

CHAPTER 1.

THE HISTORY OF INFLUENZA, 1658-1911.

That to understand the aetiology of a disease we must study both its historical and contemporary manifestations is as much a truism to the epidemiologist as the parallel proposition in the science of social and economic institutions. Acquaintance with the historical evolution of, for instance, typhus fever, prepared the discerning for events of recent years ; hardly less valuable have been the lessons drawn from the history of continued fevers or of bubonic plague. It is natural, therefore, that great expectations should be founded on the results of the historical method applied to epidemic influenza. The most cursory perusal of the annals of disease makes it plain that epidemic and even pandemic influenzas have frequently recurred in the past; the salient features are so impressive, the onslaughts so dramatic, that we hope to derive a wealth of information from the literature of earlier times. These expectations are not altogether unfounded ; the search for historical information is repaying, but the reward has not been so great as the enthusiast perhaps proposed to himself.

All diseases present, as Sydenham wrote long ago, a very evident diversity in their clinical manifestations ; but the range of variation is not equally wide for all. Sporadic cases of plague may deviate from the normal description of a text-book widely, but in an epidemic of this disease the proportion of victims conforming to the text-book type is large ; hence it is that the history of plague can be followed into the earliest ages, and its prevalence recognised there with certainty. There is no more doubt that the disease described by the authors of the book of Samuel (i. 5) was bubonic plague than that the same disease ravaged London in 1665, and destroyed several thousand lives in India in 1919. No such certainty of identification attaches to typhoid fever ; expert clinicians and epidemiologists may disagree as to whether epidemics portrayed by so great an observer as Sydenham were or were not typhoid fever. A similar doubt envelops the nature of 18th century epidemics, which may have been of malignant scarlet fever or of diphtheria. Such difficulties of clinical identification arise in the study of influenza, and no *purely clinical* criterion of it has been established ; the nearest approximation to such is the definition that outbreaks of epidemic disease in which a majority of the affected exhibit initially or early in the course catarrhal respiratory symptoms are outbreaks of influenza.

The impossibility of establishing a clinical recognition mark as satisfactory in influenza as the bubo in plague has induced a majority of thinkers to base their identifications upon demographic or epidemiological grounds, even to establish a unity

in diversity, to make the very diversity of its clinical forms a mark of influenza, provided this clinical diversity be concomitant with **the** epidemiological characteristics of (a) extremely-rapid evolution in time and place, (b) a fatality slight in comparison with the case incidence. For these and other reasons the remarkable 16th century epidemics known as the English sweats have been regarded by some as instances of epidemic influenza.

The formal objections to this view of the subject are, no doubt, grave. If we *define* epidemic influenza as a disease explosive in its manifestations, spreading rapidly, and relatively non-fatal, there can be no logical objection to regarding the English sweats as influenzas, as well as other earlier and later outbreaks of epidemic sickness, but we cannot by this method establish criteria ; it is circular reasoning to say that such and such an outbreak of "undoubted" influenza *proves* that rapidity of dissemination and low fatality characterise the disease ; this is only inferential if the definition of influenza be based upon other considerations. Some who have been impressed by the force of this objection would seek to define influenza, in terms of pathology, as a disease produced by infection with a specific germ, the bacillus of Pfeiffer or another. This definition is theoretically as inadequate as, and practically less useful than, the foregoing.

It is logically inadequate, because an epidemiological unity may not be a bacteriological unity ; diseases produced by the infections of different distinct organisms of the colityphoid group may present both clinical and epidemiological unity ; on the other hand, the epidemiological problems raised by infections with the same organism, the bacillus of Eberth, through different channels may be disparate. The definition is practically useless so far as the employment of historical records is concerned, since direct evidence of the nature of bacterial factors is necessarily lacking before the 19th century.

When thus contrasted, the defects of both methods are glaring, but it may appear that an amplification of the former process deprives it of patent weaknesses. If into the definition of influenza, while maintaining the characteristics of *apparent* suddenness, undoubted rapidity of evolution, and usually low fatality, we import the conception of peculiar, attendant circumstances, such, for instance, as a break in the uniformity of epidemiological history prior to the outburst, and also keep in mind the catarrhal element of the explosive disease as a frequent clinical experience, we shall reach a plan of identification which is not logically assailable. To make this proposal intelligible we shall first examine some events in the 17th century which came under the notice of Sydenham.

In the autumns of 1675 and 1679 epidemic coughs, followed by pleurisies and pneumonias, were prevalent in London. In the

former year the deaths " within the bills " were 275 in the week ending 2nd November, 420 in the following week, then successively 625, 413, 349, 308, 266. These are deaths from all causes; in the worst week the deaths attributed to consumption rose from 68 to 99, of "aged" from 40 to 67, of "Tissick" from 10 to 35. In 1679 the return for the week ending 11th November was 328 ; 541 in the next week, then 764, 457, 388. The trend of these figures is one which modern vital statistics of what we agree to term influenzal periods exhibit; there is no doubt that what happened in 1675 and 1679 happened also in 1889-90. But these are not the only epidemics occurring about the same time which Sydenham considered noteworthy. He has left a special account of a new fever which began to rage in London in February 1685, " atque Febri quae per " octennium ultimo praegressum invaluit, esse prorsus dis- " similem." In his detailed account Sydenham puts great stress upon the symptoms of involvement of the nervous system, observing that " haec Febris species prae ceteris quas mihi " unquam videre contigit, cerebrum petere quasi apta nata " sit," and although he asserts an equal liability to it in infants and adults, he doubts whether the clinically similar diseases in young and old be really identical (" serio advertendum est, an, " quae hoc modo tractatur Febris, pro certo hujusce Constitu- " tionis fuerit, non vero alterius speciei : quod diligenter " perquiri debet in Febris iis quae infantes corripunt, in " omnibus quibuscunque annorum Constitutionibus "). Finally an examination of the bills of mortality shows that although the gross total of deaths was almost the same as in the previous year, their allocation was different, fever (with " spotted fever ") and smallpox being both increased.

The epidemic of 1685, therefore, was characterised by (a) a great severity of involvement of the brain and nervous system, (6) a possible predilection for the adult, (c) no serious effect upon the gross mortality of the year. Each of these characters has been seen in the epidemics of cerebrospinal fever of England and Wales since 1914 ; we shall meet some at least of them in the 18th century. With respect to the forms of illness environing these outbreaks, Sydenham speaks at length of the comatose type of the continued fevers of 1673-75 (inter hujusce Febris symptomata eminebat affectus quidam comati haud dissimilis), while he characterises the fevers in and around 1678 as favourable to intermittents, " quae jam ab anno 1664, ad tredecim scilicet annos, Urbe fere exulaverant." It is significant that in 1657-59 epidemics occurred in London which have an indisputable title to be classed with those of 1675 and 1679, giving point to Creighton's remark that " Sydenham does not appear " upon the scene until 1661 ; but when his epidemic constitu- " tions do begin, it is with intermittents or agues, which lasted, " according to him, until 1664. Perhaps, if Sydenham's experi- " ence had extended back to 1657, he would have made his

" aguish constitution to begin with that year, and to go on " continuously until 1064." *

It is to be added that within a few years of Sydenham's retirement another epidemic catarrh prevailed in London—in the summer of 1688. " Never," says a contemporary writer, " were so many people sick together; never did so few of them die," while the bills of mortality exhibit the same rapid fluctuations as in 1675 and 1679. For the five weeks beginning with the last of May, the deaths run, 368, 518, 539, 435, 437.

The interpretation put upon such a sequence as this by Sydenham is expressed in his doctrine of epidemic constitutions, for a discussion of which reference may be made to the works cited in the footnote† ; in the view of those epidemiologists who define influenza in the fashion explained above we are to look upon epidemic or pandemic outbursts of influenza, not as isolated events, not even as terms of a simply periodic series, but as focal points in a system of related phenomena ; the nexus, which we may term, if we will, an influenzal constitution, includes many *apparently* disconnected outbreaks of disease, very different in clinical form from explosive influenza, but usually comprising signs and symptoms of nervous origin, this or that segment of the nervous system being specially signalled out. Such forerunners and *sequelae*, also have this in common, that they puzzle both the public and the medical practitioner, and are given new names.

It will be apparent that the need of justifying or condemning this definition, while increasing the abstract importance of historical study, reduces the practical value of many historical data. The criticisms to which it is subject are evident. The capital danger is the basing of an induction upon too scanty collections of particular instances. That in chronological association with the influenza of 1918-19 we have seen cerebrospinal fever, and " encephalitis lethargica," that after the influenza of 1679 Sydenham saw something which we shall hardly distinguish from epidemic cerebrospinal fever, and before it noted nervous forms of " fever " which reminded him of what occurred 15 years before, also in association with an influenza period, are particular instances insufficient for an induction. We are not indeed called upon to prove that

* *History of Epidemics in Britain*, Vol. 2, p. 314.

