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THE WEATHER, INFLUENZA, AND DISEASE:

FROM THE

RECORDS OF THE EDINBURGH ROYAL INFIRMARY FOR FIFTY YEARS.

BY

A. LOCKHART GILLESPIE, M.D., F.R.C.P.E.,

MEMB. SCOT. MET. SOC.; MEDICAL REGISTRAR, EDINBURGH ROYAL INFIRMARY.

[With Six Plates.]

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XVI.—*The Weather, Influenza, and Disease: from the Records of the Edinburgh Royal Infirmary for Fifty Years.* By A. Lockhart Gillespie, M.D., F.R.C.P.E.; Memb. Scot. Met. Soc.; Medical Registrar, Edinburgh Royal Infirmary. (With Six Plates.)

(Read January 20, 1896.)

In the following pages I have attempted to analyse various groups of figures derived from the records of the Royal Infirmary. When appointed Medical Registrar to the Infirmary in October 1891, it occurred to me that it might lead to interesting results if the admissions into the Medical Wards were contrasted with the varying states of the atmosphere, a sufficiently long time being taken to avoid the fallacies attendant on statistical generalisations from insufficient data. At first my intention had been to investigate the influence of the weather on the diseases of the principal systems, but as the work progressed I found that the repeated attacks of Epidemic Influenza so modified the results that I had perforce to take up the study of that disease in addition. The Infirmary year begins on the 1st of October; and, although the figures might have been calculated with some trouble for the year from the 1st of January, they have been left for the most part in their original form. The period to which most of the figures relate comprises the seven years from 1st October 1888 to 30th September 1895. Each case is noted as on admission, and each death as it occurred. Most of the figures are given as weekly totals. The year 1888–89 is included because no epidemic of Influenza occurred during it. In each of the other years epidemics were present.

The meteorological data have been obtained from the weekly reports of the Meteorological Office of London, and invariably refer to the East of Scotland as a district. The data are taken for the district, and not for Edinburgh alone, because the patients of the Royal Infirmary are drawn from the country as well as from the city. For some of these figures I have to thank Dr Buchan and Mr R. C. Mossman.

The meteorological facts taken comprise the weekly type of weather, *i.e.*, cyclonic or anticyclonic, the extremes of temperature for the district for each week, and the mean weekly rainfall for the same district. The mean weekly temperature is also noted. More use is made of the extremes of temperature than of the mean, for I believe that rapid changes of temperature have a greater influence on disease than the actual mean.

General Facts with regard to the Admissions to the Medical Wards during the Seven Years.

The total number of cases admitted into the Medical Wards during the seven years under review reached 27,569, or a yearly average of 3938. The numbers admitted during the later years showed a very considerable increase over those of the earlier part.

The number of cases belonging to the different systems were then worked out. The systems chosen were (1) the Respiratory, which was considered as a whole, all the different diseases being grouped together, while, in addition, separate tables were constructed for cases of Pneumonia and Pleurisy; (2) the Circulatory; (3) the Urinary, in which, however, only cases of Kidney disease were included; (4) cases of Acute and Subacute Rheumatism; (5) the Nervous; and (6) the Digestive system. The number of deaths was also noted, but it must be remembered that the actual date of the death was recorded, not the date on which the case was admitted. A note was also made of the admissions of patients with Chorea, Appendicitis or Perityphlitis, and with Diabetes Mellitus. The figures for the last three diseases were too small to make an extended investigation into their relations worth the labour involved.

1. Total Admissions.

The total number of admissions were, as already stated, 27,569. But the number admitted during the individual years varied very considerably. The actual figures are :—

Year.	Patients Admitted.
1888–89	3,665
1889–90	3,530
1890–91	3,887
1891–92	3,776
1892–93	3,944
1893–94	4,078
1894–95	4,689
	27,569

These numbers are taken from the official returns, but unfortunately those for 1894–95 do not correspond properly with the preceding ones, as in that year the patients admitted into two small wards in the surgical hospital, but who were really medical cases, were for the first time entered under their proper designation. The numbers involved, however, are not sufficient to account for the enormous increase chronicled for that year.

2. The Admissions of Different Classes of Disease.

The following tables represent the number of cases admitted, arranged according to the system affected, or under the actual disease.

Table I.

Year	1888–89.	-90.	-91.	-92.	-93.	-94.	-95.	Total.	Weekly.
Respiratory System,	697	800	815	844	809	913	960	5838	15·96
Pneumonia,	106	140	141	189	183	182	173	1114	3·05
Pleurisy,	116	146	163	151	102	145	119	942	2·58
Cardiac,	310	261	268	387	400	370	395	2491	6·87
Kidney,	152	181	157	172	200	221	177	1260	3·44
Rheumatism,	54	103	82	59	107	181	168	754	2·04
Nervous,	612	590	687	579	679	690	683	4520	12·35
Digestive,	449	462	469	534	569	569	675	3727	10·21
Chorea,	28	39	60	41	38	46	62	314	0·86
Appendicitis,	10	17	21	21	32	44	72	226	0·61
Mortality,	331	358	362	266	422	370	429	2638	7·24

Table II.

	Totals.	Percentage to Total Admissions.	Yearly.	Weekly.
Respiratory,	5838	21·3	834	15·96
Pneumonia,	1114	4·04	159·1	3·05
Pleurisy,	942	3·43	134·5	2·58
Cardiac,	2491	9·01	355·8	6·87
Kidney,	1260	4·5	180	3·44
Rheumatism,	754	2·7	107·7	2·04
Nervous,	4520	16·34	645·7	12·35
Digestive,	3727	13·41	532·4	10·21
Chorea,	314	1·1	44·8	0·86
Appendicitis,	226	0·78	32·2	0·61
Mortality,	2638	9·59	376·8	7·24

These figures serve throughout the paper as means from which any deviations from the normal may be detected.

The next table gives the percentages between the same classes of disease and the total admissions for the different years, with the mean temperatures and the mean annual rainfalls added.

TABLE III.—*Showing the Percentage Proportion between Different Classes of Disease and the Total Admissions for Seven Years* 1888–95.

Year	1888–89.	–90.	–91.	–92.	–93.	–94.	–95.	Mean Total.	Weekly.
Mean temp., . . .	46·6	46·9	46·0	44·5	46·3	45·8	45·3	...	45·9
Mean rainfall, . . .	28·5	27·0	31·8	29·2	27·1	34·8	28·0	29·55	0·56
Totals, . . .	3665	3530	3887	3776	3944	4078	4689	3938	...
Weekly, . . .	70·4	67·8	74·7	72·6	75·8	78·4	90·1	...	75·5
Respiratory, per cent., .	19·0	22·3	20·9	22·3	20·5	22·3	20·4	...	21·3
Pneumonia, „ . .	2·89	3·96	3·62	5·00	4·63	4·46	3·69	...	4·04
Pleurisy, „ . .	3·16	4·1	4·18	4·00	2·58	3·50	2·50	...	3·43
Circulatory, „ . .	8·4	7·3	9·4	10·2	10·1	9·07	8·40	...	9·01
Kidney, „ . .	4·1	5·1	4·03	4·50	5·07	5·40	3·50	...	4·5
Rheumatism, „ . .	1·4	2·94	2·09	1·56	2·70	4·40	3·50	...	2·7
Nervous, „ . .	16·6	16·8	17·6	15·3	16·8	16·8	14·5	...	16·34
Digestive, „ . .	12·2	13·0	12·0	14·1	14·4	13·9	14·3	...	13·41
Chorea, „ . .	0·76	1·10	1·50	1·08	0·96	1·10	1·30	...	1·1
Appendicitis, Perityphlitis, .	0·51	0·49	0·52	0·55	0·81	1·07	1·53	...	0·78
Mortality, per cent., . .	9·03	10·1	9·30	9·70	10·69	9·07	9·84	...	9·59

