be continued until the patient is well enough to take a warm bath, in which the whole skin is well scrubbed, disinfecting soap being abundantly used. The baths to be repeated every other day until four have been taken.

9. Ten days after health is quite re-established the patient may, in new clothes, without risk, re-enter his family.

10. The children of the poor, who have no means of isolating their children, to be treated in small model hospitals or houses set apart by towns or parishes for the purpose.

11. The sewers to be kept in a state of permanent disinfection where the disease prevails. This is done in Bristol under the direction of the Health Officer.

The chemical destruction of the dejections in these diseases, and especially in enteric fever and cholera, are measures of precaution which should never be neglected.

Earth is a great disinfectant, and the changes going on in the soil soon convert the excreta into harmless manures. There is no evidence to show that the disturbed cemeteries of the dead in past plagues have ever given rise to new outbreaks; and the dry earth applied on Mr. Moule's system is as safe a disinfectant as can be used, but in epidemic seasons the stuff should be buried and not be scattered on the ground. It would be well, too, as in dangerous times such precautions cannot be adopted in dealing with sewage, to disinfect it in the houses and in the sewers on its way to irrigation fields.

9. The assembly of large masses of men in pilgrimages, or in any way, produces often coalescences of zymotic elements, which thus acquire intense activity, and spread far and near: conditions for the regulation of such assemblages may be therefore fairly enforced.

10. The vessels which place distant shores in communication should be under strict sanitary regulation, to intercept the transit of epidemics.

11. The interception of the intercourse and commerce of nations by quarantine is injurious to their vital interests. It should be kept within the narrowest limits; and England should carefully abstain from treading in the steps of the fanatical populations of the Mediterranean. They should be invited to follow her example by its success.

12. As zymotic diseases of domestic animals are governed by the same general laws as the corresponding diseases of men, similar methods of prevention should be pursued in dealing with live stock.

By observing these simple rules we shall limit the ravages of common epidemics, and perhaps avert those secular plagues which have several times depopulated Europe. New species of diseases,—of zymads, may be generated, and these may under unfavourable conditions spread with destructive virulence among men, but never, we may hope, so as to recall the ravages of the Athens plague, of the Antonine plague in the second century, of the Gallus plague in the third century, of the dreadful Justinian plague of the sixth century, of the devastating black death of the fourteenth century, of the sweating sickness so fatal to Englishmen, and, still more recently, the great plagues of the seventeenth century. Cholera has been virtually subdued, and we have no reason to despair of success in the future encounters of science with these impalpable but fell destroyers.—(30th Annual Report, pp. 212–221.)

Effect of Epidemics on Mortality in Subsequent Years.—It has been stated that an epidemic is invariably followed by a period of low mortality, which is again accounted for on the supposition that the weakly die of the epidemic, who under ordinary circumstances would die a year or two years subsequently of some other disease. This, however, requires further investigation. In the former epidemic of cholera (1832) the decline of the mortality in the subsequent year was inconsiderable; but in that year the epidemic had not completely subsided. (13th Annual Report, p. 3.)

Influenza Epidemic, 1847.—It was shown in the last Quarterly Report on the State of the Public Health, that if the chance that a child in Dorsetshire under 15 years of age will die in the summer quarter be represented by 1, the chance that a child under 15 in London will die in the same time is represented by 2. It was also shown that the chance of dying among men above 35 in London, is to that in the country as 3 to 2: and it was remarked that "if the chance of dying "is increased from 2 in the country to 3 in London, *the liability to "suffer* FROM EPIDEMICS *is raised still more*." The truth of this proposition has unfortunately been too soon exemplified. The population was inadequately supplied with potatoes, and scurvy was prevalent in the beginning of the year. Meat and bread were dear, distress was rife; vagrants flocked in from the country, the poor Irish came to their kindred, the workhouses were crowded. In April and May fever became epidemic; instead of the average of 34, *fifty* died weekly in London; it steadily spread and burnt on until it killed a hundred and eleven victims in a single week. Diarrhœa, dysentery, and cholera had been a little more fatal than usual throughout the year: 17, however, only died of these diseases in the first week of July; the mean temperature of the air was above 60°; the number of deaths rose to 38, 47, 67, 125, 128, 188, by the middle of August, and then gradually subsided. Notwithstanding the continued prevalence of typhus and scarlatina, the deaths in the last week of October were only 945; one person died of influenza, 36 of bronchitis (inflammation of the air-tubes), and 62 of pneumonia (inflammation of the substance of the lungs). In the three weeks following, ending November 20, the total deaths were 1,052, 1,098, and 1,086; of which 2, 4, and 4 were by influenza; 49, 58, and 61 by bronchitis; 68, 79, and 95 by pneumonia. The wind had generally been blowing S.S.W. and S.W. since the first week of October; the weather was unusually warm; a brilliant aurora was observed, and shook the magnets on October 24th; it appeared eight times during the quarter; on Tuesday, November 16th, there was a remarkable darkness; the wind changed to N.W., and amidst various changes still blew from the north over Greenwich at the rate of 160, and 250 miles a day. The mean temperature of the air suddenly fell from 11° above, to 10° below the average; on Monday it was 54°, Friday 32°; the air on Friday night was 27°, the earth was frozen; the wind was calm three days, and on Saturday evening a dense fog lay over the Thames and London for the space of five hours. No electricity stirred in the air during the week. All was still: as if Nature held her breath at the sight of the destroyer, come forth to sacrifice her children. On Sunday the sky was overcast, the air damp, the wind changed in the night to S. by E., and passed for four days over Greenwich at the rate of 200 and 300 miles daily; the temperature suddenly rose, and remained from 2° to 9° above the average through the week ending November 27th: when the deaths of 1,677 persons—819 males, and 858 females—were registered in London; 771 persons under 15 years of age, 518 aged 15–60, and 388 of the age of 60 and upwards. Influenza was epidemic. In the first week of December *two thousand four hundred and fifty-four* persons died: 1,141 were males, 1,313 females; 1,012 children, 712 persons in the prime of life, 730 of the age of 60 and upwards. In the week following *two thousand four hundred and sixteen* persons died: 1,175 males, 1,241 females; 1,016 under the age of 15; 698 at the age of 15–60, and 702 at the age of 60 and upwards. The deaths in the weeks ending Saturday, December 18, December 25, and January 1, were 1,946, 1,247, and 1,599. 11,339 persons died in six weeks, and altogether the epidemic carried off more than 5,000 souls over and above the mortality of the season. The epidemic attained the greatest intensity in the second week of its course; raged with nearly equal violence through the *third* week; declined in the *fourth*, and then partly subsided; but the temperature falling, the mortality remained high not only through December, but through the month of January.

The epidemic was most fatal to adults and to the aged: thus in the three weeks ending November 13, the deaths under 15 years of age were 1,553; in the three weeks of the epidemic ending December 18, the deaths under the age of 15 were 2,846. In the same *two periods* the deaths at the ages 15–60 were 966 and 1,970; at the age of 60 and upwards, 576 and 1,999. The mortality in childhood was raised 83 per cent., in manhood 104 per cent., in old age 247 per cent. From the age of 4 to 25, however, the mortality was comparatively not very much increased; at the age of 10 to 15, the healthiest period of life, it was scarcely increased at all in girls.

During the seven years 1838—44 the deaths of males in London were more numerous than those of females in the proportion of 1749 males to 1,677 females; in the second week of the influenza epidemic the proportions were reversed, for 1,141 males, and 1,313 females died; in the six weeks ending January 1, the deaths of 5,580 males and 5,759 females were registered. Looking, however, at particular ages, the deaths in the six weeks under 5 years of age were—2,321 males, 2,009 females; from 5 to 55, males 1580, females 1,507; 55 and upwards 1,678 males, 2,241 females. At all ages there are more females than males living in London; at 55 and upwards the males in 1841 were 71,021, the females 90,143; at 75 and upwards, males living 6,754, females 11,124. A disease much more deadly in the old than in middle-aged and young people, therefore necessarily increases the total deaths of females more than the total deaths of males, without for that reason being more fatal to the female than to the male sex. The difference in the mortality of males and females from the epidemic is but slight, and can only be determined by nice calculation—into which I shall not enter here.

Influenza attacked those labouring under all sorts of diseases, as well as the healthy. The vital force was extinguished in old age and chronic diseases. The poison, permeating the whole system, fastens chiefly on the mucous membrane lining the sinuses of the face and head, and the air-tubes of the lungs. Hence it is fatal to the asthmatic; the deaths directly ascribed to asthma in October and November were 12 weekly; in the six weeks of the influenza epidemic, 77, 86, 78, 52, 14, 26, besides the numerous cases classed under influenza. 36 deaths were ascribed to bronchitis in the week ending October 30th, and 49, 58, 61, 196, 343, 299, 234, 107, and 138 in the nine following weeks. 62 deaths were ascribed to pneumonia in the same week, and 68, 79, 95, 170, 306, 294, 189, 131, 148, in the nine weeks following. In some of these cases the inflammation specified was the primary disease, in others secondary, and in many it was purely influenza—mis-reported. There is a strong disposition among some English practitioners, not only to localize disease, but to see nothing but a local disease; hence although it is certain that the high mortality on record was the immediate result of the epidemic of influenza—the deaths referred to that cause are only 1,157; namely, in the first week of November, 2, and in the eight weeks following 4, 4, 36, 198, 374, 270, 142, 127; and these include nearly all the cases in which influenza was returned, whether as primary, or secondary in conjunction with other diseases. A similar defect has hitherto been found in the returns of all great epidemics; in 1665, the great plague year, 97,306 burials were returned in the London Bills of Mortality, only 68,596 of which were ascribed to plague. Influenza attacked persons labouring under other zymotic diseases: thus the deaths from whooping-cough rose from 12 and 25, to 65 and 71 during the epidemic; the deaths from measles rose from 43 to 96, 89, 69, 75, during the first four weeks of the epidemic, and then subsided to 37 and 58.

Fever, which had been fatal to 70 and 80 weekly, rose to 132, 136, and 131, in the second, third, and fourth week of the influenza epidemic, and then fell to 83 and 74. Although influenza is not mentioned in these cases, it is in others, and there can be little doubt that two or more zymotic processes do often go on simultaneously in the blood and body; a fact of profound interest to the pathologist, and worthy of attentive investigation.

The epidemic was much more fatal in some districts of London than in others. To show this, I take the deaths in each of the London districts during the six weeks from November 21st, 1847, to January 1st, 1848—and, comparing them with the population, obtain the relative mortality. It was at the rate of 46 per annum to 1,000 living in London; the mortality in the seven years 1838–44, was at the rate of 25 annually to 1,000; the mortality was consequently raised for 6 weeks, by the epidemic, about 80 per cent. above the average. Lewisham, including Blackheath, Sydenham, and Eltham, is one of the healthiest districts in London; the ordinary rate of mortality is 17 annually, during the epidemic it was 27. St. George in the East is one of the unhealthiest districts; the ordinary rate of mortality is 29 in 1,000, the rate of mortality during the epidemic was 73: the increase in Lewisham was 10, in St. George in the East 44; the latter district suffered four times as much from influenza as the former. Excluding districts which contain hospitals or the workhouses of other districts, we have the following result:—

DEATHS to 1,000 annually.

—	Mean Annual Rate of Mortality, 1838-44.	Annual Rate of Mortality during the last 6 weeks of 1847.	Difference in the Mortality ascribable to the Epidemic.
LEAST UNHEALTHY DISTRICTS OF LONDON. 6 Districts of London in which the ordinary mortality of Females is low.	20	38	18
UNHEALTHIEST DISTRICT OF LONDON. 6 Districts of London in which the ordinary mortality of Females is high.	27	61	34

The epidemic of influenza killed twice as many people in the insalubrious parts of London as it did in those less unhealthy: its fatality in Lewisham and St. George in the East was, as we have seen, 1 to 4. The annual average rate of mortality for London, in 1730–39, was 41 in 1,000; the rate in the six weeks of the epidemic of 1733 was 72 in 1,000; the increase was 31 in 1733; the increase in 1847 was 21. (10th Annual Report, pp. xxvii–xxx.)

Cholera Epidemic, 1848–9.—If a Foreign army had landed on the coast of England, seized all the seaports, sent detachments over the surrounding districts, ravaged the population through summer, after harvest destroyed more than a thousand lives a day for several days in succession, and, in the year it held possession of the country, slain fifty-three thousand two hundred and ninety-three men, women, and children—the task of registering the dead would be inexpressibly painful; and the pain is not greatly diminished by the circumstance that in the calamity to be described the minister of destruction was a pestilence that spread over the face of the island, and found in so many cities quick poisonous matters ready at hand to destroy the inhabitants.

In following cholera through its fatal way, however, the inquirer meets with some grounds of consolation. He sees places on every side which the epidemic passed over, leaving the inhabitants in the serene enjoyment of health and complete immunity. And the hope is perhaps not fallacious, that an examination of the results of the second may be the means of mitigating, if not preventing a third invasion; for whatever may be the immediate cause of cholera, it will appear evident that in England it is only seriously fatal under certain known physical conditions, which admit to a great extent of remedy.

It is not necessary to describe here the nature of the disease. The task devolves on others of analysing the changes which the frame suffers under cholera; of investigating the effects of medicine; of relating the steps which were taken to relieve the population attacked in various places; of discussing in detail the various theories which have been produced to explain the phenomena; and finally of portraying in this epidemic the moral effects, which, as historians have not failed to perceive, possess the highest interest in the great catastrophes of mortality.*

Under the Act for the Registration of Births, Deaths, and Marriages, the name, sex, age, and occupation of every person who dies in England —as well as the time, place, and cause of death—are registered. The whole of this system of observation and record was in operation when cholera broke out. The quarterly abstract of deaths for the whole kingdom, and the London tables which are published weekly—presented notices of its rise, progress, and decline in particular districts. When the epidemic was over, it appeared desirable to give a complete abstract of the facts. Accordingly a list of every case of death from cholera and diarrhœa, in 1849, was transcribed from the registration volumes which for that year contained 440,853 deaths. The roll of deaths was in the following form :—

No.	District.	Sub-district.	Population. 1831	Population. 1841
458; 2	Nantwich.	Nantwich.	8560	9431

Date of Death.	Place.	Sex.	Age.	Profession.	Cause of Death.
1849. July 10	Wych House Bank, Nantwich	M.	6	Salt-boiler's Son -	Cholera, 13 hours.
" 9	Welsh Row "	F.	5	Confectioner's Daughter - -	Cholera, 6 hours.
" 10	Vauxhall "	M.	72	Labourer - -	Cholera, 28 hours.
" 8	Wood Street "	F.	48	Basketmaker's Wife - - -	Cholera, brought on by want of the common necessaries of life.—Inquest.
" 10	Wood Street "	M.	67	Shoemaker - -	Cholera.—Inquest.

The whole forms a large mass of manuscript, which contains the particulars of 72180 deaths. Upon inquiry it was found that the *list of*

* See the report of the Board of Health; and the appended Reports of Dr. Sutherland and Mr. Grainger, whose active and arduous labourer in the epidemic deserve the highest praise. The College of Physicians has, it is understood, appointed a learned committee to report on the subject. The chemistry of the disease is ably discussed by Dr. R. D. Thomson, Trans. of Royal Medical and Chirurgical Society vol. xxxiii. The disease is well described by Dr. Budd, in the Cyclopædia of Practical Medicine, and sketched in the lectures of Dr. Watson, with his accustomed felicity and accuracy.

persons who died of the two diseases would fill a thick octavo volume of about 2,500 pages. Three courses were open: (1) to publish these facts simply; (2) to publish the tabular abstracts in detail; or (3) to publish the abstracts and the salient facts relating to each locality in a condensed form. The publication of the cases in detail would have been attended with several advantages; it would have enabled the medical men of the country to study the particular facts in their respective districts, surrounded by the circumstances which affect and modify the mortality; and the publication of an extended tabular summary of the daily deaths in each of the 2,189 sub-districts of the country would also have possessed interest. As the work on either plan would, however, have been exceedingly voluminous, the third course was adopted: in the meantime the manuscript list of the 72,180 cases, and the extended tabular abstracts, are preserved among the records of the General Register Office, and will always be accessible to the local inquirer, as well as to the general student of this great and extraordinary epidemic.

It appears that 1,057 males and 877 females died from cholera during the year 1848, and that of those numbers 612 males and 493 females, died in the three months of October, November, and December.

The tables in the report show of the 53,293 deaths from cholera, and 18,887 from diarrhœa during the year 1849, how many occurred in each of the 11 divisions, 44 counties (or groups of counties), and 623 districts of England. The districts are arranged in the same topographical order as is adhered to in all the reports of this office. Each district stands in its place, although no death from cholera was registered within its limits; the population of 1841 is set forth in a distinct column, and shows the lowest numbers that could have been exposed to the attacks of the disease. In the towns, and in the manufacturing and mining districts, the population was, of course, much greater in 1849 than in 1841.

Another series of tables shows the number of deaths from cholera and from diarrhœa on each day of the year 1849, in all England, in 11 divisions, and in 44 registration counties. Thus the march of the epidemic through every county can be followed day by day.

In the returns that have previously been made of the mortality of cholera in this and in other countries, only the deaths from that disease in parts known to be severely infected have been inserted, and it is evident that under such a system—based on imperfect registration—many deaths must have escaped observation. But the causes of nearly all the deaths in England are registered, and all the deaths of 1848 and 1849 are recorded in the volumes from which the present return is derived; so that the reader can now trace the progress in place and time of the great epidemic through 17 millions of people, settled over a wide extent of country, in all the various circumstances of life. And the difference in the time of invasion, as well as the absence or the inconsiderable mortality of the epidemic in places lying by the side of districts overwhelmed by its effects—is undoubtedly one of the circumstances which most deserve attention in the study of cholera.

A fourth series of tables shows how many males and females died at *various ages* of cholera and diarrhœa in the divisions and counties of England. Taking 100 years as the limit, the lifetime is divided into twenty equal quinquennial periods; and the tables show that the deaths were distributed unequally over the whole of these periods. The deaths in each of the first five years of life are separately given; as in that short interval of age a remarkable change takes place in the form and fatality of the disease.

A swift and precipitate course ending in dissolution, is a characteristic of all plagues, and fixes attention in cholera. The duration of 39,468 fatal cases of cholera, and of 7,896 fatal cases of diarrhœa, is shown in a fifth series of tables. The duration in hours and days is exhibited at the quinquennial ages that have been already named. Tables are given for all England, for England exclusive of London, and for each division of the country. The 623 districts of England are divided into 2,189 sub-districts. The population (1841), the deaths from cholera, and the deaths from diarrhœa in each sub-district, are given in the notes which close the volume. The London Registrars returned every case of death from cholera or diarrhœa weekly, and, in the height of the epidemic, daily, accompanied by any information which either the informants, or their own observation, supplied, respecting the state of the streets or houses in which the deaths occurred. This information was necessarily collected in haste; but was found to be substantially correct, and had an excellent effect at the time, in directing the immediate attention of the authorities to some of the most crying evils that induced and aggravated the disease. A digest of these Registrars' local reports is embodied in the notes, which contain many curious and suggestive facts; and the gentlemen who abstracted the cases were requested to compile from the transcripts short notices of the first and last deaths, distinguishing the dates of such deaths; as well as the professions of the persons who died, and the localities which suffered most in every sub-district. The local inquirer is requested not to accept any opinions expressed in the notes, or the summaries of the facts themselves, as ultimate results; but to consider them only as indications of the direction in which investigation may be advantageously employed. Upon the number of deaths returned, and the tabular results, full reliance may be placed; as they have been derived directly from returns, and have been duly checked. (Cholera Report, 1848–9, pp. i–iii.)

Sex mortality from Cholera, 1848–9.—The deaths from cholera, in 1849, among males were 26,108, females 27,185; it consequently destroyed 1,077 more females than males. The proportions were reversed in diarrhœa, which was fatal to 9,637 males, and to 9,250 females. The population of England and Wales returned at the Census without revision was, on March 31, 1851, males 8,762,588; females 9,160,180. And correcting for increase of population, the mortality from cholera at all ages in 1849 was—

Males 30·2 to 10,000 living, or 1 in 331.
Females 30·0 to 10,000 living, or 1 in 333.

The mortality is thus a shade less among females that it is among males; but the difference is much less than it is from all other fatal diseases in ordinary years; when the total deaths among males is invariably greater than the deaths among females. Thus in the year 1848 the deaths of males from all causes amounted to 202,949, of females to 196,851; and in the seven years 1838–44 the annual rate of mortality among males was 2·270, females 2·104 per cent.

It is worthy of remark, that at the beginning of the epidemic the deaths of males exceeded the deaths of females very considerably; the numbers in the months of October, November, and December, 1848, were males 612, females 493; or in the proportion of 100 to 80. In the prior nine months of that year before the great epidemic had set in, the deaths of males in England ascribed to cholera were 445, of females 384, numbers in the proportion of 100 and 86.

As a general rule, when the mortality from cholera attained a very high rate, the number of deaths among females exceeded the deaths among males.

In London a remarkable change was observed in the proportion of the sexes affected in the course of the epidemic. In four weeks of October 1848 the deaths of 80 males and of 42 females by cholera were registered; in the thirteen last weeks of the year the deaths of 258 males and 210 females were registered, and there was an excess of males at all ages, but particularly in the ten years of age 15–25. In the quarter ending March 1849, the deaths of males amounted to 250, of females to 266; at the age of 25 and upwards the excess of deaths among females was considerable. In June, at the commencement of the *great outbreak*, the males again furnished the most numerous victims. At the close of July the females died in greater numbers than males, and continued to do so to the end. In the week that the mortality was highest the deaths of 895 males and of 1,131 females were returned. In the September quarter the deaths of males under the age of 25 exceeded the deaths of females, but after that age the proportions were reversed. (Cholera Report, 1849, pp. xxxix–xl.)

Cholera Mortality at different Ages, 1848-9.—Cholera was fatal to persons of all ages: it carried off 3,866 boys under 5 years of age; 3,837 men of 25 and under 35; and 2 old men of the age of 95 and upwards. Dividing the lifetime into 3 stages, the disease carried off 7,673 boys and 7,045 girls under 15 years of age, 14,861 men and 15,767 women of 15 and under 60 years of age, 3,546 men and 4,355 women of the age of 60 and upwards. The deaths were thus most numerous in the middle and most active period of life. The proportions of deaths at the several ages are different in diarrhœa, the deaths of children and of old people being much more numerous than the deaths of persons in the middle period of life. Thus the deaths of 6,794 boys and 6,058 girls under 15, of 1,235 men and 1,398 women of the ages 15–60, of 1607 men and 1791 women of the age of 60 and upwards, were referred to diarrhœa. It appears to be exceedingly probable that the cases of diarrhœa in 1849, barring a certain deduction, are cases of cholera, with the striking but not essential symptoms suppressed. And it is worthy of observation that this suppression of morbid action occurs at the ages when the organisation is most feeble, either because the system is not fully developed, or because it is worn out. Treating the mortality from diarrhœa as complementary to the mortality from cholera, it appears that under 5 years of age boys died in the proportion of 88, and girls in the proportion of 78, to 10,000 living; the rate of mortality then rapidly declines to the ages of 10–15 and 15–25; in the next decennial period 25–35, the mortality is of 31 males and 32 females to 10,000 living of each sex. At the period 35–45, the mortality to the same numbers living is 41 males and 44 females. Thus at the child-bearing age the mortality is rather greater among women than among men. From the age of 45 through the subsequent decennial periods of life, the mortality to 10,000 men living increases in the ratios 54, 70, 92, 114, 135, which is the *maximum* at the ages 85–95. The mortality of females increases in somewhat different ratios.

ANNUAL RATE of MORTALITY, at 12 Age-periods, from Cholera and Diarrhœa in England, in the Year 1849, compared with the Mortality from all Causes in the Years 1838–44.

Age.	Deaths to 100 Males living, at each Age, from				Deaths to 100 Females living, at each Age, from				Ratio of Deaths from Cholera to 100 Deaths from all Causes, at each Age.	
	Cholera (1849).	Diarrhœa (1849).	Cholera and Diarrhœa (1849).	All Causes (1838–44).	Cholera (1849).	Diarrhœa (1849).	Cholera and Diarrhœa (1849).	All Causes (1838–44).	Males.	Females.
0—	·332	·549	·881	7·072	·295	·480	·775	6·037	12·458	12·838
5—	·232	·028	·260	·926	·223	·028	·251	·900	28·078	27·889
10—	·138	·011	·149	·504	·128	·012	·140	·548	29·563	25·547
15—	·154	·011	·165	·805	·142	·012	·154	·833	20·497	18·487
25—	·293	·018	·311	·968	·303	·021	·324	1·009	32·128	32·111
35—	·383	·027	·410	1·249	·405	·032	·437	1·242	32·826	35·185
45—	·495	·048	·543	1·776	·467	·046	·513	1·548	30·574	33·140
55—	·587	·114	·701	3·141	·604	·106	·710	2·782	22·318	25·521
65—	·644	·272	·916	6·613	·678	·268	·946	5·885	13·852	16·075
75—	·597	·540	1·137	14·394	·717	·521	1·238	13·201	7·899	9·378
85—	·498	·847	1·345	29·646	·487	·623	1·110	27·553	4·537	4·029
95 and upwards	·311	·777	1·088	42·697	·330	·742	1·072	40·795	2·548	2·628
All Ages -	·302	·111	·413	2·270	·300	·102	·402	2·104	18·194	19·106
No. of Col. -	1	2	3	4	5	6	7	8	9	10

The above table is obtained by dividing the deaths from cholera and diarrhœa respectively by the numbers living at the corresponding ages in 1841; and further dividing the whole of the results by 1·11169,* as a correction for the probable increase of population in the 8 years 1841–9. This gives an approximation to the exact result.

It may be fairly inferred from the table that men of the age of 25–35 are in a cholera epidemic twice as likely to die as men 10 years younger (15–25), and that from this period the danger increases with age. The table does not express the liability to an *attack* of cholera, nor the attack having supervened, does it express the chances of recovering or of dying. The attacks of disease are not registered, consequently there are no means of throwing light on this question, which falls particularly within the scope of medical inquiry.

If persons are equally liable to attack at all ages, or if the same *proportions* of the living are attacked, the table shows the relative mortality of those attacked at different ages. If more than an equal proportion of the living are attacked in the early, and less than the due proportion are attacked at the later ages, the mortality of the table does not represent the mortality of attacks, but overstates the mortality of attacks at the earlier ages.

The mortality from all causes at the same ages, in the 7 years 1838–44, is inserted in the table. Upon comparing this mortality with the mortality from cholera, it will be seen that the epidemic did not prove fatal to life at different ages in the same degree as other diseases. If we divide the numbers in column 3 by the numbers in column 4, the ratio of the two rates of mortality is obtained; it varies at different ages. Thus under 5 years of age in males the mortality from cholera is equal to 12 per cent. of the mortality from all ordinary causes; and the

* The derivation of the value r in $r^8 = 1·11,169$ is given in the Ninth Annual Report of the Registrar General, 8vo., p. 168.

greatest relative effect is attained at the age of 35–45, when the mortality from cholera is equal to 33 per cent. of the mortality from all ordinary causes. At the advanced ages, when the absolute mortality from cholera is highest, its relative effect is least, for the mortality from other diseases increases much faster than the mortality from that malady. This is shown in the columns 9, 10. (Cholera Report, 1849, pp. xli–xlii.)

Duration of Cases of Cholera, 1848–9.—All diseases have natural stages in which they develop their phenomena, and either obstruct and destroy life, or give way before its regular healthy processes. The sick may therefore be classed together, and traced, like the living in a life table, through all the stages of the malady, until it is extinct, either by the death or recovery of the patient. Upon this basis a form of sickness table has been constructed, which shows the probability of death or recovery at every period of disease. The half of such a table for cholera has been framed from the returns of death, which in 39,468 instances state the duration of the cases in hours and days. If we assume that 100,000 persons are attacked by cholera, that 60,532 recover, and that 39,468 die at the several periods of the disease indicated in the table, some of the properties of the complete tables become immediately apparent. Thus the probability that a person attacked will die in less than 24 hours is expressed by the fraction $\frac{20{,}684}{100{,}000} = \cdot 20{,}684$; the chances are, therefore, nearly 4 to 1 that he will not die in 24 hours. The chance that he will die in 3 days is expressed by $\frac{39{,}468 - 8{,}282}{100{,}000} = \cdot 31{,}186$; and the chance that he will not die before but after 3 days is $\cdot 08{,}282$. The chance that, having survived the dangers of the first 3 days, he will yet die of cholera, are $\frac{8{,}282}{100{,}000 - 31{,}186} = \frac{8{,}282}{68{,}814}$. It is 60,532 to 8,282, or more than 7 to 1, that the patient will recover if he does not die in 3 days after the first attack.

The table* supplies a ready means of calculating the future duration of fatal cases of cholera at any stage of the disease. Thus it is found that the mean duration of the fatal disease in females is 2·102 days, in males 2·060 days; or 50·44 hours in females, and 49·44 hours in males. The woman attacked lives on an average an hour longer than the man. The duration of life, after well-marked symptoms of a fatal attack of cholera have set in, appears to diminish as age advances. Dividing the cases into three groups, the following results are obtained:—

DURATION of FATAL CASES of CHOLERA at various Ages.

	Mean Duration.	
	Days.	Hours.
Persons of the age of 15–35 - - -	2·121 =	50·904
Persons of the age of 35–55 - -	1·954 =	46·896
Persons of the age of 55 and upwards - -	1·973 =	47·352

The stated duration differs more than 4 hours, and is in excess in the first 20 years of adult age.

Fatal diarrhœa is a disease of much longer duration; and it agrees with cholera in being of somewhat longer duration in females than in males, and in both sexes, at the age 15–35, than at ages further advanced.

* *See* Cholera Report, 1848–9, p. xliv.

DURATION, in DAYS, of FATAL CASES of DIARRHŒA at various AGES.

Males, all ages	16·044
Females, all ages	16·692
Males and Females, age 15–35	18·668
Males and Females, age 35 and upwards	17·544

The fatal cases of cholera were preceded frequently, if not invariably, by a stage of diarrhœa, which attracted little or no attention. That stage is, it is believed, not included in the cholera duration, which was reckoned, by the medical attendants who made the returns, from the manifestation of the first characteristic symptoms of the epidemic. (Cholera Report, 1848–9, p. xliii.)

Cholera Epidemics of 1831–2 *and* 1848–9 *compared.*—The Board of Health in 1831–2 collected much information respecting the epidemic which it was their office to combat. A table was prepared showing the names of places attacked, the date of the first case, the date of the last case, the number of days' duration, the total deaths, the total recoveries, the proportion of deaths to cases, the population, the proportion of population attacked, and the proportion of deaths to population; and all the places were numbered on one of Arrowsmith's large maps. The table and map are now in the library of Her Majesty the Queen. At the instance of Sir James Clark copies have been made of these valuable documents, and are deposited in the General Register Office. According to the returns the deaths from cholera in "London and its vicinity," between February 14th and December 18th, 1832, were 5.275; the deaths in "the country" were 26,101; the total deaths in Great Britain, 31,376. The deaths in Ireland up to March 1st, 1833, were 21,171, making the deaths in the United Kingdom 52,547. The deaths of the year 1832, in England and Wales, amounted to less than half the number which were registered in 1849. But the returns which the Board of Health in 1832 procured were voluntary, partial, and evidently defective. The population of the places in Great Britain which made returns was 5,223,657; so it would appear that a majority of the places in the country altogether escaped attack or notice.

Notwithstanding the defects of the returns of 1832, they furnish us with the means of satisfactorily showing that the epidemic generally followed the same track in 1848–9 as it did in 1831–2, but that it was much more fatal in some places, and less fatal in others at the two periods. Thus, in the following districts the mortality from cholera was greater in the year 1849 than in the year 1832. The

DISTRICTS in which CHOLERA was more fatal in 1849 than in 1832.

Place or District.	1832.		1849.	
	Population, 1831.	Deaths from Cholera, 1832.	Population, 1851.	Deaths from Cholera, 1849.
London	1,424,896	5,275	2,361,640	14,137
Portsmouth	46,282	86	72,676	568
Bristol and Clifton	132,331	694	143,704	1,154
Shrewsbury	21,277	75	23,095	116
Wigan	20,774	30	77,545	563
Liverpool	165,175	1,523	255,055	4,173
Leeds, &c.	123,393	702	189,987	2,323
Hull	28,591	300	50,552	1,178
Merthyr Tydfil	22,083	160	76,813	1,682

places for 1832 are towns or cities, and do not often include all the same parishes as the districts of 1849, but as the populations at the two nearest Censuses are given, the rates of mortality during the two epidemics can be fairly compared.

In the following places the mortality was much less in 1849 than in 1832, and there can be no doubt about this result.

DISTRICTS in which CHOLERA was less fatal in 1849 than in 1832.

Place or District.	Population, 1831.	Deaths from Cholera, 1832,	Population, 1851.	Deaths from Cholera, 1849.
Exeter - - -	28,201	347	32,810	44
Plymouth - -	31,080	702	52,223	830
Gloucester - -	11,933	123	32,062	119
Kings Lynn - -	13,370	49	20,528	2
Norwich - -	61,110	129	68,196	38
Nottingham - -	50,680	296	58,418	18
Sheffield - -	59,011	402	103,602	114
Carlisle - - -	20,006	265	41,566	51
Newcastle-upon-Tyne -	42,760	801	89,145	295
Sunderland - -	17,060	215	70,561	363

The difference in the rates of mortality was not considerable in the following districts :—

Place or District.	Population, 1831	Deaths from Cholera, 1832.	Population, 1851.	Deaths from Cholera, 1849.
Manchester and Salford	182,812	890	315,951	1,115
South Shields - -	19,756	147	35,787	201

From Salisbury, Southampton, and some of the other districts in which the cholera was most fatal in 1849, no return was procured in 1832. (Cholera Report, 1849, pp. xlv–vi.)

The Thames, the Water Supply, and the Cholera Epidemic, 1848–9. —Before proceeding further in this branch of the inquiry, the effect of the River Thames and of the water supply on the health of London must be noticed. The Thames collects the waters of 6,160 square miles of country, extending from the Cotswold Hills in Gloucestershire to the eastern coast; and the great body of this water flows and reflows through London in tides, which carry the matter below London Bridge, a mile and a half above Battersea Bridge twice a day, and ascend as high as Teddington. The contents of the greater part of the drains, sinks, and water-closets of this vast city and of the 2,360,000 people on its sides, are discharged through the sewers into its waters; which, scarcely sullied by the primitive inhabitants, have now lost all their clearness and purity. The dark, turbid, dirty waters from half-stagnant sewers are agitated by the tides, but are not purified until they reach the sea.

The Thames presents a large evaporating surface which must be taken into account, and it gives off vapours day and night in quantities which the phenomena of a "London fog" reveal. The still air then condenses the matter which at other times enters the atmosphere invisibly, and escapes observation. The mean lowest night temperature of the Thames from May 27th to September 15th, 1849, was 64°; the mean lowest night temperature of the air was 52°; so that the wide simmering waters were breathing incessantly into the vast sleeping city tainted vapours, which the temperature of the air at night would not sustain.

It is a fact well worthy of attention, that after the temperature of the Thames has risen above 60°, diarrhœa, summer cholera, and dysentery become prevalent, and disappear as the temperature subsides. The cholera reached London in the new epidemic form about October, 1849; it prevailed through the winter, and destroyed 94 lives in the second week of January, when the temperature of the Thames was 37°; it declined rapidly through April and May; the night temperature of the Thames then rose to 62° in the week ending June 2nd; with some fluctuations it went up to 68° in July, and remained above 60° until the middle of September (week ending September 15th). The deaths from cholera registered during each of the 16 weeks were 9, 22, 42, 49, 124, 152, 339, 678, 783, 926, 823, 1,230, 1,272, 1,663, 2,026, 1,682. The mean night temperature of the Thames fell to 56°; the deaths from cholera to 839 in the week September 16–22; the temperature gradually fell to 38° on the last week of November, when there was only *one* death from cholera registered.

The mortality from cholera increases generally in descending the river on the south side, in Wandsworth it was at the rate of 100 in 10,000 inhabitants, in Lambeth 120, St. Saviour 153, St. Olave 181, Bermondsey 161, Rotherithe 205, where the water was perhaps most impure, Greenwich 75, where it had lost some of its impurities.

On the north side, commencing at the highest part of the river, the mortality from cholera was, in Kensington 33, Chelsea 46, Belgravia 28, Westminster 68, St. Martin-in-the-Fields 57, Strand 35, West London (on the old Fleet ditch) 96, London city 38, East London 45, Whitechapel 64, St. George in the East 42, Stepney 47, Poplar 71. The mortality from cholera in the three sub-districts of Stepney, adjoining the Thames, was twice as great as in the two districts away from the river. The result is here disturbed by elevation. No good analysis has been made of the Thames water at different points of its course; but the matter in suspension is perhaps greatest between London Bridge and Limehouse Reach, against Rotherithe.

The seven districts of London in which the mortality is highest from ordinary causes are, the West London District (between Smithfield and the Thames), St. Saviour, Whitechapel, St. George-in-the-East, Chelsea, St. Olave, and Rotherithe. They all adjoin the Thames.

Mr. Glaisher, of the Royal Observatory, Greenwich, was requested to make an estimate of the amount of vapour raised by evaporation from the Thames in London, and favoured the Registrar-General with the subjoined statement:—

"For some years past I have made daily experiments upon the amount of water evaporated from a surface of water, and the amount exceeded 30 inches annually.

"A depth of water of fully 30 inches must evaporate from the surface of the Thames annually; indeed, the quantity must be larger than this from the circumstance of its relative high night temperature. Take it, however, at 30 inches, and we shall have—

$2 \cdot 5 \times 9 \times 4840 = 108900$ *cubic feet* evaporated in a year from an area of water of one acre.

$\frac{108900}{0 \cdot 1605} = 678505$ *gallons* of water evaporated in one year from an acre of water.

$108900 \times 2245 = 244{,}480{,}500$ cubic feet of water evaporated from a surface of 2245 acres of water in one year.

$\frac{244480500}{0 \cdot 1605} = 1{,}523{,}242{,}991$ gallons of water evaporated in one year from a surface of water of 2,245 acres in extent, or more than 1,523 millions of gallons.

The salt water affects the water at Woolwich: it is usually what is termed brackish there. Lieut. Sanders states that at Greenwich, at high-water spring tides, the water is frequently brackish.

"The dirt and filth in solution must be very large. The 'Dreadnought' experiments are made under my direction chiefly, and I can assure you that to read the instruments is a serious affair, owing to the filth of the waters; on first pulling them up they are covered with a slimy adhesive mud; they first have to be wiped, and if the wind is blowing strongly, this muddy water is blown about and over the observer. A new trunk is now being made, with a perforated copper bottom turning downwards upon hinges, so as to get rid of the enormous deposit."

Upon Mr. Glaisher's estimate, 678,505 gallons evaporate from an acre of water in a year, which is at the rate of 1857·6 gallons daily. The bed of the Thames in London is estimated approximately at 2,245 acres; consequently 4,170,000 gallons are raised from the Thames on an average daily through the year. The quantity evaporated at low water is, perhaps, much less than this; on the other hand, the evaporation in summer is more active than in winter; and the proportion of decomposing organic matter in the water, and on the banks exposed to evaporation, is greater at low than at high water. Hence, it is probable that in summer 4 million gallons, or about 18,000 tons of water, are raised from the polluted Thames daily and discharged into, the atmosphere which is breathed by the inhabitants of London. It remains to determine how much of the organic matter in the water is raised with the vapour at different temperatures. (Cholera Report, 1848-9, pp. lix–lx.)

Elevation and Cholera Mortality in London, 1848-9.—The elevation of the soil in London has a more constant relation with the mortality from cholera than any other known element. The mortality from cholera is in the inverse ratio of the elevation. The mortality of the 19 highest districts was at the rate of 33 in 10,000, and of the 19 lowest districts 100 in 10,000. The elevation in the two groups was as 71 to 10 feet above the high-water mark of the Thames, or as 7 to 1; while the mortality was as 1 to 3, or in the inverse ratio. In the two groups of the 6 districts, supplied with the waters of the Thames at Kew and Hammersmith, the mean elevation was 35 and 175 feet, the mortality from cholera 19 and 11 in 10,000. In the two groups of 12 districts, supplied with the Thames water between the Battersea and Waterloo Bridges, the mean elevations were ⅓ foot and 10 feet; the mortality 168 and 77 in 10,000. In the two groups of 20 districts, supplied with the waters of the New River and the Lea, the mean elevation was 24 and 59½ feet; the mortality from cholera was 59 and 37. While the effects of the water and of the wealth of the districts are apparent, they do not, in this analysis, conceal the effects of elevation.

LONDON. Group of Districts.	Deaths from Cholera to 10,000 Persons Living.	Density of Population (Persons to an Acre).	Elevation in Feet above High Water Mark (Trinity).	Annual Value of Houses (Year ending April 5th, 1843.)
6 Districts supplied with Water taken from the THAMES *above* BATTERSEA	15	72	105	£ 82
20 Districts supplied with Water from the NEW RIVER, the LEA, and the RAVENSBOURNE	48	137	42	44
12 Districts supplied with Water taken from the THAMES, between BATTERSEA and WATERLOO BRIDGES	123	73	5	31

Cholera was excessively fatal in all the four districts which lie on a level with or below the Trinity high-water mark; it destroyed 144, 161, 164, and 205, in 10,000 inhabitants. In the five districts which lie 2 to 4 feet higher, on an average, the mortality from cholera was at the rate of 68, 97, 120, 153, and 181 in 10,000. Westminster experienced the lowest mortality (68) in the 9 low districts, and it is supplied with water by the Chelsea Company; while all the other districts are supplied by the Lambeth and Southwark Companies. In 10 districts, of an elevation of 50 feet and upwards, the mortality from cholera was at the rate only of 8, 8, 17, 19, 22, 22, 25, 35, 35, and 53. The mortality from cholera was not higher than 35, except in the district of St. Giles, which is an exceptional case: its elevation being 68 feet above the Thames, and the mortality from cholera at the rate of 53 in 10,000. It is a mixed district, and contains in near proximity the British Museum, Bedford Square, Russell Square, and Great Russell Street, where no death from cholera occurred; and Church Lane,—a low, damp, dirty lane, generally covered with decaying vegetables, and filled with a wretched population, where *thirty deaths* from cholera happened, in addition to its quota of 109 patients who from all parts of the district, were sent to, and died from cholera in, the Union workhouse.*

Notwithstanding the disturbance produced by the operation of other causes, the mortality from cholera in London bore a certain constant relation to the elevation of the soil, as is evident when the districts are arranged by groups in the order of their altitude. We place the districts together which are not on an average 20 feet above the Thames, and find that on this bottom of the London basin the mortality was at the average rate of 102 in 10,000; in the second group, at 20 and under 40 feet of elevation, or on the second terrace, the mortality from cholera was at the rate of 65 in 10,000; in the third group or on the third terrace, 40 to 60 feet high, the mortality from cholera was at the rate of 34 in 10,000; in the fourth group, 60 to 80 feet high, the mortality from cholera was at the rate of 27 in 10,000; in the fifth group, 80 to 100 feet high, the mortality was at the rate of 22 in 10,000; in a district 100 feet high, the mortality was 17 in 10,000; in Hampstead, about 350 feet high, the mortality was 8, or deducting a stranger infected at Wandsworth, but who died there, 7 in 10,000.

Elevation of Districts in feet.	Number of Terrace from bottom.	Deaths from Cholera in 10,000 Inhabitants.	Calculated Series (1.)
Feet.			
Under 20	1	102	$\frac{102}{1} = 102$
20—40	2	65	$\frac{102}{2} = 51$
40—60	3	34	$\frac{102}{3} = 34$
60—80	4	27	$\frac{102}{4} = 26$
80—100	5	22	$\frac{102}{5} = 20$
100—120	6	17	$\frac{102}{6} = 17$
340—360	18	7	$\frac{102}{18} = 6$

* *See* Report on Church Lane and its vicinage in the Journal of the Statistical Society of London, Vol. xi., p. 4, 1848. See also in the same volume a valuable paper on St. Giles's district, by Horace Mann, Esq., Barrister-at-Law.

By ascending from the bottom to the third terrace, the mortality is reduced from 102 to 34; by ascending to the sixth terrace it is reduced to 17. It will be observed, that the number representing the mortality on the third terrace is one-third of the number 102, representing the mortality on the first, and that the mortality on the sixth terrace is one-sixth part of the mortality on the first. And a series approximating nearly to the numbers representing the mortality from cholera, is obtained by dividing 102 successively by 2, 3, 4, 5, 6.

A comparison of the numbers of this series with the actual mortality experienced in each district, will serve to indicate roughly as much of the effect as is due to elevation; and the deviations from the scale are generally explained by the other elements of the problem.

The mortality from cholera on the ground under 20 feet high being represented by 1, the relative mortality in each successive terrace is represented by $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, $\frac{1}{6}$: or the mortality on each successive elevation is $\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{4}$, $\frac{4}{5}$, $\frac{5}{6}$, &c. of the mortality on the terrace immediately below it.

The elevation of the five terraces may be represented by 10, 30, 50, 70, 90 feet. The elevations of the two higher districts are 100, and 350 feet. It will be observed that the mortality at 100 feet is 17, at 50 feet 34 in 10,000; consequently *at half the elevation the mortality is doubled.* The half of 50 feet is 25 feet; and the double of the mortality, 34, is 68. Now observation gives 65 in 10,000 as the mortality at 30 feet of elevation. As the processes of dividing the elevation, and of multiplying the mortality by 2, may be carried on *ad infinitum*, it is evident that the mortality is not strictly in the inverse ratio of the heights of the soil; otherwise at the elevations 12·5, 6·25, 3·125 feet, the mortality would be 136, 272, 544.

Let e be any elevation within the observed limits 0 and 350, and c be the average rate of mortality from cholera at that elevation; also let e' be any *higher* elevation, and c' the mortality at that higher elevation. Then if the mortality from cholera is inversely as the elevation, we shall have the proportion

$$e : e' :: c' : c = \frac{e'}{e} . c'.$$

By adding a constant element, a, the velocity at which the mortality increases, particularly at the lower elevations, can be retarded to any extent. The equation then assumes the form (1) $\frac{e' + a}{e + a} . c' = c.$ The value of a can be most readily obtained by taking $e' = 90$, where the mortality was 22; and $e = 0$, where in three districts on a level with the Thames at high water the mortality was 177 in 10,000 on an average.

From Eq. 1 the value of a in general terms is found to be $a = \frac{e' c' - e c}{c - c'}.$

Inserting the above numbers, we have

$$a = \frac{90 \times 22 - 0 \times 177}{177 - 22} = \frac{1980}{155} = 12 \cdot 8.$$

LONDON DISTRICTS, arranged according to the Elevation of their Soil.

Number of Districts.	Elevation in Feet above Trinity High-water Mark.	OBSERVED AVERAGE.						
		Annual Mortality to 10,000 Persons living.		Number of Persons to		Average Annual Value of		Poor Rate in the £ of House rent 1842-43.
		Cholera (1849).	All Causes (1838–44).	An Acre.	A House.	Houses.	House and Shop room to each Person.	
						£	£	
16	Under 20 ft.	102	251	74	6·8	31	4·645	·072
7	20 — 40	65	237	105	7·6	56	7·358	·071
8	40 — 60	34	235	184	8·5	64	7·342	·056
3	60 — 80	27	236	152	8·8	52	6·374	·049
2	80 —100	22	211	44	7·7	38	5·183	·036
1	100	17	227	102	9·8	71	7·586	·043
1	350	8	202	5	7·2	40	5·804	—
Mean of 38 Districts -		66	240	107*	7·6	46	5·985	·064
All London - -		62	252	29*	7	40	5·419	·063

* The difference between the number of persons to an acre in the mean of 38 districts, and in all London, as separately calculated, arises in consequence of several districts of large area being thrown into the divisor in the latter case, while the effect of taking the mean of 38 districts is to render the population of each district of equal amount.

As the series is not perfectly uniform, different values of a are obtained from the formula; and 13 is an intermediate value of a, which has been employed in the construction of the annexed Table, by making e successively 0, 5, 10, 15, . . . 110, 150, 200, 250, 300, 350, in the equation—

$$c = \frac{90 + 13}{e + 13} \times 22 = \frac{103 \times 22}{e + 13} = \frac{2266}{e + 13}$$

Upon comparing the numbers of this series with the mean mortality observed in the districts at eight different elevations, it will be observed that the only considerable discrepancy is at the mean elevation (20–40) assumed to be 30 feet. The excess of mortality is in Wandsworth, West London, and Bethnal Green.

Mean Elevation of the ground above the High-water Mark.	Mean Mortality from Cholera.	Calculated Series.
0	177	174
10	102	99
30	65	53
50	34	34
70	27	27
90	22	22
100	17	20
—	—	—
350	7	6

The houses necessarily raise the people of London above the ground; and if their *habitat*, day and night, is on an average 13 feet above the ground level, it is evident that the mortality *within the limits observed is in the inverse ratio of the elevations at which the people live.* The causes of the discrepancies in particular districts are partly explained by differences in the wealth of the people and other causes.

LONDON.—Mean Mortality from Cholera at different Elevations; reduced from the observations to a regular series.

Elevation in feet above Trinity High-water Mark on the Thames.	$e + 13$	Deaths from Cholera to 10,000 Inhabitants.		Increase of Mortality in descending five feet.	
		Calculated c.	Observed (average).*	Rate of Increase $= r$.	Increase per cent.
100	113	20	17	1·0463	4·6
95	108	21	—	1·0485	4·8
90	103	22	22	1·0510	5·1
85	98	23	—	1·0538	5·4
80	93	24	—	1·0568	5·7
75	88	26	—	1·0602	6·0
70	83	27	27	1·0641	6·4
65	78	29	—	1·0685	6·9
60	73	31	—	1·0735	7·4
55	68	33	—	1·0794	7·9
50	63	36	34	1·0862	8·6
45	58	39	—	1·0943	9·4
40	53	43	—	1·1042	10·4
35	48	47	—	1·1163	11·6
30	43	53	65	1·1316	13·2
25	38	60	—	1·1515	15·2
20	33	69	—	1·1786	17·9
15	28	81	—	1·2174	21·7
10	23	99	102	1·2776	27·8
5	18	126	—	1·3846	38·5
0	13	174	177	—	—

* The observed average is obtained by taking the mean height of districts at the elevation 20–40 feet at 30, those at 40–60 at 50, &c. &c.

The relation discovered between the elevation of the soil and the mortality from cholera is so important, that it was thought right after the above calculations were made to submit the principle to another test, by comparing the elevation and the mortality from cholera of *each sub-district*. The population of the sub-districts in 1851 having been enumerated, it became possible to construct Tables;† which, although they make the mortality on the lowest level less, and although the results are deranged by the deaths in hospitals and workhouses, entirely confirms the announced law.—(Cholera Report, 1848-9, pp. lxi–lxvi.)

Conditions under which Cholera is most fatal.—It has been shown in the general analysis of the returns from the whole kingdom, that cholera has not only been most fatal in the low, and least fatal in the high parts of the country, but that the fatality has diminished proportionately as the dwellings of the population have been raised above the sea level. The epidemic began and was most fatal in the ports on the coast; and in ascending in the rivers step by step, we saw it grow less and less fatal. It became probable that a certain relation existed between elevation and the power of cholera to destroy life. The more exact information which we possess respecting the London districts establishes this connexion beyond doubt. The relation may not be expressed by the same figures in other places, or in London at other times, but it will always be the general rule that the *mortality of cholera is inversely as the elevation of the people assailed above the sea level.*

Mere density of population had not the same direct effect of increasing the mortality in this disease as in others; for in many inland towns, and in high, dense parts of London, the mortality was slight or inconsiderable. Neither does the mortality from cholera vary in the London

† *See* Cholera Report, 1848–9, pp. clxvi–ix.

districts in any ratio of the density. Still density and numbers of people are not to be lost sight of; for the cholera was not fatal to many inhabitants of thinly peopled, though low and marshy parts; while in such localities it was very fatal in nearly all towns. The law is, that the mortality in *towns of some extent and density* is inversely as the elevation.

The wealth of different places differs in amount and distribution. The differences in wealth and poverty probably have an effect on the mortality. But abstracting the indirect effect through the selection of sites and the supply of water, the great differences in the wealth of the London districts do not enable us to detect a very marked or constant influence of this element on the mortality from cholera. In the country at large there is no reason to believe that the wealth of the inhabitants increases as we ascend the high grounds which the cholera left unscathed. The reverse is probably the fact.

Elevation of the land involves several conditions which have an important effect on life and health. As we ascend, the pressure of the atmosphere diminishes, the temperature decreases, the fall of water increases, the vegetation varies, and successive families of plants and animals appear in different zones of elevation. The waters roll along the surface of the rocks, or filter through them and the porous strata of the earth to burst out below—the sources of rivers, or of tributaries which carry disintegrated rocks, with the remains and excretions of vegetables, animals, or men, in every stage of decomposition. The deposits in stagnant places, and at the estuaries, show the kind and quantity of mixed matter which the laden rivers carry down and deposit on the low margins of the sea at the tidal confluences of the fresh and salt waters.

If we take a series of towns on a river it is evident that the refuse matter of the first town will pass through the second; of the first and second through the third; of the first, second, and third through the fourth; and so on to the lowest town, which will be traversed by all the unevaporated and unwasted organic matter that has found its way into the waters on their way to the ocean. As the transformation of decaying organic matter into inorganic and innoxious elements is constantly going on, it will be in many cases completely decomposed in its course. What has been said of the refuse of towns will apply to the leaves of the forests, and to vegetable remains of all kinds.

As the rivers descend, the fall of their beds often grows less, and the water creeps sluggishly along, or oozes and meanders through the alluvial soil. The drainage of the towns is difficult on the low ground, and the impurities lie on the surface, or filter into the earth. The wells and all the waters are infected. Where the houses are built on hill sides and elevations, as in London, the sewage of each successive terrace flows through the terrace below it, and the stream widens, the ground becomes more charged, every successive step of the descent, until it is completely saturated in the parts lying below the high-water mark.

The river, the canals, the docks, and the soil of a port may be viewed as a large basin full of an almost infinite variety of organic matters, undergoing infusion and distillation at varying temperatures; and as the aqueous vapour which is given off ascends, it will be impregnated with a quantity of the products of the chemical action going on below, variable in amount, but necessarily greatest in the lowest and foulest parts. The emanations, mixing with the superincumbent atmosphere, ascend like smoke; but at the same time become less and less dense by dilution and by the gradual destructive decomposition. A glass vessel, perforated by small holes filled with pure water, and dipped into a coloured solution, might give a good idea of the atmosphere of such a town; the coloured solution flowing down the sides would grow thicker by every accession of colouring matter as it descended, and at the same time colour the water above with a tint deepening in intensity. Or if the river basins of the country were quite smooth and even, the sides descending rapidly at first and then slowly, the fall over the whole face of the country of rain flowing in thicker and thicker sheets as it descended, would present a good image of the phenomena; but perhaps not so vivid as the vapour which, when the rain ceased, would arise from the wet and saturated soil in every degree of density, from the thickest fog round the marshy bottom to the thinnest mist upon the hills.

From an eminence on summer evenings when the sun has set, exhalations are often seen rising at the bottoms of valleys, over rivers, wet meadows, or low streets; the thickness of the fog diminishing and disappearing in upper air. The evaporation is most abundant in the day; but so long as the temperature of the air is high, it sustains the vapour in an invisible body, which is, according to common observation, less noxious while penetrated by sunlight and heat than when the watery vapour has lost its elasticity, and floats about surcharged with organic compounds in the chill and darkness of night.

The amount of organic matter, then, in the atmosphere we breathe, and in the waters, will differ at different elevations, and the law which regulates its distribution, will bear some resemblance to the law regulating the mortality from cholera at the various elevations. It has been seen how rapidly in London the mortality from cholera diminishes a few feet above the low ground on a level with the Thames, while several feet of elevation in higher regions produces no sensible effect. The same thing holds in drainage. The ground on a level with the outlet cannot be drained at all, while a few feet of elevation make drainage practicable, efficient, and easy. And the law holds that while a few feet of elevation are so important near the outlet, they are of little or of no importance on the higher lands of the country. The diagram* represents roughly the facilities of drainage, as well as the mortality from cholera at the several elevations.†

It is established by observation that cholera is most fatal in the low towns, and in the low parts of London; where, from various causes, the greatest quantity of organic matter is in a state of chemical action; and it may be admitted that cholera, varying in intensity with the quantity, is the result of some *change* in the *chemical action* of this matter; leaving it open for further inquiry to determine whether, in England, that change is spontaneous, or the result of the introduction of a zymotic matter from beyond the seas; whether the poison enters the human frame in air or water, through the skin, the mucous membranes, or the air-cells of the lungs.

If the facts are so, it follows, that cholera will not only be fatal on low ground, but on high ground, if, from any concurrence of circumstances, the conditions exist there which are so constantly found in alluvial soils, lying on a level with or below the tidal waters. Now these conditions did exist in nearly every place severely visited by cholera on ground much above the sea level: in Salisbury, Merthyr Tydfil, Bilston, Newcastle-under-Lyme, and Church-street, St. Giles, London.

The atmospheric pressure and the temperature diminish with the elevation; and it is easy to conceive that either may exercise considerable

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* *See* Cholera Report, 1848–9, p. lxx.

† *See* Table relative au Mouvement de l'eau dans les Canaux et Rivières: in Leçons de Mécanique Pratique, par A. Morin, 2e Partie Hydraulique, p. 71.

influence when the elevation is considerable. The rarity of the atmosphere, or the perpetual snow on the Himalaya and the Alps, may be alleged as the causes why the epidemic never crossed their passes. But the barometric column is depressed little more than 1-10th of an inch for an elevation of 100 feet; the atmospheric pressure therefore is not 1-300th part less at that elevation in London than it is at the water level. The difference in mean temperature, produced according to the ordinary computation by that elevation, does not exceed 4-10ths of a degree of Fahrenheit's thermometer.* Both these changes of temperature and pressure affect the organisation, and they may be greater in summer than in other seasons; but when it is found that great and sudden changes of heat and pressure are borne with impunity, and moreover, that cholera has prevailed at different latitudes in different seasons, it does not appear probable that here these physical changes had much effect on the fatality of the disease. Besides this, it has been shown that an elevation of 10 feet above the water level diminishes the mortality from cholera very considerably; while a difference of *ten* feet at the higher elevation of a hundred feet, has little effect on the mortality of that disease. The variations of *temperature* and of *pressure* follow laws entirely different, and are too slight at elevations differing only ten feet to be the direct cause of the great difference in the mortality of cholera.

Certain diseases arise when men are crowded together in close dirty gaols, camps, or hospitals; when they inhale morbid exhalations, or are placed in contact with others labouring under such zymotic diseases as small-pox; and when they reside in marshy countries. The explanation of the diffusion of cholera by an organic matter is therefore consonant with what is known of the etiology of other diseases.

It has been shown already that when the cholera invades a place, it generally advances slowly at first; then that great numbers are attacked: and at the same time that many have all the symptoms of Asiatic cholera, others have cholera of a milder type: a class still more numerous have choleraic diarrhœa; and great numbers have disorder of the bowels, sickness, indigestion, and slight cramps. The stated proportion of deaths from cholera, out of a given number of cases, varies not only with the malignity of the form and with the medical treatment, but with the definition of the disease: some taking as cholera only cases in collapse, others including the mildest forms: the lighter forms of diarrhœa are seldom noticed in medical registers, and rarely come under medical observation.

Cholera has rarely been fatal in England to more than 1 in 2 attacked; and it may be laid down, that for 1 death not more than 3 persons were attacked in the severer way.† The deaths from cholera in the last 3 months of 1848, and in the year 1849, were 54,398; the deaths from the disease in 1849 were 53,293; which may be taken to represent the deaths in the two years from the Asiatic type, leaving 1,105 as from the common variety. About 160,000 persons then may have been attacked by cholera in England. The population was about 17,541,000 in the middle of 1849; so that 17,381,000 of the population escaped attack. The deaths from diarrhœa in 1849 were 18,887; 3,887 may be set down as the result of common diarrhœa, leaving 15,000; and if there are

* $f = \dfrac{e}{251 \cdot 5 + \cdot 005\,e}$ where e is the elevation in feet, and f the change of temperature in degrees of Fahrenheit.

† The cases of cholera reported to the Central Board of Health in England, 1831–2, were 82,528, the deaths 31,376; the mortality was consequently at the rate of 38 deaths to 100 cases.

100 cases to 1 death, the cases induced by the epidemic must have been 1,500,000. Less than 1 in 10 of the population were attacked by cholera or diarrhœa. By the Table* it will be seen that in all England 30 died of cholera, 11 of diarrhœa to 10,000 living; of whom, by the previous estimate, 90 must have sustained an attack of cholera, and 1,100 an attack of diarrhœa. In London, upon the same basis, it may be estimated that 1,886 in 10,000 inhabitants had an attack either of diarrhœa or cholera. In Hull, the district in which the mortality was highest, 241 died of cholera, 40 of diarrhœa, in 10,000 inhabitants, of whom 4,723 must have been attacked either by cholera or diarrhœa. If an exact return of every shade of the disease could be procured, it is probable that it would be found over a great part of the country in one form or other—differing not in nature but in intensity; never in any place attacking all the inhabitants, and, as we have seen, leaving few districts without one or more deaths to mark its presence.

Under any circumstances it is certain that in this, as in other zymotic diseases, great multitudes of the people who in one way or other take an average dose of the poison resist its influence: and it may be admitted that the numbers attacked bear some proportion to the quantity of the specific matter in the air, water, or earth of the place where they dwell. This specific matter is known only by its effects; but it has been shown that the deaths from cholera vary in some proportion to the quantity of organic matter in the state so commonly observed in the low parts of low towns. Our generalization then goes to this extent, that the cause of cholera is some chemical modification of organic matter: and here is the great practical fact—that *although elevation of habitation, with purity of air and purity of water, does not shut out the cause of cholera, it reduces its effects to insignificance.* (Cholera Report, 1848–9, pp. lxix–lxxii.)

Rise and Progress of the Cholera Epidemic, 1853–4.—The epidemic which in the year 1849 destroyed 53,273 lives by cholera, subsided, and in the year 1850 the deaths by that disease were 887; in the next two years the deaths by cholera rose to 1,132 and to 1,381; until in 1853 it appeared again in the epidemic form, attacking London and some other places slightly, and ravaging Newcastle-upon-Tyne. The disease remained torpid for a season, and then it broke out, as in former times, in a second eruption, which was in the course of the year 1854 fatal to 20,097 persons of all ages.

But it is impossible to overlook the diarrhœa which has gone on gradually increasing in fatality since the year 1838, when 2,482 deaths were referred to that cause; while in 1847 the deaths by diarrhœa were 11,595, in 1848 nearly the same number; in 1849 the deaths by diarrhœa were 17,831; thus making the deaths by cholera and diarrhœa in the epidemic year 71,104, or 72,180 if we add the cases of persons attacked while labouring under other fatal diseases.

Diarrhœa did not discontinue its ravages after 1849; the deaths in the three following years were 11,468, 14,728, and 17,617; in 1853, when cholera appeared in the epidemic form, the deaths from diarrhœa fell to 14,192; but in 1854 the number was 20,052. Thus the deaths by cholera and diarrhœa in this year were 40,149, exclusive of a certain number of deaths which epidemic diarrhœa caused in conjunction with other diseases.†

* *See* Cholera Report, 1848–9, p. cxxx.

† The deaths by cholera and by diarrhœa in 1849, as returned in the Cholera Report, were 53,293 and 18,887; but as a certain number of these persons had also other fatal diseases at the time of death, the general abstracts refer only 53,273 deaths to cholera, and 17,831 to diarrhœa: 20 and 1,056 deaths having been referred to the other heads. The epidemic was one of the causes of death; it killed sick and dying men.

Diarrhœa is often a symptom of other well-marked diseases;* and it is also the effect of a class of medicines; but this diarrhœa which always prevails in hot weather, and has been so common since the year 1846, is evidently a variety of cholera, proving fatal chiefly to young children and to old people, who do not so commonly exhibit the spasms of cholera, but have nearly all the other symptoms.

Cholera itself has probably always existed in England, and it was well described by Sydenham in the seventeenth century; but the epidemic form presents some differences† in the symptoms, as well as in the extent of its ravages. The chief characteristic is found in the duration of the fatal cases, half of which terminate within one day (24 hours) of the first appearance of decisive symptoms, while half of the cases of common cholera terminate in *three days*, and half the cases of diarrhœa extend over *six days*.

If the deaths from cholera and diarrhœa in the two years 1848–49, and in the two years 1853–54 be added together, they will amount to 84,079 and 58,760 respectively, which, after subtracting 4,000 from each number for the ordinary deaths from diarrhœa and cholera, will leave about 80,000 and 55,000, or 135,000 deaths by the two epidemics which occurred in the brief period of *seven years*. This was in England and Wales, and it is probable that the epidemic attacked in the two forms little less than *five millions*, and killed a *quarter of a million of the people of the United Kingdom*.‡

The great bulk of the deaths from cholera occurred in 1849 and in 1854; it is therefore proposed to make the deaths in these years the basis of the calculations which follow; and it will only be necessary to bear in mind that the mortality from cholera in the epidemic of 1848–49 is slightly understated, while the relative mortality of 1853–54 is obtained by adding the deaths in Newcastle-upon-Tyne and in Gateshead. As a set-off against the above restrictions in the numbers, may be placed the deaths from cholera and diarrhœa counted in 1849 and 1854, of the *ordinary form*, and which would have occurred if the years had not been epidemical.

The mortality from cholera and diarrhœa in 1849 was at the rate of 41 in 10,000, while the mortality in 1854 was at the rate of 22 in 10,000 of the population. If the 22 is made 23, on account of the earlier attack on Newcastle-upon-Tyne in 1853, still the rate of mortality, taking the increase of population into account, will be in the last epidemic little more than half (23) the rate (41) in the former epidemic.

The rates of mortality by *diarrhœa* in the two epidemics were equal; 11 and 11 in 10,000 of the population.

And in 1854 the rate of mortality by cholera was also 11; that is equal to the mortality (11) by diarrhœa; while in 1849 the rate of mortality by cholera, that is, by the severe form of the epidemic, was 30 in 10,000, or nearly three times as high as the rate of mortality by diarrhœa, and three times as high as the rate of mortality by cholera in 1854.

The epidemic of 1853–54, which broke out with so much violence at Newcastle-upon-Tyne, was of the same character as the previous

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* See Report to Registrar General on Cholera, 1848–49, p. xi.

† See Report to Registrar General on Cholera, p. xvi.

‡ The deaths returned to the Board of Health in Scotland from cholera alone were 6,848 from 31st August 1853 to 17th November 1854. The deaths by cholera in Ireland during the year 1849 were 30,156. Hence it may be inferred that the deaths by cholera in Scotland and Ireland together exceeded the deaths by the epidemic in England.

epidemics; and its intensity apparently depended chiefly on the local and meteorological circumstances.

It will be seen that the rates of mortality by diarrhœa were nearly equal in the two epidemics, and that the great differences arise under the head of cholera.

The zymotic matter of cholera—or *cholerine* as it may be called, is evidently generated or distributed at different degrees of strength, and there is a point of strength at which it strikes down all resistance, and overwhelms a population with destruction. The causes of this destructive form of the disease fluctuate much more than the causes of the diarrhœa. I shall therefore direct special attention to the development of cholera. (17th Annual Report, pp. 75–7.)

Local Fatality of Cholera, 1853–4.—In the first report on cholera it was shown that the great ravages of the epidemic of 1848–49, occurred within nine well defined regions, which were designated *cholera fields;* and named from the towns which were the great centres of the attack. These cholera fields will be sufficiently indicated here by the names of their chief towns: London, Portsmouth, Plymouth, Bristol, Merthyr Tydfil, Wolverhampton, Liverpool, Hull, Tynemouth. Only the cholera fields of London and of Tynemouth (including Newcastle-upon-Tyne and Gateshead), were revisited with great severity in 1853–54. The districts of Oxford, Brackley, Towcester, Potterspury, Norwich, Milton, Thanet (containing Margate and Ramsgate), and the marshy parts of Essex and of Cambridge—all within the cholera field round London—suffered in many instances more heavily in the epidemic of 1853–54 than in the epidemic of 1848–49. The mortality in Newcastle and Gateshead by cholera was higher than it had been in either of the epidemics 1831–32 or 1848–49. Liverpool suffered to some extent in 1853–54.

AREA, POPULATION, and MORTALITY from CHOLERA in 136 Districts of England, comprising the 9 CHOLERA FIELDS of 1849.

——	Area in Square Miles.	Population enumerated.		Deaths from Cholera.		Persons to One Square mile.		Deaths from Cholera to 10,000 Persons living.	
		1841.	1851.	1849	1854	1849	1854	1849	1854
136 Districts, comprising the nine Cholera Fields of 1849.	8,303	6,161,162	7,448,615	46,592	16,295	915	955	65	21
The 491 other Districts of England and Wales.	50,017	9,752,986	10,478,994	6,701	3,802	211	215	6	4
England and Wales	58,320	15,914,148	17,927,609	53,293	20,097	308	319	30	11

In 1849 the deaths of 46,592 persons by cholera occurred in 136 districts, on an area of 8,303 square miles, having in 1851 a population of 7,448,615; while 6,701 died in the rest of the country on an area of 50,017 square miles inhabited by 10,478,994 people. The chief mortality in like manner in 1853–54 took place within the same regions: 16,295 died there of cholera, while 3,802 died in the rest of England and Wales. Thus the mortality by cholera was at the rate of 65 in 10,000 in the year 1849, and 21 in the year 1854, in the districts of the cholera fields; in the other districts the rates in the two years were 6 and 4.

As a general rule, the mortality by cholera in the same large portions of the country was low in the two epidemics; in the last epidemic it fell to *two* thirds (4) of the rate (6) of 1849 within these regions, whereas it fell to one third (21) of the former rate (65) in the district of the cholera fields.

In the 47 districts, including the principal seaport towns (population 2,156,625), the mortality rate by cholera in 1854 was 23; in 41 of the principal inland town districts (population 2,240,192), 6; in the remaining 503 districts of the country 2, in 10,000. The mortality rates in these districts were as 23, 6, and 2 in 1854; and as 85, 38, and 12 in 1849. London, which partakes of the characters of both classes of towns, exhibited in 1849 an intermediate cholera mortality rate of 62 in 10,000, but in 1854 the cholera mortality rate of London was 43, while that of the seaport towns was 23.

Diarrhœa in the year 1854 was more fatal (20) in the principal inland towns than it was in the principal seaport towns (13); while in 1849 it was nearly equally fatal in the two kinds of towns—18 and 17 in 10,000 inhabitants.

The mortality of the 41 large inland towns by cholera both in 1849 and in 1854 was higher than the mortality of the rest of the inland districts; and it fell in 1849 chiefly on six of those town districts: Wolverhampton, Merthyr Tydfil, Manchester, Salford, Leeds, and Hunslet, where the mortality rate by cholera was 98 in 10,000 living, while in the 35 other town districts it was 11. In 1854 the cholera death rate was 9 in 10,000 living in the six districts; 5 in 10,000 in the other 35 town districts.

The 42 districts on the coalfields of England and Wales suffered severely from the epidemic in 1849, where to 10,000 living the deaths were 46 by cholera, and 13 by diarrhœa; while in 1854 the deaths to 10,000 were 12 by cholera and 14 by diarrhœa. The latter rates include the deaths from cholera and diarrhœa in Newcastle and Gateshead during the year 1853.—(17th Annual Report, pp. 77–85.)

Sex and Age Mortality from Cholera, 1853-4.—Males suffered more than females from cholera and diarrhœa at all ages under 25; at the ages of 25 to 45 the females suffered more than the males; at 45 to 55

ANNUAL RATE of MORTALITY at different Ages from CHOLERA and DIARRHŒA in ENGLAND in the Years 1849 and 1854, compared with the MORTALITY from ALL CAUSES in the Years 1838-44 and 1845-54.

Ages.	Annual Deaths to 10,000 Males living at each Age, from				Annual Deaths to 10,000 Females living at each Age, from			
	Cholera and Diarrhœa.		All Causes.		Cholera and Diarrhœa.		All Causes.	
	1849	1854	1838–44	1845–54	1849	1854	1838–44	1845–54
All Ages - -	41·3	22·0	227·0	236·4	40·2	21·2	210·4	220·5
0— - -	88·1	81·1	707·2	735·6	77·5	71·3	603·7	634·3
5— - -	26·0	9·9	92·6	91·6	25·1	9·3	90·0	89·5
10— - -	14·9	5·1	50·4	52·3	14·0	4·2	54·8	54·6
15— - -	16·5	6·3	80·5	83·3	15·4	6·0	83·3	86·3
25— - -	31·1	10·2	96·8	101·5	32·4	11·7	100·9	108·3
35— - -	41·0	14·1	124·9	130·9	43·7	16·1	124·2	129·3
45— - -	54·3	17·7	177·6	189·5	51·3	17·8	154·8	161·7
55— - -	70·1	24·9	314·1	322·6	71·0	27·1	278·2	285·5
65— - -	91·6	39·6	661·3	675·5	94·6	42·2	588·5	610·4
75— - -	113·7	72·6	1439·4	1499·1	123·8	75·5	1320·1	1365·2
85— - -	134·5	102·9	2964·6	3029·4	111·0	96·2	2755·3	2807·6
95 and upwards	108·8	126·1	4269·7	4521·9	107·2	95·4	4079·5	4522·6

the mortality rate of males was greater than the mortality rate of females in 1849, but in 1854 the rates were nearly equal; from the ages of 55 to 85 the old women suffered more than the old men; at the age of 85 and upwards the facts become too few to yield certain results, but they seem to show that proportionally more old men of 85 and upwards die of cholera and diarrhœa than old women at the same advanced age. It will be observed that the mortality of males and of females under 5 years of age was nearly as high in 1854 as it was in 1849; and at the age of 75 and upwards the numbers that express the mortality in the two epidemics do not greatly differ. From the ages of 10 to 65 the mortality of 1849 was to the mortality of 1854 nearly as *three* to 1 in both sexes.—(17th Annual Report, pp. 87–8.)

Elevation and Cholera Mortality, 1853–4.—It was shown by the investigations in the former report that the mortality of the cholera epidemic is highest on the land at the low mouths of rivers, and generally on the low ground of towns. It was also shown that in London the mortality increases as the ground on which the houses stand falls from Hampstead and from Norwood to the Thames. This important principle is confirmed by the observations in the present epidemic. I extract from the Weekly Report (December 2nd, 1854, No. 48.) a short account of the results:—

It would be out of place, however, to discuss here fully the circumstances to which the decrease of mortality may be referred, or to attempt to resolve that important question,—perhaps the most important of the day,—"What is the cause of epidemic "cholera?" Is it the effused flaky matter—from the Indian population on the delta of the Ganges, driven about like the clouds of a leavening dust in the air and in the waters,—that has reproduced itself, and has destroyed men, all over the world, either dwelling quietly in their houses, or encamped on hostile battle fields? Is it ozone, electricity, volcanic, or any other agency? None of the facts in the Weekly Tables affords a solution of these questions. But in the Report that was prepared at this office on the epidemic cholera of 1848–49 in England, certain

MORTALITY by CHOLERA in 1849 and in the $1\frac{1}{2}$ years $1853\frac{1}{2}$–1854 of SIX PORTIONS of the POPULATION of LONDON living in SUB-DISTRICTS at Six different Elevations; and other Conditions.

No. of Sub-Districts.	Elevation above Trinity High-water Mark of the Thames. Extreme Elevation of Sub-districts.	Elevation: Mean.	Density. Persons to an Acre in 1851.	Annual Value of Houses.	Annual Rate of Increase per Cent. on Population 1841–51	Mortality by Cholera and Diarrhœa, $1853\frac{1}{2}$–1854. Deaths to 10,000 Persons living. Cholera.	Diarrhœa.	Cholera and Diarrhœa.	Mortality by Cholera. Deaths to 10,000 Persons living. In 1849.	Mean in the two Epidemics.
	Feet. Feet.	Feet.		£						
6	100 — 350	137	13	40	5·761	13	21	34	12	13
5	80 — 100	88	37	45	3·496	10	21	31	20	15
24	60 — 80	69	48	60	·893	28	19	47	25	26
24	40 — 60	48	47	45	1·689	17	21	38	45	31
23	20 — 40	31	81	41	1·527	32	24	56	65	49
49	Under 20 -	5	27	32	2·178	88	31	119	103	96
All London.	3 ft. below to 350 ft. above.	39	30	41	1·982	46	25	71	62	54
1	2	3	4	5	6	7	8	9	10	11

The column 2 shows that the mean elevation of the sub-districts ranges between 100 feet and 350 feet; and the 3d column, that upon multiplying the population of each sub-district into its elevation, and dividing all the sums thus obtained by the sum of the population, the mean elevation at which the people lived in the six highest sub-districts is about 137 feet.

conditions in which cholera is fatal were brought to light; and we have now in this second epidemic an opportunity of re-examining and testing those results.

And, first, with reference to the localities in which men live. The vast population of the Metropolis is diffused over 78,029 acres of ground, which is sub-divided into 36 districts and 135 sub-districts. The sub-districts vary in size from 25 acres to 5,057 acres; in population from 1,632 persons to 47,881 persons; and in every one of these distinct sections of the population deaths from cholera occurred in 1849 and in 1854, except in the smallest, Dulwich, where, however, one person died of cholera in 1849.

The cause of cholera in its epidemic form was therefore some matter diffused over the 78,029 living acres of which London is composed; and no parish enjoys in the epidemic immunity from death by cholera, much less from the attacks either of severe cholera or of simple diarrhœa, which attend the deadlier forms of the disease.

But the fatality differed exceedingly; for in some sub-districts it destroyed 2, 4, 5, or 6 in every 10,000; in others it was fatal to 201, 206, 208, 211 or more in every 10,000 of the inhabitants.