† Sydenham's own account is to be found in the six books of *Medical Observations*, the first Epistle and the first *Schedula monitoria* (specially concerned with the new fever of 1685). A general account of the theory is contained in Greenwood's paper in *Proc. Roy. Soc. Med.* (Section of Epidem.), July 1919. Its detailed application to the case of Influenza is given in Dr. Hamer's report on Influenza to the London County Council, June 1919, while this author's *Milroy Lectures* (1906) and paper in the *Proc. Roy. Soc. Med.* (Section of Epidem.), November 1916, sustain a similar or identical thesis.

obscure nervous outbreaks were *always* followed by explosive influenza, but we should be able to show that such influenza does always cast a shadow before or behind. Power to apply the crucial test implies the existence of an objective and systematic record of what actually happened, not in one but in many series, covering more than one cycle of years within which influenza has been epidemic. But the intellectual qualities needed to guarantee the accuracy and perspicuity of such a record are rare endowments ; Sydenhams are not found in every generation. That some chronology of disease is possible from the 17th century to our own time is true, and that it has sufficed to authorise many conclusions drawn by such profound epidemiologists as Creighton, Hirsch, and Haeser is also true; but, for our particular inquiry, miscellaneous annals, the products of many minds and therefore subject to the unconscious bias of many "personal equations" and fashions of nomenclature, are of doubtful value. There does, however, exist one other chronological record, extending over a considerable space of time, which is the work of a single highly competent recorder, and we think it desirable to compare the impression conveyed by it with that derived from Sydenham's observations; we refer to John Huxham's annals of disease in Plymouth and the neighbourhood, which cover the years from 1728 to 1752 inclusive. Within these termini four outbreaks of epidemic influenza ravaged this country. In the autumn of 1729 the London deaths in the worst week were 160 per cent, of the average, in the January outbreak of 1733 they were nearly thrice the normal; in the late summer of 1737 the excess was nearly 50 per cent., and in the spring epidemic of 1743 the deaths in the week of maximum mortality were 2 1/2 times the average. These epidemics in London exhibited the other features (rapid evolution, low fatality, prevalence of catarrhal symptoms) which we still associate with epidemic influenza, and each has been noticed by Huxham at Plymouth. It will be worth while to inquire whether the influenza years in Huxham's experience can be objectively characterised as differing in some material way from the run of other years *apart from* the explosion of epidemic influenza.

The reader may be reminded of the way in which Huxham compiled his annals.* Each month of the year for 25 years is separately dealt with ; the meteorology of the month is tabulated and then a longer or shorter account of the reigning diseases is given. Interspersed through the diary are essays usually on the symptomatology and treatment of different diseases. The language is Latin, but it is not the Latin of a classical imitator (as is that of Sydenham's works), and consequently more intelligible to the modern reader.

* *Observationes de aere et morbis epidemicis.* J. Huxham. First two volumes, London, 1752. Third volume, London, 1770.

Let us now inquire whether the epidemiological events grouped around the explosions of influenza exhibit any objective contrast to those of other sequences of years. We will begin with the epoch centered in April-May 1743, under the former of which months Huxham describes the epidemic influenza in words frequently quoted and well known to all. Passing backwards from the end of April, when the explosion occurred, we find that in April intermittent fevers were common, especially tertians; in March "Variolae frequentes, Febres intermittentes plures et quotidianae et tertianae." In February there were some tertians and a catarrhal fever; nothing of importance appears until we get back to September 1742, when measles were epidemic; in August intermittents are recorded and "perpauci aliter morbi." In April, one year before the explosion, gaol typhus was epidemic at Launceston. Passing forwards in time from April 1743, for each succeeding month until September, stress is put upon the intermittents. In May, "Febres quotidianae et tertianae creberrimae longe lateque." In June, "intermittentes vero, tertianae potissimum epidemicae." In July hardly anything but intermittents; in August, "multae adhuc Febres intermittentes ruri." In the following year there were some intermittents in March; they were epidemic in May, scattered in June, and are mentioned in August and November. In December we find reference to a malignant catarrhal fever affecting French and Spanish prisoners of war, very fatal, attended often by *petechiae* and sometimes by parotid abscess, which, with its extension to the civilian population, is the chief matter dealt with until June, when a change to frank typhus is recorded and a few intermittents are noted. Waiving the discussion of this malignant catarrhal fever, which can hardly have been other than typhus, the most striking thing in the chronology is the record of epidemic intermittents in temporal proximity to the influenza; they were very common both before and after the explosive outburst. This might perhaps be thought either a normal course of events or an idiosyncrasy of the writer in his choice of material to record. But, as a matter of fact, from July 1745 to December 1752, when the record ends, during which period *no* explosion of influenza occurred in England, intermittent fevers are only *twice* again recorded, viz., under April 1748 ("nec non intermittentes sed Rure potissimum") and under April 1751, when we read of "Febres intermittentes aliquae."

We shall now examine the sequence of years from 1728 to 1742 with particular reference to intermittents.

From March 1728 (when the intermittents were "frequentiores longe quam assolent in hac regione") to October, intermittents hold the field as reigning epidemics; in the last months of the year little sickness was recorded. The first five months of 1729 hold nothing of interest. In June erysipelas and smallpox were epidemic, "Febres intermittentes remit-

" tentes praecipue, lentae, nervosae frequentes. Cepbalalgiae " et Mania passim." From July to November, first a variolous fever and then frank smallpox claim attention, until we have epidemic influenza in November, soon swallowed by smallpox, which is the reigning malady until we reach April 1730, when intermittent and remittent fevers, often with light delirium, are more frequent; these again ravage in May, and "ex " levi errore in continuas malignas, nervosas, transibant haud " infrequenter." The last six months of the year are uneventful. In 1731, coughs and pneumonias prevailed in the spring, there were intermittents in July, more or less smallpox from June to September.

In 1732 there was much whooping-cough, smallpox (in April), a few (*passim*) intermittents in August, then epidemic measles until December. 1733 opens with measles still epidemic, then in February we have the explosion of influenza, extending into March, still present in the villages in April, when pneumonia and pleurisy were fatal, while in May "Febres pulmonarice ac intermittentes, invadunt plures," and still occur in June and July. August was healthy, and there is little to remark in the remainder of the year.

In 1734 there was much spring pneumonia and a special epidemic of anginous fever in April, which extended into June ; in May and June there were intermittents. In July also there were intermittents; also " furit etiamnum Febris epidemica " inexplicabili quodam angore quosdam, vel intra sex saepe dies " perimens. Hos leve primo corripuit Delirium, quod utique " pejoris fuit ominis, quam si, more Bacchantium, aperto " exarserant Furore." This strange disease, often associated with diarrhoea and vomiting, was fatal in the next month ; in the last three months of the year smallpox was epidemic. At the beginning of 1735 smallpox was still reigning, followed in February by what was probably ship typhus. From March to June typhus and smallpox prevailed. In June some intermittents (*haud in frequentes*). Until November typhus and smallpox continued to be noteworthy and slow nervous and putrid nervous fevers are entered for the last two months. In a general summary Huxham remarks on the prevalence of intermittents and remittents in the wet years of 1734 and 1735. In 1736 there is little noteworthy before June, when there were some (*passim*) intermittents, also in July, when mention is made of miliary fevers, which continue in the diary until November. The notes for November and December suggest a local explosion of influenza, for we read of " Tusses, Destillationes, Coryzae, " Raucedines, levi non raro comitante Febricula, per omnes " undique. Plures vel in iisdem Aedibus simul ac semel " corripuntur ; evanere verohaec omnia facilime, modo se in " lectulo paululum continerent et multa tepida potione sudores " elicerent." This can hardly have been anything but an explosive influenza, for in January 1737 we read that the

" Febricula catarrhalis innumeros etiamnum infestat prout Mense Decembri," while there was a coincident horse sickness and not a little pleurisy and pneumonia amongst men. From May to August there is frequent mention of miliary fevers ; in September there is reference to anomalous intermittents, and in November we reach the explosion of influenza, which is historical, like that of 1743. At the beginning of 1738 we have the dregs of the influenza; pneumonia and pleurisies occupy attention until July ; a few intermittents occur in May. From August to November, smallpox and measles are important, a catarrhal fever of children is recorded in September; in the last two months of the year we again read much of pneumonia and pleurisy. In the first four months of 1739 measles are very prominent; there were some spring and autumn intermittents, but the situation is dominated by smallpox, first mild, then malignant, down to December.

In 1740 we read, under February, of " Febris quaedam " catarrhalis cum acute capitis dolore et vertigine accedente " aliquando phrenitide, multos detinet." In May " Febres pulmonariae" with dark *maculae* prevailed, and smallpox increased; this continued into June, when ship typhus, introduced earlier from the Fleet, claims attention ; there was smallpox in July and August, dysentery in September, and smallpox raged more or less in the remaining months. No reference is made to intermittents this year. 1741 was a year of smallpox, which was the reigning disease until September, and is mentioned every month; there were some intermittents in May and some anomalous intermittents in September. 1742 is under the sway of smallpox and measles until April, when we reach the gaol typhus, to which point in time we carried our inquiry backwards, starting from the 1743 influenza.