I could trace no connection between the mean temperature or rainfall and the admissions of any of the classes of disease enumerated above. On the other hand, the number of cases of both pneumonia and pleurisy was lower in proportion to the total admissions during the later years. The percentage of nervous cases also fell a little, while that of the digestive system showed indications of a slight increase. Cases both of acute rheumatism and of appendicitis and perityphlitis exhibited a marked increase in their numbers per cent. from the earlier to the later years.

3. THE INFLUENCE OF WEATHER ON THE ADMISSIONS.

To investigate the influence of the elements of weather on the incidence of disease, the weeks of the seven years were separated into those in which the type was mainly cyclonic, and into those during which the distribution of pressure was anticyclonic. In some cases I had to exercise my judgment with regard to the prevailing type,—that is to say, that in some instances where there were moderate gradients or small shallow local secondaries, the type was determined by the weather conditions accompanying them. The weeks were also divided into those in which the maximum temperature rose above 60° Fahr., and into those in which the thermometer did not reach that figure. The direction of the prevailing wind during each week was also noted, whether it was west by south, or east by north, but the results of this last item were so uniform, the direction of the wind had so little effect on the admissions that I have not burdened this paper with the details. The mean weekly rainfall also corresponded to the type

of weather very closely, and has not been made much use of in the sequel, in the fear that too much detail might obscure the main points of the communication.

In the following short table the weeks of the seven years have been divided into cyclonic and anticyclonic, and into those with a temperature which rose above 60° and those in which the temperature remained below the point.

Year.	Cyclonic.	Anticyclonic.	+60°.	−60°.
1888–89, ...	30	22	27	25
1889–90, ...	35	17	28	24
1890–91, ...	26	26	31	21
1891–92, ...	34	18	30	22
1892–93, ...	22	30	30	22
1893–94, ...	37	15	32	20
1894–95, ...	29	23	27	25
Total, . . .	213	151	205	159
Mean, . . .	30·4	21·5	29·2	22·7

During the seven years the type of weather was cyclonic in 30·5 of the fifty-two weeks on an average, and anticyclonic in 21·5. The temperature works out at very nearly the same figures, 29·2 weeks above, and 22·7 below 60°.

In Table IV. the relation between these meteorological factors and the weekly admissions is shown. The total number for each year is given above, the weekly means below, in each section.

First the ordinary average for the fifty-two weeks is shown, and then the average weekly admissions in relation to the type of weather and the temperature.

Cases of respiratory disease were admitted in larger numbers when the temperature remained below 60°, and when the type was cyclonic. The same holds good in the admissions of patients suffering from pleurisy, when considered separately. On the other hand, pneumonia was more prevalent in anticyclonic weather.

Reference to Table III. shows that the proportion of the total number of respiratory cases to the total number of admissions for all diseases was higher in three of the seven years 1890–92–94. These three years were marked by a greater prevalence of cyclonic weather than the other four, as reference to the table above will show.

Patients suffering from disease of the heart were admitted in greater numbers when the barometer was low and the temperature high. The same may be said of the kidney cases, while rheumatic affections were more numerous in anticyclonic weather and when the thermometer did not reach 60°. The figures for the nervous cases show a slight increase during anticyclonic weather and when the temperature was above 60°; the same applies to the digestive system. Cases of chorea and appendicitis were admitted in greater numbers when the barometric type was anticyclonic, while the

weekly number of deaths in the Medical Wards was also greater with a high barometer, a slight increase being noted in warm as compared with colder weeks.

Some objection might be taken to the inclusion of cases of chronic disease among the other figures, but it must be remembered that most cases of chronic disease admitted into the Infirmary were taken in for an acute or sub-acute exacerbation.

TABLE IV.—*Showing the Weekly Admissions in connection with the Type of Weather and the Temperature for Seven Years, with the Means added.*

Year	1888–89.	–90.	–91.	–92.	–93.	–94.	–95.	Total.	Mean.
Respiratory.									
Total, . . .	697	800	815	844	809	913	960	5838	834
Weekly, . .	13·3	15·3	15·3	16·2	15·5	17·5	18·6	111·76	15·96
Cyclonic, . .	12·9	19·5	15·0	17·0	13·9	17·9	18·0	114·2	16·31
Anticyclonic, .	14·17	13·9	16·9	14·6	16·6	16·0	19·0	111·2	15·88
Temp. below 60°, .	13·8	17·2	17·8	18·3	16·7	18·8	19·3	121·9	17·41
Temp. above 60°, .	13·0	13·7	14·5	13·5	14·5	13·1	17·3	99·6	14·21
Pneumonia.									
Total, . . .	106	140	141	189	183	182	173	1114·0	159·1
Weekly, . .	2·03	2·69	2·71	3·63	3·51	3·5	3·3	21·37	3·05
Cyclonic, . .	1·8	2·77	3·0	3·5	2·73	3·3	3·3	20·4	2·91
Anticyclonic, .	2·4	2·55	2·42	3·69	4·13	3·6	3·3	22·09	3·15
Temp. below 60°, .	2·16	2·96	2·8	3·83	3·15	3·1	3·4	21·40	3·05
Temp. above 60°, .	1·92	2·42	2·63	3·33	3·76	4·00	3·2	21·26	3·03
Pleurisy.									
Total, . . .	116	146	163	151	102	145	119	942	134·5
Weekly, . .	2·23	2·8	3·13	2·9	1·9	2·78	2·2	17·94	2·56
Cyclonic, . .	2·52	2·93	3·15	3·36	1·50	2·40	2·2	18·06	2·58
Anticyclonic, .	1·64	2·6	3·11	2·1	2·26	3·03	2·2	16·94	2·42
Temp. below 60°, .	2·25	2·92	3·18	3·15	2·13	2·70	2·20	18·53	2·64
Temp. above 60°, .	2·21	2·69	3·09	2·50	1·83	2·80	2·30	17·42	2·48
Cardiac.									
Total, . .	310	261	368	387	400	370	395	2491	355·8
Weekly, . .	5·96	5·01	7·07	7·44	7·69	7·3	7·63	48·1	6·87
Cyclonic, . .	6·00	5·27	6·65	8·36	7·18	7·40	7·60	48·46	6·92
Anticyclonic, .	5·94	4·90	7·30	6·90	8·00	5·70	7·50	46·24	6·6
Temp. below 60°, .	6·08	4·96	7·20	7·25	7·59	6·50	7·80	47·38	6·76
Temp. above 60°, .	5·89	5·34	6·80	7·75	7·70	7·60	7·40	48·48	6·92
Kidney.									
Total, . . .	152	181	157	172	200	221	177	1260	180
Weekly, . .	2·9	3·40	3·00	3·30	3·80	4·30	3·40	24·1	3·44
Cyclonic, . .	2·6	3·50	2·70	3·2	3·9	4·40	3·80	24·2	3·45
Anticyclonic, .	3·4	3·40	3·30	3·30	3·80	3·80	2·80	23·8	3·40
Temp. below 60°, .	2·5	3·10	2·40	2·70	4·10	4·20	3·60	22·6	3·22
Temp. above 60°, .	3·2	3·70	3·30	3·70	3·60	4·20	3·10	24·8	3·54

TABLE IV.—*Showing the Weekly Admissions in connection with the Type of Weather and the Temperature for Seven Years, with the Means added*—continued.