The population of London is not homogeneous; in each sub-district the people, as the returns show, differ from the rest of the population in wealth, ranging from penury to abundance, and implying great variations in food, lodging, clothing, firing, medical aid; in density; in the elevation of the ground on which they live over the water-mark of the Thames; in the drainage; in the water with which they are supplied; in the exposure to contamination; in the nuisances and church-yards which surround them; in the temperature, moisture, electricity, and other atmospherical conditions.

After arranging the several districts in the order of the mortality that they suffered from cholera, in the order of the density of population, in the order of the elevation of the ground, in the order of the house rent per head,—which is one of the best gauges of the wealth of the people that statistics furnishes,—it was found that the variations of density had some connexion with the mortality,—that wealth and poverty exercised more influence,—that unclean water was pernicious, and that in dealing with large numbers and many districts there was a certain relation between the diminution of the mortality of cholera and the elevation of the ground on which the people lived.

London is built, like ancient Rome, upon several small hills, and upon low reclaimed and imperfectly drained marsh ground, which extends from Fulham to Westminster, and again to Poplar on the north side of the Thames; and on the south side, from Battersea to Lambeth, Southwark, Newington, Camberwell, Bermondsey, Rotherhithe, Deptford, and Woolwich. From the river, covering 2,245 acres at the bottom of the great valley and from this low ground, the houses rise over undulating slopes, northwards to Hampstead Heath, which is 404 feet above the Thames, and southwards up to Norwood and Sydenham.

From the new Ordnance map of London, which was prepared at the instance of the Commission of Sewers, Colonel Dawson, in 1850, estimated, for the Registrar General, the mean elevation of the 36 district of London; and subsequently the elevation of the ground of the 135 sub-districts has been estimated approximately. The population in 1851 was ascertained at the Census; the deaths by cholera were returned each week by the Registrars; and the following resulting facts show distinctly the inverse relation that the mortality of cholera bears to the elevation of the ground.

182,560 of the people of London in 1851 lived upon sub-districts covering 2,849 acres of the marsh ground, ranging from 3 feet below to 1 foot above the high-water mark; 2,693 died there of cholera in 1849, and 2,686 in 1853½–1854, or 5,379 in the two epidemics.

263,914 of the population, in sub-districts on 13,146 acres of ground of 80 feet of elevation and upwards, lost 398 persons by cholera in 1849, and 356 in 1854, or 754 in the two epidemics.

13,569 persons died of cholera in the years 1849 and 1853½-1854, on the 18,429 acres of low ground under 10 feet of elevation, out of a population of 595,119; while in the same years, out of the more numerous population, 682,705 persons living on 21,909 acres of the higher ground of 60 feet and upwards, only 3,008 persons died of cholera, including all the deaths in the district of St. James.

On the lowest ground, taking the mean of the two epidemics, nearly *fifteen* in 1,000 of the population,—on the highest ground *one* in 1,000 of the population,—were destroyed by cholera.

At the intermediate stages of elevation was the danger of dying by cholera intermediate? To solve this important question, as regarded the epidemic of 1849, London was first sub-divided into terraces differing 20 feet in elevation; and if the same course is pursued now it is found that in the two epidemic years 16,416 persons died of cholera on the first terrace under 20 feet of elevation; 3,771 on the second terrace of ground, 20 and under 40 feet high; 2,371 on the third terrace, 40 and under 60 feet; 2,254 on the fourth terrace, 60 to 80 feet high; 424 on the fifth terrace, 80 to 100 feet; 330 on the higher terraces of 100 feet up to 350 feet. The population was 850,000 on the lowest terrace; and about equal, or 400,000, on the second, the third, and the fourth terraces; while it was 142,000 on the fifth, and 121,000 on the higher terrace or terraces.

After correcting for the increase of population, it is found that in 1849 the deaths by cholera in every 10,000 inhabitants were 103, 65, 45, 25, 20, and 12, on each terrace respectively, commencing at the lowest; while on the same sites in 1853½–54, the mortality was 88, 32, 17, 28, 10, and 13. If the mean mortality is taken, the series becomes 96, 49, 31, 26, 15, and 13; which corresponds nearly with a series calculated on the hypothesis that the mortality by cholera in any two districts is, on the large scale, *inversely as their elevation*, to the numbers expressing which a certain *constant number* is added.

If we divide the mean mortality on the first or lowest terrace by 1, 2, 3, 4, 5, and 7 respectively, this series is obtained, 96, 48, 32, 24, 19, and 14; which represents closely the series exhibiting the mortality on the second, third, fourth, fifth, and the seventh terrace, each rising 20 feet in elevation. The house-ground from 100 to 350 feet is on an average about 137 feet high, and may be fairly represented by a *seventh* terrace,—120–140 feet. The sum of the hypothetical series is 233; of the other 230.

By applying this rule to the mortality of 1854 the series becomes 88, 44, 29, 22, 18, and 13. The mortality on the *first* and *seventh* terraces is in the relation of 1 and $\frac{1}{7}$; in the others there is a disturbance; the mortality on the fourth terrace is above, on the second, third, and fifth, below, that indicated by the elevation. The deviations from the law are in opposite directions; and in this single year nearly counterbalance each other.

It will be observed in the Table, that, besides the elevation, the density of the population in 1851, the annual value of houses, the rate of mortality from all causes, and the rate at which the population increased from 1841 to 1851, are given. But no such fixed relation is found between the density of population or the annual value of their houses as is observed between the mortality by cholera and the elevation of the ground on which the people dwell.

(17th Annual Report, pp. 88–90.)

Water Supply and Cholera Mortality, 1853–4.—The effect of impure water has also been determined.

Independently of any regard to theory, it appeared to be desirable to determine the effects of the different waters on the population of London during the impending cholera epidemic; accordingly, the following circular was addressed to the Secretaries of the several Water Companies:—

Sir, General Registrar Office, 15th October 1853.

The Registrar-General will feel obliged if you will answer the accompanying inquiries for the public information.

I have the honour to be, Sir,
Your obedient servant,

To the Secretary of___________ Water Company. (Signed) T. MANN.

1. What is the source from which the Water Company obtains the water for the supply of the London districts? If wholly or partly from a river or running stream, state at what point the supply is taken.
2. Is it the same as it was in 1849?
3. Are the methods of filtration and purification the same as those in use in 1849?
4. Is the area of supply the same?
5. If any changes have been made in either of the above particulars, what are the date and nature of those changes?
6. If any change is contemplated in the existing arrangements, what is its nature and when is it likely to come into operation?

A detailed abstract of the answers of the secretaries was published in a supplement to the Weekly Return, No. 47, November 19, 1853; and the general result was thus summed up :—

From the returns received from the Water Companies it appears that cholera finds London, as regards water, in the situation in which it left it. This holds true with reference to all except the Lambeth Waterworks Company, who changed their source of supply nearly two years ago from Lambeth to Thames Ditton ; and from a Table subjoined it will be seen that the results of the present epidemic in the districts supplied by that company, as compared with some others, are rather more satisfactory than they were in 1849, an improvement which, it is hoped, in the further course of events will be maintained. But new works undertaken by other companies in accordance with recent legislation are in progress. The return of cholera at an earlier period than was anticipated furnishes a motive for increased activity in their operations. With capital, public spirit, and natural advantages of locality, London may enjoy a pure and copious supply of this first necessary of life, as well as country towns and villages, and more than some towns with municipal institutions where the burgesses are too idle, or too busy, or too poor to bring it from surrounding springs to their doors. Manchester has set a good example, and it is only necessary that the national intelligence should be generally awakened to the question, for this great end—a good water supply—to be accomplished both in town and country.

Water Companies.	Sources of Supply.	Aggregate of Districts supplied chiefly by the respective Water Companies.			Deaths to 100,000 Inhabitants.
		Elevation in feet above Trinity High-water Mark.	Population enumerated 1851.	Deaths from Cholera in 12 Weeks ending Nov. 12, 1853.	
LONDON - -	- - - - -	-	2,362,236	626	27
Hampstead and New River.	Springs at Hampstead and Kenwood, two artesian wells, and New River.	80	166,956	6	4
New River -	At Chadwell Springs in Hertfordshire, from river Lee, and four wells in Middlesex and Herts.	76	634,468	50	8
Grand Junction -	The Thames, 360 yards above Kew Bridge.	38	109,636	14	13
Chelsea - -	The Thames, at Battersea	7	122,147	22	18
Kent - -	The Ravensbourne, in Kent.	18	134,200	27	20
West Middlesex -	The Thames, at Barnes -	72	277,700	72	26
East London -	The river Lee, at Lee Bridge.	26	434,694	124	29
Lambeth and Southwark.	The Thames, at Thames Ditton, and at Battersea	1	346,363	193	56
Southwark -	The Thames, at Battersea	8	118,267	100	85
Southwark and Kent.	The Thames, at Battersea, the Ravensbourne in Kent, and ditches and wells.	—	17,805	18	101

It is believed that through nearly the whole of this Table the impurity of the waters with which the inhabitants of the several districts are supplied is in nearly a direct proportion to the mortality from cholera.

The water at St. Thomas's Hospital is thus described by Dr. R. Dundas Thomson, the Professor of Chemistry :—

The water as delivered at the pipe in the Laboratory of St. Thomas's Hospital on the 11th November was quite turbid, as it usually is, and contained diffused through it 1·16 grains of vegetable matter, dried at a steam heat, consisting principally of silica, the chief constituent of the shields of the lower class of plants. But as in its moist state it contained at least two-thirds of its weight of water, we cannot estimate the filth in the water, which could be removed by filtration, at less than $3\frac{1}{2}$ grains per gallon.

The influence of the water became more evident; and was discussed in the supplement to the Weekly Return (December 3rd, 1853), from which the following Table is taken:—

MORTALITY from CHOLERA in Districts supplied by different Water Companies.

Water Companies.	Sources of Supply.	Aggregate of Districts supplied chiefly by the respective Water Companies.			Deaths to 100,000 Inhabitants.
		Elevation in feet above Trinity High-water Mark.	Population enumerated 1851.	Deaths from Cholera in 14 Weeks ending Nov 26, 1853.	
LONDON - -	- - - -	39	2,362,236	744	32
*(1) Hampstead and (2) New River.	Springs at Hampstead and Kenwood, two artesian wells, and New River.	80	166,956	8	5
New River -	At Chadwell Springs in Hertfordshire, from river Lee, and four wells in Middlesex and Herts.	76	634,468	56	9
Grand Junction -	The Thames, 360 yards above Kew Bridge.	38	109,636	16	15
Chelsea - -	The Thames, at Battersea	7	122,147	22	18
Kent - -	The Ravensbourne in Kent.	18	134,200	31	23
West Middlesex -	The Thames, at Barnes -	72	277,700	89	32
East London -	The river Lee, at Lee Bridge.	26	434,694	162	37
*(1) Lambeth and (2) Southwark.	The Thames, at Thames Ditton and at Battersea.	1	346,363	220	64
Southwark -	The Thames, at Battersea	8	118,267	121	102
*(1) Southwark and (2) Kent.	The Thames, at Battersea, the Ravensbourne in Kent, and ditches and wells.	—	17,805	19	107

* In three cases (marked with an asterisk) the same districts are supplied by two companies.

After correcting the above Table and the tables of cholera 1848–49, for the effects of elevation, it is found that a large residual mortality remains, which is fairly referable to the impurity of the water; for it is least where the water is known to be sweetest, greatest where the water is known to be the most impure.

After the great loss of life in 1849, and the patient investigations of two able committees of the House of Commons, the present Water Companies were left in the undisturbed possession of the monopoly, which they enjoy, of selling the people of London water. In the present state of engineering and sanitary science, purer waters from gathering grounds, or from springs, could probably be procured, and be supplied at cheaper rates by new companies, or by the incorporated rate-payers. But this would disturb the values of large masses of invested capital. To avoid such a result, always undesirable, the supply is left in the hands of the existing companies; but by Act of Parliament they are prohibited from obtaining supplies from the tidal waters of the Thames and Lee, after certain fixed dates.

It is enacted, that it shall not be lawful "after those dates" to distribute the pernicious waters over London. It unfortunately happens that in the invasion of cholera with which we are threatened next year (1854), every parish, except those which the Lambeth Company supplies, may receive waters as bad as those of 1849 without a direct violation of the Act of Parliament.

But the Water Companies will do well to bear in mind that the dates in the Act are the extreme limits of time beyond which they can supply London with impure water without a direct violation of the law. They may complete the works in half the time. They can accelerate their progress. And the returns which they have furnished will enable us to appreciate their zeal and spirit in the public service under an extraordinary emergency.

Instead of the distant dates of 31st August 1855, 1856, and 1857, which were fixed when the return of cholera was not contemplated, the companies should aim at supplying London with the water which they are then bound to furnish, at a date not later than the first of July 1854. This would probably be the means of saving thousands of lives, and entitle the directors to the public gratitude.

The cholera broke out again in 1854: the effects of the bad water were watched during the epidemic; and the general results of a special inquiry are thus described in the Weekly Return (October 14th, 1854).

INFLUENCE of the WATERS of LONDON on the MORTALITY of CHOLERA.

The present epidemic of cholera in London presents a favourable opportunity for determining the influence of waters of various degrees of impurity on the mortality of cholera:

In the Report on the epidemic of 1849 the following general results were obtained:

"In the six districts which are supplied with water taken from the Thames at Kew by the Grand Junction, and at Hammersmith by the West Middlesex, 15 in 10,000 inhabitants died from cholera, and the mortality ranged from 8 to 33."

"In the twenty districts supplied by the New River, the East London, and the Kent Companies with water from springs from the Lea and the Ravensbourne, 48 in 10,000 inhabitants died of cholera, and the mortality ranged from 19 to 96."

"In the twelve districts which are supplied with water taken by the Lambeth, the Chelsea, and the Southwark Companies from the Thames between Battersea and Waterloo Bridge, 123 in 10,000 inhabitants died of cholera, and the mortality ranged from 28 to 205."

"In the second group of districts cholera was three times as fatal; in the third, *eight times* as fatal as it was in the first; one, three, and eight express the relative virulence of the epidemic in the three conditions. The density of the population was greatest in the central group, and nearly the same in the first and third groups." *Reg. Gen. Cholera Report*, p. lxi.

A part of the excessive mortality is referable to the depression of the ground in the twelve districts.

The Lambeth Company, which in 1849 took up its supply from the Thames at the part where the water is most impure, has since January 1852 drawn its water from the Thames above the tidal flow, and has thus afforded an opportunity for ascertaining the effects of this great improvement.

It was observed in the first eruption (1853) of the present epidemic that the mortality was diminished in districts which were partially supplied by that Company. (Supplement to Weekly Return November 19th 1853.)

On October 13th, 1853, a circular had been sent to the London Water Companies, and the replies of all, except the Lambeth Company, showed that their new works and improvements had not then been carried out, as they were only bound under the Act of Parliament to complete them in 1855, 1856, or 1857.*

The Southwark Company, which now supplies the most impure water, stated, however, that though the Act "allowed three years from August 1852 for the execution of the nèw works, the contracts for the whole having been made immediately after the passing of the Act, and *being now* [October] *in a rapid course of fulfilment, the works will be completed and in operation one year within the time it prescribes,*" that is in September 1854.

The hopes of the Company, notwithstanding their efforts, on the approach of cholera, were defeated, the officers informed Lord Palmerston, by a concurrence of various causes, and the impure water of the Thames is still supplied by this Company.

Bermondsey, one of the south districts of London, is exclusively supplied with the impure water, and the deaths by cholera are already more numerous than they were in 1849, while in the parish of Lambeth, which is supplied partly by the Southwark Company, and partly by the Lambeth Company, the mortality is much lower than it was in 1849.

* The Secretary of the East London Water Company in August 1854 wrote thus to Viscount Palmerston:—"In reply to your Lordship's inquiry, what steps have been taken by the East London Waterworks Company to effect a remedy in regard to the watar supplied by them, I am instructed to state that the Company has already expended 150,000*l*. in effecting improvements; the supply has, for two months past, been taken through a newly constructed aqueduct, from a point in the valley of the Lee, nearly three miles higher up than formerly; the sewage of the valley, so far as it can effect the purity of this Company's supply, has been diverted by an intercepting drain, and the whole of the water delivered is filtered. Further works are also in progress."

DEATHS from CHOLERA.

Districts.	In the year 1849.	In the 14 weeks ending 14th Oct. 1854.
Bermondsey	734	829
Lambeth	1,618	904

But the pipes of the two Companies which were once in active competition often run down the same streets, and through the same sub-districts, so that alternate streets or houses in the same sub-districts are supplied with the pure and the impure waters.

Dr. Snow, who has devoted much time to the investigation, having procured from this office the addresses of the persons who died of cholera in Kennington and some other sub-districts, states, as the result of an inquiry from house to house where the pipes of the Lambeth Water Company are intimately mixed with those of the Southwark Company, that, in the 7 weeks ending August 26th, of 600 deaths from cholera, 475 have happened in houses supplied by the Southwark Company; 89 in houses supplied by the Lambeth Company; 13 in houses supplied by pumps, wells, and springs; 8 in houses which derived their water directly from the Thames and from ditches.

The Registrars on the south side of London were instructed to inquire, in all cases of death by cholera, whether the house in which the patient was attacked was supplied by the Southwark, the Lambeth, or the Kent Companies, or with water from pumps, wells, ditches, or other sources. The inquiry was attended with considerable difficulty, as the information could not be obtained from hospitals or workhouses, and the informants and the householders themselves were often ignorant of the source of supply, as the water rate in the worst districts is paid by the landlord. The information was thus not obtained in 766 out of 3,805 instances; but it was stated that in 3,039 instances 2,284 deaths occurred in houses supplied with the impure Thames water, 294 in the houses supplied by the Lambeth Company with the purer filtered Thames water. The disparity was observed week after week in the progress of the epidemic.

The total number of houses supplied by the Southwark Company is stated to be 40,046; by the Lambeth Company to be 26,107; consequently there were in 6 weeks 57 deaths in every 1,000 houses supplied with impure water, and 11 in every 1,000 supplied with the less impure or comparatively pure water.

It is deemed right at once to state these facts now the epidemic is declining; but the important inquiry can only be made complete in all its parts by the Board of Health, who have requested the respective companies to furnish street lists in every sub-district of the houses that they supply, with which the facts in the Registers of Deaths may be compared. The effects of elevation and other causes may be thus eliminated, and the fatal effects of impure water be precisely determined.

INFLUENCE of the WATER SUPPLY on the MORTALITY from CHOLERA in the SOUTH DISTRICTS of LONDON during the Six Weeks from August 28th to October 7th, 1854.

Water Company.	Source of Supply.	Houses supplied.	Estimated Population of the Houses supplied.	Deaths registered by Cholera in Houses.	Mortality to every 100,000 Inhabitants.	Mortality to every 1,000 Houses.
Southwark Company.	The Thames at Battersea.	40,046	266,516	2,284	857	57
Lambeth Company.	The Thames at Thames Ditton.	26,107	173 748	294	169	11
Kent Company	The Ravensbourne	14,594	97,127	188	194	13

Note.—The source of water supply was not ascertained in 766 instances. The water was said to be derived from pumps, wells, rivers, and other sources in 273 instances.

At the close of the epidemic the results of the observations on the water were finally summed up in the Weekly Return, December 9th, 1854.

It has been calculated that more than four million gallons of water evaporate daily from the Thames in its course through London; and besides the supply from wells, pumps, and streams, nine Water Companies in their returns state that they pumped on an average 60,614,420 gallons of water into 302,428 houses and a certain number of manufactories daily, during the year 1853. The water that flows through the houses and streets daily is probably double the weight of the population. It is pumped at intervals into reservoirs until it is withdrawn for cooking, for cleansing, for washing linen, for ablution, and in some cases for drink by the people. It thus comes into contact with the body in many ways and it gives off incessantly at its temperature, ranging from the freezing point to summer heat, vapours and effluvia into the atmosphere that is breathed in every room; while the residue is discharged to carry the dirt of the houses and the town guano of the waterclosets into the sewers and the Thames.

A certain portion of the water of London is drawn by the New River Company from distant springs and wells in the basin of the Lea river, which is a tributary of the Thames; but a large quantity of the water of this company, as well as the whole of the water of the East London Company, is drawn from the Lea lower down its channel. The Lambeth Company draws its water from the Thames at Ditton above the tidal range, but the Grand Junction at Kew, the West Middlesex at Hammersmith, and still lower down, at Battersea, the Chelsea and the Southwark Companies draw up their water from a part where the Thames is now evidently contaminated by the sewers which discharge the drainage of the population into the river. The temperature of the water of the Thames ranged from 60° to 70° during the cholera epidemics, and the chemical composition and changes of the matters in its waters undoubtedly varied to a great extent; but the microscope and chemical analysis have confirmed the evidence of the senses, in showing that the water which the Chelsea and the Southwark Companies draw at Battersea contains the greatest quantity of organic matter; that it is the most impure; and that fragments of the muscular fibre of food exist in the Southwark water. The other waters are of a better quality.

The mortality from cholera in the sub-districts of London is shown under two aspects thus, the mean mortality of the districts wholly or partially supplied by the New River Company in the two epidemics was at the rate of 15, 28, 28, 46, and 70, in every 10,000 living on the successive terraces of elevation; and the mortality in the sub-districts that are supplied by other companies at corresponding elevations is found to differ from this scale, some in excess, others in defect.

In the supply by all the companies extensive improvements are projected, and in some cases have been partially carried out. The New River Company states in reply to an inquiry, that "works have been since June in operation to prevent "sewage from Waltham, Ponder's end, and Tottenham running into the River Lea, "which before affected the pumping station at Tottenham." On the terrace of 60 to 80 feet elevation, containing Berwick-street, the cholera was more fatal (30) in 1854 than it was in 1849 when it was 25; but on the other elevations the mortality from cholera was less than it was before, in the proportion of 18, 42, 72, and 73, in 1849; and 11, 14, 19, and 67 in 1854, to every 10,000 inhabitants, at the respective elevations, supplied with water by the New River. A similar decrease is observed in the mortality of the sub districts supplied by the East London Company, which has latterly drawn its water three miles higher up the River Lea, than it did in 1849.

The sub-districts that were supplied by the Grand Junction and by the West Middlesex Companies suffered much less from cholera in 1849 than the sub-districts of the New River and the East London; but in 1854 the mortality increased in the districts of the two former companies, and in all the districts that derive their water from the Thames, which from Kew down to Battersea and Chelsea has every year for the last five years received an increased quantity of town sewage.

The Lambeth Company has in the interval between the two epidemics changed the source of its supply from Hungerford Bridge to Thames Ditton, where the river is unpolluted by the London sewage; but the pipes of this company run into the same districts as those of the Southwark Company, against which it was at one time in active competition, so that a special method of inquiry must be here resorted to. The Tables 1 and 2 only show that the sub-districts that were supplied wholly or partially with the impurest Thames water experienced a high and extraordinary mortality from cholera in 1849, and again in 1854.

The region of London south of the Thames is divided into 11 large districts, comprising 42 sub-districts, which extend from Putney in the west to Woolwich in the east,—from the large tract of low ground along the Thames to the heights of Norwood and Sydenham. Many houses in every district derive their water supply from wells, pumps, and tidal ditches; in addition to these sources Bermondsey, St. Olave, and Wandsworth, are supplied almost exclusively by the Southwark Company; the Greenwich and the Lewisham districts chiefly by the Kent Company; in the streets of the other districts the pipes of the Lambeth and the Southwark Company—the one supplying water comparatively pure, the other impure—are so intermingled that neither the informants nor the Registrars knew in 823 cases out of 4,059 whether the house in which the death from cholera occurred obtained its water from the Lambeth, Southwark, or the Kent Company. The officers of the latter company themselves have stated that they experience almost insuperable difficulties in distinguishing the houses which they supply in every street. It is therefore evident, that in the general character of the houses, the means of the householders, the density of the population, and the elevation of their dwellings, the difference is not considerable. The water supply is the chief element in which there is an evident difference; one class of houses is now supplied by water from Ditton, the other by water which the Southwark Company draws from Battersea, where the Thames is contaminated by the London sewage. And what is the result?

In the 26,107 houses that derived the water from Ditton 313 deaths from cholera occurred in ten weeks; in the 40,046 houses that received the impure water from Battersea 2,443 persons it was ascertained died from cholera in the same time. The deaths in the latter districts exceeded by nearly 2,000 the deaths that would have occurred if cholera had only been as fatal as it was in the houses that derived their water from Ditton. The Registrars were probably in some cases misinformed, but there is reason to believe that no undue proportion of the deaths is referred to houses that the Southwark Company supplies.

The deaths are given as they were returned by the Registrars in the eleven districts; and it will be observed, that the balance of mortality is heaviest in every district against the impure water, to an extent that leaves little room for doubt on the mind.

Thus in *St. Saviour* Southwark, 280 of the deaths by cholera were in houses supplied by the Battersea water, 59 in houses supplied with the Ditton water. In the week ending September 2nd the proportions were 58 to 11; in the week ending October 14th they were 9 to 1. In *St. Olave*, containing the hospitals, and in Bermondsey, an undue proportion is perhaps referred to Southwark, as the Registrars notice no cases in houses that derived water from wells and ditches. In *St. George* Southwark 254 persons died of cholera in houses that were supplied with water from Battersea, 79 in houses that were supplied with water from Ditton; the proportions were 303 to 47 in Newington, 349 to 95 in Lambeth, 206 to 6 in Wandsworth and Clapham, 167 to 24 in Camberwell, and so the proportions ran week after week. And it will be observed that in Bermondsey, which is not entered by the Lambeth Company, 734 persons died by cholera in 1849, and 846 in 17 weeks of 1854; while in Lambeth, which is wholly supplied with impure water, in 1849, the deaths in that year by cholera were 1618, while in 17 weeks of 1854, when it was partially supplied with a comparatively purer water, the deaths by cholera were only 935; of which about four-fifths were in houses that received impure water.

Works are now in progress for procuring better water for Southwark and for the rest of London; and the salutary effects of the changes that have been already wrought justify us in anticipating that when London is well drained, and when the Water Companies supply London with the cool, pure, refreshing water of the streams from the high grounds of Middlesex, Hertford, and Surrey on the system of constant supply, the health of the metropolis will be improved, and under wise medical arrangements the devastations of cholera, if they recur, will be no longer terrible.

(17th Annual Report, pp. 90–7.)

Four Cholera Epidemics in England.—Asiatic cholera has visited England four times. It first appeared in October 1831, and in that and in the following year was fatal in many parts of the kingdom. Many thousands of the people were attacked, and many thousands perished of this new disease. The numbers are unknown, as no registration of the causes of death then existed. In the United Kingdom the deaths of 52,547 persons were reported through various channels to the Board of Health. The disease created consternation; and although it was observed closely, and combated by the most active remedies, little progress was made in the discovery of causes.

Its causes were indeed supposed to be enveloped in inscrutable mystery, and to be above human control. No comet was at hand to account for the phenomena, and there was only a whisper of telluric and meteoric influences on the Continent. "The cholera," said the Annual Register for 1832, "left medical men as it had found them,—" confirmed in most opposite opinions, or in total ignorance as to its " nature, its cure, and the causes of its origin, if endemic,—or the " mode of transmission, if it were infectious." Thus English history is written.

Now the disease was well described by the Board of Health; its pathology was studied, and the effect of a variety of remedies was to some extent tested. Great care was bestowed upon the sufferers, for whom hospitals and provisions of various kinds were made. The facts were published as far as they were known. And although it was a time of great political excitement, and a year of election riots, the people nowhere in England entertained the dreadful suspicions of occult poisoning which excited the populace to madness and to murder, not only in Hungary, but in Paris.*

And furthermore, an important discovery was made in 1832. It was found that the cholera in its worst forms was preceded by diarrhœa; and that this diarrhœa was in some cases a mild form, in others a first stage of the disease. Now, to arrest this diarrhœa is to prevent cholera, as to extinguish a spark is to prevent a conflagration. It is true that perhaps ninety cases out of a hundred of epidemic diarrhœa left to themselves go no further, but it is equally true that the ten residual cases turn into cholera if they are not treated in the first stage; and the fact that one of the ten, even with treatment, turns into cholera, does not invalidate the practice.

By the year 1866, from the observations of the three great plagues, we had learnt enough of the causation of cholera to justify us in believing that in London it could be confined within narrow limits,—in the first place, by preventing any extensive distribution of the cholera-stuff through water, as the companies, in compliance with the Water Act of 1852, had, it was believed, since 1854 carried out all their purifying filtering works; and in the second place, by the organization of Health Officers, who could secure attention to the early treatment of premonitory diarrhœa, and to the destruction by disinfectants of the cholera flux. How the actual facts turned out is shown in the Weekly Returns of the year, extracts from which are reprinted in the Appendix, pp. 295–302. Since those publications appeared four public inquiries have been instituted into the water supply of East London, and into other circumstancys affecting the outbreak. The first inquiry was by the River Commission, over which Mr. Rawlinson presided; and here Mr. Greaves, the Engineer of the East London Company, first admitted that the water of the open reservoirs had been distributed over the area supplied from Old Ford. At the instance of the inhabitants of East London, the Board of Trade instituted an inquiry, which was ably conducted by Captain Tyler, R.E., during a period extending from November 27th, 1866, to May 27th, 1867. And further evidence is supplied by Captain Tyler respecting the water of the East London reservoirs at Old Ford. The East London Company, in a very proper spirit, met the charge, and admitted their dangerous proximity to the Lea, by applying to Parliament for extensive powers to improve and augment their water by a large outlay of capital. And the Committee on the bill, under their chairman, Mr. Ayrton, the zealous member for the Tower Hamlets, also inquired into the operation of the Metropolis Water Act of 1852, and in an interesting report made some important practical recommendations.† All the London Water Companies were represented before the Committee by eminent counsel; and the cause of the East London Company was skilfully defended by Dr. Letheby, in the character of a scientific witness. The Royal Commission on Water Supply has taken evidence, but has not yet reported. The medical officer of the Privy Council has discussed the

* Annual Register 1832. History, page 306.

† Report of Select Committee on East London Water Bills. Session of 1867.

subject; and Mr. Radcliffe has conducted a careful independent inquiry into the causation of the explosion in East London. I refer to his report for a great many interesting details, and for an explanation or a confutation of some of the fallacies set afloat. This report, the report of the *Lancet* Commission, and some articles in the *Medical Times and Gazette*, should also be consulted.

Thus in the year that has followed the outbreak in East London the subject has been amply discussed under all its aspects. The waters of the Company, their reservoirs, their works, and their servants, have been examined before several tribunals; and it has all been done at leisure after the epidemic had subsided. But the Registrar-General had to speak in the midst of the tempest, and on his words at the moment the fate of the ship to some extent depended. "On the recent outbreak "of cholera in the east of London," says the Parliamentary Committee, "it was ascribed by the Registrar-General to the bad quality of the "water supplied by the East London Waterworks Company to a part "of the east of London." This was a serious charge; and the question was enshrouded in difficulties; but it will be evident that the elements of a judgment existed in the accumulated experience of the previous epidemics, in the known laws of the disease, and in the facts of the case looked at comprehensively. In a subsequent paper I have given in a narrative form an account of the steps taken at this office to unravel the mysteries of the catastrophe, in which four thousand five hundred persons perished in East London. It will be seen there how much valuable aid was given by Professor Frankland. I propose now, when the storm is over, and with all the ascertained facts before us, to describe briefly the epidemic in London, and to investigate the causes of its irregular diffusion. The lesson to be learnt is of deep interest to this country and to all nations. (Cholera Report, 1866, pp. ix–xii.)

Cholera in London, 1866.—Asiatic cholera had hovered over Europe in the year 1865. In the autumn a few victims of the disease died in England. Epidemic cases then occurred both in Portsmouth and in Southampton.* At Epping, in Essex, the Groombridge family, the medical attendant, and a woman who laid out their servant, were killed by cholera in the last days of September and the first days of October. Nothing remarkable was observed in London until the year following, on Wednesday, July 11th, when five deaths by cholera occurred; on the 12th and on the two following days 11, 20, and 15 persons died. Life was then fiercely assailed by the disease in its quick form: the deaths ran up from 14 on Sunday to 105 on Saturday July 21st; on Tuesday July 31st the deaths were 191, on Wednesday 188, or including the deaths in West Ham and Stratford, 205; they then declined.

Proceeding in weeks from Sunday, July 1st, the deaths by cholera in the five weeks that ended on August 4th were 11, 63, 481, 1,097, 1,178. Then dividing London, including West Ham and Stratford, into two portions: in that supplied by seven water companies (Grand Junction, West Middlesex, Chelsea, Southwark, and Lambeth from the Thames, Kent from chalk wells, New River from wells and Lea River,) the deaths by cholera were 10, 25, 61, 142, 196, but in the sub-districts supplied wholly or partially by the East London Water Company the deaths in the contemporaneous five weeks were 1, 38, 420, 955, and 982. Thus in the first week the East London field had *one* death, the rest of London had *ten* deaths; in the fourth week the deaths were 142 in the rest of London, and in the East London field 955 deaths from cholera

* *See* Annual Report of 1865, p. 163.

alone. Several of the earlier deaths by cholera in other districts happened to persons who had come or been sent from the East London field. Each death by cholera implied two attacks about two days before death. And for every attack by cholera there were about four attacks by diarrhœa, approaching more or less in character to cholera. As the epidemic rose so it declined more rapidly in the East than in the other regions of London.

The total deaths in London, with West Ham and Stratford, were 5,973 by cholera, 3197 by diarrhœa (about 800 referable to the epidemic), 9,170 by the two maladies. It will be observed in the tables that, although unquestionable cases of the disease occurred in every sub-district of London, and in some the number of deaths was not inconsiderable, the enormous disparity between the earlier ravages of the epidemic in the eastern waterfield and the rest of London was never effaced. (Cholera Report, 1866, pp. xii–xiii.)

Origin and Causes of Cholera.—It may be stated first, simply as hypothesis, that the cholera is propagated epidemically by a material substance, analogous in its nature to the substances which produce, under given circumstances, small-pox, cow-pox, syphilis, erysipelas. This matter may be called *cholrine*,* for the same reasons as certain substances were designated sugar long before the chemical constitution of any kind of sugar had been determined, or before that substance had been obtained pure. Dr. Snow advanced the view in 1849 that the evacuations containing this matter, distributed by contact or through water, were the sole means of propagating the cholera, which, on the cellular theory, he held was propagated by cholera-cells. Dr. Richardson contends that the cholera-matter is an "alkaloidal organic poison, which, "soluble in water, but admitting of deposit on desiccation, passes easily "from one person to another under the agency" of certain peculiar physical states.† It is a fact well established in the practice of vaccination, that the specific matter of cow-pox after insertion is developed into full activity day by day in the pustule, and then loses its qualities, so as no longer to take effect even under the most favourable conditions. In this respect the stuff is like an organism: it is produced by pre-existing forms out of other matter prepared for its reception; it is developed, produces its like, and decays. Brittain, Swayne, and Budd, indeed, held in 1849 that they had discovered the cause of cholera in a fungus:‡ Dr. Buchanan and Mr. Simon, the medical officer of the Privy Council,§ have given an interesting account of recent researches in this direction by Hallier, pointing to the action of urocystis, and by Pacini to vibrional molecules in the intestinal canal, as its specific exciter.

Pettenkofer, who first drew attention to the sanitary importance of the subsoil water line (*Grundwasser*), which rises and falls more or less in different years, showed that in Germany the localities which have their water-line nearest to the surface had suffered most from cholera, and that the epidemic coincided with the rise and subsidence of the water in the soil.‖ Cholera in Bavaria, he says, prevailed epidemically only in places

* Registrar-General's 4th Annual Report, page 200; 1842. The matter of *dysentery* is there called *enterine*, of *cholera*, *cholerine*, which I now propose to write *cholrine*, to avoid any ambiguity.

† *See* Dr. Richardson on Theory of Propagation of Cholera.—Transactions of Epidemiological Society, Vol. II., Part. II., page 432.

‡ Report to Registrar-General, Cholera Epidemic, p. lxxvi.

§ Ninth Report of Medical Officer of Privy Council.

‖ A clear account of Pettenkofer's doctrine is given by Dr. Weber in Transactions of Epidemiological Society, Vol. II., Part II., page 404. *See also* Letter from Professor Pettenkofer in Appendix, p. 280.

having a porous soil, with water never more than from five to fifty feet below the surface. It should be borne in mind than in many of these Bavarian towns water is drawn from wells by pumps or otherwise. The excretions of cholera patients give the germ, the soil develops it, says Pettenkofer. This is founded partly upon the interesting experiments of Thiersch, which have been repeated by Dr. Sanderson, who has shown conclusively that paper saturated in cholera flux, and dried, when eaten produces the disease in a transmissible form in mice. The fresh flux the first day after exposure in the air is almost inert, on the second day it grows more active, on the third it is at its maximum of activity, is less and less active on the fourth and fifth, inert on the sixth day of transformation. Of 148 mice experimented on, 95 showed no symptoms, 53 were affected, 31 died. The successful experiments were made between 9th September and 10th October, when the mean temperature was 56° ; a second series between 3d and 13th November, when the mean temperature was 49°, failed.*

This is thus far confirmatory of the hypothesis that the epidemic is propagated by cholera matter, which it may be said is not very well characterized by the stereotyped words "rice-water evacuations." In its pure form, after agitation, the cholera flux has the appearance of thin cream, from which flocculent matter subsides after the lapse of some hours, leaving a supernatant milky liquid. *One* volume was mingled for me by Professor Frankland with *ten* volumes of distilled water in a long glass tube: the flocculi subsided much more readily, leaving an opalescent liquid above. *One volume* to *one hundred volumes* of water in a long tube presented the same appearances, but in a less marked degree. Mixed in 500 volumes of water the opalescence was retained after the liquid had been passed through filter paper. Opalescence is a characteristic feature of the *cholrine*, even as it exists in a liquor holding less oxidizable organic matter than the filtered London waters; and in these minute quantities it cannot at present be detected by chemical analysis. If the matter is organized it is necessarily suspended in water and cannot be in solution.†

Numerous facts prove that cholera is communicated to a certain proportion of the women washing the clothes of cholera patients, and I showed that the parts of London near the warm infected Thames suffered in an unusual degree during the epidemic of 1849;‡ hence it is not improbable that *cholrine* is to some extent carried up from warm liquids by watery vapour.

The cholera matter is often yielded by children, and even by adults, suffering from diarrhœa, and not afflicted by the characteristic symptoms of Asiatic cholera.§ This property it has in common with scarlatina, syphilis, small-pox, and other zymotic diseases, where the mildest types communicate to other bodies diseases in their most malignant forms.

The cholera flux is of low specific gravity (1,008), and thus poured on the surface of water sinks very slowly,‖ but in the end it gradually

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* Ninth Report of Medical Officer of Privy Council, page 452.

† *See* Professor Frankland's interesting account of cholera flux. I procured this matter for the sake of studying its comportment when mixed with water in glass tubes. The liquids in the hot weather have undergone little change since the tubes were sealed, 26th October 1866, except that the cholera liquid is browner, and that the flocculent matter in the hot weather rose to the top of the water in the tube containing one-tenth of cholrine. 11th September 1867.

‡ Cholera Report, pp. lviii-lxi.

§ Virchow's Handbuch der Speciellen Pathologie und Therapie, 2 Band, 2 Abth., page 332. The article of Griesenger on Cholera gives all the German learning in a well-digested form.

‖ *Rice-water evacuations.*—Cholera flux is of low specific gravity: taking pure water as 1,000 it is given by Dr. Robert D. Thomson as 1,008; that of blood serum falls towards the bottom of the vessel, leaving slight traces in the upper stratum, and containing increasing quantities as the bottom is approached. It is important to bear this physical property in mind. For cholera flux dropping on the surface of the Broad-street well would be pumped up in proportions varying with their stage of descent, and on falling to the bottom might leave the upper water clear. I mention this simply by way of illustrating the effect of the purely physical properties of the cholera flux on the doses of it in the same quantity of water at different hours of the day, or of successive days. For the same reason the waters of contaminated reservoirs vary in zymotic strength from hour to hour.

It may appear at first sight impossible that the cholera flux of one or more patients should produce any effects in the waters of a river like the Thames. But living molecules endowed with the powers of endless multiplication are inconceivably minute, and may be counted by millions in a drop of water. Pacini, an excellent microscopic observer, has found that the germs of vibrions (*molecule vibrionali*) are less than $\frac{1}{25000}$ of an inch in diameter*; and placed in immediate juxtaposition a cubic inch would contain $(25,000)^3 = 15,625,000,000,000$ germs. Allowing for interspaces, it is evident that a cubic inch might hold millions of cholera particles, and one cholera patient might disseminate in water millions of millions of zymotic molecules. A litre of blood contains, according to the determinations of Vierordt, 5,069 *millions* of corpuscles.† The water of a city is less in bulk than its atmosphere, and disease-molecules, if freely distributed through both elements, will be rarer in air than in water. If we judge from analogy, a certain quantity of the cholera matter is necessary to render its effect at all probable, as germs of disease are as profusely expended by nature as seeds of plants.‡

The infection-power of cholera liquid is essentially transitory: it is developed in given circumstances in its intenser form, and in a

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being 1,028 in the healthy, while in two cholera cases it was 1,042 and 1,058 respectively. The most abundant matters present are flocculent bodies, which impart the characteristic aspect to the fluid. Dr. Hassall says this liquor, after being set aside for some time, let fall a deposit varying from a fourth to a sixth of its bulk, consisting, as seen under the microscope, of innumerable mucous corpuscles, globules of oil, and myriads of vibrions in every drop of every sample of rice water examined. —*Appendix to Report of the Committee for Scientific Inquiries on the Cholera Epidemic of* 1854, pp. 285–293.

* Appendix to 9th Report of Medical Officer of Privy Council, page 519; Pacini, Sulla Causa Specifica del Col. Asiatic, 1865; and the work Della Natura del Col. As., 1866.

† Carpenter's Physiology, 6th Edition, page 155.

‡ "Newport adds the important fact, established by numerous experiments, that when a very small number of spermatozoa are applied to the ova of Batrachians, they are only partially impregnated and the embryo is never fully developed . . . . With respect to plants nearly the same results were obtained by Kölreuter and Gärtner. This last careful observer found, after making successive trials on a malva with more and more pollen-grains, that even thirty grains did not fertilize a single seed, but when forty grains were applied to the stigma a few seeds of small size were formed. The pollen grains of mirabilis are extraordinarily large, and the ovarium contains only a single ovule; and these circumstances led Naudin to make the following interesting experiments: a flower was fertilized by three grains and succeeded perfectly; twelve flowers were fertilized by two grains, and seventeen flowers by a single grain, and of these one flower alone in each lot perfected its seed; and it deserves especial notice that the plants produced by these two seeds never attained their proper dimensions, and bore flowers of remarkably small size. From these facts we clearly see that the quantity of the peculiar formative matter which is contained within the spermatozoa and pollen-grains is an all-important element in the act of fertilization, not only in the full development of the seed, but in the vigour of the plant produced from such seed."

[*The Variation of Animals and Plants under Domestication.* By Charles Darwin, M.A., F.R.S. Vol. II., pp. 363–64.]

community as well as in an individual,—in India as well as in England,—it grows as well as declines by a law of its own; it is epidemic only for a time and by periods of years. It has its seed-time and its harvest in each locality, and the air or the water which on one day is poisonous may a few days afterwards be harmless. There is thus an essential difference between zymotic venom and a metallic poison like arsenic.

In its weakest form *cholrine* produces diarrhœa in a great number of persons; but in every population a large number of people appear to resist its influence. They are insusceptible. The cases of attacks of the same person twice in this as in some other zymotic diseases are rare. (Cholera Report, 1866, pp. xiii–xv.)

Localization of Cholera in East London, 1866.—We may now discuss the question of the unequal diffusion of cholera over London in the last epidemic. It may be assumed that the cholera in its Asiatic form was brought into England in 1866, and the argument will not be affected if the first cases originated on the banks of the Lea, and not on the shores of the Ganges. It may be further taken as proved that it is propagated by the cholera flux; and let those who doubt this accept the principle for the moment as hypothesis, which the subsequent crucial facts will at once either establish or dispel.

Then the elements of the disease must either have been diffused (1) by personal contact; (2) by translation through the air; (3) or by dissemination in vapour of sewers; or (4) by the various waters.

Now the evidence that cholera can be communicated in these ways by cholrine is conclusive. Instances of a cholera patient brought to a distant house and communicating forthwith the disease to an inmate are too numerous to be mere coincidences; as the chances by the doctrines of probabilities against such numerous coincidences are inconceivably great. But it is evident that as the population of every district of London is in free communication with every other district, and is constantly interchanging its residents on both sides of the river, so by this mode of communication cases would be, as indeed they were to a limited extent, freely distributed all over London. The same might be said of the air: any gas generated in any point of London is by the law of gaseous diffusion speedily distributed through the atmosphere; and matters in suspension are distributed by the winds, which are thus described during the first four weeks, extending from July 8th to August 4th, which saw the rise and decline of cholera: variable; N.E. and E.N.E.; variable; W. and W.N.W. The winds were not still, but blew in various directions over London at the rate of eight miles an hour during the first three weeks, and then with double that velocity. If they carried cholera on their wings they must necessarily have shed its poison over all London; the action of the winds could not have been confined to the small area of East London. In India the cholera matter is scattered by the natives on the surface of the earth, and may be either washed into the tanks or be dispersed in clouds of dust.* But in a town of water-closets and privies the diffusion of dry cholera dust must be exceedingly circumscribed.

In the watercloset system the cholera flux in vapour, if it is not sometimes generated, is sometimes distributed in sewers, and is driven into the dwellings of the people. An instance of diffusion in sewer vapour at Southampton is given by Professor Parkes in his masterly paper.† Professor Parkes in the same paper shows that the foul water of the Peninsular steamer "Poonah" proved much more virulent than sewer

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* *See* Fick's letter on Zürich outbreak.

† Appendix to Ninth Report of Medical Officer of Privy Council, pp. 244–253.

vapour. And it is evident that the amount of zymotic matter evaporated from cholera flux, and entering the system through air, must be inconsiderable as compared with the amount that may enter through a water supply contaminated with sewage.* All over London the sewage exhalations went on during the summer of 1866, and produced certain effects. It happened, too, that several districts in the group so heavily visited by cholera lie in the particular region which then derived no advantage from the contemplated low-level sewer. But too much importance must not be attached to this circumstances. The whole of the region on the Thames, from Chelsea to the city of London inclusive, is in the same predicament, and there the mortality by cholera in the present epidemic was low; in the Chelsea water-field, for example, the deaths by cholera did not exceed 4 in 10,000, nor is the rate exceeded by the average mortality of the whole region along the proposed low-level sewer except in the East London water-field, where the mortality by cholera was at the rate of 72 deaths in 10,000 living! Again, West Ham with Stratford-le-Bow has an independent drainage system of its own; and over this region, where the same water went, the same dreadful mortality prevailed.

The cause of the mortality of cholera in London, whether on the north or the south of the river, up to the rate of 5 in 10,000, it may be admitted on all hands is explained by the diffusion of the cholera-stuff through personal intercourse, sewers, and the slight contamination of the waters either of wells or of the Thames and of the Lea after filtration by the water companies. All those companies had before 1866 professedly carried out extensive works for taking their waters from better sources, for filtering it, for storing it, for distributing it, in conformity with the provisions of the Metropolis Water Companies Act of 1852; and their works had been pronouuced very good by three engineers appointed by the President of the Board of Health. "The requirements," said the three engineers, "set forth in the Metropolis Water Act, 1852, have in "all essential respects been fully and satisfactorily complied with by "the several companies."†

The East London Water Company's works are described in the Engineers' report: in 1850 it had six open reservoirs, one at Lea bridge, one at Stamford Hill, and four at old Ford; in 1855 the new filter beds at Lea bridge were completed; the filtered water was brought, in a four-feet iron pipe, to Old Ford, into two oval reservoirs, which, used formerly as subsiding reservoirs, were now covered over with brick arches and earth. "*The other reservoirs of the company near Old* "*Ford and that at Stamford Hill are*," says the reporters, "*now* "*thrown out of use.* * * * The large depositing reservoirs upon "which they had to rely for clearness of the water have *now been* "*abandoned, and all communication between them and the mains has* "*been cut off*."‡ In the reporters' map the small covered reservoirs of 2½ acres is engraved; the two open reservoirs of 9 acres, east of the Lea, are suppressed in the map, on the ground probably above alleged, that "they were thrown out of use." These open ponds do not figure in the elaborate water map of R. W. Mylne, C.E., published in 1856.

* Dr. Hassall remarks that the sporules of some fungi are aerial and repel water, but *vibrions* are true aquatic productions: he found no *vibrions* in the water distilled from rice-water flux at a low temperature.—Appendix to Board of Health Report of Committee for Scientific Inquiries, page 305.

† Report to Right Hon. W. Cowper, M.P., President of Board of Health, on "Metropolis Water Supply," 1856, by H. Austin, W. Ranger, and A. L. Dickens, Superintending Inspectors, p. 101.

‡ Ibid, pp. 65, 67.

The open reservoirs contain water admitted to be unfiltered; and Mr. Greaves, the engineer, speaking for the company, in his letter to the *Times*, dated August 1st, 1866, made this statement: "The facts are " * * that the canal having been since 1853 *disused for all purposes* " *of supply, is only maintained as a drain from the filter to a lower* " *part of the river; that not a drop of unfiltered water has for several* " *years past been supplied by the company for any purpose.*"*

This was perplexing, but the company, by taking the unfiltered water from the open reservoirs, violated an Act of Parliament, and on the ground, perhaps, that they were not bound to criminate themselves, they, in the words of their engineer, besides pleading "not guilty," boldly proclaimed their innocence on August 1st. Shortly afterwards Mr. Greaves, however, admitted candidly, that the open reservoirs of unfiltered water could be drawn on; and by the report of Professor Frankland (August 25th) goes a step further. "Communication," Professor Frankland says, "can be established between these reservoirs " and the pumping wells supplying the public, but Mr. Greaves assured " me that *it was never done, except in case of emergency*."† In his examination before the Pollution of Rivers Commission on December 10th, Mr. Greaves advances another step, and states, that "a small " quantity of water was taken out of one of the open reservoirs this " spring;" "he had not the date," "probably June was the latest date," but he could not say definitely. Further revelations were made by the workmen under examination by Captain Tyler; and the story is at length thus told by officers of the company:—

The foreman of the company died quite suddenly of apoplexy early in this year (1866). In appointing a new man, in giving him discretionary instruction as to how he was to manipulate the water, "I " described," says Mr. Greaves, "this possibility [of drawing on the " open ponds] as something which he must keep in mind, rather than " suffer an accident, and so I suppose he may have acted in that sense." He, Mr. Greaves, kept these open ponds in reserve, as the question of quantity was important, "to meet such necessities as might arise."‡

The Lea, Mr. Beardmore asserts, was full of water in 1866; how then could the supply be in any way deficient in July? This is explained to some extent by Mr. Maine, the manager of the works at Lea Bridge. The rapidity of filtration is very variable; and in the month of July every year§ a slimy matter is rapidly deposited on the sand, blocking up its pores, and stopping this filtration altogether. In August this slimy matter grows, and no sooner produces green confervoid fibres than the power of the filters is restored; the water flows freely.

The foreman of the works, in his evidence, says that he considered the water in the open reservoirs available as a reserve in the event of the water getting low in the cövered reservoir, to prevent the damage of the engine with the higher suction. *He kept no notes*, but he believed that he allowed the water to run from the open to the covered reservoir not more than three times during the year 1866; at the latter end of March, at the latter end of June, *and some time in the early part of July*. The sluice was never open after cholera broke out; he is certain of that. *He had no fear of its doing harm.*||

A carpenter, twenty-four years at Old Ford, appears to have been the only man who worked the sluice between the open and the closed

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* See Appendix, p. 92.
† See Appendix, p. 124.
‡ See Extract from Mr. Greaves's Evidence, pp. 100-101.
§ See Professor Frankland's Report, Appendix, p. 123.
|| Appendix, p. 105.

reservoirs. He did other jobs, but that was his specialty. He opened that sluice *frequently* in 1864, *frequently* in 1865, and three times (!) in 1866. He describes in three cases what he did. In March he was at the engine-house: the engine began to draw air; and he was ordered by the engineer of the company to open the sluice. He left it open two hours. In June he was about the yard, when the *engine driver* called to him, and "ordered him to let him have some water." He complied by command of the foreman. About *two P.M.* early in July, and this may have been the first fatal day, he opened the sluice again, and left it open for about the same period of the day. "He considered the water in "the open reservoir to be very good, and had often drunk it."*

When this statement is compared with that in Mr. Greaves's letter,† and when it is borne in mind that these dependent men were not giving evidence on oath, that the opening of the sluice would be precisely one of those acts of which no record was desired, we can scarcely expect a more explicit statement. It is enough to have in evidence, that immediately before the outbreak in July the foul water of the reservoirs was pumped over the parts of East London where cholera was epidemic.

Again, there was another channel for the entrance of the foul water of the Lea directly into the covered reservoirs supplying the pumps. Professor Frankland sagaciously remarked, that the bottom of these reservoirs, within a few yards of the river, is 16 feet beneath the low ground, which is here only just above the level of spring tides. When the tide was high, and the water of the reservoir was low, the permeation of the water through the gravelly bottom into the reservoir was on hydraulic principles inevitable. Captain Tyler describes graphically how he put this to the proof, and established the fact, by wading over the bottom. The reservoir was on Sunday, February 24th, at his instance, pumped, in 36 hours, as low as possible, the bottom was found foul, but the water at last came in faster than it could be pumped out by the powerful engine. The patience of the waiting company was exhausted; the water still came in.

Cholera flux, with the other excremental matters in the channel of the Lea, thus must have found its way from the reservoirs to the pump wells of the company at Old Ford.

Mr. Greaves himself could not perhaps describe precisely what took place in July, but this is substantially what occurred:—The Lea at Old Ford was much more polluted in the summer of 1866 than it was in 1854, for, besides the sewers emptying into it on the side of East London, the whole sewage of Stratford and West Ham on the Essex side has since 1861 been discharged into the Bow Creek arm of the river at the iron bridge. This sewage is washed up and down the stream by the ebb and flow of the tide twice daily between and in close proximity to the open and the storage reservoirs of the company. The storage reservoir, full, holds 6,000,000 gallons of water in the morning; in the day 8,000,000 gallons flow into it by the iron pipe from Lea Bridge; and as the pumps distribute 11,000,000 gallons in the day, 3,000,000 gallons are left in the reservoir at the close of the day, to be augmented to 6,000,000 in the night when the distributing pumps cease working. But one day, early in July, probably on Monday or Tuesday July 9th or 10th, at 2 o'clock in the afternoon, the storage reservoir was at the lowest ebb, and the dregs of the water were drawn on, the well was scantily filled, the pump gave unmistakable signs of distress, the engine-driver called out for water; and then the old carpenter opened the sluice and let in the contents of the northern stagnant pond, with

* Appendix, p. 105. † Appendix, p. 92.

its bottom pervious alike to the waters of the Lea and to the waters of its sister reservoir, which had been recently refilled by soakage from the Lea, and was slightly turbid and milky on the 9th of August.* How often this was repeated in July it is impossible to tell, as the engineer did not even know that the pond water had been used at all in that month, and the old carpenter's memory, minute in some respects, reproduced facts too imperfectly to form a basis for a negative argument. If the scanty supply of water was due to slimy obstructions of the Lea Bridge filter bed, Mr. Maine tells us that the slime lasts till its germination in August. Again, if the supply from Lea Bridge in July *was less than in May* the East London Company *must have drawn on its open reservoirs*, for in their return they give the quantities supplied at 2,167,885 gallons *a day more in July* than *in May*. They distributed 636,000,000 gallons of water in July, where did it all come from?

The lowness of the water level in the storage reservoir would during the same month let in impurities from the Lea every evening.

Several cases of cholera and choleraic diarrhœa had occurred over London in May, and on 27th June, at 12, Priory Street, Bromley, one poor Hedges, a labourer, and his wife, both of the age of 46 years, died of "cholera Asiatica," the former after 15 hours, the latter after 12 hours illness. Their cases are minutely described by Mr. Radcliffe, who traces the discharge into the watercloset of 12, Priory Street, and thence 300 yards down the sewer to its opening into the Lea at Bow Bridge, half a mile below the Old Ford reservoirs.† He attaches great importance to these first cases; and they undoubtedly sufficed to pour into the sewers and waters millions of zymotic molecules, which day by day grew more and more frequent in the Lea by every hour's choleraic discharges on both sides of the river. On Wednesday, 11th July, the first four deaths of the explosion occurred, one in each of four distinct sub-districts; and allowing for duration and incubation, it is not improbable that the four persons took the poison early in the week. Nine deaths occurred on the 12th in *seven* of the East London sub-districts wide apart. On Wednesday the 18th, were 59 deaths, singly, or sometimes in clusters of 8 or 9 deaths in 16 sub-districts of the East London water-fields; a few deaths dropped in here and there in a sub-district of the other water-fields; but this mass of death in East London was due evidently to some superadded agency. It operated mainly in every district supplied by the Old Ford pumps, that is, in Bow, Bromley, Poplar, Limehouse, Mile-End-Old-Town, St. George-in-the-East, Whitechapel, parts of Bethnal Green and West Ham, which Captain Tyler tells us would in the ordinary way be supplied "on the "greater part of week days from Old Ford."‡

The East London field is supplied by the company from pumps at two different sources, three miles apart: (1) from the Lea Bridge pumps drawing their water direct from filter beds, and beyond the range of tidal sewage contamination, and (2) from the Old Ford pumps.

At Old Ford there are houses with five pumps and steam-engines of 640 horse-power, at Lea Bridge two engines of 300 horse-power. The power in the gross is equal to the delivery of 38,000,000 gallons of water daily. The actual supply during the year 1866 was 19,380,739 gallons daily.§ Of this, Captain Tyler says, 11,000,000 gallons are

* See Professor Frankland's Report in Appendix, p. 125. Extract from Letter of Mr. J. Hutchings, who passed by the East London ponds at Old Ford nearly every day during the year 1866.

† Appendix to Ninth Report of Medical Officer of Privy Council, p. 285.

‡ Report on the Quantity and Quality of the East London Water Supply. Parliamentary Paper, No. 339, Session of 1867, p. 16.

§ Appendix to Report of Select Committee on East London Water Bills, Session of 1867, pp. 266, 269.

delivered daily from Old Ford, and the rest (8,380,739) from Lea Bridge. With some variation, this is the order of the work:—the engines at Old Ford are started at 5½ in the morning and stopped at 7½ P.M.; and from 7½ in the evening till 5½ A.M. of the next day the water supply "is entirely produced from the Lea Bridge station."* "The Old Ford engines do not," says Captain Tyler, "work at night "*or on Sundays.*" "The water from Lea Bridge at those times "supplies the whole district [water-field] passing by Old Ford, and even "to the Essex part of the district."† Three hundred miles of street are traversed by the company's pipes: the pipes of six inches and upwards, called by the engineer "mains," are 147 miles long; while the smaller "service pipes," some constantly charged, the others turned on once a day, are 328 miles long.‡

The effect of all this is, that the Lea Bridge waters usually meet the Old Ford waters at a fluctuating line running from Victoria Park, through Bethnal Green, onwards to Spitalfields. Far south of this line the Lea Bridge waters pass on Sunday, and even early in the morning, but only in very rare instances could the Old Ford waters be carried into Hackney north of that line.

It was precisely in the region of the Old Ford waterfield that cholera raged. There, in three months, it killed little less than 4,000 men, women, and children; while in the Lea Bridge field, and in all the other water-fields of London, the epidemic was kept within such narrow limits of fatality as would be accounted for by diffusion through sewers, direct contact with cholera matter in various ways, and the slightly contaminated filtered river waters of the other companies.

It must be evident that the dose of cholera matter in a given quantity of the water supplied from Old Ford would vary indefinitely in different localities, for example, assume that the North Woolwich main was filled by water pumped from the covered reservoir *before* 2 *o'clock* on the fatal afternoon of July, when the old carpenter confesses that he let in the open pond water, or that it was filled on Sunday with the water of Lea Bridge, and in either case the water of the main would be comparatively pure. In fact as the composition of the water in the supply reservoir would vary from day to day and from hour to hour as the level of the water got lower, and as the tide of the river happened to be in or out, it is evident that the composition of the water in the supply pipes at any given moment would vary to an inconceivable extent.

But the cholera matter, after it leaves the body, undergoes changes of which some may render it more, others less and less, active from day to day; and, moreover, this flux holds in suspension active matter heavier than water; hence it is probable that in an aggregate of several districts thrown together, to get rid of accidental disturbances, the effect of the cholera flux will be least in elevated and in remote districts supplied by mains constantly filled. The cholera flux in a six-inch iron pipe, rising for a mile to an elevation of a hundred feet, would comport itself very much as we see it in a glass-tube; thus, if the flux was equally distributed from the reservoir over the field of a company varying in elevation, the quantity of *cholrine* in a given quantity of water, like the quantity of cholera in a given population consuming that water, would vary with the elevation. The cholrine might also vary with the distance of the point of discharge, as the velocity of water and the quantity of matter it carries in suspension change under most complicated hydraulic laws, to

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* Evidence of Mr. Greaves before Rivers Commission, Q. 384, page 11.
† Captain Tyler's Report (Parliamentary Paper, p. 16).
‡ Appendix to Report of Select Committee on East London Water Bills, p. 267.

say nothing of the laws of the changes affecting cholrine itself.—(Cholera Report, 1866, pp. xv–xx.)

Cholera in the several Water fields of London, 1866.—I now proceed to call attention to the mortality from cholera in the various water-fields of London.* As their areas correspond with none of the other recognised divisions of London, the 135 sub-districts have been distributed into 15 groups, under the various heads corresponding as nearly as possible with the water-fields. It will be seen that while there is a certain mortality from cholera in every condition, the excess above this standard is constantly in proportion to the impurities of the water during the epidemic period.

London is now supplied with water by *eight* companies. South of the Thames it is supplied by *three* companies; the Lambeth and the Southwark companies taking their waters from the Thames; the Kent drawing its waters, the officers say, from wells, and not as formerly from the Ravensbourne. *London*, north of the Thames, is supplied by *five* companies, the Chelsea, the Grand Junction, and the West Middlesex taking their waters from the Thames, the East London from the Lea, the New River from the Lea mainly, and from wells. The area which each company respectively supplies I call its water-field, and London is consequently divided into eight such fields. In some cases the water-fields of two or three companies are intermingled at their edges, and do not coincide precisely with the registration districts. Pumps exist to some extent, and draw water from shallow wells. By taking the sub-districts included in each water-field we get, however, eight areas, each of which is supplied almost exclusively by one of the eight companies, and where the mortality by cholera in three epidemics can be determined with sufficient exactness. Then we have a group of the sub-districts supplied conjointly by the New River and the East London companies, some streets of each sub-district getting water from one company, other streets getting water from the other company; and so it is in the case of other companies. Thus 15 groups of sub-districts have been formed; each of 8 supplied by a single company, and each of 7 by two companies.

The proportion of deaths by cholera to 10,000 inhabitants in 1866 will show the relative fatality of the disease. Thus the deaths by cholera in the field of the Chelsea company were in the proportion of 4; in that of the West Middlesex 4; in that of the Grand Junction 3; nor do the proportions differ from those above given to any extent in the sub-districts supplied conjointly by any two of the companies, as is shown in the Table. The rate of mortality in the group supplied by the West Middlesex Company and the New River is necessarily corrected, for of the 48 deaths there by cholera 36 took place in *University College Hospital*, among patients brought from all the sub-districts in its vicinity. After a correction for these imported cases, the proportion is reduced to the average. The deaths in the water-fields of the three companies, including all the three sub-districts which they supplied jointly with the New River, amounted to 266 by cholera, 687 by diarrhœa, among a population of about 739,279, giving 4 in 10,000 as the death-toll by cholera, and 9 as the death-toll by diarrhœa, which included a certain proportion of choleraic cases.

The fatal cause, and the means employed to hedge it in, produced a very uniform result over the first seven groups of the Table*; and upon taking the 27 western sub-districts of which they consist, covering an area of 15,020 acres, and extending from Fulham on the Thames to

* Cholera Report, 1866, Table 33 (Appendix, p. 83).

Charing Cross and Hampstead, the differences of cholera death in the sub-districts are not of any significance.

The water-field of the *New River* is extensive; it covers the large part of London lying along the Thames from Hungerford Bridge over the city of London down to St. Catherine's Dock, and extends northwards to Stoke Newington and Highgate. This company supplies exclusively 39 sub-districts on an area of 8,755 acres, inhabited by about 834,617 people. The deaths in this region were 661 by cholera, 846 by diarrhœa. The deaths by cholera were in the proportion of 8 to 10,000 inhabitants, by diarrhœa 10. The mortality by cholera was more than double that of the western water-fields; but by diarrhœa there was only a slight excess; indeed, the deaths were proportionally less than in the West Middlesex water-field.

The water-field of the *East London* Company covers all the area of London on the river Lea, and extends to Stratford and West Ham, which are not yet in London. The deaths in the 22 sub-districts supplied by this company were 3,947 by cholera, 813 by diarrhœa; the deaths by cholera were thus 72, by diarrhœa 15, in every 10,000 inhabitants. This dreadful mortality by cholera was *nine* times as great as in the New River sub-districts, and *twenty* times as great as in the north-western sub-districts. In seven populous sub-districts supplied jointly by the East London Company and the New River the deaths were in the proportion of 34 by cholera, 11 by diarrhœa.

And it will be remarked that the mortality by cholera was excessive in every one of the 29 sub-districts supplied by this company wholly or partially from the Old Ford reservoir, except Stamford Hill, which is said by the officers to have got its water from Old Ford.*

Crossing over the Thames, the whole of South London lies before us. There the three high sub-districts of Sydenham, Norwood, and Streatham lost out of every 10,000 inhabitants 3 by cholera; they were supplied by the Lambeth and Southwark Companies. The deaths in the exclusive field of the Southwark Company were 7, and in that of the Kent Company 15; the cholera deaths in the 17 sub-districts supplied conjointly by the Southwark and the Lambeth Company were 6 in 10,000 inhabitants; and 6 in Peckham, which is supplied by these companies in conjunction with the Kent Company.

In the whole of South London the cholera deaths were 8 in 10,000 inhabitants, which stands in strong contrast to the 72 deaths to an equal population in East London.

It is then evident that in the year 1866 the epidemic cholera matter (*cholrine*) found its way into every district of London; that its quantity varied, and was limited in every district within narrow limits, except in the water-field of the East London Company, where the cholera deaths also varied from place to place, but were in nearly every locality so excessive as to leave no doubt that an excess of *cholrine* was distributed over that field.

That neither less poverty, depression of soil, nor density of population suffice to account for the diminished prevalence of the epidemic in South London is evident on comparing the cholera deaths of the same sub-districts in the year 1849 and in 1854.

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* Mr. Greaves, in his evidence before the Rivers Commissioners, says: "The "Stamford Hill district I am able to supply either from Lea Bridge or from Old "Ford. . . The Lea Bridge water-wheel is now (Dec. 10, 1866) working to "Stamford Hill, but for some years past I was entirely supplying Stamford Hill "from Old Ford." (Rivers Commission, 2nd Report, Vol. II., Evidence, p. 11.)

Confining our attention to South London, there is no reason to believe that the poverty of the districts was greater in 1849 and in 1854 than it was in 1866; the density of population was less, the depression of the soil was the same, and yet in 1849 the cholera deaths to 10,000 inhabitants were 121; in 1854 the cholera deaths were 94; and, as we have seen, in 1866 they fell to 8. The cholera deaths to 10,000 fell at once in the four sub-districts supplied exclusively by the Lambeth Company from 93 in the year 1849 to 17 in the year 1854; in the sub-districts supplied jointly by the Lambeth and the Southwark Companies from 138 to 95; in the sub-districts supplied by the Southwark alone the proportions rose from 135 to 154. Some deterioration in 1854 is noteworthy in the Chelsea water-field, but there is a noteable amelioration in the water-fields of the New River and the East London. In the water-field of the Grand Junction Company, the fatality of cholera greatly increased in 1854; and that not only in the Golden-square sub-district in the vicinity of Broad-street pump, but in Kensington town, and St. John, Paddington. The mortality by cholera in the Chelsea and the West Middlesex water-fields was higher in 1854 than in 1849; and the waters of the upper Thames had grown impurer.

The companies were appealed to (see Appendix, pp. 297–301), and several of them improved their waters materially before the Act of 1852 came into operation; but in the beginning of the year 1853 the Lambeth Company, quitting its source of supply at Hungerford Bridge, where the Thames was foully polluted with London sewage, drew its water from Thames Ditton, above Teddington Lock and beyond the reach of London sewage, but even then apparently exposed to the pollution of the drainage of Thames Ditton.* Still the whole character of the Lambeth water was changed; it could no longer be contaminated by the cholera flux of London, and the result was astonishing. As the Southwark water then remained the same, while the Lambeth water was changed, the operation of other causes remaining the same in the two intermingled fields, the phenomena were analyzed, and the vast differences in the mortality of the people living in the two fields were evidently due to the differences of the water.

The reasoning may be put in this form: the excess of the mortality (x) by cholera in the Southwark and the Lambeth water-fields in 1849 and 1854 was produced by one or other of the possible causes all existing in 1849, represented by a, b, c, d, e, z; in the second period, as well as the first, all the possible causes remained unchanged, except the possible cause z, which varied, and with it varied x so as to diminish as z diminished; therefore z was the cause of x. If the enumeration of possible causes is complete, and the assumption that the forces of $a\ b\ c\ d\ e$ are substantially unchanged, it is difficult to resist the conclusion that z was the cause of x. The obvious possible causes are exposure to infection (a), bad drains (b), crowding (c), poverty (e), imperfect medical relief (f), impure water z: none of these, as far as it is known, differed, as far as Lambeth is concerned, in 1849 and in 1854, except the water (z), which was very impure in 1849, much purer in 1854. Again, all these causes, except z, were substantially the same in the Southwark and the Lambeth water-fields in the year 1854; but then the water in the Southwark water-field became worse, and there x increased, while in the adjacent Lambeth field the reverse happened.

In the interval between the year 1854 and the year 1866 the water of all the eight companies was taken from points higher up the rivers,

* This may be inferred from a passage of the Engineers' Report to the Right Hon. W. Cowper, p. 50.

and filtered, and following this, in 1866, cholera in every water-field was fatal to comparatively few when it visited London under nearly the same epidemic circumstances, and, as far as could be judged from continental experience, with undiminished virulence, except in the water-field of East London.

The East London Company itself had succeeded by filtration* and other means in reducing the cholera mortality, which was 59 in 1849, to 34 in 1854; and the deaths by diarrhœa remained nearly stationary In the years after 1854 the waters of the Lea grew every year fouler by the discharges of the sewers on its west bank, and by the drainage of West Ham into its eastern margin; a work designed by an eminent engineer, that has gradually extended since it was first opened in the autumn of 1861,† and now (1867) pours the contents of the water-closets of 10,000 houses into this tidal tributary of the Thames,‡ above its loop at the iron bridge, only a mile and a half below the water reservoirs of the *East London* Company. A large part of the sewage is discharged by gravitation, but about 4,600,000 gallons were pumped daily into the river in the year 1866. "The effect of the sewer " outlets," says Mr. Beardmore, the able engineer of the Lea Trust, " is no doubt to keep the tidal water *in a foul state, especially during* " *the summer and autumn months, when there is not an excess of water* " *in the Lea.*"§ The river is as foul, in the opinion of Mr. Marshall, as the West Ham sewage. "It looks as foul, and certainly no sensible " impression is produced on the river Lea that I could ever detect, even " when we are pumping into it at all times of the tide. A large area " of bank is exposed every tide; it is covered with a slimy deposit of " mud of a most offensive appearance, and certainly with no agreeable " smell." "In hot weather, what kind of sensation have you when " walking near that mud?—I always have the sensation that I should " like to be somewhere else."‡ "We found it expedient, during the " last summer (1866), *to wash out the sewers.* I believe that we should " *not have had occasion to do so except to please the people on account* " *of the cholera.*"

West Ham is out of London, so, although the great metropolitan sewer passes over its main sewer at Abbey Mills pumping station, the Lea, instead of deriving any advantage from that circumstance, thus grew liable to further pollution by the discharge into its waters of the overflow of the metropolitan great sewer in times of storm.

The East London Company had apparently no defence against the tidal waters encompassing its reservoirs round about and growing fouler and fouler every year after 1861; thus at Old Ford it lost in 1866 the advantages it gained by filtration at Lea Bridge, besides being exposed to the temptation of resorting to the vast stagnant infected ponds in close proximity to the Lea. The cholera deaths from 34 in 10,000 in 1854 rose to 72 in 1866, while the cholera and diarrhœa deaths in the same epidemics rose from 51 to 87.—(Cholera Report, 1866, pp. xx–xxiv.)

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* Before 1852 the East London Company employed no means of filtration, but relied upon its large depositing reservoirs to which reference has been made. By June 1854, that is, before the height of the London epidemic of that year, *half of their filtering beds* were in operation. See Engineers' Report to the Right Hon. W. Cowper, p. 67.

† First contract let in 1858. J. Meeson.

‡ J. G. B. Marshall, C.E., Engineer to Board of Health, West Ham. Evidence before Rivers Commission, River Lea, 2d Report, Vol. II., Evidence, pp. 126–8.

§ Letter dated November 1, 1867.

Scientific Elements of Cholera; Epidemic of 1866.—ELEVATION.—Cholera was very unequally distributed over England. 14,378 people were slain by the disease in 641 districts; and of that number 10,889 fell in 37 districts of London, and in 24 other town districts; 3,489 in 342 districts; while in 238 districts no death from cholera was recorded.

All the districts, with the exceptions of Wigan and Merthyr Tydfil, were seaport towns, or districts in their immediate neighbourhood; the populations were dense, and were nearly all dwelling on the lower alluvial soils of the kingdom. These correlations have been observed in all the epidemics. The exceptions are accounted for by such peculiar circumstances as the mortality around the Broad-street pump, London, in 1854, and in St. Giles's London, in 1849, where either the people were excessively dirty and crowded, or took in water large doses of cholera matter in a very active state.

To get a clear idea of the operation of elevation it is necessary to exclude the notion that the mere fact that people live a few feet above the sea level has in itself any direct influence on health. It is the indirect influence of elevation on the air and water of a place that produces the surprising effects observed.

The zymotic matter being organized lives irregularly distributed in air or in water. It is in suspension either in the atmosphere or in the waters; and as it is necessarily under the influence of gravitation, it is as a general rule in larger quantities in the lower than it is in the higher strata. Pasteur has proved this by experiment as far as the atmosphere is concerned. He deposited at the Academy of Sciences 73 flasks, each holding a quarter of a litre; they were carefully prepared so as to exclude air and were one third part full of limpid yeast water, susceptible in the highest degree of the influence of ferments. Twenty flasks were opened in the open country at the foot of the Jura; 20 were opened on the Jura at the height of 850 metres, and 20 were opened at Montanvert, near the *Mer de glace*, at an elevation of 2,000 metres. Of the 20 opened on Montanvert, only 1 sustained any alteration from the air admitted; of the 20 receiving air on the top of the Jura, 5 were affected; and of the 20 opened on the plain, 8 were thrown into fermentation. The greatest precautions were taken and are required in these experiments.* He only closed the other 13 flasks, opened on the heights, after having left them in the air of the bedroom of the little inn at *Montanvert* for the night; in 10 of the 13 infusoria were found. Thus the atmosphere is in some parts pure; in other parts it is pervaded by mists of living matter; and the density of these mists increases near the earth, as would be indeed the case in the unorganized water globules of clouds, if they were not in the lower strata volatilized by the heat of the earth into transparent vapour.

The law regulating the distribution of cholera matter in water is very easily shown by mixing the cholera flux with 10 times, 100 times, 500 times its bulk of distilled water in glass tubes a metre long†; after agitation the liquid is opalescent, and grows denser and more opaque as the bottom is approached, where there is a flocculent deposit if the proportion of cholrine is considerable.

Now the waters of London form a continuous communicating sheet resting on the London clay under gravel and other ground, and as the houses and the water sheet rise from the river brink up to Hampstead

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* Pasteur, Annales des Sciences Naturelles, 4e série, Zoologie, tome xvi., pp. 76–8.

† For displaying the distribution of suspended matter in tubes, sewage water or Thames water at the old intakes of the water companies may be used.

and Norwood, all round the London basin, it is pretty certain that sewage matters finding their way into that water exist in greater proportions in the underground water of the low than in the underground water of the high districts. The wells of the undrained low level of South London were excessively impure in 1849 and in 1854; since those dates the soil has been drained, and that is equivalent to elevating it.

The mains and pipes of the waterworks form a subsoil network all over the London area; each company has its centre of supply, but in 1849 and even in 1854 their sub-divisions may be treated as parts of one great homogeneous system for the present purpose. Then round the Thames at the bottom of the basin, to get definite ideas, take an area under 20 feet of elevation; a second area of 20 and under 40 feet of elevation; a third of 40 and under 60 feet; a fourth of 60 and under 80 feet; a fifth of 80 feet and upwards, all permeated by water mains and pipes filled by steam power, with the waters of the Thames and of the Lea containing various sewage ferments, and among others the cholera ferment in suspension; then it is plain that if the proportions of the cholera ferment in water as in air vary in the various belts it will be densest in the lowest belts, and the mortality it occasions will increase in descending on every successive terrace of the metropolis. This was observed both in the epidemic of 1849 and in that of 1854.

The greater the quantity of cholrine in a given quantity of water, the greater is the inequality in its distribution; thus with one part of cholera flux in ten of a water solution a considerable quantity of the matter falls to the bottom; with the strength of 1 in 100 or a portion of 1 in 1,000 nearly the whole matter remains after shaking pretty evenly in suspension as far as the eye can judge.

There was a direct relation between the elevation of the ground and the mortality of cholera when the waters were saturated largely with sewage, and in 1854 a similar relation obtained in the fields of the several water companies so far as they could be distinguished.