From this necessarily condensed summary of a long story, certain conclusions may be drawn. We think Huxham's narrative establishes the proposition that the epidemiological features of the cycle of years within which influenza exploded once or more were, *apart from such explosion*, different from the characteristics of the influenza-free epochs. Huxham's crowded references to intermittents around the explosive manifestation of influenza in 1743, his silence between 1745 and 1752, the paucity of his remarks on the subject during the quiet years 1739-42 are paralleled in the story told by Sydenham. We are also justified in making a comparison between the strange nervous fevers incidental to Huxham's narrative and Sydenham's new fever of 1685. With these long-sustained chronologies by skilful observers to guide us, it is not fantastic to suppose that the inter-relation of "agues" and influenzas to which Dr. Creighton called attention in the section of his history dealing with the 16th and 17th centuries, is more than casual and not a mere reflection of some theoretical pathology.

As an annalist Huxham had no successor of equal professional ability continuously recording observations through so long a term of years ; but one of the witnesses of the 17(52) pandemic has left some notes which recall Huxham's findings. This was Dr. John Rutty, who described the 1762 explosion in Dublin.* The influenza came in May 1762, and was, thought Rutty, " plainly a disease of foreign extraction, having visited Copenhagen a month before it reached London, and London about a month before it arrived here ; and it gradually extended itself over every province of the kingdom." Rutty did not therefore himself connect the explosion with anything which went before in his experience. This is his record of the previous months :—

"Some mild intermittents appeared in April; but in May intermitting fevers were very frequent, particularly the tertian, and pleurisies and chin-coughs still continued to be epidemical. In the beginning of May a fever was common which resembled the scarlet fever in every circumstance except the eruption. In the beginning, after the shivering, the face was much flushed, with a severe headache, dry, burning skin, quick pulse, and soreness in the throat; sometimes attended with superficial ulcerations in the tonsils, and often a crick in the neck. In some it disappeared in three or four days ; in many, after running out to the fourteenth day or longer, the skin peeled off in branny scales, as in the scarlet fever, though no eruption had appeared."

The explosion of influenza began in the middle of May.

Creighton has cited three witnesses—Baker and Reynolds in London and Barker of Coleshill—to the prevalence of " agues " between 1780 and 1785 (the influenza explosion was during the summer of 1782), while Willan remarked on the absence of intermittents in London during the last 10 years of the 18th century a period free from pandemic influenza.

No chronological records apt to bring out these points have been published by the observers of the 1803 or of the 1831-37 explosions, but Dr. Peacock, in his treatise on the 1847 influenza, † took occasion to remark that, " throughout the spring and early summer, intermittent fevers were common, and, in March, April, and May, purpura was frequently met with, either as a primary or secondary disease." The remark quoted from Peacock is the latest of its kind. The chronological method was already obsolete in 1847 ; the introduction

* " *A Chronological History of the Weather and Seasons and of the Prevailing Diseases of Dublin,*" by John Rutty, M.D.: London, 1770: (The portion dealing with the influenza of 1762 is reprinted in Dr. Theophilus Thompson's " *Annals of Influenza* " : London, 1852.)

† " *On the Influenza or Epidemic Catarrhal Fever of 1847-48.*" T. B. Peacock, M.D.: London, 1848.

and subsequent development of vital statistics dissuaded physicians of the calibre of Sydenham and Huxham from giving to the compilation of chronicles an attention better rewarded in other scientific pursuits. All reform involves some loss ; while conferring upon us great benefits, the vital statistician has deprived us of testimonies which would have been valuable in the present connection. Henceforward we must rely almost wholly upon statistical records and nearly always upon bills of mortality. If the clinical sequences noted by our ancestors still occurred, we should hardly expect to find their traces in the records of mortality. The nosology of the "agues," "intermittents," and "remittents," of the obscure nervous fevers, and of other concomitants of the explosive influenzas may be as obscure as ever, but their marshalling under less ambiguous statistical banners is easy ; intermittent and remittent fevers or agues have no longer a significant share in the recorded causes of death ; whether, as Welsh* put it, the revolution has been in the cycle of disease or in the mind of the practitioner, whether what Sydenham and Huxham claimed to have seen might have been seen by them in our time, are mere matters of conjecture. We shall find that vital statistics reveal an unusual state of the public health before the explosion of influenza in 1847, and do so again before the great catastrophe of 1918; but we shall gather little intelligence from the years ending in 1890. The real significance of the observations just described is therefore likely to remain a matter of dispute, and to be differently assessed in accordance with the habit of the inquirer. The most important practical inference is that an objective chronicling of disease, the keeping of a diary upon the model of Huxham, is not the task of supererogation some have deemed it to be ; such records would be valuable additions to the material of a health intelligence service.

With these necessarily incomplete observations we must leave the pre-statistical history of influenza and pass to the events of the mid-nineteenth century.

The Influenza of 1847-48.

Between the explosions of 1837 and of 1847, influenza prevailed extensively in Central Europe, during 1841, and there are signs of it in this country (*vide infra*) in the same year ; it is claimed by Hirsch to have been generally diffused over North America in 1843, and the same writer assigns epidemics to England in 1843 and 1846; but there was certainly no pandemic before 1847, the earliest date of onset assigned to that year being September for France.

Our General Register Office was established in 1837, and the first annual report deals with the year 1838, but the early

* Cited by Murchison, *Treatise on the Continued Fevers of Great Britain*, 3rd Edition, p. 44.

years were transitional and the methods of tabulation in the experimental stage out of which Dr. Farr developed a system destined to become the great exemplar of vital statistical methods.

Some hundreds of deaths attributed to influenza were registered in England and Wales in each of the years from 1838 to 1842, and in 1841 the total reached 1,659; figures are not available from 1843-46. In London the figures are recorded for all but two of these years; in 1841, *i.e.*, the year with 1,659 in England and Wales, there were as many as 220 in London, in 1843 there were 104, and in 1846 115. In no other year were there more than 100. Thus there is a suggestion of increased prevalence in 1841, and perhaps also in 1846, the year before the explosion.

In the year of the epidemic and before the explosion, the public health of the country was unsatisfactory. Dr. Farr records that the first quarter of the year was unhealthy, and that in the second quarter "common cholera was fatal; scurvy prevailed" more or less over the country, from the want of vegetable "food, the potato having failed; all food became scarce and "dear; typhus broke out, is still epidemic, and shows no signs "of decline." Purpura was unusually common in London (a fact noted by Peacock, *vid. sup.*). In the third quarter there was a slight improvement in the country generally, but none in London, where typhus never killed less than 50 in the week and claimed as many as 111 victims in the third week of September, while the weekly average for this quarter in the previous five years had been only 30. The great influenza which began in November increased the mortality in the least unhealthy districts of London at the rate of 18 per 1,000 per annum, but in the unhealthiest by 34 per 1,000 per annum.

There is then no doubt that before the epidemic the public health was unsatisfactory—a circumstance attributed by most epidemiologists to the reflux of the great Irish famine and typhus of 1846. After the influenzal wave had passed, the country was destined to be submerged by a flood of cholera in 1848-49, so that, from the sanitary point of view, influenza was intercalated between two epochs of profound unhealthiness. Under the rubric of influenza the deaths of 2,215 men and 2,666 women were recorded in 1847; there were 3,810 deaths of men and 4,153 deaths of women in 1848, 738 and 873 in 1849. Judged by this imperfect criterion, the metropolis suffered much more than the crowded industrial districts of the North-western area; these districts, with nearly equal populations, having 1,913 and 1,278 deaths respectively. To study the epidemic in detail, however, it is best to confine attention to London, a course which will be taken in our subsequent account, because for the metropolis the weekly records of deaths at ages have been regularly tabulated and published. The relevant documents for 1847-48 have been collated by Dr. F. A.

Dixey*, and Table 1 is a condensation of his results. To this is added Table 2 which shows the deaths at ages from certain

TABLE 1.

London Influenza, 1847-48. From 46th week of 1847 to 12th week of 1848.