Year	1888-89.	-90.	-91.	-92.	-93.	-94.	-95.	Total.	Mean.
Rheumatism.									
Total, . . .	54	103	82	59	107	181	168	754	107·7
Weekly, . .	1·03	1·98	1·57	1·11	2·05	3·40	3·20	14·34	2·04
Cyclonic, . .	0·94	1·98	1·76	1·03	2·04	3·30	2·10	13·15	1·87
Anticyclonic, .	1·11	2·10	1·46	1·26	2·13	3·80	4·50	16·36	2·33
Temp. below 60°, .	1·25	1·96	1·90	1·25	2·31	3·40	3·50	15·57	2·22
Temp. above 60°, .	0·78	1·98	1·41	0·9	1·93	3·40	2·80	13·2	1·88
Nervous.									
Total, . . .	612	590	687	579	679	690	683	4520	645·7
Weekly, . .	11·7	11·3	13·2	11·0	13·0	13·2	13·1	86·5	12·36
Cyclonic, . .	11·5	11·2	12·0	10·9	13·9	13·6	13·2	86·3	12·32
Anticyclonic, .	12·1	11·5	14·4	11·4	12·4	12·2	13·0	87·00	12·42
Temp. below 60°, .	12·8	10·1	13·3	11·2	13·0	13·6	11·6	85·60	12·2
Temp. above 60°, .	10·7	12·6	13·0	11·0	13·3	13 0	14·5	88·1	12·58
Digestive.									
Total, . . .	449	462	469	534	569	569	675	3727	532·4
Weekly, . .	8·6	8·9	9·0	10·2	10·9	10·9	13·0	71·5	10·21
Cyclonic, . .	8·9	9·0	9·0	9·9	10·0	10·0	12·8	69·6	9·94
Anticyclonic, .	8·5	8·6	8·9	10·4	11·5	11·3	13·1	72·3	10·32
Temp. below 60°, .	9·3	8·8	8·3	9·5	10·9	10·9	13·0	70·7	10·1
Temp. above 60°, .	7·9	8·7	9·4	10·6	10·9	10·9	13·2	71·6	10·22
Chorea.									
Total, . . .	28	39	60	41	38	46	62	314	44·8
Weekly, . .	0·53	0·75	1·15	0·78	0·73	0·88	1·19	6·01	0·86
Cyclonic, . .	0·53	0·60	1·00	0·61	0·81	0·81	1·27	5·63	0·80
Anticyclonic .	0·53	1·05	1·30	1·11	0·66	1·06	1·08	6·79	0·97
Temp. below 60°, .	0·60	0·66	1·28	0·59	0·77	1·00	1·28	6·18	0·88
Temp. above 60°, .	0·47	0·81	1·06	0·93	0·70	0·81	1·10	5·88	0·84
Appendicitis and Perityphlitis.									
Total, . . .	19	17	21	21	32	44	72	226	32·2
Weekly, . .	0·36	0·32	0·4	0·4	0·61	0·84	1·38	4·31	0·61
Cyclonic, . .	0·43	0·25	0·34	0·32	0·63	0·77	1·51	4·25	0·60
Anticyclonic, .	0·27	0·47	0·46	0·55	0·6	1·00	1·21	4·56	0·65
Temp. below 60°, .	0·48	0·20	0·40	0·22	0·63	0·75	1·36	4·04	0·57
Temp. above 60°, .	0·25	0·42	0·41	0·53	0·60	0·90	1·40	4·51	0·64
Mortality.									
Total, . . .	331	358	362	366	422	370	429	2638	376·8
Weekly, . .	6·36	6·88	6·96	7·03	8·11	7·11	8·24	50·69	7·24
Cyclonic, . .	6·00	7·21	6·92	6·87	7·77	7·10	7·30	49·17	7·02
Anticyclonic, .	7·05	6·35	7·00	7·31	8·20	7·00	9·40	52·31	7·47
Temp. below 60°, .	6·20	6·69	6·80	6·65	7·90	7·40	8·60	50·24	7·17
Temp. above 60°, .	6·50	7·07	7·06	7·65	8·26	6·90	8·20	51·64	7·27

Influenza.

Sir Arthur Mitchell and Dr Buchan published two papers in the *Journal of the Scottish Meteorological Society* in the numbers for 1889 and 1890, dealing in an exhaustive manner with the two epidemics of Influenza which occurred in London, as well as in the rest of the country, during the course of these years. By making use of the mortality returns they deduced several very striking facts; while, on further comparing these returns with the weather conditions for periods both before and during the epidemics, they found very little connection between the two. Their figures dealt with the deaths due to or occurring with the prevalence of influenza, and they remarked that some further statistics dealing with actual cases of the disease would be of value.

Influenza has been epidemic in this country on twenty-three occasions from the year 1510 to the year 1890. A considerable interval intervened between the great majority of the attacks.

List of Epidemics.

1510	1675	1767	1831	1855	1893
1557	1709	1775	1833	1857–8	1893–4
1580	1732–3	1782	1836–7	1889–90	1895
1587	1743	1789–90	1847–8	1891	...
1591	1762	1803	1850–1	1891–2	...

It is worth noting that five epidemics occurred in the sixteenth century, only one in the seventeenth, eight in the eighteenth, and, up to 1895, as many as fourteen in the present century. Since the winter of 1889–90 we have passed through no fewer than six distinct epidemics, varying in intensity. At no period from the beginning of the sixteenth century until six years ago have there been so many attacks in so short a time. From 1510 to 1889 the number of years which intervened between the different epidemics averaged sixteen. In six instances only the attacks followed one another at all closely, viz., in 1587, 1591, 1831, 1833, and in 1855, 1857–8. The occurrence of influenza in epidemic form on so many separate occasions during the last six years brings the number of recorded outbreaks since 1510 up to twenty-eight in 385 years, or one in every 13·7 years. The occurrence of six well-marked epidemics of influenza during the last six years must have had a great influence on the incidence of disease in the same period, when we remember the vigorous action of the poison on the respiratory, the circulatory, and the nervous systems. From the statistics of the Edinburgh Royal Infirmary it is clear that sixty-eight weeks out of the 312 from 1st Oct. 1889, to 30th Sept. 1895, were marked by the prevalence of influenza in epidemic form, that is to say, one week in every four and a half. In order that these figures might be verified Dr K. M. Douglas kindly gave me the numbers of cases of this disease occurring among the staff of the Post Office in Edinburgh for the same period. The figures obtained from the Post Office are particularly valuable, as the total number of those who could be attacked is known, the cases are all drawn from one class, and that

class is, by reason of its work, the first to be attacked among the community. On the other hand, the numbers being limited, the end of the epidemic does not correspond with the end of the attack when all classes are involved, as is the case in the Infirmary. The data, then, derived from the Post Office returns are of value in arriving at the true date of the onset, but not of the duration of the epidemic. In dealing with the records of the Infirmary it must also be remembered that cases of influenza are rarely admitted simply as influenza, as they are usually unsuitable for treatment in a hospital which does not admit cases of infectious disease. In fact, most of the cases are admitted for acute complications, of which the cause may not be found until after residence in hospital, when a history of a preceding attack of influenza is elicited.