In 1866 it becomes necessary to separate the supplies of the several companies, and it is seen that when this is done the same general law prevails. The mortality in the East London sub-districts was at the rate of 103 in 10,000 living at elevations below 20 feet; it was 71 at the elevation 20–40 feet; 20 at 40–60 feet, and 4 at 60–80 feet above Trinity high-water mark.

In measuring elevation the height should be taken above the level from which the water is lifted, but in 1849 I took the elevations from the ground. The mortality was inversely as the elevation; thus let e be any elevation and e' any higher elevation of the house ground, c' being the mortality by cholera at the higher, and c the mortality by cholera at the lower elevation, then $e + a : e' + a :: c' : c = \frac{e' + a}{e + a} \cdot c'$ expresses the general relation between the mortality by cholera and elevation above the Thames. a is a constant quality, and was in 1849 taken as 13. Thus at $e' = 90$ feet we had $c' = 22$ and $c = \frac{90 + 13}{e + 13} \times 22 = \frac{2266}{e + 13}$ gave the series of mortalities for the elevations 70, 50, 30, 10, 0 feet; at 27, 34, 53, 99, and 174 deaths from cholera in 10,000, which agreed very closely with the observed mortality at those elevations, namely, 27, 34, 65, 102, and 177.* The same law prevailed in the epidemic of 1854.

* See Cholera Report for year 1849, pp. lxi–lxviii; extracts therefrom are given on pp. 343–7. (Editor.)

The general results are subjoined, as an opportunity will, we may hope, never recur of measuring the effects of cholrine diluted in water on two or three millions of people living at such regulated elevations above a tidal river.

DEATHS from CHOLERA in the Year 1866 to 10,000 Persons living, at different Elevations in the Fields of the WATER COMPANIES.

COMPANIES furnishing the greater part of the WATER SUPPLY.	ELEVATION IN FEET ABOVE TRINITY HIGH-WATER MARK.			
	Under 3 Feet.	3–10.	10–20.	Under 20.
Thames Companies:—				
Grand Junction, West Middlesex, & Chelsea	(1)* 6·93	(4)* 7·54	(6) 2·53	(11) 4·53
Southwark and Lambeth	(16) 6·78	(8) 5·76	(2) 5·30	(26) 6·40
From River Lea:—				
New River - -	—	—	(1) 56·68	(1) 56·68
East London - -	(1) 171·30	(2) 95·08	(3) 101·64	(6) 103·06
From the Ravensbourne and Wells:—				
Kent - - -	—	(2) 38·86	(3) 12·26	(5) 19·33

COMPANIES furnishing the greater part of the WATER SUPPLY.	ELEVATION IN FEET ABOVE TRINITY HIGH-WATER MARK.				
	20–40.	40–60.	60–80.	80 and upwards.	All Elevations.
Thames Companies:—					
Grand Junction, West Middlesex & Chelsea	(1) 2·25	(2) 3·08	(8) 2·93	(5) 3·48	(27) 3·60
Southwark and Lambeth	(1) 1·71	(1) 2·57	(2) 2·44	(2) 3·10	(32) 5·89
From River Lea:—					
New River - -	(8) 10·72	(16) 11·56	(13) 7·87	(4) 3·98	(42) 8·72
East London - -	(13) 71·30	(4) 20·34	(1) 3·65	—	(24) 70·50
From the Ravensbourne and Wells:—					
Kent - - -	—	(1) 1·49	(3) 13·34	(1) —	(10) 15·30

Note.—The facts from which these results are calculated are given in Table 31 (see Appendix to Cholera Report, 1866, p. 79.) for each Sub-district, arranged in the order of its elevation, and grouped according to its water supply.

* The small figures of this Table represent the number of sub-districts at each elevation supplied by the respective companies.

In the New River sub-districts the mortality ran down from 57 to 11, to 12, and to 8 on the four successive twenty feet vertical terraces, and as low as 4 at the elevations over 80 feet.

In the Grand Junction, West Middlesex, and Chelsea fields the mortality was at the rate of 5 in 10,000 at levels below 20 feet, and it was uniformly 2 or 3 in 10,000 at all the higher levels, that is, it was uniformly low as might be expected where there was very little effect from the waters.

In the field of the Southwark and Lambeth companies supplying South London the mortality was 6 in 10,000 at elevations under 20 feet, and 2 or 3 at the higher elevations.

The field of the Kent company presented some suspicious circumstances during the epidemic; and it now appears that their reservoirs are in "dangerous proximity" to the foul waters of the Ravensbourne, and being below its level are in such hydraulic conditions as to render occasional contamination not only possible but probable. This will account to a certain extent for the high rates of mortality observed there in the advanced state of the epidemic in Woolwich and Deptford. In this field the influence of elevation was also felt. The mortality was at the rate of 19 in 10,000 below 20 feet, while above it was 13 in 3 sub-districts.

If we conceive that the water in one vertical column A contains ten times as much of the *chlorine* as the water of another column B, it is evident that the lower sections of B may only contain as much of the stuff as the higher sections of A; so the mortality at different elevations would be the same under such circumstances.

In the epidemic of 1849, when the waters were generally contaminated, the mortality was regulated by elevation; the same law was observed in 1854; and in 1866, after throwing the sub-districts into water-fields, as there was a striking difference in the quality of the waters, the law is still found to prevail.

DENSITY.—It may be stated generally that the cholera is most fatal in densely peopled districts, and where it finds its way into a school, a prison, a workhouse, or a barrack under bad sanitary conditions, it is generally fatal in proportion as the inmates are crowded.

But the water-supply and the elevation together have hitherto masked the effects of density in London, and if 9 of the densest districts containing from 197 to 258 persons on an acre are placed by the side of 9 of the sparsest districts containing from 5 to 34 inhabitants to an acre it will be observed that the mortality was highest in the thinly peopled districts both in 1849 and in 1854, the scale being accidentally turned in 1866 by St. George-in-the-East. This is explained by the other columns of the subjoined Table; six of the last nine districts got the worst water of the Thames, the Lee, and the Ravensbourne, or, as in Rotherhithe, drew water from the tidal ditches and foul wells. The ground was often undrained, whereas there was a partial drainage of the higher dense districts.

When cholera matter is distributed by water, as it was in St. James's in the year 1854, among a dense population, the consequences are rendered the more appalling.

Initial of Water Companies.	Elevation.	DISTRICTS.	1866. — Persons to an acre.	DEATHS BY CHOLERA. to 10,000.		
				1849.	1854.	1866.
		DENSEST DISTRICTS :—				
N.R.	51	St. Luke - -	258	34	10	15
N.R., E.	40	East London - -	246	45	23	14
N.R.	50	Strand - - -	238	35	22	6
N.R.	53	Holborn - - -	217	35	6	7
N.R.	68	St. Giles - - -	213	53	22	10
N.R., E.	48	Shoreditch - - -	212	76	23	11
G.J., N.R.	58	St. James, Westminster -	208	16	142	5
S.L.	0	St. George, Southwark -	204	164	121	1
E.	21	St. George-in-the-East -	197	42	36	97
—	43	Mean - -	221	56	45	18
—	43	Mean - -	21	71	59	17
		LEAST DENSE DISTRICTS :—				
E.	8	Poplar - - -	34	71	42	89
S., L.	0	Rotherhithe - -	33	205	165	9
G.J., W.M., C.	40	Kensington - - -	31	24	38	4
K., S.	27	Greenwich - -	27	75	49	20
N.R., E.	53	Hackney - - -	25	25	15	11
S., L.	4	Camberwell - -	19	97	99	6
N.R., W.M.	350	Hampstead - - -	11	8	12	1
L., S.	24	Wandsworth - -	7	100	85	5
K., L.	87	Lewisham - - -	5	30	22	6

SEWERAGE.—A system of sewerage is the necessary complement of a water supply. It carries off the water charged with the various impurities of houses, shops, manufactories, and streets. These impurities are however of subordinate importance. The watercloset throws into the sewer the evacuations of the sick, and carries them in the sewage sometimes directly into a river, and sometimes over land. The matters undergo various transformations, and sewage is sometimes innoxious and inoffensive; at other times, where there is stagnation or languid circulation, fermentations arise, and, as at Southampton, the germs of disease ascend into streets and into dwellings.

There is, however, good reason to believe that where the circulation is sustained and rapid the danger from this source as far as cholera is concerned amounts to little, and is certainly insignificant when compared with the evils resulting from the accumulation of the cholera flux in streets and cesspools, whence it often finds its way into the wells and canals and streams close to inhabited places.

Almost coincidently with the first appearance of epidemic cholera, and with the striking increase of diarrhœa in England, was the introduction into general use of the water-closet system, which had the advantage of carrying night-soil out of the house, but the incidental and not necessary disadvantage of discharging it into the rivers from which the supply was drawn.

The water-closet was invented by Bramah, apparently at the close of the last century; the dates of its general introduction are thus described by Mr. W. Haywood, the able engineer to the corporation of the city of London:—"Water-closets were invented about 45 years ago (1813), "and became general in houses of the better class about 30 or 35 years "since (1833 or 1828), and the entire discharge of the dejecta from the "houses in which the water-closets were fixed in many cases took place. "Nevertheless even their introduction did not directly in all cases lead "to this, inasmuch as the interdiction of the Commissioners of Sewers "prevented it; and the custom obtained, to a large extent, of building "cesspools having overflow drains just beneath their doming, by which "means the solid matters were deposited, and the supernatant liquid "only ran off; but gradually the existing mode of construction crept in "and the entire refuse of the better class of new houses flowed by the "drains into the public sewers.

"In the year 1849 what may be said almost to be an organic change "in the system took place. In 1848 the City Commission of Sewers "obtained its Act for sanitary purposes, which became operative upon "the 1st of January of the following year (1849); for the first time "indeed then was this discharge into the sewers legalized. Previously "a penalty might have been enforced for such an usage of them, but "henceforth, within the City of London, those incurred a penalty who "failed, upon notice, to construct the drainage of premises in such a "manner as not to discharge all waste waters *and fæcal matters* "*directly into the public sewers*" [*i.e.* directly into the sources of water supply], "of which the full utility was therefore for the first time "recognized by statute; this Act was speedily followed by others for "the remaining area of the Metropolis and for the entire country, the "clauses of the City of London Sewers Act being the basis upon which "they were framed."

The deaths from cholera and diarrhœa increased in London in 1842; increased still more in 1846, when the potatoe crop was blighted, and in 1849 culminated in the epidemic cholera.

The experience of South London might be specially cited to show the great utility of sewerage in conjunction with a liberal supply of such water as is obtained from the Thames above Teddington Lock; and to prove that cholera matter is not distributed to any considerable extent by such sewers as those of South London. Good sewers lower the level of the wells, and ensure the filtration of the surface waters through a greater thickness of earth.

WEALTH AND POVERTY.—Wealth gives the command of the necessaries of life in food, clothing, dwelling; it implies personal purity, and also secures prompt and skilful medical treatment. Poverty presents the sad reverse. Hence the poor as a general rule suffer more than the rich in cholera.

But that is by no means always the case, particularly where the water is impure. Thus in East London many of the victims were in good circumstances. The poorest man in St. George, Southwark, was less likely to be attacked by cholera than the richest man in Stepney. The pauper of Hampstead escaped in 1849, while the opulent perished in Belgravia. And the same rule obtained all over the kingdom where there were equivalent differences in the qualities of the waters.

The relative economical condition of the various districts of London is shown by the assessed annual value of the houses, but with the value of the dwelling houses is unfortunately mixed up the value of the shops, manufactories, and other structures so as to give an undue degree of relative value to the city and to some other districts. Still the division of the assessed annual value of the property in each district by its population supplies a good index of its condition. On comparing the four lowest and poorest Surrey districts of South London with the wealthiest districts of Middlesex the subordination of this cause to others is evident.

With the density the parks produce some disturbing effect, and the Broad-street explosion of 1854 throws a heavy charge on St. James's, Westminster, in 1854. But it will be observed that in spite of depressed soil, density, and poverty, the mortality by cholera of the four south districts in 1866 was very little above the mortality of the favoured districts of West London. Bethnal Green is by our standard the poorest district in London, and the deaths by cholera in 1866 were in the proportion of 63 in 10,000, but even this high rate is not so high as the proportion in the other and wealthier districts supplied from Old Ford with water. There in the five districts paying nearly double the mean rent of Bethnal Green the deaths were 64, 76, 89, 97, and 116 in 10,000.

—	Initials of Water Companies.	Elevation.	Density.	House Rent of each Person.	DEATHS by CHOLERA to 10,000 living.		
					1849.	1853–4.	1866.
				£ s.			
Bermondsey - -	S.	0	94	2 7	161	179	6
St. George Southwark -	S.L.	0	204	2 11	164	121	1
Newington - -	S.L.	-1	149	2 12	144	112	3
Rotherhithe - -	S.L.	0	33	2 18	205	165	9
All London - -	—	39	39	5 0	62	46	18
Kensington - -	G.J., W.M., C.	40	31	6 6	24	38	4
St. George Hanover-square	G.J., C.	34	81	11 8	18	33	2
St. Martin-in-the-Fields -	N.R., C.	38	70	12 8	37	20	5
St. James Westminster -	G.J., N.R.	58	208	13 10	16	142	5

Sex and Age.—The fatality of an epidemic depends not only on external conditions but also on the internal organization. It is found by experience that the two sexes at different ages are not affected to the same extent by all diseases, either because by the habits of life they are not exposed to the same extent to the causes of disease, or because the power of resisting the operation of those causes varies.

The three epidemics of cholera supply data for determining the mortality of cholera at different ages in the two sexes, for the deaths were 102,186, inclusive of about 14,418 deaths by the epidemic, which were registered under the head of diarrhœa. It is important to include these outside deaths in estimating the effect of age, inasmuch as the occult form of the disease is not met with in equal proportions at all ages; and it is evident that we have the means of framing an estimate by comparing the deaths registered from diarrhœa in the epidemic years (1849, 1854, and 1866) with the deaths under the same head in ordinary years, such as the three years 1848, 1853, and 1864.

The characteristic symptoms, it will be seen at a glance, are not so well marked in early infancy or in the second infancy of old age; and the reason of this is that the muscular and nervous systems being then less active, and giving rise to less convulsive and violent symptoms, the medical attendants return the cases as diarrhœa.

At all ages above 5 and under 55 the number of such cases of occult choleraic diarrhœa is not considerable; while under the age of five years, according to this estimate, four cases of diarrhœa must be added to every six deaths registered from cholera to get the actual deaths by the epidemic. At the age of 75 and upwards also there is a large addition of these occult cases.

After correction we find that the mean of the mortality in the three epidemics was, of males 18·0, females 17·8 to 10,000 living at all ages.

The addition for occult cases was nearly the same, or 2·6 to the male and 2·5 to the female mortality.

The mean mortality from all causes in the three cholera years was, for males, 19·3 in excess, for females, 17·9 in excess of the average mortality to 10,000 living; so females suffered less than males.

The mortality is higher in boys than in girls at all the ages under 15; at the ages of reproduction, 25–45, the mortality of women, many of them pregnant, exceeds the mortality of men; but at the ages after 65 the mortality of men exceeds the mortality of women.

There is evidently a law of mortality involved in the age, independently of sex: thus in the three first lustres of life the deaths of boys to 10,000 living were 31·8, 13·2, and 7·6; of girls 28·4, 12·6, 6·4; and the mean mortalities of the two sexes at the same ages were 30·1, 12·9, and 7·0, which differ little from the series 30·1, 14·5, and 7·0, where the numbers are obtained by assuming that the mortality is inversely as the age, and decreases about 14 per cent. for every year of age, or is less than half at 5–10, and less than a fourth at 10–15, what it was in the first five years of life.

After the age of puberty, or from the age of 15–25, the mortality also increases very little; it is 8·1 for males and 7·8 for females; and at the six decennial ages extending from 25 to 85, the mortality increases from 15·4 to 43·6, at a very constant rate, as is seen on comparing the calculated series with that observed in both sexes.

Ages.	Observed in 3 Epidemics, the Deaths by Cholera to 10,000 living at each Age.			Calculated Series.
	Men.	Women.	Mean.	
25–35 - -	15·2	15·6	15·4	15·4
35–45 - -	19·5	20·2	19·8	19·0
45–55 - -	23·5	23·1	23·3	23·4
55–65 - -	28·4	31·4	29·9	28·9
65–75 - -	35·9	35·4	35·7	35·7
75–85 - -	42·2	44·9	43·6	44·0
85–95 - -	46·0	41·4	43·7	54·0
95 and upwards -	82·4	32·8	57·6	67·0

NOTE.—Let m_x = mortality by cholera at age x, then $r^n m_x = m_{x+n}$ = mortality at age $x + n$. In the series given the logarithm of r is taken at $\bar{1}\cdot93665$. This applies only to the ages under 15. At the ages from 25 to 85, and even upwards, the logarithm of r is 0·00911.

$$r = \left(\frac{35\cdot65}{15\cdot4}\right)^{\frac{1}{40}} = \left(\frac{m_{70}}{m_{30}}\right)^{\frac{1}{40}} = 1\cdot0212. \quad \text{And logarithm } r = 0\cdot00911.$$

Thus to 10,000 men living of the age 25 and under 35 the deaths by cholera and choleraic diarrhœa, as above defined, were 15·2; to 10,000 women the deaths were 15·6; and the mean mortality of the two sexes in equal numbers is expressed by 15·4. The mean deaths by cholera at the next age (35–45) were 19·8 to the 10,000 living, and so on. The calculated series approximates very closely to the observed facts: it is a series in geometrical progression, and may be conceived as representing this principle, that human life loses the power of resisting the zymotic life of the cholera epidemic year by year after the age of puberty, or what is equivalent, that the lethal power of the epidemic on the organism increases at the rate of 2·12 per cent. Thus, for instance, 1,000,000 persons of the age 30 are exposed to cholera, and 1,540 of them die; then of the same number of the age 31 exposed to the same epidemic under precisely the same circumstances, 1,573 will die; and to 1,000,000 persons of one year of age older, or age 32, the deaths will be 1,606. So some force is taken away from the organism every year of life, every second we may conceive, by which its constituents become less able to resist the action of the cholera leaven. And the diminution of resisting force obeys a law which is of this nature: the loss is an accumulating quantity, and in the end becomes so great as to leave the life at the mercy of other forms of life, or of other forces.

Thus the mortality at one age being given, the mortality at any other age within certain limits can be calculated.*

Small-pox, scarlatina, diphtheria, measles, and whooping-cough obey special laws of their own, yet all of them agree in this: the mortality by them declines as age advances; but the fevers and the other zymotic diseases taken in the aggregate are more closely allied to cholera, for the deaths by them are most numerous at advanced ages.†

* $m_{60} = r^{30} m_{30} = 15\cdot40\, r^{30} = 15\cdot40 \times (1\cdot0212)^{30} = 28\cdot89$. By logarithms $\lambda\, 15\cdot40 + 30\, \lambda\, r = \lambda\, m_{60} = \lambda\, 28\cdot89$.

† *See* Supplement to Registrar-General's 25th Annual Report, Tables on pp. viii and ix.

Attacks of Cholera.—The resistance which the body offers at different ages may be of two kinds; it may resist an invasion and, as in unsuccessful vaccination and in unsuccessful inoculation, not *take a disease*, as it is called; or it may take the disease and live through it, or succumb to it, in variable proportions.

All the cases of cholera have never been registered in any epidemic, and it is impossible to determine directly what relative numbers are attacked at each age.

The deaths out of 3,635 cases of cholera at different ages were investigated by the Scientific Committee of the Board of Health, and the result showed that, given 100 men attacked at the age 25–35 about 36 died, while of 100 attacked at the age 35–45 about 44 died; and generally the mortality of persons actually attacked increases as age advances, according to a determinable law. So in the ages before puberty the mortality of cases declines until it reaches the minimum. Here observation grows more difficult, as the mortality of cases of choleraic diarrhœa has not been determined, and it cannot be derived from the mortality of cases of diarrhœa selected indiscriminately for medical observation at hospitals or dispensaries.

To avoid fallacies of observation the cases of cholera, and the deaths at the ages 25–55, when the symptoms are well marked, may be taken; and having the number of deaths by cholera given at three ages to a fixed number living, we can calculate the corresponding number of attacks at those ages from the Scientific Committee's returns. Thus the mean mortality by cholera at the age 25–35 is by the three epidemics 15 to 10,000 living; then by the Committee's returns 107 deaths occur in 300 attacks: therefore in this proportion the 15 deaths imply 42·1 attacks. Applying the same method, the attacks at other ages have been calculated.

Ages.	Population.	Men.		Women.	
		Attacks.	Deaths.	Deaths.	Attacks.
25–35	10,000	41·3	14·7	15·1	42·8
35–45	10,000	42·8	18·9	19·4	45·2
45–55	10,000	43·8	22·4	21·9	44·7

Thus it may be inferred that at these ages the proportion of men attacked differs little from 43, and of women little from 44 in 10,000; men and women in the prime of life, in the reproductive ages, are nearly equally liable to attack, but the influence of advancing age is manifest in the advancing mortality.

The proportions attacked appear to be greater after than before the age of 55, but this disparity may be compensated by the cases of choleraic diarrhœa; all that is certain is that old women are more liable to attacks of cholera than old men.

The facts are displayed in the annexed Table, deduced partly from the observations of the Scientific Committee of the Board of Health on the epidemic of 1854.

The morbility differs less than the mortality.

Ages.	Death to One Attack.		Estimated Proportion to 10,000 Living.			
			Males.		Females.	
	Males.	Females.	Attacks.	Deaths.	Attacks.	Deaths.
All Ages -	·486	·480	31·6	15·4	31·9	15·3
0–5	·611	·632	31·5	19.3	27·0	17·0
5–10	·542	·424	22·9	12·4	27·7	11·7
10–15	·437	·500	16·5	7·2	12·5	6·2
15–25	·328	·389	23·9	7·8	19·2	7·5
25–35	·356	·354	41·3	14·7	42 8	15·1
35–45	·441	·429	42·8	18·9	45·2	19·4
45–55	·513	·491	43·8	22·4	44·7	21·9
55–65	·562	·519	46·5	26·1	55·0	28·5
65–75	·589	·578	52·1	30·7	51·8	29·9
75–85	·741	·695	40·1	29·7	49·4	34·3
85–95	·858	·667	31·7	27·2	44·3	29·6
95 & upwds.	—	·500	—	20·6	59·6	29·8

Duration of Fatal Cases.—The greater the dose of any poison the more fatal it is, and the more rapidly it is fatal. By parity of reasoning it may be presumed that the more destructive an epidemic is the more rapid are the cases in their course.

The mortality by cholera in the epidemic of 1849 was at the rate of 30 in 10,000, and the mean duration of the fatal cases was 50 hours. As the mortality by cholera in 1866 was only at the rate of 7 in 10,000, we may expect to find the fatal cases of longer duration, if the duration is in an undetermined degree inversely as the mortality. The duration of fatal cases in 1866 was in fact 61 hours; and we have this exponential equation from which the value of x can be found $\left(\frac{30\cdot 3}{6\cdot 8}\right) = \left(\frac{61\cdot 4}{49\cdot 9}\right)^x$. That upon trial is found to be $x = 7\cdot 2$. Put m for mortality of cholera in the epidemic when the duration of cases was shortest (t), and m' for mortality for time (t') when the cases were longest; then $\frac{m}{m'} = \left(\frac{t'}{t}\right)^x \therefore$ $\left(\frac{m}{m'}\right)^{\frac{1}{x}} = \frac{t'}{t} \therefore m = m' \left(\frac{t'}{t}\right)^x$ and $t' = \left(\frac{m}{m'}\right)^{\frac{1}{x}}.\ t.$ The value of x is $7\cdot 3$ or $7\cdot 0$ according as it is deduced from the facts of 1849 and 1854, or 1854 and 1866; so that $7\cdot 2$, or nearly 7, may be taken as the mean value.

The duration therefore of fatal cases of cholera in two epidemics varies inversely as the 7th (or more closely $7\cdot 2$) root of the mortality.

To give an illustration, let us apply this formula, deduced from the observations of 1849 and 1866, to determine, from the duration of fatal cases, the mortality of the epidemic in 1854. Then $\left(\frac{49\cdot 9}{57\cdot 4}\right)^{7\cdot 2} \times 30\cdot 3 =$ $11\cdot 06$ mortality by cholera in 1854. The observed mortality was $10\cdot 9$. Thus the calculated series is $30\cdot 3$, $11\cdot 1$, $6\cdot 8$, while the observed series is $30\cdot 3$, $10\cdot 9$, $6\cdot 8$.

The *numbers* and the *logarithms* (λ) are subjoined.

Epidemic Year.	Mortality by Cholera. Deaths to 10,000 (m)	Mean Duration of Fatal Cases in *hours* (t)	$\lambda\, m$	$\lambda\, t$
1849	30·3	49·9	1·4814	1·6981
1854	10·9	57·4	1·0374	1·7589
1866	6·8	61·4	0·8325	1·7882

It is probable that the mortality, as well as the duration of cases of cholera, follows some such law in different epidemics and localities.

And it may be laid down as a general law of each particular zymotic disease that the quicker the fatal disease is in its course in any given epidemic the more fatal the epidemic is to the affected population.

MORTALITY ON DIFFERENT DAYS OF THE WEEK.—In spite of the popular belief in ill-omened Friday, it is evident that the days of the week can in themselves have no more influence than the deities after which they are named on the fatality of cholera. It happens that in all England the fewest deaths in the epidemic occurred on Saturday, and next to it on Sunday. On Wednesday the greatest number of deaths occurred, and next to it stands Tuesday. In the epidemic of 1849, the deaths on Tuesday and Saturday stood highest, on Thursday and Friday lowest. In London the deaths were highest on gay Monday and Tuesday, lowest on dull Friday. If the temperate or intemperate habits of any of the working classes of London had any effect on this series of facts, they therefore raised the deaths on Monday, lowered the deaths on Friday.

DEATHS from CHOLERA on EACH DAY of the WEEK in the 23 Weeks ending 3rd November 1866.

—	Total in 23 Weeks.	Sunday.	Monday.	Tuesday.	Wednesday.	Thursday.	Friday.	Saturday.
In England and Wales -	13,553	1,897	1,903	1,987	2,039	1,940	1,900	1,887
In East London and West Ham - - -	4,284	577	585	632	680	666	549	595
In England and Wales, exclusive of East London and West Ham -	9,269	1,320	1,318	1,355	1,359	1,274	1,351	1,292
Proportion on each day to 1,000 deaths on the average day in East London and West Ham	Average. 1,000	943	956	1,033	1,111	1,088	897	972
	Defect or Excess over average daily deaths -	−57	−44	+33	+111	+88	−103	−28
Proportion on each day to 1,000 deaths on the average day in the rest of England - -	1,000	997	995	1,024	1,026	962	1,020	976
	Defect or Excess over average daily deaths -	−3	−5	+24	+26	−38	+20	−24

The order of deaths in 1866 was quite different in East London. There the deaths were high on Tuesday, Wednesday, and Thursday; low on Sunday, Monday, Friday, and Saturday. The excess was greatest on Wednesday, and the defect was greatest on Friday. The outbreak there began on a Wednesday, and attained its maximum on a

Tuesday and Wednesday. It will be recollected that the pumping from Old Ford ceased every Saturday at 7½ p.m., and was only resumed on Monday morning at 5½ a.m., the whole water-field being supplied on Sunday from the purer Lea Bridge reservoirs.—(Cholera Report, 1866, pp. lii–lxiv.)

Fever Mortality at different Ages.—The annexed Table shows the mortality of all forms of fever in the London Fever Hospital at different ages; in which it will be seen that the mortality is at the rate of 9·67 deaths to 100 cases of persons of the age of 15–25, and 15·41 deaths to 100 cases of persons of the age 25–35. But in all England 3,189

ADMISSIONS, DEATHS, and RATE OF MORTALITY PER CENT. at different Periods of Life of all Cases of "CONTINUED FEVERS" admitted to the LONDON FEVER HOSPITAL during the Ten Years 1848–57.

(*The facts of this Table were supplied by Dr. Murchison.*)

AGES.	ADMISSIONS.	DEATHS.	MORTALITY PER CENT.
ALL AGES - -	6,628	1,059	15·98
Under 5 Years - -	33	3	9·09
5– - -	401	29	7·23
10– - - -	809	51	6·30
15– - -	2,481	240	9·67
25– - - -	1,207	186	15·41
35– -	816	201	24·63
45– - - -	445	170	38·20
55– - -	231	110	47·62
66– - - -	77	46	59·74
75 and upwards -	10	7	70·00
Age not stated -	118	16	13·56

Note.—Under "Continued Fevers" are included Typhus, Enteric Fevers, Relapsing Fever, and Febricula; but all cases of "Fever" dependent on local disease are excluded. Dr. Murchison shows the mortality of each of the three forms.

deaths by fever were returned of the first age, and 1,898 of the second age; consequently if the mortality of cases of fever in the country at large is truly represented by that of the London Fever Hospital, the 3,189 died out of 32,952 attacked, of ages 15–25, and 1,898 died out of 12,317 persons attacked by fever of the ages 25–35. The same calculation is applicable to the deaths at other ages, and hence it may be inferred that at least 152,653 persons were attacked every year, and 17,491 died of these fevers. In this great annual battle 17,491 Englishmen were killed, and 135,162 were severely wounded, but ultimately recovered.

The mortality of the severe fever hospital cases is probably twice as great as the mortality of cases out of hospital, so it is possible that as many as 150,000 slighter cases might be left out of this reckoning; which will more than counterbalance the cases of fever dependent on local disease, improperly returned as fevers, and classed under that head in our tables.

The fever itself subsides earlier; but the sickness which follows its complications protracts the duration of cases, which, on an average of the 152,653 cases, imply about a month's sickness in each; so the average fever population during these years was 12,721. They would fill 127 hospitals, each containing a hundred beds, and require more than 4,643,000 days' subsistence.

About 56,784 cases and 8,901 deaths occurred among men and women of the age of 15 and under 65; and in their illness 1,703,520 days of suffering were experienced, and 1,460,160 working days were lost.

Children and aged people are not often treated in fever hospitals, so that Dr. Murchison supplies no facts respecting infants, and few facts respecting children of 5–15, or old people of the age of 65 and upwards; but it is evident that the mortality is lowest at the age of 10–15, and rapidly increases as age advances; observing a very regular law of increase, from which the mortality at one age, between 15 and 55, being given, the mortality at any other age within that limit can be calculated.*

It appears to be established that patients are not liable to a second attack, either of typhus or of typhia, but that relapsing fever (typhinia) often recurs; and typhus follows typhia, as typhia follows typhus; both being as independent of each other as small-pox and measles. This being so, it is evident that as age advances the proportion of people susceptible declines, and we find that the calculated average liability of people living to attack decreases, until at the age 45–55 the minimum liability is attained; and then only 20 in 10,000 or 2 in 1,000; one annually in 500 experiences attack. At the age 35–45 the proportional number of attacks among 10,000 persons is 26·93, at 25–35 it is 43·30, at 15–25 it is 93·20. The facts do not justify us in proceeding further towards infancy, but they seem to imply that in childhood the liability to invasion, from greater susceptibility rather than from greater exposure to it, causes a maximum proportion of attacks.

We have then greater liability to attack in early manhood, conjoined with greater power of resisting the disease; so that the final result is an equal rate of mortality among the population at the ages extending from 25 to 45; for 6·67 died out of 10,000 living of the age 25–35; and 6·63 died out of the same number living in the next age, 35–45.

The higher rate of mortality, 9·02, at the ages 15–25, is probably connected in some way with the migration from the country to the towns, where the new comers are exposed to stronger forms of the zymotic exciter. "As far as the figures [of Louis, Chomel, and Murchison] go," says Dr. Murchison, "they show that recent residence "in an infected locality increases the fatality of pythogenic fever."†

* The calculated and observed rates of mortality in fever cases are shown below:—

Age.		Observed.		Calculated.
15—25	-	9·67	-	9·77
25—35	-	15·41	-	15·44
35—45	-	24·63	-	24·40
45—55	-	38·20	-	38·57

The mean annual increase of the death-rate is 4·7 per cent. for each year of age $\because m_{x+n} = m_x r^n = m_x (1 \cdot 047)^n$.

† Murchison on Ccntinued Fevers, p. 533.

The expressive name, derived from πύθομαι, putresco, and γεννάω, Dr. Murchison gives to typhia in his classical treatise; thus pointing to the constant fountain of impurity from which this bitter water springs to poison the kingdom. This is the form of fever which is so common in France; and which was characterized by Bretonneau of Tours in 1820 under the name of *dothinenterite*, and was analytically studied by Louis in Paris, and described by him in his great philosophical work, Sur la *Fièvre Typhoide* in 1829.* The putrid state of the air of the *cabinets* in all the hotels and houses of Paris at that time is an argument in favour of Dr. Murchison's doctrine,—that the fever is "often generated spontaneously by fæcal fermentation," and is occasionally communicated by the sick to the healthy directly through this medium, or through the air of cesspools and drains. The impurities and the seeds of the disease can only be eventually got rid of by a vigilant sanitary police; and by the effectual destruction of *typhine*, its exciting leaven.

Typhus and famine fever (typhinia), like the pythogenic fever (typhia), are lit up by a specific zymotic matter which is generated whenever human beings are badly fed, and are crowded together dirty in an inadequate supply of fresh air. These two forms of fever fluctuate in intensity as the operation of their causes does, and give rise to the great spreading epidemics, which follow war and famine, and afflict the world.—(25th Annual Report, pp. 176–181.)

7. Class and Occupational Mortality.†

Class Mortality; Kings and Peers.—The average reigns of kings should correspond with the expectation of life at the period of accession. This varies in elective and hereditary princes. The mean age at accession is higher, and the reigns shorter, in the former than in the latter case. The popes represent the electoral system; 156 successors of St. Peter occupied the papal chair 1,023 years (800—1823). Each continued pope at an average 6½ years. In England, from William the Conqueror to William IV., 34 sovereigns reigned 763 years; the mean age at accession was 30 years, and the mean length of the reigns 22½ years. The hereditary kings were younger men on their accession than the popes: the kings who gained the throne by violence, or were chosen by the peeple, have been above 30 years of age in England. William the Conqueror was 42 years of age; Cromwell, 52; William III., 39; George I., 55; at the time they ascended the throne. When, as in the case of George IV. and William IV., the crown devolves upon a brother the age at accession is advanced, and the reign shortened. The ancients reckoned three generations to a century; and the estimate is very near the truth, where the line is uninterruptedly kept up from father to son. In the English peerage 31¾ years intervene, at an average ,between the birth of father and son, in the line of ancestors of any peer. Newton, in his Chronology, found, upon taking 11 monarchies, that 189 kings reigned 3,597 years; and that the mean of all the reigns was 19 years.

Of the 34 English sovereigns, 10 died violent deaths; 2 died in battle; 3 by accidents; 1 was publicly executed; 4 were assassinated

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* English and American students, and I among the number, had then an opportunity of studying this disease clinically under Louis at La Pitié, and thus carried away clear ideas of a disease which could no longer be confounded with typhus.

† For class mortality of children aged under five years, see Extract on p. 202.

by other sovereigns. Suspicion of poisoning was popularly entertained in other instances. The mean expectation of life of the 34 sovereigns at the time of their accession was 33 years, according to the English Table: they should, therefore, have died aged 63; but died actually at the age of 52½; their life was 11 years shorter than it should have been, according to the rate of mortality prevalent among the people generally in the present century. If the Manchester Life Table, (7th Report of Registrar-General, 8vo. p. 338,) which represents a lower mortality, be referred to, the mean duration of the reigns should have been 27 years instead of 22½ years.

These facts point out the dangers which have surrounded the throne; they evince no less distinctly the progress of civilisation, in the increased security of life enjoyed by the heads of the government. Of the 17 first sovereigns, 7 died violent deaths; of the 17 last, (including Charles I.), only three died violent deaths. Sharon Turner gives lists of the reigns in the kingdoms of Kent, Wessex, Bernicia (Northumbria), and Mercia, from which it appears that the mean duration of 83 reigns, betwen A.D. 449—836, was 14 years: from Egbert to Harold II. (800—1065), 20 kings reigned, each upon an average 13 years. This proves incontestably that the life of sovereigns is infinitely safer in popular than in despotic—in civilised than in barbarous states. The same truth is exhibited by the following observations. In Germany (1056—1792), the reigns of 38 emperors lasted at an average 19 years; in Sweden (1066—1818), 41 kings reigned 752 years, 18 years each; in Russia (1073—1825), 50 czars reigned 750 years, or upon an average 15 years, when the English kings reigned 22½ years! The lives of the nobles partook of the insecurity of those of the sovereigns, in the early ages; and they were equally interested in the progress of civilisation, which mitigated violence, and suppressed many other causes of premature death.*

The mortality of English peers has been investigated by Mr. Edmonds.† The inquiry extended to 707 peers. The author reduced the number to 675 peers by excluding 32 whose deaths were violent or accidental: a proceeding by which he probably proposed to render the results more applicable to the peerage of the present day; as it would otherwise have been unjustifiable to exclude deaths which are, in certain states of society, of constant occurrence, and only accidental in the same sense as a fever or a pleurisy. The number of lines of succession was 109; the number of peers observed, 675; the aggregate of ages at accession, 20,390; the aggregate of years of rule, 17,931; the average age at accession, 30·21 years; the average period of rule, 26·56 years.‡ The *expectation*, or mean duration of life, after accession, when the peer acceded between the ages 10–19 was 38·29 years; 20–29, 27·03 years; 30–39, 23·87 years; 40–59, 15·99 years. In other terms, the mean future duration of the life of the peers who acceded at the mean age 34½ was 23·87, nearly 24 years.

* Article by William Farr, Esq., the writer of this article, in the *British Annals of Medicine*, July 14, 1837.

† Lancet, Feb. 1838.

‡ 26½ years is the average duration of the reigns of the 24 sovereigns who died in the ordinary course of nature, from William I. to George IV.—*Edmonds*. The *first* peers are excluded from the calculation: for the reasons explained in speaking of sovereigns they are older at the period of accession, and their period of rule is shorter than that of their lineal descendants.

PEERS who acceded to TITLE, and who died in each DECENNIAL INTERVAL of AGE; also the ANNUAL DEATHS out of 100 living at each DECENNIAL INTERVAL of AGE.

PEERS.										
Age	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99
Entering - - -	62	128	157	147	90	55	27	8	1	..
Dying - - - - -	5	8	29	67	106	142	142	130	40	6
Mortality per Cent. per Annum - -	1·8	·7	1·2	1·9	2·7	4·3	6·4	13·8	18·9	37·5
East India Company's Labourers - -	..	..	·8	1·5	2·4	4·3	9·2	10·7	..	..

We have subjoined the rate of mortality which prevailed among the East India Company's labourers; and it will be observed that, after the influence of selection has ceased in the latter, at the age of 50 and upwards, there is a near approximation in the rates of mortality. And it must be recollected that 32 violent deaths have been excluded from the peers. Are we to infer that the mortality among peers is now higher than among labourers, crowded within the metropolis? Should we not rather infer, that as the investigation extends far back into the centuries of bloodshed and pestilence, that the lives of peers were then shorter, and are now longer, than the lives of labourers? The plague, which was born in huts, and nursed by famine, rioted in luxurious halls, and smote the highborn.

Dr. Guy and Mr. Neison have recently* determined the duration of life in the males of the families of the peerage and baronetage; it is 35 years at the age 25, 27 years at 35, 18 years at 50.—(McCulloch's Account of the British Empire; Art. Vital Statistics, pp. 552–4.)

Mortality of Males engaged in different Occupations, 1851.—The previous investigations of the various rates of mortality in the districts of the kingdom have shown how much the health and life of the population are affected by fixed local influences. The professions and occupations of men open a new field of inquiry, on which we are now prepared to enter, not unconscious, however, of the peculiar difficulties that beset all inquiries into the mortality of limited, fluctuating, and sometimes ill-defined sections of the population.

Laudable attempts have been made by ingenious men to determine the effects of professions on health, by general observation, unaided by exact recorded facts. Ramazzini and Thackrah in this way deduced some useful practical results and rules for the improvement of the health of artizans. More recently the *mean age at death* has been relied on to show the healthiness or insalubrity of certain occupations. And this method, as well as that of the annual rate of mortality without distinction of age, is applicable in certain definite conditions where only approximations are required.

But the *mean age at death* evidently depends upon many circumstances besides health, and among others, upon the ages of the living, which vary in proportions in almost every profession, according as it is a profession that people enter early or later in life, and according as the numbers that enter it annually increase or decrease.

The mortality is at the rate of 20 in 1,000 among men of the age of 20 and upwards in England; but this gross rate is compounded of all

* *See* Journal of the Statistical Society, 1845, p. 76.

the varying rates, from the age of 20 to the age of 100. For while the annual rate of mortality among men of the age of 25 and under 35 is 9 in 1,000, the rate among men of the age of 45–55 is nearly 18, and the rate among men of the age of 65–75 is 64: so, as the age of the living in different professions may vary almost indefinitely, the gross rate of mortality affords only an imperfect indication of the influence of occupation on health and on the duration of life. The rate of mortality among farmers of the age of 20 and upwards is 28 in 1,000, among tailors 20 in 1,000; yet it will be shortly shown that when the rates of mortality among men of *corresponding* ages are compared, the farmers are much the healthier of the two classes.

To obtain results upon which reliance can be placed for the purposes of sanitary inquiry and of life insurance, several extended series of observations are required, and have now been obtained in England. The Census Report exhibits the number of persons in each occupation at each decennial age in 1851, and the present Report shows the numbers in those professions dying at corresponding ages.

Upon examining the results of these two series of observations, it is evident that the unsettled nomenclature of the professions throws in the way of the inquiry another formidable difficulty, which can only be gradually removed. Thus it is impossible at present to determine the relative mortality of the classes that are respectively engaged in the silk, cotton, linen, and woollen manufactures, as great numbers of men are registered as *weavers* simply, without any further distinction; so all the persons that are engaged in the textile manufactures are thrown together. *Miners* in iron, lead, copper, coal, and the manufactures of the metals, have for the same reason been thrown into one group. Again, as the large class of agricultural labourers has in the registers often been confounded, under the indefinite term "labourer," with labourers on roads, on railways, in quarries, labourers have been dealt with in the aggregate.

By selecting a few of the well-defined occupations in which large numbers of men are employed, and by grouping together in one line classes easily confounded in the returns, certain striking and interesting results have been obtained, which are embodied in the Tables. In some instances these results confirm preconceived opinions; in others they bring to light important facts of which we had before no idea.

FARMERS.—Of the twelve classes in the Tables, the farmers are the oldest and the longest livers; out of 225,747 there are 31,720 of the age 25 and under 35; 48,378 of the age 35–45; and 53,608 of the age 45–55. Their numbers then decline, and there are 45,585 of the age 55–65; 28,660 of the age 65–75; 11,363 of the age 75–85; and 1,711 of the age 85 and upwards. Their numbers, depending on the number of farms, have been probably stationary for some years in England, and it is evident that men enter the class at all the ages up to 45–55, when the number living is greater than the number at any other period of life. Few become farmers after that age. The total deaths in the year were 6,426; and the deaths to 1,000 living at each of the decennial ages commencing at 35–45 were nearly 9, 12, 25, 55, 148, 324.

The deaths to 1,000 labourers at each of the corresponding ages were 13, 17, 29, 68, 174, and 418. The advantages in respect to health of the farmer over the labourer are considerable at every age after the age of 35; but singularly enough, the mortality of the young farmers of the age 25-35 is rather higher (10·15) than the mortality (9·79) of the young labourers of the same age.

The labourers of all classes that are brought into the calculation were 1,192,909, of whom 25,801 died in the year. They constitute nearly one fourth part of the male population of England; and their mortality is at nearly the same rate as that of the whole population, except in the very advanced ages, when the Poor Law apparently affords inadequate relief to the worn-out workman.

The four classes which on the whole experience the heaviest rates of mortality are *miners, bakers, butchers*, and *inn and beershop keepers*. Thus at the age of 45–55 out of every 1,000 farmers 12 died; of 1,000 shoemakers 15 died; of 1,000 weavers and others employed in the manufacture of cotton, silk, and wool, 15 died; out of an equal number of grocers 16 died; of blacksmiths 17 died; of carpenters 17 died; of tailors 17 died; of labourers 17 died; of miners 20 died; of bakers 21 died; of butchers 23 died; of inn and beershop keepers 28 died;—the mortality at that age among the whole population of England being at the rate of 18 in 1,000.

At every period of life the mortality of the inn and beershop keepers is in excess of the mortality of all the other classes except the *butchers* at the age of 55–65 who died at the rate of 41 in 1,000; while the rate among the *inn and beershop keepers* of the same age was 39 in 1,000; the rate among the whole population being 30.

Among the important class of men, 55,315 in number, variously designated hotel keepers, inn keepers, licensed victuallers, and beershop keepers, distributed all over the kingdom, but concentrated especially in towns, the causes of this unusually heavy rate of mortality deserve careful and extensive investigation. Many highly respectable men of the class lead regular lives, and are of steady habits; but others, exposed by their business to unusual temptations, live intemperately, and enjoy less quiet at night than the rest of the community. They are also exposed to zymotic diseases, by intercourse with large numbers of people.

But in a matter of so much importance these remarks *must* only be viewed as indications of the direction that the inquiry should pursue in the hands of competent persons.

BUTCHERS.—This useful body of men amounted to 49,403, and they experienced a much heavier rate of mortality than any other class except that preceding—at the ages under 65. Thus at the age 35–45 the rate of mortality per 1,000 among farmers was 9, carpenters and joiners 10, shoemakers 11, blacksmiths 12, tailors 14, bakers 15, butchers 17. At the next decennial age (45–55) the mortality of butchers was 23; at 55–65 it was 41, or higher than the mortality that any other class suffered. The mortality of the old butchers of the age of 65 and upwards is near the average.

While much has been written about the diseases of shoemakers, weavers, tailors, miners, and bakers, the extraordinary mortality of butchers appears to have escaped observation. Calculation alone has taught us that the red, injected face of the butcher is an indication of a frail habit of body.

Here is an important problem for solution. On what does the great mortality of the butcher depend? On his diet, into which too much animal food and too little fruit and vegetables enter?—on his drinking to excess?—on his exposure to heat and cold?—or, which is probably the most powerful cause, on the elements of decaying matter by which he is surrounded in his slaughter-house and its vicinity?

BAKERS and CONFECTIONERS.—The habits of bakers in town and country differ considerably; but the mortality among the 42,717 was at the ages from 35 to 65 much above the average. The young bakers of the age (25–35) experienced a low rate of mortality (7·59 in 1,000).

MINERS die in undue proportion, particularly at the advanced ages, when their strength begins to decline. In this particular they resemble labourers.

TAILORS die in considerable numbers at the younger ages (25–45); but their mortality after the latter age, though higher than that of the former, is below the average of the people in general.

CARPENTERS, GROCERS, WEAVERS, and SHOEMAKERS in early manhood, 25–45, do not experience a high rate of mortality; and subsequently the range of the rate below or above the average of all classes is not considerable.

BLACKSMITHS, 75,998 in number, are distributed all over the kingdom in shops, where they work under peculiar conditions. Their mortality differs little from that of labourers, but it is excessive after the age of 55, and from the age of 55 to 75 it exceeds the mortality of labourers.

In the annexed Table the several classes are arranged in the order of the mortality at the age (45–55). The facts deserve to be carefully studied.

MORTALITY per 1,000 living at SIX AGE-PERIODS.

AGES.						
25–	35–	OCCUPATION.	45–	55–	65–	75–
10·15	8·64	Farmer - -	11·09	24·90	55·30	148·02
9·12	10·59	Shoemaker -	15·03	28·69	65·05	164·46
7·97	10·56	Weaver - -	15·37	32·99	74·59	173·08
7·63	10·46	Grocer - -	15·79	22·65	49·72	124·57
8·12	12·40	Blacksmith -	16·51	37·24	74·43	167·10
9·45	10·32	Carpenter - -	16·67	29·66	65·86	142·86
11·63	14·15	Tailor - -	16·74	28·18	76·47	155·28
9·79	12·52	Labourer - -	17·30	29·20	67·90	173·94
8·49	11·35	Miner - - -	20·15	34·50	80·51	178·67
7·59	14·75	Baker - -	21·21	33·01	66·78	150·66
11·30	16·53	Butcher - -	23·10	41·49	66·47	154·49
13·83	20·45	Innkeeper - -	28·34	38·97	81·51	180·84
9·48	12·36	All England -	17·87	30·31	63·96	140·55

Every occupation has its peculiar dangers, which in their results sometimes counterbalance each other. Thus, the tailor is not exposed to the explosions which are fatal to the miner; and the labourer has exercise which is denied to the tailor. It is hence probable that the diseases of classes that experience the same rate of mortality differ; so, necessarily, do the measures by which those diseases may be obviated.

Insurance offices and friendly societies will probably find the facts in these tables of use to them in their transactions. For it is evident that the lives of farmers, for example, may be safely insured at much lower rates than the lives of licensed victuallers. Life Tables may be constructed from these death-rates, showing the probabilities of life or the mean life-time of several classes on a wider basis of facts than those which were employed by the eminent actuary, Mr. Milne, in constructing the Carlisle table. But before the tables are constructed the inquiry must be extended over other years; and must embrace the diseases, and several other circumstances on which it is desirable to obtain satisfactory information before constructing new tables on which large pecuniary investments may be made to depend.

The result of the inquiries which the facts that have been already analysed suggest, will, I trust, lead to great reductions in the rate of mortality from which all the unhealthy professions now suffer.—(14th Annual Report, pp. xv–xxiii.)

Mortality of Males in various Occupations, 1861–2 *and* 1871.—Small principalities and republics have alike contributed their quota to art, science, and literature; and among them Modena under the house of Este deserves mention. There, on the northern slope of the Appenines, Fallopius first saw the light; and Bernard Ramazzini, born in 1633 at Carpi, has made Modena for ever memorable by his *De Morbis Artificum Diatriba.* In the University he was the Professor of the theory of medicine from the year 1678, the date of its foundation by the Duke Francis II., and in Modena during his practice to the end of the century, when he was called away to take a chair in Padua, he collected the observations on the diseases of men engaged in the arts and professions. And that city may be well held in the same regard as the cities that the "starry Galileo" made so famous by his observations, for though the observations were made in workshops and not in celestial space, their immediate result was the relief of the incidental sufferings of the men to whom the world owes much of its progress and many of its enjoyments.

Ramazzini created a new art, the art of preserving the health of the men who are engaged in the arts of life. In his work he refers the abundant and varied crop of diseases from which artisans suffer to two distinct heads: the noxious materials in which they work, and to the violent disorderly movements of the body, as well as its incongruous attitudes, acting on the structure of the vital machine.

He commences with the miner and passes in review all the workers in metals; describes the diseases arising from working in mines, from quicksilver, antimony, lead, copper, tin, arsenic, iron; all those maladies that afflict the *vir metallicus,* to use the characteristic designation of Hippocrates. He then takes the workers in materials of vegetable origin, and devotes a special chapter to the agriculturist. His chapters on wet nurses and midwives are highly curious. He surveys nearly the whole field of human activity in an Italian city.

In his chapter on soldiers (*milites*) he treats of the diseases of armies in the field, not, as he says, from personal experience, but from report. But he had in some Brunswick physicians excellent informants who had been engaged in the last Hungarian war, and he sets the causes of camp fevers, dysenteries, and other maladies in the clearest light. Sir John Pringle in his classical work developed and established the true doctrines of military hygiene, so that our subsequent losses due to its disregard were quite inexcusable.

The chapters on the health of the learned and the scientific professions are elaborated with great care. And leaving the homes of workmen, Ramazzini wrote a special treatise on the health of vestal virgins, a name by which he designates nuns, who, he says, excelled the vestal virgins of old, whose vows were for thirty years. A second treatise *De Principum valetudine tuenda* is full of instruction, and deserves to be read, not only by all princes, but by all persons of wealth and rank. He pleads with them the cause of their own as eloquently as if he were pleading for his own life.

Ramazzini was in possession of all the ancient learning, and he everywhere refers with reverence to Hippocrates as the *Divine* Preceptor. He is equally well versed in the most recent discoveries of that age. No one has expounded more clearly the immense importance in all medical reasoning of Harvey's immortal discovery of the circulation of the blood.

What is most defective is due to the imperfection of the chemistry of his day, and to the absence of exact observations on the mortality of men in the different professions.

Thackrah wrote an excellent work on the effects of various occupations on health. It is the result of conscientious study, and if not marked by the learning and eloquence of Ramazzini is characterised by sound professional sense. French and German writers have contributed much information on this subject; but nearly all of the previous writers employed methods which could render no precise results, except in cases where the influences they dealt with were very powerful. The effects of compensating circumstances in a trade could not be weighed, and they were more impressed by the sickness than the mortality of the workmen in any particular business.

The mean age at death of people in different businesses often furnishes very erroneous indications, as it is affected as much by the ages at which people enter and leave, and by the increase or decrease of employment, as by the salubrity or insalubrity of any particular profession. The only way in which the mortality, and the duration of life, of miners, tailors, farmers, labourers, or any other class of men can be accurately determined is to determine the ratio of deaths at each age to the living during a certain time—in fact to apply the same method to each class as is applied to determine the mortality and the mean life-time of all classes in a town, in a district, or in the whole kingdom.

The materials for such an inquiry extending over all the recognised trades of the men in England were in part supplied ten years ago in the Supplement to the Registrar-General's 25th Annual Report; and it has now been deemed right to publish as a sequel the deaths in 1871 in the same classes at ten different ages in England and Wales, in each of its divisions and in eighty town districts.

This series will serve as a good basis to the inquiry into a subject next to none in importance in an industrial country. The inquiry must embrace at least the various questions of which an outline is given in the Census Report of 1861 (pp. 29–30). It well deserves the attention of the Health Officers. Every help may be expected from the intelligent artisans of the country, who have, in the Reports of the Odd Fellows Society, shown their appreciation of it by giving the rates of sickness and mortality in different trades. The late Mr. Neison and his son have ably discussed the materials derived from the various friendly societies, and with their observations those here published may be usefully compared. They throw light on each other.

As an illustration of the uses to be made of the facts relating to occupations two sets of tables have been calculated, the one of sixteen groups constituted so as to embrace well-defined occupations or groups of allied and easily confounded occupations. The results are sufficiently remarkable.

The high mortality of those two important classes the publicans and butchers is unfortunately still maintained. It may be well if the many persons of intelligence and influence amongst them would inquire into its causes.

In the Appendix to the Report of the Commission on Mines, over which Lord Kinnaird presided, I have given life tables for miners, and tables showing the deaths of miners from different causes, which may assist those who are engaged in investigating other occupations, as the same methods are applicable to all.*

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* *See* Extracts from this Report on pp. 404–11.

The results deducible from the returns for the learned and other professions are given in Tables, which are instructive, but have to be read with care, as the numbers are not large and are only for one year.

By adding these results of 1871 to those for the two years 1860 and 1861, a large basis of facts is obtained; and sufficient to enable us to determine the relative mortality of men of various ages in all the leading, numerous, and well-defined professions. The clerical work in the reduction of these Census and registration tables is very great, and nothing analogous to it has yet been undertaken in any other country. The results fully justify the expenditure in the collection and analysis of the facts, which are now submitted to the hygienic student. They will repay his careful study of the mortality in its relations to the circumstances of every occupation.

The degree of confidence to be attached to the rates depends to some extent on the numbers of deaths which on that account are given in the same table.*

I can only call attention here to some of the more remarkable results.

The *publicans* and *butchers* it will be recollected according to the previous returns experienced high rates of mortality. As they still maintain a high position it has been thought expedient to commence the analysis by dividing them into groups; the first group following their occupation in London, the second group the corresponding occupation in the rest of the country.

In the annexed table the mortality of butchers and publicans is shown in comparison with the mortality of males of all classes.

ANNUAL MORTALITY per Cent. among BUTCHERS and PUBLICANS in the Years 1860, 1861, and 1871, at different Periods of AGE, in LONDON and in England exclusive of London; also among MALES of ALL CLASSES at the same periods of LIFE during the Ten Years 1861–70.

Ages.	London.			England exclusive of London.		
	All Males, 1861–70.	Butchers, 1860, 61, 71.	Publicans, 1860, 61, 71.	All Males, 1861–70.	Butchers, 1860, 61, 71.	Publicans, 1860, 61, 71.
15–25 -	·703	·492	·686	.727	·383	1·003
25–35 -	1·086	1·050	1·642	·972	·996	1·407
35–45 -	1·714	2·060	2·324	1·281	1·669	1·981
45–55 -	2·568	2·764	3·766	1·812	2·157	2·797
55–65 -	4·385	4·582	5·487	3·154	3·624	4·228
65–75 -	8·283	9·052	10·383	6·489	8·121	7·088
75 and upwards.	18·451	24·424	32·692	16·288	19·731	21·034

The mortality of butchers' boys and potboys is lower in London than the mortality at the same ages (15–25) of all classes.

The mortality of London butchers exceeds that of country butchers, and would no doubt be still lower if their cattle were slaughtered at public abattoirs and not in private slaughter-houses.

Young publicans (15–25) die at a faster rate in the country than in town; at all ages after 25 the mortality of London butchers is excessive;

* *See* Tables in Supplement to 35th Annual Report, pp. clxxii–iv.

it is beyond not only the mortality of all other classes in London, but beyond the mortality of the butchers of the rest of the country.

Fishmongers experience full as high a mortality as butchers.

The numerous body of men who supply the community with drinks, food, and entertainment in inns, are shown to suffer more from fatal diseases than the members of almost any other known class. They might themselves institute a strict inquiry into its causes. But there can be little doubt that the deaths will be found to be due to delirium tremens and the many diseases induced or aggravated by excessive drinking. It seems to be well established that drinking small doses of alcholic liquors, not only spirits, the most fatal of all the poisons, but wine and beer at frequent intervals without food, is invariably prejudicial. When this is carried on from morning till late hours in the night few stomachs—few brains can stand it. The habit of indulgence is a slow suicide. The many deaths of publicans appear to prove this. Other trades indulge in the publicans' practice to some extent, and to that extent share the same fate. The dangerous trades are made doubly dangerous by excesses.

The clergy of the Established Church, Protestant ministers, Catholic priests, and barristers, all experience low rates of mortality from ages 25 to 45. The clergy lead a comfortable, temperate, domestic, moral life, in healthy parsonages, and their lives are good in the insurance sense. The young curate compared with the young doctor has less cares.

The mortality of Catholic priests after the age of 55 is high ; perhaps the effects of celibacy are then felt.

Solicitors experience the full average mortality after the age of 35; the legal work is hard.

Physicians and surgeons from youth up to the age of 45 experience a mortality much above the average; after that age they do not approach the priesthood in health, but differ little from the average. Many young practitioners have hard struggles to encounter. They are in contact with the sick; are exposed to zymotic disease, and their rest is disturbed. In states of depression deadly poisons are at hand. There is an excess of practitioners in cities. Country practitioners have to visit their patients in all weathers, at all hours. The causes from which the medical men suffer demand careful study.

Chemists and druggists are younger than medical men, because pharmacy is a separate business, and is of more recent growth. Their mortality, like that of medical men, is high, and above the average, especially in the younger ages. Manufacturers of chemicals, dyes, and colours also experience a mortality above the average.

Commercial clerks experience an exceptionally high rate of mortality. The rooms in which they work are generally close and ill-ventilated. They often stoop at their desks. They require Sir John Lubbock's holidays.

The railway service taken collectively experience a high rate of mortality, somewhat higher than medical men at advanced ages.

Coachmen (not domestic servants) and cabmen experience nearly the same high mortality as the railway service from the age of 20 to 35; after 35 the mortality is in still greater excess; the causes are probably drink, exposure to the weather, and violent deaths. The mortality of horse-keepers and grooms is, without hard exercise, nearly as high at the ages of 25 and upwards as the mortality of coachmen.

Veterinary surgeons and farriers of the age of 25 and upwards experience a very high rate of mortality; higher than physicians and surgeons.

Gamekeepers offer an example of the healthiness of out-door life; their mortality is very low. The exercise of genuine sport is no doubt as salutary to the amateur sportsman as it is to the professional descendant of the hunters of old.

Publishers and booksellers fare well in health and life; they are generally masters in better circumstances than their confederates, bookbinders and printers, including masters and men, who often work in badly ventilated rooms, and die at a rate of mortality exceeding the average.

Tool, file, and sawmakers have among them the grinders who suffer so much from sharp particles of stone and steel inhaled into the lungs; their mortality is still high, and at the ages 45 to 65 excessive. The mortality of needle manufacturers at 35–45 is excessively high.

Coachmakers of all branches working in wood, iron, binding, and paint, up to the age of 45, experience a low rate of mortality; afterwards the mortality exceeds the average. They live in towns.

Wheelwrights working chiefly in wood, and scattered all over the kingdom are healthy; their mortality is low at all ages.

To carpenters, joiners, sawyers, and workers in wood generally the same observation may be extended; their mortality is low; their occupation is healthy.

The mortality of the blacksmiths, also scattered over the country, and working in heat and iron, is higher than that of the wheelwright and carpenter.

The carver and gilder suffers less than he did. But both he and the plumber and glazier require further protection against the metallic poisons. The mortality is high among them from age 35; but at the age of 45–55 it approaches 50 per cent. higher; at 55–65 it is near the ordinary mortality of men.

The wool, silk, cotton manufacturing population no longer experience an exceptionally high mortality. Lord Shaftesbury and his enlightened colleagues must be gratified, if not entirely satisfied, with the success that has crowned their life-long labours. And it is creditable to the mill-owners to find the men and boys in their employ suffering less than many other people in towns.

The people working in wool are the healthiest; at all the young ages their mortality is the lowest; at 45 and upwards the cotton workers suffer much more than the workers in wool and silk.

The mercers and drapers are not so healthy a class as could be desired; their mortality is above the average, especially is this the case from 25 to 45. Perhaps much of their in-door work is better suited to women than to young men.

The hairdressers, barbers, and wig-makers, living chiefly in cities, experience, according to these returns, high rates of mortality at all ages; and so do hatters.

Shoemakers at all ages, except 20–25, and at advanced ages, experience a rate of mortality below the average.

Tailors on the contrary die at rates much above the average. For their health and for shoemakers, both classes counting more than 300,000 men, much remains to be done.

Bakers experience a mortality very little above the average, and that is chiefly at advancing ages.

Grocers at all ages after 35 experience a low rate of mortality.

The tobacconists, snuff, and tobacco manufacturers suffer very much at all the younger ages; indicating clearly how prejudicial smoking is to young men.

They present a strong contrast at the corresponding ages to tanners and curriers who are healthy up to 45, and then show signs of suffering.

The earthenware manufacture is one of the unhealthiest trades in the country. At the age of joining it is low; but the mortality after the age of 35 approaches double the average; it is excessively high; it exceeds the mortality of publicans. What can be done to save the men dying so fast in the potteries and engaged in one of our most useful manufactures?

Among the glass manufacturers the mortality is higher at 25–35 than among the earthenware manufacturers; but much lower afterwards.

The men engaged in copper manufactures from 20 and upwards experience a mortality somewhat above the average; at 55–75 their death-rate is heavy—much heavier than it is among the workers in brass and in iron.

The men in the iron manufactures do not die at the average rates under 45; after that age the average is exceeded.

Working in wood on the whole is comparatively cool compared with working in iron; the loss by perspiration is excessive among such men as puddlers, and they require a great deal of drink, which should contain little or no alcohol.

Taken in the aggregate the metal worker—the metallic man in all England does not experience the average rate of mortality under 45, after that age the table turns against him and his losses grow heavier and heavier every year.

Miners in the aggregate experience a heavier rate of mortality, largely from violent death, than metal workers; and the mortality of both classes greatly exceeds that of the agricultural labourer.

Independently of the influence of the material and of the work itself on health, the place in which men work exercises so great an influence that it has to be taken into account in judging of the salubrity of their occupations.

Man is naturally an open air animal; he is made to work, and the sky is his native covering. So after taking everything into account, the hunter, the sportsman, and the husbandman in a cultivated land are at present the healthiest of all workmen. All would no doubt be the better if the higher parts of the brain had their due share of activity; and this, though not often the case now, we may hope will come.

The farmers and agricultural labourers are at present among the healthiest classes of the population classified according to occupation. The young farmer for some reason or other suffers a higher mortality than the labourer; but at 35 and upwards the British farmer enjoys comforts which are beyond the reach of the labourer. It is probable that in no country is the agricultural population healthier than in England. Ramazzini thus writes of the agriculturist in Italy:

O fortunatos nimium, sua si bona noruit agricolas.

So it might perhaps have been, he says, with that pristine race of mortals who cultivated the paternal acres with their own oxen, but it is not so in this age with our husbandmen, who struggle on another man's land (alieno fundo) with perpetual toils and extreme poverty. Then he enumerates their diseases,* pleurisies, peripneumonias, ardent fevers,

* De morbis artificum, cap. xxxviii.

fluxes, and other maladies to which they are particularly liable "at "least," he adds, "in Italy," and especially in the region of the Po. Carelessness is one cause of their ill-health; for before the cowhouses, pigsties, and dwellings, which may indeed be called augean stables, they they heap up ordure to dung the fields, and keep it there "for a "nosegay all summer*;" whence it cannot but be that fetid exhalations arise continually and pollute the air. In no men does the blood undergo greater changes in a short time from exposure to the weather and work. Galen denounces the air of gardens for a similar reason *ob stercorationem et arborum parvos hælitus*. Ramazzini notes that the country people do not bear bleeding even in pleurisies. The reapers in the Ager Romanus every year fill the hospitals, and it is uncertain whether the scythe of death or the lancet of the surgeon is the more fatal.

The English farmer is in a very different plight; his blood is not poor and he is not ill fed. The weather it is true troubles his mind, but against its severities he is well sheltered. His capital not being sunk in the purchase of land he has more to expend on stock, implements, labour, and fertilizing materials. His profits are greater. No doubt the dirt which feeds zymotic disease germs, cattle and human alike, still pollutes the farmyards, and the farm ponds; but foot-and-mouth disease, peripneumonias, and cattle-plague will in the end teach the intelligent farmer that in his management of all live stock cleanliness is next to godliness.

The mortality of the English farmer is not now high; but it may by care be reduced to a lower figure. To what is the high mortality of the young farmer of 15–25 due? Farmers' sons appear to be healthy. The labourer experiences a higher rate of mortality than the farmer at all ages after 35.—(Supplement to 35th Annual Report, pp. lii–lviii.)

Mortality of Miners, 1848–53 *and* 1860–2,† *Cornwall*.—From the evidence given before us by Dr. Farr, F.R.S., Chief of the Statistical Department of the General Register Office, and from a Return prepared for us by the Registrar General and printed in the Appendix, we are enabled to show the rates of mortality prevailing among the miners of Cornwall at different periods of life, as compared with those prevailing among the non-mining population of the same districts, for the five years 1849–53 inclusive, and also for the more recent triennial period 1860–62 inclusive.

The districts selected for the purposes of this comparison were those of Liskeard, St. Austell, Truro, Helston, Redruth, and Penzance. The death-rates were computed from the aggregate numbers of males, and of deaths of males of the two classes respectively in the whole six districts taken together. The subjoined table shows the rates of mortality from all causes during the earlier period 1849–53, among the two sections of the population, for the several successive decennial periods of life, from the age of 15 up to that of 75 years.

* Such is Dr. James's translation of "per totam æstatem pro delitiis." He is not often so happy, when not literal.

† This extract is a summary of Dr. Farr's evidence given before the Royal Commission on the Condition of Mines in 1864, of which Lord Kinnaird was Chairman, and is reprinted from the Commissioners' Report, together with some of the Tables furnished by Dr. Farr, the remainder of which will be found in the Appendix to that Report.

AVERAGE ANNUAL NUMBER of DEATHS per 1,000 MINERS, and per 1,000 Males exclusive of Miners, in Cornwall, from all Causes, during the five years 1849–53 inclusive.

Ages.	Metal Miners.	Males, exclusive of Miners.
Between 15 and 25 years -	8·90	7·12
" 25 " 35 " -	8·96	8·84
" 35 " 45 " -	14·30	9·99
" 45 " 55 " -	33·51	14·76
" 55 " 65 " -	63·17	24·12
" 65 " 75 " -	111·23	58·61

From the figures in the above table it appears that the rates of mortality among the miners are not materially different from those prevailing among the non-mining males of the same districts until after the age of 35 years, after which there is a large and progressive excess of mortality among the mining section of the male population. If we assume the rate of mortality among the non-mining males at each decennial period of life to be represented by 100, then that among the miners would be represented by 125 between the ages of 15 and 25 years, by 101 between 25 and 35, by 143 between 35 and 45, by 227 between 45 and 55, by 263 between 55 and 65, and by 189 between 65 and 75 years. That the large and progressive excess of mortality among the miners between the ages of 35 and 65 years must be due to unwholesome conditions incident to their occupation may be inferred from the fact that it does not commence until they have had full time to operate. The somewhat higher rate of mortality among miners between the ages of 15 and 25 years probably arises from the circumstance that many of the boys are put to work in the mines at too early an age.

That the excessive mortality among the miners in Cornwall is not caused by the mere working underground in dark galleries, a necessary condition of the miner's occupation, and must therefore be mainly due to other causes, is clearly proved by some statistics relative to the coal miners of Durham and Northumberland, also given in evidence by Dr. Farr. The annexed Table shows the rates of mortality among the coal miners of Durham and Northumberland during the five years 1849–53 inclusive, for each decennial period of life, from the age of 15 up to that of 75 years, compared with the rates among the Cornish miners already quoted.

AVERAGE ANNUAL NUMBER of DEATHS per 1,000 CORNISH METAL MINERS, and per 1,000 NORTHERN COAL MINERS, from all Causes, during the five years 1849–53 inclusive.

Ages.	Cornish Metal Miners.	Northern Coal Miners.
Between 15 and 25 years -	8·90	8·50
" 25 " 35 " -	8·96	8·49
" 35 " 45 " -	14·30	10·13
" 45 " 55 " -	33·51	16·81
" 55 " 65 " -	63·17	24·43
" 65 " 75 " -	111·23	65·16

Assuming, on the authority of the previous table, the rate of mortality among the coal miners at each period of life to be represented by 100, then that among the Cornish miners would be represented by 105 between the ages 15 and 25 years, by 106 between 25 and 35, by 141 between 35 and 45, by 199 between 45 and 55, by 258 between 55 and 65, and by 171 between 65 and 75 years. The rates of mortality among the Cornish miners from the age of 35 years upwards are thus shown to have been almost as much in excess of the rates which prevail among the coal miners in the selected districts of Durham and Northumberland, as they were above the rates prevailing among the non-mining male population of Cornwall.

The evidence regarding the more recent period 1860–62 shows that the great excess of mortality among the Cornish miners still continues, although the proportions are slightly different. The subjoined table shows the rates of mortality among the two sections of the male population respectively, from all causes, during the three years 1860–62, for the same periods of life as the former table.

Average Annual Number of Deaths per 1,000 Miners, and per 1,000 Males exclusive of Miners, in Cornwall, from all Causes, during the three years 1860–62 inclusive.

Ages.	Metal Miners.	Males, exclusive of Miners.
Between 15 and 25 years -	9·44	7·50
" 25 " 35 " -	9·57	8·32
" 35 " 45 " -	15·12	10·08
" 45 " 55 " -	29·74	12·50
" 55 " 65 " -	63·21	19·96
" 65 " 75 " -	110·51	53·31

Again, assuming the rate of mortality at each period of life among the non-mining males to be represented by 100, then the rate among the miners would be represented by 126 between the ages of 15 and 25, by 115 between 25 and 35, by 150 between 35 and 45, by 238 between 45 and 55, by 317 between 55 and 65, and by 207 between 65 and 75 years.

From Dr. Farr's evidence, supplemented by the Registrar General's Return, it further appears that the excessive rate of mortality among the Cornish miners is mainly caused by the large number of deaths from pulmonary consumption and other diseases of the lungs. As, however, deaths which are registered in some districts as due to consumption are registered in other districts under different names, such as asthma and bronchitis, it is best for statistical purposes to throw all the diseases of the lungs into one class under the general name of Pulmonary Diseases, an arrangement which enables the rates of mortality from diseases of the lungs in different districts to be more accurately compared with each other than it the several diseases of these organs were nominally kept separate. The class of pulmonary diseases thus formed comprises, phthisis, laryngitis, bronchitis, pleurisy, pneumonia, asthma, and all cases returned as "diseases of the lungs."

The annexed table shows the average annual rate of mortality per 1,000 persons from pulmonary diseases among miners, and also among males exclusive of miners, during the three years 1860–62 inclusive, for each decennial period of life between the ages of 15 and 75 years.

AVERAGE ANNUAL NUMBER of DEATHS per 1,000 MINERS, and per 1,000 Males exclusive of Miners, in Cornwall, from Pulmonary Diseases, during the three years 1860-62 inclusive.

Ages.		Metal Miners.	Males, exclusive of Miners.
Between 15 and 25 years	-	3·77	3·30
" 25 " 35 "	-	4·15	3·83
" 35 " 45 "	-	7·89	4·24
" 45 " 55 "	-	19·75	4·34
" 55 " 65 "	-	43·29	5·19
" 65 " 75 "	-	45·04	10·48

Assuming as before, that the rate of mortality among the males exclusive of miners is represented at each period of life by 100, then that among the miners would be represented, by 114 between the ages of 15 and 25 years, by 108 between 25 and 35, by 186 between 35 and 45, by 455 between 45 and 55, by 834 between 55 and 65, and by 430 between 65 and 75 years. It is therefore evident that pulmonary diseases are the chief cause of the excess of mortality among the Cornish miners; and that these diseases are due to the conditions incident to the miners' labour may also be confidently inferred, as in the case of the death-rates from all causes, from the fact that the excess of mortality arising from them does not reach its acme until after the middle of life, when these conditions have had full time to produce their effect on the health of the miners. A much greater discrepancy will be observed between the rates of mortality from pulmonary diseases among the miners and non-miners than has been shown to exist between the rates of mortality from all causes among the two sections of the population respectively. This is undoubtedly due to the fact that exposure to the peculiar evils incident to the occupation causes many miners to die of pulmonary diseases who in different circumstances would have died of other complaints.

The subjoined table contrasts the rates of mortality among miners at the two periods 1849-53 and 1860-62, both from all causes and from pulmonary diseases.

AVERAGE ANNUAL NUMBER of DEATHS per 1,000 MINERS in Cornwall from All Causes and from Pulmonary Diseases in 1849-53 and 1860-62.

Ages.		All Causes.		Pulmonary Diseases.	
		During the five years 1849-53.	During the three years 1860-62.	During the five years 1849-53.	During the three years 1860-62.
Between 15 and 25 years	-	8·90	9·44	3·05	3·77
" 25 " 35 "	-	8·96	9·57	4·42	4·15
" 35 " 45 "	-	14·30	15·12	8·47	7·89
" 45 " 55 "	-	33·51	29·74	24·31	19·75
" 55 " 65 "	-	63·17	63·21	44·46	43·29
" 65 " 75 "	-	111·23	110·51	55·87	45·04

It will be seen in the above table that the only material difference in favour of the more recent period is that existing between the 45 and 55 years. A comparison of the rates of mortality from all causes among the non-mining section of the male population also shows a similar improvement in favour of the more recent period.

YORKSHIRE AND NORTHERN COUNTIES.—From a return prepared at our request by the Registrar General, and printed in the Appendix, it appears that, as has been shown to be the case in Cornwall, so also in these northern districts the rates of mortality are much higher among the mining than among the non-mining section of the male population.

The districts comprised in the return are the lead-mining districts of Northumberland, Durham, Cumberland, Westmorland, Yorkshire, and Lancashire. But inasmuch as the numbers of miners, and of course the numbers of deaths of miners, in some of these counties were too small, taken separately, to justify any deductions with regard to the comparative health of the mining and non-mining sections of the population, we shall only quote from the return of the death-rates as computed from the aggregate numbers of males, and of deaths of males of the two classes respectively, in all the lead-mining districts of the six counties taken together. In order to show the comparative health of the two sections of the population at the present time, the rates of mortality comprised in the return have been calculated for the three years 1860–62 inclusive; these years have been selected because the last Census was taken in 1861, the middle year of the term which renders the calculations as nearly accurate as possible. The subjoined table shows the average annual rates of mortality per 1,000 miners, and per 1,000 males exclusive of miners, from all causes, for the several successive decennial periods of life from the age of 15 up to that of 75 years.

AVERAGE ANNUAL NUMBER of DEATHS per 1,000 LEAD MINERS, and per 1,000 Males exclusive of Miners, from All Causes, during the three years 1860-62 inclusive.

Ages.	Metal Miners.	Males, exclusive of Miners.
Between 15 and 25 years -	9·53	7·57
„ 25 „ 35 „ -	12·38	9·19
„ 35 „ 45 „ -	17·64	10·13
„ 45 „ 55 „ -	33·11	16·18
„ 55 „ 65 „ -	78·34	29·38
„ 65 „ 75 „ -	127·52	66·10

The figures in the above table show that at all ages from 15 years upwards the miners die in larger proportions than the men of the same districts not employed in mining, and also that this excess of mortality among the miners increases largely and progressively with increasing age, up to that period of life after which few miners continue to work underground. Thus if it be assumed that the rate of mortality among the non-mining section of the male population at each successive period of life quoted in the table is equal to 100, then the rate among miners between the ages of 15 and 25 years would be 126; between 25 and

35 years, 135; between 35 and 45 years, 174; between 45 and 55 years, 205; and between 65 and 75 years, 193.

From the return prepared by the Registrar General it also appears that this excess of mortality among miners is mainly due to the greater prevalence and fatality of pulmonary diseases among them, as compared with that among the non-mining section of the male population. The subjoined table shows the average annual rates of mortality per 1,000 miners, and per 1,000 males exclusive of miners, from pulmonary diseases, for the several successive periods of life from the age of 15 up to that of 75 years.

AVERAGE ANNUAL NUMBER of DEATHS per 1,000 LEAD MINERS, and per 1,000 Males exclusive of Miners, from Pulmonary Diseases, during the three years 1860–62 inclusive.