Week.	Influenza.			Pneumonia			Bronchitis.			Phthisis.		
	0-15.	15-60.	60-.	0-15.	15-60.	60-.	0-15.	15-60.	60-.	0-15.	15-60.	60-.
1847.												
Nov.												
46th week	3	1	—	66	7	6	29	8	21	12	101	8
47th "	3	—	1	76	15	4	31	11	19	13	87	8
48th "	3	10	23	137	20	13	80	55	61	22	119	12
49th "	38	48	112	219	56	31	96	96	151	21	158	19
50th "	80	113	181	221	44	29	85	83	131	14	168	10
Dec.												
51st week	75	67	128	144	34	11	72	54	108	19	122	7
52nd "	37	41	64	107	13	11	37	25	45	16	87	7
53rd "	47	35	45	124	15	9	63	38	37	20	132	4
1848.												
Jan.												
1st week	42	34	26	109	11	5	47	28	31	13	129	8
2nd "	39	32	31	133	16	9	51	28	46	15	129	10
3rd "	24	30	35	105	21	11	42	42	54	23	122	7
4th "	12	19	25	128	25	3	52	44	47	20	144	5
5th "	9	19	31	110	16	10	42	54	61	29	116	10
Feb.												
6th week	12	15	20	94	25	10	42	32	47	25	115	7
7th "	8	7	12	81	12	3	31	25	24	16	98	5
8th "	13	11	9	70	15	4	37	28	21	18	110	7
9th "	5	4	9	67	9	5	29	16	23	9	100	6
Mar.												
10th week	3	3	5	60	12	—	42	21	32	23	108	10
11th "	3	4	3	57	5	3	33	15	33	17	125	5
12th "	6	3	7	64	13	2	34	18	24	25	104	10

diseases in London for 1847, 1848, 1849 ; Table 3 contains the death rates at ages for influenza (England and Wales) in 1847-48, and a similar table calculated from the All-England data in the non-epidemic period of 1848-72 (the material is given in Dr. Farr's decennial review of 1861-70); taking into account other causes of death, the excess mortality attributable to the epidemic in London was nearly 7,000, and the most considerable contributor to the excess, apart from influenza, was bronchitis ; in the maximum week of the epidemic the incidence of bronchitis was nearly 800 per cent, above the normal.

* *Epidemic Influenza* by F. A. Dixey, Oxford, 1892.

TABLE 2.

Deaths at Ages in London from Influenza, Pneumonia, Bronchitis, and Phthisis in 1847, 1848, 1849.

Age Groups.	Proportion of Population at Ages.	Four named Causes.		Influenza.		Pneumonia.		Bronchitis.		Phthisis.	
		Nos.	Per Cent.	Nos.	Per Cent.	Nos.	Per Cent.	Nos.	Per Cent.	Nos.	Per Cent.
	1847.										
0-15 -	31·5	5,634	33·3	304	24·3	3,168	73·8	1,298	29·9	564	12·3
15-60 -	62·4	7,969	47·2	334	26·7	716	16·7	1,177	27·1	5,742	81·9
60 and over	6·1	3,293	19·5	615	49·0	496	9·5	1,868	43·0	404	5·8
TOTALS-	100·0	16,896	100·0	1,253	100·0	4,290	100·0	4,343	100·0	7,010	100·0
	1848.										
0-15 -	31·6	4,945	35·9	202	30·6	2,793	79·6	1,138	37·5	812	12·4
15-60 -	62·3	6,867	49·9	207	31·4	499	14·2	769	25·3	5,392	82·1
60 and over	6·1	1,955	14·2	251	38·0	218	6·2	1,127	37·2	359	5·5
TOTALS-	100·0	13,767	100·0	660	100·0	3,510	100·0	3,034	100·0	6,563	100·0
	1849.										
0-15 -	31·7	4,999	37·6	40	31·5	2,918	81·1	1,239	38·1	802	12·7
15-60 -	62·2	6,378	47·9	31	24·4	444	12·4	753	23·1	5,150	81·4
60 and over	6·1	1,927	14·5	56	44·1	235	6·5	1,261	38·8	375	5·9
TOTALS-	100·0	13,304	100·0	127	100·0	3,597	100·0	3,253	100·0	6,327	100·0

TABLE 3.

Death Rates per Million from Influenza (Persons), England and Wales.

Ages.	1847-48.	1848-72.	1890-91.	1881-90.	1891-1900.	1901-10.
0—	713	149	306	26	288	161
5—	80	13	55	4	49	31
10—	49	7	46	3	41	24
15—	51	9	115	7	97	53
25—	79	12	197	12	151	86
35—	139	20	347	19	281	147
45—	284	41	595	27	492	264
55—	809	125	1,060	45	1,013	574
65—	2,372	439	1,985	83	2,214	1,325
75—	5,510	1,103	3,355	191	4,703	2,927
85—	11,243	1,816	4,821			
	5,883	1,192	3,522			

TABLE 3—*continued.*
Expressed as Percentages of the Rate at Ages 0—5.

Ages.	1847-48.	1848-72.	1890-91.	1881-90.	1891-1900.	1901-10.
0—	100	100	100	100	100	100
5—	11	9	18	15	17	19
10—	7	5	15	12	14	15
15—	7	6	38	27	34	33
25—	11	8	64	46	52	53
35—	19	13	113	73	98	91
45—	40	28	194	104	171	164
55—	113	84	346	173	352	357
65—	333	295	649	319	769	823
75—	773 } 825	740 } 800	1,096 } 1,151	735	1,633	1,818
85—	1,577 }	1,219 }	1,575 }			

It was mentioned above that 1,611 persons were recorded to have died of influenza in 1849, and the total is above 1,000 in every year until 1861,* reaching 3,568 in 1855. Thereafter it declined and in the decennium ending with 1889 was only thrice more than 100, viz., in 1880, 171; 1883, 107; 1885, 138. That the disease entered in the death registers as influenza between the years 1847 and 1890 was necessarily identical with the malady of pandemic times is, as pointed out by the late Dr. Parsons in his official report, doubtful. Amongst the public, "influenza" has almost as vague a connotation as a "touch of liver" and, for the reasons explained above, the doctor had not (and still has not) any instrument of precision which enabled him in this matter to rise superior to the temptation of a conveniently loose phraseology. But it is going too far to assert that the large fluctuations of the deaths attributed to "influenza" in some of the years are capricious or to believe that no persons died in the ten years preceding 1890 of "undoubted" influenza. One small but instructive incident suggesting the need of caution was the localised outbreak of a disease in the district of Northallerton during February 1887; it was reported on by Dr. Page of the Local Government Board; a very brief abstract of his findings is printed in the report of the Board's Medical Officer for 1887-8 and some further particulars are quoted by Dr. Parsons in his study of influenza. These particulars are sufficient to prove that had the disease affected a wider area no one would have hesitated to classify it as influenza in the sense of either 1890 or 1918. We do not therefore think it proven or probable that the pathogenic

* All the figures are tabulated in Parsons' Report to the L.G.B. on the Influenza of 1889-90 (Cd. 6387). This report and its successor by the same author (C. 7051 of 1893) are hereinafter cited as Parsons I., and Parsons II. For a more minute analysis of the statistics of the 1890-2 influenzas than given in the body of the present report, reference should be made to the work of Dr. Parsons amplified in certain directions by the above quoted monograph of Dr. Dixey.

materials of a conflagration were absent from this country between 1880 and 1889. Yet it has to be plainly stated and fully grasped by the reader that the recorded history of an epoch which, as we now know, came to a definite end in December 1889 in no way prepared us for the subsequent events.

We have seen that the influenza period of 1675-88, of 1729, of 1734, and 1743 are set in circumstances which are harmonious one with another ; we have this on the faith of continuous records kept by skilful observers. One witness, Ruttly, speaks to a like sequence in 1762 ; three or four give concordant accounts of the 1782 period; we can properly attribute our confusion respecting the 1803 and the 1833-37 influenzas to the decay of one mode of recording and the infancy of another. For 1847, the evidence, not indeed of "nervous" and "intermittent " satellites but of profound disturbance in the public health apart from the explosion of influenza is unchallengeable. Almost as strong evidence is available respecting the antecedents of 1918. But little in written history can be brought forward as foreboding an impending change in the years immediately before 1890. So far as "influenza " deaths are concerned 1889 had the lightest toll of the decennium ; 55 in England and Wales, 5 only in London, three of these of young children. The general death rate of the year was very low ; measles and diarrhoea were more prevalent than in 1888, but below the rate of any other year in the decennium. Such vague headings as cerebro spinal fever, remittent fevers, agues, covering morbid conditions which might be harbingers of a new " constitution," provide statistics which show mere random fluctuations. Nor is there much non-statistical evidence; no epidemic studied by the medical inspectors of the Local Government Board between 1881-90 (other than the Northallerton incident) and published in official reports throws direct light* upon the antecedents of the influenza of 1890.

In 1889 this country had been free from pandemic influenza for more years than in any previous epoch since the middle of the 17th century. The pandemic period of 1658 is separated by less than 20 years from that in Sydenham's cycle which was followed within 10 years by the events of 1688-1693. Not quite 20 years more bring us to the influenzas of 1710-12 and the succeeding intervals continue to be of about 20 years ; thus the years from 1712 to 1732 bring us to the middle of another epoch which closed in or about 1743 ; another twenty years pass and we have the pandemic of 1762; 1782 and 1803 are again storm centres. The gap lengthens to nearly thirty years, then we have three pandemics within six years, 1831, 1833, 1837. The following interval is much shorter, only ten years, and the resulting outbreak was of the first order of severity. Statistics give no reason to suppose that

* Dr. F. G. Crookshank (*Journ. Roy. San. Inst.*, September 1920) has, however, justly called attention to the severe epidemic of pneumonia in Middlesbrough and its neighbourhood during 1888 which the late Dr. Ballard investigated (App. A., No. 18, *Report* of M.O. to L.G.B. for 1888).

influenza was truly epidemic in England in any year later than 1858, so that the interval free from explosions must be put as at least 30 years, although, during this period influenza was pandemic in Europe and North America in 1874-5 and in North America in the previous year. Judging from the earlier experience we ought to have had pandemic influenza in 1875; actually the only even minor outbreaks before 1890 and after 1874 were in Norfolk (1878) and the Northallerton incident mentioned above. Hence both in respect of interval as well as of lacking portents in our general mortality experience, the events of 1889 and following years were surprising. The subsequent history reveals other novelties.