Sir ARTHUR MITCHELL and Dr BUCHAN, in the papers already quoted, point out that the epidemics of influenza recorded in this country have usually occurred during the winter months, and have then been accompanied by complications which were chiefly respiratory and circulatory in type. In spring epidemics the nervous centres showed a greater tendency to be implicated; and in the only summer epidemic previously recorded in this country during the nineteenth century, diarrhœal disorders were very prevalent. These authors were unable to trace any connection between the weather, as regards the element of temperature, and the epidemics of 1889–90.

GENERAL DESCRIPTION OF THE SIX EPIDEMICS.

In the records of the Edinburgh Royal Infirmary from 1888 to 1895, the first case of influenza admitted into the hospital was registered in the week ending the 21st of December 1889, one week later than the first death registered in London from that disease. The first case diagnosed as influenza among the employees of the Post Office occurred on 20th December, a fact which corresponds so closely with the Infirmary records that the beginning of the first epidemic may be definitely stated to be the week 15th–21st December 1889. The maximum in the Post Office occurred in the following week, in the Infirmary not till the second week of 1890, a week earlier than the maximum *mortality* from influenza in London. The Post Office epidemic had practically ceased by the middle of January, but cases continued to be admitted into the Infirmary until the week ending 15th February. The epidemic may therefore be regarded as having lasted for nine weeks. Single cases were reported in the Infirmary up to the end of June.

No further entries were made in the books until the third week of November 1890, when two isolated cases were admitted. Scattered cases continued to be taken in until May 1891, when the numbers increased considerably, and only began to diminish early in July. In the Post Office, patients were invalided owing to influenza in rather scanty numbers throughout March and April, and in greater numbers in May and June. The epidemic, however, never reached any great proportions. In London it started in the middle of April. A glance at the numbers of respiratory cases treated at the Infirmary

for the month of April shows that it was much above the average. The epidemic of this year may therefore be assumed to have begun in Edinburgh and district about the middle of the month, and to have gone on until the end of the week ending 11th July, a period of thirteen weeks.

The admission of cases of influenza practically ceased from the date last mentioned until 25th October 1891. During the next sixteen weeks patients suffering from influenza were admitted in large numbers. This attack proved to be the worst of the six, with regard to the results, in the Infirmary. The maximum may be assigned to the week ending 5th December 1891, and the end of the epidemic to the week ending 13th February 1892, although scattered cases were taken in for some time afterwards. The Post Office records agree in almost every particular with those from the Infirmary. The epidemic commenced at the same date, reached its highest level during the same week, but diminished sooner, as might be expected.

The attack which occurred in the spring of 1893 can hardly be dignified with the name of an epidemic, if the number of patients admitted for the disease be alone considered. A great increase, however, took place in the admissions of respiratory cases, an increase which, being out of season, must be looked upon as due to some abnormal cause. In the Post Office, influenza was present in a mildly epidemic form during March and April, commencing on the 15th of March. From this fact, and owing to the rise in the respiratory admissions after 11th March, the beginning of this epidemic may be assigned to the week commencing at that date. A short attack, lasting to the end of April, it only continued for seven weeks.

The fifth epidemic of the series began towards the end of October 1893 and lasted until the end of January 1894. I have given the date of the commencement of this epidemic on 15th October, as agreeing with the Infirmary records, but the postmen were not affected until the 21st. The maximum in the Post Office occurred in the second and third weeks of November, while in the Infirmary it was not reached until the first week of December.

List of Epidemics.

Year.	Duration.	Winter.	Spring.	Summer.
1. 1889–90, . .	9 weeks	Dec. 15–Feb. 15	...	...
2. 1891, . . .	13 „	...	...	Apr. 12–July 11
3. 1891–92, . .	16 „	Oct. 25–Feb. 13	...	...
4. 1893, . . .	7 „	...	Mar. 11–Apr. 28	...
5. 1893–94, . .	16 „	Oct. 15–Jan. 31	...	...
6. 1895, . . .	7 „	...	Feb. 11–Mar. 31	...
Total weeks, .	68	41	14	13

The other months of 1894 were comparatively free from influenza, a few cases being recorded in December. In February 1895 it again became epidemic, and reached its

height in the middle of March. The actual duration of the attack was only seven weeks, viz., from 11th February to 31st March. The Post Office figures coincide in every particular.

Of the six epidemics, three occurred in winter, two in spring, and one in early summer. If the total number of weeks be added together in which influenza was epidemic during the last six years, we arrive at the large figure of sixty-eight,—that is, one in every four and a half.

The spring epidemics were, as a rule, of shorter duration than those occurring in the winter, the one summer attack holding a mediate position.

For the sake of clearness, the subjects of the weather on influenza, and of the influence of influenza on disease, are taken up *seriatim* in the sequel, first in connection with each epidemic, secondly with regard to the epidemics treated together.

Number of Cases involved.

Before considering the relations between the epidemics and the weather, it would perhaps be as well to give the number of patients attacked during the course of each epidemic, both in the Infirmary and in the Post Office. As the total number of the possible patients in the Post Office is close upon 1000 (probably a little above that figure), the percentage attack can be calculated.

Number of Cases.

Year.	Infirmary.	Post Office.	Percentage in Post Office.
1889–90, ...	26	95	9·5
1891, ...	28	35	3·5
1891–92, ...	189	139	13 9
1893, ...	19	15	1·5
1893–94, ...	59	116	11·6
1895, ...	44	74	7·4
Total, . .	365	474	47·4
Per year, . .	60·8	79·0	7·9

The three winter epidemics have therefore been the most severe, judging by the number of cases of pure influenza which were recorded during their course.

The Weather and Influenza.

1. The first epidemic, which began on the 15th of December 1889, and continued for nine weeks, was preceded by six weeks of cyclonic weather, which was not, however, accompanied by a heavy rainfall. The temperature had been a little above the mean

for the seven years, and did not show any marked diurnal variations. Throughout the course of the epidemic the type continued to be almost exclusively cyclonic, with a heavy rainfall, a high temperature, and a great deficiency of sunshine. The four weeks immediately following were also chiefly cyclonic, but with a smaller precipitation. The wind throughout was westerly, except during the last week of the epidemic and the next two, when it was from the east. (The actual figures for these statements will be found in Table V.)