Ages.	Metal Miners.	Males, exclusive of Miners.
Between 15 and 25 years -	3·40	3·97
" 25 " 35 " -	6·40	5·15
" 35 " 45 " -	11·76	3·52
" 45 " 55 " -	23·18	5·21
" 55 " 65 " -	41·47	7·22
" 65 " 75 " -	53·69	17·44

With regard to the above table, if it be again assumed that the rate of mortality from pulmonary diseases among the non-mining section of the male population at each successive decennial period of life is equal to 100, then the rate among miners between the ages of 15 and 25 years would be 88; between 25 and 35 years, 124; between 35 and 45 years, 334; between 45 and 55 years, 445; between 55 and 65 years, 574; and between 65 and 75 years, 308.

Thus it appears not only that the rate of mortality from pulmonary diseases among the lead miners in these counties is higher than that among the male inhabitants of the same districts who do not work in the mines, but also that this excess of mortality does not begin until after the age of 25 years, when the unwholesome conditions contingent on working in the mines have had sufficient time to exercise a sensible influence on the health of the miners. The smaller rate of mortality from pulmonary diseases which will be observed to exist among miners between the ages of 15 and 25 years, as compared with that among the non-mining section of the male population at the same ages, may be presumed to arise from the very probable fact that youths with known tendency to diseases of the lungs are not usually put to labour in the mines. On the other hand, the much larger discrepancy between the rates of mortality among miners and among other males from pulmonary diseases, as compared with that between the respective rates of mortality from all causes, is undoubtedly due to the fact that exposure to the peculiar conditions attendant on their occupation causes many miners to die of pulmonary diseases who in different circumstances would have died of other complaints, and therefore the great excess of deaths from pulmonary diseases does not in the same proportion raise the general rate of mortality, although, as has been seen, it does so to a very large extent.

NORTH WALES.—The returns of mortality relating to North Wales, prepared for us by the Registrar-General, have reference only to the district of Holywell. The subjoined table shows a very considerable excess in the rates of mortality from all causes among the lead miners, as compared with the other section of the male population, during the three years 1860–62 inclusive.

AVERAGE ANNUAL NUMBER of DEATHS per 1,000 LEAD MINERS, and per 1,000 MALES exclusive of Lead Miners, from all Causes, in the District of Holywell during the three years 1860–62 inclusive.

Ages.	Lead Miners.	Males, exclusive of Lead Miners.
Between 15 and 25 years -	6·04	7·46
„ 25 „ 35 „ -	15·72	10·52
„ 35 „ 45 „ -	18·05	12·57
„ 45 „ 55 „ -	25·74	15·19
„ 55 „ 65 „ -	55·19	28·11
„ 65 „ 75 „ -	86·96	75·78

Assuming, as in the previous sections, that the rates of mortality among the males, exclusive of lead-miners, are represented at each period of life by 100, that among the lead miners will be represented by 81 between the ages of 15 and 25, by 149 between 25 and 35, by 144 between 35 and 45, by 169 between 45 and 55, by 196 between 55 and 65, and by 115 between 65 and 75 years.

As in the other metal-mining districts referred to in this report, so also in this district, the excess of mortality among the metal miners, over that which prevails among the other section of the male population, is mainly due to the excess of deaths from pulmonary diseases. The subjoined table shows the mortality from these diseases, among the two sections of the population respectively, for each decennial period of life from the age of 15 up to 75 years.

AVERAGE ANNUAL NUMBER of DEATHS per 1,000 LEAD MINERS, and per 1,000 Males exclusive of Lead Miners, from Pulmonary Diseases, in the Districts of Holywell during the three years 1860–62 inclusive:—

Ages.	Lead Miners.	Males, exclusive of Lead Miners.
Between 15 and 25 years -	3·02	3·39
„ 25 „ 35 „ -	4·19	5·79
„ 35 „ 45 „ -	10·62	5·41
„ 45 „ 55 „ -	14·71	7·06
„ 55 „ 65 „ -	35·32	12·21
„ 65 „ 75 „ -	48·31	16·96

Again, assuming the rates of mortality among the male population not engaged in lead mining to be represented at each age by 100, then that among the lead miners would be represented by 89 between the ages of 15 and 25, by 72 between 25 and 35, by 196 between 35 and 45, by 208 between 45 and 55, by 289 between 55 and 65, and by 285 between 65 and 75 years.

The excess of mortality among the lead miners of the Holywell district over that which prevails among the other section of the male population is thus evidently much less striking than has been shown to be the case in the Cornish and Northern metal-mining districts, both as regards the deaths from pulmonary diseases and those from all causes. Nevertheless, the above statistics clearly indicate that the Holywell lead miners suffer from some causes of disease and premature death from which the rest of the male population are exempt. Reasoning from analogy, it is therefore but fair to presume that in this as in the other metal mining districts, the excess of mortality among the miners arises in some way from conditions incident to their occupation. (Report of Royal Commission on Condition of Miners, 1865; pp. x–xxxvi.)

Mortality in the Royal Navy and in the Mercantile Marine.—The Registrar-General of Shipping and Seamen returns the strength of the Merchant Service in 1871 at 199,738 men and boys, exclusive of Masters, and the deaths occurring in the year out of that strength at 4,338, the rate of mortality being equivalent to 21·7 deaths per 1,000 of strength. The death-rate shows a further decline from the very high rates in several preceding years, and was in fact lower than in any year since 1864. But that it is and has been for some years excessive, will be evident from a comparison of the two decenniums 1852–61 and 1862–71; the mean annual mortality was 19·2 in the former as compared with 23·1 in the latter period. As the condition of the Mercantile Marine is just now engaging a good deal of public attention it may be worth while to see how that Service compares in point of mortality with the Naval Service and the general home population at corresponding ages. The mean age of the men afloat in the Merchant Service is about 28 years, while that of the men in Her Majesty's Navy is about 26 years, so that there is really little difference between the two in respect of age. Now the mortality among the English male population at the age 28 is by the English Life Table 9·7 per 1,000; in the Navy the average annual rate of mortality in the years 1856–72 was 14 per 1,000; in the Merchant Service from 1852–71 it was 21 per 1,000. (34th Annual Report, pp. xxiv-v.)

8.—Meteorology and Mortality.

Influence of Climate.—In the diseases registered in twenty-five divisions of the kingdom, the influence of cities, occupations, and perhaps climate, may be traced. The tables may be advantageously compared with the corresponding tables of ages, and with the births; for where the number of births is greatest in proportion to the population, the number of deaths at early ages, and the diseases of children, will be found to preponderate.

It appeared important to compare the fatal diseases with the population, and to endeavour to ascertain the influence of climate, of the north and south, the east and west, the maritime and inland parts of the island. With this view a separate calculation for each county might have been entered into, but three objections presented themselves against that course. The population increases rapidly and irregularly in different counties, the districts of the respective counties are not invariably coincident with the boundaries in the population returns, and the population of some of the counties is too small to neutralise accidental fluctuations. By taking groups of counties, comprising a mean population of about 1,400,000, the basis of calculation, these objections were obviated. The population of the metropolis and the ten classes of counties in England and Wales, in 1838, was calculated from the rate of increase in the ten years, 1821–31; 4 per cent. was added to the metropolis, and 0·4 per cent. to the ten other classes, for the numbers not enumerated. The increase was placed exclusively to the account of the males, when the sexes were distinguished.

In investigating the effects of climate, the influences of density, of the ages of the living, of occupation, and of differences of food, must be eliminated. The climate of the channel is the same as it was at the end of the last century, but the mortality of the crews of vessels in the channel is probably not now a third of the mortality at that period. The army reports, drawn up with so much ability by Major Tulloch and Mr. Marshall, exhibit the influence of barracks, as decisively as they do the effects of climate on English soldiers.

Sir James Clark, in his "Influence of Climate," observes that "although the power of different climates to produce as well as to "alleviate and cure diseases is well established as a matter of fact, "yet, perhaps, there is nothing in general science more unsatisfactory "than the manner in which we are able to explain this influence; "and certainly, there is nothing in physic more difficult than to direct "successively its application." Climate should always be considered separately, in reference to the indigenous inhabitants, and to strangers, the natives either of a similar or of a different climate.

The diseases of the 324 classified districts will throw light upon this and a variety of collateral subjects. Town districts, watering places, and districts in any way remarkable, have been distinguished; the diseases of similar and contiguous districts have been thrown together in one column. The extent of epidemics, and their order of succession, will be shown by this annual series of tables.

The separation of Wales—or the districts chiefly inhabited by the Celtic race—from the districts of England, will show at some future time if there is any difference in the diseases of the two races. But the ordinary laws of mortality are at present disturbed in Wales by the confluence of workmen within the mining districts. The population, suddenly collected by mining operations, is exposed to all the evils of dense districts, with few of the alleviations which spring up in towns of slow growth, having well-organized intelligent municipal councils. (2nd Annual Report, pp. 86–88.)

Influence of Seasons.—In order to determine the exact influence of the changes of the seasons, the general condition of the people should remain uniformly the same through the year; or corrections should be made for accidental privations, abundance, and the perturbations caused by epidemics. The metropolis presents a series of facts which enable us to dispense, to a certain extent, with these difficult corrections. It would, perhaps, be vain to expect less fluctuation in the condition of any large mass of people than has been experienced by the population of the metropolis within the 3½ years ending in June 1841 : hence, for the present purpose, the mortality from the pressure of privation may be fairly considered to have been nearly invariable within that period, and to have exhibited fluctuations, directly or indirectly, dependent on the seasons, if we except the results of improvements going on in the sewerage, and the decline of the epidemics of small-pox and typhus.

A table shows the deaths from different causes in each quarter of the 3½ years—1838 to June 1841. The quarters of the years 1840–1 have been obtained by adding together the deaths returned in the Metropolitan Tables of Mortality for periods of 13 weeks; and, although the facts were abstracted from the unchecked Weekly Returns, and do not precisely correspond with the dates of the other years, the summary in the table is sufficiently accurate for all the purposes of this inquiry.

The mean temperature of the seasons is given from the observations made at the apartments of the Royal Society.

It is found that the degree down to which the mean monthly temperature falls in December, January, or February, determines, to a great extent, the mortality of winter.

The January of 1838 was the coldest month of the 3½ years : the mean temperature of the two cold months—January and February—was nearly the same in 1839–40, and the winter of 1841 was anticipated by the cold December of 1840, when the mean temperature attained the minimum, and rose slowly through January and February.

The deaths registered in the seasons of the three years are compared with the temperature expressed in degrees of the Fahrenheit and Centigrade thermometers. The number of deaths has been corrected, on the assumption that each period embraced 275 days.

The causes of death which proved the most fatal in the cold months belong principally to the pulmonary class and the cerebral diseases of the aged ; those which prove most fatal in summer belong to the diseases of the bowels ; but in almost every class there were one or two diseases over the fatality of which temperature exercised a marked influence.

Of the diseases in the epidemic class, influenza and whooping-cough followed the same law as the pulmonary—cholera, dysentery, diarrhœa, and thrush, as the abdominal affections.

Persons affected by the following diseases died in greatest numbers when the temperature was low. It has been already rendered probable that many cases, arranged under apoplexy and sudden death, are the effects of congestions in the lungs—a sort of spontaneous asphyxia, the development of which appears to be favoured by a temperature below the freezing point of water.

The range of temperature in this climate appears to have little effect upon some of the fatal diseases of infants and adults.

As the corresponding seasons of different years present fluctuations in the temperature, this will supply another test of its influence.

The autumn of 1840 was much colder than the autumns of the two preceding years; the mortality of the diseases under the influence of temperature was raised in an equal degree.

The fluctuations in the temperature of the three summers were less marked; their influence was scarcely sensible in any of the diseases most fatal in warm weather.

At what degree of cold does the mortality begin to rise ? And how soon after the cold weather has set in is its effect experienced? The

Weekly Tables of Mortality furnish replies to these questions. It will be recollected that the tables of the week comprise the *registered* deaths, about half of which must have *occurred* when the rate of mortality was uniform, in the week preceding.

Meteorologists have observed that the mean temperature of October represents very nearly the mean temperature of the year and the place; and the facts in the table show that the mortality rises progressively, as the mean temperature falls below the *mean temperature* of London (50°·5); the deaths in the week rising to 1,000 and upwards when the *temperature* of night falls below the freezing point of water, and to 1,200 when the *mean temperature* of day and night descends a degree or two lower than 32°.

The rise in the mortality is immediate, but the effects of the low temperature go on accumulating, and continue to be felt 30 or 40 days after the extremities of the cold have passed away. The cold destroys a certain number of persons rapidly, and in others occasions diseases which prove fatal in a month or six weeks. The relation of the temperature and mortality may be distinctly shown; where accidental irregularities may be diminished by extending the number and the period of the observations. The practical lesson taught by these facts is obvious. A great number of the aged, and those afflicted with difficulty of breathing, whether it arises from emphysema, chronic bronchitis, diseased heart, or impairment of the function of respiration, cannot resist cold sunk so low as 32°. The temperature of the atmosphere in which they sleep can never safely descend lower than 40°; for, if the cold that freezes water in their chamber do not freeze their blood, it impedes respiration, and life ceases when the blood-heat has sunk a few degrees below the standard.

So far as statistical investigation has hitherto gone, temperature appears to have no influence on the fatality of consumption (tubercular phthisis); while it exercises a well-defined influence in emphysema and in the inflammatory diseases of the chest. (3rd Annual Report, pp. 102–9.)

Weather and Mortality; Summer Quarter of 1860.—The weather of this quarter may be looked at as an experiment on the health of the people. Employment has been easily obtained by workmen, but the prices of provisions have been high. And this general survey seems to establish the fact, that the salubrity of the season is chiefly due to two circumstances; the reduced temperature of summer, and the abundant supply of water by rain. The low temperature retarded the putrefaction of the town impurities; and the water washed them away; so both the forces acting in the same direction gave a great result. A careful study of the circumstances of each locality by which the result was produced, cannot fail to be instructive; and to confirm the faith of the authorities in the simple sanitary elements with which nature works.

If Wolverhampton is, as the Registrar conjectures, extraordinarily healthy, "because the frequent rains have swilled away the impurities "from which in hot summer weather noxious effluvia arise, thereby "preventing the sickness, and diarrhœa more especially, caused by "such vapours in the air, and impurities in the water supply," why should Wolverhampton ever be again as unhealthy and as dangeróus to its inhabitants as it was before? It is true the town has no command over the rain; but it has unquestionably the power to wash away the impurities from its cesspools and its sewers. Its engineers can supply the town with sweet waters in abundance for the use of the inhabitants. If the Birmingham and Aston district too lose only 1,243 inhabitants by death when the town is well washed, why should they ever die again at the rate of last summer when 1,815 of the people perished ?

The remedy is too simple to obtain immediately all the attention it deserves from the municipal authorities. But they cannot do better than imitate the great oriental dignitary suffering from leprosy, as our towns are now suffering from other diseases, who, although he was wroth when told to "wash and be clean," yet finally obeyed the injunction, and was healed.—(23rd Annual Report, pp. xxv–vi.)

Meteorology and Health.—Any investigation of the laws of health and sickness, life and death, in connexion with meteorological phenomena, which is confined in its scope to *mean* temperatures, must be imperfect, and can hardly be expected to be crowned with any important results. The facts observed were entities; they had an actual existence, and they produced actual effects ; but the mean forces derived from them exist only in the tables of the meteorologist. Two periods of equal length might be compared as regards the mean force of the wind, and two amounts might be obtained exactly equal. One of those periods, though generally marked by tranquillity of the air, might in one or two short intervals have given birth to hurricanes, and in this latter mood the noblest trees may have been uprooted, the ocean strewed with wrecks, buildings overthrown, and their inhabitants buried under them. Throughout the second period the movement of the air, undisturbed by convulsions, may have sufficed only to maintain a healthy and agreeable freshness. The character of the two periods, estimated, by total work done in each, by the anemometer, would be the same ; the facts on which it was based, and the effects produced by these on the face of nature, would be entirely different. The temperature, weight, humidity of the atmosphere, and other physical forces should not be masked under mean values, but laboriously traced throughout their course from day to day, and if it were possible, from morning to night and from night to morning, and observed in connexion with the contemporaneous facts that relate to human life, as these also are successively recorded, if the sway which they exercise is to be appreciated in its full significance.—(28th Annual Report, pp. xviii–xix.)

Low Winter Temperature, and the Public Health; London 1855 *and* 1874.—Men, as well as other animals with warm blood, have the power of producing heat so as to maintain their temperature very constant; but this power varies under different circumstances. And the demands on it vary still more; for the loss of heat by the surface of the body, and especially by the lungs which lose heat by evaporation, and by contact with the cold air inspired at an inconceivably more rapid rate in cold weather than in warm. The heat has to be supplied by the food consumed, and the conversion into heat is accelerated by exercise. If food is the fuel, exercise is the blast that makes it burn.

It was well established by the researches of Villermé and Edwards that young children die in considerable proportions by exposure to cold, and it was known in a general way that the winter is more fatal to old people than to young.

The Weekly Tables carry us much further, and show that the mortality after 20 increases with age rapidly, and that after a determined law. Thus, if we divide life into vicennial stages, then beginning at 20, 40, 60, 80, the result in London in the six weeks of very cold weather ending 24th February 1855 was found to be that the mortality due to cold at the four ages was 2·0, 7·5, 44·9, 181·8; so rapidly did the power of resistance decline with age. Taking the increase of mortality by cold between 20–40 as *one*, then the mortality became 2, 4, 8, and so on, "doubling every 9 years."

The effects of the cold of the five weeks that ended on 19th of December (1874) have been tested in the same way by comparing the deaths at each age with the deaths in the five previous average weeks. The deaths were raised from 6,967 to 9,871; so the excess due to cold was 2,904 in the five weeks, and on an average 581 weekly. The mortality, higher than before, increased with age at the same rate; it was in every 1,000 living at the four ages, 2·2 at 20–40; 9·4 at 40·60; 46·9 at 60–80; and 218·3 at 80 and upwards.

The mortality from cold increased 8 per cent. for every year of age; or it doubled every 9 years from the age of 20, as it did in 1855. There is thus a law of mortality from excess of cold. But it must not, therefore, be assumed that the mortality is beyond control.

The air we inhale at 28° or lower is raised not to blood heat but to something approaching 98° when it is exhaled; and as about a gallon of air is thus heated every minute, and as the evaporated vapour in the breath also carries off a considerable quantity of heat, the loss by the lungs is large, however warm the clothing may be.

The cold is most effectively combated by exercise which excites the heating energy of the system, and warmth is sustained by nutritious food; by artificial heat; by warm woollen or fur clothing; and by the respirator, which retains the heat exhaled by respiration.

TABLE of the MORTALITY due to COLD in 1855 and 1874.

AGES.	ESTIMATED POPULATION divided by Number of Weeks in a Year.		WEEKLY EXCESS of DEATHS by COLD in		ANNUAL RATE OF MORTALITY per 1,000 by EXCESS of COLD in	
	1855.	1874.	6 Weeks ending 24th Feb. 1855 over the Average.	5 Weeks ending 19th Dec. 1874 over Deaths in preceding 5 Weeks.	6 Weeks of 1855.	5 Weeks of 1874.
ALL AGES -	48,826	65,176	328	581	6·7	8·9
0- - -	20,351	27,830	70	192	3·4	6·9
20- - -	16,811	21,747	33	47	2·0	2·2
40- - -	8,673	11,548	65	109	7·5	9·4
60- - -	2,804	3,799	126	178	44·9	46·9
80 & upwards -	187	252	34	55	181·8	218·3

Note.—The increase of mortality by cold due to age increased from the age of 20–40 at such a rate as to double every 9·21 years in 1855; in 1874 the time of doubling was 8·77; the geometrical mean of the two was 9·01 years.

(Weekly Return, No. 51, 1874.)

9.—MORTALITY IN PUBLIC INSTITUTIONS.

Mortality in Metropolitan Workhouses, 1837.—The following Tables exhibit the mortality in workhouses. They are from the Appendix to a Report by the Select Committee on the Poor Law Amendment Act (1838).—Medical Evidence :—

Year 1837.	Average Number constantly Resident.		Average Number constantly			Admitted Ill.
	Males.	Females.	Sick.	Infirm.	Healthy.	
Ten Metropolitan Workhouses	1,252	1,926	462	1,591	1,125	1,318
One Hundred Workhouses in various Counties, taken indiscriminately	4,650	4,485	945	2,864	5,334	2,717

Year 1837.	Total Admitted.		Total discharged, including Deaths.		Total Deaths.	
	Males.	Females.	Males.	Females.	Males.	Females.
Ten Metropolitan Workhouses	2,316	2,942	2,174	2,749	402	504
One Hundred Workhouses in various Counties, taken indiscriminately	10,764	9,172	8,935	7,341	970	676

Some of the results deducible from the above facts are contained in the annexed Table.

Year 1837.	Average Number of Paupers in each Workhouse.	Proportion in 100 Paupers.			Annual Deaths to 100 constantly Resident.		
		Sick.	Infirm.	Healthy.	Males.	Females.	Mean.
The Metropolitan Workhouses	317·80	14·5	50·1	35·4	32·1	26·2	29·1
One Hundred Workhouses in various Counties, taken indiscriminately	91·35	10·3	31·3	58·3	20·9	15·1	18·0

It will be observed that the mortality was highest in the metropolitan workhouses, and among males. This immense mortality is not confined to workhouses under the New Poor Law Regulations: it is, *cæteris paribus*, equally high in all workhouses; and is an insuperable objection to the extension of the workhouse test (so called) or its substitution for a labour test. The ages of the inmates may be conjectured from the following enumeration made at the same time as the returns :—

——	0–10.	10–20.	20–40.	40–60.	60–70.	70, &c.	Total.
Sick	43	34	61	76	52	53	319
Infirm	7	12	59	220	362	369	1,029
Healthy	300	215	148	174	61	13	911
Total	350	261	268	470	475	425	2,259

Twenty-five in 100 were sick when admitted into the metropolitan workhouses; 14 in 100 when admitted in the workhouses in other unions. This will account for part of the excessive mortality; infirmity for another part; age for a third part; leaving a large residual mortality to be accounted for in the same manner as the mortality of prisons. The mortality of paupers out of doors has not been ascertained; the mortality is probably raised 50 per cent. by confinement in the workhouses. In a depression of trade, or in a densely inhabited district, it must be considered a hazardous experiment to bring crowds of the sickly and depressed classes within the walls of one building. Nothing is more likely to generate an epidemic. The system of administering relief in workhouses should, on this ground alone, be reduced within the narrowest possible limits.—(McCulloch's Account of the British Empire, Art. Vital Statistics, Vol. 2, pp. 569–70.)

Prison Mortality.—Considerable misapprehension prevails respecting the mortality in prisons. The deaths have been divided by the committals, instead of the average population, and the quotient has been compared with the annual mortality out of doors. In this way the result appears so much in favour of the prisoners, at first sight, that a French minister declared the gaols the healthiest places in the world; and in a recent report, one of the English inspectors "confidently "affirmed that in very few situations of life is an adult less likely to die "than in a well-conducted English prison."* Only 1 in 500 prisoners dies; so, according to this view, if a man desires to live to the age of Methusaleh, he should go to Newgate.

As serious intentions appear to be entertained of substituting the Penitentiary system for transportation; and in the greater number of cases for hanging, we have endeavoured to ascertain the actual effect of imprisonment upon mortality. In the elaborate gaol returns under 4 Geo. IV. c. 64, and 5 Geo. IV. c. 12, the average population of the respective gaols is not given; but a sufficiently near approximation to this may be obtained from the numbers "remaining" at the Michaelmas term of every year, when the returns are made. We took the first 93 gaols (omitting only 5 or 6 which were incomplete) for the 5 years Michaelmas 1826-31; and found that the mean constant population, from 6 enumerations, amounted to 9,409; while the deaths in the 5 years were 769. The mean annual mortality was 16·3 per 1,000.

Mean Prison Population.	Annual Deaths.	Annual Deaths per 1,000.
9,409	153·8	16·3

In deciding whether this is a high or a low rate of mortality, the *age* of the prisoners must be taken into the calculation; and for the present purpose it may be assumed to be 20–30 years. Of 23,612 committed in 1837, not less than 14,396 were "aged 30 years and above 16."† We subjoin a comparative view of the annual mortality of different populations at the age 20–30.

Annual Deaths to 1,000 *Living.*

Sweden, 1811-30.	Belgium, 1829.	England and Wales, 1813-30.	English Prisons, Mich., 1826-31.
8	9	10	16

* Report on Prisons, by Dr. Bisset Hawkins, 1836, p. 2.
† Table showing the Number of Criminal Offenders in the year 1837.

Here it will be observed at a glance that the mortality in the English prisons was 60 per cent. higher than the mortality at the same ages in England and Wales.

The extent to which a class of individuals are affected in epidemics is a good sanitary test of the circumstances in which they are placed. In the year ending Michaelmas 1832, when cholera was epidemic, the deaths in the same prisons amounted to 300.

Year.	Mean Prison Population.	Deaths.	Annual Deaths, per 1,000.
1832	10,497	300	29

The mortality was nearly three times as high as the ordinary mortality in England and Wales; and we know that the general mortality at the same age was raised to nothing near this pitch.

Again, the prisoners rarely labour under any serious disease at the time of their committal. And it will be found by a reference to the facts, that the mean term of their detention is 48 days: for there were 267,771 committals to 35,503 years of imprisonment, or nearly 7 weeks to each committal. The prisoners at the time of their committal must be considered in the same light as those who seek to assure their lives: they have no dangerous disease, and their health has scarcely time to become seriously affected in 48 days before they are removed. Of 12,886 persons entering the Equitable Assurance Society, between the ages 20–40, 43 died in the ensuing year: if they had all been committed to the English prisons, 210 at least would have perished. In the second year of the policy 113 died out of 12,361; in the third year, 99 out of 10,982.

If this doctrine of the mortality in prisons be correct, it may be expected that the health of the prisoners will gradually decline, and the mortality increase as the imprisonment is protracted. This is the case. The health of many of the prisoners before they reach the hulks is in a bad state; and the mortality in the convict hulks is nearly double the mortality in the prisons. 907 deaths occurred in the Convict Hulk Establishment, England in 9 years (1820–9, exclusive of 1821), when the average convict population was 3,583. The mean term of detention was 1·22 years, or 1 year 2½ months. It gives, therefore, the following results:—

Annual Mortality per 1,000.

First Year. Equitable Society.	General Population, England and Wales.	English Prisons.	Hulk Establishments.
3	10	16	28

Such is the effect of inaction, privation, and confinement in a close atmosphere, upon the criminal. It may be said that the prisoners are men of bad shattered constitutions. But does this apply to the great majority? and would not imprisonment have quite as fatal an effect upon persons unaccustomed to privations of any kind?

After every allowance has been made, if 200 deaths occur in the English prisons annually, 60 must be set down as the direct effect of imprisonment; and 50 of the 100 annual deaths in the hulks must be ascribed to the punishment. Only 8 criminals were executed in England and Wales during the year 1837; while in the 5 years ending 1834, the average annual number of deaths due to imprisonment was 51.

We submit these facts with great deference to those who have studied criminal punishment, and particularly to those humane individuals who would abolish capital punishments and substitute solitary confinement in cells for transportation. Let them bear in mind that *the present system of imprisonment destroys* 10 *times as many lives, and produces* 1,000 *times as much actual suffering, as the executioner.* The mortality of prisons has been greatly reduced: and admits of further reduction, although no system of pains and penalties can be conceived, which will not increase sickness and mortality; for it is an eternal law of our nature that sensation has a tendency to cease, when deprived of objects, or thrown into agony: mercy has made pain the gate of death.

We have no means of knowing the mortality among convicts in the penal colonies; but, judging from all analogies, the immediate effect of assembling them in large buildings and solitary cells would be to raise the mortality very considerably. This is not an insuperable objection to the Penitentiary system; but it must be taken into account as a part of the punishment, which, while it injures the health and destroys more lives than the executioner, produces little impression upon the minds of the spectators.

We shall here add, from a paper by Mr. H. Marshall, the mean number of native prisoners confined in gaols throughout the presidencies of Bengal and Agra during the year 1833; the number of deaths, and the ratio of deaths per 1,000, of the mean strength.

Year.	Mean Prison Population.	Died.	Deaths per 1,000.
1833	39,658	2,613	66

Eight hundred and eighty-two of the deaths were from enteritis, dysentery, and diarrhœa, 586 from cholera, 511 from fevers. The ratio of mortality among the native troops of the same presidencies was 10·6 per 1,000, in 1833.*

Dr. Baly, the physician to the Millbank Penitentiary, has latterly instituted an extensive inquiry into the mortality and fatal diseases of that and other penal establishments.† Dr. Baly's investigations confirm and extend the principles laid down in the above sketch, which appeared in the former edition of this work. In the 18 years, 1825–1842, the total number of deaths in the Millbank Penitentiary amounted to 205; the average number of prisoners during the same period was 532; and the average annual mortality was therefore 21 in 1,000, But besides the 205 prisoners who died in the Penitentiary, 355 were invalided, or pardoned on medical grounds; and according to Dr. Baly's estimate, 123 of the 355 cases would have terminated fatally before the completion of imprisonment, had no pardons been granted. The mortality to which confinement gave rise was therefore 34, or, excluding 31 deaths from cholera, 31 in a 1,000 annually; while the mortality in

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* *British Annals of Medicine*, 1837, p. 490. The materials were derived from a *Report on the Medical Management of the native Gaols throughout these Governments.* Mr. M justly adds, that great praise is due to Mr. Hutchinson for collecting and publishing the statistical materials which are appended to this report.

† Paper on the Mortality in Prisons, &c., by W. Baly, M.D. Read Feb. 25, 1845. See Trans. of Med. and Chirurg. Soc. for that year. Dr. Baly's is one of the best papers which have appeared in the Transactions of this learned Society, and throws more light on the effects of imprisonment than any other publication in this or any other country.

London between the ages 15 and 70 is about 15 in 1,000. "The "criminal's liability to die was more than doubled by imprisonment in "the Penitentiary."

The average number of prisoners (1838–41) in 36 of the largest county gaols was 8,657, the deaths in the five years 823, or 19 per 1,000 annually; or after a correction required for pardons 23 per 1,000 annually. The average duration of imprisonment in the English county gaols was about 46 days; in the Penitentiary 2 years. Dr. Baly shows in the following table, that the mortality goes on increasing from the first to the fourth year of confinement, when it is more than quadrupled; for 13 in 1,000 die in the first, 57 in 1,000 in the fourth year.

Years.	Number of Prisoners exposed to the Chance of Death.	Deaths in the Penitentiary.	Prisoners Pardoned.	Total Deaths (estimated).	Deaths to 1,000 Prisoners.
1st - -	3,365	38	20	45	13
2nd - -	2,682	61	100	96	36
3rd - -	1,645	41	130	86	52
4th - -	611	10	72	35	57
5th - -	94	—	12	4	44

In the first 3 months of confinement, not 1 convict was pardoned and only 1 in 3,571 died; in the second 3 months 15 died in 3,470, and 1 was pardoned.

The mortality of men in twelve great prisons of France during each of 10 years of imprisonment was 37·6, 57, 59, 55, 41, 41, 41, 39, 31, 36 to 1,000 living in the first, second, &c., years of imprisonment. In the Eastern Penitentiary, Philadelphia, the mortality was ·022 in the first year of imprisonment, ·048 in the second, ·039 in the third year, and ·025 in the fourth year. The highest degree of mortality appears to be experienced generally in the third and fourth years of imprisonment.

"Fever, formerly such a scourge, is now comparatively a rare disease in the English gaols; it does not produce in ten years as many deaths as it formerly caused in one, and I (Dr. Baly) believe never rages in them as a contagious epidemic. Yet both fevers and bowel complaints are, even at the present period, much more frequent causes of death in prisons than amongst the general population." (P. 61 of Dr. Baly's paper.)

The writer shows that the mortality from *fevers and bowel complaints* among persons between the ages of 15 and 60 in London is 1·2 annually; while among the prisoners of 32 county gaols it is 3·4, of Millbank Penitentiary 5·9; of Wakefield House of Correction 8·9 to 1,000 from the same causes. These diseases are promoted by bad drainage, dirt, crowding, poor unvaried diet.

Consumption and scrofula are shown by irrefragable evidence to be the diseases to which the excessive mortality of prisoners under long confinement is due. Thus while in London 4·4 in 1,000 persons between the ages of 15 and 70 die annually of consumption, the proportion of deaths in the Millbank Penitentiary was 7·6 in 1,000; and it is estimated that 5·6 should be added to them from those pardoned; making in all 13·2 per 1,000 or three times the ordinary mortality of the population from consumption. About 2·87 in 1,000 convicts die of other scrofula diseases; which prove fatal to only ·03 in 1,000 of the general population. In 1840, of 1,052 prisoners received into the Penitentiary 12 had symptoms of consumption; of the 1,040 remaining only 523 were Penitentiary prisoners. *Forty-seven* of the 523 came under treatment, and 17 died of consumption before the end of 1843. Fourteen of the 1,052 prisoners had, on admission, signs of scrofula, combined in 4 cases with consumption; 527 of the 1,038 remaining were Penitentiary prisoners, and 37 of them before the end of 1843 came under treatment for external glandular scrofula, which was combined in 14 cases with consumption. The development of these diseases is due to deficient ventilation, cold, sedentary occupations, and the want of exercise, a listless if not dejected state of mind, and poorness of diet; some of which have no necessary connection with a state of incarceration. (McCulloch's Account of the British Empire, Art. Vital Statistics, Vol. 2, pp. 565–69.)

Mortality in Public Institutions.—The great majority of the people of England live in detached dwellings; and a certain number reside in barracks, asylums, workhouses, hospitals, lunatic asylums, and prisons, or in public institutions, as they have been called, of various kinds.

The mortality of the inmates of some of these institutions is for various reasons much above the average; so the inmates having been returned at the Census, it was thought right to pick out the principal institutions in which the mortality was likely to be so great as to affect the mortality of the sub-district in which the institution is situated.

The list has been compiled on this principle, and does not include a great number of institutions of various kinds. It includes all the principal hospitals and workhouses.

The Commissioners in Lunacy, the Inspectors of Prisons, and the Poor Law Commissioners publish in their annual reports accounts of the respective institutions which come under their cognizance. The statistics of the hospitals of the country are not given at all, or are not given upon a uniform plan. Miss Nightingale, who perceived all the importance of this information, suggested that the hospital statistics should be collected in forms, of which the members of the Statistical Congress in London approved.* And if the hospital boards carry out the plan, they will place the hospital statistics on a level with those of the other institutions of the country.

The number of institutions in the selected list is 853, which held 154,602 inmates on the day of the Census, exclusive of the officers and servants. 32,437 inmates died in the year; and assuming that the average is represented by the enumerated population, the mortality was at the rate of 20·98 per cent., or 210 per 1,000; while the mortality of the population of all England was at the rate of 22 in 1,000, or 2·163 per cent.

The mortality in these institutions was ten times as high as the mortality in the population generally.

The annual rate of mortality in the lunatic asylums was at the rate of 11 per cent., in the workhouses 19 per cent., and in the hospitals 57 per cent.

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* English Programme of International Congress, pp. 63–5. See also Report of the Proceedings.

With respect to hospitals, then, while the annual mortality of the general population was 2·16 per cent., the mortality of their inmates was at the rate of 56·87 per cent., or 26 times as high. The inmates of hospitals are, it is scarcely necessary to say, all suffering from diseases which tend generally to increase the risk of death.

The hospitals are filled by a succession of inmates, who remain for a time varying from a day to a month or a year, and the mortality is often given as so many deaths per cent. on the cases treated. The mean term of treatment varies in different hospitals; in many it averages 36·5 days, or the tenth part of a year. Assuming that term of treatment to be applicable, the mortality of the cases in these hospitals was 5·687 per cent. in 36·5 days; or the hospitals to every 100 beds occupied had nearly 57 deaths annually.

MORTALITY in GENERAL HOSPITALS in ENGLAND and WALES, 1861.

(Special Hospitals are excluded from this Table.

—	NUMBER of HOSPITALS.	INMATES.	AVERAGE NUMBER of INMATES in each HOSPITAL.	DEATHS.	MORTALITY per cent.
TOTAL HOSPITALS -	80	8535	107	6220	72·88
Hospitals containing—					
300 Inmates and upwards	5	2090	418	2101	100·53
200 and under 300 - -	4	916	239	838	91·78
100 and under 200 - -	22	2898	132	2041	70·43
Under 100 - - -	49	2634	54	1240	47·08

Hospitals enable the charity of the country to supply the sick with skilful medical advice upon the cheapest terms, and this has led to the establishment of the institution upon the voluntary principle in every county. An eminent physician or a surgeon can visit his patients in a short time as they lie in the same or in contiguous wards; and he often consents to attend them without any fee or salary. The collection of the sick under one roof conduces also to economy in the nursing department, in the kitchen as well as domestic service, and in the pharmacy, as the drugs can be purchased and dispensed at a cheap rate. A resident medical officer can attend to all the urgent cases.

The cost of the building is generally so great as to make the lodging much dearer than the best cottage accommodation.

One great evil has often counterbalanced all the advantages. The collection of a number of persons, exceeding those of an ordinary family, under one roof, has hitherto always had a tendency to increase the dangers of disease; for several diseases are, like fire and ferments, diffusible. The danger is increased when all the inmates are sick, for their breath and excretions spread through the wards. The dangers too are likely to increase in a faster ratio than the numbers, and the patients are less likely to recover health in the sickly atmosphere of a large building in a city than in pure country air.

These institutions were accordingly at one time infested by hospital gangrene and by erysipelas; the lying-in hospitals were depopulated by fever (metria); infants perished by hundreds in the foundling hospitals; and even in the present day patients often die of hospital pyæmia, so frustrating the hopes of the skilful surgeon.

It must be stated that scarcely anything could be worse than the ventilation and all the arrangements of the old hospitals.

The classes of cases which are admitted into particular hospitals, and the reasons for which patients are discharged, differ largely, so that the investigation of the effects of hospital air, and of treatment in the various establishments, requires great care and skill. It is so important, however, that it should be undertaken for the sake of the sick, and for the sake of medical science.

A careful comparison of the duration and of the rate of mortality of certain well-defined diseases in hospitals and in private practice would settle the question.

In the meantime it is evident from the preceding table that the mortality of the sick who are treated in the large general hospitals of large towns is twice as great as the mortality of the sick who are treated in small hospitals in small towns.

It remains to be seen whether the mortality in small hospitals is not twice as great as the mortality of the same diseases in patients who are treated in cottages.

Should this turn out to be the case, the means of realising the advantages of the *hospital system*, without its disadvantages, will then be sought and probably found, as the problem is not insoluble. (24th Annual Report, pp. 229–31.)

Hospital Treatment of Infectious Diseases.—In the interests of sanitation and of public health, hospital treatment of infectious diseases, in cases where home-isolation is an impossibility, has been frequently urged as the only practical means of controlling zymotic fatality, and the Public Health Acts of 1872 and 1875 have invested local sanitary authorities with powers to facilitate the erection of hospitals for the reception of non-pauper cases of these diseases. While the advantage to the community arising from the removal and treatment in hospital of cases of infectious diseases occurring in families living in crowded tenement houses is undoubted, it becomes important to record accurately the results of hospital treatment in the mortality of the cases. Until cases of infectious diseases are registered, there will, however, be no trustworthy basis for calculating the mortality of such cases not treated in hospitals.

During the year 1876 the Registrar General was favoured, through the courtesy of the several authorities, with weekly returns of admissions, discharges, and deaths in the Metropolitan Asylum Small Pox and Fever Hospitals, and also in the London Fever Hospital. The Registrar General has to regret that he was unsuccessful in his attempt to obtain similar returns from the Small Pox Hospital at Highgate.* In the Metropolitan Asylum hospitals, more than 2,000 cases of small-pox, more than 800 cases of scarlet fever, nearly 300 of enteric fever, and 145 of typhus were under treatment. In the London Fever Hospital 518 cases of scarlet fever, 93 of enteric fever, and 23 of typhus were admitted.

At the London Small-Pox Hospital the mortality among 7,850 cases recorded during the years 1780–99 and 1828–36 was equal to 31·5 per cent. During the London small-pox epidemic in 1870–1–2, 14,808 cases were treated in the Metropolitan Asylum Hospitals, showing a mortality equal to 18·7 per cent. During 1876 the number of completed cases treated in the same hospitals was 1,377, and the 338 deaths

* These returns have since been furnished to the Registrar General.

(46 per cent. of all the small-pox deaths in London) were equal to a mortality 24·5 per cent. Thus the mortality during the present epidemic has been higher than it was during the epidemic five years ago, although it is considerably lower than it was between 1780 and 1836. The 1,377 cases included 1,018 vaccinated and 359 unvaccinated; the mortality was 13·2 per cent. among the vaccinated, and 56·8 per cent. among the unvaccinated. The proportion of vaccinated cases to total cases treated was 74 per cent., against 75 per cent. during the epidemic of 1870–1–2.

The 804 completed cases of scarlet fever recorded in the Metropolitan Asylum Hospitals during 1876 showed a mortality of 10·7 per cent., against 14·0 per cent. among the 1,077 cases treated in 1875; among 321 cases at Homerton the mortality in 1876 was only 8·1 per cent., whereas it was 12·4 per cent. among the 483 cases treated at Stockwell. In the London Fever Hospital 551 completed cases of scarlet fever were reported during 1876, of which 50 were fatal cases, equal to a mortality of 9·1 per cent.

The completed cases of typhus in the Asylum District Fever Hospitals were 145 last year, against 76 in 1875, and the mortality 19·3 per cent. in 1876 and 19·7 per cent. in 1875. In the London Fever Hospital only 26 cases of typhus were treated, and the 7 deaths give a mortality of 26·9 per cent.; these numbers are, however, too small for the calculation of a trustworthy rate of mortality.

Of enteric fever the treatment of 270 cases was completed at the Asylum Fever Hospitals, showing a decline of 67 from the number in 1875; the proportional mortality, which was 22·0 per cent. in 1875, declined to 20·7 per cent. in 1876. In the London Fever Hospital 86 cases of enteric fever were treated in 1876, of which 13 proved fatal, equal to a mortality of 15·1 per cent., a rate considerably lower than that which prevailed in the Asylum Fever Hospitals, either in 1875 or 1876.

It is generally believed that the rate of mortality among cases of epidemic disease treated in hospital is greater than among those treated at home. Assuming, however, that the proportion of deaths to recoveries is the same under both circumstances, it may be estimated that during the year 1876 the number of persons in London attacked by small-pox was 2,994, by scarlet fever 22,886, by typhus 796, and by enteric fever 4,030. These numbers would be under-estimated if the rate of mortality out of hospitals is, as supposed, lower than among the cases treated in hospital. (Weekly Return, No. 51, 1877.)

Mortality of Lunatics in Asylums.—The condition of lunatics in this country has, within the present century, attracted much public attention; and in 1807, 1815, 1816, and 1827, the management of the asylums provided for their confinement was investigated by Committees of the House of Commons. Many abuses were brought to light; and the last committee, of which Mr. Gordon was chairman, stated in their report, after a searching and able inquiry, that the abuses discovered in 1815 still existed. They "repeated, adopted, and confirmed" the recommendations of the committees of 1807 and 1815. Enactments subsequently passed the legislature; and several county asylums (among which that of Middlesex deserves to be particularly mentioned,) have since been erected. No parliamentary inquiry has been instituted since 1827; but Mr. Ewart has given notice of his intention to move in the House of Commons for the appointment of a committee in the present session of Parliament.

The persons of unsound mind in England amount to several thousands. They are usually of middle age, frequently parents, and are of all conditions and ranks of life: 494 lunatics confined under the Crown possess property yielding an annual income of 317,154*l*.* Men of the highest intellectual rank—men of genius—are not exempted from the visitations of this disease; it stoops to the lowest, and disorders the meanest brain. It makes the labourer a pauper, and too often ruins the families of the middle classes. 6,402 idiots, and 7,265 lunatics, have been returned to Parliament as paupers. Such a disease, which disorders the senses, perverts the reason, and breaks up the passions in wild confusion;—which assails man in his essential nature,—brings down so much misery on the head of its victims, and is productive of so much social evil—deserves investigation on its own merits, by statistical as well as other methods. But it has an additional claim upon the attention of this society. A considerable portion of the insane are under confinement, and have to be provided for or watched over by the State; which, as it permits them to be deprived of liberty, is bound to afford them protection, and to assure them the best means of restoration to health.

Great improvements have taken place in the treatment of lunatics. In the best asylums they are no longer shut up in cells like wild beasts, nor punished by harsh keepers. Their chains have gradually been struck off. A further step has been attempted. At the Middlesex Asylum no strait-waistcoats, straps, or other instruments of personal coercion have been used since the 21st of September, 1839. The experiment was first tried at Lincoln, and it is now contended by persons of experience, ability, and integrity—by Mr. Hill, Dr. Conolly, and the visiting justices of Middlesex,—that in a house properly built, with skilful medical supervision, and a sufficient number of humane and intelligent keepers, personal coercion should be abolished. This is denied by other gentlemen of equal humanity, who maintain that although all restraint *may* be dispensed with, the strait-waistcoat should still be employed as a remedy in the paroxysms of mania. A keen controversy has been waged on the subject. Asylums not only differ widely in the extent to which restraint is carried, but in the space allotted to patients, in their employment, food, and medical treatment. The cost of criminal lunatics at Bethlem is 15*s.* a-week; of idiots or lunatics in the workhouses, 2*s.* 10*d.* to 3*s.* 6*d.* a-week. Some of the asylums are under the control of the visiting justices, others are visited by the Metropolitan Commissioners; the hospitals of Bethlem and St. Luke are not visited at all, but are managed by the officers and governors; while a very large number of lunatics are farmed out, or confined in workhouses, by the parish authorities.

Amidst these various circumstances and conflicting systems, we ask which is the most advantageous? and it will be replied by all parties, "that is the best system under which the greatest number of lunatics "recover their reason in the shortest time." But in a slow disease, presenting so much diversity in individuals, it is evident that the superiority of any system of treatment can only be determined by the average results, by a comparison of the recoveries and deaths, in fine, by statistics; and the Statistical Society, as a body quite disinterested, is probably better qualified than any other society to collect information upon the subject, and to submit the results to the public, to the parties concerned, and to all those humane persons who devote attention to a class of our fellow-creatures suffering under one of the saddest calamities which can befall our nature.

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* *See* Parliamentary Return, Session 1839, No. 378.

The number of lunatics and dangerous idiots under confinement in Middlesex, and in the parts of Surrey and Kent within the jurisdiction of the Metropolitan Commission, is about 3,110.

In the licensed houses 459 men and 419 women are not paupers; and many persons insane in different degrees remain at home under the care of their friends. The London workhouses contain a considerable number of idiots and lunatics. Exclusive of these 3,110 persons, others are confined as lunatics in the public institutions of the metropolis. When it is considered that insanity is a long disease, which not only disables the patient, but often renders him difficult to control, and dangerous to himself and to society, the fact that 7 in 10 of the 3,110 lunatics fall upon the public for support and treatment will not be deemed surprising.

The Hanwell Asylum was opened on May 16, 1831, and the number of lunatics admitted in the $9\frac{1}{4}$ years, ending September 30th, 1840, was 2,029; the number discharged was 1,171; of whom 449 had recovered, 66 had been relieved, and 656 had died; 858 remained in the asylum. More than *half* the patients die in Hanwell, and more than *one-third* are cured.

It has been a question whether the deaths should be divided, as in this case, by the 2,029 patients admitted, or by the 1,171 discharged, in order to obtain the mortality of the cases. It is evident that the latter is the true divisor; for, if the mortality remained the same, the probability is that the 858 patients *to be discharged* would, *cæteris paribus*, be discharged cured, relieved, and dead, in the same proportions as the 1,171 already discharged.

The average number of lunatics in the Hanwell Asylum, since it was opened, has been about 589, or 250 males and 339 females.

The deaths in the $9\frac{1}{3}$ years ending 30th September 1840 were 656 (males 374, females 282); and the insane population out of which they occurred was = 5,498 living one year; the males 2,334, and females 3,164. The average number of males resident was = 250, and $250 \times 9 \cdot 34$ years, the term of residence, = 2,334 years of life. The *annual mortality* of the men was 16 per cent., of the women 9 per cent., and of the whole population, without distinction of sex, 12 per cent.

What is the mean term of residence in the Middlesex Asylum?—This is not given in the Visiting Justices' Report, but it may be deduced from the numbers living, and the numbers discharged. Divide the 5,498 years of residence by 1,171, the number of discharged lunatics, and the result is $4 \cdot 48$ years; which is an approximation to the average term of treatment.

Nearly equal numbers of men and women are admitted at the County Asylum (males 1,013, females 1,016); but the number of women resident is 36 per cent. greater than the number of men (females 339, males 250); because women remain there about 6 years on an average, and men nearly $3 \cdot 7$ years. The men are discharged more rapidly than the women, both by death and recovery; 11 men per cent. were annually discharged cured, or relieved, and only 8 women. This distinction will explain many anomalous facts; and it should always be taken into account in estimating the prevalence of diseases. Thus there may be ten times as many lunatics in civilised, as in barbarous countries and times; not because the tendency to insanity is greater, but because the lunatics live ten times as many months or years. The tendency to insanity in a class is expressed by the proportion that become insane.

Let us now compare the facts observed in the Hanwell Asylum with those submitted to the Society by Colonel Sykes, relative to the lunatics in the licensed houses within the jurisdiction of the Metropolitan Commission. Colonel Sykes's Returns have been analysed according to the same methods.

The deaths to 100 *cases* were more numerous at Hanwell than at the licensed houses; but, in the *annual mortality* per cent., the proportions were reversed.

	Years of Residence.	Died.	Annual Mortality per cent.
Licensed Houses, from 30th June 1833 to 31st May 1839 - -	9,671	1,504	15·5
Hanwell, from 16th May 1831 to 30th September 1840 - -	5,498	656	11·9

The annual mortality per cent. at Hanwell was to that in the licensed houses as 100 to 130. For various reasons the patients remain longer in the Hanwell Asylum than in the licensed houses, from which 37 per cent. were annually discharged alive; while not more than 9·4 per cent. were discharged annually, cured and relieved, from the County Asylum. The number admitted during the six years, June 1833–39, into the licensed houses was 5,386; making 278 more than 5,108, the number discharged by death, recovery, or otherwise. There were 1,435 in the licensed houses on 30th June 1833, and 1,713 on 31st May 1839. The number of inmates had increased 19 per cent., and, notwithstanding the erection of Hanwell, the increase bore principally upon paupers, for 202 of the 278 were paupers.

The lunatics in the licensed houses are divided into two classes—paupers, and other patients belonging to the independent classes of society. It will be right to compare the paupers in the licensed houses with the paupers in Hanwell, and, for this purpose, to separate the paupers from the other class.

The comparative mortality was as follows:—

	Annual Mortality per Cent.	Deaths out of 100 cases discharged.	Mean term of treatment in years.
Paupers in Licensed Houses - -	21	35	1·67
" Hanwell - - -	12	56	4·48
Other patients in the Licensed Houses -	11	23	2·15

The annual mortality of paupers in the licensed houses is thus shown to have been excessive.

I proceed to compare the mortality of the male and female paupers at Hanwell and in the licensed houses, with that of the other class of lunatics, and the following results have been deduced:—

	Annual Mortality per Cent.		Deaths out of 100 Cases discharged.		Mean term of Residence in years.	
	Males.	Females.	Males.	Females.	Males.	Females.
Licensed Houses:—						
Pauper Lunatics -	26·8	16·4	37·5	31·8	1·40	1·93
Other Lunatics -	13·2	8·4	25·9	20·3	1·96	2·41
Hanwell - -	16·0	8·9	58·5	53·0	3·65	5·94

It will be observed that the annual mortality of both male and female paupers in the licensed houses was *nearly twice as great as the mortality of paupers at Hanwell, and twice as great as the mortality of other lunatics in the licensed houses.*

Pauper lunatics were received at six licensed houses during the term over which Colonel Sykes's Returns extend, and at the four houses numbered 18, 32, 33, 35, during the whole period. A small number of paupers was treated at No. 2, until May 1837, and after that year at No. 12; the great majority, however, of pauper lunatics was treated at the four large houses, and although 1,156 other lunatics were treated there, with 2,563 paupers, the mortality was *twice as high* as in the 36 smaller houses.

Each of the four large houses contained 265 patients on an average, and the annual mortality was 19 per cent.; in the small houses, containing 17 lunatics on an average, the mortality was 9 per cent., and the annual mortality in the four houses increased with the number of lunatics. It was 16 per cent. in the house No. 18; 18 per cent. in Nos. 32 and 33; and 23 per cent. in No. 35. Of the higher class of patients, 26 in 100 cases perished in the large houses, and 21 in 100 in the smaller houses, where the term of treatment was somewhat longer.

What is the mortality among lunatics in favourable circumstances? Is insanity a fatal disease?—Upon the latter question there has been a considerable diversity of opinion. Some lunatics live to an advanced age. Of 213 admitted by Dr. Conolly at Hanwell, 15 were aged 60 and upwards, 1 was between 75 and 80; and 58 of 753 at Hanwell had been labouring under the disorder between 20 and 50 years. In 1835 an action (Fisher *v.* Beaumont) was brought at the York Assizes to recover from the *Providence Assurance Company*, 2,000*l.* insured upon the life of the Rev. Mr. F * * *. In charging the jury, the judge said that they had to consider whether insanity had a tendency to shorten life? If insanity had such a tendency, they must find for the defendant; if not, for the plaintiff. The medical evidence was conflicting; and the jury, after a short deliberation, found for the plaintiff, on the ground that insanity had no tendency to shorten life!*

We had no means of ascertaining the mortality of lunatics at large; but the mortality of lunatics in asylums is much higher than the mortality of the general population, and the excess cannot be ascribed entirely, although it may partially, to the confinement, the unwholesomeness, or the usages of mad-houses. The mean age of lunatics in asylums is about 35-40. The average age of the patients admitted at Bethlem, (1830–34) was 36 years (36·2); and the mean age of 213 admitted at Hanwell by Dr. Conolly was 36½. The mortality at the age 30–40 is 1·2, and at 40–50 is 1·5 per cent. in England and Wales. In cities the mortality at a corresponding age is not more than 2 per cent. annually. Now the annual mortality at Bethlem, where dangerous cases are carefully excluded, was 9 per cent., in 1827–39. At Gloucester, one of the county asylums, at which the treatment is the most successful, the diet is generous and nutritious, and the patients live as much as possible in the open air,—the annual mortality is 7 per cent.

The annual mortality of severe cases of insanity cannot, I think, in favourable circumstances, be less than 6 per cent.; so that the mortality is three times greater among lunatics, than among the general population, at the same age. We have seen, however, that the annual mortality among the better class of patients in the licensed houses was

* Medical Gazette, August 8th, 1835.

11 per cent., among paupers at Hanwell 12 per cent., among paupers in the licensed houses 21 per cent., and among pauper men at one licensed house 27 per cent.;—as high as the rate of mortality experienced by the British troops upon the western coast of Africa, and by the population of London when the plague rendered its habitations desolate!

To what is this excessive mortality to be ascribed—to the disease, or to the treatment?—The question cannot be positively answered, nor can the causes of the difference in the mortality be determined, without a careful examination of all the circumstances. I shall briefly notice the chief causes to which the mortality of lunatics in asylums *has been*, or *may be*, ascribed.

The visiting justices of Hanwell state as "an extraordinary and "disgraceful fact," that numbers of patients are sent into the asylum, as it would seem, to die. Of 656 deaths, 64 occurred within a month after admission. A similar complaint is made at many hospitals; and there is probably a tendency to send dangerous cases, or cases in their most critical stage, to public institutions. The exclusion of such cases from Bethlem reduces the mortality, but they cannot all be excluded without giving the asylums the advantages of that *selection*, which is so profitable to Assurance Offices. For in a disease so fatal as insanity, a certain number of lunatics are necessarily on the verge of death at the period of the disease when admission into an asylum is usually sought; and a due proportion of such cases cannot fairly be excluded.

Reference has also been made to the fact that out of 834 patients in Hanwell on December 31st, 1839, about 655 had been in other asylums or workhouses for considerable periods. Many cases were admitted in the chronic stages of insanity; but this, though it will account for a smaller number of recoveries, and the high proportion of fatal cases, will not account for a high *annual rate* of mortality. The *annual rate* of mortality is greater in the acute than in the chronic stage of insanity. Thus at the hospitals of Bethlem and St. Luke the annual mortality among the class called "curables" was 11 per cent., and only 6 per cent. among "incurables" (chronic cases). At Hanwell the annual mortality of lunatics in the state of mania, monomania, or melancholia appears, so far as it can be determined, to be about 12 per cent., while in cases of incoherence, imbecility, or dementia, (chronic stages of insanity,) about 8 per cent. die annually.

A return in the Hanwell Report shows the numbers admitted during each separate year into the asylum, and the numbers discharged cured, relieved, or dead, year by year. The return extends from May 16th, 1831, to September 30th, 1840, and shows that 422 lunatics were admitted in the year 1832; that 55 of them were cured or relieved, and 55 died during that year, leaving 312 to enter upon the next year (1833), when 27 of them were cured or relieved, and 31 died; and so on, year succeeding year, until September 30th, 1840, when 137 remained in the asylum. The patients admitted in 1831, and in 1839–40 (the two last years), have been set aside; and the 1,389 lunatics admitted in the seven years (1832–38) have been followed to the end of 1839. The 422 lunatics, it may be assumed, were admitted at equal intervals of time in 1832, or the middle of the year 1832 may be taken as the mean time of their admission; whence it follows, that of 422 admitted in the year 1832–55 died in the *half-year* following; 31 in the next *year*, &c. The return, therefore, permits us to trace 422 lunatics admitted in 1832, to death, recovery, or relief, during $7\frac{1}{2}$ years; and 325 admitted in 1838 to the end of 1839, or for a period of only $1\frac{1}{2}$ year.

From a summary of the facts in this return, it appears that of 1,389 lunatics *entering* upon the *first* period ($\frac{1}{2}$ year) 125 were discharged cured, 25 relieved, and 152 dead in the next *half-year*; of 1,087 who entered upon the *second* period, 142 were discharged cured, 13 relieved, and 130 dead in the subsequent *year*, at the end of which 208 were lost sight of. For the reason before stated, it will be observed that the *first* period extends to the end of the 6th month; the second from the end of the 6th to the end of the 18th month; the third from 1½ to 2½ years, &c.

From such an arrangement of the facts, the annual rate of mortality and recovery in the several stages of insanity, subsequent to admission, at Hanwell, may be deduced.

INSANE PERSONS living, cured, and dead; and the ANNUAL RATE OF MORTALITY in different stages of Insanity.

No.	Period of the disease from the date of Admission.		Number living one year.	Cured or relieved.	Died	Out of 100 living, one year. Cured or relieved.	Out of 100 living, one year. Died.
	Years.						
1	0	0½	619	150	152	24·2	24·6
2	0½	1½	944	155	130	16·4	13·8
3	1½	3½	1,033	32	87	3·1	8·4
4	3½	5½	673	20	48	3·0	7·1
5	5½	7½	383	9	27	2·3	7·0
	0	7½	3,652	366	444	10·0	12·2

The numbers stated to have been *relieved* were 14 per cent. of the numbers *cured and relieved*; and as the proportion remained nearly the same through the seven years, the two classes of facts have not been distinguished.

The annual rate of recovery in the *first half-year* was 24 per cent.; and the rate of mortality was nearly 25 per cent. The two rates remain high in the *second period* (the rate of recovery 16, and of mortality 14, per cent.), while they declined respectively to 3, and to 8 per cent. in the *third* period; and to 2·3, and 7·0 per cent. annually, between the 5½ and 7½ years after admission into the asylum.

The rate of mortality in a unit of time increases as the malady advances up to a certain point, and then declines regularly, in all diseases which have hitherto been investigated arithmetically. In cholera the rate of mortality is highest at 18 to 24 hours; in small-pox, the morfality is highest from the 10th to the 15th day; in consumption the rate to mortality appears to be greatest from the 6th to the 9th month.

Insanity is regulated by analogous laws; and a majority of the patients are admitted at Hanwell before the disease has passed the point at which the mortality declines, although many are admitted afterwards, when the rate of recovery is reduced much more than the rate of mortality.

At Hanwell, 18 in 100 living die annually in the first 1½ year; and 8 in 100 annually for 6 years afterwards. If an asylum, therefore, contained none but persons in the first year and a half of the disease, (after admission is always understood,) the mortality would be 18 per cent.; while it would be 8 per cent. in an asylum for chronic cases between 1½ and 7½ years. Without implying any disparagement to the treatment in the former case, the rate of recovery in the two asylums would differ in a still greater degree, as it would be 19 per cent. in the first asylum, and only 3 per cent. in the second, set apart for the exclusive reception of the advanced cases. This separation seldom takes place in practice. The chronic and acute cases are always mixed in an institution like Hanwell; but it is evident that in the first years after it was opened, the proportion of cases in the early stages must have been greatest, and the proportion of lunatics in advanced periods of the disease must have since progressively increased. According to the above laws, the proportion of deaths and recoveries should gradually have declined, and this was the fact.

The annual mortality was 17 per cent. in the first three years, 11 per cent. in the second, and 10 per cent. in the last three years; the annual rate of recovery was 14 per cent. in the first, 7 per cent. in the second, and 8 per cent. in the last period. In the licensed houses which have been many years in existence, the annual rate of mortality was 13·6 per cent. in 1833–36, and 17·2 in 1836–39!

When the rates of mortality and recovery in the several stages of insanity are ascertained, the effects of treatment and external influences can be compared in asylums containing the various classes of patients, in proportions as different as at Hanwell in 1831–33 and 1839–40. The rule is:—multiply the number of lunatics existing at the several periods of the disease by the corresponding rates of mortality and recovery (0·242, 0·246, &c.), and the sum of the products will represent the number of deaths and recoveries. By this rule the deaths in Hanwell during the $1\frac{3}{4}$ year ending September 30th, 1840 should have been about 149, and they were 128; the numbers cured or relieved should have been about 126, and they were 154.

It will be found by this rule that the rate of mortality among paupers in the licensed houses, and in Hanwell, has differed less than the first results of the returns would lead us to suppose, although it has been excessive in both. The paupers remain little more than a year and a half (1·67) in the licensed houses, in which the annual mortality was 21 per cent.; at Hanwell the annual mortality in the first $1\frac{1}{2}$ year after admission was 18 per cent.

From the facts previously referred to part of a table of mortality and recovery may be constructed for lunatics.

NOSOMETRICAL TABLE.

No.	Period of the Disease dating from the day of Admission.	The number of Lunatics who			Cases terminating in each Period.		
		Enter upon each Period.	Will Recover.	Will die Insane.	Total Number.	By Recovery.	By Death.
	Years.	a	b	c	d	e	f
1	0	1,000	380	620	217	108	109
2	0·5	783	272	511	213	112	101
3	1·5	570	160	410	61	21	40
4	2·5	509	139	370	48	12	36
5	3·5	461	127	334	43	11	32
6	4·5	418	116	302	41	11	30
7	5·5	377	105	272	35	9	26
8	6·5	342	96	246	32	8	24
9	7·5	310	88	222	—	—	—

The above table shows that if we take 1,000 lunatics at the stage of the disease corresponding to the time of admission at Hanwell, 217 will be discharged (108 recovered or relieved, and 109 dead) in the half-year following, leaving 783 to enter upon the second period, to be reduced year by year, until at the end of $7\frac{1}{2}$ years only 310 remain. The range of the present series of observations extends no further, but the relative proportion of recoveries and deaths remains nearly as 88 to 222 during the last six years; and to complete the scheme of the table it may be assumed that 88 of the 310 will recover, and 222 will die. Of 1,000 cases, 380 will recover, and 620 die; at the end of $1\frac{1}{2}$ year, 160 will recover and 410 will die.

In the first half-year out of 1389 cases, 150 were cured, and 152 died; consequently, 108 were cured, and 109 died out of 1,000 cases. As 217 cases terminated during the first half-year, 783 entered upon the second period, when the amount of recovery having been $= \frac{155}{1087}$, and the mortality $= \frac{130}{1087}$, exactly 112 recovered, and 101 died. By continuing the process, the deaths and recoveries are obtained for each year.

Halley invented the Table of Mortality, which consists of three columns, showing the number of persons who die or survive in each successive year. The events it exhibits are of one kind; all the persons die. But cases of *disease* may terminate in two ways—by death, and by recovery. A different tabular construction was therefore required for sick persons, such as the one preceding, from which the *mean future duration*, the *probable duration*, the *probability* of *recovery*, and the *probability of a fatal termination* in any given time, can be determined at any period of the disease.

The *mean future duration of insanity*, or *the expectation of disease*, cannot be deduced from the preceding table, because it breaks off at the end of $7\frac{1}{2}$ years; but if the annual rate continued the same (1·10), 7 of 310 would remain insane 40 years, and the mean future duration of insanity at the period of admission at Hanwell would be 6·7 years; at the end of half a year it would be 8 years; and after $1\frac{1}{2}$ years, it would be 10 years.

In the six years 1834–39, when the inmates were = 3,875 living 1 year, 706 were discharged; one in 5·5 therefore was discharged annually. If the institution had existed several years, and the numbers admitted and discharged had been equal, the mean duration would have agreed with this, and have been 5·5 years; but as Hanwell was opened in 1831, and only 1,179, out of 2,029 admitted, had been discharged on the 30th September 1840, the 6·7 years is probably nearer the true mean duration.

In determining the mean term of treatment, which was attempted in the early part of this paper, it may at first sight seem that the years of residence should have been divided by the mean of the numbers admitted (2,029), and discharged (1,171). This method would make 4·8 years the mean term of treatment in the six years ending 1839—(for $\frac{3875}{801} = 4\cdot8$); and 1·9 years the mean term of treatment in 1831–3; when 920 were admitted, 362 discharged, and the years of residence were = 1,248. Divide 1,248 by the number discharged (362), and 3·44 years would be the given term of treatment; but even this, as the experience of the six following years evinces, is much below the truth. The errors are the same as if the division of the children under three years old by the mean number of births and deaths, or by the deaths alone, were supposed to give the expectation of life at birth; whereas the division by the deaths at that early period, though the nearest approximation of the two, gives a less number than the expectation of life in years.

Dr. Conolly ascertained the previous duration of the disorder in 191 cases (exclusive of 10 congenital cases) admitted during the year; 66

had been labouring under the disease less than six months; 26 between 6 and 12 months; 24 between 1 and 2 years; and 1 had been insane 39 years. The mean previous duration was 3·4 years. But, as little more than *half* the number had been insane *twelve months*, the time at admission may be represented by 1, or $1\frac{1}{4}$ year.

The mean age of 213 persons at admission was $36\frac{1}{2}$ years; the mean age of 195 at the time of the *first attack* of insanity was stated to be $32\frac{1}{2}$ years.

The *probable future duration of insanity* is shown to be $2\frac{1}{2}$ years at the time of admission; for, in $2\frac{1}{2}$ years, the 1,000 cases are reduced to 509. The chances that a patient will, or will not, remain insane $2\frac{1}{2}$ years are 509 to 491, or nearly equal. Among those who remain insane half a year after admission, the probable future duration of the disease is nearly 4 years.

The *probability of recovery* at admission $= \frac{380}{1000} = \cdot 380$; of dying insane $= \frac{620}{1000} = \cdot 620$. Half a year after admission the probability of recovery is $\frac{272}{783} = \cdot 347$; of dying insane $\frac{511}{783} = \cdot 653$. The numbers in juxtaposition, in columns *b* and *c*, express the respective chances of death and recovery; thus, $5\frac{1}{2}$ years after admission at Hanwell, the chances are 272 to 105 that a lunatic will *not recover*. All these probabilities depend more or less on the assumption that 88 in 310, remaining at the end of $7\frac{1}{2}$ years, will ultimately recover.

The *probability of recovery, or of dying*, within any year or years up to $7\frac{1}{2}$, is accurately shown by the table. In the first half-year the *probability of recovering* is $\frac{108}{1000} = \cdot 108$; the probability of recovering in $3\frac{1}{2}$ years is $\frac{380-127}{1000} = \frac{253}{1000} = \cdot 253$. Out of 1,000 cases, 253 recover in that time; hence $\cdot 253$ is the probability of recovery. The *probability of dying* in the first half-year is $= \frac{109}{1000} = \cdot 109$; in the two years following $\frac{511-370}{783} = \frac{141}{783} = \cdot 180$.

From a table of this kind the lives of lunatics can be insured; and, from the present table, they may be insured for a limited number of years.

The table is an instrument by which the effects of treatment on the mortality—the number of recoveries—and the duration of all diseases, can be accurately measured. It enables us to compare two or three different plans of treatment, and to determine their effects upon the principal results at which all medical treatment aims—the reduction of the mortality, and of the duration of the disease. Thus, if 139 of 509 lunatics that have been $2\frac{1}{2}$ years in Hanwell will recover under the present treatment, and 200 recover under any new mode of treatment that may be introduced, the advantages of the latter would be obvious; and still more so, if the *probable duration* of the disease were reduced from 10 to 5, or 2, years.

The returns from the licensed houses do not state the ages; and the ages of few lunatics are given in the interesting report of Dr. Conolly. From other observations it is known generally that the mortality increases, and that the probability of recovery declines, as age advances.

The sex, age, and stage of the disease are the principal internal causes that influence the mortality, except the form of the disease, which, exclusive of congenital idiocy, may be, perhaps, reduced to an element already discussed—the "stage of the disease." The influence of complications, of sex, and of age, may be assumed to be nearly the same in the licensed houses and Hanwell, as in ordinary asylums—the asylum, for instance, at Gloucester, where the mortality does not exceed 7 per cent. annually. The mortality of 7 per cent. may be fairly ascribed to insanity. The excess above this must be attributed to the diseases generated by the limited space in which the unhappy lunatics are confined—to the collection of large numbers under the same roof—the impurity of the atmosphere—the want of exercise and warmth—the poor unvaried diet—and the deficiency of medical attendance.* But the influence of these agents can only be ascertained by a Parliamentary inquiry; and it will not be denied that the causes should be investigated which raised the mortality of lunatics above the standard—57 per cent. among private patients, 71 per cent. at Hanwell, and 200 per cent. among paupers in the large licensed houses !

The Bethlem Hospital differs essentially from the Hanwell Asylum as well as from the majority of the licensed houses, in the stricter selection of patients for admission. By the rules the following cases are inadmissible :—lunatics who have been insane for more than twelve months ; who have been discharged uncured from other hospitals ; in a state of idiotcy ; afflicted with palsy, or with epileptic, or convulsive, fits ; and suffering from any dangerous disease. Notwithstanding the instructions in the admission papers, the petitions of 58 out of 311 (19 per cent.), who applied in 1836, were rejected. The patients are not allowed to remain longer than one year. 253 lunatics admitted in 1836 had been insane 83 days, on an average ; 117 had been insane less than a month.

It would be exceedingly interesting to determine the mortality of this selected class of lunatics for 12 months. But, if dangerous symptoms come on at Bethlem, the patients are dismissed, when practicable, as *improper objects*. Thus, of 3,026 discharged in 10 years, 829 were dismissed uncured, 483 as *improper objects*, and 145 dead. A great number of the "improper objects" would die soon after they left Bethlem ; and their dangerous state, or supposed incurability, was the alleged cause of their dismissal. Paralysis, however slight, even of a finger, is the forerunner of death in the insane ; and of 210 dismissed as improper objects (1831–36), 87 were paralytic, 59 "sick and weak," 24 epileptic, 4 apoplectic, 2 had "fits," and 28 were idiotic. The lunatics at *Bethlem* are divided into three classes ; "curables," "incurables," and "criminals."

Of the lunatics on the list of the hospital, 21 were constantly out on leave of absence ; and during the 13 years, 122 individuals were discharged as "out on leave of absence."

Of 100 "curable" patients discharged, 54·5 were cured, 5·2 died. The mean term of treatment was ·586 of a year, = 7 months ; or ·49 of a year, = 6 months, if the time spent out of the hospital, on leave of absence, be excluded. The lunatics discharged as "improper objects" were 14·5 per cent. ; a considerable portion of whom would have been numbered with the dead if they had remained.

The *annual* mortality was 8·8 ; the recoveries 92·0 per cent. ; 24·5 per cent. were discharged as improper objects, 43·4 were discharged uncured ; 2·1 were out on leave of absence. 171 were discharged annually out of a constant population of 100.

If the deaths which occur among those out on leave of absence are not recorded, the annual mortality to 100 resident in Bethlem is 10·5.

Incurables.—72 "*incurables*" were admitted ; 72 discharged (33 men, 39 women), and the average number resident for 13 years was 64·2. The years of life were therefore = 64·2 × 13 = 834. Nine

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* The diet and the condition of lunatics at Hanwell have been latterly ameliorated very considerably by the Visiting Justices, at the suggestion of the present physician (Dr. Conolly) ; and the mortality may be expected to be reduced in proportion. It is also right to state that in some licensed houses the mortality of private patients does not exceed 7 per cent.

incurables were cured, 39 died, and 24 were discharged at the request of their friends.

Of 100 cases, 13 recovered, 33 did not recover, and 54 died. One in 11·6, = 6 per cent. were discharged annually; the mean term of residence was 11·6 years. 1 in 21, = 4·7 per cent. died, and 1 per cent. was cured annually.

"Incurables" is an improper term; but it is a recognition of the law that recovery is infrequent in advanced stages of insanity.

Criminals.—In the 13 years 71 criminal lunatics were admitted at Bethlem (56 men, 15 women); 51 were discharged, namely, 26 died, 2 escaped, and 23 recovered. The average number resident was 57·3, the years of life 745.

Of 100 cases, 45 recovered, 51 died. The annual rate of mortality was 3·5, of recovery 3·1 per cent.; the mean term of treatment deduced from the years of life, and the number discharged, was $14\frac{1}{2}$ years. The numbers admitted and discharged in the 11 years (1827–37) were nearly equal (36 and 39); and the years of life divided by the number discharged $= \frac{653}{39} = 16{\cdot}7$ years.

It is evident that several of the criminals, such as Oxford, cannot properly be said to labour under insanity—in the sense of a disease. It is, if anything, like idiocy, a congenital misdevelopment of the brain.

The number of recoveries is considerable at Bethlem, but less than at some private asylums, notwithstanding the careful selection of cases. The mortality is reduced by excluding dangerous cases, and by dismissing the patients on the verge of death, as "improper objects." It is difficult, under these circumstances, to account for the death of nine or ten in 100 annually, upon any other supposition than that the mortality is high at the early stage of the disease in Bethlem.

The last Committee of the House of Commons on Lunatics, stated in their report, "It has been clearly established in evidence, that there is "no due precaution ***with respect to the certificates of admission, to the*** "***consideration of discharge***, or to the application of any curative pro-"cess, to the mental malady."* Lunatics under confinement, it should be well recollected, are *prisoners;* and every one will admit that the depriving a man of his personal liberty, or turning loose a lunatic on society, are acts involving great responsibility,—a responsibility which, if it exist at all, is very imperfect in the present state of the law. In order to deprive a lunatic of his estates, a formal inquiry is publicly instituted; but a person who has been seven days chargeable to the parish may be committed as a lunatic to the County Asylum by two justices of the peace on the certificate of *any* physician, surgeon, or apothecary, asserting that the "said person *appears* to be insane of "mind." 2,780 pauper lunatics are confined under these certificates in the county asylums.† But there are 1,389 lunatics, and 7,007 idiots, "under the care of the parish officers as indoor or outdoor paupers." Many of them are necessarily under restraint, without either warrant or certificate, which is only required when the parishes think it necessary to send them to a public asylum, where their treatment costs two or three times as much as the workhouse fare.

Paupers may be sent to licensed mad-houses by a justice, or by the officiating clergyman and overseer, with one medical certificate; and other persons may be sent to a licensed house by any layman, upon the certificates of *any two* medical men.‡ It appears also that by law, any

* Report, 1827, p. 4.
† Return to the House of Commons, 5th July, 1836.
‡ 9 Geo. IV. c. 40; 2 & 3 Will. IV. c. 107: 3 & 4 Will. IV. c. 107.

person whom the governors choose to admit as a lunatic, may be confined at Bethlem, or St. Luke's Hospital, for an unlimited time.

The liberation of persons in confinement as lunatics, takes place under no better regulation. Medical visitors have been appointed, in the words of Lord Lyndhurst, "to see that the Chancery lunatics are well "cared for, but above all *to watch the least glimmering of returning "sanity, and see that the parties are not detained one day longer than "necessary.*" The relatives, parish-officers, proprietors, justices in petty-sessions, and the Metropolitan Commissioners, release lunatics from the licensed houses; but the mode in which this is effected is by no means satisfactory. "When once," says Colonel Sykes, "they "(pauper lunatics) get shut up in a mad-house, it is indeed difficult for "them to regain their liberty."* Lunatics are discharged at the discretion of the visiting justices from the county asylums; by the governors from Bethlem, St. Luke's, and other hospitals supported by subscription; and by the parish officers from workhouses.

Many cases of abuse have occurred under the present system, which will be probably thought by the Society to require extensive alterations. And although there would be much difference of opinion on many points, all will probably agree that *no person should be placed under restraint as a lunatic in asylums, hospitals, or houses of any kind, who has not been examined by a public officer, practically acquainted with insanity.* I would therefore suggest that by some modification of the present system of inspection, the circumstances of every lunatic confined should be investigated personally by a crown officer, and recorded previous to committal, at the expiration of every quarter of a year after admission, and at the time of dismissal. The sex, and age, the stage, form, and complications of insanity should be registered, on entering and leaving the several institutions, by impartial officers. This would be a protection to lunatics, and to the public; the deaths and recoveries would be registered on a uniform plan, and an invaluable statistical check on the results of treatment would be obtained.

We may then discover the causes of insanity, the laws which regulate its course, the circumstances by which it is influenced, and either avert its visitations, or mitigate their severity; perhaps, in a later age, save mankind from its inflictions, or, if this cannot be, at any rate ensure the sufferers merciful treatment. (Journal of Statistical Society, Vol. IV., pp. 17–33.)