In table 4 are shown the deaths attributed to influenza in London for each year since 1889 to the middle of 1919.

TABLE 4.

<i>London Influenza.</i>				No. of Deaths.
Date.				
1890 -	-	-	-	648
1891 -	-	-	-	2,336
1892 -	-	-	-	2,242
1893 -	-	-	-	1,526
1894 -	-	-	-	750
1895 -	-	-	-	2,156
1896 -	-	-	-	496
1897 -	-	-	-	671
1898 -	-	-	-	1,283
1899 -	-	-	-	1,817
1900 -	-	-	-	1,950
1901 -	-	-	-	664
1902 -	-	-	-	1,073
1903 -	-	-	-	644
1904 -	-	-	-	709
1905 -	-	-	-	689
1906 -	-	-	-	895
1907 -	-	-	-	967
1908 -	-	-	-	1,350
1909 -	-	-	-	1,216
1910 -	-	-	-	723
1911 -	-	-	-	496
1912 -	-	-	-	535
1913 -	-	-	-	862
1914 -	-	-	-	613
1915 -	-	-	-	1,058
1916 -	-	-	-	915
1917 -	-	-	-	751
1918 -	-	-	-	12,927-
1919 (to 10th May)	-	-	-	3,871

We shall shortly have to examine more detailed statistics, but this table suffices to bring out some important points. Although it is practically certain that the attack rate of

influenza was higher in 1890-1 than in any subsequent year until we reach the summer of 1918, the deaths attributed to influenza in 1890 are among the fewest of the series; in the first decennium, 1896 alone returns a lower number. In the second decennium, the lowest total that of 1903 is almost equal to that of 1890, while in the decennium now drawing to a close only 1911 and 1912 provide decidedly smaller quotas. The years 1890-93 are to be counted pandemic years; 1895 was another. This remark applies to 1898-1900, and London was not exempt from the pandemic of 1907-8 which, as may be inferred from Table 5, affected most of the States making returns. Apart from the statistical

TABLE 5.
Influenza Deaths.

—	Popu- lation in Mil- lions, 1905.	1905.	1906.	1907.	1908.	1909.	1910.
England and Wales.	34·0	6,953	6,310	9,257	10,112	8,992	6,504
Scotland - -	4·6	912	313	425	419	314	274
Ireland - -	4·4	1,219	978	1,720	1,798	1,303	1,332
Denmark (urban population).	—	268	58	244	299	146	149
Norway - -	2·3	138	54	177	150	46	186
Sweden - -	5·3	404	113	429	912	209	534
Switzerland -	3·5	1,202	486	1,018	663	766	463
Prussia - -	37·1	6,380	2,516	5,512	8,824	4,252	4,098
Bavaria - -	6·5	1,733	485	1,648	2,130	657	1,098
Saxony - -	4·5	765	277	693	998	430	630
Wurtemberg -	2·3	545	180	537	648	287	411
Baden - -	2·0	329	99	456	418	164	256
Holland - -	5·6	783	516	925	946	557	714
Belgium - -	7·2	1,364	1,136	1,379	1,316	1,171	1,221
France - -	39·2	No data	6,891	16,024	7,765	11,782	5,797
Portugal - -	5·7	1,605	1,354	2,194	1,463	1,616	—
Spain - -	19·0	14,287	10,478	18,565	9,103	10,511	9,835
Italy - -	33·2	6,870	4,309	8,043	4,450	5,719	2,780
Connecticut -	1·0	237	207	532	396	193	264
Massachusetts -	3·0	443	203	510	337	237	250
Michigan - -	2·6	649	321	897	633	370	458
Maine - -	0·7	243	109	278	241	170	105
Japan - -	47·7	2,720	1,676	4,319	2,304	2,803	2,641
New South Wales	1·5	183	145	330	168	107	130
Victoria - -	1·2	133	243	276	166	110	100
Queensland - -	0·5	53	59	222	177	71	63
South Australia	0·4	27	38	57	35	23	26
West Australia -	0·3	16	29	16	37	24	18
Tasmania - -	0·2	16	24	33	31	12	7
New Zealand - -	0·9	70	132	223	64	47	141
TOTALS -		50,517	39,739	76,939	57,003	53,089	40,487

adjustments needed to make the annual figures strictly comparable, something is to be allowed to fashion of nomenclature ; but when all discounts equitably due have been made it will still be found that the position lost in 1890 has never been regained, that such phrases as the return of influenza, the reimportation of influenza, etc., are mere figures of speech ; we have never lost it again since 1889.

We shall now attend to some finer points. Table 6 provides the annual death-rates at ages for London from influenza, bronchitis, pneumonia, and phthisis for each year from 1891 to 1911. The age grouping used in the weekly returns has been retained, although it is statistically inferior to that of the

TABLE 7.
The Special Outbursts.

Year.	Duration.	Average Weekly Deaths in the [Epidemic.				Proportion of Mortality from Influenza and Pneumonia borne by Age Group 20-40.	
		Influenza.	Pneumonia.	Bronchitis.	Phthisis.		
1890	15 weeks from 4th January 1890.	38·5	147·3	354·4	213·2	Percentage 19·9	
1891	17 weeks from 18th April 1891.	124·5	145·1	216·2	166·5	15·4	
1891-92	18 weeks from 19th December 1891.	120·9	180·9	447·3	184·3	11·6	
1893-94	27 weeks from 4th November 1893.	44·9	162·7	263·7	165·9	12·3	
1895	16 weeks from 16th February 1895.	116·6	178·9	382·0	179·6	10·0	
1899-1900	28 weeks from 2nd December 1899.	75·4	191·1	287·1	180·3	13·3	
1908	22 weeks from 4th January 1908.	50·7	159·5	149·8	139·6	10·1	
		WEEKLY DEATHS IN 1889.					
1st Quarter		-	-	95·9	269·9	151·0	10·2
2nd "		-	-	77·5	120·2	149·2	11·5
3rd "		-	-	46·5	80·6	137·5	12·6
4th "		-	-	91·5	219·5	158·3	12·4
						Proportion of the Populations, aged 20-40.	
CENSUS POPULATIONS.							
1891						33·9	
1901						35·4	
1911						34·6	

Death-rates per Million from Influenza, Pneumonia, Bronchitis, Phthisis, in London, 1889-1911.