2. The summer epidemic of 1891, from 13th April to 11th July, followed a fine winter and spring, during which anticyclonic conditions were largely prevalent. Anticyclones reigned supreme from the middle of November to the end of February, practically without a break. The extremes of temperature were widely separated from each other, and the rainfall was small. In March barometric depressions from the Atlantic governed the type of weather, with an increased rainfall. It was during this weather that the respiratory cases in the Infirmary began to increase, but it was not until the type again changed to the anticyclonic that the epidemic could be said to have commenced. A study of the figures for the six weeks preceding shows that the rainfall was above the normal, the temperature low, and the percentage of sunshine small. When the epidemic began, the type was anticyclonic. While the epidemic lasted the type remained largely anticyclonic, or with small local cyclones, the rainfall was not excessive, and the sunshine plentiful. During the last two weeks the rainfall became very heavy, and continued so for the four following weeks, with cyclonic weather and west winds. The temperature throughout remained high. In this case, then, the epidemic was preceded by wet weather and a low barometer, took place in dry weather (if the last two weeks be missed out, when the attack was declining), and was followed by wet, cyclonic weather in its turn.

3. The great winter epidemic of 1891–92 (25th October to 13th February) followed an extremely wet and broken autumn. September and October were particularly wet, though not cold, while the chief type of weather was cyclonic. If the figures for the six weeks preceding this epidemic be consulted, it will be seen that their mean rainfall was nearly an inch and a half, and the weather cyclonic throughout. The maximum temperatures registered during these weeks were above 60°. Simultaneously with the establishment of an anticyclone, with east wind, practically no rain, and a diminution in the temperature, the epidemic commenced. The anticyclone only lasted for two weeks, and during the rest of the epidemic the type was mainly cyclonic. The rainfall and amount of sunshine registered varied very markedly, but had no influence on the course of the disease. The maximum thermometer never rose above 60°, while the minima on several occasions fell below 10°. As the epidemic subsided the weather changed its character, not so much in its type, which was very variable, as in the diminished rainfall and the presence of great extremes in the temperature. The advent of warmer weather and more equable days saw the disappearance of the epidemic. A long period of cyclonic conditions, extending over ten weeks, in the autumn of the

same year, accompanied by a heavy rainfall, was marked by the occurrence of a few cases of influenza towards its close. No further cases, however, were registered until the spring of the next year. The epidemic of 1891–92 was therefore ushered in, after a preceding period of cyclonic weather with a heavy rainfall, by an accompanying change to anticyclonic conditions, but, unlike the last, it declined at a time when there was no excessive rainfall.

4. The fourth epidemic, although small in extent, seems to me to be the most interesting of the series. The temperature in the first two weeks of January 1893 fell to a very low point, under the influence of anticyclones which had persisted from the middle of December. In the third week of the year the barometer was affected by depressions to the west and north of our islands. These continued until the week commencing on the 5th of March, when anticyclonic conditions again resumed their sway, and continued unchecked until 23rd June, sixteen weeks later. Of the six weeks which preceded the epidemic, five were cyclonic in type, with a heavy rainfall, and a high temperature for the time of year. The last week before the outbreak was anticyclonic, and such conditions continued throughout the epidemic, with practically no rainfall until the last two weeks. The temperature remained uniformly high, rising above 70° in the last weeks of the outbreak. The weather for the four weeks after the subsidence of the epidemic continued to be anticyclonic in type, but with a slightly increased rainfall, less sunshine, and a greater mean temperature.

The fourth epidemic was therefore preceded by a wet period, ushered in by dry weather, accompanied by great heat, and its close occurred in slightly wetter weather, but under anticyclonic conditions.

5. The middle of October 1893 saw the advent of still another outbreak, the third of the winter epidemics. The six weeks before may be divided into two parts. The first four were influenced by cyclones, and were consequently warm and wet; the last two—that is, those immediately preceding the attack—were anticyclonic, colder, but still with a considerable rainfall. Throughout the sixteen weeks during which the influenza lasted, the weather remained cyclonic, with a heavy rainfall. At the close of this period the precipitation became very large—2·2 inches in two weeks. The four following weeks were also very wet, with a mean of 1·32 inches. Coincident with this heavy rainfall, the epidemic subsided. The fifth epidemic, therefore, began after a short anticyclone had become established over our islands, continued during a long spell of cyclonic weather with a considerable rainfall, but was, so to speak, drowned out by the heavy rains of the last two weeks of January and of the whole of February.

6. The sixth and last epidemic of which this paper treats took place in the spring of 1895 (11th February to 31st March), following a period of severe cold, and persisting through, for the first two weeks, a still more intense frost. In this case, again, the preceding weeks were cyclonic in character, with a marked rainfall, and with a great deficiency of sunshine. And again the epidemic began on the establishment of anticyclonic conditions. The rainfall was very small until the last two weeks of the

epidemic,—indeed, the precipitation of these two exceeded the total of the other five. Cyclones prevailed in the weeks after, with a very moderate rainfall. The sixth visitation of our modern plague thus commenced after cold and wet weather, continued in very cold but drier weather, and subsided in warmth with a moderate rainfall.

TABLE V.—*Meteorological Conditions prevailing before, with, and after the Different Influenza Epidemics.*

Period.	Type.		Mean Temperature.	Mean Rainfall.	Percentage Sunshine.
	Cyclonic.	Anticyclonic.			
1. *Epidemic of* 1889–90.					
6 weeks before, . .	6	0	41·06	0·21	23·5
2 first weeks, . . .	1	1	40·85	0·5	6·0
9 weeks of epidemic, .	7	2	39·36	0·7	19·4
Last 2 weeks, . . .	1	1	36·4	0·25	30·0
Next 4 weeks, . . .	2	2	39·36	0·4	23·75
2. *Epidemic of* 1891.					
6 weeks before, . .	5	1	37·08	0·58	28·5
First 2 weeks, . . .	0	2	41·3	0·15	42·0
13 weeks of epidemic, .	6	7	49·07	0·38	34·8
Last 2 weeks, . . .	1	1	57·1	0·85	30·0
Next 4 weeks, . . .	3	1	57·12	0·67	26·5
3. *Epidemic of* 1891–92.					
6 weeks before, . .	6	0	49·92	1·42	29·2
First 2 weeks, . . .	0	2	41·75	0·05	24·0
16 weeks of epidemic, .	11	5	38·01	0·6	21·9
Last 2 weeks, . . .	1	1	40·1	0·3	31·5
Next 4 weeks, . . .	3	1	32·3	0·5	20·2
4. *Epidemic of* 1893.					
6 weeks before, . .	5	1	39·23	0·63	25·0
First 2 weeks, . . .	0	2	41·38	0·1	55·0
7 weeks of epidemic, .	0	7	44·61	0·18	45·0
2 last weeks, . . .	0	2	47·75	0·3	36·5
Next 4 weeks, . . .	0	4	51·32	0·27	33·0
5. *Epidemic of* 1893–94.					
6 weeks before, . .	4	2	49·65	0·63	35·3
First 2 weeks, . . .	2	0	49·45	0·5	27·0
16 weeks of epidemic, .	13	3	39·77	0·66	19·6
Last 2 weeks, . . .	2	0	37·3	1·1	24·0
Next 4 weeks, . . .	4	0	38·0	1·32	33·0
6. *Epidemic of* 1895.					
6 weeks before, . .	5	1	29·35	0·58	16·6
First 2 weeks, . . .	0	2	26·45	0·15	41·0
7 weeks of epidemic, .	3	4	35·24	0·42	26·5
Last 2 weeks, . . .	2	0	41·6	0·9	21·5
Next 4 weeks, . . .	3	1	43·87	0·35	32·3

The preceding table (Table V.) gives the figures for the different epidemic periods, and for the weeks immediately preceding and following them. A glance at the table shows that the conditions were very variable in many respects, regular in others. The most constant condition was the decreased rainfall at the time when the disease was becoming epidemic. Another point that may be noted was the prevalence of anti-cyclonic weather at that time. The outbreaks of 1889–90 and of 1893–94 continued during wet weather; in the four other epidemics the rainfall during the continuance of the attack was very small.