Correction of Local Death-rates for Deaths in Public Institutions; Workhouses.—In calculating the mortality of the respective London districts, the deaths and population of these outlying workhouses were taken from those districts in which they happen to be situated, and placed in the districts to which the inmates belong. No other correction for workhouses is required, unless it is attempted to calculate the mortality of sub-districts. Then if the workhouse population, and the paupers who die, can be referred to their respective sub-districts, that is the proper course for determining the relative mortality of the sub-districts among themselves. The condition of the workhouse is an important element in the health of the district; and sub-districts supply the workhouse with paupers in very different proportions; but when the localities from which workhouse paupers come is unknown, no better *general* rule can be laid down than the following: distribute the deaths in the workhouse, at each age, over the several sub-districts, in the proportions of the deaths registered out of the workhouse in those sub-districts; distribute the population in the workhouse, at each age, over

* Journal of the Statistical Society, vol. iii., p. 146.

the several sub-districts, in the proportions of the population enumerated in those sub-districts; and then divide, as usual, the deaths by the living at corresponding ages.

Hospitals. In deducing the mortality of the several London districts, the population and the deaths in the hospitals were subtracted from the population and deaths of the respective districts in which the hospitals happened to be situated.—(See Tables, in 8th Report, folio, pp. cxviii—cxxix.) The hospital population and deaths at each age were then distributed over all the districts of the metropolis by the following formula:—

$$\frac{P'_x}{P^x} \times \frac{D_x}{D'_x} \times m'_x = m_x : \text{ or}$$

$$(\lambda P'_x + \kappa P_x + \lambda D_x + \kappa D'_x) = \lambda c_x ; \text{ and } \lambda c_x + \lambda m'_x = \lambda m_x :$$

in which $P_x =$ the population of London at any age x;
$P'_x =$ the population of London at the same age x, exclusive of the population of the same age in hospitals;
$D_x =$ the deaths in London at the age x;
$D'_x =$ the deaths in London at the age x, exclusive of the deaths at the same age in hospitals; $m'_x =$ the rate of mortality at the age x in any district, without correction for deaths and population in hospitals, of persons belonging to that district.
$m_x =$ the corrected rate of mortality at the age x.

(9th Annual Report, p. 160.)

10. Marriage and Mortality.

Influence of Marriage on the Mortality of the French People.—The changes which age induces in the vital forces have been calculated. The differences in the mortality of the two sexes are known. Men have investigated the effects on life of air, water, hills, plains and marshes—of the sun in various seasons and climates—of food, animal and vegetable—and of alcholic drinks. The fatality of foul exhalations of every kind has been made manifest. But the life of man is affected by still more subtle agencies. The action of the various parts of the body in industrial occupations produces specific effects. Every science modifies its cultivators. The play of the passions transfigures the human frame. How do they influence its existence?

These are some of the higher fields of speculation which have not yet been explored by sanitary research. I have now, however, to submit to the department the results of an inquiry into intermediate phenomena.

The family is the social unit; and it is founded in its perfect state by marriage. The influence of this form of existence is therefore one of the fundamental problems of social science.

A remarkable series of observations, extending over the whole of Frnnce, enables us to determine for the first time the effect of conjugal condition on the life of a large population. The French people may be classed in three great groups, exclusive of minors under age:

I. The married consisting of two groups: (*a.*) Husbands, 6,986,223, and (*b.*) wives 6,948,828, making a total of 13,935,051.

II. The celibate, who have never married, namely, (*a.*) bachelors, 4,031,582; and (*b.*) spinsters, 4,547,952, making a total of 8,579,534.

III. The widowed in two groups, (*a.*) widowers, 836,509; and (*b.*) widows, 1,687,583; making a total of 2,524,092.

Deparcieux, in the middle of the last century, investigated the relative mortality of monks and nuns in France; and he compared their life with that of Tontine annuitants, consisting partly of married and partly of unmarried persons. From the age of 20 to 40 the mortality of the monks and nuns living in "single blessedness" was lower, and after the age of 40 it was higher than the mortality of the annuitants. The excess of mortality was considerable in the monks. The condition of these members of religious houses is at all times peculiar, and besides their vows of chastity involved a peculiar discipline likely to affect their lives. Many of them lived in Paris. We can now deal with the whole population of France, amounting, in 1851, to thirty-six millions of people. * * * * It contained in the year 1851 nearly fourteen million married people of both sexes. What was their rate of mortality? Under the French law, young men of the age of 18, and young women of the age of 15 can legally marry. Of the few young married pairs living, the mortality in both husbands and wives was excessively high under the age of 20. Twice as many wives under 20 died in the year as died out of the same number of the unmarried; and the mortality was much higher than it was among husbands and wives in the subsequent decennial of life. The result confirms the common opinion of the evil consequences of marriage in many cases under the age of 20, before the growth of the individual man or woman is completed.

The wives of the next 20 years of age experience a rate of mortality half as high again as that which the husbands of those ages suffer.

The mortality of the husbands is exceedingly low, 6·5 and 7·1, while wives of 20 to 30 die at the rate of 9·3 in 1,000, in rather higher proportions than the wives of the subsequent age, 30 to 40, when the mortality is 9·1. This excess is fairly ascribable to the sorrows of childbearing, and to no small extent to ignorant midwives.

At the age 40 to 50 the mortality of the husbands (10·3) is slightly higher than that of the wives, and so it remains higher ever afterwards, but the difference is not considerable.

Age.	Husbands.	Wives.
50–60	18·3	16·3
60–70	35·5	35·4
70–80	88·6	84·9
80–90	183·6	180·4

Thus, to 1,000 husbands living at the age 60 to 70 there are 35·4 deaths; to 1,000 wives 35·4 deaths. And so the old people go on in the table tottering down the hill till they "sleep together at the foot."

How fares it with the unmarried—the celibate?

At the younger ages under 20 the mortality is, as I have already stated, much lower in the two sexes than it is in the married.

Age unmarried.	Males.	Females.
15–20	6·7	7·7 in 1,000 die.

At all the ages from 20 to 60 unmarried men experience a much higher rate of mortality than unmarried women. The excess of the mortality of males at the age of 20–30 was in the ratio of 11·3 to 8·7. It was aggravated by the deaths of the soldiers dying in Algeria, and in the Casernes at home; but in the subsequent periods this element does not interfere to any extent.

Annual deaths to 1,000 living:—

Age of the unmarried.	Males.	Females.
30–40	12·4	10·3
40–50	17·7	13·8
50–60	29·5	23·5

At the age 60 and upwards the unmarried of both sexes are nearly equally mortal.

But how is it as between the married and the unmarried women?

Why at 20–25 the maidens have the advantage, and the difference is not inconsiderable.

Of 1,000 Females.	Married.	Unmarried.
Annual deaths	9·8	8·5

At the age 25–30 the mortality of the unmarried is slightly in excess (9·2 to 9·0). At the next age (30–40) the wives are the halest; the mortality of the wives being 9·1, and of the unmarried women 10·3. At the age of 40 the married women experience a much lower rate of mortality than the unmarried:—

	Married.	Unmarried.
40–50	10·0	13·8
50–60	16·3	23·5
60–70	35·4	49·8

and so it runs through all ages.

The contrast between the health of the bachelors and of the married men is still more striking; the young bachelors enjoy an advantage, the old ones suffering in the comparison.

Mortality per 1,000 among married men and bachelors:—

	Married.	Unmarried.
15–20	29·3*	6·7
20–30	6·5	11·3
30–40	7·1	12·4
40–50	10·3	17·7
50–60	18·3	29·5
60–70	35·4	49·9

And after the ages of 80 the mortality of the two classes becomes nearly equal.

If unmarried people suffer from disease in undue proportion the have-been-married suffer still more. At the ages under 40 the mortality of widows is higher than the mortality of unmarried women. At the earlier ages the mortality is doubled. At 40 and upwards their mortality is lower than the mortality of unmarried women of corresponding ages. At all ages widows are more mortal than wives.

Young widowers under the age of 30, and even under the age of 40, experience a very heavy rate of mortality; and after 60 the widowers die more rapidly, not only than husbands, but more rapidly than old bachelors.

This is the general result:—Marriage is a healthy estate. The single individual is more likely to be wrecked on his voyage than the lives joined together in matrimony.

* * * * *

* This is an accidental exaggeration; the facts are insufficient.

Finally, it is held generally that the suppression of a physiological function is prejudicial to health, which our tables confirm, and at the same time qualify. Chastity in itself does not, as in the case of Deparcieux's nuns, raise the mortality of women under forty; and notwithstanding the consequences of vice in the vicious, the selection operating against the unmarried, and the pangs of disappointed love, the mortality of unmarried women in all France is lower than the mortality of married women. After that age the health of the nuns gave way to some extent; but this was, perhaps, as Deparcieux asserts, the consequence in that period of various kinds of austerities, an absence of personal cleanliness, and the want of little comforts which were found in the dwellings of simple artizans, who knew how to keep their houses in order. The effects of religious chastity in France have been recently discussed by Dr. Mayer, who with some Catholic authorities contends that it has in itself no prejudicial effect; but this is not the prevalent opinion. Levy professes the contrary doctrine.

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FRANCE.—Rate of Mortality per Cent. in 1853.

Ages.	Males.			Females.		
	Unmarried.	Married.	Widowers.	Unmarried.	Married.	Widows.
All Ages - -	2·093	1·756	7·249	2·024	1·534	5·804
15– - -	·668	2·934	18·688	·772	1·364	10·673
20– - -	1·128	·654	2·877	·874	0·930	2·310
30– - -	1·236	·714	1·849	1·030	0·911	1·365
40– - -	1·774	1·026	2·005	1·381	0·999	1·366
50– -	2·945	1·830	2·952	2·347	1·627	2·169
60– - -	4·986	3·544	5·414	4·977	3·540	4·670
70– - -	10·974	8·859	12·871	11·337	8·490	10·717
80– - -	21·072	18·363	24·799	24·143	18·044	22·850
90– - -	28·096	26·016	41·344	29·580	18·778	36·273
100– - -	76·767	98·674	48·605	45·847	70·505	42·856

The table may be read thus:—In 1853 to every 100 unmarried men living in France of the age 20—30 there were 1·128 deaths of unmarried men or 11 in 1,000; to every 100 married men at the same age ·654 deaths of married men, or nearly 7 in 1,000; and to every 100 widowers, 2·887 deaths of widowers, or 29 in 1,000.

A correction has been made for increase of population, on the assumption that the increase has been uniform at every age, and that the same rate of increase has taken place since 1851 as was observed between 1846 and 1851. A correction has also been made both in population and deaths for ages not stated.—(Transactions of the National Association for the promotion of Social Science, 1858, pp. 504–12.)

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OF

PART V.—LIFE TABLES.

PART V.—LIFE TABLES.

INTRODUCTION.

ONE of the most valuable uses to which trustworthy rates of mortality can be put is for the construction of life tables; and it may further be asserted that the construction of life tables is almost necessary in order to give scientific value to death rates. The first extract in the following selections bearing upon the inter-relations of death-rates and life tables shows that even in the First Annual Report Dr. Farr fully appreciated the enormous value of the civil registration of deaths (showing the ages at death and the causes of death), not only as the basis of mortality statistics for stimulating sanitary progress, but as a means for the construction of true life tables, that would give increased trustworthiness to death-rates, to life insurance, and to the system of life annuities. It will be evident, to those who read these selections from his writings, how much thought and labour were devoted, from time to time, by Dr. Farr to the utilisation of the accumulating mortality statistics derived from the national Death Register for life table purposes. The first of Dr. Farr's English life tables, known as No. 1, was published in the Registrar General's 5th Annual Report, and was based upon the enumerated population in 1841 and the registered deaths in the same year. The following extracts include several from this report, in which appeared a general dissertation upon the history, construction, and properties of life tables, in addition to a detailed description of the English Life Table No. 1. This report also contained shortened life tables for the Metropolis, for Liverpool, and for the county of Surrey, which exemplified scientifically the effect of extreme urban and of rural death-rates upon the lifetime of a population.

In the Registrar General's 12th Report was published Dr. Farr's English Life Table No. 2, which was constructed upon a more extended basis, namely, the registered deaths in the seven years 1838–1844, and the Census enumerations in 1831 and 1841. The last of Dr. Farr's national life tables was based upon the recorded deaths in the 17 years 1838–54, and upon the three Census enumerations of population in 1831, 1841, and 1851. Such an extended series of observed facts had never before served as the basis of a life table. The near agreement of the results arrived at in these three English life tables is very remarkable, and accentuates the fact that English mortality, notwithstanding fluctuations from year to year, was, on the whole, notably stationary during the first 33 years of civil registration, 1838–70.

The English Life Table No. 3 was not only based upon a far larger series of observations than either of the Tables No. 1 or No. 2, but contained a far more complete and elaborate series of tables. This life table* was published as a separate volume, containing more than 500 pages, a great portion of which was devoted to joint life tables.

* English Life Table. Tables of Lifetimes, Annuities, and Premiums; with an introduction by William Farr, M.D., F.R.S. Longman & Co.; 1864.

The limits of this volume forbade the selection of but comparatively few extracts of more general interest, and necessitated the omission of much possessing intrinsic mathematical and actuarial value. The main object of the selection was to take those portions of the reports which dealt with general principles and possessed value or interest for those who use the life table as a scientific exponent of mortality, rather than as a guide to insurance or annuity operations. It is necessary, therefore, to refer those who would study the more purely mathematical aspect of the question to the original reports in which the several life tables were published.

The Healthy District Life Table was based upon the mortality during the five years 1849–53, in 63 English registration districts which showed a mean annual death-rate not exceeding 17 per 1,000 persons living during the ten years 1841–50. This life table formed the subject of a Paper read by Dr. Farr before the Royal Society on 7 April, 1859, and printed in the Journal of the Transactions of the Society for that year. The tables based upon this Healthy District experience were afterwards added to and extended; and a selection from them was published in an Appendix to the Registrar General's 33rd Annual Report. Dr. Farr pointed out that this Healthy District Life Table expresses "very accu-" rately the actual duration of life among the clergy and other classes "of the community living under favourable circumstances." As representing, therefore, a standard of attained healthiness* (it is impossible, however, to say how much it is below an attainable standard), this healthy district mortality is most valuable as a means for measuring the excess of mortality due to insanitary condition, and generally to preventable causes.

The careful study of the following selection of extracts from Dr. Farr's writings on the construction and use of life tables cannot fail to convince all students of vital statistics that a life table supplies the only scientific and thoroughly trustworthy method for ascertaining the true import of rates of mortality in increasing or decreasing populations, whether such increase or decrease be due to the difference between birth-rates and death-rates, or to the effect of migration. The construction of a life table by Dr. Farr's shortened method (see description and formulæ on pp. 465–7) does not entail an amount of labour that should deter medical officers of health for large urban districts from undertaking it. A detailed and thoroughly practical description of the construction of an extended life table (for each year of age from 1 to 100) may be found in a Paper read before the Statistical Society in April 1883.† This description was written with a view to facilitate the operation for those whose knowledge and practice of this branch of mathematics might be insufficient to enable them to work with the sole help of Dr. Farr's formulæ, a selection from which is to be found in the following extracts.

Exigencies of space alone prompted the rejection for the purposes of this volume of a valuable contribution on what Dr. Farr called "Finance "of Life Insurance," and which he describes as "a branch of the "science of life insurance which has hitherto (in 1850) been much "neglected, and is only noticed cursorily in the standard works of Price, "Morgan, Baily, and Milne." This branch of the subject, however, is not only of a thoroughly technical character, but its interest is mainly confined to those practically engaged in the business of life insurance.

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* Dr. Farr wrote, respecting these so-called healthy districts, "the sanitary condition of the people in these districts is, however, still in many respects defective."

† Journal of the Statistical Society, vol. xlvi., pp. 189–213.

This contribution may be found in the Registrar General's 12th Annual Report, pp. xvi–xxxiv.

Among Dr. Farr's other life table contributions which have been necessarily omitted from these selections through want of space, it is especially desirable to call attention to the shortened life tables for England and Wales, the Healthy Districts, London, Liverpool, and the fifteen great towns. These tables, together with others (which may be called Life Tables of Disease), showing of what diseases and at what ages a million live-born children may be expected to die in England and Wales, the Healthy Districts, Liverpool, &c., were published in that mine of statistical information and suggestion, the Supplement to the Registrar General's 35th Annual Report, in the preliminary tables, pp. lxxxiii–clxxxv.

(EDITOR.)

Death Registration, and Life and Annuity Tables.—In the Abstract of Deaths (the registration of which even for this first year has been effected with signal success) are shown the deaths of persons of each sex at every successive year of age. Such details are of acknowledged value as data for determining the laws of mortality—as bases for calculations materially affecting the interests of millions. Tables exhibiting the proportion of deaths at every successive year of age are among the most important materials from which are deduced the true principles on which should be founded the systems of life annuities and of life insurance, and the rules of Friendly Societies established for the use of the poorer classes. The materials hitherto accessible are admitted to have been too limited for framing, satisfactorily, tables to regulate the amount of contribution at various ages, by which members of such societies may become entitled to allowances in old age, or to sums payable at death. The insufficiency of the data hitherto collected, and the contradictory nature of the several tables founded on them are strongly set forth in the Report of the Select Committee of the House of Commons, in 1827, on the laws respecting Friendly Societies. It is there stated that, "according to the Northampton Tables, out of 1,000 " persons existing at the age of 25, there survive at the age of 65, 343 " persons. By the Carlisle Tables, no fewer than 513 persons will " survive;" whereby it appears " that a society which should adopt the " Northampton Tables would, if the mortality among its members should " correspond with the Carlisle Tables, have *three* annuitants where it " calculated upon *two*. Of those annuitants, moreover, a larger proportion " would live to enjoy the annuity for a considerable number of years; " for instance, of the 343 persons, who would be annuitants according to " the Northampton Tables, 98 would live for 15 years; according to the " Carlisle Tables, 162 persons would survive through that period, and " attain the age of 80 years." But still more clearly will it appear how great is the want of further facts for the elucidation of these important subjects, and the establishment of a safe standard, by viewing in a tabular form a comparison of the various results of seven approved tables of mortality (see the following table), extracted from the above-mentioned report. The recommendation of that report, that measures be adopted for making "an accurate and extensive collection of facts," whereby may be facilitated " the solution of all questions depending upon the duration " of human life," is at length carried into effect; ample materials, thus conducing to ameliorate the condition of the working classes, are now afforded in the certified copies of registers deposited in the General

Register Office; and each year's accumulation will increase the value of such records, by augmenting the number of facts upon which calculation may be brought to bear.

In pursuance of these objects, I have felt that it was of great importance not only to give an abstract for the whole kingdom of England and Wales, but to exhibit the difference which prevails in different portions of the kingdom; to compare town with country—agricultural districts with manufacturing and mining districts—the hilly with the low and level—the maritime with the inland—the eastern and northern with the western and southern parts. Nor are these diversities matters of merely curious speculation, but they may be made the source of important benefits, especially to the poorer classes. It was stated in evidence before the Committee on Parochial Registration in 1833, by the Actuary of the National Debt Office, that the extent of difference which then existed was utterly unknown—that tables for the use of the poor, in reference to sickness and mortality, and in reference to the regulation of their Friendly Societies, could not then be constructed for two districts differing in character, from the want of such information as an improved system would afford; and that,

——	By Dr. Price's Table, founded on the Register of Births and Burials at Northampton.	By the first Swedish Tables, as published by Dr. Price, for both Sexes.	By M. Deparcieux's Table, founded on the Mortality in the French Tontines, prior to 1745.	By Mr. Milne's Table, founded on Mortality observed at Carlisle.	By Mr. Griffith Davies's Table, founded on the experience of the Equitable Life Insurance Office.*	By Mr. Finlaison's Tables, founded on the experience of the Government Life Annuitants.	
						According to his *first* Investigation, as mentioned in his Evidence in 1825.	According to his *second* Investigation, as mentioned in his Evidence in 1827.
						Mean of both Sexes.	Mean of both Sexes.
Of 100,000 persons, aged 25, there would be alive at the age of 65	34,286	43,137	51,033	51,335	49,330	53,470	53,950
Of 100,000 persons, aged 65, there would be alive at the age of 80	28,738	23,704	29,873	31,577	37,267	38,655	37,355
Expectation of life at the age of 25 years	30·85	34·58	37·17	37·86	37·45	38·35	38·52
Expectation of life at the age of 65 years	10·88	10·10	11·25	11·79	12·35	12·81	12·50
Value of an Annuity of 1*l.* on a life aged 25, interest being at 4 per cent.	£ 15·438	£ 16·839	£ 17·420	£ 17·645	£ 17·494	£ 17·534	£ 17·634
Value of an Annuity of 1*l.* on a life aged 65, interest being at 4 per cent.	7·761	7·328	8·039	8·307	8·635	8·896	8·751
Value of a deferred Annuity of 1*l.* commencing at 65, to a life now aged 25, interest at 4 per cent.	0·55424	0·65842	0·85452	0·88823	0·88723	0·99078	0·98334

* In all the Tables above mentioned, it is to be observed that the Mortality is deduced from an equal, or nearly equal, number of each sex, with the single exception of Mr. Davies's Table, founded on the experience of the Equitable, in which office, from the practical objects of life insurance, it is evident the male sex must have composed the vast majority of lives subjected to mortality. But as it is agreed on all hands that the duration of life among females exceeds that of males, it follows that the results of Mr. Davies's Table fall materially short of what they would have been, if the facts on which he has reasoned had comprehended an equal number of each sex.

if two societies of poor men residing in districts of a totally different character were, at the same time, to apply to him for tables to guide them in preserving their societies solvent, he "should be under the "necessity of giving the same tables to both, though knowing perfectly "that the rates which were adequate in one case were inadequate in "the other" It was also stated to the Committee on Laws respecting Friendly Societies, by another eminent actuary (Mr. Milne), that no one table or scale of contributions can, with propriety, be adopted by all Friendly Societies; that one composed of members living in or near a manufacturing town required a table very different from that which would be required in places where the population is less dense, and where a considerable proportion of the members are chiefly employed in the open air; but that these are differences which he could not "pre-"tend to estimate for want of *data*." The useful principle of comparison may, if requisite, be carried out into a more minute system of subdivision than I have, in this first instance, deemed it necessary to adopt. But there was danger lest, in attempting a more subtle discrimination, we should lose sight of broad distinctions which it was important to observe; and it was necessary to remember, that to diminish by subdivision the number of facts on which calculation could be brought to bear was materially to diminish their value. The extent to which division should be carried is a question not to be decided by any established rule, and which necessarily admits of much diversity of opinion; and it has been sought to pursue a middle course between the opposite extremes of subdivision and condensation, by dividing the kingdom into the twenty-five portions in which are exhibited abstracts of deaths at different ages. In doing this, regard has been had not so much to the observance of established boundaries as to those circumstances from which diversity may be expected to arise; in some instances, contiguous counties, similar in soil, climate, elevation, and the employments of the people, have been included in the same table, while, in other instances, the boundary of the county has been disregarded where it was desirable to compare two large portions of its inhabitants pursuing very different occupations.—(1st Annual Report, pp. 15–18.)

Mortality at Groups of Ages for Life Table Purposes.—The most important use of Abstracts of Deaths is their application to the construction of tables of mortality, which, it must be remembered, are constructed, not from enumerations of deaths alone, but from two series of facts—the numbers living at different ages, and the numbers dying at the same ages—and the observed relation between those facts. This relation of the living to the dying is varying daily; but it is obvious that however complete might be the record of facts, complete beyond all conceivable possibility of attainment, these variations in the minuter portions of time would be too irregular for the safe deduction of any general laws; and that it is only by including large numbers of facts, and long portions of time, that we surmount the difficulties which such casual irregularities create, and arrive at the ascertainment of any well-founded laws of mortality.

In the assignment of these periods, the quinquennial division is found to be recommended, both by its correspondence with the enumeration we already possess of the ages of the living and by the authority of those who have already adopted it. The ages of the living in 1821 were enumerated for quinquennial periods up to the age of 20, and for decennial periods after that age. The numbers of the living at different ages were not enumerated in 1831. It is earnestly to be wished that such enumeration may be made in future, and for quinquennial periods beyond the age of 20; but it is useless to expect that an enumeration more minute than for quinquennial periods for all above childhood can be effected with success. If, therefore, the utmost to be expected with respect to the future enumeration of the living is that it be given for quinquennial periods, it becomes advisable that the age at which persons have died should be given in a corresponding manner. I may further observe, that no authentic table of mortality in practical use has ever been been calculated from an enumeration of deaths at every separate year of age; and that no actuary has yet shown that tables can be deduced more accurately from deaths so enumerated than from quinquennial or decennial periods. The well-known Carlisle Table of Mortality was calculated by Mr. Milne from Dr. Heysham's Tables of the Living and Dying, in which the ages of the latter are arranged in the same manner as in the present abstracts, except that the divisions were less minute, containing only decennial divisions after the twentieth year.

The Swedish Table was calculated by Dr. Price from abstracts of the numbers of the living and dying in Sweden during 21 years, arranged in quinquennial periods after the fifth year. The Northampton Table, the Montpellier Table, and Deparcieux's Table of Annuitants, though calculated upon data less complete than those which were the bases of the Carlisle and Swedish Tables, were formed by regulating the decrements, or by taking the mean mortality of quinquennial or decennial periods; and in addition to the eminent writers on the law of mortality above mentioned, I may quote, in support of such arrangement, Mr. Morgan and Mr. Edmonds.—(2nd Annual Report, pp. 13–14.)

History of Life Tables.—The table called by different writers *a Table of Mortality*, *a Table of Vitality*, or *a Life Table*, was invented in England by Halley the illustrious astronomer, who "first ventured "to predict the return of a comet which appeared accordingly in "1759." By this simple and elegant table the mean duration of human life, uncertain as it appears to be, and as it is with reference to individuals, can be determined with the greatest accuracy in nations, or in still smaller communities. I refer to the form, and not to the mode of construction, which has been since greatly improved.

Halley's Table was calculated on the deaths in the city of Breslau, which for various reasons he selected from the imperfect data at his disposal "as the most proper for a standard, and the rather for that the "births did a small matter exceed the funerals." He was aware that "he wanted the number of the whole people" for an accurate calculation; but Halley's Table, constructed upon nearly the same hypothesis as the Northampton Table, represented the mortality of mankind with as little inaccuracy, and was upon the whole quite as good a "standard." He observes "it may be objected that the different salubrity of places "does hinder the proposal from being universal, nor can it be denied;" "but" he concludes, "it is desired that in imitation hereof the curious "in other cities would attempt something of the same nature, *than which* "*nothing perhaps can be more useful.*" The table, which gave "a more "just idea of the state and condition of mankind than anything then "extant, had manifold uses, showing among other things the chances of "mortality at all ages, and likewise how to make certain estimate of "the value or annuity for lives, which had been previously done by an "imaginary valuation."

The Government of the Revolution, it will be recollected, introduced the system of borrowing money upon Life Annuities, and after having failed to procure subscriptions upon the terms of the Act of 1691, succeeded in making good the deficiency by granting Life Annuities in the following year at 14 per cent. Halley, referring to the measure in his paper, remarks that his calculation shows "the great advantage of "putting money into the present fund lately granted to their Majesties "giving 14 per cent. per annum, or at the rate of 7 years' purchase for "a life, when young lives at the usual rate of interest are worth above "13 years' purchase." In the ignorance then prevailing as to the duration of life, annuities were granted at the same rate to persons of every age; and Halley pointed out "the advantage of young lives over "those in years, a life of 10 years being almost worth 13½ years' "purchase, whereas one of 36 is worth but 11."*

Tables of the lives of French annuitants, monks and nuns, were published by Deparcieux in 1746; and in 1783 Dr. Price constructed a correct Life Table from the population and deaths in Sweden and Finland. This was the first National Life Table ever made, and redounds much more to Dr. Price's fame than the Northampton Table of Mortality —so called—which, founded upon the misapplication of an hypothesis, never represented the mortality of Northampton, or of any other community, and ought not to have been published after the appearance of the admirable essay and tables of Deparcieux in 1746.†

The Carlisle Table was calculated by Mr. Milne, on two enumerations of the population of Carlisle, and its environs, made by Dr. Heysham in 1779 and 1787, with the deaths in nine years. The mean population was 8177, and the deaths 1840. Mr. Milne has described, in his treatise,‡ the care with which the observations were taken, and the method employed in the construction of this justly celebrated table, which was the first correct representation of the vitality of any portion of the English population.

"Although the *data* necessary for determining the law of mortality among the people, and the value of pecuniary interests dependent upon the continuance or failure of human life, cannot be obtained," observed Mr. Milne, in 1831, "without the active concurrence of many persons of influence and authority, yet for all the tables containing information of that kind relative to this country, and published before the year 1829, the public were indebted to the zeal and industry, and the separate efforts of a few individuals. But in March 1819, Mr. Finlaison was appointed by Government, with all the aids they could afford him, including proper assistants, and access to the registers of the nominees in tontines, and others on whose lives annuities had been granted by Government for more than a hundred years before, in which registers the exact ages at which the annuitants were nominated, and those at which they died, were stated. Thus the *data* not otherwise accessible being provided, and the labour lessened by the number of calculators employed, the expense also being defrayed by the public, at the end of 10 years, *viz.*, in March 1829, Mr. Finlaison made a report to the Lords of the Treasury, which was printed by order of the House of Commons, and in tables filling 50 folio pages, shows the rates of mortality and the values of annuities on single lives at all ages, among

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* An estimate of the mortality of mankind, drawn from various tables of the births and funerals in the City of Breslau, with an attempt to ascertain the price of annuities upon lives, by Mr. E. Halley, *Transactions of Royal Society, London*, vol. xvii., 1693, p. 596, No. 196.

† Essai sur les Probabilités de la Durée de la Vie Humaine, 1746.

‡ Milne on Annuities, 1815. See also two articles by Mr. Milne in the Encyclopædia Britannica,—"Annuities" and "Mortality."

many different classes of annuitants, both separate and combined, the sexes being generally distinguished in exhibiting both the law of mortality and the value of annuities."*

The Equitable Assurance Society published in 1834 a valuable abstract of the accumulated facts in their possession, from which Mr. Morgan deduced a table of mortality. The excellent example of the Equitable Society was followed by the Amicable Society. The Societies' abstracts distinguished the persons who entered at each year of age, a point which, it is to be regretted, was neglected in Mr. Finlaison's tables, although the granting of annuities calculated on the lives of persons, sick or healthy—to selected persons in health, particularly at advanced ages, is well known to be, and has since proved, a matter of serious importance in a pecuniary point of view.

At the suggestion of Dr. Cleland, the civic authorities of Glasgow, with a laudable zeal, enumerated the ages of the population of that city in 1831; and the registration of deaths was so complete, that Mr. Milne was enabled to construct "a table of mortality, which he expects to publish," from the observations made in the 10 years 1820–30. I am not aware that any other set of observations has appeared from which a true life table can be constructed. I have already stated that Sweden is the only *nation* for which tables of this kind have been constructed upon correct principles. France has no accurate life table;† nor have the *data* from which a life table can be constructed, namely, the ages of the living and the dying, ever been published. No life tables have been constructed for the population of Prussia or of Austria; but the *data* exist, and have to a certain extent been published, though in forms which present considerable obstacles to the calculation. The Census of Prussia, in which the ages are distinguished, is taken every three years; and periodical abstracts of the deaths have been carefully made by Mr. Hoffman. The ages of the living are, however, unfortunately divided in an irregular manner, entirely different from the correct divisions adopted by Mr. Hoffman in the returns of deaths: which renders it impossible, without a preparatory interpolation, to compare the deaths with the living at the several given ages. The same objection applies to the forms of the Austrian returns. Registers of deaths are kept by the clergy of the Russian empire; but I am not aware that life tables have been framed for any portion of the Russian population. The Census has been taken decennially with great regularity in the United States of America, and the ages are properly distinguished; but abstracts of the registers of deaths have only been published by the cities of New York, Philadelphia, Boston, and some of the more advanced towns where property has accumulated, and life is watched over with more care or facility than in the back settlements —scantily peopled, with a fluctuating population. No correct life table can therefore be formed for the population of America, until they adopt in addition to the Census, the system of registration which exists in European States.

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* "Annuities," Encyclopædia Britannica, 1831, p. 203.

† Duvillard states that his table, which is used by French life offices, and is given every year in the *Annuaire de France*, was founded on 100,542 deaths, at different ages, in different parts of France, among a population of 2,920,672. He has said very little about the *data*. The mean duration of life in France, according to Duvillard's table, is only 28·76 years. The duration of life is, I believe, longer in England than in any other country; but it is scarcely credible that the lives of Frenchman should be 12 years shorter than the lives of Englishmen, and 10 years shorter than the lives of Swedes. The table probably involves the same errors as the Northampton Table.

Since an English life table has now been framed from the necessary data, I venture to express a hope that the facts may be collected and abstracted, from which life tables for other nations can be constructed. A comparison of the duration of successive generations in England, France, Prussia, Austria, Russia, America, and other States, would throw much light on the physical condition of the respective populations, and suggest to scientific and benevolent individuals in every country—and to the Governments—many ways of diminishing the sufferings, and ameliorating the health and condition of the people; for the longer life of a nation denotes more than it does in an individual—a happier life—a life more exempt from sickness and infirmity—a life of greater energy and industry, of greater experience and wisdom. By these comparisons a noble national emulation might be excited: and rival nations would read of sickness diminished, deformity banished, life saved—of victories over death and the grave,—with as much enthusiasm as of victories over each other's armies in the field; and the triumph of one would not be the humiliation of the other; for in this contention none could lose territory, or honour, or blood, but all would gain strength. (5th Annual Report, pp. 16–19.)

Rural and Urban Life Tables; Surrey, London, and Liverpool.—As it might be expected, from the similarity of the human organisation, that all classes of men would, *cæteris paribus*, live on an average the same number of years, it becomes important to ascertain whether this be the case; and if it be not, to determine to what extent life is shortened in unfavourable circumstances. The life table answers this purpose; and is as indispensable in sanitary inquiries as the barometer or thermometer, and other instruments in physical research. Upon applying it in a number of well-selected cases the influence of any external cause or combination of causes can be analysed; while without its aid and extended observation and calculation we are liable to be misled at every step by vague opinions, well-concocted stories, or interested statements, in estimating the relative duration of life; which can no more be accurately made out by conjecture than the relative diameters of the sun, moon, and planets of our system.

Three examples of the application of the table to the determination of the relative duration of life in three different portions of the population of this country have been calculated; the population of Surrey (out of the Metropolis), of the Metropolis, and of Liverpool. Surrey presents a specimen of the rate at which life wastes in the country population; Liverpool is an example at the other extreme, of the effects of concentration in towns, without any adequate provision for removing the effluvia, and for securing by art the degree of purity in the dwellings and atmosphere which is partially maintained by nature in an open cultivated country. It should be distinctly understood that Surrey has not been selected as the healthiest county, and to state that it will probably be found upon inquiry that there are parts of most towns in England as unfavourable to human life as Liverpool.

The population of the extra-metropolitan parts of Surrey happens to be a little greater than the population of Liverpool, yet in 1841 the deaths in Surrey were 4,256, the deaths in Liverpool 7,556. Out of 14,450 boys under 5 years of age 2,087 died in Liverpool; of 14,045 boys in Surrey, only 699 died in the same time. By this immense mortality in Liverpool the number of males living at the age of 10–15 is reduced much below the number in Surrey at a corresponding age; the living in Surrey aged 20–30 were 18,746, but the influx of immigrants into Liverpool raised the number of males living there at that age to 23,494, who were rapidly cut down by sickness and death; so that at the age 45–55, only 7,504 males were enumerated in Liverpool, whils 9,281 were living in Surrey. From the Life Tables we shall be able to determine how many survive each successive age, and to calculate the expectation of life.

According to the Surrey observations 75,423 of 100,000 children born, attain the age of 10 years; 52,060 live to the age of 50; 28,038 to 70: in Liverpool only 48,211 of 100,000 live 10 years; 25,878 live 50 years; and 8,373 live 70 years: in the Metropolis 64,921 live 10 years; 41,309 live 50 years; and 16,344 live 70 years. The probable duration of life in Surrey is 53 years, in the Metropolis 40 years, in Liverpool 7 or 8 years: the Expectation of life does not differ so enormously; it is, however, 45 years in Surrey, 37 years in the Metropolis, and only 26 years in Liverpool; at the age of 30 the expectation of life is 35 years in Surrey, 27 years in Liverpool; at 50 the expectation of life is 21 years in Surrey, 16 years in Liverpool.

EXPECTATION OF LIFE (in Years).

Age.	PERSONS.			MALES.			FEMALES.		
	Surrey.	Liverpool.	Metropolis.	Surrey.	Liverpool.	Metropolis.	Surrey.	Liverpool.	Metropolis.
0	45	26	37	44	25	35	46	27	38
1	50	33	43	50	33	41	50	34	44
2	51	38	46	51	37	45	52	39	48
3	52	41	47	52	40	46	52	42	49
4	52	42	48	52	41	46	52	43	50
5	52	43	48	51	42	46	52	43	50
10	49	41	45	49	41	44	49	42	47
15	45	37	41	45	37	40	45	38	43
20	42	34	38	42	33	36	42	34	39
25	38	30	34	38	30	32	38	31	35
30	35	27	30	35	27	29	35	27	32
35	31	24	27	31	23	25	31	24	28
40	28	21	24	28	21	22	28	22	25
45	24	18	20	24	18	19	24	18	22
50	21	16	18	21	16	17	21	17	18

It might be cited as an illustration of the necessity of registration and of calculation in these matters, that, before the Annual Abstracts of Deaths were published, some of the best informed people believed Liverpool one of the healthiest spots in England; and the late Mr. Rickman inserted, doubtless on what he at the time considered good authority, the following note in the Population Abstracts of 1831:—"The great *increase in the town of Liverpool is attributed to the* "*salubrity of the air*, and the progressive improvement in its trade, "commerce, steam navigation, and railroads."

It has been stated that the mean duration of life in Surrey is about 45, in Liverpool about 26 years; now if all the inhabitants lived 45 years in Surrey and 26 years in Liverpool, the difference would be obvious; but such is not the law of nature; in both a certain number of deaths takes place at all ages, and at the Census 3 males and 11 females were returned as living in Liverpool at the advanced age of 95 years and upwards. Little dependence, it is true, can be placed upon the statements of age in the table deduced from the returns in one year

(1841) after the age of 90; but though it is quite possible that isolated individuals may live 100 years in Liverpool, they have little or no effect on the average duration of life, which differs from that of Surrey, as has been already seen, in the proportion of 26 to 45 years.—(5th Annual Report, pp. 31–7.)

Uncertainty of Individual Life and Constancy of Averages.—Addison, in one of his popular papers, "The Vision of Mirza," has an allegory which was probably suggested by Halley's table; he compares "human life to a bridge consisting of threescore and ten entire arches, "with several broken arches, which, added to those which were entire, "made up the number to about a hundred." "I see multitudes of "people passing over it," said I, "and a black cloud hanging on each "end of it. As I looked more attentively, I saw several of the "passengers dropping through the bridge into the great tide that "flowed underneath it; and upon further examination perceived there "were innumerable trap-doors that lay concealed in the bridge, which "the passengers no sooner trod upon, than they fell through into the "tide, and immediately disappeared. These hidden pitfalls were *set* "*very thick at the entrance of the bridge*, so that throngs of people "no sooner broke through the cloud, but many of them fell into them. "They *grew thinner towards the middle, but multiplied and lay closer* "*together towards the end* of the arches that were entire." Our life table follows "a throng" of 100,000 that "brake through the cloud" into life at the same moment, and counts them as they step on every arch. It shows, therefore, how many fall through the "hidden pitfalls." The danger is exactly measured. The arches over which sickly multitudes pass, are the same in number as those traversed by a healthy people; but the "trap-doors" and "hidden pitfalls" in their way are twice as numerous, though they can only be perceived by careful observation and counting; while a difference of 26 and 45 "arches" would be obvious to the unassisted eye.

In the law which regulates the waste of life two things have been reconciled: the uncertainty of the hour of death, and the constancy in the same circumstances of the mean duration of man's existence. The days of successive generations are numbered, yet a child born to day may die in any day, hour, or minute, of the next *hundred years;* and until a very advanced age the chances always are that the time of death will be several years distant: the danger of death we know varies at different ages, and in different states of health; but if the limit of life be 100 years, it is on an average 36,525 to one that a person will not die on a given day; 876,600 to one that he will not die on a given hour, and 52,596,200 to one that he will not die at a given minute. These chances—which vary as life advances—are so low that practically they have little or no influence in ordinary affairs; and as a general rule men have no fear of dying upon any *day;* yet the knowledge that they *may* die at any instant exercises a salutary check upon their conduct; and, notwithstanding its sometimes appalling effects, the changing certainty or uncertainty of life, according to the different aspects and points of view, is in harmony with the feelings, hopes, moral constitution, and destinies of mankind.

The serious disadvantage which arose from the difficulty of perceiving the changes in the duration of life, and consequently the influence of external causes upon health and longevity, has now been overcome in this country by the arduous labours of scientific inquirers, and by the conjoint enumeration of the ages of the population and the registration of births and deaths.

Man does not pass through all the stages of his physiological and intellectual development in less than 70 years: yet it has been shown that in the most favourable circumstances in which large bodies of the English population are placed, the mean life attained is only 45 years; and that other large bodies of the people fall short of this relatively low standard, to the extent of nineteen years—years of childhood and youth principally—years of toil too and poverty perhaps, but of life—years also of manhood in its prime, wisdom in its maturity, virtue in its height of usefulness and glory. The facts and calculations upon which these results rest, will not be disputed by those who have studied the subject most deeply; I believe that they will be confirmed by the still more extended data which are every year accumulating under the present system of Registration. In the mean time enough has been advanced to direct public attention to the "hidden pitfalls," which had so long lain concealed, which destroy every year thousands of lives, and which it is believed admit, to a considerable extent, of removal by the judicious application of sanitary measures.—(5th Annual Report, pp. 37-8.)

Mean Duration of Life and Mean Age at Death.—As the mean duration of life, technically called the expectation of life, differs very widely from the "mean age at death," and from some éstimates which have been made of the relative health of different portions of the population, it may be right, before I close this Report, to point out the errors into which inquirers are liable to fall in reasoning upon the "age at death;" or, which is the same thing, constructing life tables from the deaths alone. Mr. Milne has very clearly pointed out the fallacies of all calculations and pretended tables of mortality, founded upon returns of the ages at death alone; and I should consider it sufficient to refer to his able article "Mortality" in the "Encyclopædia Britannica," if the error had not survived and assumed new forms very much calculated to mislead those who have had time to pay but a cursory attention to the subject.

The duration of life in England is 41 years; if the population were *stationary* the mean age of those who died would be 41 years; and 1 in 41 would die every year. The population has however increased 1·41 per cent. annually during the last 40 years; and we find that the mean age of the persons who died in the year 1841, instead of being 41, is 29 years; while 1 in 46 of the population died. This agrees with what Mr. Milne lays down as the result of other observations, that "when the population has been increasing, the mean duration of life "according to the table will be less than the number out of which one "person dies annually in that population, but *the difference will be* "*small* except under particular circumstances;" and again, that the mean age at which persons die "will fall short of the number of the people "out of which one dies annually *by a much greater number* than in "the case we have just been considering." "When the proportion of "the people dying annually is known," he adds, "it will not be "difficult to judge whether a table of mortality for that people has "been constructed properly from the necessary data; or, what is much "more common and more easily effected, by summation of the deaths "at all ages."* "The mean age at death," it may be here stated, is obtained by simply summing up the ages at which people die, and

* By applying this test, Mr. Milne has shown that some recent life tables—the mode of constructing which has not been explained—have been constructed from the ages at death alone—apparently without any kind of correction.—*See* Article "Mortality" before referred to.

dividing the number of years by the number of deaths. It is only a pity that the method is not as accurate as it is easy.

Its errors may be further illustrated by comparing the English with two foreign observations:

	Mean duration of Life.	Mean Age at Death.	One Death in
England, (1841) -	41 years.	29 years.	46 Living.
France, (1817–31) -	40 „	34 „	42 „
Sweden, (1801–5) -	39 „	31 „	41 „

The average age of the persons who died, or the "mean age at death," was 34 years in France, 31 years in Sweden, 29 years in England; yet we know that the "expectation of life" is greater in England than in Sweden or in France. A Society that granted life annuities to children in England would have to make 40 annual payments on an average, and only 38 in Sweden. The annual funerals were inversely as the "mean "age at death," or 1 in 41 in Sweden; 1 in 42 in France; 1 in 46 in England. Mr. Milne has stated the fact, at first sight paradoxical, that in an increasing population the average age at death is less, and the annual mortality less, than in a stationary population having the same expectation of life. I will endeavour to explain the cause of this as briefly as possible.

The births exceed the deaths in England, and in the year 1841 the births registered amounted to 512,158, the deaths to 343,847. If the population were stationary the births would be 343,847; they would maintain the existing population; but the annual excess of 168,311 children, more or less, which have been thrown for many years into the English population has produced a preponderance of the youthful over the aged part of the population. If the law of mortality had remained constant, and the births and deaths had been equal for the last century, it would have been found that on an average about 35 in 100 of the people were under 20, and 14 in 100 above 60 years of age; but it appears from the last Census that 46 in 100 were under under 20, and only 7 in 100 above 60 years of age.

The people are younger than in France, or Sweden; the mean age obtained by dividing the sum of the ages of those who die in England by the number of deaths is consequently lower than the age at death in Sweden and France. But why, it may be asked, is the mortality 1 in 46 if the expectation of life be 41 years? The reason is, that as the increase of the population has been long and progressive, an excess has been accumulated of persons between the ages of 5 and 55, among whom the mortality is lower than it is among persons of all ages. With the reduction in the relative numbers above the age of 60 this has more than compensated for the high rate of mortality among the excessive number of children under 3 years of age; and has reduced the mortality below 1 in 41 annually, which it would be if the population were stationary. As the populations of France and Sweden have not increased more than half as fast as the English population, the diminution of the age at death has been less considerable, though sufficient to derange all calculations and all comparisons, such as that of the "mean age at death" deduced upon the supposition that in the populations compared the births and deaths have been equal,—the mortality uniform,—for a long series of years.

The deaths of children under 1 year of age were 74,210 in the year 1841, and the total deaths 343,847. But it must not be inferred in cases of this kind, as it has been frequently, and as it always is in tables of mortality deduced from the ages at death alone, that 74,210 of 343,847 children die in their first year. Nothing can be more erroneous: the deaths occurred out of a number certainly not less, and probably more, than 512,000; for though all the births have not been registered, the births of 512,158 children were registered in the year 1841, and 502,303 in 1840. The error is as striking when the deaths under 5 years of age are compared with the total deaths, instead of the births, in the preceding years.

If the reasoning upon "the mean age at death" be employed to determine the relative salubrity of towns and professions as well as of different classes of the community, the nature of the results may be readily divined. The mean age at death is 29 years in England, 29 years in the Metropolis, 34 years in Surrey; the true mean durations of life being nearly 41, 37, and 45 years, so that the errors by this method amount to 12 years, 8 years, and 11 years! The rate of increase, the duration of the increase of population, the emigration, the relative numbers of children and adults, the mean age of the living—upon all of which the "mean age at death" depends—differ in town and in country, in agricultural and manufacturing districts, to an extent which renders any application of the method to the construction of local life tables, or to the calculation of the relative duration of life, difficult and doubtful, if the proper corrections be made; absurd and misleading, if the "mean age at death" be taken to represent the expectation of life.

The numbers following different professions fluctuate more than the general population; the relative proportion of young and aged persons varies from year to year; certain professions, stations, and ranks are only attained by persons advanced in years; and some occupations are only followed in youth; hence it requires no great amount of sagacity to perceive that "the mean age at death," or the age at which the greatest number of deaths occurs, cannot be depended upon in investigating the influence of occupation, rank, and profession upon health and longevity. If it were found, upon an inquiry into the health of the officers of the army on full pay, that "the mean age at death" of "Cornets, Ensigns, and Second Lieutenants" was 22 years; of "Lieu-"tenants" 29 years; of "Captains" 37 years; of "Majors" 44 years; of "Lieutenant-Colonels" 48 years; of general Officers, ages still further advanced—and that the ages of Curates, Rectors, and Bishops; of Barristers of seven years' standing, leading Counsel and venerable Judges—differed to an equal or greater extent, a strong case may no doubt be made out on behalf of those young, but early-dying Cornets, Curates, and Juvenile Barristers, whose "mean age at death" was under 30! It would be almost necessary to make them Generals, Bishops, and Judges—for the sake of their health. The Assurance Societies are happily so considerate and liberal that they do not attach the slightest importance to the mean age at death, but assure the lives of young men of all the professions at the age of 24 upon the assumption that they will live 38 or at the least 31 years, and pay 38 or 31 annual premiums on an average before they die; while they make the Bishops, Judges, and Generals who go to insure their lives at 60 pay as if they would live but 13 or 14 years.

It has been somewhere stated that the "mean age at death" of dress-makers is exceedingly low, and this has been adduced as a proof of the destructive effects of their employment. If the inquiries had been extended to boarding schools, or to the boys at Christ's Hospital, the "mean age at death" would have been found still lower. Mr. Grainger states, in his interesting Report, that the majority of dress-makers are between the ages of 16 and 26; and it is understood that if they die after they marry they are not often designated by that title in the register. This source of error and the increase of population will be found to affect the estimate of the influence of other occupations. That the lives of dress-makers are very much shortened by the severe hardships and ignorant mistreatment to which they are exposed cannot be doubted; but false arguments injure instead of aiding their cause.

In a thriving commercial country like England there is a general movement, such as has been noticed in the army and the liberal professions—from the lower into the higher ranks of society. The servant becomes a master; shop-boys grow into merchants or aldermen; the tradesman retires and is classed either as "independent," "in easy "circumstances," or a "gentleman," at the Census, and in the mortuary registers. But these promotions as a general rule are slow; and those only attain the higher positions who live long. If the mean age, at which masters and servants, the wealthy and indigent die, were noted and made the basis of any reasoning respecting the relative health and longevity of the lower and upper classes, the differences would evidently be exaggerated. The exaggeration is increased in another way; many poor people are reduced to seek an asylum at advanced ages in the workhouses, and are not often designated by the occupations which they followed in manhood, but by the general name "paupers": the ages of those who die in the ranks of their respective trades and professions are thus reduced to the same extent as the ages of the paupers who die in workhouses are raised above the average. In 1841 the mean age of 45,507 persons who died in London was 29 years; the mortality was 1 in 40; in the same year 4282 persons died in the London workhouses at the advanced age of 49 years, which they must have nearly attained before they entered those establishments, inasmuch as the mortality there appears to have been about 22 per cent., or 1 in 5 annually.* Contrast 49, the "mean age at death," of paupers in the workhouses, with other statements, which make the "mean age at "death" of the same or a superior class of persons 16 or 20 years.

One in 116 of the boys in Christ's Hospital died annually, in the 12 years 1831–42; the mean age of the boys who died was 11 years. The "mean age at death" and the mortality were both low. This illustration, taken from an extreme instance, shows why, while the mortality is lower, the mean age at death is less in England than in some other countries. The English population contains more young persons, more of the age of the Christ's Hospital boys, than the foreign populations.

The life table affords the most satisfactory measure of the relative duration of life, either of classes or of different communities. The mortality obtained by dividing the deaths by the living at each age, is also an unimpeachable test; it is the preliminary to the construction of a true life table. The ratio of the total deaths to the total population affords the next best test that can be employed; if the populations compared be of the same age, their relative mortality will be correctly given by this method; if the ages and the rate of increase differ, the "mean duration of life will be less than the number out of which *one* "dies annually, but the difference will be small in the increasing popu- "lation." The "mean age at death," or pretended life tables constructed from the deaths, without reference to the ages of the living, or the ages of the living without the ages of the dying, are, as I have already stated, only calculated to mislead in inquiries of this kind, unless great care and discrimination be employed in their application. It happens, nevertheless, in some cases that they afford the only resource; the total

* The pauper population of the London Workhouses was 19,412 at the time the Census was taken in June; it would probably be greater in Winter.

deaths are not registered, or the ages of the living have never been enumerated; the ages at death may then be compared with the ages at death of *other populations—known to be increasing at nearly the same rate*, or corrections may be made upon the hypothesis of a uniform rate of increase during a certain number of years.

In France, for instance, where the ages of the living have never been abstracted, M. Demonferrand has constructed a life table, which is probably not very erroneous, from the ages at death; assisted, however, most essentially by the complete registration of births, and the annual enumeration of the young men who attain the age of 20. In Ireland, where the deaths are not registered, abstracts have been made of the ages of the population; and the Commissioners of the last Irish Census included in "the personal return a table in which every head of a "family was requested to insert all the deaths which had occurred in "his family within the last ten years, stating the cause of each death, "and the age and occupation of the deceased." In addition to this, they sent to every hospital and lunatic asylum forms which were filled up. From the ages at death thus obtained they constructed tables, which will be found in pages 80–82 of their Report—a Report, I may remark in passing, which is replete with valuable information. As the population of Ireland, notwithstanding the emigration going on, increased 14·19 per cent. in the 10 years ending 1831, and 5·25 per cent. in the 10 years ending in 1841, the births must exceed the deaths. The tables, which could only be correct if the births and deaths had been equal, and there had been no emigration, are therefore not true life tables; and the "expectation of life" deduced from them, which is 29 years at birth in the "rural," and 24 years in the "civic" districts, must be understated to a certain but unknown extent. The deaths returned for the year 1840 were 141,536, making the mortality 1 in 57·5: the return is evidently defective, but, as the Commissioners correctly remark, this will not affect "the mean age at death," provided that the deaths omitted occurred at the same ages as those returned. The Commissioners had not at their disposal the *data* requisite for calculating the true "expectation of life" in Ireland: the application of the term is an inadvertency rather than an error, and I should not have noticed it here, if the tables had not afforded some interesting points of comparison with the English observations. Tables have been constructed from the deaths in England, upon the same plan as the Irish tables; and if the population of the two Divisions of the United Kingdom had increased for many years at nearly the same rate, or if the emigration had been nearly in the same proportion, the "expectations of life," as we may call them for a moment, will be equally erroneous: they may therefore be compared. The results are given in the following tables.

EXPECTATION OF LIFE.—MALES AND FEMALES.
(Erroneously deduced from the Deaths alone.)

Age.	Males.			Females.		
	England.	Ireland, Civic Districts.	Ireland, Rural Districts.	England.	Ireland, Civic Districts.	Ireland, Rural Districts.
0	28	24	30	31	24	29
5	42	35	41	42	35	40
20	35	28	34	36	29	33
40	25	19	23	27	20	23
60	14	11	13	15	12	12

EXPECTATION OF LIFE.—PERSONS.

(Erroneously deduced from the Deaths alone.)

Age.	Ireland.		England.					
	Civic Districts.	Rural Districts.	England and Wales.	Surrey.	Metropolis.	Liverpool.	London,* 1728-37.	London,† 1759-68.
0	24	29	29	34	29	21‡	19	26
5	35	41	42	44	42	36	36	39
20	28	33	35	37	33	28	29	29
40	19	23	26	27	22	19	20	20
60	11	13	14	15	12	11	12	12

* From Simpson's Select Exercises. The observations were corrected (?) by Simpson.
† Deduced from Dr. Price's Table 13.
‡ The more exact "mean age at death" in Liverpool is 20·54.

The "expectations of life" (if we may call them so,) are the same at birth in the "rural districts" of Ireland as in all England; they are less after 20, but agree remarkably at all ages with the expectation of life in the Metropolis. This resemblance between a table of the ages at death in a city, and the ages at death in the rural districts of Ireland, would be caused to a certain extent by a diminution in the latter of the proportion of births within the last 10 years. The (erroneous) "expectations "of life," in the "civic" districts agree after 20 with those of Liverpool; at birth the expectation is higher in the Irish towns than in Liverpool, but lower than in London. The "expectation of life" therefore is not so low as it is represented in the tables of the Commissioners. Judging from the analogy of the English tables, the expectation of life is less in Ireland than in England; the inhabitants of the "civic" districts, perhaps, attaining a mean age of 30 years, while in the rural districts they live on an average to 37. The life tables of the Metropolis, and Liverpool or Manchester, would probably apply to the two sections of the Irish population; but this can of course be only conjecture. The Irish tables may be corrected to a considerable extent by means of the ascertained rate of increase, and the enumerated ages of the living; some of the methods to be employed were investigated by Euler, and are given by Lacroix in his "Traité élémentaire des Probabilités,"* p. 207. Implicit confidence, however, could not be placed in the results.

It is a curious feature of the Irish tables that the men appear to live longer than the women in "rural" districts; and the women longer than the men in "civic" districts. Frenchmen live longer after 20 than the women, if the expectations of life in the two sexes be equally correct or incorrect in M. Demonferrand's tables. In England the lives of females exceed those of males by about a year—except at birth, when the difference is greater. In Surrey the females from the age of one year and upwards live little longer than the males; the difference is greater in the Metropolis, where it amounts, at some ages, to two or three years. This may, perhaps, account for the differences in the expectations of life deduced from male and female annuitants. According to Mr. Finlaison's tables—the lives of men are from four to six years shorter than those of women; a discrepancy which in its extent is entirely at variance with all other observations. If the majority of the annuitants before 1829 were inhabitants of London, and more than a

* Mémoires de l'Académie de Berlin, anno 1760, p. 144.

due proportion of the women lived in the country, such a discordant result would however be produced.—(5th Annual Report, pp. 38–46.)

Mean Duration of Life deduced from incomplete Observations.—A publication has appeared professing to give the mortality which has prevailed among seventeen life offices.* The author, Mr. Jones, states that "by the liberality of several of the life offices, and the disinterested "zeal and services of a committee of some of the most experienced "and eminent of the actuaries, we have now data for the construction "of a rate of mortality, not simply of the experience of the Equitable "and Amicable, but of the combined experience of no less than 17 life "offices, embracing 83,905 policies; and a rate of mortality has been "adjusted by one of the most eminent mathematicians on the committee, "from the combined town and country experience, embracing 62,537 "assurances."—(*Int.*, p. x.) "The committee state that "the most "striking features exhibited in these tables are the *great mortality* "*that prevails among Irish lives, and the marked difference in the* "*rate of mortality among males and females.* The near agreement with "each other of the tables for 'town' and 'country' assurances is also "very remarkable, considering that no adjustment has been employed." "(p. xvi.) The committee very justly observe that their tables "represent a *lower rate of mortality than can be expected to prevail* "*in a longer period of time than that over which the present observa-* "*tions extend;* for the average duration of policies embraced in nearly "one-half of the experience is *under* $5\frac{1}{2}$ *years;* and taking the whole "of the experience together, which includes that of the 'Equitable' "and 'Amicable,' the two oldest offices existing, the average duration "of all the *policies* is *not* $8\frac{1}{2}$ *years.*" (p. xix.)

These tables are exceedingly interesting, as they show the experience of the life offices so far as it extends, and the actual effect of their more or less imperfect selection of lives. It is an objection to all tables framed in this manner, on the experience of life offices and on annuitants, that you have to wait 50 or 100 years before all the lives have expired, and have then, in applying them practically, to assume that the future annuitants, &c., will be selected on the same principles, and be placed in the same circumstances.

The most conflicting results are necessarily obtained by the incomplete observations; thus, while Mr. Finlaison's Table makes females at 20 live 44·0 years, and males 38·4 years, the Actuaries' Table presents a result exactly the reverse: females selected for assurance at 20 have, according to their table, an expectation of 35·9 years, males of 39·8 years!

It will be observed that the expectation of life among males, by the English Table, lies between the expectations of life for males by Mr. Finlaison's and the Actuaries' Tables; it agrees very closely with the mean expectation of the two tables. The expectation by the former, at the age of 41, is 26·39 years, by the latter 25·42; the mean is 25·91 years; and the expectation of life is 25·91 by the English Table; so it happens that neither of the tables from incomplete observations is very incorrect for males. With regard to the expectations of females, Mr. Finlaison's and the actuaries' statements differ to the extent of eight years at the age of 20; at the age of 26 the expectations, according to the two statements, are 40·17 years and 33·79 years —difference, 6·38 years—mean, 36·98 years. The expectation of life for a woman aged 26 is 36·86 years by the English Table; Mr. Finlaison's result is 3·19 years above, the Actuaries' 3·07 years below the

* A Series of Tables, &c., by Jenkin Jones, 1843.

average of the national table; while the expectation of life for males is nearly the same at 26 by the three tables—namely, 35·41, 35·88, and 35·65 years.

DIFFERENCES from the English Table, by excess or defect, in the Expectations of Life deduced from Mr. Finlaison's and the Actuaries' Tables.

MALES.				FEMALES.		
Age.	Expectation of Life by English Table.	Differences by		Differences by		Expectation of Life by English Table.
		Mr. Finlaison's Table.	Actuaries' Table.	Actuaries' Table.	Mr. Finlaison's Table.	
	Years.	Year.	Year.	Defect in Years.	Excess in Years.	Years.
20	39·88	—·49	—·04	—4·95	+3·18	40·81
25	36·47	—·57	+·16	—3·11	+3·29	37·52
30	33·13	+·04	+·04	—2·52	+3·32	34·25
35	29·83	+·34	—·31	—1·92	+3·32	30·99
40	26·56	+·46	—·50	—1·36	+3·40	27·72
45	23·30	+·45	—·67	—1·22	+3·38	24·43
50	20·02	+·28	—·61	—1·02	+3·28	21·07
55	16·68	+·47	—·47	—0·85	+3·16	17·63
60	13·59	+·80	—·12	—0·62	+2·92	14·40
65	10·86	+·77	+·01	—0·92	+2·48	11·52
70	8·51	+·71	—·17	—1·10	+1·96	9·03
75	6·53	+·59	—·50	—1·55	+1·54	6·92
80	4·92	+·02	—·17	—0·45	+1·30	5·20

Thus, at the age of 40, the mean future duration of life is 26·56 years for males, according to the English Table; or ·46 of a year more by Mr. Finlaison's Table; and 0·50 years less by the Actuaries' Table: at the same age for females, the Actuaries' Table differs from the English Table 1·36 year by defect; Mr. Finlaison's Table 3·40 years by excess. The sign +, *plus*, denotes excess over the expectation by the English Table. The sign —, *minus*, denotes the reverse.

The expectation of life is less for *males* by Mr. Finlaison's than by the Actuaries' Table up to the age of 30: it is afterwards more; but in females the difference in the expectation is enormous.

Age.	Difference in the Expectation of Life by Mr. Finlaison's and the Actuaries' Tables.	
	Males.	Females.
	Years.	Years.
20	— ·45	+8·13
25	— ·73	+6·40
30	·00	+5·84
35	+ ·65	+5·24
40	+ ·96	+4·76
45	+1·12	+4·60
50	+ ·89	+4·30
55	+ ·94	+4·01
60	+ ·92	+3·54
65	+ ·76	+3·40
70	+ ·88	+3·06
75	+1·09	+3·09
80	+ ·19	+1·75

The sign + denotes excess of the expectation by Mr. Finlaison's over that by the Actuaries' Table.

Although the tables of the "Actuaries" and their remarks, referred to in this publication are, from some cause not satisfactorily explained, inaccessible to the public, it would appear from the statements of Mr. Jones that the tables are considered by them incomplete, and not a safe basis for the guidance of pecuniary transactions. It is scarcely necessary to add that, although no such great difference in the longevity of the two sexes exists in nature, it can readily be conceived that men and women may be selected whose lives differ, or appear from an incomplete series of observations to differ, as much as the lives of the males and females in the Actuaries' and Mr. Finlaison's Tables. (5th Annual Report, pp. 338–41.)

Construction of Life Tables; De Moivre's Hypothesis.—De Moivre gave his name to an hypothesis, according to which the numbers living decrease in an arithmetical progression down to nothing, at the age 86.* It has been since assumed, as stated by Mr. Milne, that "*the* " *number* of the living in any year of their age is an arithmetical mean " proportional between the numbers that annually enter upon and that " annually complete that year."† If δ deaths occur in a year, upon this hypothesis, they are assumed to take place "at δ equal intervals"; and it is by the same hypothesis that, in calculating the expectation of life, writers assume that "the number of living of the age of n years " and upwards is less than the sum of those that annually complete " that and all the greater ages by half the number that annually com- " plete that year of their age."—(*Milne*, pp. 85–6.) This hypothesis, which is interwoven into all the calculations of interest and of life annuities, brings them within the range of algebra; for, without the assumption that the interest of money and the mortality remained uniform for some certain definite time, the resources of the calculus must be called into requisition. The errors which result in life assurance from the hypothesis of an equal decrement are small and quite insignificant when compared with the errors of observation, and the errors incurred by the assumption that the interest of money and the mortality will remain stationary for a long series of years. Still, it must be borne in mind that the rate of mortality varies (insensibly) every moment, and that the errors involved in the hypothesis are greatest in the first year of life. By making the births the basis of the table (if the births are all registered), the decrement in the first year, where the error would, by the other method, be of some magnitude, will be correctly represented. The deaths in the second year of life, out of 100 constantly living, were 6·503; and, by the hypothesis, 1·03252 would be alive at the beginning, ·96748 at the end of the second year; the fraction $\frac{96748}{103252}$ would therefore express the chance of living the second year. If 43,104 were alive at the beginning, 40,388 would be alive at the end of the second year; for 103252 : 96748 : : 43104 : 40388; or $\frac{96748}{103252} \times 43104 = 40388$. In this manner the series, down to 5 years may be calculated. The mortality against the age 5–10, namely, ·00955, was taken to represent the mortality of the middle year (in this instance 7–8), and the mortality of the intermediate years was interpolated. As the series is short, and terminates at 10–15, it is not easy to test any theory of interpolation, particularly as the mortality at 10–15 is, I believe, through the error of speaking in tens, understated. It is improbable that the mortality of 10–15 should be 50 per cent. lower than the mortality at 15–20. Neither this nor any

* Treatise of Annuities on Lives; Preface, &c., by De Moivre.

† Milne on Annuities and Life Assurances, p. 85.

other table which I have seen, derived directly from observation, is very satisfactory up to the age of 15; although the earlier ages must generally be known, they have not been so correctly stated at the censuses as could be desired. Whatever system of interpolation may be employed, however, the expectation of life will not be much affected by it from 1 to 15; and the numbers after 15 are quite independent of those before 15. In framing the English Table (No. 1), the *mortality* at every age was interpolated by the logarithm which expressed the ratio of the increase in the mortality at every year of life; and the chance of living each year was deduced from $\frac{1-\frac{1}{2}m}{1+\frac{1}{2}m}$.

I do not find that Dr. Price ever explained the method of interpolation which he employed in framing the Northampton or Swedish Tables of Mortality. It was probably empirical. Mr. Milne has adduced, in his excellent Treatise, a method by which he says, "when "the number of the living and of the annual deaths are taken for "intervals of several years each, the number of the living in each "particular year of their age, included in any one of those intervals, "may be interpolated with sufficient exactness."* He has also given, in the eighteenth table of his work, "the logarithm of the fraction "which measures the probability that a life of an assigned age will "survive one year, according to the *Carlisle* Table of Mortality." (5th Annual Report, pp. 349–50.)

A Short Method of constructing Life Tables.—The arithmetical labour involved in the construction of correct life tables, showing the living at every year of age, is very considerable. But for a great many purposes the number surviving every five years, after the five first, and the expectations of life at those intervals, furnish quite sufficient information. These results were obtained by employing the following method in calculating the life tables for the Metropolis, Surrey, and Liverpool:—

Up to the age of five years the method is the same as that already described,† and it was thus found that of 50,521 boys born in Surrey, 43,637 live a year, 41,857 two years, 40,704 three years, 40,031 four years, 39,550 five years. The next point was to determine how many of the 39,550 attain the age of 10 years. The living enumerated at the age 5–10 were 13,588, the deaths 145; and after the proper correction the mortality m was ascertained to be $\cdot 01050$; so $\frac{m}{2} =$ $\cdot 00525$, and $\frac{1-\frac{1}{2}m}{1+\frac{1}{2}m} = \frac{\cdot 99475}{1\cdot 00525} = \cdot 98955$ the probability of living *one year* at the middle of the period, or at seven and a half years of age. But it may be assumed that $\left(\frac{1-\frac{1}{2}m}{1+\frac{1}{2}m}\right)^5 = p_{5,5} =$ the probability of living the *five years* from the age of 5 to 10; and $(\cdot 98955)^5 =$ $\cdot 94885$; which, multiplied by 39550, gives 37527 = the numbers surviving at the age of 10.

* Annuities and Assurances, p. 100.

† *See* previous extract, p. 464.

If the calculation be continued down to 15, 20, 25, and every fifth year to the end, the following table will be obtained :—

SURREY LIFE TABLE—Males (1841).

Age.	Living.	Quinquennial Periods + $\frac{1}{2}lm$.	Age.	Living.	Quinquennial Periods + $\frac{1}{2}lm$.
0	50,521	476,444	40	29,822	179,047
			45	28,069	149,225
1	43,637		50	25,973	121,156
2	41,857		55	23,892	95,183
3	40,704		60	21,459	
4	40,031		65	18,235	
			70	13,976	
5	39,550	425,923	75	9,836	
10	37,527	386,373	80	5,393	
15	36,469	348,846	85	2,031	
20	35,338	312,377	90	290	
25	34,061	277,039	95	58	
30	32,742	242,978	100	11	
35	31,189	210,236	105	2	

Add up the column headed "living" to the number 39,550 (against the age 5 years), and the sum will be the number of five years—of *lustres*—which the 39,550 persons will live $+ \frac{39,550}{2} = 19,775$. Subtract, therefore, 19,775 from the sum 425,923, and 406,148 will remain; which, divided by 39,550, gives for quotient 10·269 *lustres* as the expectation of life at that age. A lustre is five years; consequently the expectation of life in years is five times 10·269, or 51·3 years. If 425,923 be divided by 39,550, the quotient will be 10·769; and $10{\cdot}769 - {\cdot}5 = 10{\cdot}269$, the same result as before. The expectation of life will be found to be 34·5 years at the age of 30.

The number of living at every five years except the first, deduced by this method, may be considered nearly correct; the expectation of life is slightly overstated by the assumption that the living at the ages 5, 6, 7, 8, 9, 10; and 10, 11, &c., are series in arithmetical progression. The error does not exceed one-tenth part of a year from 5 to 60 years of age. At birth, and after 70, it does not exceed half a year, which may be subtracted as a correction. But by calculating the number surviving every year up to the age of five, a sufficiently close approximation to the expectation of life at birth will be obtained. The years of life under five are $\frac{5}{6} \times 256,300 = 213,583$; and the years of life, after the age of five $= 5 \times (425,923 - 19,775) = 2,030,740$, and $\frac{2,030,740 + 213,583}{50,521} = 44{\cdot}4$, a boy's expectation of life at birth in Surrey.

A life table still shorter may be constructed by taking intervals of 10 years, and using $\left(\frac{1 - \frac{1}{2}m}{1 + \frac{1}{2}m}\right)^{10}$. The errors in the calculation of the expectation of life from the living at every tenth year, can be corrected. They are always of the same nature. If we take the numbers "living" against every 10th year from the English Table, it will be found that the excess of the expectations of life, ranges at the ages 10 to 50, from ·1 to ·2 or ·3 of a year. At birth the true expectation will be obtained very nearly by subtracting one year from the expectation, derived from the decennial table.

By adding up the column headed "living," in the subjoined table, dividing by the first number 100,000, multiplying by 10, and subtracting 5, we obtain 42·05 years as the expectation of life, which is too much by nine-tenths of a year.

		Years.
Age 0	$\frac{470,530}{100,000} \times 10 = 47{\cdot}05$; and $47{\cdot}05 - 5 =$	42·05
	True expectation of life	41·16
	Error	·89
Age 10	$\frac{370,530}{70,612} \times 10 = 52{\cdot}47$; and $52{\cdot}47 - 5 =$	47·47
	True expectation of life	47·44
	Error	·03

DECENNIAL LIFE TABLE.—(From the English Table.)

Years.	Living.	Expectation of Life.
0	100,000	42·05 − ·89 = 41·16
10	70,612	47·47 − ·03 = 47·44
20	66,059	40·40 − ·06 = 40·34
30	60,332	33·76 − ·08 = 33·68
40	53,825	27·23 − ·09 = 27·14
50	46,621	20·67 − ·12 = 20·55
60	37,996	14·23 − ·23 = 14·00
70	24,531	9·29 − ·51 = 8·78
80	9,398	= By the decennial table; = Error; = By the annual table
90	1,140	
100	16	

(5th Annual Report, pp. 362–5.)

Mean Duration of Life in Metropolitan Districts.—When sufficient data have been collected, it is proposed to calculate the mean duration of life, or the expectation of life, for different parts of the metropolis. Several corrections have to be made. The following is a specimen of a Decennial Life Table for two districts. It was computed and corrected (in the manner already described)* on the population and deaths of 1841,

ST. GEORGE, HANOVER-SQUARE.					
Decennial Life Table.				Expectation of Life.	
Age.	Persons.	Males.	Females.	Males.	Females.
0	100,000	51,949	48,051	37·4	39·7
10	63,732	33,011	30,721	47·0	50·2
20	60,434	31,176	29,258	39·5	42·5
30	57,178	29,016	28,162	32·1	34·0
40	52,266	26,097	26,169	25·2	26·2
50	45,451	22,279	23,172	18·7	19·0
60	36,048	17,926	18,122	12·2	13·1
70	22,229	10,493	11,736		
80	6,502	2,942	3,560		
90	601	329	272		

* *See* previous extract, p. 465–7.

Whitechapel.					
Decennial Life Table.				Expectation of Life.	
Age.	Persons.	Males.	Females.	Males.	Females.
0	100,000	50,991	49,009	31·0	34·3
10	58,125	29,141	28,984	41·6	45·6
20	55,464	27,720	27,744	33·5	37·5
30	50,773	24,847	25,926	26·7	29·8
40	43,865	20,917	22,948	21·1	23·1
50	35,369	16,186	19,183	15·9	16·7
60	24,024	11,245	12,779	10·9	12·8
70	13,458	5,721	7,737		
80	4,004	1,345	2,659		
90	399	137	262		

when the mortality was low in both districts. The deaths in St. George's Hospital and the London Hospital were all excluded, except the proportion at the several ages due to these districts, in common with others in which there were no hospitals. (5th Annual Report, p. 443.)

Properties and Applications of Life Tables; Dr. Price's Fallacies.—The applications and uses of national life tables are almost innumerable; without an intimate knowledge of their properties it is impossible to determine the laws of population, which are the bases of statistics, or to reason upon such matters without falling into great errors, of which, if it were not invidious, too many instances might be cited from current works on population and public health. I therefore strongly recommend the student to make himself master of this subject, by a careful perusal of the writings of Halley, Deparcieux, Demoivre, Simpson, Price, Duvillard, Baily, Milne, Gompertz, Davies, Edmonds, De Morgan, Babbage, and others.

A great improvement in the life table, suggested by Graunt and invented by Halley, was made in 1806 by Duvillard. Barrett discovered the advantages of an analogous construction in calculating life annuities; Mr. Baily explained some of the uses of the new column, and showed its applicability to joint life tables in the description of Barrett's method, appended to his "Doctrine of Life Annuities and "Assurances" (1813). Mathieu has given for some years, in the "Annuaire de France," a table deduced directly from Duvillard's new column (S.*y*); it is the development, as Mathieu remarks, of a shorter table in Duvillard's work.* Mr. Griffith Davies, adopting Barrett's method, extended it, and facilitated its application to the calculation of life annuities and assurances, in a small and very useful volume —"Tables of Life Contingencies" (1825); which was to have been followed by "a more extensive work," containing "a New Theory "of the Doctrine of Annuities and Assurances,"—unfortunately never completed. Mr. Davies's views have been, however, developed in the work of Mr. David Jones on Annuities; and De Morgan has described the construction, arrangement, and use of the new tabular form in two

* Analyse et Tableaux de l'Influence de la Petite Vérole, p. 123; 1806. Duvillard states that his table, which is evidently constructed on imperfect data, was presented to the Institute, An. V of the Republic.

elegant papers inserted in the Companions to the British Almanac for 1840 and 1842.