Ages.	0-5.				5-20.				20-40.				40-60.				60-80.				80 and upwards.				All Ages.			
	Influenza.	Pneumonia.	Bronchitis.	Phthisis.	Influenza.	Pneumonia.	Bronchitis.	Phthisis.	Influenza.	Pneumonia.	Bronchitis.	Phthisis.	Influenza.	Pneumonia.	Bronchitis.	Phthisis.	Influenza.	Pneumonia.	Bronchitis.	Phthisis.	Influenza.	Pneumonia.	Bronchitis.	Phthisis.				
1889	4	4,307	7,682	527	—	155	80	500	—	333	159	2,604	—	868	1,726	3,761	8	2,279	12,039	2,137	—	3,866	38,782	119	1	982	2,179	1,872
1890	114	5,745	10,033	640	24	237	110	604	115	633	292	3,025	321	1,656	2,824	4,262	611	3,411	16,087	2,489	1,051	5,782	46,960	526	156	1,489	2,977	2,170
1891	498	5,820	9,544	540	87	227	106	598	253	677	267	2,777	877	1,993	2,940	4,021	3,315	4,604	18,769	2,152	7,873	7,011	55,054	402	554	1,640	3,118	2,013
1892	395	5,684	8,409	607	62	217	85	523	216	483	203	2,636	876	1,667	2,307	3,677	3,335	3,933	15,715	2,019	9,660	5,616	47,119	337	533	1,450	2,631	1,890
1893	302	5,669	7,685	700	64	265	90	547	204	744	203	2,621	545	2,158	2,162	3,624	1,938	4,541	14,418	2,174	4,559	7,579	44,104	330	356	1,681	2,431	1,910
1894	178	5,859	6,708	594	33	174	54	493	94	390	140	2,357	277	1,081	1,422	3,438	897	2,600	9,629	1,890	1,829	4,734	31,576	538	174	1,233	1,811	1,748
1895	505	6,722	7,714	543	57	194	59	505	175	385	186	2,459	733	1,151	2,135	3,620	3,058	3,066	14,732	2,163	10,223	5,744	46,585	158	496	1,378	2,446	1,834
1896	144	6,598	6,802	564	19	181	52	466	64	336	121	2,346	173	963	1,249	3,593	530	2,460	9,289	1,949	1,239	4,957	28,710	568	113	1,264	1,726	1,776
1897	147	5,792	5,943	576	24	156	39	444	76	313	115	2,307	231	1,025	1,280	3,631	827	2,189	9,492	2,145	2,227	4,251	32,493	557	152	1,145	1,679	1,782
1898	233	6,187	5,707	601	48	159	50	426	106	357	119	2,307	431	1,035	1,434	3,696	1,837	2,446	10,552	2,052	4,565	7,939	32,551	595	289	1,224	1,750	1,792
1899	316	6,570	5,696	581	48	207	41	498	185	502	158	2,372	621	1,589	1,840	3,909	2,250	3,380	13,260	2,329	8,905	6,131	45,158	827	406	1,489	2,058	1,897
1900	206	6,586	5,648	452	56	221	47	444	174	579	133	2,185	673	1,795	608	3,760	2,564	3,907	12,368	2,336	9,833	7,064	40,350	668	432	1,594	1,928	1,780
1901	143	6,043	4,961	463	22	174	34	424	69	398	103	2,132	216	1,347	1,267	3,471	787	3,166	10,173	2,245	2,438	5,766	33,574	891	146	1,349	1,613	1,705
1902	187	7,373	4,934	571	34	195	37	437	97	452	112	2,052	325	1,369	1,258	3,409	1,413	3,160	11,363	2,179	4,712	6,052	42,920	508	237	1,497	1,742	1,681
1903	147	6,344	3,599	523	19	171	24	415	65	344	76	1,950	201	1,113	804	3,303	731	2,910	6,994	2,146	2,778	7,468	27,778	638	142	1,285	1,156	1,621
1904	127	6,940	3,616	569	28	211	18	483	50	393	95	2,054	203	1,274	1,043	3,435	975	3,666	9,291	2,112	3,143	7,587	36,186	943	156	1,458	1,406	1,708
1905	116	6,817	3,426	484	14	227	30	391	60	443	76	1,808	195	1,428	942	2,976	Ages 60 and upwards.				—	—	—	—	153	1,530	1,335	1,503
1906	135	6,235	2,835	547	33	233	23	414	68	426	69	1,856	274	1,386	835	3,000	1,354	4,310	9,583	1,835	—	—	—	—	198	1,453	1,182	1,530
1907	146	7,820	3,446	544	31	209	20	446	91	424	84	1,816	287	1,488	940	2,897	1,400	4,701	10,230	1,908	—	—	—	—	214	1,663	1,328	1,515
1908	112	6,480	2,408	499	36	214	21	376	99	424	71	1,806	381	1,345	868	2,742	2,265	4,562	9,829	2,011	—	—	—	—	298	1,487	1,180	1,469
1909	114	6,540	2,303	409	28	246	24	387	97	499	87	1,724	330	1,699	1,070	2,744	2,000	5,438	11,514	2,059	—	—	—	—	268	1,667	1,352	1,443
1910	85	6,460	2,275	358	18	225	22	352	55	422	61	1,564	208	1,365	784	2,333	1,160	4,450	9,156	1,768	—	—	—	—	162	1,488	1,115	1,273
1911	77	6,042	2,370	526	20	198	26	409	46	Ages 20-45.		1,780	215	Ages 45-65.		2,306	Ages 65 and upwards.		1,343	—	—	—	—	—	110	1,238	1,151	1,349

annual reports, and variations of classification, one consequence of which is to raise the influenzal rate in later years, necessitate caution in making comparisons. In Table 7 summaries of the features of the special exacerbations or explosions are set out. In Table 8 are shown the proportional mortality from notified

TABLE 8.

Influenza. Proportion borne by Age Group 20-40.

Year.	Influenza.	Pneumonia and Influenza.	Pneumonia.	Bronchitis.	Season of Year.	Proportion of Population at Age 20-40.
1890	24·9	19·9	18·6	4·6	Winter	33·8
1891	15·4	15·4	15·5	3·2	Summer	33·9
1891-92	12·9	11·6	10·7	2·7	Winter	34·0
1893-94	17·3	12·3	10·9	2·7	"	34·3
1895	11·2	10·0	9·2	2·5	Winter and spring.	34·5
1899-1900	13·3	13·3	13·3	2·5	"	35·3
1908	10·3	10·1	10·1	1·9	"	34·8

influenza, pneumonia, and bronchitis borne by the age-group 20-40, allowance being made for changes of age constitution; but chance fluctuations of undefined magnitude are to be expected. Age corrections are not, of course, applicable to the data of the recent prevalence.

It has already been seen (Table 3) that the participation of different age-groups in the mortality was different in 1890 from the experience of 1847; the very much greater share taken by the young adults in 1918-19 makes it pertinent to inquire whether a uniform trend in this direction can be found in the interval between 1890 and 1915. Although it is permissible to conclude that during the past 30 years the share of mortality borne by young adults has been greater than in the 1847 experience, there is no sign of a uniform progression. These figures relate to death-rates; we shall discuss incidence rates in a later section.

Before passing to the detailed study of the events of 1915 and subsequent years it will be proper to make some general reflections upon the epidemiological history of the quarter of a century which succeeded the pandemic explosion of 1889-90. Whatever view may be taken of the incidents, or lack of incident, which ushered in the new cycle, the general truth of Dr. Creighton's remark (uttered in 1893) that the new age differed profoundly from anything that had gone before will by now be plain to the reader. Since 1890 the endemic prevalence of what has at least been called influenza main-

tained itself at a height entitling it to be regarded as an important cause of recorded mortality. In no single year have less than 450 of the inhabitants of London come by their deaths from "influenza"; in each of 11 years more than a thousand fatalities have been allotted to this cause group. Five times the tide has risen sufficiently to justify the word "explosion" or "epidemic" and mention of the fact in the press. We may not be able to explain these events, but we must take serious note of them.

To explain outbursts of epidemic disease an appeal has always been made to one of two conflicting principles. As Dr. Singer has expressed it: "The history of the doctrine of "epidemics may be summed up in one sentence, as a struggle "between the ideas of *miasma* and *contagion*." Down to a quite recent time the doctrine of miasmatic influenza probably commanded a majority of supporters, and it was incumbent upon Dr. Parsons to devote much space in his report on the influenza of 1890 to a demonstration that the principal argument in favour of a miasmatic or air borne *materies morbi*, viz., the spread of the disease with a velocity exceeding that of human travel and its alleged appearance in localities exempt from human importation was fallacious. Perhaps no medical man now adheres to the doctrine of miasma, but the dramatic character of the epidemics, the patent discontinuity in respect of prevalence between epidemic and non-epidemic years, has led to almost universal acquiescence in a theory of re-importation. It is argued that the disease has been reintroduced at intervals from some other country in which the *materies morbi* had acquired a peculiar virulence or infectivity, that not otherwise can we account for the catastrophic increase of cases and deaths.

Not to pause upon the fact that this explanation proceeds *ab ignoto ad ignotius*, since nothing that has been ascertained of the immediately exciting causes of influenza gives any warrant for believing that the conditions of those remoter countries into which the origin of influenza has been exiled—the favourite location is Russia—are peculiarly favourable to an exaltation of infectivity, we may note that the basal assumption is unsound. It is not true that a sudden transition from a low endemic to a dramatically epidemic level of prevalence needs the postulation of a new factor. Sir Ronald Ross first showed mathematically that a disease, the continued existence of which depends upon the conjoined action of several factors, might as a consequence of a small and undetectable variation in one of the factors suddenly assume epidemic proportions. So long as one or more of the factors remain below a critical value the disease smoulders and may pass almost unregarded; let the critical point be passed and the disease will increase with great rapidity. A numerical example will make the theory more vivid, Under certain

conditions,* when the number of anophelines per head of population in a district is 40 the malarial case rate will be 5 per 1,000 ; an increase of anophelines to 44 will be associated with a threefold increase of malaria ; when the mosquitoes reach 46 the malaria rate will be 50 per 1,000, and when the anophelines have reached 49, 10 per cent, of the human population will be infected. Thus an increase of anophelines so slight that it "could scarcely be detected by our present methods" might be attended by an increase of the malaria rate amounting to a severe epidemic.

The application of this reasoning to our present problem is obvious. It does not, of course, exclude the possibility of re-importation being a factor of the situation, but, just as the evidence collected by Dr. Parsons convinced most epidemiologists that contagion could not be excluded as a vehicle of dissemination, that no instances of outbursts without the possibility of contagion were known, the analysis of Sir Ronald Ross shows that we might have explosions of influenza even if Russia or Spain did not exist and the British frontiers were hermetically sealed. We should blunt Occam's razor if we failed to inquire whether any factors might exist, the variation of which above or below a critical value would explain the observed sequences. In the case before us we must start from the recognition of the fact that whatever the nature of the aetiological elements they are such that social evolution in the later years of the 19th century raised them more nearly to the critical value, and has maintained them ever since closer to that value than in any earlier age. We must observe that this remark applies not only to Great Britain, but to all Western Europe and to the North American Continent. European experience since 1889 is, indeed, closely paralleled by that of the United States. In Massachusetts, for instance, the death rate from "influenza" never reached 100 per million per annum between 1868 and 1890, and never again fell below that level until 1902, exceeded 200 per million five times between 1890 and 1901, and in 1918 attained the same calamitous dimensions as seen in Europe.