Reference to the next table (Table VI.) makes several of these points much clearer. In this table the six weeks before each epidemic are considered together, and the same is done with the other different periods during and after the attacks. The mean for the same weeks for the seven years has also been worked out, and placed alongside the other figures for reference. The first thing which will attract attention is great disproportion between the number of weeks before the epidemics in which the type of weather was cyclonic to those in which the type was anticyclonic,—cyclonic 31, anticyclonic 5, in the thirty-six weeks. The mean for these weeks in the seven years was 26 to 10. The temperature for the preceding periods of six weeks was lower

TABLE VI.—*Meteorological Conditions prevailing during the Total Epidemic Periods.*

	Cyclonic.	Anticyclonic.	Mean Temperature.	Mean Rainfall.	Percentage Sunshine.
1. *The* 36 *weeks preceding the six attacks.*					
The 36 weeks, ...	31	5	41·37	0·67	26·3
Mean for same weeks in 7 years, . . .	26	10	43·01	0·56	...
2. *The first* 2 *weeks of all the Epidemics.*					
The 12 weeks, ...	3	9	40·22	0·24	32·5
Mean for same weeks in 7 years, . . .	9	3	41·27	0·56	...
3. *The* 68 *weeks of the Epidemics.*					
The 68 weeks, ...	40	28	41·21	0·47	27·8
Mean for same weeks in 7 years, . . .	40	28	41·31	0·53	...
4. *The last* 12 *weeks of the Epidemics.*					
The 12 weeks, ...	7	5	43·82	0·61	28·9
Mean for same weeks in 7 years, . . .	7	5	42·36	0·53	...
5. *The* 24 *weeks following the Epidemics.*					
The 24 weeks, ...	16	8	43·28	0·56	28·12
Mean for same weeks in 7 years, . . .	14	10	43·08	0·49	...
6. *The* 36 *weeks* (4 *and* 5) *at close of Epidemics.*					
The 36 weeks, ...	23	13	43·47	0·58	27·5
Mean for same weeks in 7 years, . . .	21	15	42·84	0·5	...

than the mean, while the rainfall was higher. The first two weeks of each attack, taken collectively, were characterised by very different weather conditions. During these 12 weeks, anticyclones prevailed in 9, cyclones in only 3,—exactly opposite to the normal conditions in the mean of seven years. The temperature was again lower, while the rainfall was less than half the mean, and about a third of the rainfall for the preceding weeks. The distribution of barometric pressure for the 68 weeks of the epidemics was normal, a remark which also applies to the mean temperature, while the rainfall was slightly less. If the last two weeks of each of the epidemic periods be considered separately from the total, we find that the type was normal, the rainfall heavier, and the temperature a degree higher than the means for the same weeks in seven years.

I do not wish to draw any conclusions from these facts, but simply to state that the figures adduced seem to suggest that a type of weather which is liable to cause catarrhs and other affections of the respiratory tract precede the epidemics, but that the occurrence of influenza in *epidemic form* does not appear to take place until another and drier type has been established. In the preceding period evidences that the disease is present are not wanting, but the number of cases are few. As the weather changes the numbers go up with a rush. I had expected to find more evidence of excessive rainfall at the close of the attacks than I did, for this was only marked in four out of the six.

A suggestion has been made that the cause of influenza might be disseminated, apart from those cases carried by persons and by infected articles, by the currents of air, especially by those induced by the state of barometric pressure termed anticyclonic. The great majority of the pandemics of influenza have travelled over Europe from east to west at that time of the year when the weather of the continent was dominated by the great winter anticyclone which is almost constant at that period over Russia and Siberia. The air, following the well known rule that in anticyclonic systems the currents flow out from the centre, is constantly flowing from east to west from Russia over the countries of Central Europe, and it has been supposed that the germs of the disease might be disseminated by this current of air. It is quite possible that such might occur. Several of the epidemics of these latter years, however, have not been truly pandemic, and cannot thus be accounted for. On the other hand, as the movement of the air in cyclones in this country is, regarding the cyclone as a whole, from west to east,—the track of the majority of cyclones being in that direction,—one can understand how an air-borne disease, postulating that influenza is air-borne, is unlikely to be spread by the air-currents under such conditions. Apply this reasoning to the facts noted above, and perhaps the supposed rapid spread of influenza on the establishment of anticyclonic conditions may be explained. The air in the cyclonic vortex, drawn chiefly from the atmosphere over the ocean, is moist, and contains none of the contagion ; that of the anticyclone, derived from the higher strata, and thus from distant cyclones, descending, blows gently over the land to the nearest cyclone, and,

being drier, is more able to carry suspended particles with it. Temperature has nothing to do with the problem, except in so far as the different types of weather may modify it.

If reference be made to the "Annals of Influenza" we find that the epidemic of 1510 was preceded by a period of moisture, and followed by remarkable storms; the fact that nothing is recorded of the weather during the attack may indicate that it was dry and uneventful. The epidemic of 1580 was preceded by weather "of a moist, rainy, southerly constitution," and commenced in October, after the setting in of a cold dry wind. In 1758, in September, an outbreak occurred during easterly winds. The spring epidemic of 1782, probably the most widely spread of any, occurred in weather which was "cold, gloomy, humid, with occasional dry fogs." In the other epidemics the meteorological records are confused, and the weather generally reported as being variable. In Creighton's *History of Epidemics of Britain*, vol. 2, it is stated that the epidemic of influenza which occurred in the spring of 1658 was attended by a north wind. It again broke out in 1659, the following note being taken from Willis:—"having had no warm weather before, but a rainy and black week, the sun not appearing for five or six days together, just before the holiday (Easter), when on a sudden that warm weather breaking forth," the outbreak occurred. All these records point to the occurrence of similar phenomena to those noted during the majority of the epidemics of the last six years. I do not mean to assert that such meteorological conditions are by any means indispensable to the spread of influenza in epidemic form, but that they afford favourable facilities for it.

Influenza and the Admissions of the Different Classes of Disease.