The English Life Table shows, out of 100,000 children born alive, the respective numbers of males and females born, and the numbers attaining each age, or birth-day, from the first to the 110th, according to the rates and laws of mortality, deduced from the Returns of the Population, Births and Deaths in England (1841). Thus, in 100,000 children born alive, 51,274 are boys, and 48,726 girls; 33,060 males, and 32,464 females attain the age of 21; and 11,824 males, 12,708 females, live to 70. The males and females are not distinguished in Halley's Tables, in the Northampton Table, or in Mr. Milne's Carlisle Table. Dr. Price constructed three life tables from the Swedish observations; one for males, another for females, and a third for "males "and females collectively." * He made 10,000 males and 10,000 females the bases of his male and female tables; to which there can be no objection, except that the construction does not show the relative numbers of the two sexes born, and living together at each age. The table of "males and females collectively," is constructed from the other two tables, upon an erroneous principle, which Dr. Price lays down, and thus illustrates:—"Table 44 shows, that of 2,701 males living at "60 years of age, 560 will die in five years; and that of 3,167 females "living at the same age, 588 will die in the same time. From hence "it may be easily deduced, that of 2,930 persons living at 60, consisting "*one half of males and one half of females*, 576 will die in the same "time. The number, therefore, living at 60 will at 65 be reduced "to 2,354; which number *must again be supposed to consist one half* "*of males and the other half of females*, and the proper decrement "for the next five years deduced in the same manner from Table 44. "And it is in this method that the whole of this Table (45) has been "constructed, which, *therefore, must exhibit more accurately than any* "*other* the probabilities of living among the general mass of mankind, "consisting of males and females taken collectively." Granting that the 2,930 persons at the age of 60 consist of an *equal number* of males and females, we shall have the following results, according to Dr. Price's data:—

	Persons.	Males.	Females.
Living at the age of 60 - -	2,930	1,465	1,465
Die in the next five years -	576	304	272
Actually living at the age of 65, according to Dr. Price's facts	2,354	1,161	1,193
Living at the age of 65, according to Dr. Price's new supposition	2,354	1,177	1,177
Errors in the supposition -		+ 16	− 16

Dr. Price arbitrarily substituted 16 males for 16 females at the end of five years, and proceeded to calculate the reduction in the next quinquennial period on 1,177 instead of 1,161 males, and 1,177 instead of 1,193 females. As the mortality of males in the five years is greater than that of females (at the age 60–65, the ratio is ·207 to ·186), the mortality is exaggerated, and the same error pervades the whole table, and the subsequent tables of the value of annuities on single and joint lives in general; for it is evident that if annuities were granted to

* Price's Works, by Morgan, 7th edition; vol. ii., pp. 406–414.

equal numbers of males and females, at 60 or any other age, the excess of surviving female annuitants could not at the end of every five years be arbitrarily set aside and replaced by males.*

The Swedish Table of Mr. Milne is free from the errors† of the distinguished writer who had the merit of first constructing a national life table, and shows the numbers of males and females who complete every year of age out of 10,210 males, and 9,790 females born in that kingdom. It is, therefore, to this eminent man that we are indebted for the first correct national life table. The numbers in Mr. Milne's Table 5 multiplied by 10, and those of Table 4 multiplied by 5, $\left(\text{or } \frac{10}{2}\right)$, may be compared with the English Life Table; the basis of which is 100,000 children born alive = 51,274 boys + 48,726 girls. The numbers in the English Table are connected by simple laws, derived directly from and representing the mean results of the observed facts; it terminates, if we descend no lower than unity, naturally at 103; but, according to the same law, more than two in 10 millions born see their 108th birthday. The registers give a proportionally greater number of centenarians; but the evidence of these advanced ages is almost always unsatisfactory, and it was thought right in this instance to deviate from the observations, and to carry out the table according to the law deduced from the more numerous and more accurate statements of the earlier part of old age; the result of which is a middle course between the tables of old writers, that terminated at 84, 90, or 96 years, and the recorded instances of very advanced age. (6th Annual Report, pp. 524–6.)

Mortality in Increasing Populations.—It is frequently stated that the proportion of deaths to the population is raised in an increasing population by the excess of young children, among whom the mortality is greater than it is among adults; but this is not borne out either by experience or by theory. The mortality among males in England is 2·29 per cent.; three births are registered to two deaths, and the mortality would be 2·49 per cent. if the births and deaths were equal. The solution of the following question may throw some light upon this subject.

A population has been stationary and the mortality the same for a century. The births, which had been equal to the deaths, are suddenly increased in the proportion of 3 to 2, and remain the same, or one-half more than they had been. How many annual deaths will occur to 100 living of all ages, assuming that the law of mortality remains invariable?

Taking the English Table for males, the radix of 51,274 births will become 76,911, which will in 10 years add 192,593 ($\frac{1}{2}Q_{0|10}$) to the population, originally 2,059,501; but the deaths to the 192,593 at that age will be $= \frac{1}{2}D_{0|10} = 7,855$; and the ratio of the deaths to the population will be 59,129 : 2,252,094. The formula will be in all cases $\frac{D_0 + \frac{1}{2}D_{0|y}}{Q_0 + \frac{1}{2}Q_{0|y}}$; and by making y successively 0, 10, 20, 30, 40, 50, 60, 80, and 105, and taking the numbers out from the table, the following results are obtained:—

* Dr. Price's Swedish table of mortality is printed without comment by Baily and Mr. David Jones. Baily has since adverted to the error.

† Milne on Annuities, &c., Tables 4, 5, pp. 566, 569.

Years.	Population maintained by the original number of annual Births (= 51,274).	Increase of Population by the increase of 25,637 annual Births.	Total Population.	Annual Deaths in the original Population.	Annual Deaths in the new Population.	Total Annual Deaths.	Annual Mortality. Per Cent.	Annual Mortality. One in
	Q_0	$\frac{1}{2}Q_{0\mid y}$	$Q_0+\frac{1}{2}Q_{0\mid y}$	D_0	$\frac{1}{2}D_{0\mid y}$	$D_0+\frac{1}{2}D_{0\mid y}$	$\frac{100\ D_x}{Q_x}$	$\frac{Q_x}{D_x}$
0	2,059,501	—	2,059,501	51,274	—	51,274	2·490	40
10	2,059,501	192,593	2,252,094	51,274	7,855	59,129	2·626	38
20	2,059,501	365,238	2,424,739	51,274	8,975	60,249	2·485	40
30	2,059,501	524,925	2,584,426	51,274	10,400	61,674	2·386	42
40	2,059,501	669,163	2,728,664	51,274	12,065	63,339	2·321	43
50	2,059,501	795,633	2,855,134	51,274	13,949	65,223	2·284	44
60	2,059,501	901,922	2,961,423	51,274	16,233	67,507	2·280	44
80	2,059,501	1,019,083	3,078,584	51,274	23,479	74,753	2·428	41
105	2,059,501	1,029,751	3,089,252	51,274	25,637	76,911	2·490	40

The mortality of the new population in the first 10 years is much greater than ·02490; after 20 it becomes less, and the aggregate mortality remains less than ·02490 until the constitution of the population, in respect to age, is restored to its original state.

If the births, from any cause, increased in a geometrical progression, and the rate of increase were r annually, the column D would become $(1+r)^1 . D_{105} + (1+r)^2 . D_{104} + (1+r)^3 . D_{103} + \ldots . (1+r)^{106} . D_0$; and all the other columns of the table being derivable from D, it is evident that, the law of mortality remaining the same, the numbers dying (C_x) and living (P_x) would, relatively to the total numbers, be increased at the earlier ages, while the proportion of deaths to the population would be diminished. If the increase were temporary, the contrary result might be produced.

The annual mortality of persons of all ages, and of persons of the age of 20 and upwards is nearly the same, for $\frac{D_0}{Q_0}$ is nearly equal $\frac{D_{20}}{Q_{20}}$. If the population of a city were for a century recruited partly by emigrants from the country at the age of 20, the proportion of deaths to the population would not be much disturbed by that circumstance; but, if the immigrants entered at 25, the apparent mortality would be increased, for $\frac{D_0 + D_{25}}{Q_0 + Q_{25}} > \frac{D_0}{Q_0}$.—(6th Annual Report, pp. 534–5.)

Statistical Methods for determining the relative Health and Mortality of different Classes of the Population.—It is universally admitted by persons acquainted with the subject, that the relative mortality of a mixed population, consisting of persons of all ages in different proportions, can only be accurately determined by ascertaining the proportion of the deaths, in a given time, to the living at the several quinquennial, or decennial periods of age; and that the mean duration of life attained by such a population can only be positively and conveniently ascertained by a construction which is called a "Table of Mortality," or a "Life "Table." The two series of facts—(1) the living at different ages, and (2) the dying at the same ages, are not always known; and two methods of approximation have been proposed and employed in such cases with various success.

The first method is this: The ages of those who die are added up, and the sum is divided by the number of deaths; the quotient is the "mean age at death." The health of two populations and their mean lifetime are supposed to be in the ratio of the "mean age at death" so obtained. This method was first employed in the 17th and 18th centuries, before any Census of the population was taken; and certain corrections of the errors in its results were proposed by Dr. Price in the construction of the Northampton Table; which, deduced from the deaths at different ages in All Souls' Parish, gave the "mean age at "death," and not the "expectation of life," in Northampton.

The other method of determining the relative mortality which has been employed in the present century by statists is equally simple: the mean population is divided by the annual deaths; or the proportion dying in a year to 100 living of all ages is found; and the relative mortality of two districts, or counties, is thus compared.

The two methods are subject to error from the disproportion in the numbers of young and old people, which may arise from the marriages being earlier or later, from emigration, immigration, and a great variety of causes, besides the mortality. In an increasing population, with an excess of children and young adults, the "mean age at death" is reduced in a certain ratio to the rate of increase, and there is nothing to neutralize the tendency or to diminish the error. By the second method, as the mortality is highest in the first year of life, and lowest about the age of 10–15, there are two elements in an increasing or decreasing population, acting in an opposite direction; the introduction of an excess of children under four years of age tending to raise the aggregate mortality, on the one hand; on the other, the excess of young persons above five years tending to depress it below the average. The inquirer who has made himself master of the nature of a life table, or even takes the fact just stated into account, can have no difficulty in deciding upon the relative merits of the two methods.

Attention has been latterly attracted to the health of towns, and of particular parts and streets; and, as it may be hoped that the vast importance of these difficult local inquiries will induce those who have entered upon them to prosecute their researches with renewed vigour, I have endeavoured to state, in a popular manner, the best method of determining the relative mortality, and to point out the fallacies to which the old method of the "mean age at death" is peculiarly liable.

If 100,000 persons born at the same moment were followed through life, the numbers that died in each year of age noted, and the sum of their ages divided by 100,000, the average ages which they lived would be obtained. It would be the mean duration of their lives, or what is often called their "expectation of life." Say that it is found to be 41 years. If another 100,000 were taken in worse circumstances, dealt with in the same manner, and their average duration of life were found to be 26 years, you infer that life is shortened 15 years in the latter circumstances.

By taking the population living in the middle of a year (1841 for instance) at each age—0–1, 1–2, 2–3, 3–4, 4–5, 5–10, &c., and the deaths in the same year at the same ages, we find how many die in each year of age out of a given number living; and can calculate, therefore, how many will arrive at the age of 1, 2, 3, 4, 5, 20, 30, &c. years; or determine the true mean duration of life. This was the method which Dr. Price pursued in framing the Swedish Table. This was the method which Mr. Milne pursued in framing the Carlisle Table. Everybody admits that this method gives as correct a result as can be obtained.

If there is no emigration or immigration, and the births and deaths are nearly equal for 100 years, the "mean age at death" will coincide with the "mean future lifetime" or the expectation of life. Thus, if the births and deaths had for a long time been equal in England, all persons born had died in it, and no strangers had entered, or if those who entered were of the same age as those who emigrated, "the mean "age at death" would be 41 years; but the births exceed the deaths more than 50 per cent., and the "mean age at death" in England, instead of 41 years, is 29 years, while it was 33 years in Mr. Rickman's time!

When tested, the error in the result by this method is 12 years in 41 years!

But it may be asked, Will not this method serve as a means of comparison, where there are not the data, nor skill, nor time requisite for calculating the true duration of life? Does not this method give results more accurate than those deducible from a comparison of the "proportion of the deaths to the population?" To this the answer must be in the negative. Neither method gives the true mean duration of life. Nobody pretends that the latter does; but it gives the nearest approximation, for, as a general rule, wherever the mortality is high the duration of life is low, and the reverse. I know no exception to this rule. In the last Report instances were given in which the indications of "the mean age at death" are altogether erroneous; thus, the "mean "age at death" is higher in France, where the true duration of life is lower and the mortality higher than in England.

	1	2	3
	Mortality: or one Death	"Mean Age at Death."	Mean Life-time; or the "Expectation of Life."
England (1841)	In 46 living	29 years	41 years.
France ,,	42 ,,	34 ,,	40 ,, (?)
Sweden ,,	41 ,,	31 ,,	39 ,,
Metropolis ,,	41* ,,	29 ,,	37 ,,
Liverpool ,,	30 ,,	21 ,,	26 ,,
Surrey (extra-Metropolitan)	52 ,,	34 ,,	45 ,,

* One in 39 was the average of five years, 1838–42.

The last column gives the true mean duration of life; where this has not been determined, the method, of which the first column contains the results, gives an approximation, sufficiently near for many purposes, to the relative mortality. Thus, according to that column, we should arrange the six classes of people in the following order of healthiness:—

(1) Surrey, 52; England, 46; France, 42; Sweden, 41; Metropolis, 39 (average of five years); Liverpool, 30.

And this is the order in which they are placed according to the expectations of life, which are as follows:—

(2) Surrey, 45; England, 41; France, 40; Sweden, 39; Metropolis, 37; Liverpool, 26.

Let us test the method of the "mean age at death" in the same way, by substituting the numbers in the second column for the others:—

(3) Surrey, 34; France, 34; Sweden, 31; England, 29; Metropolis, 29; Liverpool, 21.

Now, according to this method, the French live five years longer than the English, and the duration of life is the same in the metropolis as in all England. The method, like a rough and very bad instrument, gives you some idea of the thing which it pretends to measure, but its indications are, in many cases, entirely wrong. It neither gives the true duration of life, nor the relative duration of life in different circumstances.

Up to the date of the first edition of Dr. Price's book, the method (of which that of the "mean age at death" is a rude fragment), was the only one in use ; the *deaths* could not be compared with the *population* of London in the 18th century, because the population had not been enumerated. Dr. Price's Table, and the previous Table of Simpson, gave the "mean age at death," as deduced by them from the London Bills of Mortality,* with a correction for the adults who came to settle in London. Dr. Price believed that the births did not, in his time, exceed the deaths in England, and upon this hypothesis, which he supported very ingeniously, the "expectation of life," and the "mean "age at death," would have been the same. Halley, Simpson, Price—all the great writers on the subject in the sixteenth and seventeenth centuries—could not obtain returns of the ages of the living, and had to calculate their tables from the deaths alone as given in the Bills of Mortality then in use. To avoid the errors introduced by comparing the ages at death of populations in which the births and deaths are not equal, they expressly selected towns, &c., in which they were led to believe the births and deaths were nearly equal. As the populations of England and Europe formerly increased very slowly, their tables (of Breslau, London, Northampton) are not very erroneous at advanced periods of life.

Mr. Milne's views† have been misunderstood and misrepresented ; he distinguished (1) The "mean life," or "expectation of life." (2) The mortality expressed by the numbers out of which one death occurred annually; and (3) The mean life deduced from the deaths alone, or the "mean age at death." Thus in 1801–5 the true "mean duration of life" in Sweden, he says, was 39·39 years; *one* died annually in 40·90 living, and the "mean age at death" was only 30·86 years in the same period. Mr. Milne shows, from ten examples, that the two first sets of numbers are the same in a stationary population and differ slightly in an increasing or decreasing population. He shows that the "ages of death" differ from these two sets of numbers in an increasing population; thus in Sweden the difference was 40·90 — 30·86 = 10·04 years. In other instances the difference amounts to 6, 7, 9, 10 years; in England it is 12 years.

Mr. Milne says, "When tables of mortality are constructed from the "*numbers of deaths only* in the different intervals of age, without com-"paring them with the *numbers of living persons* in the same intervals "* * * * and the population is increasing, the number of years in "the mean duration of life from birth ('ages of death') will fall short "of the number of the people out of which one dies annually ('propor-"'tions of deaths to the population') by *a much greater number* than in "the case we have just been considering, of the table of mortality having "been properly constructed from the necessary data, as the following "statement will show." (Here follows a table with 10 examples showing the differences.)

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* Price's Works, by Morgan—the London Tables; also Simpson on Annuities, p. 1.

† *See* Art. "Mortality," in Ency. Britannica.

Mr. Milne's Carlisle Table of mortality,* as he explains, represents a *population* in which the births are equal to the deaths, and in which there is neither immigration nor emigration, such as everybody knows does not exist in nature. All correct life tables are constructed upon the same hypothesis, and *therefore admit of comparison.* Tables might be constructed representing populations in which the births exceeded the deaths, or the contrary; but they would not admit of comparison unless the births bore the same proportion to the deaths in the two cases. Such tables would not show the survivors at each year of age out of a given number born, or a given number attaining any age; the probable duration of life could not be calculated from them, nor the mean duration of life.

The "adjustment," which makes a life table represent as nearly as possible the progress of a human generation year by year through life, has been employed upon the same principle that astronomers "*reduce* " as it is termed, all their observations, both of right ascension and " declination, to some common and convenient epoch." * * "By the " term correcting or *equating* the observation for nutation," says Herschell,† "is always understood, in astronomy, the getting rid of a " periodical cause of fluctuation, and presenting a result, not as it *was* " *observed*, but as *it would have been observed*, had that cause of " fluctuation had no existence."

The method of the "mean age at death," taking the crude results of observation on a population subject to fluctuations in births and deaths, immigration and emigration, only furnishes true results in a perfectly stationary population; while with the tables deduced from the proportion of deaths at each age to the living at each age—the method employed in the construction of the Swedish, Carlisle, and English Tables— " Whether the population be stationary, or increasing, or decreasing, " and whether such changes be produced by procreation, mortality, or " migration, or by the joint operation of any two or more of those " causes, provided that the mode of their operation be uniform, or " nearly so, and not by sudden starts, the law of mortality may be " approached near enough for any useful purpose by actual *enumeration* " and the *Bills of Mortality*."‡

Several illustrations were given in the last Report of the errors produced by applying the "mean-age-at-death" method to fluctuating populations. In many cases, the mortality and unhealthiness of two classes of persons are inversely as the mean age of death. Without entering into any mathematical details, I will now show that the "mean " age of death," considered as a measure of health, must give erroneous contradictory, exaggerated results.

The mean age of death is determined by adding up the ages of all the persons whose deaths are registered in a parish or other register—say, during a year—and dividing the sum of the ages thus obtained by the number of persons who lived those ages. The error consists in the assumption that this average age represents the average age which the inhabitants (the same rate of mortality prevailing) will live, or the average age which would be obtained by following 1,000 children, born in the parish, through life, adding up the ages which the 1,000 attained, and dividing the sum by 1,000. The results of these two methods are the same in a stationary population, and totally different in an increasing, decreasing, or migratory population. The population is increasing in

* Art. "Mortality," Ency. Britannica.
† Herschell, Astronomy, p. 174.
‡ Milne.

almost every district of England, and there is a constant flow of population to the towns. To show the effects of these movements, I give two or three extreme instances.

(1.) Let us suppose that in two contiguous parishes, equally healthy—A and B—all the children are born in A and remain there up to the age of 20, and if they die are registered in the parish register; that at 20 all the survivors emigrate year by year to B, and when they die are registered by the clergyman of B in his register. Now if the mean age of death were taken in the parish A, it would be about *four* years (according to the present rate of mortality in England), while it would be 60 years in the parish B. The numbers living, out of which one death would take place annually, would be 1 in 43 in A and 1 in 40 in B. The mortality and healthiness, taking the difference of age into account, would be the same in A and in B. Notwithstanding the difference of the mean age at death produced by emigration, a comparison of the deaths with the living at each age would demonstrate, that although the *deaths of none above twenty* were registered in A, *two* in every *three* born in A survived the age of 20, and died at more advanced ages elsewhere. In B, as none died under 20, it would be inferred that none entered the parish under that age.

The emigration of a part of the adult population to towns produces an effect of precisely the same kind, though to a less extent.

(2.) In the former illustration, the births were supposed to be equal on an average to the deaths in A and B; and the error in the mean age at death would be got rid of by combining the deaths in A and B in one table, instead of placing them in contrast. Suppose the two parishes united—that after a stationary stage, through the women marrying earlier and in greater numbers, the births rise from 1,000 to 2,000 annually—while the salubrity, and the mortality at the respective ages remain precisely the same: what would be the effect of an abstract of the parish registers 20 years after the increase had set in? Why that, without any increase in the mortality, the deaths under 20 would be doubled; and the mean age at death, instead of being 41 years, would be less by many years. The comparison of the past and present mean ages at death in the united parishes would be absurd; so would the comparison with any other parish in which the increase and emigration had proceeded differently. But upon comparing the deaths with the living at each age—as by the hypothesis the living under the age of 20, as well as the deaths under the age of 20, would be found twice as numerous in the year as they were 20 years ago—the ratio between the two would be found to be the same; the survivors year by year, and their expectation of life, could be determined. With regard to the proportion of deaths at all ages to the living at all ages, a sort of compensation would be produced—the excess of infants under 5 years of age tending to raise the relative number of deaths; the excess of persons from 5 to 50, and the diminished proportion of persons above 60, having a tendency exactly the reverse.

In England, during the whole of the present century, there have been more than 3 births to 2 deaths; and the result, as has been shown, has reduced the mean age of death to 33 years in 1831, and to 29 years in 1841; while the real duration of life—the expectation of life—is 41 years, and has varied little. The number living to 1 death was 46 in 1841, and 45 in the preceding four years.

(3.) Take a street (C) in a town, where, from the erection of new factories, or from any new field of labour being thrown open, a considerable number of young men and women have been attracted within the last 10 or 15 years; there is a demand for the labour of children; marriages take place; nearly all the young couples have children, two, three, or four in a family. Take another street (D) inhabited by artizans, whose business and numbers have remained nearly stationary, and tradespeople who have succeeded to old shops established by their fathers;—Suppose the salubrity of the two streets, and the rate of mortality at the corresponding ages, the same,—it is evident that as the street C contains no old people, and the mortality in the first two or three years is always relatively high, the deaths registered will be at early ages—the mean age of death low; while in the street D, the deaths will many of them be at old ages, and the mean age at death relatively high. If all the inhabitants of the two streets died in one year, the mortality would be the same. Yet the mean age at death would differ in the same ratio as the mean age of the living. The same results would be produced by the death of *one thirtieth* of the inhabitants in each street. The cases which have been put will enable us to understand such a case as is said to have occurred in Leicester, where the mean age at death was 13½ years in the undrained streets, and 23½ in the drained streets. That the real mortality was higher in the one class of streets than in the other is probable; but this is not proved by the method, for the *undrained streets* may be new streets, inhabited by young people—a part of the 8,600 in 46,000 not born in Leicestershire; while the drained streets may be old streets inhabited by the old inhabitants of the town.* On account of the system of compensation which it involves, the method of comparing the total deaths to the population of the streets gives results nearer the truth; but no one acquainted with inquiries of the kind would place much confidence in any other method, as applied to *particular streets* or *small districts*, than that upon which the Life Table is founded—the comparison of the numbers living with the numbers born and dying at the several periods of life. In the Registrar-General's Report, the mortality is only given for statistical districts of an average population of 50,000.

The correct method, to which I have so often adverted, yields uniform consistent results; and next to this in accuracy is that obtained by the proportion of the deaths to the living among numbers, or over a time, sufficient to obviate errors liable to be introduced by accidental fluctuations.

The papers of Mr. Edmonds in *The Lancet*† may be referred to as early models of the methods of determining the relative mortality of particular localities, and at particular ages, both with complete and imperfect data. *See* also Mr. Chadwick's Paper "On the best mode of "representing accurately, by statistical returns, the duration of life," in the *Statistical Journal*, vol. vii., p. 1; and the following Paper in the same Journal, p. 40, "On a method recently proposed for conducting "inquiries into the sanitary condition of various districts," by Mr. Neison, who has given several striking illustrations of the results of the new method.—(6th Annual Report, pp. 570–6.)

Relative Duration of Life among Males in Manchester and in England.—The mortality of Manchester and Liverpool is nearly the same, or only differs at some ages; it is rather the highest at certain ages in the former town. The enormous extent of the mortality in both these large places is appalling. The excess over the mortality of Surrey shows to what an extent it is unnatural and susceptible of remedy.

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* I find, upon turning to the Census Returns, that the populations of some of the new and old streets in Leicester differ in the manner described.

† See *The Lancet* volumes for the years 1833-39.

RELATIVE DURATION of LIFE among MALES in MANCHESTER and in ALL ENGLAND.

Precise Age.	Manchester.	England.	Manchester below the Average.
	Expectation of Life.		
	Years.	Years.	Years.
0	24·2	40·2	16·0
1	33·1	46·7	13·6
10	40·6	47·1	6·5
20	33·3	39·9	6·6
30	26·6	33·1	6·5
40	20·6	26·6	6·0
50	15·2	20·0	4·8
60	10·3	13·6	3·3
70	6·8	8·5	1·7
80	4·6	4·9	*
90	3·2	2·7	
100	1·2	1·5	

* The facts for MANCHESTER are too few to admit of a comparison after the age of 80.
The mean duration of life among Males in MANCHESTER is 24·2 years, or 16·0 years less than 40·2 years, the duration of life in all ENGLAND.
By another method the expectation of life at birth is 25·5 years in MANCHESTER.

Many of the irregularities in the columns of the life table from which the expectation of life in Manchester given in the above table has been calculated are from erroneous statements of age; the ages guessed at being almost always referred to the round numbers 20, 30, 40, 50, &c., make the numbers in the corresponding quinquennia excessive. These errors are not of great importance, and have not been corrected in this table, which, by a very simple arrangement of the facts, enables us to answer very readily many questions relative to the population of Manchester. The mean age, for instance, of the people of Manchester, males and females, is 25 years; as is shown by dividing the number of years lived (4,141,701) by the number of persons (163,561). The mean age of persons above 20 is 38 years. Other properties and uses of the Table are sufficiently obvious.—(7th Annual Report, pp. 329–39.)

Expectation of Life; *afterlifetime.*—*Expectation of life* is an incorrect term: the time which it is *expected* a person will live is the time which it is an even chance he will live; it is the *vie probable* of the French, and is correctly expressed by "probable lifetime." The afterlifetime can only be the same as the probable lifetime on Demoivre's hypothesis—that the surviving form an arithmetical progression. The term "expectation of life," first used by Demoivre, is correct, on that supposition, which is, however, in itself quite erroneous. The idea intended to be expressed by "expectation of life" is the *mean time* which a number of persons at any instant of age will live after that instant: it is the French *vie moyenne*; and this technical idea is strictly and shortly expressed by *afterlifetime*, a pure English word, formed on the same analogy as *afterlife*, *aftertimes*, *afterage*, *afterhours*. See the words in Johnson. Among the examples he quotes are,—

"What an opinion will *afterages* entertain of their religion?"—
Addison.

"So smile the heavens upon this holy act,
That *afterhours* with sorrow chide us not."—*Shakespeare.*

"You promised once a progeny divine
Of Romans, rising from the Trojan line,
In *aftertimes* should hold the world in awe,
And to the land and ocean give the law."—*Dryden.*

Todd adds "afterlife" from Dryden, Heywood, and Butler. "Afterlife: the remainder of life."

"All of a tenor was their *afterlife,*
No day discolored with domestic strife."—*Dryden.*

The *afterlifetime* of men at the age of 30 is 33 years by the English Life Table: 33 years is not the precise time probably that any one of that age will live, but the average time that a number of men of that age will live, taken one with another. *Age + afterlifetime = lifetime.* At 30 this is 30 + 33 = 63, the average age which men now aged 30 will attain. At birth this is 0 + 40 = 40; when *lifetime* and *afterlifetime* are the same thing. The *lifetime* simply, without the addition *at a given age,* will serve to express in one word what is often improperly called *the expectation of life at birth:* thus the *lifetime* of males in England is 40 years, the *lifetime* of males in Manchester is 24 years. Those who from habit prefer "expectation of life," can always substitute it for *afterlifetime;* from the use of which in this paper no ambiguity can arise.—(8th Annual Report, pp. 279–80.)

English Life Tables, Nos. 1 *and* 2.—The Ninth Report contained an elaborate series of tables, showing from the returns of deaths in the *seven years* 1838–44, and from the Census returns of 1841, the *mortality* of *males* and *females* at *different ages* in England and Wales, as well as severally in the 11 divisions, 44 counties, &c., and 324 groups of districts. The population was 15,914,148; the deaths in the seven years 2,436,648. A second English Life Table for males during this period has been constructed, as well as several new series of tables of use in all the ordinary operations of life insurance. The Life Tables (1 and 2), it will be seen, agree very closely, although the one is constructed on the deaths in 1841, the other on the deaths in the seven years 1838–44; the population of 1841 serving as the basis of both.

RESULTS deduced from the Two ENGLISH LIFE TABLES (Males).

—	Ages.							
	0	10	20	30	40	50	60	70
Afterlifetime or Expectation of Life:—								
(1841) English Table, No. 1	40·17	47·08	39·88	33·13	26·57	20·03	13·59	8·52
(1838–44) " No. 2	40·36	47·47	39·99	33·21	26·46	19·87	13·60	8·55
Annual Premium to insure 100*l.*:—	£ *s.* *d.*	£ *s.* *d.*	£ *s.* *d.*	£ *s.* *d.*	£ *s.* *d.*	£ *s.* *d.*	£ *s.* *d.*	£ *s.* *d.*
English Table, No. 1 -	2 5 10	1 5 0	1 11 11	2 1 1	2 14 7	3 17 6	6 2 7	10 3 2
" No. 2 -	2 5 7	1 4 5	1 11 8	2 0 9	2 14 11	3 18 6	6 2 7	10 2 0
Present Value of Annuity of £1 (payable at the end of every Year):—								
English Table, No. 1 -	18·2167	23·0333	21·1765	19·1347	16·7209	13·7365	10·0598	6·6516
" No. 2 -	18·2660	23·2042	21·2334	19·1943	16·6689	13·6272	10·0572	6·6837

Various methods of graduation were tried. The abstracts of the population for 1841 distinguish the numbers living at each quinquennial period of life, and the abstracts of deaths are taken at corresponding periods, except in the first five years of age, when the rate of mortality varies so rapidly that every year and even month is marked by a change. But by a careful examination of the facts it was found that the rate of mortality in decennial periods, after the age of 15, furnishes the most satisfactory basis for determining the series of fractions to express the probabilities of life. At the earlier ages the mortality for each year was directly deduced from the returns, and, after careful comparison, the first series of logarithms was drawn gradually into the second—the second into the third. At another time I hope to be able to discuss in detail the various methods of graduation, and to describe that which was found most successful in practice. (12th Annual Report, pp. i–ii.)

Old and New Northampton Life Tables; Carlisle Table; Experience Table.—Life tables have been constructed in two ways:—

(1) By a comparison of the *deaths* and the *living* at each age, which gives the rates of mortality and survivorship. Tables so constructed, in the words of Dr. Price, "must be correct."

(2) From the deaths alone, or with reference only to the ages at which the deaths have taken place. Tables so constructed are only correct if the "population" of the place among whom the deaths occur is stationary, if the births and deaths are equal, and if there is no disturbing migration for a century. It was in this second way that the Northampton Table, from the want of better materials, was constructed by Dr. Price.

I was enabled to obtain data for constructing two new Northampton Tables; one on the plan of the Northampton Tables by Dr. Price, in common use, the other on the plan which "must be correct."

It is a remarkable circumstance that the *new* Northampton Table (2) which was constructed, like that of Dr. Price, on the deaths alone, yielded similar results. The mean lifetime, or duration of life, by the table of Dr. Price was 25·18 years, by the other table 24·88 years; and the same agreement in the resulting expectation of life, the values of annuities, and the premiums of insurance, is maintained at all ages.

But the correct Northampton Table, deduced from the Census of the living at each age in 1841, and the deaths in the seven years 1838–44, differs entirely and largely from both the other tables; thus, the mean duration of life in Northampton is found to be 37·57 years, or thirteen years longer than it is given by the untrue table; and at all the earlier ages the values of annuities and the rates of premiums, by the true table, agree generally with the English and other tables, constructed from adequate data, but differ totally from those based on the old Northampton Table, on which so large a part of the insurance business of this country has hitherto been transacted.

It is shown in the paper referred to that the lifetime in Northampton was about 30 years when Dr. Price's observations were taken, whereas it is now 37½ years*; that the town contained then, as it does now, great numbers of Baptists, who repudiate infant baptism, and thus, consequently, by reducing the ratio of the christenings to the births, induced Dr. Price to believe that the population was stationary, although, as shown from other sources, it was, like the staple shoe trade of the place, constantly increasing. Dr. Price assumed that the population of

* Reg. Gen. 8th Report, pp. 277–348.

the parish was kept up by immigration, and that all the immigrants entered at the age of 20; as a correction for this disturbance he was induced to alter his facts, and the alteration had the effect of increasing the error of the original table.

Dr. Price had not the data for constructing a true Northampton Table; for this reason he failed. He constructed from proper data a Swedish Table, which is nearly correct; and he recommended, in the first instance, his Chester Table, which is less erroneous than the Northampton Table; but the directors of the Equitable "judged it less safe."

The deaths, Mr. Morgan says, were afterwards found to be one third *less* in the Equitable experience than the Table indicated.

Great injustice has been done by the use of this Northampton Table; which, in mutual offices makes one member pay 40, 30, 25, 20, or 10 per cent. more than the premium which is required to secure a policy of the same value, and distributes the surplus thus acquired unequally. The old offices, which have used the Northampton Table, have a great difficulty in setting themselves right. By its use the proprietary offices have exacted enormous and unequal premiums from the portions of the community who happened to be ill-versed and ill-instructed in the intricate science of life insurance.

A false life table can be defended by the same arguments as a depreciated currency; and the substitution of a correct table causes the same kind of disturbance in the value of the shares of members as a re-coinage of clipped money, or a return from a depreciated paper to a metallic currency, introduces into the value of commodities and securities. The Northampton Table has still silent adherents, but few open defenders; and some of the old offices have, greatly to their credit, since the error in that table has been placed beyond doubt, abandoned its use.

The Carlisle Table was deduced from two enumerations of the population of the parishes of Saint Mary and Saint Cuthbert, Carlisle; the first in January 1780, when the inhabitants were 7,677 and the second in December 1787, when the inhabitants amounted to 8,677, namely, 3,864 males and 4,813 females. The deaths in the two parishes were 1840, males 881, females 959, in the *nine* years 1779–1787. It is now well established that the mortality in towns is understated at the age 15–35, when they are entered by healthy immigrants from the country: of whom many reside while they continue healthy in comfortable "situations" as domestic servants, and when they are attacked by consumption return to the country to die. The fact that the females in these parishes exceeded the males by nearly 1,000, and the great excess in the number of persons (1,501) of the age of 20–30 over those in the town of the age of 30–40 (991), indicate the character of the population with tolerable distinctness. Some of the irregularities in the graduation of the Carlisle Table may be referred to the limited extent of the observations; for the deaths in each decennial period (20–90) only ranged from 89 to 173 in number.

The "*Experience*" *Table* is the result in part of a highly praiseworthy effort which was made by a Committee of Actuaries to collect all the extant observations on the mortality of persons whose lives have been insured. The *Equitable* and the *Amicable* Life Offices had before published their experience; and had thus offered a valuable and liberal contribution to the science of life insurance. The Committee of Actuaries induced the following 15 offices out of more than a hundred then existing, to contribute but not to publish their experience:—the Alliance, British, Commercial, Crown, Economic, Guardian, Imperial, Law Life, London Life, Norwich Union, Promoter, Scottish Widows Fund, Sun, Universal, and the University.* (12th Annual Report, pp. iv–vi.)

Selection of Lives for Insurance.—When life insurance was first commenced, in the absence of experience it was uncertain whether the rate of mortality among persons who insured their lives would be higher or lower than the rate of mortality prevailing in the nation generally of which they formed a part.

Dr. Price anticipated an excessive rate of mortality in insurance societies, for he says :—"Those persons will be most for flying to these "establishments who have feeble constitutions, or are subject to "distempers which they know render their lives particularly precarious; "and it is to be feared that no caution will be sufficient to prevent all "danger from hence."†

Mr. W. Morgan in 1829, after fifty years experience as actuary in the Equitable Life Office, thus expresses himself on this subject :—

"Between a number of select lives and the general mass of mankind "the difference in the rate of mortality will at first be considerably "in favour of the former; but this difference will be continually "lessening, till in process of time it will vanish altogether, as it is "found to have done among the lives of long standing in the *Equitable* "*Society*. Should any institution, therefore, of this kind, in the early "period of its existence be tempted, by the higher probability of life "among its members, either to reduce its premiums or to adopt any "other violent measures for impairing its resources, the consequences, "though not immediate, must ultimately terminate in disappointment "and ruin."‡

Mr. Milne, after much experience, also observes on the same subject: § "Although the members of such a society [as the Equitable] when "they first enter are select lives, they are not even then so much "better than the common average as many persons suppose; for the "more precarious a life is, the stronger is the inducement for parties "interested in its continuance to get it insured, so that bad risks are "frequently offered to such companies. And many proposals for insurance "are accepted by the directors that are not thought very eligible at "the time, in cases where they are not aware of any specific objection "to the life proposed. Besides, it is to be considered that of the "number in a society at any one time but a small proportion can have "been recently admitted, and in a few years from the time of admis- "sion *the members* will generally have come down to the *common* "*average of persons of the same ages.*"

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* A few copies only of the "Experience" Table were printed and circulated, it appears exclusively among the insurances offices. Unlike the Equitable and the Amicable societies, the Directors of the insurance companies have not yet evinced such an anxiety to promote the science of life insurance, or to supply the English public with information, as might reasonably be expected from a class so enlightened and so anxious to promote the general good. The few facts in the text are derived from the subjoined works, and they agree closely with the similar results derived from the Equitable experience by Mr. Morgan, and recently by Mr. Peter Hardy :

Life Contingency Tables. By Edwin James Farren. Part I.
A Series of Tables of Annuities and Assurances. By Jenkin Jones.
Insurance Magazine.

† Works, vol. i. pp. 176–7.

‡ A View of the Rise and Progress of the Equitable Society. By W. Morgan, F.R.S., 1829, p. 46.

§ Human Mortality, Encyclopædia Britannica, vol. xv., part II., page 555.

The effect of selection is now well known, and the facts have been investigated by Mr. E. Farren, who has separately deduced the mortality among insured lives during the first year, and the mortality among the same lives in the first as well as subsequent years; he has also compared the results with those derived from the first English Life Table.

The mortality per 1,000 at 5 ages is thus given.*

Age.	Among insured Lives.		Among the general Male Population of England.
	First Year.	First and subsequent Years.	
30 - - -	6·584	8·732	10·220
40 - -	8·588	10·796	13·195
50 - - -	14·595	16·398	16·994
60 - -	28·368	31·082	31·441
70 - - -	54·382	62·676	67·001
	A	C	P

After eliminating the influence of selection over the first year Mr. Farren concludes that the rates of mortality of persons insured "would not particularly differ from those prevailing among the male "population at large, taken indiscrimately without regard to health."

The observations of the most distinguished writers, these recent investigations, and the nature of the case, clearly show that in the present state of our knowledge the National Life Table—or a table derived from the same facts—is the soundest and justest basis of the life insurance business of the country; for if there is a disposition to pass an undue proportion of "bad lives" into an insurance society, such arrangements can be made as, when skilfully conducted, reduce the mortality below the average of mankind in general. Any favourable result of this application of technical skill may be set down as legitimate *profit*, for if such skill is not applied the mortality will be above the average of the nation, and the result "loss."

The selection of lives is not yet fully understood, but it may be broadly stated that 27 in 1,000 men of the population, of the age of 20 and under 60, are suffering from some kind of disease or other; that several of the diseases are of long duration, that others are recurrent, and that some are hereditary; that consumption, the most common fatal disease, lasts on an average two years, although it varies considerably in duration; and that cancer, another form of chronic fatal disease, is much more common in women than it is in men.† On all these grounds it is evident that selection will diminish the mortality in the first year, or two or three or four years subsequent to its exercise. As age advances the influence of selection increases; and in this way it is stated that a former Government incurred heavy losses by the sale of life annuities on old lives to unscrupulous speculators.

Investigations seem to indicate that selection under the existing tests is more effective in the case of females than in the case of males; and that it is not safe at present to insure females at lower premiums than males. (12th Annual Report, pp. vi–xi.)

* The Chances of Premature Death, and the Value of Selection among assured Lives. By E. J. Farren, 1850, Part I., p. x. and p. xiii.

† Walshe on Cancer.

Rise and Progress of Life Insurance.—Up to the 17th century the population of England experienced at intervals periodical plagues which destroyed a third or a fourth part of the population of London and of other cities; at the same time the interest of money continued 6 per cent. per annum, while it was 3 per cent. in Holland and Italy—a decisive proof, in addition to historical examples of the bad faith of the times, that in this case, as in nearly all others, the excess in the rate of interest over 3 per cent. is no more than covers the risk of the *class of securities* on which the high rate of interest is charged. The average duration of human life, and its modifications by age, were then unknown. In such a state of things life insurance on any solid rational principles was impossible; nor is there any proof that the social condition of the people of the 17th or any previous century, was such as would induce them to insure their lives extensively for the benefit of their families. After the revolution, and the establishment of the Bank of England, the financial state of the country became settled; and the Government borrowed money on life annuities but on very disadvantageous terms. Men began to have confidence in each other, and the way was opened to investments for long terms. Halley constructed a life table, and inserted it in the Transactions of the early and glorious days of the Royal Society. Demoivre, Simpson, and Dodson, in their works, showed its practical application to all questions in which money payments are dependent upon human life; and the doctrines of life insurance were extended by the financiers of Holland, Germany, and France. Sweden contributed its national tables. Dr. Price, Mr. Morgan, and the directors of the Equitable Society, in various ways, gave a great impulse to life insurance at the close of the 18th century. Mr. Pitt mitigated the injustice of his income tax by exempting from taxation that part of the income which was paid as premium for insurance; a modification in favour, he said, "of those who have recourse to that *easy, certain, and* "*advantageous mode* of providing for their families by insuring their "lives."* The fire offices commenced insuring lives. The Equitable advanced rapidly, and new offices were established. Baily enumerated 15 life insurance companies in 1813; Mr. Babbage analysed 32 in 1825, thirty of which engaged the attention of 528 directors. The science received considerable accessions by the writings of W. Morgan and Baily. In 1815 Mr. Milne's admirable work appeared, containing a systematic and original digest of the science of life contingencies, which has been extended, modified, and enriched by the analyses and contributions of Barrett, Griffith Davies, De Morgan, Gompertz, Edmonds, Galloway, A. Morgan, Ansell, Neison, Jones, Sang, and other English as well as foreign writers. The number of offices which now exist exceeds 150; and the knowledge of insurance is extending in every direction.

The whole of the commerce of the country turns on contingencies which demand the application of scientific observation and calculation; and as English agriculture has its chemists, English commerce must—to keep pace with it—ultimately employ actuaries, to calculate the risks, which are now only roughly guessed at; and thus extend the useful sphere of an important scientific class of men at present almost peculiar to this country.

Her Majesty's Government, by facilitating that part of their undertaking which life offices have hitherto found to be attended with most difficulty, namely, the exhibiting of such accurate, clear, and frequent statements of their financial condition and progress as may

* Speech in the House of Commons on 14th December 1798.

inspire the public with entire confidence in the success of their arduous engagements—will contribute to their prosperity, and will tend to make England, what it has already partly become, a great emporium for the highest class of securities—policies on lives.

The families of the classes living on wages are still in nearly the same condition, as respects life insurance and a provision against infirmity and age, as the professional and middle classes in the last century; but the stimulus which the facilities and security that the Government could afford, would undoubtedly induce them, in the course of time, to make such a provision for the future as would be satisfactory to their own minds through life, preserve them from humiliation in old age, and in the event of untimely death secure as an inheritance for their widows and fatherless children a decent livelihood, instead of a life of anguish, infamy, or crime. (12th Annual Report, pp. l–lii.)

Construction of the English Life Table No. 3.—The English Life Table No. 3 was calculated in the General Register Office with the help of the Scheutz calculating machine, and was based upon the Census enumerations of 1841 and 1851, and upon the 6,470,720 deaths registered in the 17 years 1838–54. It consists of three parts, or three Life Tables, each of seven columns; the first part for Persons, consisting of such proportions at each age of the two sexes as are produced by the births; the second part for Males; and the third part for Females. The base of the Table for Persons is 1,000,000 children born alive; and as boys and girls were born in England during the period of observation in the proportions of 511,745 boys to 488,255 girls, these numbers were made respectively the bases of the Male Life Table and of the Female Life Table.

In the Synoptical Table the numbers of the males and females living and dying at each year of age are given as they would exist in a population under the law of birth and mortality, found by direct observation to prevail in England and Wales, undisturbed by emigration, by excess of births over deaths, or by any other element of that kind.

The males, we find, if there is no emigration, exceed the females in number in infancy, in childhood, and in manhood up to the age of 53, when the women after the age of childbearing enjoy a firmer hold on life, and die at a lower rate than the men; so that the number of women of 53 and upwards exceeds the number of men of the corresponding ages. The males are to the females of all ages as 20,426,138 to 20,432,046; thus proving decisively that the disparity in the numbers of the two sexes of the English population is due exclusively to emigration.

The Male and Female Life Tables were constructed independently; that of the Persons was obtained by combining the other two in one.

The Life Table is based upon the observed *rates of mortality* at different ages in England and Wales.

The rate of mortality—or, in a technical sense, the mortality—expresses the ratio between three elements: (1) men living; (2) time; and (3) men dying.

The men living, and the *time expressed in years*, multiplied into each other, produce the years of life with which the deaths are compared. A *year of life* is the lifetime unit. It is represented by one person living through a year. Any number of persons living, one at a time, *in continuous succession* through a year, yield also one year of life. There are 525,949 minutes in a year; and 525,949 persons living through one minute also enjoy *one year* of life.

The years of life are determined by enumerating the population at certain points of time, and thence deducing the numbers living through the time.

The following four cases may be distinguished :—

1. The population is known or is assumed to be *stationary*. Thus a population of *ten thousand* living through *two years*, yields *twenty thousand years of life*. Let the population be P, and the years of life y; then in x *years*, $y = x\text{P}$ in all these cases. Here x may be an integer or a fraction.

2. The population increases by equal numbers in equal times; that is, it increases in *arithmetical progression*. If the population is 4,000 at the beginning and 6,000 at the end of a period, the mean population will be the sum of these numbers divided by 2, that is, 5,000; which will also be the population in the middle of the period. 5,000 multiplied by the intervening years gives the years of life. Thus if P_0 is the population at the beginning, and P_x the population at the end of x years; $r = \dfrac{\text{P}_x - \text{P}_0}{x} =$ *annual* increase; for the increase (r) is equal in equal times by hypothesis. The population at the end of any time is $\text{P}_x = \text{P}_0 + rx$. And $dy = \text{P}_0\, dx + rxdx$ is the differential of the lifetime, from which we have by integration $y_x = x\,\text{P}_0 + r\,\dfrac{x^2}{2} =$ the years of life = the population in the middle of the period $\left(\text{P}_0 + r\,\dfrac{x}{2}\right)$ multiplied by the years (x) over which the observation extends.

3. If the population fluctuates much, and frequent enumerations are made, the mean of each successive couple of enumerations, multiplied by the time, expressed in years and fractions of a year, will give nearly the years of life. When the numbers at the beginning and at n equal intervals of time are ascertained, the half of the extremes added to the intermediate terms makes a sum which, divided by one less than the number ($n + 1$) of enumerations, gives the mean population.

4. The population of a country naturally increases in equal proportions in equal times, or in geometrical progression; for this is a necessary result if the increase also increases. Thus, let a population represented by 1 become $1 + i$ in the first year; then :—

$$1 : 1 + i :: 1 + i : (1 + i) \times (1 + i) = 1 + 2\,i + i^2.$$

Thus the increment of $(1 + i)$ is $i + i^2$; the i growing out of the population represented by 1, and i^2 growing out of the population represented by i. The population in two successive equal intervals of time will be in the ratio $1 : 1 + i : 1 + 2\,i + i^2$; and the arithmetical mean of the first term and the third term $= 1 + i + \dfrac{i^2}{2}$; which in a short time, or when i is a small fraction, differs inappreciably from the middle term $(1 + i)$, for the $\dfrac{i^2}{2}$ may be neglected. And so it is if the mean of several terms is taken. The result, therefore, in such cases, differs little from the result which is obtained under the second head.

The division of the average annual deaths by the arithmetical mean population of the extremes, understates the mortality $\left(\dfrac{d}{\text{P}} = m\right)$, which varies inversely as the population. For the same reason the division by the population living in the middle of the period overstates the mortality. The shorter the period the less is the error; indeed the two values approximate indefinitely as the period is shortened, and as the ratio (r) recedes to unity. Either divisor may be employed where great precision is unattainable, or is not required.

The mean population existing at the two points equidistant from the two extremes—in 1841 and in 1851—is near the true mean population living through the 17 years 1838–54. By taking these years the error in the years of life is reduced to a minimum.

Thus the mean population of the age 15–25 was by the different methods :—

MALES :—

$\frac{y_{17}}{17} = 1{,}591{,}550 =$ true mean population, on the hypothesis that the population increased in geometrical progression at a uniform rate.

$\frac{P_{41} + P_{51}}{2} = 1{,}591{,}618 =$ arithmetical mean of the population living in 1841 and 1851.

$\frac{P_0 + P_{17}}{2} = 1{,}595{,}424 =$ arithmetical mean of the population living at the beginning and end of the 17 years.

$r^{8\frac{1}{2}}\ P_0 = 1{,}589{,}606 =$ population living in the middle of the period.

The annual rate of mortality is determined for the several periods of life by dividing the deaths at each age by the contemporaneous years of life out of which they occur. If P represents the years of life enjoyed by men of the age of 20 and under 30, and d the corresponding deaths, then $\frac{d}{P} = m =$ the annual rate of mortality among the men of that age. $100\ m =$ the annual rate *per cent.*

AVERAGE ANNUAL RATE of MORTALITY in ENGLAND and WALES in the 17 years 1838-54.

AGES.	PERSONS.	MALES.	FEMALES.
All Ages	·02245	·02328	·02165
0–	·06738	·07250	·06228
5–	·00916	·00920	·00911
10–	·00527	·00517	·00538
15–	·00838	·00822	·00853
25–	·01028	·00999	·01055
35–	·01277	·01283	·01270
45–	·01715	·01851	·01587
55–	·02992	·03183	·02816
65–	·06319	·06689	·05999
75–	·14027	·14758	·13437
85–	·28820	·30136	·27915
95 and upwards	·43501	·44031	·43223

The rate of mortality at each age is thus deduced from the deaths registered at that age, and from the population of the corresponding age enumerated at the Censuses. Now it is generally admitted that the ages of a certain number of women are understated; and I had to consider what correction was necessary upon this ground.

The probable extent of the error in the statements of women's ages, it was shown in the Census Report for 1851, is not considerable; but as the effect of the error is not always understood, some explanation is necessary.

The English Life Table is not deduced from the population or from the deaths alone, but from the ratio the one bears to the other at different ages; and to display the effect of transfers from one age to the other, assume that the following numbers represent the exact numbers living and dying at the three ages 25, 35, and 45.

Age.	FEMALES.		Annual Rate of Mortality.
	Living.	Dying in a Year.	
(x)	P_x.	d_x.	m_x.
25	313,095	3,024	·00966
35	281,506	3,279	·01165
45	247,434	3,555	·01437

The mortality, it will be observed, increases as age advances; so that if all the women of 35 were returned as ten years younger than they are, the mortality at the age 25 would be overstated; the excess being ·00199. But there is less chance of women of 35 being returned at death as 25 than there is of their being so returned at the Census; and the corrective effect of this excess in the proportion of women at the Census transferred to the earlier ages is apparent, on inspection of the formulas below. d represents the deaths, P the population, m the mortality, and r^{10} the increase of the rate of mortality between the ages 25 and 35. Thus—

$$\frac{d_{25}}{P_{25}} = m_{25}\ ;\ \frac{d_{35}}{P_{35}} = r^{10} m_{25}\ \therefore\ \frac{d_{35}}{r^{10} P_{35}} = m_{25}.$$

It is evident that an increase in the population and a decrease in the relative deaths transferred from 35 to 25 might reduce the error to insignificance. From the numbers living at several periods of age a series representing the numbers living at each year of age was obtained by the method of finite differences; and from these numbers again the living at the ages 25–35, 35–45. . . . . were obtained. The residuary errors affecting the values m_x are, it is believed, inconsiderable.

Upon comparing the female rates of mortality with those of males, and the rates of progression in the mortality of the two sexes, I have come to the conclusion, after carefully weighing the facts, that this correction is adequate; that the rates of mortality represent very nearly the mortality of the female population; and that the probabilities of female life, deducible from the mortality, are substantively true.

The rates of female mortality are in singular accordance with those deducible from observations on males; the mortality of females being slightly higher at the ages 10 to 35 than the mortality of males at home in England.—(Introduction to English Life Table, No. 3, pp. xiv–xxii.)

Constitution of a Life Table, or Normal Population.—The constituent individuals of a population are its elements; and the population is normal when its elements, arranged in corresponding groups, are in the same proportions as the elements of the Life Table. The births = deaths in the same time; to a given number born, the living at each year of age are in the same proportion as P_x to l_0; the rates of mortality are the same; the population lives a number of years after each age, represented by the calculated lifetime.

In a normal population there is an indissoluble connexion between (1) the numbers living, (2) the mean lifetime, (3) the births, (4) the deaths, (5) the rate of mortality, (6) the probable duration of life. Thus by the Life Table of Persons 1,000,000 annual births imply 1,000,000 annual deaths; sustaining a population of 40,858,184, of whom 20,426,138 are males, 20,432,046 are females; half of the persons living 45 years = the probable lifetime; and the mean lifetime being 40·858184 or nearly 41 years; that is = the mean age at death = the number of years of life falling to the share of the children born. To 41 persons living there is *one* birth, *one* death, annually; the rate of mortality is 1 in 41; and 41 is the mean duration of life.

It has been shown that the *rate of mortality* involves three elements, —time, numbers living, numbers dying; thus, if out of 102 living men of a given age 4 die at equal intervals in the year, 98 will live to the end of the year; so $\frac{98}{102}$ = the probability of living a year; $\frac{4}{102}$ = the probability of dying in the same time; and by hypothesis the 102 men in the year enjoy among them $\frac{102+98}{2} = 100$ years of life; now the years of life to be passed by the survivors in the next year will, if 4 die in the year, be 96, and thus the years of life will accumulate year by year, until the last life shall expire. All the years of life belong to the 102 men; and dividing the said years of life by 102 the mean afterlifetime is determined. Thus the units of the numbers that express living men, men dying, and years of life, are produced by men living a definite number of years and then dying.

By retaining one unit of time, and one living, in all cases, the variations of the numbers dying express the variations in the rate of mortality. By fixing the numbers living, and taking the death as a unit, the mean interval of time—which varies—between each death, will express the velocity of dying in the scale of time, under different conditions; and by making the living man a unit, the death becomes a unit, and the variations in the years of lifetime express the different degrees of longevity. By making the time a unit (one year), and the death a unit, the variations in the *numbers living*, out of which 1 death occurs annually—or the relative amount of resistance to death by life is expressed—under the given conditions. One death in *one* year to 41 *living* implies a mean lifetime of 41 years. It was shown before that 41 persons living through *one year* enjoy the same number of *years of life* as *one person* living *forty-one years.*

In a population which is disturbed by emigration, by immigration, by varying excesses of births over deaths or of deaths over births, or by pestilence, the *mean age of the dying* (G_0) can be determined from the registers by arranging the deaths consecutively in a column (d_x) at the various ages, and drawing up from this column the columns corresponding to l_x and L_x, or even to Q_x. But people are born in one place, die in another, and moreover the number of births is scarcely ever the same as the number of deaths. So there is no necessary connexion between the ages of these persons at death, the rate of mortality, the probability of living, or the mean duration of the lives of children born and living in precisely the same circumstances. The results nearly coincide sometimes with those deduced, on correct principles, from a life table; and the early life tables of Halley, Simpson, Dr. Price, and others, were constructed from the burial registers of Breslau, London, and Northampton, without any reference to the living. The errors of such tables are illustrated in the Appendix to the 8th Report of the Registrar General, where the old incorrect Northampton Table is compared with a new table for Northampton constructed on nearly the same plan as the English Table.*

The mean age of those who died in England in the 17 years 1838–54 was 29·4; whereas the mean lifetime of children born in England during the same period is 40·9 years by the life table. This reduction of the age at death, 11·5 years below the mean lifetime, is the result of the introduction of an excess of young lives; as in addition to the 380,631 births to balance the 380,631 deaths, 191,068, making 571,699 children in the whole were born annually and thrown into the population. The mean age of the dying = the mean age to which people live, in a normal population; but as our population is increasing, the mean age of the dying in a limited time is 11·5 years less than the mean lifetime. The mean age of the population of England was 26·4 years in 1851, instead of 32·1 years; so the excess of young people reduces the age of the nation by 5·7 years, or by half the difference $\left(=\frac{11\cdot5}{2}\right)$ between the age at death (29·4) and the mean lifetime (40·9). Instead of living as long as they have lived (26·4 years), they will live about 35·6 years $(= E_{26\cdot4})$—(Introduction to English Life Table, No. 3, pp. xxxi–xxxvii).

The Rate of Mortality and the probability of Dying.—If on an average of years out of 1,000 children born simultaneously, 149 die in the twelve months following the date of birth, the probability of dying is expressed by the fraction 0·149: that is the *death-chance* of a new-born infant under the given law of mortality. As 851 of them survive, 0·851 is the fraction to express the probability of living; it is the *life-chance*. Now ·851 + ·149 = 1 = life-chance + death-chance.

This probability is often expressed thus: the chances are 851 to 149 that a new-born child will live a year. The value of £1 payable if the child should live a year is 17*s.* (£·851); the value of £1 payable on the death of the child is 3*s.* (£·149); the chances in favour of life being greater than the chances in favour of death.

The lives may be looked at with a view to determine the persistency of the life-force; which is such in the present case, that 851 live out of 1,000 during one revolution of the earth; at the age of 20 it is such that 992 out of 1,000 men live a year. The proportions vary under varying conditions, but these variations do not accurately denote the vital force, which is only correctly measured on the *scale of mortality*.

The mortality is determined by the ratio which the deaths bear to the years of life. "The men living, and the time expressed in years, "multiplied into each other, produce the years of life with which the "deaths are compared. A year of life is the lifetime unit."† It is represented by one person living through a year; or by two persons living through half a year. A regiment of an average strength of 1,000 men during three years represents 3,000 years of life; and if the deaths in the three years are 60, the rate of mortality is thus expressed: $m = \frac{60}{3000} = \cdot02$; or the mortality is said to be at the rate of 2 per cent.

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* *See* Extract on pp. 480-2.

† *See* Introduction to English Life Table, pp. xiv–xx; and extract on pp. 485–8.

per annum. The 100 years of life are a fixed quantity; and as it is found that under various circumstances, and at different ages, the rate varies from 1 to 2, 3, 4, 5 up to 50, this scale serves to measure the life-force, or the complementary death-force, in the same way as the centigrade scale of the thermometer serves to measure heat.

A thermometer is not a convenient measure of heat unless at all temperatures it contains the same quantity of mercury, and unless each degree measures equal expansions of the mercury. If the mercury escapes, a correction is required to give the expansion of equal quantities of mercury at every degree of temperature. In observing with the barometer, the measure is adjusted at both ends, so as to give the exact height of the column above the mercury in its well.

So, to determine the rate of mortality on a strength of 1,000 men joined by no recruits, it is necessary to take their mean strength during the whole period of observation; for if one man dies at the end of a week, 999 only remain afterwards exposed to risk, and if the numbers are reduced at variable intervals to 990, to 985, to 911, to 700, to 600, and so on, it is evident that the years of life in the same time will be less than the years of life in a regiment which obtains a recruit for every casualty. All that is required in such cases is to take the observations so as to give the true years of life; and the ratio which these years of life bear to the deaths is the exact measure of the mortality. It is evident, on the other hand, that such a measure is not supplied by a comparison of the deaths in a year, for example, to the living at the beginning of that year. The results by this method are only strictly comparable when the deaths are in the same proportion and occur in the same periods of the year.

By the English Life Table 1,000 infants followed through their first year of age yield nearly 903 years of life; and the mortality is at the rate of $\frac{149}{903}$, or, more correctly, $\frac{149493}{902781} = \cdot 16559$. It is $16 \cdot 559$ per cent. per annum. The probability of dying is $\cdot 149493$; and upon the erroneous assumption that this is the rate of mortality it would be $14 \cdot 949$ per cent. per annum; less by $1 \cdot 610$ than the true rate, with which it should never be confounded.

At other ages than the first year the rate of mortality serves to give the probability of living a year, and thus supplies the fundamental elements of a life table. The difference between the rate of mortality (m), and the probability of dying ($1-p$), becomes less in proportion as the two fractions diminish; for upon the hypothesis that the deaths in a year occur at equal intervals in the year, the relation of p and m is thus expressed:

$$p = \frac{1 - \frac{1}{2}m}{1 + \frac{1}{2}m} = \frac{2 - m.}{2 + m.}$$

(Supplement to 25th Annual Report, pp. iv–v.)

General Description of a Life Table; Healthy Districts.—The Transactions of the Royal Society contain the first life table. It was constructed by Halley, who discovered its remarkable properties, and illustrated some of its applications. The Breslau observations did not supply Halley with the data to frame an accurate table, for reasons which will be immediately apparent; but the conception is full of ingenuity, and the form is one of the great inventions which adorn the annals of the Royal Society.

Tables have since been made correctly representing the vitality of certain classes of the population; and the form has been extended so as to facilitate the solution of various questions.

In deducing the English Life Tables from the national returns, I have had occasion to try various methods of construction; and I now propose to describe briefly the nature of the life table, to lay down a simple method of construction, to describe an extension of its form, and to illustrate this by a new table representing the vitality of the healthiest part of the population of England.

The life table is an instrument of investigation; it may be called a *biometer*, for it gives the exact measure of the duration of life under given circumstances. Such a table has to be constructed for each district and for each profession, to determine their degrees of salubrity. To multiply these constructions, then, it is necessary to lay down rules, which, while they involve a minimum amount of arithmetical labour, will yield results as correct as can be obtained in the present state of our observations.

A life table represents a *generation of men* passing through *time;* and time under this aspect, dating from birth, is called age. In the first column of a life table *age* is expressed in *years*, commencing at 0 (birth), and proceeding to 100 or 110 years, the extreme limit of observed lifetime.

If we could trace a given number of children, say 100,000, from the date of birth, and write the numbers down that die in the first year, living therefore less than one year against 0 in the table, and on succeeding lines the numbers that die in the second, third, and every subsequent year of age until the whole generation had passed away, these numbers would form a *Table of Mortality*, showing at what ages 100,000 lives become extinct.

Again, if the 100,000 children were followed, and the numbers living on the first, on the second, and on every subsequent birthday until none was left, the column of numbers would constitute a *Table of Survivorship*. So if of 100,000 children born at a given point of time, the numbers dying (d_x) in each subsequent year were written in one column, and the numbers surviving (l_x) at the end of each year in another column, the two primary columns of the life table would be formed.

It is evident that if one of these columns is known the other may be immediately deduced from it; for if of 100,000 children born 10,295 die in the first year of age, 3,005 in the second year of age, it follows that the numbers living at the end of one year must be 89,705, at the end of two years 86,700. Upon adding the column (d_x) from the bottom up to the number against any age (x), the sum will represent the whole of the numbers *dying after that age;* and consequently the numbers *living at that age*, as shown in the collateral column (l_x).

The 100,000 children born at the same moment, and counted *annually* to determine the numbers *living* at *the end of every year*, would by our table completely pass away in less than 107 years. If another generation of 100,000, born a year afterwards, were followed, the numbers dying in the various years of age would not be very different, the circumstances remaining the same; and the numbers of those entering each year of age would vary inconsiderably from those of the first series. If 100,000 children again were born at annual intervals, and were subject to an invariable law of mortality, they would form a community of which the numbers living at each age would be represented by the successive numbers (l_x) in the life table. The sum of these numbers, by the new Table of Healthy Districts, would be 4,951,908. The births are here assumed to take place simultaneously at annual intervals; immediately before the births, therefore, in such a community its population would be 4,851,908, to which it would fall progressively from 4,951,908 by 100,000 successive deaths in the year.

The average number constantly living would be some number between 4,951,908 and 4,851,908; and it would be very nearly the mean of these limiting numbers.

In the ordinary course of nature, the births in a community take place in remittent succession; and if it is assumed that the 100,000 births occur at equal intervals over every year, it is evident that at any given date a certain number will be found living at all the intermediate points of age between 0 to 1 year, 1 to 2, 2 to 3, and all the remaining years of age. The population in the above instance would be found by enumeration to be nearly 4,899,665.

The annual *births* would be 100,000 in such a community. The annual deaths would also be 100,000; and by taking out the deaths at each year of age, from the parish registers of a single year, the second column (d_x) of the life table would be found. By adding this column of deaths up and entering the sum of the numbers year by year against every year of age (x), the third column (l_x) of the life table would be obtained; for it has been already shown that the numbers attaining any age x are equal to the numbers dying at that age, and all the subsequent ages. From the registers of the deaths, a table of the numbers of the *population living* in a parish *so constituted* could be immediately determined without any enumeration. Its deviations from the truth would be accidental; and they would be set right by taking the mean of many years. So also from a simultaneous enumeration of the *numbers living in each year of age*, the two columns d_x and l_x of the life table could be constructed without reference to any registry of the deaths at different ages.

The *mean age at death* in such a community would express the mean lifetime, or the expectation of life at birth; and the product of the number expressing the annual births multiplied into the mean age at death would give the numbers of the population.

The deaths in each year of age are called the *decrements of life*. The decrement in the first year is large; in the first five years the decrements of life are considerable; at the age of 10 to 15 they fall to their minimum; slowly increase to the age of 56; increase more rapidly until the maximum is attained at the age of 75; then decline gradually to 85, and after that more rapidly until every life is extinct at the age 107 by this table. ("On the Construction of Life Tables, illustrated by a new Life Table of the Healthy Districts of England," in the Transactions of the Royal Society, 1859, pp. 838–41.)

Basis and uses of the Healthy District Life Table.—Halley first pointed out the financial applications of the life table, and first calculated the values of life annuities. That branch of science, in the various forms of life insurance, has since received great developments. The new table shows that the duration of life, among large classes of the population by no means in unexceptionable sanitary conditions, exceeds the term of the ordinary tables, and proves that life annuities cannot be sold advantageously by offices, or by the Government, to large classes of lives for less than the values deducible from the new table.

A new branch of science has been developed since Halley's day,—it is the Science of Public Health. And here a new application of the life table is found.

It is probable, upon physiological grounds, that man goes through all the phases of his natural development in a hundred years; and that the period of active life seldom extends beyond eighty years. But this is a very indefinite measure, as the rates of mortality, in all the intermediate ages, are left undetermined after it has been ascertained in what proportions men attain the extreme limits.

Generations of men, under all circumstances, die at all ages; but the proportions vary indefinitely under different conditions from a slight tribute to death each year, down to the point of extermination by pestilence. If we ascertain at what rate a generation of men dies away under the least unfavourable existing circumstances, we obtain a standard by which the loss of life, under other circumstances, is measured; and this I have endeavoured to determine in the Life Table of Healthy English Districts. And recollecting that the science of public health was almost inaugurated in England by a former president of this society (Sir John Pringle), who encouraged and crowned the sanitary discoveries of Captain Cook, I feel assured that it will receive with favour this imperfect attempt to supply sanitary inquirers with a scientific instrument.

HEALTHY DISTRICTS.—Population, 1851. Deaths in the Five Years 1849 to 1853. Average Annual Mortality per cent.

Ages.	Population.			Deaths.			Average Annual Mortality to 100 living (m).		
	Persons.	Males.	Females.	Persons.	Males.	Females.	Persons.	Males.	Females.
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
All ages -	996,773	493,525	503,248	87,345	43,736	43,609	1·753	1·772	1·733
Under 5 -	130,635	65,700	64,935	26,361	14,282	12,079	4·036	4·348	3·720
5— -	122,406	61,733	60,673	4,209	2,080	2,129	·688	·674	·702
10— -	110,412	56,651	53,761	2,377	1,087	1,290	·431	·384	·480
15— -	181,339	90,066	91,273	6,603	3,113	3,490	·728	·691	·765
25— -	136,892	65,422	71,470	5,869	2,675	3,194	·857	·818	·894
35— -	108,056	52,734	55,322	5,208	2,447	2,761	·964	·928	·998
45— -	85,244	42,383	42,861	5,252	2,698	2,554	1·232	1·273	1·192
55— -	62,857	31,105	31,752	7,001	3,568	3,433	2·228	2·294	2·162
65— -	39,453	18,860	20,593	10,313	5,173	5,140	5·228	5·486	4·992
75— -	16,737	7,718	9,019	10,297	4,946	5,351	12·304	12·817	11·866
85— -	2,614	1,097	1,517	3,581	1,555	2,026	27·399	28·350	26·711
95 & upwards.	128	56	72	274	112	162	42·813	40·000	45·000

The Healthy District Life Table was constructed in 1859 from the Census enumeration of 1851 and from mortality observations extending over the five years 1849 to 1853 in 63 districts of England and Wales which showed during the ten years 1841–50 a mean annual death-rate not exceeding 17 per 1,000 persons living. It has been found by experience that this Healthy District Life Table expresses very accurately the actual duration of life among the clergy and other classes of the community living under favourable circumstances.—("On the "Construction of Life Tables, illustrated by a new Life Table of the "Healthy Districts of England," in the Transactions of the Royal Society, 1859, pp. 838–41.)

CONTENTS

OF

PART VI.—MISCELLANEOUS.

PART VI.—MISCELLANEOUS.

INTRODUCTION.

THE selections embraced by the Parts devoted to Population, Marriages, Births, Deaths, and Life Tables have occupied so large a portion of the available space in this volume that the selection from Dr. Farr's writings in other branches of statistics has necessarily been very restricted.

The first section of this Miscellaneous Part deals with sickness and health insurance. The social and public-health aspects of sickness invest with unquestionable interest and importance all trustworthy statistics bearing upon this subject. The scarcity of such statistics, and the difficulties of even defining practically and satisfactorily the term sickness, are discussed in the extracts given in this section. As there is no national system of registration of sickness, Dr. Farr had to content himself with the best available information from independent sources for that portion of his article on Vital Statistics in McCulloch's British Empire dealing with this subject, from which several extracts are printed in the following pages. These independent sources included friendly society returns, and returns of sickness among dockyard labourers, labourers in the East India Company's service, and in the metropolitan police force. Sickness returns, apart from their value as a complement to returns of mortality, supply the only trustworthy basis for the calculation of tables for health insurance, or rather for sick-pay allowances. The national importance of health insurance, both from a social and political standpoint, was fully appreciated by Dr. Farr, who strongly advocated the advisability of establishing a government system of health insurance; partly on the ground that the financial condition of so many friendly societies was far from satisfactory, thus tending to check this form of thrift in the working classes, which, if fully developed, would materially reduce the expense of poor-law relief. Recent legislation has given a more healthy financial tone to friendly societies, but the condition of many of them is still far from satisfactory, and the position of not a few borders on bankruptcy, threatening disastrous loss to members whose contributions have been paid out of hardly-earned wages.

The Registrar General's educational statistics, based upon the steadily declining proportions of signatures by mark in the marriage Register, afford trustworthy and thoroughly impartial evidence of the improvement of elementary education during the past half century. Dr. Farr initiated this branch of statistics in the early days of civil registration, and there are few of the first 40 Annual Reports of the Registrar General that do not contain pertinent comments on this subject. A selection from these comments appears in the following pages; and for the benefit of those whose interest in the subject may lead them to wish for further acquaintance with these statistics, it may be worth noting that in the 31st Annual Report, on pp. xxxvi–xliv, will be found a reprint of a larger selection of these comments than could be provided for in this volume. It was not unreasonably claimed for these statistics, and the repeated deductions therefrom, that they "incidentally helped to "strengthen the movement in favour of State education for the poor," which bore fruit in the Education Act of 1870.

The third section of this Part contains a few extracts bearing upon the history and defects of civil registration of marriages, births, and deaths, and upon the improvements and changes therein effected by the Births and Deaths Registration Act of 1874.

The remaining sections contain selections from contributions upon the "Cost and Economic Value of Man," on "Risk of Fatal Railway "Accidents, and Insurance against Death or Injury through Railway "Accidents," and on "Family Nomenclature in England."

A reference to the biographical sketch of Dr. Farr at the commencement of this volume will show that from a considerable proportion of his work no extracts have been selected for these pages. The intention of those who initiated and carried out the proposal to publish this memorial volume was to make it as far as possible a storehouse of the facts and principles concerning Vital Statistics deduced and enunciated by Dr. Farr in the course of his laborious and useful career. With this object in view it was inevitably necessary to confine the selection as far as possible to those works which most intimately and directly dealt with that subject. This, and no want of appreciation for other work of Dr. Farr's pen, has led to the exclusion of much matter of undoubted interest and value, although not distinctly bearing upon pure Vital Statistics.

EDITOR.

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1. Sickness, and Health Insurance.

Relation of Sickness to Mortality.—It appears that in manhood, when 1 person in 100 dies annually, 2 at the least are constantly sick; and although this exact relation is, perhaps, not preserved in infancy and old age, or where the rate of mortality deviates much from the standard, it may be safely assumed as an approximation to the truth. Admitting, then, that the annual mortality is 2·19 per cent., after the corrected returns, and that the population of England and Wales is at present (1846) 17,000,000, the total number constantly disabled by sickness will amount to 744,600 persons; and if the same proportions be extended to Scotland and Ireland, to 1,247,000. This reduces the efficient population of the empire 1-23rd part; and the productive power, as far as it depends on human labour, 1-15th part, if the maintenance and attendance of the sick cost half the produce of their labour in health:* an example will show how it would be erroneous to suppose that two populations, in which the same absolute proportion of sick existed, suffered consequently to an equal extent. Two-fifths of the registered deaths occur below 5 years of age, yet the mortality in England has latterly (1841) not been more than 63·5 per 1,000 at this early age: in Sweden it was (1755-75) 90·1 per 1,000; and it is probable that at the same period the mortality of infants in England was not a great deal lower than in Sweden; so that, if sickness have diminished at the same rate, the proportion of infants constantly ill is not by one-third so great as it was

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* In the English provincial hospitals the maintenance and the drugs administered to each patient cost 1*s.* 5*d.* daily; in Paris, 1*s.* 5½*d.*; in London considerably more.—(*British Medical Almanac*, p. 118.)

a century ago. But children being entirely helpless, and in no way contributing to the nation's actual strength, a diminution of sickness among them, however desirable, adds little immediately to national power and happiness, compared with an improvement in the health of adults, between the ages of 15 and 60 years, such as has been observed in London since the 16th century, when the destructive epidemics ceased.

The magnitude of the subject, and the fact that a million and quarter of the inhabitants of the United Kingdom are disabled by disease and suffering, is of less importance than the consideration that their condition may be vastly ameliorated. In one class of districts the mortality of boys below 5 years of age, is 145 in 1,000, in another 48 in 1,000: between the ages of 15 and 55 it varies from 18 to 11, implying a difference of 14 men constantly sick in 1,000 living. In the former districts about 36, in the latter 22, are constantly suffering from disease, and absolutely disabled from labour. If the population of the United Kingdom, and the adjacent islands (28,487,000), were as unhealthy as that of Liverpool and Manchester, 1,937,000 would be ill, and 968,500 would die annually; whereas if the whole people enjoyed as good health as the inhabitants of other parts of England, only 1,026,000 would be constantly ill, and only 513,000 would die annually on an average. In the former case, the mean duration of life would be 25 years, in the latter 45 years. Whether it be possible or not to raise the standard of health to the height enjoyed in the healthiest counties, or to one still higher, the importance of the subject recommends it to a careful experimental investigation; because, when the character and causes of our diseases are known, some provision may be made for their alleviation; the extent of the injuries which they inflict upon the public will be determined; and the standard of salubrity, indicating an increase or diminution of physical strength, will afford the best index of the prosperity of the nation, and of the extent to which it is affected by atmospherical, political, or economical influences. (McCulloch's Account of the British Empire, Article "Vital Statistics," Vol. II., pp. 542-3.)

Sickness and Mortality at various Ages, and from different Diseases.—The rate of mortality declines as age advances from birth to puberty, and then increases according to certain determinable laws. The mortality decreases to the age of puberty, and then increases somewhat slowly to between 50 and 60. After the age 55 the mortality increases at such a rate that it is doubled for females every 8·24 years in the healthy districts, and every 8·95 years in England and Wales. At the ages 20–50 the mortality of females increases one sixth part for every 10 years of age in the healthy districts, and so would not be doubled at that rate in less than 47 years. In England the mortality of females (20–50) increases nearly one fourth part every 10 years of age; the mortality of males (20–40) increases somewhat faster, and from 40 to 50 the increase is intermediate between that of the previous age and the future, which may be called the final age increase-rate.

It may now be shown that there is a certain relation between the number of deaths by any disease and the number of attacks by that disease. Some diseases are fatal to nearly every one they attack, and so they can occur but once in a lifetime: such are hydrophobia, glanders, cancer, tetanus, tabes mesenterica, phthisis, hydrocephalus, softening of brain, some heart diseases, aneurism of aorta, angina pectoris, ascites, ileus, perforation of intestine, ischuria, Bright's disease, Addison's disease, diabetes, ovarian dropsy (without operation), cyanosis, fractures of base of skull, wounds of vital parts; extensive burns; poisoning by high doses of prussic acid, strychnia, and other poisons, solid, liquid, and gaseous; submersion under water for a few minutes; suffocation. Every death here represents one case of disease or injury. As medicine affords alleviation but cannot cure, their prevention is the great end to be aimed at.

Apoplexy and paralysis are fatal generally after two or three attacks.

Then there are two other great *classes* of diseases; (a) one is fatal to a certain number of the attacked, and (b) the other causes inconvenience, but is not fatal.

Of the first class, certain diseases, as a general rule, attack a patient only once, and that in early life; such are small-pox, measles, scarlet fever, whooping-cough, enteric fever. The deaths imply a number of attacks varying with age: thus it has been shown that the mortality was such in the London Small-pox Hospital, that there was 1 death to 2·44 cases in children under 5 years of age; 1 in 2·93 at the ages 20–30; and in the two next decenniads 1 in 2·15 and 1 in 1·71.* According to a report of the Committee of the Metropolitan Asylum District, 1872, the mortality from small-pox after the age of five was half as high, but increased in the three decenniads of age 20–50; it increased at the same rate, the deaths being 1 in 5·98, 1 in 4·22, and 1 in 3·40 among the vaccinated and unvaccinated taken indiscriminately; the mortality of the unvaccinated being much higher than the mortality of the vaccinated. So the mortality from cases of fever has been shown to increase with age.

When the cases to one death at the respective ages have been determined, the attacks from each disease can be calculated from the deaths by that disease in the expanded life table (pp. xciv-v of this Report).