The historical student recalling the substitution principle of Robert Watt, approved by Farr, and, perhaps, extravagantly eulogised by Creighton, will inquire whether in the extinction or decline of some national disease for which influenza is substituted we are not to look for the needed variation. At the first blush we seem to open up here a promising path. The most noteworthy feature of our vital statistics, so far at least as adults are concerned, in the last quarter of the 19th century was the decline of the tuberculosis death rate. The effect of this has been presumably to leave in the population an appreciable percentage of persons who would otherwise have died of tubercular disease. But, as all records of influenza explosions

* "*Prevention of Malaria*," by Sir Ronald Ross, 2nd edition, London 1911.

show, and as so many early writers have observed, the infection of influenza, if not specially attracted by the phthisical, is at least particularly deadly to them. Might it not be that the addition to the population of a steadily increasing percentage of those susceptible naturally to infection through the respiratory tract is precisely the slight change of a factor of prevalence which is required? Can it be that the slighter intensity and frequency of influenza explosions between 1910 and 1918 is due to the fact that the decline of tuberculosis was less active in the decennium 1901-10 than in the previous decennium? Does not this hypothesis cast a ray of light upon the especial severity of the disease upon young adults in the last great pandemic, immediately prior to which the conditions unfavourable to the now considerable population of young susceptibles to phthisis had been accentuated all over the world through the direct and indirect consequences of war?

A superficial examination of European vital statistics would indeed seem to lend support to this hypothesis. In 1901-5 the death rate per million from pulmonary tuberculosis in England and Wales was 1,218, and the influenzal death rate 192; in 1905-10 the phthisis rate fell to 1,107, and the influenza rate rose to 235. In France and Italy on the other hand the tuberculosis (pulmonary) rates hardly changed.

For the great towns of France the successive quinquennial rates were 2,673 and 2,675 for Italy, 1,050 in each quinquennium. The influenza rates of these two countries showed much less increase than in England; that of the French cities only rose from 205 to 212; that of Italy actually fell from 156 to 150. But the very figures we have quoted are enough to show how rash it would be to build anything upon them. No allowance for differences of age constitution would make it probable that the tuberculosis rates in reality differ so much from country to country as the figures assert. Even if they could be accepted at the face values a wider survey destroys the illusion. In Massachusetts the tuberculosis rate fell more sharply than in England and Wales from 1,630 to 1,438, but the influenza rate instead of increasing declined (125 to 97). In Spain, which seems always to have an enormous *statistical* prevalence of influenza,* both pulmonary tuberculosis and influenza declined together.

The obvious inference is that a comparison of international vital statistics cannot lead us to any reliable conclusions on this point. There remains the suggestion that the steady increase of movement and intermingling of population associated with the improvement of communications may be the factor we are in search of. We do not mean that owing to improvements in methods of transit it is now easier for the *materies morbi* to be brought from its supposed endemic centre into Western Europe, although this is a possibility, and Dr. Parsons (I. 53) wrote in

* See p. 236.

1891 that " the progress of the epidemic over the globe, taking " Russia as its starting point, has been more rapid than that of " previous epidemics." We are now examining the facts, which Dr. Parsons (II. 39) in his later study said, pointed " not " to dissemination of the disease over the globe from a single " centre as appeared to be the case in 1889-90, but to the " revival of epidemic activity at or about the same time in " several different centres in different parts of the world." The centralisation of industries, the tendency not merely in England, but in all advanced industrial nations, for the workers in cities to seek habitations in the outer suburbs, was already making itself felt in the eighties of the last century, and has proceeded with an accelerated velocity in the past 30 years. This evolution has been favourable to the public health in the relief of housing congestion in the centres of the urban districts which it effected, but it has had consequences which may be less advantageous from the present point of view. The larger unit of industrial production in which numerous human beings are brought into contact one with another, even if under conditions definitely more favourable to life than those obtaining in the smaller industrial units of an earlier age, must render frequent the opportunities of transfer from one to another of *materies morbi* formerly confined to separate groups.

Suppose we had a chess board over the squares of which the leaves of some plant were scattered and a number of caterpillars were then thrown at random upon the board ; suppose also that the leaves were capable of nourishing the caterpillars, but not especially attractive to them. Then it is to be expected that the insects will sample the leaves on the squares upon which they alight, but wander further afield until all the squares have been visited. If partitions had been erected around each square, the caterpillars must have stayed where they fell and been forced by hunger to consume the not too attractive nourishment provided. In the one case we shall find slight effects of the invasion over the whole board ; in the other some squares will have been swept clean, others will remain untouched. This apologue illustrates the possible effects of concentration in great industries. When the nature of the disease and normal powers of resistance to it are, such that successful invasion needs repeated attacks, massive dosage, the distribution of workers into a number of small badly constructed work places will produce the maximum of evil. When the condition of spreading is less exacting, the infectivity high and normal resistance low, aggregation of workers, however favourable the conditions, so long as mixture occurs at all, will achieve the maximum result. It is probable that tuberculosis is in the former category hence the apparently paramount importance of home conditions, and the deplorable results of

home industries; it is possible that influenza is in the latter class. When we recollect that a corollary of centralised main industries and centrifugal housing is the great tide of railway, tram and tube traffic which has arisen so steadily during the past thirty years, it is *possible* that we have come upon the varying factor which now always oscillates so close to the critical point of epidemic prevalence. It is probable that all epidemic diseases owe their epidemicity to the conjoined working of numerous factors, that the failure of any one of these factors to pass a critical point destroys the whole sequence. The history of bubonic plague, of smallpox, and of typhus has afforded examples.

We have in the plague history of England an epoch of approximately 350 years during which the conditions in this country were such that some slight and inappreciable variation of a hidden factor was sufficient to precipitate an epidemic; in our own time, on the other hand, the introduction of infection, even the establishment of an epizootic through a wide area not only did not result in a general epidemic, but did not even give rise to a local outbreak; the disease flickered, killed half a dozen persons, and went out. What link was wanting in the chain we do not know and, in view of our aetiological ignorance respecting so clear cut and assiduously studied a disease as plague, we need not attach great importance to the speculative identification of the required factor of epidemic influenza with the modern tendency to peripheral housing and centralised industries. Yet the speculation has at least one character of a true hypothesis in that it will co-ordinate the seemingly contradictory experience of influenza through the past two centuries.

If it is a fact that promiscuous intermingling of a random population will raise the disease from an endemic to an epidemic level or rather make the transition from one to the other but a step, we should expect that under social conditions not securing such intense mixing, epidemics of influenza will only occur under special conditions.

We may put it in this way. The epidemic is generated by the correlated action of several factors *a, b, c, d, e, &c*, if the intensity of one of these, *a*, say, exceeds a certain minimum, then very small variations of *a* and also of the remainder are needed to generate an epidemic. When *a* is varying upon a lower level great changes in all are necessary. If *a* be the measure of commingling which we suppose to be more intense than ever before, small variations of it and concomitant small variations of the others, which must include general resisting powers, are enough to lead to an outbreak. When *a* is on a lower level this is not so; there must be big changes. Therefore as precursors of epidemics at a time when *a* swings about a lower level we shall have evidence

of general or special "unhealthiness in the community ; when the status of *a* has been raised we shall not. *En revanche* after the other factors have fallen to their common average no more will be heard of influenza as an epidemic for many years under the old system; under the new, breaking out in an apparently healthy community the disease will continue at quite short intervals to pass above the flash point, and be responsible for epidemics. This seems to be what has happened in influenza. We can also, upon this supposition, make light of the difficulties and conflicts of testimony as to the direction along which influenza extended to this country. Somewhere in the decennium 1880-90, the *a* factor, which we identify with a certain frequency of commingling in a population, members of which carry the infective principle, reached a critical intensity and the epidemic of 1890 was generated; it appeared in many different countries at about the same time, not because some volcano outside their borders awoke to a new and sinister activity, but because the parallel developments of civilisation in all reached approximately the same level at nearly the same time ; the earlier or later development of the particular intra local epidemic depended upon local and minor variations of the several factors. The materials of the conflagration came from within in each case, but were not brought to red heat at the same moment.

An unstable equilibrium has existed throughout Europe and America the disturbance of which has had for consequence the frequent epidemics of the past quarter of a century. The impossibility of making any accurate prediction as to when such will occur depends upon the present difficulty of accurately measuring the variations of the postulated factor. In one sentence, the problem of epidemic influenza is largely an internal problem of each nation ; there is no question of shutting the wolf out of the sheep fold, he has been regularly lying down with the lamb for years; his ravages depend as much upon the disposition of the sheep within the fold as upon his appetite. Thus broadly stated, the hypothesis neglects some portion of the truth; however combustible the material, there can be no fire without a spark, and when the fire has been started, it may spread to material not naturally combustible. We must not ignore this consideration, but it has, perhaps, been over emphasised in current discussion.