In working out the effect of the different epidemics on disease, as represented by the admissions into the Medical Wards, I took, in the first place, the admissions for the weeks during which Influenza was prevalent; and secondly, for a period of 16 weeks, commencing one month after the close of each attack. The interval of a month was necessary to obviate the inclusion of any late cases of Influenza. A period of 12 weeks could only be taken after the epidemic of 1891, owing to the short time which elapsed before the epidemic of 1891–92 set in. The total admissions for these periods were first noted, and then the numbers of cases of different disorders. In the table (Table VII.) following, the figures so obtained have been arranged in columns. The first column contains the total numbers admitted during the periods under consideration. The second column represents the weekly average during the same periods, contrasted in the third column with the mean weekly averages for the year in which the epidemic took place. The last two columns show the percentage of the admissions of different classes of disease to the total numbers during the epidemic weeks, contrasted with the normal percentage of the year. At the head of these last two columns the relative percentages between the total admissions of the year, represented as 100, and the total admissions during the periods under review, are given.

The percentages are added to enable a comparison to be made between the different periods, without the varying element of different admission-rates intruding.

Reference to the first of these tables—that one which deals with the epidemic periods—reveals that in the 9 weeks of the first epidemic, that of 1889–90, every third case admitted suffered from disease of the Respiratory system. The normal proportion was a little over one in every five. Cases of Pneumonia and Pleurisy were very much more numerous than usual, while the number of deaths occurring in hospital were only slightly raised over the mean for the year. Putting it in another way, we find that the number of Respiratory cases admitted in the 9 weeks were increased 47 p.c., of Pneumonia 50 p.c., and of Pleurisy 64 p.c. above the normal. On the other hand, diseases of the Circulatory and Nervous systems were below the normal, the Nervous as

TABLE VII.—*Showing Admissions and Percentages during the Six Epidemics.*

	Totals.	Weekly.	Normal Weekly.	Percentage to Admissions.	Normal Percentage.
1889–90. 9 *Weeks.*					
Total Admissions,	615	68·3	67·8	100·8	100·0
Respiratory System,	204	22·6	15·3	33·1	22·3
Pneumonia,	36	4·0	2·69	5·8	3·96
Pleurisy,	41	4·5	2·8	6·6	4·1
Circulatory System,	41	4·5	5·01	6·6	7·3
Kidney Diseases,	33	3·5	3·4	5·3	5·1
Acute Rheumatism,	17	1·8	1·98	2·7	2·94
Nervous System,	87	9·66	11·3	14·1	16·8
Digestive System,	86	9·55	8·9	13·9	13·0
Mortality,	67	7·4	6·88	10·9	10·1
1891. 13 *Weeks.*					
Total Admissions,	1050	80·7	74·7	107·5	100
Respiratory System,	222	17·0	15·36	21·1	20·9
Pneumonia,	56	4·3	2·71	5·3	3·62
Pleurisy,	50	3·9	3·13	4·7	4·18
Circulatory System,	93	7·1	7·07	8·8	9·4
Kidney Diseases,	54	4·1	3·0	5·1	4·03
Acute Rheumatism,	17	1·03	1·57	1·6	2·09
Nervous System,	171	13·1	13·2	16·2	17·6
Digestive System,	116	8·9	9·0	11·0	12·0
Mortality,	104	8·0	6·96	9·9	9·3
1891–92. 16 *Weeks.*					
Total Admissions,	1219	76·1	72·6	105·0	100·0
Respiratory System,	356	22·2	16·2	29·2	22·3
Pneumonia,	79	4·9	3·63	6·4	5·0
Pleurisy,	64	4·0	2·9	5·2	4·0
Circulatory System,	121	7·5	7·44	9·9	10·2
Kidney Diseases,	42	2·6	3·3	3·4	4·5
Acute Rheumatism,	25	1·5	1·11	2·0	1·56
Nervous System,	160	10·0	11·0	13·1	15·3
Digestive System,	144	9·0	10·2	11·7	14·1
Mortality,	118	7·3	7·03	9·6	9·7

TABLE VII.—*Showing Admissions and Percentages during the Six Epidemics* —continued.

	Totals.	Weekly.	Normal Weekly.	Percentage to Admissions.	Normal Percentage.
1893. 7 *Weeks.*					
Total Admissions,	518	74·0	75·8	97·7	100·0
Respiratory System,	131	18·7	15·5	25·2	20·5
Pneumonia,	34	4·8	3·51	6·5	4·63
Pleurisy,	17	2·4	1·9	3·2	2·58
Circulatory System,	49	7·0	7·69	9·4	10·1
Kidney Diseases,	19	2·7	3·8	3·6	5·07
Acute Rheumatism,	12	1·7	2·05	2·3	2·7
Nervous System,	74	10·5	13·0	14·2	16·8
Digestive System,	73	10·4	10·9	14·0	14·4
Mortality,	54	7·8	8·11	10·4	10·69
1893–94. 16 *Weeks.*					
Total Admissions,	1207	75·4	78·4	96·2	100·0
Respiratory System,	290	19·2	17·5	24·0	22·3
Pneumonia,	69	4·3	3·5	5·7	4·46
Pleurisy,	41	2·5	2·78	3·3	3·5
Circulatory System,	104	6·5	7·3	8·6	9·07
Kidney Diseases,	57	3·5	4·3	4·7	5·4
Acute Rheumatism,	14	0·8	3·4	1·1	4·4
Nervous System,	195	12·2	13·2	16·1	16·8
Digestive System,	184	11·5	10·9	16·0	13·9
Mortality,	124	7·7	7·4	10·2	9·07
1895. 7 *Weeks.*					
Total Admissions,	680	97·1	90·1	108·0	100·0
Respiratory System,	178	25·4	18·6	26·2	20·4
Pneumonia,	42	6·0	3·3	6·2	3·69
Pleurisy,	18	2·5	2·2	2·6	2·5
Circulatory System,	58	8·2	7·63	8·5	8·4
Kidney Diseases,	18	2·5	3·4	2·6	3·5
Acute Rheumatism,	28	4·0	3·2	4·1	3·5
Nervous System,	73	10·4	13·1	10·7	14·5
Digestive System,	98	14·0	13·0	14·4	14·3
Mortality,	73	10·4	8·24	10·7	9·14

much as 15 p.c.; cases of Acute Rheumatism were also less than usual, while diseases of the Kidney and of the Digestive system were very slightly in excess. The weather record for the same period shows it to have been the wettest of the six, and at the same time we may notice that this epidemic was marked by a greater excess of Respiratory disorders than any of the others.

The table for the 13 weeks of 1891 shows that the total Respiratory cases were not nearly so numerous, although the cases of Pneumonia were again much above the average. The total admissions were 7·5 p.c. above the normal for the year, the Respiratory cases 11 p.c., Pneumonia 55 p.c. and Pleurisy 25 p.c. The admissions for diseases of the other systems correspond very closely to those noted in the previous epidemic.

The total admissions for the 16 weeks of the third epidemic, 1891–92, were 5 p.c. above the normal, the mortality slightly below. The Respiratory cases were again much above the mean, 36 p.c., Pneumonia 36 p.c., and Pleurisy 36 p.c.— a curious similarity; while all the other classes investigated were below the average except that of Acute Rheumatism, which was slightly above it.

During the epidemic of 1893, a spring epidemic, the total admissions were 2·3 p.c. below the normal, the Respiratory cases 20 p.c. above, Pneumonia 32 p.c., and Pleurisy 21 p.c. over the mean for the year; but if it be remembered that the epidemic occurred when these diseases are nearly at their lowest for the year, the increase is more marked in reality than the figures show. The numbers of all the other systems were down below the mean.