The mortality of the cases of cholera in London, 1854, was such, that to one death there were only 2 cases; but the death-rate ranged with age from 1 in 1·36 to 1 in 2·86.† Then the contemporaneous epidemic of diarrhœa was not by a thirtieth part so fatal; there was, taking all ages, one death in 61 cases: in children under 5 *one* death in 17 cases; in adults of 35–45 only *one* death in 199 cases; the mortality in old age increasing rapidly. By applying the proper factors the attacks of cholera or diarrhœa are calculated from the deaths.

There is a peculiar class of the sometimes fatal diseases that are recurrent; such are intermittent fever, remittent fever, neuralgia, rheumatism, gout, epilepsy, asthma; one attack, far from precluding, facilities another apparently, so that one death may represent several attacks by the same disease of the same person.

Among the diseases to which the deaths give little or no clue, because theh are rarely or ever fatal, may be reckoned chicken-pox, cow-pox, febricula, mumps, gonorrhœa, primary syphilis, epistaxis, varicose veins, nævus, toothache, tonsillitis, dyspepsia, worms, hæmorrhoids, gastrodynia, hydrocele, orchitis, paramenia, flat feet, obesity, corns, skin diseases of various kinds, slight wounds and injuries.

A vast amount of incapacity in the army arises from these causes; and the necessity of recording the cases of diseases, both fatal and not fatal, is evident. But it is to be borne in mind that a death is a much more evident thing than attacks of disease varying indefinitely in intensity. The death returns are the basis of all sanitary statistics. (Supplement to 35th Annual Report, pp. xxxv–vi.)

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* M'Culloch's Account of the British Empire, vol. 2. Article, "Vital Statistics," p. 594.

† Report of General Board of Health, Committee of Medical Council on Cholera Epidemic of 1854.

Early Sickness Tables.—A Bill, embodying a plan for enabling the labouring poor to provide support for themselves in sickness and old age, by small weekly savings from their wages, was introduced by Mr. Dowdeswell, and approved by the House of Commons, in 1773; but it met with the same fate as another Bill framed by the Commons in 1789, and founded on tables computed, at the request of a committee, by Dr. Price. The Lords rejected both Bills; and thus deprived the labouring poor of the guidance of a legislative Act in the formation of friendly societies for half a century. The tables of sickness, computed for the first Bill, were published by Baron Maseres in the second volume of his *Treatise on the Doctrine of Life Annuities:* Dr. Price's tables, which have till latterly been in general use, were published, in the edition of his work on Annuities, by Mr. Morgan. These tables were founded partly on observations and partly on an ingenious hypothesis: no extensive observations were ever made to determine the average time of incapacitation from labour produced by sickness, till the subject was taken up and investigated by the Highland Society (1824). Since then two committees of the House of Commons have sat on benefit societies, and the subject has obtained more attention. (McCulloch's Account of the British Empire, Vol. II., Article "Vital Statistics," pp. 570–1.)

Definition of Sickness.—Sickness, in practical statistics, is employed in a general sense. If we consider man as a material body, acting intelligently, anything in the condition of the body itself, which interrupts or impedes that action, is sickness. Any disturbance in the functions of the body, or alteration in the organs by which they are executed—from the skin to the brain and spinal marrow—from the time the food enters the mouth, till it exhales from the skin and lungs in vapour and gas—is a disease: and the sum of sick-time, produced by all diseases, constitutes the sickness of which statisticians speak. It is of various kinds. In acute or severe diseases, such as fever, inflammation of an important part, or malignant ulcer, a man is often able to think and move, just as he can digest a small quantity of food; but not with any energy, or at least with the energy required by an ordinary occupation. Any attempt at exertion aggravates and prolongs the sickness. This, we believe, is called *bedfast* sickness by the friendly societies. In other chronic diseases, slow inflammations of internal organs, reduced dislocations, rheumatisms, ulcerations, the patient can attend partially to his business: he is in possession of half his faculties; whether he can make them in any way available depends on circumstances. This is walking sickness. The infirm, the crippled, the maimed, may either be entirely helpless and bedridden, or capable of some of the duties of life: their sickness differs from the bedfast, and from the walking, in being beyond the pale of recovery. The Highland Society calculated that of ten weeks' sickness, among persons of all ages under 70, two may be assumed as bedfast sickness, five as walking, and three as permanent.* (McCulloch's Account of the British Empire, Vol. II., Article "Vital Statistics," pp. 571–2.)

Sickness in Friendly Societies.—The following table of sickness, from the *British Medical Almanac*, presents a comparative view of the mean proportion of sickness incidental to members of English and Scotch benefit societies; according to (1.) the observations of the Highland Society; (2.) returns obtained by Mr. Ansell, and published in his work by the Society for Promoting Useful Knowledge; and (3.) a table of

* Report of Friendly Societies, by a Committee of the Highland Society, p. 108.

Mr. Edmonds's, agreeing very nearly with Dr. Price's, at one time in general use :—

PROPORTION of SICK out of 100 Living at different Ages in Friendly Societies.

Between Ages.	Sick Time in 100 of Life Time. Scotch Benefit Societies.	Sick Time in 100 of Life Time. English Benefit Societies.	Sick Time in 100 of Life Time. Theroetical Table by Mr. Edmonds.	Between Ages.	Sick Time in 100 of Life Time. Scotch Benefit Societies.	Sick Time in 100 of Life Time. English Benefit Societies.	Sick Time in 100 of Life Time. Theoretical Table by Mr. Edmonds.
20 to 30	1·14	1·54	1·72	70 to 80	31·70	32·50	..
30 — 40	1·32	1·83	2·30	80 — 90		40·00	..
40 — 50	1·97	2·56	3·10	90 — 93		67·00	..
50 — 60	3·60	4·32	4·51				
60 — 70	10·80	11·26	9·36	All Ages	2·45	2·76	..

These observations show, that, in the different circumstances, 1·32, 1·83, and 2·30 men in 100, between the ages of 30 and 40, were constantly ill : the sick-time increasing regularly with age. It is easy to deduce from this table the average days of sickness to each individual.

These Scotch and English observations represent, so far as limited numbers can, the sickness to which men, who are healthy at the time of entering benefit societies, are subsequently liable : the general proportion of sickness is higher. Tables of sickness for the entire population would be formed by taking 100,000 persons, of given ages, indiscriminately, and observing them for one, two, three, &c., years, they would consequently comprehend 4,000 and 5,000 individuals sick when the observation commenced expressly excluded by the rules of benefit societies, as well as those suffering from syphilitic diseases and accidents incurred through drunkenness or brawls. In the parish of Methven, Perthshire, it was ascertained that 35 out of 743, or 4·7 per cent. of the male population above 15, would, from bodily or mental infirmity, not have been admitted as members of the friendly societies.* Medical men are well aware that labourers often go about their work with diseases of the heart, tubercles in the lungs, and disorders of considerable severity. Dr. Forbes ascertained, by the personal examination of 120 Cornish miners, in actual employment, that only 63 had good health ; of the remaining half, 26 had difficulty of breathing, 14 pain of chest, 10 pain of stomach and bowels, 5 lumbago, pain of shoulder, palpitation, scrofula, or fits.† Out of 115 children below 18 years of age, Dr. Bisset Hawkins states, that 84 had good health ; 25 middling health ; 6 bad health. Of the miners at work only 53, of the factory children only 73 per cent., enjoyed good health. How much sickness exists among the actual labourers of this country, independently of those definitely incapacitated by disease, and who are either discharged on this account or set aside as inefficient, there are no satisfactory statistics for determining. (McCulloch's Account of the British Empire, Article "Vital Statistics," pp. 571–2.)

We are indebted to Mr. Neison for a most important contribution to vital statistics, in the shape of an inquiry into the sickness and mortality experienced among the members of friendly societies. The data, published in detail by Mr. Neison, have been derived from two sources. One portion, relating to the friendly societies of England, was obtained

* Report of Friendly Societies, by a Committee of the Highland Society, p. 280.

† Medical Topography of Penwith, Cornwall, by J. Forbes, M.D. ; Trans. of the Medical Association, vol. iv. p. 187.

through Mr. Tidd Pratt; and consists of the quinquennial returns for 1836–40, made under the Friendly Societies Act, 10 Geo. IV., c. 56. s. 34, as amended by 4 and 5 Will. IV., c. 40, s. 6. The other portion was procured by Mr. Neison himself from the friendly societies of Scotland. The abstracts, made under his supervision, and at his own expense, have been liberally communicated to the public. They are the most extensive returns of the kind extant; and the results are of the greatest practical importance.

The returns of sickness and mortality are separately given for the rural, town, and city districts of England and Scotland. They will be found in a condensed form in the annexed tables.

The sickness returned in these tables is much higher than that given in the previous returns of the Highland Society, and of Mr. Ansell. Thus the amount of sickness experienced in the 30 years of age, from 20 to 50, is by the Highland Society's returns 22 weeks, Ansell's 31 weeks, Neison's 33 weeks; from the age of 30 to 60 it is 34 weeks, 45 weeks, and 52 weeks in the respective returns. From 20 to 60 the sickness does not differ materially from that experienced by the East India Company's labourers.*

SICKNESS in FRIENDLY SOCIETIES according to various Returns.

Ages.	Average Number constantly Sick to 100 living at each Age.				
	Friendly Societies.				East India Company's Labourers.
	Scotland. (Highland Society.)	England. (Ansell.)	Scotland. (Neison.)	England. (Neison.)	
20–30	1·14	1·54	1·65	1·69	1·62
30–40	1·32	1·83	1·66	1·91	2·06
40–50	1·97	2·56	2·44	2·89	2·69
50–60	3·60	4·32	5·17	5·21	6·58

The Society of Odd Fellows had, in the year 1844, nearly a quarter of a million of members. The Board of Directors, at Manchester, procured a return in 1845, of which Mr. Neison gives the following analysis:—

ANALYSIS of RETURNS made to the MANCHESTER UNITY OF ODD FELLOWS for the Year 1844.

District.	Average No. of Members during 1844.	Deaths of Members.	Deaths of Members' Wives.	No. of Weeks' Sickness.	No. of Members out of which		Average Sickness Yearly to each Member expressed in Weeks.
					One Member died.	One Member's Wife died.	
Rural - -	66,208	608	434	57,795	108·89	152·55	0·873
Town - -	77,070	700	554	70,435	110·10	139·01	0·913
City - -	99,818	978	662	98,687	102·09	150·83	0·988
Whole Unity -	243,126	2,286	1,650	226,917	106·35	147·34	0·933

* See extract on pp. 508–11.

In explanation of the above table, it may be stated that the rural district is composed of those places the population of which is under 5000, the town district of those places the population of which is 5000 and under 30,000, and the city district of such places as have a population of 30,000 and upwards.

During the year 1844, it will be seen that the mortality for the whole Unity was, as already stated, about 1 to every 106 members; while for the rural districts it was 1 in 109, for the town districts it was 1 in 110, and for the city districts it was 1 in 102. The average amount of sickness to each member is 6½ days*.

The contributions in the Odd Fellows Society appear to be inadequate to secure a member the advantages which they promise for any length of time, under an economical management; and it would appear, that the expenses are at present extravagant. The income in 1844 was 325,200*l.*; the expenditure 241,604*l.*; the sum paid to sick members was 107,440*l.*; for funerals, district, and widow and orphans' funds, 62,743*l.*; and sundries 71,421*l.*! The average age of the members is 32 years; and to secure 10*s.* a-week in sickness, 10*l.* at the death of a member, and 5*l.* at the death of a member's wife, the annual payment should, according to Mr. Neison's computation be 1*l.* 14*s.* 5*d.* The actual sum demanded according to the new scale, No. 1, is 1*l.* 2*s.* 9*d.* This is irrespective of 5*s.* or 6*s.* a-year in "Sundries" to each member. The premiums of those societies are not graduated according to age. Upon the whole they exhibit, amidst much good feeling, a want of knowledge, calculation, and foresight—which must involve the managers in discredit and the members in deep distress, unless an immediate and effective reform be carried out in all the lodges. The contributions must be raised and graduated, the expenses cut down to the narrowest limits.

In 1834 the number of members in the order was about 60,000, at the beginning of 1846 the number was 251,727. The entrance fees in 1844 amounted to 49,382*l.*, so that upwards of 40,000 members were initiated in the year; and as the increase of members was only 21,461 in that year, "upwards of 20,000," say the directors, "must "have left the order after paying their initiation money and contribu- "tions for a length of time." This, although it neither denotes stability nor confidence in the order, is a large source of revenue; which may be taken into account in estimating the resources, and fixing the premiums.

Reverting to the tables of returns from other societies, it will be observed, that nearly one-third of the members are between the ages of 30 and 40; the greatest number appear to enter between the ages of 20 and 30; but new members come in at 30 and 40 and greater ages. The returns for England are from an average number of 229,449 members observed 5 years (1836–40), those for Scotland only from an average of 5,879 members for 12 years (1831–42). Nearly six-tenths of the English, and seven-tenths of the Scotch members belonged to "rural" societies; the remainder to societies in towns and cities. The mortality in all the societies was comparatively low; in the Scotch higher than in the English; and in the whole not higher than in Surrey, one of the healthiest English counties. The mortality under 30 in England and under 20 in Scotland, was somewhat higher in the rural than in the town societies; after those ages the mortality was considerably higher in the towns and cities than in the country; thus, in England, of 149,210 members of the age 40–50 only 1,378 died, while 1,520

* Observations on Odd Fellow and Friendly Societies, by F. G. P. Neison, F.L.S., and Actuary to the Medical and Invalid Life Office.

members died in the town and city societies out of 107,286 members. The mortality in the country was ·924, in the towns 1·417 per cent. annually. The mortality in Scotland at the same age, 40–50, was ·997 per cent. in the rural, 2·097 in the city and town societies. The higher mortality in the towns, Mr. Neison appears disposed to ascribe to occupation, and the different "physical exercises" to which the several "classes of society" are "habituated."* We cannot agree with him. That "physical exercise" and occupation have an effect on the mortality is admitted on all hands; but Mr. Neison should not have forgotten at the moment he was writing, that the excess of mortality in towns among children under 5 years of age, and among women is as great or greater than any he has discovered among the artizans and labourers belonging to friendly societies. From the age of 10 to 60 there were in England to every annual death from 2·3 to 2·7 members constantly on the sick fund. The mean of the 5 decennial periods is 2·5 years of sickness to every death; or in other words 2·5 members constantly sick to *one* death in a year. The ratio of the numbers receiving relief to a death is least at the age of 30–40; when the earnings of a man are greatest, and the calls on him from a dependent family are most urgent; at a period, therefore, when the *difference* between "wages" and "sick-pay," and his indisposition to forego this difference, are at a maximum. We have seen that many artizans are constantly at work while labouring under severe—to say nothing of slight illness; and it is evident, that the illness, lameness, or infirmity, which incapacitates a policeman from doing duty, or from walking 20 miles a-day, would scarcely prevent a tailor and weaver, from plying the needle and shuttle. Instead of inferring from the facts, as Mr. Neison appears disposed to do, that *sickness* and *mortality* are not connected together "as cause and effect;" we should lay it down as a principle, not true, but somewhat the less paradoxical of the two, that there is no connexion between the time men of different trades in friendly societies are in the receipt of sick-pay and the actual sickness which they experience. The variable extent to which equal degrees of sickness are likely to throw artizans of different trades on the sick fund, should be borne in mind, in advising societies, consisting of two or three prevailing professions. The mortality is greater, the sick-time less in the Scotch than in the English societies; we do not know whether this is connected in any way with the cholera, which was epidemic in the period over which Mr. Neison's Scotch returns, and not in that over which his English returns, extend. An epidemic like cholera, in which the cases are of short duration and fatal, would account for the anomaly in the Scotch returns, which are little more than four-tenths in extent of those returned by English societies. At the age of 60 and 70, when the earnings are inconsiderable, and infirmities gain ground on the strength, there are *four* or *five* constantly on the sick and pension fund to one annual death; the whole of the illness experienced probably appears in the returns; and much that in earlier life would be shaken off, or not be called illness.

The members of friendly societies are selected men, and do not exhibit either the mortality or sickness of the classes from which they are taken. Yet we are inclined to think the mortality of the members still understated; and that like the sick-time, it will be found to increase with the successive returns. This may be put to the test by analysing the returns for the 5 years 1841–5; which are probably, in conformity with the Act of Parliament, now at the Home Office or the House of

* Con. to Vital Stat., pp. 109, 110.

Commons. The numbers who enter and leave the societies at each age should also be ascertained. The following are interesting tables, showing the mortality and sickness rates in friendly societies, and the average duration of attacks of sickness.

Age.	Rural, Town, and City Societies.			Rural Societies.			City and Town Societies.		
	Population or Years of Life.	Deaths.	Sickness. In Weeks.	Population or Years of Life.	Deaths.	Sickness. In Weeks.	Population or Years of Life.	Deaths.	Sickness. In Weeks.
9	65	—	30	50	—	11	15	—	19
10	34,367	217	28,243	23,145	163	·19,283	11.222	54	8,955
20	276,984	1,972	244,885	181,595	1,310	158,566	95,389	662	86,319
30	365,471	3,067	364,074	213,994	1,586	194,842	151,477	1,481	169,232
40	256,496	2,898	387,336	149,210	1,378	188,302	107,286	1,520	199,034
50	138,257	2,635	375,705	84,687	1,400	199,421	53,570	1,235	176,284
60	55,828	1,972	428,870	39,458	1,249	301,075	16,370	723	127,795
70	17,046	1,289	356,791	12,805	884	261,343	4,241	405	95,448
80	2,611	335	76,378	1,832	213	47,423	779	122	28,955
90	115	5	2,120	107	2	1,770	8	3	350
100	3	—	—	3	—	—	—	—	—
Total	1,147,243	14,390	2,264,432	706,886	8,185	1,372,041	440,357	6,205	892,391

Age.	Annual Mortality per Cent.			Constantly Sick in 100 Members.			The constantly Sick, and the Years of Sickness to one Annual Death.		
	Rural, Town, and City Societies.	Rural Societies.	City and Town Societies.	Rural, Town, and City Societies.	Rural Societies.	City and Town Societies.	Rural, Town, and City Societies.	Rural Societies.	City and Town Societies.
9	—	—	—	—	—	—	—	—	—
10	·631	·704	·481	1·575	1·597	1·529	2·494	2·268	3·178
20	·712	·721	·694	1·694	1·673	1·734	2·380	2·320	2·499
30	·839	·741	·978	1·909	1·745	2·141	2·275	2·354	2·190
40	1·130	·924	1·417	2·894	2·419	3·555	2·561	2·619	2·509
50	1·906	1·653	2·305	5·208	4·513	6·307	2·733	2·730	2·736
60	3·532	3·165	4·417	14·722	14·623	14·961	4·168	4·620	3·388
70	7·562	6·904	9·550	40·114	39·114	43·132	5·305	5·666	4·517
80	12·830	11·627	15·661	56·061	49·609	71·234	4·369	4·267	4·548
90	—	—	—	—	—	—	—	—	—

Age.	English Friendly Societies. Days of Sickness in a Year to One Member.			Scotch Friendly Societies. Days of Sickness in a Year to One Member.		
	Rural, City, and Town Societies.	Rural Societies.	City and Town Societies.	Rural, City, and Town Societies.	Rural Societies.	City and Town Societies.
10	6	6	6	6	6	5
20	6	6	6	6	6	7
30	7	6	8	6	6	7
40	11	9	13	9	8	11
50	19	16	23	19	18	21
60	54	53	55	50	50	49
70	147	143	158	150	147	165
80	205	181	260	216	208	264
90	—	—	—	236	—	263

Members of the age of 20 and under 30 had, on an average, six days of sickness annually—or they received pay for six days of every year that they were entitled to pay.

Average Duration of Attacks of Sickness. (From Returns of Scotch Friendly Societies, framed by G. P. Neison, Esq.)

Age.	Total Number of Attacks, including those ending in Recovery and those ending in Death.	Total Amount of Sickness, including that ending in Recovery and that ending in Death.	Average Duration of each Attack of Total Sickness, including that ending in Recovery and that ending in Death.
		Weeks.	Weeks.
10–15 - -	12	39·428	3·286
15–20 - -	117	749·571	6·407
20–25 - -	637	2830·285	4·443
25–30 - -	985	5483·000	5·566
30–35 - -	1,074	5014·143	4·668
35–40 - -	872	4524·714	5·188
40–45 - -	758	4158·714	5·486
45–50 - -	519	3445·714	6·639
50–55 - -	537	6634·285	12·354
55–60 - -	491	7171·571	14·606
60–65 - -	350	9102·286	26·004
65–70 - -	135	5934·714	43·960
70–75 - -	116	8867·999	76·448
75–80 - -	29	4588·857	158·236
80–85 - -	19	4027·000	211·947
85–90 - -	—	—	—
90–95 - -	1	353·000	353·000
	6,652	72925·281	10·957

(McCulloch's Account of the British Empire, Article "Vital Statistics," Vol. II., pp. 581–6.)

Sickness among Dockyard Labourers.—The following tables are based upon returns relating to the labourers employed in Portsmouth Dockyard during the three years 1830–1–2, showing the numbers employed, and the cases and causes of absence from work.

Years.	Average Number of Men.	Number of Cases.		Days of Sickness from Disease.	Days of Sickness from Injuries.	Total Days of Absence from Work.
		Diseases.	Injuries.			
1830 -	2,079	697	357	9,188	5,884	15,072
1831 -	2,002	888	325	9,605	4,620	14,225
1832 -	1,867	665	329	8,617	5,086	13,703
Total in 3 years	5,948	2,250	1,011	27,410	15,590	43,000

This table furnishes, as the mean of the three years, the following interesting results. In the year, 1 man in 6 is seriously hurt; 2 in 5 fall ill. Each man, on an average, has an attack of illness, either spontaneous or caused by external injury, every 2 years; and, at an average, each disease lasts 14 days.

So far as the returns from the other dockyards can be understood and admit of comparison, they confirm these results; and between Woolwich and Portsmouth, where hurts and sickness are distinguished, there is a remarkable coincidence in the time lost by sickness, although that from injuries is very different.

TIME LOST by SICKNESS from DISEASE or INJURY among LABOURERS in PORTSMOUTH and WOOLWICH DOCKYARDS.

—	Mean Number of Workmen.	Days Lost by Sickness.	Days Lost by Accidents.	Constantly Sick, per Cent.	Constantly suffering from Accidents, per Cent.	Constantly Ill from both Causes, per Cent.
Portsmouth	5,939	27,410	15,590	1·26	0·73	1·99
Woolwich -	2,243	10,593	8,594	1·29	1·05	2·34

It may be safely assumed that of the labourers employed in the dockyards 2 per cent. are constantly kept at home by diseases or injury; and that diseases, independent of external mechanical injury, constitute almost two-thirds of the entire sickness. No details or explanations accompany the original returns; but it may be presumed that the sickness only of the men who recovered, and returned to the dockyards, is intended in the tables, and this, with the selection on entering, excludes the greater proportion of sickness prevailing in a population, although it expresses that experienced by the actually working class. The sickness of the working labourers in the East India Company's service was, we shall show, 1·65 per cent.; and this is little more than a fourth part of the entire sick-time experienced by the whole number employed, including those pensioned. This proportion would make the sick-time of the dockyard labourers 7·8 per cent. of the lifetime.—(McCulloch's Account of the British Empire, Article "Vital Statistics," pp. 572–4.)

Sickness among Labourers employed by the East India Company in London, 1823–34.—A return of the state of health among the men employed by the East India Company in London deserves especial attention, as no observations so accurate or extensive have before been published, relative to the sickness and mortality among labourers in large cities. This return was obtained "in the form of a large volume, " containing a list of 2,461 labourers, employed in the month of April, " 1823, with a statement of the number of days' illness experienced by " these labourers, one by one, year by year, for the 10 succeeding years; " also the date of every death, and the date when any labourer ceased to " be employed, by being superannuated and pensioned, dismissed, or by " voluntarily leaving the service of the Company."*

Every labourer put upon the sick list is allowed 1*s*. 6*d*. a day, Sundays included; he is also seen every day by the surgeon, and therefore remains no longer absent than the case requires.

During the 10 years, 496 died, 248 were pensioned, and 208 left the service, or were dismissed. The reporter, Dr. Mitchell, has calculated

* Factories Inquiry; Supplementary Report by Dr. Mitchell, vol. i. p. 48.

a table of the duration of sickness per annum for every age, from 16 to 81, which we subjoin:

Age.	Average Duration of Sickness per Annum for every Man employed.	Average Duration of Sickness for every Man sick.	Age.	Average Duration of Sickness per Annum for every Man employed.	Average Duration of Sickness for every Man sick.
	Days.	Days.		Days.	Days.
Under 21	4·02	13·96	51 to 61	7·00	28·60
21 to 31	4·94	18·70	61 — 71	10·08	29·07
31 — 41	5·06	22·63	71 — 81	11·63	31·77
41 — 51	5·31	23·21			

Dr. Mitchell has unfortunately withheld the *data* from which these results were derived. He has not stated the total days' sickness, and attacks at each age, nor arranged the observations so as to exhibit the complete years of life. But the report contains tables showing the number of the men at every year of age, from 16 to 78, in the beginning of April 1823; the ages at which the 248 pensioners were put upon the list; and the ages at which the 496 men died whilst classed as workmen, as well as the ages at which 161 of the pensioners died. It appears that the deaths of the pensioners were obtained in a separate return, extending from April 1823 to January 1834, nine months over the ten years in which the other deaths happened. From these facts we first deduced the number living at each decennial period of life, on the supposition that the 2,461 individuals alive in 1823 remained in the service ten years; and thence subtracted the years of life lost by deaths and dismissals. Dr. Mitchell having omitted to state when or at what age the 208 men left the service, it has been assumed that the younger men left in rather greater proportion than the aged, but that all remained in the service five full years; which is the same as supposing the dismissals were equally distributed over the ten years. A similar correction was made for the deaths: 1–14th part was deducted from the deaths of pensioners for the nine additional months in which they were observed.

NUMBER of LABOURERS in the East India Company's Service, April 1823; from Ten Years' Observations, the NUMBER living complete Years between 16 and 90 years of age; the DEATHS among the WORKMEN and PENSIONERS; the Mortality compared with the Mortality among MALES in London.

Age.	Labourers.			Deaths.		Annual Deaths per Cent. among				
						Workmen.				
	On the Books, April 1823.	Living in One Year.	Living during One complete Year.	Of Workmen.	Of Pensioners.	Entire Number.	Attacked.	Pensioners.	All the Labourers.	Males, London, 1813-30.
16—20	31	48	33	..	..	..	..	..	..	..
20—30	437	2,301	2,066	16	1	·78	2·9	6	0·83	1·22
30—40	779	6,671	5,939	86	2	1·46	6·5		1·48	1·69
40—50	599	6,749	5,764	136	8	2·38	10·4	17·7	2·43	2·54
50—60	451	5,365	4,255	147	40	3·52	14·2		4·27	4·04
60—70	137	2,739	1,819	95	75	5·88	15·7	16·5	9·24	8·12
70—80	27	675	426·5	16	30	5·66	11·7		10·71	15·97
80—90	..	56	35·5	..	5	..	..	23·2	13·90	30·91
										33·84
	2,461	24,610	20,343	496	161	2·50	10·6	16·5	3·13	..

These observations are equivalent to observations on 20,343 men during one complete year, and between the ages of 30 and 70 are sufficiently extensive to furnish a near approximation to the mortality in four decennial periods: earlier or later they are of little separate value. The annual rate of mortality was 3·13 per cent.; and, notwithstanding the selection, it agrees, between 40 and 60, very nearly with the general mortality of males in London (1813–30).

The mortality under 40 is not so high among the labourers, because the greater part of them are selected healthy men, received into the service between the age of 20 and 35; after 50 it is higher than the general mortality in London. These men were well supplied with food and clothing; their work, without being hard, insured regular muscular exercise; in sickness they had rest and proper medical attendance; yet, between 40 and 50, the mortality was 67 per cent., between 50 and 60, as much as 82 per cent. higher than the mortality at the same ages in all England. Such facts as these annihilate the supposition that the increased mortality in cities is due to want of food, and greater misery; nor, although these men drank freely, can we admit that their moral habits differed so greatly from those of country labourers as to account for their greater mortality.

Of the 2,461 labourers, 10 per cent. were pensioned in the course of ten years; 8 per cent. were discharged, or quitted the service; 1 man in 81 working a year was pensioned; 1 in 4 had an attack of sickness; 1 in 60 was constantly on the sick list; 1 in 21 (4·79 per cent.) of the labourers was a pensioner; and 1 in 6 of the pensioners died annually. The mean duration of life, after being pensioned, would therefore be six years; five years and a half less than the mean duration of life among the general class of men in cities at the same ages.* This, and the evidence of the medical attendant, Mr. Lewis Leese, prove clearly that the greater part of the pension-time must come under any comprehensive definition of sickness; the pensioners were declared by a special report of the surgeon, permanently disqualified for labour; and that not by age alone, for the majority were pensioned between the ages of 50 and 70, but by the mechanical injury of a limb, some infirmity, or a slow but fatal disease. Half the pension-time may therefore be safely viewed as sick-time.

SICKNESS, &c. STATISTICS of LABOURERS employed by the East India Company in London, 1823–34.

Ages.	Labourers Employed a complete Year.	Attacks of Sickness.	Days of Sickness.	Pensioned.	On the Pension List one complete Year.	Out of 100 Men Working One Year.		Sick in 100 Labourers.†	Of 100 Living.	
						Cases of Sickness.	Pensioned.		On the Pension List.	Sick, and on the Pension List.
16—20	33	10·9	152	..	..	28·5	..	1·10	..	1·10
20—30	2065	546·5	10,203	4	5·5	26·4	·20	1·36	·27	1·62
30—40	5907·5	1320·5	29,891	13	41	22·4	·22	1·38	·69	2·06
40—50	5703·5	1305·5	30,286	13	72	22·9	·23	1·46	1·25	2·69
50—60	4169	1020·4	29,183	76	199	24·5	1·82	1·91	4·70	6·58
60—70	1615·5	560	16,284	105	483·5	34·7	6·50	2·76	23·85	26·50
70—80	316·5	116	3,681	35	201	36·6	11·06	3·20	46·49	48·78
80—90	23	1?	35?	2	21·5	..	8·70	?	69·65	..
	19,838	4880·8	119,715	248	973·5	24·6	1·23	1·65	4·79	6·44
						1 in 4	1 in 81	1 in 60	1 in 21	1 in 15·5

* The expectation of life at the mean age when the 248 men were pensioned was 11·4 years, according to the city table of Mr. Edmonds.

† Obtained by multiplying the mean number working by the days of sickness experienced by one person: this sickness is a fraction higher than that given by Dr. Mitchell, as the days opposite 21–31, &c. in his table were applied to the numbers 20–30, &c. in this. He has improperly compared the 9th instead of the last column with the sickness of the Highland Societies, which comprehended every kind of incapacitation for labour.

The proportion attacked by sickness out of 100 men, at each age, working one year, differed inconsiderably between 20 and 60: the number pensioned between 20 and 50 was also the same (·0022); from 6 to 11 per cent. of the workmen were placed on the pension-list between the ages of 60 and 90; of the actually working class the sick-time increased with age from 1·1 to 3·2 per cent.; the pensioners, at the ages 60–70, formed 24, at 70–80 more than 46 per cent. of the living. The total sick-time (including pension-time) increased up to 50, in geometrical progression, at the rate of nearly one-third every ten years; and if half the pension-time after 60 be counted as sickness, it rather more than doubled in the subsequent decennial periods. The rate of sickness, including all the pension-time under 50 years of age, is much higher than that found by the Highland Society: it lies between the rate assumed by Dr. Price and the observations by Ansell on the English benefit societies.* There were rather more than two years of incapacitation for labour to each death. The deaths were to the sick and pension-time as 3·13 to 6·44.

Friendly societies, and companies who, like the East India Company, may deem it prudent to make their men subscribe to a sick and pension fund, will find these tables very valuable. They also throw great light upon the state of health prevailing in the metropolis: the mortality and other considerations show that these men, labouring in warehouses in the heart of the city, yet well provided for, occupy, as regards health, a middle point between the worst classes and the inhabitants of the cleaner and less crowded districts. (McCulloch's Account of the British Empire, Article "Vital Statistics," Vol. II., pp. 574–7.)

Sickness in the Metropolitan Police Force.—This was embodied in the year 1830, and had subsisted eight entire years at the end of the year 1838. The average strength of the force during the eight years was 3,314, the numbers being very nearly stationary throughout the whole period. In order to maintain the average strength of 3,314 men, it was found necessary to recruit annually as many as 1,100 new members, the vacancies being created by 1,068, who are removed or retire from the force, and 32 who die every year. The average duration of the service of each policeman is, consequently, three years. The average at which the men enter, is 28½ years; about two-thirds enter between the ages of 20 to 31, and the remainder, with a very few exceptions, enter between the ages of 31 and 35 years. The annual mortality was ·97 per cent. or very nearly 1 per cent. The average number constantly sick during the eight years was 2·81; or the days of sickness in a year to each man, were 10·3. For every annual death 2·90 were constantly sick, consequently there were nearly three years of sickness to every death. Out of 100 living, 3·78 were constantly sick in the month of January, and 2·38 in the month of July; the months of the year in which sickness was respectively at a maximum and minimum. The men are first chosen as being of sound and vigorous health, and the force is afterwards kept select by frequent discharges of men showing symptoms of impaired health or strength.

Each individual has to walk 20 miles every day in going his rounds, besides being obliged to attend charges at the police offices, the labour of which may be estimated as equal to walking five miles more, in all 25 miles a day. During two months out of every three, each police constable is on night duty, for nine hours each night, from 9 o'clock in the evening till 6 in the morning.

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* See Extract on pp. 501–7.

We have been favoured by the *Commissioners of Police for the Metropolis* with the following return in continuation of that communicated by them to the Committee of the Statistical Society. The return of the average force for each year is an additional column. Our calculations based upon this column differ slightly from those of the Committee.

RETURN of SICKNESS and MORTALITY in the METROPOLITAN POLICE.

Years.	Admitted.	Removed and Retired.	Average Force.	Died.	Days o' Sickness Suffered.	Annual Mortality per Cent.	Days of Sickness to each Man.
8 Years, 1831–38	8,868	8,494	3,395	256	272,391	·94	10·0
7 Years, 1839–45	8,057	6,431	4,157	224	222,913	·77	7·7

Ours are we believe correct. It will be observed that in the last seven years the dismissals, the deaths, and the sick-time have been less—though the average force was 800 greater than in the preceding period. —(McCulloch's Account of the British Empire, Article "Vital "Statistics," Vol. II., pp. 580–1.)

Sick-time increases with Age in Geometrical Progression.—If the number of attacks at each age be the same, the duration of each attack and the sick-time will increase in the same ratio; and conversely if the duration of the cases and the sick-time augment at the same rate, the number of attacks at every age will be equal. Any two of the elements being given, the third may always be deduced from them. Again, if the mortality of the attacked increase at the same rate as the mortality of the entire population, the proportion attacked at every age will be the same. Among the London labourers the mortality between 30–40, 40–50 was 1·48 and 2·43 in 100 living; the mortality among 100 attacked was 6·5 and 10·4. Now 1·48 is to 2·43 very nearly as 6·5 is to 10·4; and it results from this, that the attacks, whatever their absolute number may be, whether 22 or 52, were the same in both periods. The deaths below apply equally to the attacks and to the

Ages.	Mean Number Living.	Annual Attacks.	Annual Deaths.
30–40	100	22	1·48
40–50	100	22	2·43

living: they apply however high the absolute number of attacks be raised, provided it be raised to the same degree in both periods; but cease to apply if the number of attacks in each period be different.—(McCulloch's Account of the British Empire, Article "Vital Statistics," Vol. II., p. 594.)

Health Insurance.—Sickness is not easily defined. It varies very much in degree; but for practical purposes the line is drawn by friendly societies, police, army, navy, and by patients in civil life with sufficient accuracy. Such sickness as confines a member to bed, called *bedfast* sickness, or at home from work, a policeman from duty, a soldier or sailor to hospital, figures as sickness in the respective returns. Enthetic disease is not recognised by the friendly societies or the police; but it swells the sickness of the army and navy returns. In civil life men work and take physic when their ailments are slight, whereas in the public service they are sent to hospital. Women oftener return themselves sick than men. The sickness of very young and very old people has not been accurately determined.

But it has been found by experience that in England to *one annual death* in a body of men *two* are on an average constantly suffering from sickness of some severity. There are *two years* of severe sickness on an average to *one death.* In the police and in some friendly societies the constantly sick to one annual death are 2·8; in the army (1873) at home 4·2; enthetic disease will account for the difference.

As there are now 700,000 annual deaths in the United Kingdom it may be inferred that there are 1,400,000 constant sufferers from severe sickness; and 2,000,000 sufferers from such sickness as requires medical relief, or throws the members of friendly societies on their funds. That would give 100 patients each to 14,000 hospitals and 6,000 dispensaries. The sickness is of every shade, from the darkest mortal ailments to the lighter pains and muscular weaknesses, and is so related to the mortality that the deaths and sickness within certain limits rise and fall together; thus, if the constantly sick in the population could be reduced from 1,400,000 to 1,050,000 the deaths could be reduced from 700,000 to 525,000; or the annual mortality would be reduced to the desired rate of 17 in 1,000. The diminution of human suffering keeps pace with the diminution of the death-rate; so do the ineffectives of the working population and the claims on the funds of friendly societies.

Sickness occurs irregularly through a man's life in attacks as they are called; still under such a law that there is an *average amount* of sick-time to every death; men are also subject to an average number of attacks during their lifetime under the same sanitary conditions; the liability of adults to attacks of one kind or other being the same at different ages, but the fatality and the duration of the illnesses from those attacks rising with the advance of age according to the same laws.*

It is evident that these societies are most useful adjuncts in sustaining health; when the head of the family is disabled, they supply him with medical attendance and a sum sufficient to meet his most urgent wants. And as there is a law of average sickness while every man's life or health is uncertain, they are indeed *Friendly Societies*, and with good management and proper tables will confer all the benefits they promise. The ordinary premiums are often inadequate to provide sick-pay—that is, really annuities—after the age of 65†; and the societies do not profess to support the members through chronic diseases of more than 12 or 18 months duration. Here the aid of the fortunate steps in to help the artizan and labourer in misfortune. Under the English Poor Law the sick man in need is provided with medical relief and sustenance; every man's life is insured against death by starvation, provided that, if able, he is willing to work.

Unhappily no community can, in our present state, undertake to supply all its members with all they want; and if we express in money the price of drink, food, heat, physic, clothing, lodging, cleansing, including sewerage required for the enjoyment of the longest mean lifetime (L) we shall have this equation, putting I for income:

$$\frac{I}{d+f+h+p+c+l+s} = x\mathrm{L}$$

* McCulloch's Account of British Empire, Vol. II., Article "Vital Statistics," pp. 570–96.

† *See* Extract from Registrar General's 12th Report, pp. 514–17.

where x is a fraction approaching *unity* as the full cost of the commodities of life approaches the income. Galen justly remarks that there is one hygiene for those who can command all the necessaries of life, another for those whose means are limited. To decide on the comfort to be sacrificed with least lost by the poor is an important life problem for the hygienic student.

The deaths in England in the year 1871 were 514,879; implying 1,029,758 persons constantly sick from diseases of some severity; that is equal to a number sufficient to fill 10,298 hospitals, each containing 100 beds always occupied. And it may be assumed that the numbers are sustained by an annual influx of 12,357,096 patients, ill a month on an average, of whom 11,842,217 recover, 514,879 die.

46,556 persons died in the year in public institutions—in hospitals 13,706, lunatic asylums 4,097, workhouses 28,753; and 468,323 died in their own homes or elsewhere. Whether the patient in hospital or home shall recover or die often depends upon the medical attendant.

Under the new and judicious Friendly Societies Act the sickness and mortality returns will no doubt be so organised as to throw much light on the health of different occupations as well as on the finance of sickness insurance.* (Supplement to 35th Annual Report, pp. lxxvii–viii.)

Health insurance may be effected on the same convenient plan for servants and artizans as life insurance. Thus a man servant, aged 20, who pays ·650*l.* or 13*s.* at the beginning of every quarter (1*s.* a week) for 5 years would, without the payment of any further premium from the fifth year inclusive, be entitled to ·454*l.* or 9*s.* 1*d.* *a week*,—for every week of sickness, that he experienced during the next 40 years; or until the age of 65, when the payment of his deferred annuity should commence. He would be entitled to 1*s.* 10*d.* a week during sickness in the first year, 3*s.* 8*d.* in the second, 5*s.* 6*d.* in the third, 7*s.* 3*d.* in the fourth, and 9*s.* 1*d.* a week during sickness in the fifth year, at the end of which it is assumed that the payment of his premiums ceases. A young artizan of the age of 16, by continuing the payment of 1*s.* a week for 11 years, insures 1*l.* a week in sickness from the age of 27 to the age of 65; and a sum rising every year from 1*s.* 11*d.* a week to 1*l.* in the intermediate years of age 16 to 27.

For a guarantee fund some addition should be made to the net premium; the rate of pay in sickness should be less than the wages, and the usual proofs of sickness should be demanded.

Clerks, artizans, and all the labouring classes obtain salaries and wages—incomes—much earlier in life than the higher professional classes, and it is a fortunate circumstance—of which they are apparently unaware—that by setting aside every year a small sum for the 8 or 10 years after their earnings commence, they can INSURE THEIR LIVES, purchase a PENSION in OLD AGE, and insure a PROVISION in SICKNESS, before they ARE MARRIED, and *thus leave the whole of their income after marriage free to meet the increased expenses of housekeeping.*

The two following tables have been framed, and will be found: the first, applicable to the class of artizans who earn wages ranging from 25*s.* to 42*s.* a week; the second to the class of labourers on wages ranging from 8*s.* to 15*s.* a week. The premiums should be deducted every week from the wages; and if the employers contribute a sum annually, equivalent to one third, one fourth, or one fifth of the

* Friendly Societies Act, 38th & 39th Vict. c. 60., 1875.

premiums, it will form a guarantee fund, and there will in all healthy trades and places be a surplus which may be distributed among the members, either as a deposit available like money in a savings bank,—or a sum insured and payable at the death of the member to his widow, children, relatives, or friends.

WEEKLY PREMIUM to insure PAY in SICKNESS at the rate of £1 a week.

Age.	Weekly Premium from this Age to the Age following.	Age.	Weekly Premium from this Age to the Age following.
	d.		s. d.
15—	3	56—	1 0
17—	4	57—	1 1
22—	5	58—	1 2
33—	6	59—	1 3
40—	7	60—	1 4
45—	8	61—	1 5
48—	9	62—	1 6
51—	10	63—	1 7
54—	11	64—	1 8

The table may be read thus:—A person of the age of 17, or of any age under that following (22), insures, for a premium of 4*d.* a week, sick pay at the rate of 1*l.* for every week of sickness, or of 3*s.* 4*d.* for every *day of sickness*, except Sunday.

WEEKLY PREMIUM to insure PAY in SICKNESS at the rate of 7*s.* 6*d.* a week.

Age.	Weekly Premium from this Age to the Age following.	Age.	Weekly Premium from this Age to the Age following.
	d.		d.
15—	1½	58—	5
22—	2	59—	5½
36—	2½	60—	6
44—	3	61—	6½
49—	3½	62—	7
53—	4	63—	7½
57—	4½	64—	8

The table may be read thus:—*A person of the age of* 22, 23, *or of any age under* 36, insures, for a premium of 2*d. a week, sick pay* at the rate of 7*s.* 6*d.* for every *week* of sickness, or of 1*s.* 3*d.* for every day of sickness, except Sunday.

The table is graduated on this principle: 2*d.* a week insures 7*s.* 7*d.* a week at the age 35–36, and at the age 22–23 it insures a larger sum, as the sickness is then less; these larger variable sums, which the premiums cover may be paid if the contribution of the employer is liberal, and the persons who keep and audit the accounts are ready calculators who have time to spare. The annexed table will enable such persons to determine the sick pay that every penny a week of premium will provide, at every age from 20 to 64, among *workmen of average health.*

The NUMBER of PENCE which for every Week of SICKNESS a Premium of a PENNY a Week will provide.

Weekly Premium, a Penny.					
Age.	Weekly Sick Pay in *Pence.*	Age.	Weekly Sick Pay in *Pence.*	Age.	Weekly Sick Pay in *Pence.*
	d.		*d.*		*d.*
20	61	35	45	50	27
21	60	36	44	51	26
22	59	37	43	52	25
23	58	38	41	53	24
24	57	39	40	54	23
25	56	40	39	55	22
26	55	41	38	56	21
27	54	42	36	57	19
28	53	43	35	58	17
29	52	44	34	59	16
30	51	45	33	60	15
31	50	46	32	61	14
32	48	47	30	62	13
33	47	48	29	63	12
34	46	49	28	64	11

RESULTS in reference to HEALTH INSURANCE, deduced from Returns procured by Mr. Neison and Mr. Thomas Cleghorn, Registrar of Friendly Societies in Scotland; compared with the results deduced from the English Life Table, No. 2.

Age.	Number of Pounds, Shillings, or Pence which a Premium of 1*l.*, or 1*s.*, or 1*d.* a Week, will provide over a single Year.		
	By 67 Scotch Societies 1846–50.	By Scotch Societies before 1845 (Neison).	English Life Table, No. 2.
18	69·648	61·920	65·674
23	71·607	59·390	58·345
28	70·390	61·381	53·236
33	58·010	63·712	47·763
38	54·269	57·127	41·829
43	46·226	48·689	35·712
48	29·073	34·543	29·820
53	17·692	22·007	24·503
58	14·836	16·658	17·922
63	8·519	10·118	12·281
	Col. 1	2	3

The table may be read thus :—A man aged 23, who for the year after that age pays a premium of a penny per week, would be entitled to pay, during sickness, of 71·607 pence weekly by column 1, 59·390 pence by column 2, and 58·345 pence by column 3, deduced from the English Life Table.

It will be observed that the sum that can safely be insured is larger at the earlier ages by the Scotch returns than it is by the column deduced from the English Life Table.

In conformity with the existing practice of friendly societies, the members of the fund should contribute for *three* or for *six* months before they are admittted as free members to receive pay in sickness.

After the age of *sixty-five* the line of demarcation between health and infirmity or sickness becomes indistinct, and for the practical purposes of health insurance can be drawn with neither certainty nor uniformity. What under one set of circumstances is considered health is under another paid for as *sick-time*. The provision for the age of infirmity and non-production should therefore be of the nature of a deferred annuity; the premium commencing early, and ceasing about the age of 25 or 35; the annuity opening at 65.—(Appendix to 12th Annual Report, pp. xxxvii–xli.)

2. Elementary Education.

Education, and Signatures in the Marriage Register.—In considering in what manner the records deposited in this office may be rendered useful in illustrating the condition of the people, I have found the registers of marriages calculated to throw much light upon the state of education, with respect to writing, among the adult population of England and Wales.

Almost every marriage is duly registered, and every register of marriage is signed by the parties married;- those who are able writing their names, and those who are unable, or who write very imperfectly, making their marks. Therefore, an enumeration of the instances in which the mark has been made will show the proportion among those married, who either cannot write at all, or write very imperfectly.

It may be said in recommendation of this criterion that it is free from the disadvantage of selection, including alike every class and condition, and every age, except children and very old persons. It must at the same time be remembered, that although a fair average is thus afforded, the portion of the whole population exhibited in the yearly returns of marriages is small. It appears that there are usually about 7 or 8 marriages to every 1,000 of the population. If, therefore, it be assumed that persons between the ages of 18 and 65 constitute half the population (which the enumeration of ages in 1821 shows to be very nearly the case), it will follow that of those who may be considered the marriageable portion of the community about 30 in every 1,000 (or 3 per cent.) are married yearly. The portion, therefore, whose signatures appear on the marriage registers of a single year is sufficiently small to be easily affected by accidental circumstances; and it cannot safely be asserted that the 30 in 1,000, from whose signatures we would draw an inference respecting the other 970, may not happen to consist of more than the proportionate number of uneducated persons. It must not therefore be hastily assumed upon the evidence afforded by the returns of a single year, that the inhabitants of any particular county or district are less educated than their neighbours. The experiment must be repeated often, and be attended with similar results, before this inference can be drawn with safety; and it is only when returns of the same description, given for several successive years, shall have exhibited similar facts, that it will be perfectly justifiable to arrive at any unfavourable conclusion with respect to any particular district.

It is obvious that this criterion gives no insight into the amount and nature of the education *now* afforded. It can be applicable only to the past, and particularly to such as existed between 10 and 20 years ago. It is confined to the signatures of persons married, and is not extended to those of witnesses in the marriage registers, or of informants in the registers of births or of deaths; and for this reason, that the signatures of persons married are entirely free from the objection of being selected instances, and that it is almost impossible that the same person should have signed twice in the same year; whereas the informants are in some degree selected persons, and the signature of the same informant is liable to occur many times.

Inability to write is, without doubt, indicative of considerable deficiency in other kinds of elementary education. Opinions will differ as to the extent to which such deficiency may from thence be inferred; and this is a question the solution of which I will not now attempt.—(2nd Annual Report, pp. 7–8.)

Elementary Education and Crime.—The proportion of those who wrote their names in 1845 was rather less than in 1844: but there was a great increase of marriages in 1845, and it is probable that the increase was greater among the ignorant than among other classes of the population, which will account for the change without implying that the population at a marriageable age in 1845 were less able to write than the population at the corresponding age in previous years. The serious fact remains, that there is no evidence that any improvement in the mere elementary education of the people took place in the period when the men and women married in the seven years, 1839–45, were educated; and that the state of education was such that 4 in 10 English men and women could not write their own names. The state of education differs in different counties. And it has recently been shown, in an analysis of the criminal returns, compared with the facts published in previous Reports, that crime is most prevalent in the districts where in proportion to the whole the fewest numbers can write. "It is found, that out of 22 different combinations formed of " the various districts of England and Wales, in every instance there " is an excess of crime where there is the least education or instruction; " and, comparing the respective sections of each group of counties, it " will be seen that there is an average excess of 25 per cent. of crime " in the sections of inferior education over that of higher education; " and in some districts the excess is as much as 44 per cent."*—(8th Annual Report, pp. 32–3.)

Signatures at Marriage as an Educational Test.—It may be here useful to inquire, of what value is this test? as by some it has been misunderstood, and by others mis-stated.

Men to the number of 164,520, of whom about *five-sevenths* were of the age 20–30, and the same number of women, of whom *five-sevenths* were also of the same age, and the rest younger or older, went through the various marriage ceremonies in the established churches, in the chapels of Protestant dissenters, in the Roman Catholic chapels, in the meeting houses of various kinds, and in the register offices in 1853. At the end of the ceremony the husband and wife are invited in all cases to sign the register book, in the presence of the officiating minister or the registrar; they having the option, if they cannot write, to sign by making a *mark* against their names.

The parties are not asked whether in their own opinion they can or cannot write, but are asked to *write their names* on an important occasion, when on many accounts it is desirable that they should append

* Statistics of Crime in England and Wales 1834–44, by F. G. P. Neison; Journal of Statistical Society, Vol. xi., Part II., p. 140.

their names, in their own handwriting, to a public register. The abstracts which have appeared in my Reports show how many men and how many women under these circumstances *do sign with marks.*

Two questions are raised on these signatures: Is the man or the woman who signs with a mark unable to write? Are the men or the women who write their names, able to write anything else? Some men and women who can write imperfectly, do undoubtedly sign with marks. Upon the other hand, some persons can write their names who cannot write a letter or keep an account in writing. The former class is perhaps the most numerous. Some of the 30 men, some of the 44 women, who sign with marks *can* write their names. Some of the 70 men and the 56 women who write their names, write little else; and are evidently unpractised writers, as their signatures are often almost illegible; not the flourishes of penmanship in which some men conceal the letters of their name, nor the undecipherable scrawl in which others write, but the uncouth, ill-formed, letters of men and women who have never advanced at school beyond the first rudiments.

Looking at both sides of the question, the obvious inference is, I believe, correct; and we have practically 49,983 young men, and 72,204 young women unable to write, out of 164,520 of each sex who married, and will be the fathers and mothers of the next generation of English men and English women.

Of these persons unable to write, it is known that large numbers are unable to read.

On the hypothesis that the numbers who can write in the ordinary sense of the word are understated or are overstated, the test is still available for purposes of comparison; as the timidity which prevents some men and women from writing their names, or the vanity which prompts others to try who can scarcely put letters together, must be almost equally powerful in the several counties of England. These disturbing causes leave the important fact unexplained, that in *ten* counties from 15 to 28 men, and in ten other counties from 39 to 50 men, in 100, sign with marks when they are required to write their names.

The value of this test is also questioned upon the ground that it is, in itself, no proof of education; and it must be at once admitted that at the utmost it shows only how many out of a given number can or cannot write. Many of the men and women who cannot now write, as in the days of old when barons and knights signed with marks, possess great intelligence and have acquired many useful arts; so thousands, on the other hand, who read and write, are ill educated, and know nothing of those liberal arts and sciences which enlarge, refresh, and invigorate the mind as the sunshine and showers fertilize and adorn the soil of England.

In fine, the arguments that the marriage registers supply in favour of the extension of education cannot be set aside by a few stories about young girls, terrified in the presence of the clergyman, making marks when they are able to write their names. The marks of the men alone are conclusive. (16th Annual Report, pp. iv–viii.)

Intermarriage of Persons who can write, with those who sign by mark.—Each marriage constitutes a family; and to the family the fact that one of its members can read and write, is of more importance than the fact that both can read and write. Now as 107,267 men and 89,441 women wrote their names in 1855, it is evident that the 196,708 may have been so distributed in pairs, as to leave no pairs in which neither the husband nor the wife could write.

Such a combination, however, does not take place. But if it is assumed that the men and women who can write, and that the men and women who cannot write, have no tendency to intermarry greater than that which disposes them to marry those who are not in the same class as themselves, it follows from a well-known mathematical formula* in the calculus of probabilities that the 152,113 married couples would have been distributed as they are in the second column of the annexed table.

——	Numbers if no selection had existed.	Numbers as given in the registers.	Difference.
Husband AND wife *write* -	63,072	76,734	+ 13,662
Husband OR *wife writes* (mixed marriages) - -	70,564	43,240	− 27,324
Husband AND wife do not write	18,477	32,139	+ 13,662
(1)	(2)	(3)	(4)

Here the indisposition to mixed marriages is evinced in the fact that instead of 70,564, there were only 43,240 couples in which *one* or other of the two could write; half the difference of those numbers or 13,662 being added to the 63,072 couples in which both husband and wife write, and the other 13,662 to the 18,477, in which neither the husband nor the wife writes. As the poor intermarry, and the wealthy intermarry, so naturally the classes who cannot write intermarry; and thus, instead of having the greatest number possible of cases in which at least *one* writes, there is not the due mathematical proportion of such cases, but in 32,139 of the new families, neither the father nor the mother will be able to write.

The number of married couples in England was about 3,150,470 in the year 1855. It is certain that at the date of their marriages, elementary education was less diffused even than it is in the present day, consequently the *proportion* of the cases in which neither the man nor the woman writes will be greater among these 3,150,470, than it was among the couples married in 1855, or even in 1847; but upon applying the proportions deduced from the facts of 1847, it is found that in 1855 there must have been nearly 1,488,000 families in which the husband and wife could both write their names; 905,912 families in which one could write the other could *not* write; and 756,558 families in which neither the husband nor wife, the father nor mother, could write their names. How defective the rest of their elementary education must have been is self-evident. (18th Annual Report, pp. v–viii.)

Elementary Education in England and in Scotland, 1862-4.—It should be recollected that the marriageable women of a country are a selected class, and include very few of the infirm, deformed, idiotic, or

* Let m denote the number of men who are able to write their names, and m' the number of men unable to write their names; also let f denote the number of women able, and f' the number not able to write; then putting $\left\{\begin{matrix} m+m'=\mathrm{M} \\ f+f'=\mathrm{F} \end{matrix}\right\}$ and multiplying the terms of the two equations into each other, we have $mf+m'f+mf'+m'f'=\mathrm{MF}$

$$\therefore \frac{mf}{\mathrm{MF}}+\frac{(m'f+mf')}{\mathrm{MF}}+\frac{m'f'}{\mathrm{MF}}=1$$

The first term gives the proportion of combinations in which both write, the second in which the man or the woman writes, the third the proportion in which neither writes.

others incapable of learning. They can nearly all learn to write if they have the opportunity. And upon turning to the Report of Dr. Stark, addressed to the Registrar General of Scotland,* I find that all the women of the county of Kinross who married wrote their names in the registers; the proportions per cent. were also 98 in Peebles, 98 in Kincardine, 96 in Roxburgh, 96 in Kircudbright, 94 in Perth, 92 in Fife, 91 in Edinburgh, and 93 in the far off Orkneys. Under these circumstances he must be an extreme optimist who can contend that the state of education of the women of England is the best possible, when it is found that by the same test in 100 of the marrying women of the county of Bedford only 55 write their names, in Cornwall only 60, in Stafford only 52, in Lancashire 53, in the West Riding only 57, in Durham only 62, in Monmouthshire only 48, in North Wales only 51, and in South Wales only 44.

The women of London come as immigrants in large proportions from every county; 83 in 100 of the brides wrote their names. Middlesex, Surrey, Sussex, Hants, Rutland, deserve to be mentioned as counties in which 80 or more of 100 brides wrote their names in the register. In Westmorland 79 women wrote their names; but it is in the education of the men that the Northern Counties approach and even excel, several of the Scotch counties.

In Scotland we discover a state of things highly creditable to the people of that part of the United Kingdom; and it is difficult to explain the difference in any other way than that in the general struggle for the church property at the Reformation the people had the good sense to endow the schoolmasters with small stipends, and not to give the whole revenue of the land either to the clergy or to the nobility. Between the minister and the lord stood the schoolmaster in the presence of the people. The advantages of the Scotch system of education became so apparent that it was expanded in the period of the civil wars (1646), anh firmly established after the Revolution by the celebrated statute of William and Mary in 1696. The endowment was small, and stimulated instead of slackening the exertions of the schoolmaster, who had to depend largely on his own industry, zeal, and popularity for support. M'Culloch estimated the average fixed stipend at 25*l.* 10*s.*, exclusive of house and garden; the school fees at 22*l.* 10*s.*; the income from all sources at about 63*l.*†

It is impossible to say how much Scotland owes to this system of schools, and to the universities, which are accessible to the youth of the kingdom. There was probably as much revenue proportionally devoted to education in England as in Scotland, but the money was in various ways misappropriated, so that before the Reform Bill passed, and even in 1837, when the registration of marriages commenced, the working classes, entirely ousted from the educational charities and universities, were in the most deplorable state of ignorance. *One* in *three* of the young men, and *one* in *two* of the young women, of England could not write their names in the marriage register even in 1841, after some efforts had been made in the cause of popular education.

Happily a considerable improvement is visible in the registers; *one* in *four* of the men, and *one* in *three* of the women, now sign with marks. In twenty-three years the marks-men have fallen from 33 to 23; the marks-women from 49 to 32 in 100.

Still in common education the great body of the people of England are many degrees below the people of Scotland, and it is impossible to

* Eighth Detailed Annual Report of the Registrar-General of Scotland—Abstracts of 1862, p. xxiii.

† Statistics of British Empire, vol. II., p. 373.

calculate the advantage this superiority gives the Scotchman over the Englishman at home and abroad. The superior education of the people of Scotland is a benefit to the world; without it Watt could not have invented, Burns could not have written. The brightest boy in a village without a school has no chance of distinction, except by accident. (27th Annual Report, pp. xvii–xix.)

Progress of Elementary Education.—The legislature has now (by the Education Act of 1870) decreed that every child in the country shall be brought under educational influences, and the effect of this wise provision should ultimately be seen in the decline of the proportion of marks in the marriage registers, until all the marriageable people of the pre-educational period have given place to generations of men and women capable not merely of writing their names, but instructed in other essential branches of knowledge, the possession of which can hardly fail to raise the national standard of mortality as well as of intelligence.

As the year 1871 will form a new point of departure in educational matters, it may be useful to show here the extent of the improvement which has taken place as regard the substitution of signatures for marks in the marriage registers since 1841.

PROPORTION per Cent. of MEN and WOMEN who SIGNED the MARRIAGE REGISTER with MARKS, 1841–80.

PERIODS of Five Years.	To every 100 Marriages the annual proportion who signed the Marriage Register with Marks.		Quinquennial Decrease per cent. of signatures by Marks.	
	Men.	Women.	Men.	Women.
1841–45	32·6	48·9	—	—
1846–50	31·4	46·2	3·7	5·5
1851–55	30·2	43·5	3·8	5·8
1856–60	27·1	38·1	10·3	12·4
1861–65	23·6	32·9	12·9	13·6
1866–70	20·5	28·3	13·1	14·0
1871–75*	18·5	25·2	9·8	11·0
1876–80*	14·8	20·0	20·0	20·6

* The figures for years since 1871 have been added to the Table to bring the information down to a more recent date.—ED.

And the best proof that the marriage returns do yield approximately reliable evidence of educational deficiencies is the fact that year after year the same localities preserve a uniform character whether of high or low proportions of signatures. If the question of signature or mark were one of timidity, or of mere caprice with the men and women who marry, it is inconceivable that whole counties should maintain for years the same position relatively to one another as they are found to do. (34th Annual Report, p. xiii.)

3.—CIVIL REGISTRATION OF MARRIAGES, BIRTHS, AND DEATHS.

Defective Registration of Births, and of Deaths, 1837–75.—The Act of 1836† lays it down in clause 19, that the parent of a child, or the occupier of the house in which a child was born, "MAY *within forty days*

† 6 & 7 Will. 4. c. 86, clauses 19, 20.

"*give notice of the birth to the Registrar;*" and in clause 20 enacts, that the parent or occupier shall give the required information, *on being requested so to do by the Registrar*. It was not enacted that the persons who best know shall give the information; and there is no punishment for the neglect; no penalty for refusal. Any one who has administrative experience will see the difficulty of working such an enactment. How can a Registrar, who is paid a shilling a case for every birth registered, ascertain the occurrence of every birth, legitimate or illegitimate, in every house, in every street of London? In other large towns, or in wide districts, the Registrars encounter similar, or equal difficulties. The Registrars have been urged, through the Inspectors, to adopt the most effective means for getting information from all sources, and it is gratifying to me to state that through their exertions, with the assistance of the enlightened part of the public, the number of births that escape registration has constantly declined. The precise extent of the deficiency cannot be determined; but there is reason to believe that the annual deficiency in the last ten years does not exceed the estimate in the last Census Report,* and that was 13,614 out of 763,623. The probable annual deficiency in the ten years 1841–50 was 38,036, in the next ten years 19,323, and in the last ten years, as has been already shown, 13,614. The deficiency thus rapidly declined: calculated on 1,000 births occurring, it was in the three decades, 65 in the first, 29 in the second, and 18 in the third. There is little hope of effecting the registration of all the births until the Legislature enacts the carrying out of the intentions of the Act under the pressure of a penalty clause, which in practice would rarely or ever after the first year have to be enforced. If every parent of a child were directed to give early information of its birth to the Registrar, and subjected to a penalty for neglecting this duty to the child and to the State, few births would escape registration. The record would be complete; the missing links in pedigrees would be reduced to a minimum; children would be under the protection of the law, and they would no longer be under the many disadvantages arising from inability to prove their age and parentage, by a birth certificate.

There is reason to believe that a certain number of children born alive are buried as still-born, and that of deaths buried without a Registrar's certificate a few are never registered. The officiating clergyman is bound in every such case to give notice of the burial to the Registrar of the sub-district in which the death occurred; but this is not, for various causes, invariably done.

The causes of death are certified on forms supplied, in the great majority of cases, by the medical attendants of the deceased or by the coroners; but in 1871 in about 8 per cent. of the deaths the cause was not certified by a qualified practitioner. A certain small number of medical practitioners refuse to fill up the certificates for various reasons; in about 2 per cent. of the cases there was no medical attendant; and in the residue of the cases the sick children and adults were attended by chemists and druggists, by herbalists, by bone-setters, by quacks, and by various orders of unqualified people. In a considerable number of sub-districts every death is certified; in a few sub-districts, especially of Wales and Cornwall, the certificates fall to a very low proportion.

The grant of the certificate, which is now voluntarily given by the great majority of practitioners, should be rendered compulsory to meet the exceptional cases, and some means should be adopted to secure the best returns of the cause of death procurable in every case. While

* Vol. 4., Appendix A., p. 55.

asking power to meet exceptional cases thanks are due to the College of Physicans and to the medical profession generally for their friendly co-operation in carrying out the Act. (35th Annual Report, pp. v, vi.)

Results of Civil Registration, and Improvements in Civil Registration Law effected by the Act of 1874.—Births, deaths, and marriages have been partially registered in the parishes of England since the days of Queen Elizabeth; and the names of the great mass of the people of all classes, ranks, and ages who have lived since that date have been inscribed in one or other of these national records. But many of the Church register books have perished. And through the development of religious dissent and other causes they every year grew more defective until the Legislature passed the Act which came into operation in 1837: and not only relieved many consciences, but provided a better machinery for the record, not indeeed of important religious rites, but of the facts of birth, death, and marriage, with such particulars as might be of use not only in connexion with the history of families and with property, but with the social life and health of the nation. One notable column was added to the register, which has turned out to be of great importance. Inquests into violent and sudden deaths have been held for centuries in England; but now the opinions —the verdicts—of the medical men of England on the causes of all their patients' deaths are certified; and undoubtedly these recorded opinions have been already of great use, and will be of still further use to science in future times. The Legislature of England has thus taken the lead in advancing the health of Europe.

The following passage occurs in the last work of Dr. E. A. Parkes, F.R.S., the author of the best work on Hygiene that has appeared in any country: "The attention now paid to public health is in a large "degree owing to the careful collection of the statistics of births "and deaths, and of the causes of death, which have been collected in "England for the last thirty-eight years. It may truly be said indeed, "that not only all Europe, but gradually the entire world, has been "influenced by the work of the Registrar-General of England. We "are now able to determine the limits of mortality and its causes with "some precision, and are being led up to the consideration of the "causes which bring about a too high death-rate." *Public Health, by the late E. A. Parkes, M.D., F.R.S., p.* 61.

The following pages contain some account of the improvements which have, after thirty-seven years experience, been made by the new Act in the system of registration. Emigration and immigration affect the population of England more perhaps than that of any other State in Europe; and the subject has been discussed at some length, particularly noticing the influx of returning emigrants which was first noticed in the last Census report, and accounts for a certain proportion of the 24,093,767 of people in England at the end of 1875, during which year the population increased by 297,695. The English emigrants were much less numerous than in the previous six years. The seasons made their influence felt; the winter was excessively severe, and the rainfalls of the summer flooded the lands, and raised the rainfall of the year above the average. The prices of bread were low, of meat high. Indeed, in the last 20 years the price of beef rose 50, of mutton 29 per cent. How much the cattle diseases and quarantine, interrupting the freedom of trade, have contributed to this result I do not discuss; but the scarcity or abundance of food affects the registers sensibly, and so does the state of trade, which was still depressed throughout the year; yet fewer out-door paupers were relieved than in previous years. Marriage is a civil contract, and is always registered in England; as we may trust will also be soon as effectually done in the other divisions of the United Kingdom. Three in four marriages are celebrated according to the rites of the Established Church; and the fashion of marrying by banns rather than by license has sensibly increased during recent years. The most important change is in the greater frequency of early marriages since civil registration was established; and this is discussed at some length. The spinsters married were on an average 24 years of age; and instead of 13 in 100, as in 1841–5, no less than 22 were under age (of 21). The effect of this important fact requires investigation. One of the most gratifying circumstances is the diminution of the numbers both of men and women who sign the marriage registers with marks, thereby professing inability to write their own names. The proportion signing with marks in 1841 was 33 men, 49 women, out of 100; in the year 1875 the proportions fell to 17 and 23. Thus in 30 years the proportion of ignorant husbands fell from 33 to 17; of ignorant wives from 49 to 23. The ranks of writers increased every year; those of women more rapidly than those of men; so that if the same rate of increase be maintained in the next as in the last 34 years, nearly all the men and women who marry will be educated at least to this extent—they will be able to write their names. It is gratifying to find that the disparity between men and women is diminishing; and that in 22 years at the same rate of approximation as has prevailed for ten years the numbers of husbands and wives who write will be nearly equal. The buildings registered for public worship and for the celebration of marriages still increase. While the births went on at the average rate it is satisfactory to find that the proportion of children born out of wedlock decisively decreased. In the 10 years preceding *six* children were born out of, to *a hundred* born in—wedlock; in the year 1875 only *five* were born out of, to 100 born in—wedlock. For 30 years the proportion of children born out of wedlock has progressively declined; it fell 30 per cent. Eleven years ago, out of a much smaller number of children born, 47,448 were bastards; in the year 1875 the number fell to 40,813; thus 6,635 children have now fathers and mothers who instead of repudiating recognize their duties to their offspring. It is premature to attempt to assign the cause of the change; but data are supplied which will assist the investigation. At the rate of illegitimacy that prevailed 30 years ago *seven*, at the present rate *five*, in every 100 of the people we meet would be illegitimate, if the mortality of this unfortunate class did not exceed the average; but that, as is well known, is far from being the case. Of 1,000 infants born in 1875 no less than 158 died in the first year of life; while in certain selected districts, of 1,000 infants born out of wedlock nearly double that number died in the same time. In some country districts the difference in the mortality is much greater; in Stratford-on-Avon out of 1,000 of each class born 69 legitimate, 293 illegitimate children perish; in Kendal the proportions of the two classes are 91 and 329. The assigned causes is given of infant deaths in Driffield and Preston where the mortality of the children born out of wedlock is among the highest. The deaths in excess are not due to violence, but to the want, so well shown by Dr. Russell of Glasgow of the mother's milk and care. The general result is that as the unfortunate children are cut down prematurely by thousands, the proportion surviving in the population bears no sort of relation to the numbers born. The multiplication of the breed of men and women who abandon their children is checked by an inexorable law.

The mortality year by year in the urban districts is shown in juxtaposition with the mortality of the rural districts, which will enable the inquirer to trace the relative fatality of disease in the two classes of population; thus, for 29 years the deaths in the town districts were to the deaths in the country districts as 25 to 20; but while in the first four years 1847–50 the deaths in the towns were to those in the country as 27 to 21, they were in the last five (1871–5) as 24 to 19. Then it is shown that the excess of the aggregate mortality in 1875 was due to the excess of the mortality of both males and females at the ages above 35; the excess due to the cold weather increased rapidly as age advanced after that term.

The death registers serve the purpose of self-registering inspection. Sometimes great sums are expended on works without any apparent results; time has not ripened their fruits; or they are left imperfect; pure water is supplied without sewers, or main drainage is created without branches to connect the great trunks with every dwelling; the dwellings remain sordid and crowded; sanitary regulation is neglected. All this is revealed by the death-rate. Death cannot be deceived by sham defences. In the last and in this present Report is shown the mortality of several districts, with a summary view of the sanitary work achieved by sanitary organization.

The registers at the end of 1875 contained 54,078,314 names; 25,241,938 of children born, 12,298,886 of men and women married, and 16,537,490 of persons deceased at all ages. The birth registers are not quite complete, as a certain number of births were never registered; but on account of the excess of births over deaths in an increasing population and emigration they exceeded the deaths, which again exceed the number of persons of both sexes married. The certified copies are at Somerset House; the original registers are in the several registration districts in the custody of the registrars and superintendent registrars who are empowered to grant certificates on the same terms as the central office. In addition to the large number of searches and certificates so granted, 25,407 *searches* were made in the year 1875 at Somerset House and 19,639 certificates were granted, for which 3,879*l.* 15*s.* 6*d.* were duly handed over to Her Majesty's Exchequer.

The births, deaths, and marriages for the United Kingdom are given; and the several rates which differ somewhat from the rates of England, chiefly in consequence of the defects of the marriage registers of Ireland and Scotland, where the registration of marriage is not enforced as it is in England. Dr. Burke, the Registrar-General of Ireland, has shown that the births in Ireland are depressed by the emigration of women at the child-bearing age, so that the low birth-rate of 26·1 per 1,000 in Ireland to 35·5 in England, and to 35·4 in Scotland, is not entirely due to defaults of the Irish registration officers. Dr. Burke points out how by more judicious arrangements the registration of deaths might be rendered more complete in Ireland; and, no doubt, under his energetic administration the registration of marriages and births will ere long be as complete in Ireland as it is in England. The defect of the records of the most important events in the lives of the people is remedied in France, Belgium, and Italy by recording every marriage as a civil act without interfering at all with the solemnities of religious ceremonial. In the meantime the English rates may be accepted as representing pretty accurately the corrected returns for the United Kingdom; with which the returns procured from the most advanced States of Europe may be compared.

The members of the International Statistical Congress have undertaken to draw up under different categories a series of reports based on official returns from the different States. The first on the population of Europe has been issued by Dr. Berg, the delegate for Sweden, and is worthy of that eminent statist and of his country, which enjoys the renown of having taken the first Census in modern times—1751. Dr. Berg returns the population up to 1870 or 1872; and a careful estimate has been framed of the area and population of the several States in 1875 and 1876 by Herr Behm and Dr. Wagner. By this estimate the population of Italy expressed in millions is 27½, England (U.K.) 33⅓, France (1872) 36. Austro-Hungary 37¾, Germany 42¾, Russia in Europe 73½ millions. The population of the great States with their colonies and dependencies is, by the latest estimates: British empire 236 millions, Russian empire 87 millions, Turkish empire 48 millions, German empire 43 millions, France 42 millions, Austro-Hungary 38 millions, Italy 27 millions. The area of the British empire is 20 million square kilometers, of the Russian empire 22 million square kilometers.

Since 1st of January 1875, the Act which amends the previous statutes regulating registration of births and deaths has been in force; it *compels*, under a penalty, parents to record births, and nearest relatives to record deaths, in the civil register books.

This amending Act was considered necessary with a view to making more complete than formerly the record of births, and in the hope of obtaining increased accuracy with respect to each particular registered concerning deaths.

Formerly many births annually escaped being recorded in the civil registers, more particularly illegitimate births in large towns. It may be hoped that this *compulsory* clause may reduce the number omitted, although the birth register is not as yet quite complete.

With respect to deaths, very few escaped civil representation, and the chief defect was the want of accuracy in the information supplied for record by persons "present at death," and "in attendance" during fatal illness.

Many mistakes were consequently made as to the exact number of Christian names, the precise spelling of surnames, the age, the occupation of the deceased, and the cause of death; occasioning necessarily much trouble to the Bank of England, insurance offices, friendly societies, clubs, &c., and to everybody who had occasion to use certificates of death.

Now it has become the duty of the "nearest relatives," in addition to burying the deceased, to record in the civil register, within five days after death, the various particulars rendered necessary by statute; and thus it is to be hoped that the original entries will be correct, requiring no or few corrections—a change which I shall be glad to see, as alterations in registers are not to be encouraged.

This *compulsory* system, under penalties, imposes new duties on the public, and accordingly the Statute makes it imperative that the registrar shall be at home at certain fixed hours on particular days in each successive week, and thus be accessible to informants, who, on repairing to his office at these times, which are announced and published, will be certain not to have made a useless journey, and will be enabled at once to make the entry.

Moreover, registrars have, in order to meet the convenience of the public, to attend at "stations" on fixed days in distant parts of their sub-districts, where the inhabitants may avail themselves of the opportunity of meeting the registrar in their own immediate neighbourhood.

Prompt registration, quickly effected after the occurrence of a birth or death, is gratuitous; unless a householder prefers requiring the registrar to attend at his residence rather than go himself to the office; in such a case he can make that arrangement on paying the small fee of one shilling.

When a death occurs, the nearest relative is permitted to send "notice" of the event, accompanied with a medical certificate as to the fatal disease, to the registrar, and if the death is recorded within 14 days no penalty is incurred.

Formerly births could not be registered when more than six months had elapsed; now, under special authority, they may be recorded even within seven years.

An arrangement has been made for registering births when parents, having omitted to perform that duty, having gone into a distant part of the country; which is very convenient for the migratory portion of the community.

No name of a putative father can now be registered without his consent, and unless he himself sign the entry in conjunction with the mother.

Greater facilities are afforded for recording any name which, having been given after registration to an infant in baptism or otherwise, it is desirable to add to or to substitute for the named recorded in the first instance.

Coroners are required to transmit to registrars verdicts of juries, to be recorded in registers of deaths, more promptly than formerly.

An infant cannot legally be buried as still-born without the production of a certificate or declaration; which may be considered a very great improvement on the former loose system. I trust that the clergy and the cemetery authorities will strictly carry out this salutary law.

Registered medical practitioners are now required, under a penalty, to certify the causes of their patients' deaths, which are registered together with the names of the certifying practitioners. The number of uncertified deaths has already been greatly diminished under the new statute, and the inquiries which the registrars now make when no medical certificate is produced cannot but tend to strengthen the protection to human life which registration supplies.

Greater facilities are given for changing boundaries of districts.

Deputies must be nominated by all registration officers.

Offences against the Registration Acts may now be summarily brought under the notice of magistrates in petty sessions, whereas formerly in most cases of prosecution it was necessary to proceed by the expensive process of indictment at assizes; consequently many escaped unpunished. When the offence is held to be serious, the delinquent may still be prosecuted by indictment.

Returns are to be made at a very cheap rate to sanitary authorities and school boards; and so are certificates to friendly societies, as well as to factory inspectors; and this, although convenient for the public, is not perhaps unnaturally felt to be a grievance by registration officers.

Persons registering births may now, on paying the small sum of 3*d*., receive a statement recording name and date of birth, which, although not evidence in a court of law, may be useful in after days.

Parliament has sanctioned the payment to each registrar of 4*l*. 10*s*. annually, in addition to his former small emoluments, in acknowledgment of the trouble he takes, and has during many years gratuitously and cheerfully taken, in sending extra periodical returns to be made use of in the Weekly, Quarterly, and Annual Reports issued from this office.

An alteration has been made in the mode of correcting errors of fact and substance incurred in the registers; and the method is a great improvement upon the former system, which was much too lax.