We have felt authorised to devote so much space to the display of what is after all an unproven hypothesis, a mere speculation, because of the important inferences to which it leads.

The wisdom of insuring against fire depends at least as much upon the consequences of a fire if it break out as upon the probability of a conflagration ; the value of a hypothesis depends both on its intrinsic credibility and its practical

consequences. Were this hypothesis to be true, it would follow that the problem of influenza is a graver problem now than in the past. When the postulated factor normally fluctuated well below the flash point, influenza could only become pandemic if some grave antecedent disturbance of the public health occurred. Signs would be vouchsafed which the instructed observer could recognise as portents; we have seen them in the chronologies of Sydenham and Huxham, also perhaps in the unsavoury conditions of 1846-7. But when the pendulum swings always close to the danger limit, we shall not receive the warning, we shall always live in the shadow of a possible disaster. Our position in face of influenza will be that of the 17th century physician in regard to plague, and our remedy will not be specific but general, not found in the exclusion of infection from our shores, not even in specific immunisation, but in the more laborious and less dramatic task of attending to the general principles of hygiene. This will, of course, still leave a possibly wide field of usefulness for *ad hoc* or specific measures when the conflagration rages or is immediately in front of us, and it is by no means a counsel of despair. But it removes influenza from the class of capricious or alien foes to be dealt with on simple military lines.

With these tentative reflections we must leave the general historical problem of influenza. We can no longer regard the miasmatic or cataclysmal theory as adequate; the researches of Parsons and others in the early years of the present cycle effectively destroyed that theory. Neither, we think, can influenza be reduced to the category of imported infections, the consequences of which might be obviated by attention to a foreign endemic focus. We believe that the general treatment of the problem will ultimately be found to be parallel with that appropriate to the now obsolete plague of typhus in Great Britain, and we have little reason to expect that the years 1918-9 are to play that part in the history of influenza assigned by fate to the years 1665-6 in English experience of plague.

TABLE 9A.

FEMALES.—Deaths from Influenza, all forms of Pneumonia and Bronchitis, in England and Wales from 1889-1917.

Ages.	0-5.			5-10.			10-15.			15-20.			20-25.			25-35.			35-45.			45-55.			55-65.			65 and over.		
	Influenza.	Pneumonia.	Bronchitis.	Influenza.	Pneumonia.	Bronchitis.																								
1889	15	6,335	12,110	1	468	232	—	194	46	—	205	53	1	271	76	—	714	268	—	809	705	1	783	1,508	2	1,023	3,123	6	1,626	9,703
1890	240	7,170	12,817	50	575	296	51	208	71	62	313	72	79	417	104	203	1,034	371	227	1,352	969	246	1,340	2,177	282	1,527	4,362	668	2,299	12,179
1891	688	8,009	14,026	150	541	301	101	183	63	203	287	77	242	389	87	597	935	402	729	1,251	966	1,035	1,431	2,367	1,373	1,756	4,874	2,947	2,685	14,460
1892	556	7,415	12,455	118	568	231	84	208	55	184	250	62	181	290	85	467	819	331	654	1,066	867	915	1,150	1,937	1,392	1,505	4,224	3,513	2,389	13,450
1893	400	7,222	10,256	92	542	250	78	222	62	131	293	58	166	342	93	380	979	294	484	1,285	759	507	1,248	1,728	765	1,519	3,678	1,858	2,492	11,773
1894	377	7,634	10,845	58	430	183	46	169	34	86	209	40	87	244	71	234	649	238	264	845	526	336	914	1,223	521	1,084	2,723	1,383	1,792	8,817
1895	634	8,137	10,943	93	498	197	75	174	58	143	216	57	138	282	73	375	652	285	491	915	753	634	988	1,747	1,076	1,253	3,956	3,048	2,167	12,558
1896	217	8,426	10,114	49	499	200	47	166	44	52	223	39	57	250	53	135	664	221	201	838	528	216	972	1,231	252	1,147	2,707	615	1,890	8,711
1897	296	8,033	9,354	65	491	156	50	173	37	87	241	46	91	235	40	193	700	220	282	893	529	289	926	1,223	495	1,073	2,701	1,155	1,907	9,227
1898	491	8,559	8,777	78	451	127	58	158	40	105	218	43	118	232	54	306	655	193	405	913	525	508	917	1,254	847	1,123	2,787	2,479	2,102	9,851
1899	499	8,716	8,503	78	487	145	80	186	48	115	244	45	149	320	52	363	794	225	479	1,072	630	703	1,114	1,613	1,023	1,368	3,454	2,843	2,500	11,396
1900	491	9,277	8,956	93	506	160	87	213	33	124	265	39	164	324	70	409	886	215	548	1,196	718	856	1,299	1,607	1,495	1,575	3,814	4,295	2,612	12,251
1901	246	8,329	7,643	54	482	125	38	158	39	65	259	40	75	274	45	195	747	178	260	963	545	315	1,039	1,294	421	1,232	2,929	1,085	2,307	9,885
1902	298	9,909	7,603	40	627	139	49	227	33	83	325	31	98	405	41	237	1,021	166	311	1,278	448	381	1,405	1,127	589	1,698	2,745	1,638	2,748	9,971
1903	267	9,398	6,830	65	512	91	41	178	25	59	253	26	76	312	37	229	778	138	238	1,024	414	329	1,172	898	507	1,426	2,179	1,444	2,677	8,012
1904	278	8,963	6,995	47	553	113	32	204	25	62	280	29	71	320	34	167	867	178	216	1,146	426	284	1,082	1,058	482	1,617	2,597	1,273	3,094	10,155
1905	271	9,365	5,990	42	588	106	48	201	29	83	279	26	87	353	28	196	923	125	270	1,191	404	346	1,278	1,013	547	1,703	2,518	1,676	3,418	9,715
1906	219	8,467	5,011	60	566	111	42	264	25	54	242	27	63	321	33	204	927	123	255	1,182	357	338	1,233	938	484	1,696	2,454	1,467	3,301	9,206
1907	346	10,388	6,035	70	607	85	55	232	21	75	275	21	90	353	37	247	881	143	355	1,225	419	448	1,344	1,066	755	1,750	2,785	2,385	3,499	11,169
1908	305	8,963	5,441	85	501	80	51	206	22	96	253	35	114	318	26	273	847	117	368	1,056	374	521	1,224	969	823	1,507	2,504	2,634	3,233	10,275
1909	240	9,015	4,787	61	610	98	46	227	28	71	278	33	91	381	44	277	1,031	126	355	1,260	419	432	1,464	1,100	751	1,973	2,801	2,368	4,135	11,978
1910	191	8,229	4,350	52	510	74	32	203	20	57	222	32	72	270	35	163	833	107	213	1,062	329	308	1,144	849	508	1,496	2,113	1,655	3,250	9,482
1911	148	8,134	4,604	33	550	95	30	193	24	33	226	33	35	271	43	134	692	129	183	990	377	236	1,015	949	366	1,325	2,398	914	2,664	10,021
1912	185	8,129	4,308	42	503	88	38	186	29	45	195	44	55	233	44	140	666	158	202	962	407	239	987	1,054	402	1,263	2,489	1,327	2,879	11,818
1913	176	8,338	4,330	42	536	90	28	169	21	56	207	29	81	241	39	166	687	156	243	945	403	299	952	1,069	478	1,262	2,407	1,455	2,688	11,171
1914	194	8,513	4,563	25	610	109	45	219	37	48	222	41	61	259	43	149	662	139	225	971	440	276	1,077	1,102	458	1,376	2,475	1,377	3,145	11,823
1915	363	10,256	4,931	63	759	118	59	275	38	96	294	44	98	331	54	255	842	192	318	1,172	485	459	1,402	1,296	715	1,731	3,069	2,830	3,898	15,679
1916	190	7,148	3,774	45	538	102	46	246	32	68	259	41	83	252	54	180	731	164	276	952	426	380	1,142	1,054	677	1,466	2,501	2,563	3,377	13,726
1917	191	7,308	3,624	53	566	118	39	265	31	70	249	48	76	280	38	143	653	168	205	1,019	412	311	1,125	987	526	1,475	2,446	1,949	3,245	12,954
1891	1,785,928			1,701,806			1,612,769			1,485,690			1,399,066			2,288,718			1,717,729			1,305,085			886,879			766,014		
1901	1,861,347			1,748,298			1,670,770			1,638,621			1,648,278			2,769,886			2,064,062			1,505,982			1,035,305			856,681		
1911	1,918,270			1,849,501			1,752,057			1,681,726			1,673,066			3,124,580			2,509,373			1,833,936			1,213,229			1,069,146		