Births and deaths at sea are recorded here more completely than before, and certified copies of the same are obtained by the public without difficulty.

Such are some of the new enactments, and it may be confidently expected that they will be found to be conducive to the public benefit.

Steps have been taken to make the provisions of the new Act generally known, and it is satisfactory to state that it has not been found necessary to take proceedings to enforce the compulsory clauses, except in a few instances, where a breach of the law had been aggravated by the conduct of the offender.—(38th Annual Report, pp. v–x.)

Registration Sub-Districts of England and Wales, 1872.—The registration of births and of deaths is performed either at the houses of the people or at the offices of the 2,195 registrars. As each informant has to go to the office of the registrar of his sub-district, or the registrar has to go to the house in which the event occurred, it is evident that the size of the sub-district is one important element in the administration of the Act. A second element is the population; for the births and deaths bear a certain though variable relation to the existing numbers. A third element is also important, and that is the mode in which the population is distributed over the area, as the population may be dispersed pretty evenly in farms and cottages over a wide area of country, or a dense ward of a city; again, it may be, and is often, concentrated chiefly in a town, but with wide suburbs, and with open country parishes associated with the town for registration purposes. The original church registration of baptisms and burials, as well as marriages, was parochial; it was performed at the church; so the informants had to go to the registering clergyman, but had not to travel further than the limits of the parish which, however, might be great or small. That system of registration was, as is well known, incomplete as regards both births and deaths.

The sub-district was substituted for the parish as the registration administrative area; and containing a variable but an average number of 7 parishes, it increased the distances to be travelled; with this alleviation to the public, but aggravation to the labour of the registrar, that the registration of birth or death might be performed in the house where the event occurred.

There were countervailing advantages: where the registrars were paid by a fee for each event registered, an extensive population might supply them with sufficient employment, and such an income as would command the services of educated men.

The division of the country into sub-districts in the first instance was made by the Poor Law Commissioners and Guardians, apparently without any very definite rule as to size or population; but the general result is, that there are seven parishes on an average to each; that the average area of a sub-district is 26½ square miles, the average population in 1871 *ten thousand three hundred and forty-seven:* while the average number of persons married in a sub-district in that year was 173, of births 363, of deaths 235. Then the weekly number in an average sub-district was 7 births, and 4 or 5 deaths; making about 11 births or deaths weekly. If the registrars visit every house to register births and deaths, they cannot on *an average* travel more than *two* miles in each case, nor probably much less than one mile unless they arrange to register the births periodically in beats. Their pay is at the rate of a shilling an entry, and 1*s*. 6*d*. additional for the first 20 births or deaths.

While the average area and population are as given above, the extremes are very wide from the average. The sub-district of Berwick-street, St. James's, London, comprises only 24 acres (0·0375 mile), while Bellingham in Northumberland, round the tributaries of the North Tyne comprises 175,131 acres (274 square miles).

It appears that 11 sub-districts have less than 1000 inhabitants; and 11 have populations ranging from 71,319 to 123,915.

Thus it will be noted that 475 of the sub-districts had an area of 20 and under 30 square miles, equivalent in area to circles with radii ranging from 2·82 to 3·34 miles; that 2 of them had a population under 1000; 244 a population under 5000; 166 a population of 5–10,000, 54 a population of 10–20,000; and 11 a population of 20–30,000.

When a country has once been sub-divided for any administrative purpose in which officers are appointed to distinct portions of territory, any change is attended with some inconvenience, and some disturbance of vested interests. But there can be no doubt that with the experience that has been acquired, a better working division of the country could be made now; so as to retain or secure the services of able registrars, and at the same time to offer the public greater facilities. Thus the sub-districts of 80 square miles of territory, equal to a superficies of 8 by 10 miles are too large; and this is still more the case with sub-districts of 90, 100, and so on up to 274 square miles.

Upon the other hand as regards area, the sub-districts of less than a square mile are below the mark; though many of these very small sub-districts are populous, and five have a population exceeding 50,000.

The large sub-districts of Croydon with 71,319 inhabitants, of Preston* with 85,427 inhabitants, including something more than the towns, are conveniently served by one registrar; and the same may be said of the other 9 most populous sub-districts, one of which (Everton* in West Derby district, near Liverpool) contained in 1871 *one hundred and twenty-three thousand nine hundred and fifteen* inhabitants.

The advantages in towns attainable in ample sub-districts are various; good officers, with due care in the selection, can be obtained, as the remuneration is sufficient to pay for the whole of their time, and a place for the registry office can be found in some well known central public building. In the continental cities it is in the Town Hall. As a general rule the largest sub-districts are among those in which the registration is by far the most efficiently performed. (35th Annual Report, pp. xxiv–vii.)

Delay in the Publication of the Registrar General's Annual Reports.—Before closing this Report, it may be permitted to advert to a circumstance which has sometimes been made the subject of observation, namely, the interval of time, which to some persons may appear to be longer than is necessary, between the close of the year to which the subjoined tables relate and the date at which they are ready for publication. In the present instance their preparation, and work which must be done antecedently to that preparation, have occupied a period of fifteen months. It has been asked: Why this delay? The question may be put by some whose haste to gain knowledge is not immoderate, but who have not become acquainted practically with the immense labour involved in the construction of statistical tables, and in the calculations based on them. It is put by others whose great desire will

* The sub-districts of Preston and Everton have since been sub-divided—ED.

not be satisfied till the statistics of the British empire for this current year 1862 are laid with the morning journal on their breakfast tables on New Year's day 1863, and who even then, because they live in an age of mechanical invention, for which by some process of thought they take credit to themselves, will not consider it their duty to be surprised at so remarkable a result. In answer to the question it may be stated :—

1. That this office was established by Act of Parliament, primarily, for the purpose of collecting, arranging, paging, examining, correcting, binding, and indexing the certified copies of the English registers, and of supplying stamped certificates of births, deaths, and marriages to all persons who may apply for them; that the certified copies are received quarterly, but the returns are not completed till nearly three months after the end of each quarter; and that the preparatory duties which have been mentioned, and which occupy a majority of the clerks engaged in the office during a period of eight months after the quarterly arrivals have begun, must be performed in respect to each volume before it can pass into the hands of the statistical clerks. As the work in the Record Department advances, each quarterly volume is released for the preparation of the statistical abstracts; but the entire number of volumes of any registration year are not available for this purpose till the September following the termination of the year.

2. That in conformity with a provision of the Registration Act, a general abstract is prepared, in each year, of the number of births, deaths, and marriages registered during the foregoing year, in order that it may be laid before Parliament; but the detailed abstracts that constitute the "Annual Reports" are works of much labour and skill, and necessarily occupy considerable time in preparation. These reports are not designed merely to answer a temporary purpose. They may be regarded as storehouses of facts which have been arranged on methods that are approved as the most useful and convenient, and to which, both now and in future years, students of vital statistics may resort for the elucidation of questions bearing on the social condition of the people, on national progress, on life, health, and disease. It is important that they should be *done well*. It is desirable only in the next degree that they should be *done quickly*.

It will be urged that the machinery of registration should be employed to give immediate warning of epidemic diseases, to trace in contemporaneous reports their beginning, progress, and decline, and to assist in investigating general and local conditions in which they are developed. When the plague is at the door, the people will not wait till its history can be written in a blue book. This is quite true, and it will be sufficient to state in reference thereto, that a weekly report for London and other large English towns is published on the Tuesday following the termination of each week, and a quarterly report for England and Wales within a month after the close of each quarter. (23rd Annual Report, pp. xliii–iv.)

4. Cost, and the Present and Future Economic Value of Man.

The characteristic of life property in wages, and in incomes from professions, commerce, trades, and manufactures, is that it is inherent in man, and is the value of his services—of the direct produce of his skill and industry. In slaves it is vendible and transferable; in freemen it is inalienable; but is not the less on that account property, which in the early states of society is assessed and taxed in the form of personal services. It is combined with stock in all productions; and the proportion of the elements varies in every kind of product.

The labour of the parents, and the expense of attendance, nurture, clothing, lodging, education, apprenticeship, practice, are investments of capital, at risk extending over many years; and the return appears in the form of the wages, salaries or incomes, of the survivors, commencing at various ages, 12, 15, 18, 21, 24, 27, 30, 33, 36, 39, and ages still greater; for the incomes in the higher professions increase probably up to the age of 50 or 55. The outgo increases from infancy up to a certain age; the earnings then commence, and ere long equal the outgo; they are subsequently in excess throughout manhood, and at advanced age decrease, until they are extinguished amidst the feebleness and infirmities of old age. The present value of the person's probable future earnings, *minus* the necessary outgo in realizing those earnings, is the present value of that person's services. Like capital invested in the soil, in the vintage, or in a commercial adventure, the capital invested in the life of man returns, in happy natures, profit of a hundred-fold; in other cases fifty, twenty, tenfold; in others it is barely returned; in some it is entirely lost, either by death, sickness, vice, idleness, or misfortune.

A large part of the profit of trade, and even of professions, is derived from external capital. I leave this for the moment out of consideration. And then, in large classes of cases, as well as in individuals, the incomes differ; but they will be found, on an average, to bear a very constant relation to the amount of capital invested in preparation—to the risk under which it is exposed—and to the time that it is under investment. The latter element is of greater importance than is generally imagined; for the fact that the earnings commence at ages ranging from 15 to 45, will account for much of the difference in the incomes of different classes. This may be illustrated by cases of deferred annuities. Thus, if interest is reckoned at 5 per cent., 100*l.* a year from birth to the age of 15 is worth 148*l.* a-year from that age to the end of life; 100*l.* a-year from birth to the age of 25 is worth 362*l.* a-year from that age to the end of life; 100*l.* a-year from birth to the age of 30 is worth 540*l.* a year from that age to the end of life; 100*l.* a-year from birth to the age of 40 is worth 1,180*l.* a-year from 40 to the end of life. Thus, capital yielding the same profit in different professions may, during the age of return, yield average incomes respectively of 100*l.*, 200*l.*, 300*l.*, 400*l.*, 500*l.*, ... 1,000*l.*

The following table has been calculated by the formula $\frac{N_{0|x}}{N_x}$ = the deferred annuity which a premium of 1*l.* a-year from birth to the age x will provide from that age to the oldest age in the Life Table.

The DEFERRED ANNUITY which a PREMIUM of 100*l.* a-year will purchase if continued up to the AGES of 15, 25, 30, and 40 years respectively, allowing either 3 or 5 per cent. per annum interest.

(Results deduced from the new English Life Table.)

Age.	3 per Cent.	5 per Cent.
	£	£
15 - - -	91·42	148·36
25 - -	202·75	362·10
30 - - -	287·12	539·72
40 - -	563·36	1180·05

Thus the premium of 100*l.* a year, allowing the rate of interest to be 5 per cent. per annum, provides deferred annuities of 148·36*l.*; 362·10*l.*, 539·72*l.*, and 1,180·05*l.*, according as the premium is continued from birth to 15, 25, 30, or 40 years.

From the English Life Table we find the number of persons who live from birth through every year of age to the end of a century. Let the average wages, salary, or professional income, earned in the year of age x to $x+1$ be represented by w_x; then as P_x represents the numbers in the life table living through that year; $w_x\,P_x$ will be the sum of the wages; in like manner $w_{x+1}\,P_{x+1}$ will be the sum of the wages in the year of age $x+1$ to $x+2$; and so on to the end of the table, age ϖ. Let this column be added up from the oldest age to the age x, and the sum be represented by W_x; then W_0 against the age $0 =$ the sum of the wages of the generation. As the sum of the column P_x in the life table is Q_0 (= the total numbers living at all ages, to a given number of births, D_0), it is evident that $\frac{W_0}{Q_0} =$ the average annual earnings per head of the whole generation; and $\frac{W_0}{D_0}$ = the average earnings of each person from birth to the end of his life.

So if the average cost of maintenance of a child age 0–1 were known to be y_0; and of a person through any year of age x to $x+1$ were y_x; then the cost of maintaining P_x persons would be $y_x\,P_x$; and the sum of a column of such numbers from the end of the table to the age x would be Y_x; the cost of the maintenance of the generation would be Y_0. The difference between the wages and the cost of maintenance is $W_0 - Y_0$; or the surplus of the earnings over the cost of necessary subsistence. $W_0 - Y_0$ may be called the profit; as W_0 represents the produce, and Y_0 the cost of production. Then $\frac{W_0 - Y_0}{Q_0}$ = the *annual* profit per head; and $\frac{W_0 - Y_0}{D_0}$ = the average aggregate gain on the life of each individual.

If we assume for a moment that the profit $W_0 - Y_0$ is in the possession of an individual A; and is a transferable value; the price will depend upon the rate of interest (i) at which investments of the kind are made. Thus, if the rate of interest is 5 per cent. per annum, the annual revenue $W_0 - Y_0$ will be worth 20 years' purchase. For in this case $\frac{W_0 - Y_0}{i} = \frac{W_0 - Y_0}{\cdot 05} = 20\,(W_0 - Y_0)$. The produce or income will be at the rate of $\frac{100\,W_0}{20\,(W_0 - Y_0)} = \frac{5\,W_0}{W_0 - Y_0}$ per cent. on the capital; the expenditure or outgo $\frac{5\,Y_0}{W_0 - Y_0}$ per cent.; the profit $\frac{5\,W_0 - 5\,Y_0}{W_0 - Y_0} = \frac{5\,(W_0 - Y_0)}{(W_0 - Y_0)} = 5$ per cent. on the capital invested.

If instead of the series P_x in the life table, the series $(1+\frac{i}{2})\,v^{x+1}\,P_x$ be employed; the present values at birth, and at any age x (1) of the future wages, (2) of the future cost of maintenance, are immediately obtained: the difference is the value of the future profit. And on dividing by the column $D_x = v^x\,l_x$, the present value of the average wages, cost, and profit of a man of the age x is found.

The value of w_x and y_x can only be learnt by observation. And the actual wages of classes of men in different trades and professions, as well as the actual cost of education and maintenance, are *desiderata* in statistics.

The tables from which an extract is given at the end of this paper, have been framed from returns of the wages of agricultural labourers, with which I was some time ago favoured by Sir James Kay Shuttleworth, and from returns collected by witnesses before a committee of the House of Commons.

The cost of maintenance is an estimate. Instead of the series P^1_x,* the series D_x has been used throughout (Table C.), which is equivalent to assuming that the wages and cost in the several years of age were equal in value to the sums in the columns w_x and y_x, paid down to or for each person at the precise age x. The character of the results is thus indicated with sufficient exactness for illustration and for all practical purposes.

It will be seen that at the age 20, the value of an agricultural labourer's future wages is 482*l.*; that the value of the estimated cost of necessary maintenance is 248*l.*; that the net value of his services is therefore 234*l.*

TABLE A.—DIGEST of SIR J. KAY SHUTTLEWORTH'S RETURN of the WAGES of the BEST CLASS of LABOURERS in NORFOLK.

Age.	Number of Labourers.	Earnings of Man.	Earnings of Wife and Children.	Earnings of Family, including Gleaning.
		£	£	£
17–20	4	77	—	77
20–25	14	374	7	381
25–30	27	813	39	852
30–35	37	1,160	137	1,297
35–40	37	1,140	175	1,315
40–45	37	1,164	237	1,401
45–50	29	924	274	1,198
50–55	19	581	134	715
55–60	13	407	90	497
60–65	4	126	31	157
65–70	3	77	7	84
70–75	2	36	4	40
75–80	1	16	—	—
80–85	—	—	—	—
85 and upwards	—	—	—	—
Total	227	6,895	1,135	8,014

* The above series, P^1_x, is not in the life table, and has only been calculated at 3 per cent. interest for Table D. *See* p. 536.

TABLE B.—WAGES and COST of MAINTENANCE of AGRICULTURAL LABOURERS in ENGLAND. (Extract from a Complete Table.)

1. Age. x.	2. Living at each Age. l_x.	3. Sum of the Living at each Age and upwards. N_x.	4. Expense of Maintenance per Annum for one Person. y_x.	5. Wages Earned per Annum by one Person. w_x.	6. Expense of Maintenance for all the Living the year following the Age x. $y_x\,l_x$.	7. Wages Earned by all the Living in the year following the Age x $w_x\,l_x$.	8. Expense of Maintenance for the whole of the Living at each age x and upwards. Y_x.	9. Wages of all Living at the Age x and upwards. W_x.	10. Net Profit = the Difference between the Income and Outgo. (W_x-Y_x).
			£	£	£	£	£	£	£
0	513	20,961	7	—	3,591	—	268,539	420,488	151,949
5	372	18,848	7	—	2,604	—	253,741	420,488	166,747
10	355	17,029	8	—	2,840	—	241,008	420,488	179,480
15	346	15,272	12	12	4,152	4,152	224,501	415,249	190,748
20	335	13,561	15	23	5,025	7,705	201,945	386,913	184,968
25	321	11,914	15	29	4,815	9,309	177,240	344,124	166,884
30	307	10,337	15	31	4,605	9,517	153,585	297,143	133,558
35	291	8,834	15	31	4,365	9,021	131,025	250,519	119,494
40	275	7,410	15	31	4,125	8,525	109,665	206,375	96,710
45	257	6,071	15	31	3,855	7,967	89,580	164,866	75,286
50	237	4,826	15	31	3,555	7,347	70,905	126,271	55,366
55	215	3,685	15	31	3,225	6,665	53,790	90,900	37,110
60	189	2,660	15	31	2,835	5,859	38,430	59,156	20,726
65	156	1,780	15	29	2,340	4,524	25,215	32,008	6,787
70	118	1,074	15	21	1,770	2,478	14,625	13,807	— 818
75	79	560	15	16	1,185	1,264	6,915	4,359	— 2,556
80	44	239	15	4	660	176	2,100	378	— 722

The Table B. should be read thus: of 513 males born annually, 335 attain the age of 20; and the sum of the numbers who attain that and every subsequent birthday is 13,561: the expense of bare maintenance in the year following is 15*l.* (rather less than 6*s.* a week); the wages of one labourer in the same year are 23*l.*; the cost of maintaining the 335 is 5,025*l.*; their wages amount in the same time to 7,705*l.*; the cost of maintaining all at and above that age is 201,945*l.*, while their wages are 386,913*l.*; the difference or the net annual profit is 184,968*l.*

TABLE C.—MONEY VALUE of a MAN; or VALUE of the FUTURE EARNINGS and of the COST of MAINTENANCE of an AGRICULTURAL LABOURER. (Interest 5 per Cent.)

Age.	Present Value of			Annuity Equivalent in Value to		
	Future Earnings, $\frac{W_x}{D_x}$	Cost of Future Maintenance, $\frac{Y_x}{D_x}$	Excess of Earnings over Cost of Maintenance, $\frac{W_x - Y_x}{D_x}$	Future Earnings, $\frac{W_x}{N_x}$	Cost of Future Maintenance, $\frac{Y_x}{N_x}$	Excess of Earnings over Cost of Maintenance, $\frac{W_x - Y_x}{N_x}$
	£	£	£	£	£	£
0 -	147·89	142·52	5·37	10·75	10·36	·39
5 -	260·32	204·38	55·94	14·81	11·63	3·18
10 -	347·88	231·01	116·88	19·84	13·17	6·67
15 -	438·85	247·30	191·55	25·73	14·50	11·23
20 -	482·06	248·47	233·59	29·10	15·00	14·10
25 -	487·90	241·55	246·35	30·31	15·01	15·31
30 -	474·35	233·19	241·16	30·53	15·01	15·52
35 -	451·73	223·51	228·22	30·35	15·02	15·34
40 -	423·71	211·69	212·02	30·02	15·00	15·02
45 -	391·11	198·35	192·76	29·59	15·01	14·58
50 -	350·64	182·27	168·37	28·78	14·96	13·82
55 -	301·41	163·59	137·82	27·46	14·91	12·56
60 -	238·29	141·08	97·22	24·76	14·66	10·10
65 -	165·20	119·20	46·00	19·93	14·38	5·55
70 -	97·09	96·32	·77	13·92	13·81	·11
75 -	49·11	73·66	−24·55	8·55	12·82	−4·27
80 -	10·25	51·27	−41·01	2·20	11·00	−8·80

TABLE D.—VALUE of the FUTURE WAGES of AGRICULTURAL LABOURERS, and of PROFESSIONAL INCOMES. (Interest at 3 per Cent.)

Age.	Interest 3 per Cent. — Value of Future Wages and Salaries.			Without Interest. — Amount of Future Wages and Salaries.		
	Of Agricultural Labourers.		Of Persons in Professions on Moderate Incomes.	Of Agricultural Labourers.		Of Persons in Professions on Moderate Incomes.
	On High Wages.	On Low Wages.		On High Wages.	On Low Wages.	
	£	£	£	£	£	£
11	542	—	—	1,187	—	—
15	607	456	—	1,195	886	—
20	637	487	—	1,151	859	—
25	627	481	5,329	1,068	796	10,462
30	597	459	5,700	965	718	10,240
35	556	424	5,951	856	629	9,844
40	509	373	6,038	746	530	9,250
45	456	312	5,932	636	427	8,451
50	397	253	5,584	527	335	7,424
55	330	201	4,933	416	256	6,140
60	255	157	3,979	306	191	4,641
65	172	116	2,718	198	135	2,961
70	100	72	600	112	80	609
75	49	32	—	52	34	—
80	8	5	—	8	5	—

NOTE.—The amount of the future income is the average amount received after the Ages in the first column.

The table should be read thus.—The value of the future earnings of (1) an agricultural labourer on good wages at the age of 25 is 627*l.*, (2) of an agricultural labourer on low wages 481*l.*, (3) of persons in a profession returning a moderate income of about 288*l.* a year is 5,329*l.*; the average amount of wages after that age is 1,068*l.*, and 796*l.*, and 10,462*l.* respectively.

Here $Q^1_x = (1 + \frac{1}{2})(v^{x+1} P_x + v^{x+2} P_{x+1} \ldots + v^{w+1} P_w)$. And P_x the average number of persons living through the age x to $x + 1$ by the life table.

W_x is obtained from the series Q^1_x by multiplying the several terms by $w_x, w_{x+1} \ldots.$

Then $\frac{W_x}{D_x}$ = the present value of the wages.

The values in this table are given on the extreme hypothesis that the wages are as certain to be paid as Government Life Annuities at 3 per cent. interest. Compare these values with those in Table C., where the interest is 5 per cent.—(Paper on the Equitable Taxation of Property in Journal of the Statistical Society, Vol. XVI., pp. 38–44.)

5. Risk of Fatal Railway Accidents, and Insurance against Death or Injury through Railway Accidents.

The persons killed on railways in 1868 amounted to 797, 714 being males and 83 females; 34 of the persons (21 males and 13 females) were returned as killed by manslaughter. Of the deaths, 24 (21 of males and 3 of females) were suicides: the unhappy victims threw themselves on the railways, and converted the trains into steam Juggernauts.

This return differs largely from that made to the Board of Trade for the same year, showing only 150 deaths in England and Wales.* The companies speak with confidence of the accuracy of their returns of passengers, 39 of whom they state were killed by causes beyond the passengers' own control, and 14 by causes referable to misconduct or want of caution. In the two previous years, 24 and 28 passengers were killed. The return of accidents to servants of companies and of contractors is said to be incomplete, because many railway companies are not required by law to report accidents to such persons to the Board of Trade. It is in this respect that the return to the Board of Trade is most defective. It is probable that none of the railways return deaths occurring some weeks after the injury. The numbers "injured" by the English railways in 1867, as stated in the returns, was 660 to 138 deaths; in 1868, it was 528 to 150 deaths, or excluding the Abergele accident, to 117 deaths.

Registration records only 13 deaths by collision in 1868. In the five years 1863–7 only 82 persons were said to have been killed by collision, 31 by trains running off the line. That makes 23 deaths annually including engineers and stokers. It is probable, therefore, that the return by the companies of 105 passengers killed in three years (1866–8), or 35 annually, though under-stated, may serve as a basis of computation; and the number, as compared with the number of journeys, is not considerable. Thus in the year 1867, besides 84,418 season ticket

* Number of accidents of injury to life and limb which have been reported to the Board of Trade during the year 1868. Parliamentary Paper 162, July 1, 1869. The deaths for Scotland were 47, for Ireland 15.

holders, 250,598,982 passengers travelled by rail; and as 35 were killed on an average of the three years 1866–7–8 according to the returns, the chance of this disaster on the way to any one is represented by the fraction ·000,000,12, after correcting for season ticket holders. Hence it follows that a premium of 1-eighth of a farthing, will insure 1,000*l.* on an average journey, and taking 600 journeys a year ·072*l.* = 1*s.* 5*d.* will insure 1,000*l.* on any life killed during a year of average journeys. Then, as about 23 passengers are injured to one killed, by taking the duration of illness into account, we see how those ingenious persons who undertake insurance against railway accidents make their calculations and profits.*

The chances against being killed in any single journey vary with the line, and perhaps with the distance; but if the return is correct, the general chance is more than 8,000,000 to *one* that a passenger will arrive at the end of the journey alive; and the chances are more than 362,000 to *one* against his being either injured or killed. It is probable that there is now no safer kind of locomotion than railway travelling. It is safer than riding on horseback, or in a carriage.

This degree of safety is only maintained by the laudable vigilance of the companies, and of their officers: and the vigilance is kept up by the heavy pecuniary fines to which they are liable for every injury or death inflicted on a passenger by their default.

Seeing the small number of accidents to passengers, it has been too readily assumed that there is no danger to passengers in railway travelling; and this saying has been quoted: "a person who wishes to " put himself in the safest place possible cannot do better than enter a " first-class railway carriage."

This is based on a fallacy. The rate of mortality from *all causes* is always given, like the rate of interest, so as to show the rate per cent., or per 1,000 *per annum;* and at the age of 30 this is 10 per 1,000, at 50 it is 20 per 1,000 *per annum.* The railway mortality has been calculated hitherto on the journey, which is on an average of 9·6 miles and may be of half-an-hour's duration, more or less. The rate which has been given above is, therefore, *per half hour;* and as there are 17,520 half-hours in the common year, the rate *per annum* is 17,520 times the rate per half-hour. When the multiplication is performed it will be seen that the rate of mortality on a constant average railway-travelling population is 2 per 1,000. This is an appreciable addition to the ordinary mortality of men, which ranges from 10 at the age of *thirty*, to 20 at the age of *fifty*, and to 40 at the age of *sixty-three*.

Dangers can be numerically appreciated with great exactness on a large scale, but in practice it is not customary to take into account additions or diminutions of the rate of mortality not exceeding one-10,000th part: and men every day encounter dangers of that measured magnitude without hesitation. Unless they had this sufficient amount of courage human affairs could not go on; the lion in the path would bring everything to a standstill. But when the annual rate is raised under any exceptional conditions such as railway travelling by *one*, and certainly when it is raised by *two* in 1,000, the increase under those conditions cannot be entirely

* The railway companies return 68 killed to 1,557 injured by their default; the numbers injured by the passengers' own defaults is evidently wrong. It is only 16 injured to 37 killed in the three years 1866–7–8. I take the proportion from those reported killed and injured by the companies.

neglected. The railway carriage cannot be held up as a harbour of perfect safety.

But taking the railway passengers' rate of mortality at 20 in 10,000 for the whole year round it is evident that a season ticket-holder who is on an average railway only an *hour* a day for 300 days adds less than one-10,000th to his risk: it is, therefore, below the degree of commonly appreciated danger. For double the time the risk may be doubled; but even this is only an addition of 2 to the ordinary risk of 150 in 10,000 from all other causes incurred by a life at the age of *fifty*. Insurance offices constantly neglect such slight additional risks in dealing with men living in different circumstances, in different professions. As the assayer of gold cannot test its fineness from alloy with any certainty beyond the 2 or 3 ten thousandth part, so it is in scientific assays of the value of human life.

It is gratifying to find that the risk to the railway passenger has continually decreased since the early observations of the year 1840–3, when the passenger encountered a risk five times as great as our computation gives; and this improvement may be in part fairly ascribed to the laws under which railway companies are liable to heavy claims from injured passengers for damages. The least want of vigilance, inefficient training of the staff, overwork, defaults in the construction of the line, defects in the engines or the carriages, lead to most disastrous consequences.* Against the divers elements of danger we have the natural anxiety of the directors, and of a very skilful body of officers to ensure the safety of the lives of their passengers. All their efforts in this direction are sharpened by the heavy penalties of the law. And it is easily conceivable that any relaxation of existing safeguards might lead to an immediate increase of danger to passengers, so that the deaths, injuries, and fears of travellers may become twice as great as they are now.

The "servants of companies or contractors" do not appear practically to enjoy the same legal protection as passengers, and they are killed in considerable numbers: in the year 1868 the companies returned 53, and "many companies" do not take the trouble to report such deaths to the Board of Trade, "not being required to do so by law." This is very evident, for in 1868 while 150 deaths on the railways in England and Wales are returned from all causes, to the Board of Trade, the total of such deaths distinguished in the registration returns are, after deducting 24 suicides, no less than 773! After the deduction of 53 passengers, and of 34 trespassers or persons killed at level crossings, 686 remain, who must have been chiefly "servants of the companies "and contractors." No fines, we may presume, were inflicted in these cases, as the relatives would have no means of bringing actions under Lord Campbell's or any other Act. The workmen have no remedy when they are killed "by causes beyond their own control;" and their deaths in most instances are from causes under their control.

It must on these grounds and on others be admitted that the people at large, and the railway companies, have reason to be dissatisfied with the present state of the law. In the year 1867, when the railway companies returned the deaths of 28 passengers, 15 were killed by causes beyond the control of the said passengers; and 13 by "their

* See Neison's Contributions to Vital Statistics, p. 247. His paper is an excellent digest of results deducible from the Board of Trade Returns down to the year 1852. In 1840–3 *sixty-one* passengers were killed in 57,617,578 "passages," or *one* in 944,550. 260 passengers were injured. But the average distances travelled then were 18 miles for which allowance has to be made, as the distances are now less than 10 miles.

"own misconduct or want of caution," if we adopt the judgment of the companies in the matter. The persons injured in the two categories, they state, were 578 and 6, the latter evidently wrong; for that year the companies paid 322,985*l.* as "compensation for personal injury, &c."* This is a large sum; it is 2·4 per cent. on the 13,534,281*l.* of fare-receipts from passengers. It does not include all the legal expenses of the party injured; and we have no means of knowing the amounts or the per-centage on the sums awarded by juries.

The companies have just grounds to complain of the costs of litigation, which are probably included in the above sum, and of the uncertainty of awards, which are based on appreciations of the extent of injuries often obscure,† and of the value of men's life incomes, scarcely within the capacity of juries, or of the ordinary courts. The public have still greater ground for dissatisfaction. The families of poor men can derive little advantage from the law; and the result to the opulent is uncertain. Some railways deal with sufferers in a liberal spirit; others are said to oppose every claim by hostile litigation: here is another ground of inequality under the laws.

In endeavouring to arrive at remedies, four things have to be especially kept in view; (1) the principle that to ensure the utmost care on the part of the railway authorities loss of life or limb is to be compensated, so far as this can be equitably done, by payments in money bearing some reference to the economic value of the person injured; that (2) the railway should know beforehand the amount it may be called upon to pay; that (3) both the railway company and the person injured should be relieved from any unnecessary expense in obtaining an equitable settlement; and that (4) the tribunal for determining the extent of injury, the value of the life, and the division of blame, should be skilful and competent.

I have shown elsewhere that the economic value of men can be estimated by deducting the present value of their necessary subsistence from the present value of their future earnings. Thus, taking his wages as the basis, the value of a Norfolk agricultural labourer, at the age of 25, was found to be 246*l.*‡; while the value of the income of a professional man earning 300*l.* a year being 5,000*l.*, the deduction of his necessary professional subsistence may reduce the money value of his life to something like 3,000*l.* By neglecting this element, the values of a life are sometimes exaggerated. The compensation for injury can never exceed the value of the life; and the injuries to body and limb may be classified by a tariff, so as to bear definite proportions to the value of the whole life. The tariff would be subject to modification in singular cases which can be easily conceived; thus the loss of a finger may deprive a great violinist of his fortune.

Objections may be raised to this principle of compensation. The lives of the Queen's subjects are all equal in the eyes of the law. And no one admits that a railway company can be justified in neglecting any precaution in the case of a single passenger, be he rich or poor. The same vigilance and care are required and given in all cases. Why then should the company pay more for the life of an officer than for the life of a soldier, for the life of a judge than for the life of a solicitor, for

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* Parliamentary Return, No. 484, 1868; what the "&c." means in the return is not clear.

† The difficulty of the surgical questions will be at once seen on referring to the Classic essay on "Railway and Street Injuries of the Nervous System, by J. E. Erichsen, Professor of Surgery in University College."

‡ Journal of Statistical Society, March 1853, pp. 39–44. The value of the wages is 488*l.*; of the necessary subsistence 242*l.* (*See* Extracts on pp. 531–7.)

the life of a bishop than for the life of a curate. Yet the loss or injury on a carriage full of curates might not exceed 30,000*l*., while the loss on the life of two bishops might raise claims for a larger sum. The answer to this is that the compensation in money is to the individual, or to his family, for the pecuniary loss, to which it must therefore bear some defined proportion. Besides, as all classes are mixed up in a train, the effect of the larger fines on the railway companies is to awaken a vigilance calculated to prevent injury—and that is after all the main object—to the lives of all classes be they of small, or be they of exorbitant value. It is possible, however, and even desirable to save disputes, expenses and uncertainty, to try and find some average minimum amount, suitable to the majority of cases, and susceptible of expansion to meet exceptional instances. This can be done on the principle of insurance.

(1.) Thus to deal with the *Cases of Death for which the railway company is exclusively liable.* Let a fixed sum be paid by the company for each passenger killed by its default, and let the sum, varying for the three classes of passengers, be fixed after careful inquiry. I assume for the moment that the sums have been determined; and that they are 1,361*l*. for first class, 1,000*l*. for second class, and 600*l*. for third class passengers.* Then the tariff of injury would be graduated on these scales: assume for the moment that on the 23 annual deaths from the companies fault the amount is 23,000*l*.; and that the rate for injuries is so graduated as to amount to an average of 300*l*.; then 519 injuries a year will cost 155,700*l*.; making with compensation for deaths 178,700*l*. That is less by 144,285 than was paid by the English companies in 1867 as compensation for personal injury "&c." in the latest year for which we have returns. It leaves a reserve.

Where Parliament limits the fares to meet a special purpose it may limit the compensation.

(2.) The passengers killed by what the return designates their own "misconduct or want of caution" appear at first sight to have no claim; but in each of these cases a small fine should be levied, in order to enforce attention to provisions of prevention on the part of the company. Here is an illustrative case:—A solicitor (J.), enjoying an income of 2,000*l*. a year is killed under these circumstances: he is startled from sleep, and attempts to leave the carriage as the train starts; he is stopped by a servant of the company, who is an old soldier, and acts in strict conformity with the regulations; in the struggle, J., falling between the platform and the iron wheels of the carriage, is crushed to death. He is found stretched on the ground, with torn clothes, and a physician has to communicate the sad intelligence to his wife, now a widow, who was awaiting his return to dinner. He was killed, as the return would say, "by his own misconduct." But it was held by the jury, that if instead of a narrow step for the foot, the interval between the platform and the carriage had been protected, as it is in some other cases, J. could not have been crushed, his family could not have been deprived of 2,000*l*. a year, Another solicitor was killed shortly after, not under the same, but under similar circumstances. The structural alteration suggested by the jury involved some expense; it was not carried out. It may possibly be inexpedient on other grounds, but it is quite certain that if in all such cases the company were subject to a fine on the old principle of the deodand, no means would be neglected to prevent passengers being killed by such "misconduct" of their own, or by any want of precaution on the part of the company.

* These sums are in proportion to the average fares of the three classes:—2·11*d*.; 1·55*d*.; and ·93*d*.

(3). The guards, engine-drivers, stokers, and other servants of the company, who are killed by causes beyond their own control, are justly entitled to compensation, at a settled rate. The workmen of the company or of contractors, often strong but dull, require drilling, training, and instructing against the dangers of the line. The contractors and companies could by discipline prevent many deaths, and would exert themselves more diligently in this direction if they had in every case of death or injury on the line to pay a definite fine. Some of the companies liberally contribute to the friendly societies of their servants, which should be made the universal rule. The whole of the members of such a fund, as well as the company, should be called upon to contribute at every death on the line, to give every one an interest in saving life.

(4). There is no provision to meet those extreme cases from which the companies suffer, inasmuch as the claims upon them appear practically unlimited. How much has been demanded cannot be stated, but 13,000*l.* it is said were paid in one case; 7,000*l.*, 5,000*l.*, 4,000*l.*, 3,000*l.*, 2,000*l.*, and 1,000*l.* are apparently common claims. These cases give rise to expensive litigation, and the scientific estimate of the value of a life income, on which the amount hinges, is thrown into the hands, and left to the decision, of an ordinary jury. What the result may be is a matter of chance. A trial, for a family left destitute, is a hazardous speculation. These cases will be met by the companies insuring the lives up to 5,000*l.* The passenger will thus appraise his own life, and will pay a premium partly recovering the risk, sufficient, with some addition from the company's reserve, to pay the sums insured wherever the passenger is killed on the line, whether by accident to the train or otherwise. Thus in three years (1866–8) 35 passengers were killed annually: 12 by their own want of caution or misconduct, 23 otherwise. This is from the company's return. The proposal is to pay the *insurance* on the 12 deaths, as well as on the 23 deaths. These sums are insured by special premiums paid by the passengers; and will therefore be independent of the compensations covered by the tariff under the first head.

I may here answer a preliminary objection: "There are *Railway* "*Passengers Insurance Companies* in existence, and any other insurance "is unnecessary." The answer is: these companies have no control whatever over the causes of death and injury, and the principle here upheld is that the losses on lives should be met by the parties who can exercise a certain control over the events against which insurance is effected. Besides, these insurance companies limit their insurances to 1,000*l.*; and if the returns of the companies are complete, the insurance is curtailed of its fair proportion by a proviso, somewhat misleading, that the insurance shall extend "to such injury only as shall be caused "by some injury or *accident to the train*." They pay for nothing beyond the above 23 deaths; so for a third of the deaths returned they pay nothing; and the death of J. above cited under such a policy would not have been by *accident to the train;* and had he held a policy his family would have got nothing from a Railway Passengers Insurance Company. Their general policy even apparently does not cover all the deaths by accident on a railway, while it extends to other accidents.

An action by law is now maintainable against a person who by his *wrongful act*, *neglect*, or *default* may have *caused the death* of any person.* This action, under the Act, can now be brought "notwith-

* Preamble to 9 & 10 Vict. cap. 93. Lord Campbell's Act is entitled, "An Act "for compensating the Familes of Persons killed by Accidents." (26 Aug. 1846.)

"standing the death of the person injured." Every such action shall be for the benefit of the wife, husband, father, mother, grandfather, grandmother, step-father, step-mother, son, daughter, grandson, granddaughter, step-son, and step-daughter of the person killed. The jury may give such damages as they think *proportioned to the injury resulting from such death to the parties respectively* for whose benefit the action is brought.

By the Judicial Statistics, we learn that 203 actions were brought under the Act in the year 1868; 122 of the verdicts were for the plaintiff, 3 were subject to special case or reference; 29 verdicts were for defendant, in 6 jury was discharged without verdict, in 5 a juror was withdrawn, 38 were cases of nonsuit, or were otherwise disposed of. The total amount recovered was 68,092*l.*; which if equally divided among the successful plaintiffs, taken at 124, gives an average of about 549*l.*; in 9 of the cases the damages were 1,000*l.* to 2,000*l.*; 6 were 2,000*l.* to 3,000*l.*; 1 was 3,000*l.* to 5,000*l.*; and in 1 the damages were 9,750*l.** Actions were brought in 98 other cases of injury from negligence; of which 47 resulted in verdicts for plaintiff, 4 were subject to special case, and 9 to reference; 7,202*l.* were recovered, we may assume by 60 plaintiffs, or on an average 120*l.* each. The largest damages in a single case are said to have been between 2,000*l.* and 3,000*l.*†

The expenses of the 301 trials are not stated, but they would necessarily be large; and the dread of expense necessarily deters many executors from moving. To meet this difficulty to some extent, the Act was, in 1864, amended by 27 & 28 Vict. cap. 95, which gave other persons beneficially interested power to bring actions.

Many of these actions were brought against railway companies; but the whole amount of 75,294*l.* recovered goes but a short way towards the compensation for personal injury as shown in the returns to the Board of Trade. There is a wide margin for law expenses, and the greater part of the residue must go to meet unlitigated claims.

(4). Any common tariff to compensate for deaths or injuries can only provide for the cases of persons of moderate fortunes; and should only be pitched to meet a part of the pecuniary damage sustained, as the fine is not vindictive but preventive, and in mitigation of a family's losses. Railway life insurance by the companies ensures the continuance of vigilance on their part, substitutes definite for unlimited claims, and gives families the fullest benefit free from the uncertainty and expenses of litigation.

The insurance could be most conveniently effected by annual policy tickets, to be issued by each company, but in such terms as to insure, for a commensurate premium, any sum from 500*l.* up to 5,000*l.*, payable by the *company owning any railway in the United Kingdom on which the passenger insured was killed*; and in case of injury a sum proportional to the extent of loss, always a fractional part of the sum insured, sustained by the passenger.

The risk of death on a single journey being so slight we have no coin small enough to pay a premium for 1,000*l.*; but taking 600 average journeys, nearly 6,000 miles for the year's travel, of an average person

* This was an action of "Howard *v.* The Great Indian Peninsular Railway Company, tried at Lewes, Sussex, on 17th July 1868, before Mr. Justice Willes. The jury found a verdict for the plaintiffs for 9,750*l.*, which they distributed thus:—to the widow 3,750*l.*, and to each of three children 2,000*l.*"

† Judicial Statistics, 1868. Part II., pp. 3–11.

likely to insure, the exact premium calculated on the companies' own returns to the Board of Trade is 1*s.* 5*d.* (·072) for 1,000*l.* on each death Take the injuries by the same returns at 15 to each death $\left(\frac{524}{35}\right)$; and let the damages for an injury be on an average 1-third of the sum insured at death; they would necessarily have a large range as the injury was slight or severe; then the premium to insure against injury would be 7*s.* 3*d.*, making 8*s.* 8*d.* in the aggregate. To settle the premium minute preliminary inquiries would have to be made into all the results of experience attained, and into the circumstances affecting the loss of value of the professional life by injuries, but for the purpose of illustration let it be assumed that 8*s.* a year will henceforward insure the passenger's life to the extent of 1,000*l.* against death or injury by any railway accident, without raising the question of default on his own or the company's part; and of this let 7*s.* be paid by the insurant, 1*s.* by the company.

The insurance might be thus worked. The passenger would take out an annual policy; the premium being 7*s.* for 1,000*l.*; 35*s.* for 5,000*l.* If he take out a season ticket he will take out the insurance ticket at the same time; and in all other cases he will take his insurance ticket at the station nearest to his residence. Each railway in the United Kingdom will issue insurance tickets, and the premiums will be paid into one fund under separate accounts; and the compensations for death or injury on each railway will be written off the account of that railway which will be called upon to make up its own deficiencies. There will be many arrangements of detail necessary to insure the well-working of such a system; but it could all be brought in England under the railway clearing house system. The premium should be subject to approval by a Government office, and be so rated as to render it the interest of companies to reduce the current mortality.

I have assumed for the moment that the insurances would not be taken for more than 5,000*l.*; but as sometimes larger sums are awarded it may be deemed right to insure for larger amounts; at the above rates a man of large professional income might insure 10,000*l.* for an annual premium of 3*l.* 10*s.* The actual compensations are paid by the passengers, whose fares are fixed with due reference to the compensations as well as other charges, and the premiums for the additional sums required to meet the cases of lives of more than ordinary value would relieve the companies to a considerable extent.

Each man having appraised himself in his policy no further question of the economic value of the whole life could be raised. That would be fixed by the tariff for all uninsured cases, and by the policy of insurance in other instances. It is understood that the tariff price would be paid on every person killed by the default of any railway company, as well as the extra sum insured.

The cases of *injury* are so infinitely diversified, and so difficult to measure, that to deal with them it may be necessary to establish a special court of arbitration, consisting of a barrister, a surgeon, and an actuary, who would soon acquire experience and be able to lay down general rules for future guidance.

Under these arrangements, we might expect improved means for the prevention of deaths in travelling on railways, and fewer deaths among the servants of the companies and of the contractors. At the present time a battalion is killed every year. (31st Annual Report, pp. 203–8.)

6. Family Nomenclature in England and Wales.

In former Reports* have been described the nature and important use of the indexes prepared in this department, by means of which the entry of any registered birth, death, or marriage can be generally referred to, on the mere mention of the name, in a very short space of time. These indexes, which are separately prepared for the births, deaths, and marriages registered in each quarter, receive a yearly addition of upwards of 1,350,000 names; and at the end of the year 1854 they contained the names of 4,828,464 persons married, of 9,598,276 children born, and of 6,622,108 persons who died during the period of 17½ years from 1st July 1837, when the system of general registration commenced. More than 21,000,000 of the names of the immediate subjects of one or more of the important events of birth, death, and marriage were thus inscribed in the indexes to the registers, which thus form a nominal list of no inconsiderable number of the people of England, living or deceased.

The personal or family nomenclature of the inhabitants of any country is a subject of considerable interest. Much that is illustrative of their early condition, customs, and employments is often discoverable in the names which have been handed down to them from bygone generations, and an investigation of the origin and character of these names will always afford matter for curious speculation and useful inquiry. English surnames have already to some extent engaged the attention of antiquaries and others, who have brought to light many interesting facts on the subject; but several curious questions as to the number and extension of particular surnames have never, owing doubtless to the want of a sufficient collection of observations, been fully examined. As a contribution in aid of such inquiries, it may prove not uninteresting to notice here a few of the more obvious facts derived from the indexes to the registers, leaving the application of them to those whose tastes may lead them to follow up the subject.

The most striking circumstance presented by the indexes is the extraordinary number and variety of the surnames of the *English* people. Derived from almost every imaginable object,—from the names of places, from trades and employments, from personal peculiarities, from the Christian name of the father, from objects in the animal and vegetable kingdoms, from things animate and inanimate,—their varied character is as remarkable as their singularity is often striking. Some of the terms which swell the list are so odd and even ridiculous that it is difficult to assign any satisfactory reason for their assumption in the first instance as family names, unless indeed, as has been conjectured, they were nicknames or *sobriquets*, which neither the first bearers nor their posterity could avoid.

In Wales, however, the surnames, if *surnames* they can be called, do not present the same variety, most of them having been formed in a simple manner from the Christian or fore-name of the father in the genitive case, *son* being understood. Thus, Evan's son became Evans, John's son Jones, &c. Others were derived from the father's name coalesced with a form of the word *ap* or *hab* (son of), by which Hugh ap Howell became Powell, Evan ap Hugh became Pugh, and in like manner were formed nearly all the Welsh surnames beginning with the letters B and P. Hereditary surnames were not in use even amongst the gentry of Wales until the time of Henry VIII., nor were they generally established until a much later period; indeed, at the present day they can

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* First and Sixth Annual Reports of the Registrar General.

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scarcely be said to be adopted amongst the lower classes in the wilder districts, where, as the marriage registers show, the Christian name of the father still frequently becomes the patronymic of the son in the manner just described.*

The probable number of surnames in England and Wales has been the subject of conjectural estimates based on a small collection of facts. By the careful collation of all the registration indexes it could be approximately ascertained; for during a period of more than seventeen years it is probable that almost every resident family contributed to the registers an entry of birth, death, or marriage. The task of collating upwards of two hundred immense quarterly indexes would, however, involve a vast amount of labour without any commensurate result; moreover the number of names is constantly varying, owing, on the one hand, to emigration, or to the extinction of families by death, and on the other, to the introduction of fresh names by foreigners and immigrants, to the corruption of existing names always going on amongst the illiterate, and to various other circumstances. The numbers of different surnames contained in one quarterly index of births, and in another of deaths have been ascertained; the former selected with reference to the period of the last Census, and the latter without premeditation. The following are the results:—

	Persons registered.	Different surnames.
BIRTHS. Quarter ending 31st March 1851 -	157,286	25,028
DEATHS. Quarter ending 31st March 1853 -	118,119	20,991

According to these numbers, there were for every 100 of the births registered about 16 different surnames, and for every 100 of the deaths about 18, reckoning every surname with a distinctive spelling, however slightly it may differ from others, as a separate surname. Taking the two indexes together, and by a careful collation eliminating all duplicates, the numbers stand thus:—

Persons registered.	Different surnames.	Different surnames to every 100 persons.	Persons to *one surname*.
275,405	32,818	11·9	8·4

An alphabetical list of 32,818 surnames, the largest collection yet made, is thus obtained; and as this result is furnished by two quarterly indexes only, it may be assumed as a rough estimate that the whole number in England and Wales is between *thirty-five* and *forty thousand*. It is important, however, to remember that the list includes a large number derived from the same roots as others, commonly agreeing in sound, but differing in orthography often only to the extent of a single added or substituted letter. By these trifling variations the number is immensely increased. The name of Clerk, for instance, is also commonly spelt Clark and Clarke, one and the same primary name (from *clericus*) being implied in the three forms; but three separate items necessarily appear in the list, for practically as *surnames* they represent different and distinct persons and families. Again, the widely spread name of Smith appears in family nomenclature also as Smyth, Smythe, and even as Smijth. It is not usual, however, to regard these diverse forms as

* So late as the time of the accession of the House of Hanover, the unabbreviated prefix "ap" was very commonly used, and, by employing it with the contracted form, three generations could be expressed in one name; thus *Richard ap Pritchard* implied Richard the son of Pritchard the son of Richard.

representing one name only, nor would all their bearers probably concur in admitting the common origin of the several variations. Until a comparatively recent period, an entire disregard of uniformity and precision in the mode of spelling family names prevailed, even amongst the educated classes, and many family Bibles and writings might be adduced as evidence that this was apparently less the result of carelessness than of affectation or design. While the *sound* was in a great measure preserved, the number of different surnames became greatly multiplied by these slight orthographical variations, as well as by other corruptions; and if, in reckoning the number, each original patronymic with its modifications were counted as one, the list of 32,818 would be considerably reduced.

The contribution of Wales to the number of surnames, as may be inferred from what has been already stated, is very small in proportion to its population. Perhaps nine tenths of our countrymen in the Principality could be mustered under less than 100 different surnames*; and while in England there is no redundancy of surnames, there is obviously a paucity of distinctive appellatives in Wales, where the frequency of such names as Jones, Williams, Davies, Evans, and others, almost defeats the primary object of a name, which is to distinguish an individual from the mass. It is only by adding his occupation, place of abode, or some other special designation, that a particular person can be identified when spoken of, and confusion avoided in the ordinary affairs of life. The name of John Jones is a perpetual incognito in Wales, and being proclaimed at the cross of a market town would indicate no one in particular.

From the circumstance of their common British origin it might be supposed that the Welsh people and the inhabitants of Cornwall would exhibit some analogous principles in the construction of their surnames; such, however, is not the case. The Cornish surnames are mostly local, derived from words of *British* root, and they are often strikingly peculiar. A large number have the prefix *Tre*, a town; the words *Pol*, a pool; *Pen*, a head, *Ros*, a heath, and *Lan*, a church, are also of frequent occurrence in surnames. The Cornish family nomenclature differs materially from that of the rest of England.

The local distribution of surnames is not the least interesting branch of this subject; for most persons will have remarked that every district of the country possesses some surnames rarely met with anywhere else, the origin of which must be sought for in circumstances peculiar to the locality. To trace out the connexion between the surnames and these circumstances is a task which may be most advantageously undertaken by local inquirers; and the indexes prepared by each superintendent registrar, and preserved with the registers in his custody, would prove useful adjuncts in such investigations.

While it is obvious that the original adoption of a particular surname was the result in most cases of arbitrary circumstances,—since John Smith, instead of being called after his occupation, might equally have chanced to become John Johnson from his father's Christian name, or John Wood from the situation of his abode, or John Brown from his complexion,—it is curious to remark the predominance of certain names, which seem to have been adopted preferentially by large numbers

* Of the 328 registration officers and their deputies acting in the districts of Wales, 207 are comprised under 17 surnames, in the following proportions; viz., Jones 46, Williams 26, Davies 16, Evans 16, Thomas 15, Roberts 14, Lewis 11, Hughes 10, Edwards 8, Lloyd 8, James 6, Griffith 6, Morgan 6, Rees 6, Owen 5, Morris 4, and Ellis 4. There is only one officer of the name of Smith. The districts referred to are numbered 581 to 623 in the Abstracts, and include some portions of English Counties on the Welsh border.

of the people, or conferred upon them by others, and now prevail in every county of England. Do these common names hold the same rank in point of numbers which they had at first, or have some of them spread and multiplied more rapidly than others? For instance, is the present predominance of the Smiths amongst English surnames due to the original numerical strength of that great family, or to some special circumstances acting upon the ordinary laws of increase, owing to which the descendants of the hammer-men have multiplied at a greater rate than the bearers of any other name? Has the progency of the tawny Browns increased faster than that of the fair complexioned Whites, relatively to the original numbers of each race, so as to account for the excess of the former over the latter; or were the Browns in a majority in the first instance? Various are the surmises and speculations to which such questions may give rise. One point, however, the registration indexes enable us to determine; the particular names which have ultimately attained the strongest hold on the people; and also, with tolerable certainty, the relative numbers of the adherents of each.

The subjoined list of 50 of the most common surnames in England and Wales is derived from 9 quarterly indexes of births, 8 of deaths,

FIFTY of the most common SURNAMES in ENGLAND and WALES, with the aggregate Number of each entered in the Indexes of Births, Deaths, and Marriages in the Year ending 30th June 1838, of Births in the Quarter ending 31st March 1851, and of Births, Deaths, and Marriages in the Year 1853.

—	Surnames.	Number of Entries of each Surname.	—	Surnames.	Number of Entries of each Surname.
1	Smith - -	33,557	26	Harris - -	7,042
2	Jones - -	33,341	27	Clark - - -	6,920
3	Williams - -	21,936	28	Cooper - -	6,742
4	Taylor - -	16,775	29	Harrison - -	6,399
5	Davies - -	14,983	30	Davis - -	6,205
6	Brown - -	14,346	31	Ward - - -	6,084
7	Thomas - -	13,017	32	Baker - -	6,013
8	Evans - -	12,555	33	Martin - -	5,898
9	Roberts - -	10,617	34	Morris - -	4,888
10	Johnson - -	9,468	35	James - -	5,755
11	Robinson - -	9,045	36	Morgan - -	5,691
12	Wilson - -	8,917	37	King - -	5,661
13	Wright - -	8,476	38	Allen - -	5,468
14	Wood - -	3,238	39	Clarke - -	5,309
15	Hall - -	8,188	40	Cook - -	5,300
16	Walker -	8,088	41	Moore - -	5,269
17	Hughes - -	8,010	42	Parker - -	5,230
18	Green - -	7,996	43	Price - -	5,219
19	Lewis - -	7,959	44	Phillips - -	5,124
20	Edwards - -	7,916	45	Watson - -	4,771
21	Thompson -	7,839	46	Shaw - -	4,759
22	White - -	7,808	47	Lee - -	4,731
23	Jackson - -	7,659	48	Bennett - -	4,671
24	Turner - -	7,549	49	Carter - -	4,648
25	Hill - - -	7,192	50	Griffiths - -	4,639
				Total - -	440,911

and 8 of marriages; and although the inquiry might have been extended over a more lengthened period, it was found that the results were in general so constant as to render a further investigation unnecessary. When arranged according to the numbers in each index, the names appeared almost always in the same order, and the variations, when they occurred, rarely affected the position of a name beyond one or two places. These 50 names embraced nearly 18 in every 100 of the persons registered. The 3 names at the head of the list, Smith, Jones, and Williams, are, it will be observed, greatly in advance of the others; and if the numbers may be taken as an index of the whole population, it would appear that on an average one person in every 28 would answer to one or other of these 3 names.

Regarded with reference to their origin, it seems that of the 50 most common names more than half are derived from the Christian or fore-name of the father, and are thus literally *sire*-names or *sirnames*. This is the most primitive form of a second name, and it was extensively used amongst the Anglo-Saxons as well as by other European nations. Names derived from occupations are next in number, and contribute 13 to the list. After the Smiths come the Taylors, who are about half as numerous as the Smiths; next the Wrights, amounting to about half the number of the Taylors; then the Walkers, Turners, Clarks, Coopers, Wards, Bakers, and Clarkes. The Clarks and the Clarkes, if taken collectively, would occupy the third place in the list of names derived from employments; a fact which points significantly to the importance attached to the clerkly office, and to the possession of a moderate amount of learning, in rude and unlettered times, when a king received his characteristic epithet (Beau-clerc) from his scholarship. This class of surnames is peculiarly instructive as illustrating the pursuits and customs of our forefathers; many of them furnish evidence of a state of society impressed with the characteristics of feudal times; and not a few are derived from terms connected with the amusements of the chase and other field sports to which our ancestors were so ardently attached. Widely different would be a national nomenclature derived from the leading occupations of the present day. The thousands employed in connexion with the great textile manufactures would take precedence even of the Smiths; while the Taylors would give place to the shoemakers (now scarcely recognizable under the not common surname of Suter with its variations, Soutter, Sowter, &c.), as well as to the Colliers, the Carpenters, the Farmers, and others. The Hawkers, Falconers, Bowyers, Fletchers, Arrowsmiths, Palmers, Pilgrims, Friars or Freres, and a host of other family names derived from various callings which have become obsolete in this country, would be wanting. Seven of the 50 surnames belong to the class of local surnames, and are expressive of situation, as Wood, Hall, Green, &c.; and two (Brown and White) are derived from personal peculiarities.

The surname of Smith is pre-eminently the most common in England, as that of Jones is in Wales; and so great is the multitude of the Welsh Joneses, that the latter name not only enters into competition for priority in point of numbers with the Smiths, but in several years shows a majority over its rival. With a view to determine the relative frequency of these two widely-spread surnames, the numbers of each entered in the indexes during the years 1838–54 have been ascertained. The result is that the births, deaths, and marriages of the Smiths registered in this period were 286,037, and those of the Joneses 282,900, the excess in favour of the former being 3,137 in the 17 years. Smith is, therefore, unquestionably the most common surname amongst us, though the Joneses are little less numerous, and in six of the years actually contributed to the registers larger numbers than the Smiths. Together, the bearers of those two common names amounted to 568,937, or 1 in 36 of the whole number registered, during the period referred to.

Assuming that the persons of the surnames of Smith and Jones are born, marry, and die in the same proportions as persons of *all surnames*, it will follow that in England and Wales there are not less than *half a million* of persons bearing one or other of those two surnames. The Smiths, amount to rather more than a quarter of a million, and the Joneses to little less; together forming no inconsiderable portion of the English population. These numbers represent, on the assumption that the average number of persons in a family is the same as in the whole population at the Census, viz., 4·8 persons, about 53,000 families of Smiths, and 51,000 families of Joneses; and to give an illustration of their numerical powers, it may be stated that these two great tribes are probably sufficiently numerous to people the four towns of Birmingham, Bristol, Leeds, and Hull, without any addition of persons of other surnames.

Upon the facts derived from the indexes of the registers for the year 1853, the probable number of persons in England and Wales bearing each of the 50 most frequent surnames has been computed. From this estimate it appears that the persons by whom these 50 surnames are borne amount to about 3,253,800; nearly one sixth of the entire population of England and Wales. On an average, it seems, one person in 73 is a Smith, one in 76 a Jones, one in 115 a Williams, one in 148 a Taylor, one in 162 a Davies, and one in 174 a Brown.

It is sometimes useful, in dealing with an extensive list of names, to know the proportionate numbers commencing with each letter of the alphabet. With such information, the names may be subdivided, according to the initial letters, in groups, large or small, so as to secure tolerably equal numbers in each group. The experience of the department in this respect, derived from the registration indexes, shows that the letter B is the most frequent initial of surnames amongst us, comprising more than a tenth of the whole. Next in number are the surnames ranked under the letter H (9·5 per cent.); then those under S. and W. (8·9 and 8·7 per cent.) The vowels, which enter largely into the words of the English language from their occurrence in the prefixes *ab*, *ac*, *ex*, *in*, *im*, *un*, &c., are not extensively used as the initial letters of surnames; and amongst the consonants N and K are the first letters of the fewest surnames, except X and Z. As many words in common use, chiefly of Anglo-Saxon origin, have been adopted as surnames, the philologist may probably trace some relation between the surnames and the words of the language beginning with the same letters; but so large have been the additions made to the English vocabulary in modern times, that such a connexion is by no means obvious in reference to the words now found in our dictionaries. (16th Annual Report, pp. xvii–xxiv.)

APPENDIX.

APPENDIX.

THE "FARR TESTIMONIAL FUND."

As soon as it became known that Dr. Farr had resigned his appointment as Superintendent of the Statistical Department of the Registrar General's Office, a general feeling prevailed among those who fully appreciated the value of his public services, especially with reference to their influence upon the progress of public health in England, that some effort should be made to secure for them some public recognition. A meeting of those interested in this project was held at Somerset House, early in April 1880, at which the Earl of Derby had consented to take the chair. It was decided to start a Farr Testimonial Fund, and an Executive Committee was appointed to carry the proposal into effect. Mr. Richard B. Martin, M.P., agreed to act as Honorary Treasurer, and Mr. Noel A. Humphreys, of the Registrar General's Office, as Honorary Secretary. Measures were taken to bring the Farr Testimonial Fund under the notice of the general body of the medical profession, and of the Members of the Royal Society, Statistical Society, Institute of Actuaries, British Association, and Social Science Association, with all of which Societies Dr. Farr had been more or less intimately connected. More than 20,000 circulars, setting forth the object of the movement, and asking for subscriptions to the fund, were thus distributed. During more than twelve months the efforts of the Executive Committee were directed to the promotion of the fund, and resulted in the collection of 1,132*l.* 3*s.* 6*d.* The following is a full list of the subscriptions:—

LIST OF SUBSCRIPTIONS.

	£	*s.*	*d.*
The Earl of Derby	50	0	0
De Cappelaine, J.	52	10	0
Heywood, James, F.R.S.	25	0	0
Proprietors of *The Lancet*	50	0	0
Carpenter, Alfred, M.D.	20	0	0
Apothecaries' Society	10	10	0
Graham, Major George	20	0	0
Curling, T. B., F.R.S.	5	5	0
Tuke, T. Harrington, M.D.	5	5	0
May, George, F.R.C.S.	1	1	0
Simon, John, C.B., F.R.S., D.C.L.	5	5	0
De Chaumont, F., M.D., F.R.S.	1	1	0
Rigden, George, M.R.C.S.	1	1	0
Jevons, W. Stanley	1	0	0
Hill, Alfred, M.D.	1	1	0
Westgarth, W.	10	10	0
Westgarth, W. (2nd don.)	10	10	0
Chadwick, Edwin, C.B.	10	0	0
Pitter, Joseph	2	2	0
Hassall, Arthur Hill, M.D.	2	2	0
Logie, Cosmo Gordon, M.D., F.R.C.S.	2	2	0
Martin, R. Biddulph, M.P.	10	10	0
Grimshaw, T. W., M.A., M.D.	3	3	0
Druitt, Robert, M.D.	2	2	0
Clover, Joseph Thos., F.R.C.S.	2	2	0
Stevenson, Thos., M.D.	1	1	0

	£	*s.*	*d.*
Paget, Sir James, Bart., F.R.S.	5	5	0
Bailey, A. H., Pres. Inst. Act.	5	5	0
Spottiswoode, William, Pres. R. S.	2	2	0
Erichsen, John Eric, F.R.C.S.	10	10	0
Henniker, Sir Brydges P., Bart.	5	0	0
Clode, William	3	3	0
Fayrer, Sir Joseph, K.C.S.I., F.R.S.	2	2	0
Oakes, Thomas	2	2	0
Humphreys, Noel A.	2	2	0
Thomson, James	10	10	0
Acland, Henry W., M.D., F.R.S., D.C.L.	5	0	0
Burrows, Sir George, Bart., M.D., F.R.S.	5	5	0
Greenhill, W. A., M.D., Oxon	2	0	0
Carillon, Wilson, F.S.A.	2	2	0
The Earl of Shaftesbury, K.G.	10	0	0
Jenner, Sir William, Bart., K.C.B., M.D.	5	5	0
Bennett, J. Risdon, M.D., L.L.D., F.R.S.	2	2	0
Frankland, Professor, F.R.S.	5	5	0
Fraser, Thomas R., M.D., F.R.S.	2	2	0
Vacher, Francis, F.R.C.S.	2	2	0
Gairdner, Professor W. T., M.D.	5	5	0
Rawlinson, Robert, C.B.	5	0	0
Corfield, W. H., M.A., M.D.	2	2	0
Mouat, Fred. John, M.D.	5	5	0

	£	s.	d.
Lewis, James	2	2	0
Balding, D. B., F.R.C.S.	2	2	0
Saunders, W. Sedgwick, M.D.	5	5	0
Hamilton, Archibald	10	10	0
Janson, F. H.	5	5	0
Newmarch, William, F.R.S.	10	10	0
Philipson, G. H., M.A., M.D.	2	2	0
Norman, George Ward	25	0	0
Hart, Ernest	5	5	0
Brassey, Thos., M.P., Pres. Statis. Soc.	10	10	0
Lord Aberdare	10	10	0
Watson, Sir Thos., Bart., M.D., F.R.S.	10	10	0
Lubbock, Sir John, Bart.	5	5	0
MacLaren, A. C.	5	5	0
The Earl Fortescue	10	0	0
Lord Houghton, D.C.L., F.R.S.	5	5	0
Bristowe, John Syer, M.D.	3	3	0
Bain, W. Pellew, M.D.	3	3	0
Ogle, William, M.D.	2	2	0
Rendle, William, F.R.C.S.	2	2	0
Rendle, George, M.R.C.S.	2	2	0
Walter, John, M.P.	20	0	0
Gull, Sir William W., Bart., M.D.	10	0	0
Latham, B., C.E.	5	15	6
Lord Ebury	10	10	0
Eassie, W., C.E.	2	2	0
Watson, J. W.	1	1	0
North, S. W., M.R.C.S.	1	1	0
Richardson, B. W., M.D., F.R.S.	5	5	0
Field, Rogers, C.E.	5	5	0
Hubbard, Right Hon. J. G., M.P.	10	10	0
Robinson, W. K., M.D.	2	2	0
Pagliardini, Tito	1	1	0
Ligertwood, Thomas, M.D.	1	1	0
Buchanan, George, M.D.	3	3	0
Montefiore, Nathaniel	10	0	0
Ransome, Arthur, M.D.	2	2	0
Liddle, John, M.R.C.S.	2	2	0
Vian, W. J.	1	1	0
White, Joseph, F.R.C.S.	2	2	0
Guy, W. A., M.B., F.R.S.	10	10	0
Longstaff, G. B., M.B.	20	0	0
Tyndall, John, F.R.S.	5	5	0
De la Rue, Warren, F.R.S.	5	5	0
Harrison J. Thornhill	1	1	0
Lord Mount-Temple	5	0	0
Harcourt, A. V., F.R.S.	1	0	0
Taylor, John Edward	2	2	0
Smith, Protheroe, M.D.	2	2	0
Kent, C.	1	0	0
Smith, Robert Mackay	2	2	0
Wilkinson, Thomas Reed	2	2	0
Sprague, Thomas Bond	5	5	0
Spalding, Samuel	5	5	0
Messent, John	2	2	0
Lovegrove, Natalie	5	5	0
Welton, Thomas A.	2	2	0
Christison, Sir Robt., Bart., M.D.	5	5	0
Rivers, Major-General A. P.	2	2	0
McKewan, Wm.	3	3	0
Gibbs, G. S.	2	2	0
Darwin, Charles, F.R.S.	5	5	0
Bourne, Stephen, F.S.S.	1	1	0
Jamison, Patrick	0	5	0
Smith, Colonel J. S.	2	2	0
Hill, Frederic	1	0	0
Philip, George	5	5	0
Winch, W. R.	2	2	0
Cleghorn, J.	2	2	0
Copperthwaite, W. C.	2	2	0
Goodman, J. D.	2	2	0
Russell, J. A., M.B.	1	0	0
Hodge, W. B.	5	0	0
Mocatta, F. D.	5	5	0
Albright, Arthur	2	2	0
Willans, J. W.	1	1	0
Beddoe, J., M.D., F.R.S.	1	1	0
Thomas, C. J., J.P.	1	1	0
Blower, Benjamin, M.R.C.S.	1	1	0
Sanders, W. R.	5	5	0
Baines, Mrs. M. A.	3	0	0
Armitage, T. R., M.D.	2	2	0
Clark, Sir John	2	2	0
Lord Napier of Magdala	3	3	0
Bunyon, C. J.	2	2	0
Bayley, J.	2	2	0
Windeatt, John	1	1	0
Paget, Joseph	1	0	0
Andrew, J., M.D.	2	2	0
Greig, J. A.	1	1	0
Balfour, General Sir George, M.P.	5	5	0
Brennan, A.	2	2	0
Scott, Exors. of Russell	25	0	0
Brind, F. W.	5	5	0
Duke of Devonshire	20	0	0
Morley, Samuel	10	10	0
Williams, C. J. B., M.D., F.R.S.	5	5	0
Barrett, T. B., M.R.C.S.	1	1	0
Nightingale, Florence	10	10	0
Farmer, James	1	1	0
Darwin, G. H.	2	0	0
Homersham, T. C.	5	5	0
Atkin, W., M.D., F.R.S.	1	1	0
Baylis, C. O., M.D.	1	1	0
Palgrave, R. H. Inglis	5	5	0
Welsh, J. Kemp, J.P.	5	5	0
Bratton, J., F.R.C.S.	1	1	0
Anderson, Mrs. E. G., M.D.	2	2	0
Macpherson, H. M.	2	2	0
Brodie, Sir B. C.	3	3	0
Hannyngton, Major-Gen.	3	3	0
Singer, C. Douglas	5	5	0
Buchanan, Andrew. M.D.	2	2	0
Sanderson, J. Burdon, M.D., F.R.S.	2	2	0
Lawson, Inspector-General R.	3	3	0
Prestwich, Joseph, F.R.S.	2	2	0
Bowles, Robert L., M.D.	2	2	0
Crothers, R., M.D.	1	1	0
Hendriks, Frederick	2	2	0

	£	s.	d.
Lewis, Waller A., M.B.	2	2	0
Farre, Arthur, M.D., F.R.S.	2	2	0
Sibley, S. W., M.D.	3	3	0
Iliff, W. T., M.D.	1	1	0
Rogers, H., M.R.C.S.	2	2	0
Russell, Hon. F. A. R.	1	0	0
Stephenson, E. J.	2	2	0
Wilkinson, R.	2	2	0
Begley, W. C., M.D.	3	3	0
Baylis, Mrs. C. O.	1	1	0
Morris, Thomas, M.D.	5	5	0
Thomas, G. D. P., M.D.	1	1	0
Priestley, W. O., M.D.	5	5	0
Cleaton, John D., M.R.C.S.	5	5	0
Williams, F. J.	0	10	6
Hill, Berkeley, F.R.C.S.	3	3	0
Ace, the Rev. Daniel, D.D.	1	1	0
Wells, T. Spencer, F.R.C.S.	5	5	0
Tidy, C. Meymott, M.B.	1	1	0
Quain, Richard, F.R.C.S., F.R.S.	5	0	0
Radford, Thomas, M.D.	1	1	0
Hallett, J. G. P., M.A.	6	6	0
Waters, A. C.	0	5	0
Balfour, J. Graham, F.R.S.	2	2	0
Sayer, G. E. H.	0	2	6
Brown, J. B.	2	2	0
Tytheridge, H. B. H.	0	5	0
Roth, Matthias, M.D.	1	1	0
Sutherland, John	5	0	0
Hawkesley, Thomas, M.D.	1	1	0
Dunbar, Eliza W., M.D.	1	1	0
Elliott, Robert	1	1	0
Dickson, Frank, F.R.C.P.	1	1	0
Wilkes, James, F.R.C.S.	5	0	0
Martin, J. B.	5	5	0
Thompson, Sir H.	5	5	0
Tonsino, P.	1	0	0
Clapham, J.	2	2	0
Jones, George I., M.D.	1	1	0
Lee, John, L.S.A.	1	1	0
Soames, E.	5	0	0
Pochin, J. D.	5	5	0
Porter, G. H., M.D.	2	2	0

	£	s.	d.
Chapman, J. H.	1	1	0
Little, James, M.D.	2	2	0
Martin, James, M.D.	1	1	0
Porter, H. W., B.A.	2	2	0
Winstone, Benjamin, M.D.	1	1	0
Ballard, Edward	1	1	0
De Grave, J. F., M.R.C.P.	10	10	0
Davis, T.	1	1	0
Foster, M., M.D., F.R.S.	1	1	0
Davis, E., M.R.C.S.	1	1	0
Wilson, J. H., M.K.Q.C.P.	1	1	0
Tatham, J. F. W., M.D.	1	1	0
Wilson, E. J., M.B.	1	1	0
Tilley, S., F.R.C.S	2	2	0
Shiers, D., M.D.	1	1	0
Barnes, Robert, M.D.	2	2	0
Thompson, James, M.D.	1	1	0
Jellicoe, Charles	1	1	0
Mapother, E. D., M.D.	1	1	0
Holden, Luther, F.R.C.S.	5	5	0
Mann, Horace	2	2	0
Wood, Mrs. S. G.	5	0	0
Cadge, William	2	2	0
Webb, F. E., M.R.C.S.	1	1	0
Sutton, J. Maule, M.D.	2	2	0
Hastings, G. W., M.P.	10	10	0
McIntyre, J., M.D.	2	2	0
Keeling, J. H., M.D.	1	1	0
Langshaw, J. P., F.R.C.S.	1	1	0
Major, H. C.	1	1	0
Hollis, W. M., M.R.C.S.	1	1	0
Hughes, H. S., M.R.C.S.	2	2	0
McKellar, E., M.D.	1	1	0
Hardman, William, M.B.	1	1	0
Williams, R. Price	2	2	0
Tripe, J. W., M.D.	1	1	0
Sykes, J., M.D.	1	1	0
Eddowes, A., M.D.	1	1	0
Eddowes, W., M.R.C.S.	1	1	0
Rayne, S. W., F.R.C.S.	2	2	0
Page, H., M.R.C.S., S.Sc. C. Cantab.	1	1	0
Turner, G.	1	1	0
Rix, W. H., M.R.C.S.	2	2	0

With the full concurrence of Dr. Farr, the amount of subscriptions, less the expenses for printing, advertising, postage, &c., was invested in Bank of England Stock in the names of the Honorary Treasurer and of the Honorary Secretary, as Trustees, on the understanding that the dividends should from time to time during his lifetime be re-invested, and that after his death the dividends of the accumulated fund should be applied by the Trustees to supplement the slender provision that Dr. Farr had been able to make for the support of his three unmarried daughters.

On the death of Dr. Farr in April 1883, the Executive Committee of the Testimonial Fund brought the claims of Dr. Farr's daughters before the Government in the hope that some pension might be allotted to them, but the efforts on their behalf only resulted in a contribution of 400*l.* to the Testimonial Fund. Miss Nightingale, who had originally subscribed ten guineas to the Fund, made a further donation of 100*l.* to the Fund on Dr. Farr's death. These sums, together with the sum of 92*l.* 13*s.* 6*d.*, which had accrued as dividends, were also invested in Bank of England Stock. The Fund was not finally closed until after the receipt of the

October dividends in 1883. The following Balance Sheet, audited by Messrs. J. O. Chadwick and J. Whittall, sets forth the receipts, disbursements, and investments in connexion with the Fund:—

FARR TESTIMONIAL FUND.

BALANCE SHEET.

Receipts.

	£	s.	d.
Subscriptions received (as per Detailed List)	1,132	3	6
Government Donation to Fund	400	0	0
Miss Nightingale, additional subscription	100	0	0
Dividend Bank of England Stock (6 Oct. 1881)	15	3	11
Do. do. do. (6 April 1882)	16	15	11
Do. do. do. (6 Oct. 1882)	16	15	11
Do. do. do. (6 April 1883)	18	1	10
Do. do. do. (6 Oct. 1883)	25	15	11
	£1,724	17	0

Disbursements.

	£	s.	d.
Printing, Lithographing, &c.	44	9	6
Advertisements ("Times" and "Eddowes Journal")	37	6	0
Envelopes	8	17	3
Addressing covers, copying letters, &c.	10	16	3
Postage (10,747) Circulars	82	5	7
Expenses of Irish Committee	1	1	0
Extra postage, cabs, porters, &c.	2	6	8
	187	2	3

	£ s. d.				£	s.	d.
Purchase	(319 18 11)	Bank of England Stock		(23/5/81)	920	0	0
Do.	(24 14 8)	do.	do.	(2/3/83)	73	17	0
Do.	(6 0 4)	do.	do.	(12/4/83)	18	1	10
Do.	(165 4 7)	do.	do.	(23/8/83)	500	0	0
Do.	(8 9 7)	do.	do.	(16/10/83)	25	15	11
	£524 8 1						
					£1,724	17	0

RICHARD B. MARTIN, M.P., *Hon. Treasurer*.
NOEL A. HUMPHREYS, *Hon. Secretary*.

We have examined this Statement in detail with the Vouchers and Bankers' Account, and found it correct.

London, Dec. 5th, 1883.

J. O. CHADWICK, J. WHITTALL } *Auditors*.

From the above Balance Sheet it may be seen that the total amount received on behalf of the Fund, including the re-invested dividends, was 1,724*l.* 17*s.* 0*d.*, and that the total expenses were 187*l.* 2*s.* 3*d.* When the Fund was finally closed, and the Balance Sheet audited on 5th December 1883, the nominal amount of Bank Stock standing in the names of the two Trustees was 524*l.* 8*s.* 1*d.*, which at the quoted price of the day was worth 1,550*l.* 15*s.* 6*d.* This was the net result of the Farr Testimonial Fund.

NOEL A. HUMPHREYS,
Honorary Secretary.

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