The outbreak which occurred during the winter of 1893–94, and lasted for 16 weeks, was not characterised by a great increase of Respiratory disorders, only 3 p.c., though the Pneumonia cases admitted were 23 p.c. above the mean. Pleurisy, on the other hand, was below the normal average, as much as 6 p.c. Diseases of the Digestive system were, however, above their average, as much as 6 p.c. The total admissions and cases from other systems were below the normal for the year.

The last epidemic occurred in the spring of 1895. During it the total admissions rose 8 p.c. over the year's mean, the Respiratory cases 35 p.c., Pneumonia 80 p.c., and Pleurisy 12 p.c. The excessive rise in the Pneumonia cases may be readily accounted for by the very severe weather of the period. The mortality was also above the mean, while the other classes were either below or about the normal for the year.

If the figures for the whole 68 weeks be treated in the same manner (Table IX. p. 602), we find the same relation between the cases and the total admissions. Thus the total admissions themselves were 3 p.c. above the average for seven years, cases of Respiratory disease 4·8 p.c. up, compared with the normal percentage of these cases to the total admissions, or, to put it differently, the actual increase in numbers over the normal was 9·1 p.c. The cases of Pneumonia admitted were increased 1·9 p.c. above the normal percentage to admissions, of Pleurisy 0·87 p.c. The actual increase over the normal was 54 p.c. for Pneumonia, the average for 68 weeks being 204 cases, the actual 316, and for Pleurisy 31 p.c., or 231 cases instead of 176. The number of deaths for the same weeks was below the mean if considered in relation to the total admissions, slightly above the actual mean in point of numbers. All the other systems investigated showed a diminution in numbers, the Nervous as much as 10 p.c.

Consideration of the facts adduced above shows that in all the six epidemics the Respiratory system was the one chiefly implicated, while there was a diminution in the cases of disease of other systems, both actually and in relation to the number of total admissions. The mortality in the Medical Wards was little altered.

A very different picture is presented by the figures of the periods following the Influenza epidemics. The tables (Table VIII.) for these periods have been drawn out in exactly the same manner as those relating to the epidemic weeks.

TABLE VIII.—*Showing Admissions and Percentages for the Periods of Sixteen Weeks after the Six Epidemics.*

	Totals.	Weekly.	Normal Weekly.	Percentage to Admissions.	Normal Percentage.
1889–90. 16 *Weeks.*					
Total Admissions,	1083	67·6	67·8	99·9	100·0
Respiratory System,	240	15·0	15·3	22·1	22·3
Pneumonia,	47	2·9	2·69	4·3	3·96
Pleurisy,	47	2·9	2·8	4·3	4·1
Circulatory System,	76	4·7	5·01	7·01	7·3
Kidney Diseases,	64	4·0	3·4	5·4	5·1
Acute Rheumatism,	24	1·5	1·98	2·2	2·94
Nervous System,	196	12·2	11·3	18·0	16·8
Digestive System,	141	8·8	8·9	13·0	13·0
Mortality,	104	6·5	6·88	9·59	10·1
1891. 12 *Weeks.*					
Total Admissions,	827	68·9	73·6	92·5	100·0
Respiratory System,	160	13·3	15·7	19·3	21·6
Pneumonia,	23	1·9	3·17	2·7	4·31
Pleurisy,	24	2·0	3·0	2·9	4·09
Circulatory System,	65	5·4	7·25	7·8	9·8
Kidney Diseases,	29	2·4	3·15	3·4	4·26
Acute Rheumatism,	13	1·08	1·34	1·5	1·8
Nervous System,	141	11·8	12·1	17·0	16·4
Digestive System,	114	9·5	9·6	13·7	12·05
Mortality,	62	5·1	6·99	7·4	9·5
1891–92. 16 *Weeks.*					
Total Admissions,	1148	71·7	72·6	98·8	100·0
Respiratory System,	244	15·2	16·2	21·2	22·3
Pneumonia,	65	4·0	3·63	5·6	5·0
Pleurisy,	38	2·3	2·9	3·3	4·0
Circulatory System,	146	9·1	7·44	12·7	10·2
Kidney Diseases,	63	3·93	3·3	5·49	4·5
Acute Rheumatism,	17	1·06	1·11	1·4	2·7
Nervous System,	173	10·8	11·0	15·0	15·3
Digestive System,	166	10·3	10·2	14·2	14·1
Mortality,	116	7·2	7·03	10·1	9·7
1893. 16 *Weeks.*					
Total Admissions,	1206	75·3	75·8	99·5	100·0
Respiratory System,	210	13·2	15·5	17·4	20·5
Pneumonia,	47	2·92	3·51	3·89	4·63
Pleurisy,	25	1·56	1·9	2·0	2·58
Circulatory System,	134	8·3	7·69	11·1	10·1
Kidney Diseases,	54	3·3	3·8	4·4	5·07
Acute Rheumatism,	28	1·7	2·05	2·3	2·7
Nervous System,	225	14·06	13·0	18·9	16·8
Digestive System,	182	11·3	10·9	15·0	14·4
Mortality,	122	7·6	8·11	10·1	10·69

TABLE VIII.—*Showing Admissions and Percentages for the Periods of Sixteen Weeks after the Six Epidemics*—continued.

	Totals.	Weekly.	Normal Weekly.	Percentage to Admissions.	Normal Percentage.
1893–94. 16 *Weeks.*					
Total Admissions,	1278	79·8	78·4	101·4	100·0
Respiratory System,	277	17·3	17·5	21·6	22·3
Pneumonia,	51	3·1	3·5	3·9	4·46
Pleurisy,	56	3·5	2·78	4·3	3·5
Circulatory System,	130	8·1	7·3	10·1	9·07
Kidney Diseases,	86	5·3	4·3	6·6	5·4
Acute Rheumatism,	58	3·6	3·4	4·5	4·4
Nervous System,	220	13·7	13·2	17·2	16·8
Digestive System,	155	9·7	10·9	12·1	13·9
Mortality,	107	6·7	7·11	8·29	9·07
1895. 16 *Weeks.*					
Total Admissions,	1447	90·4	90·1	100·4	100·0
Respiratory System,	295	18·4	18·6	20·3	20·4
Pneumonia,	54	3·3	3·3	3·7	3·69
Pleurisy,	41	2·5	2·2	2·8	2·5
Circulatory System,	123	7·7	7·63	8·1	8·4
Kidney Diseases,	59	3·7	3·4	4·0	3·5
Acute Rheumatism,	43	2·7	2·2	2·9	3·5
Nervous System,	231	14·4	13·1	15·9	14·5
Digestive System,	212	13·1	13·0	14·6	14·3
Mortality,	141	8·8	8·24	9·7	9·14

During the 16 weeks following the attack of 1889–90, and beginning one month after the attack had ceased, as explained above, the weekly averages show a practically normal admission-rate, a number of Respiratory cases slightly below the normal, although the cases of Pneumonia and Pleurisy were still in slight excess, while more patients were admitted with diseases of the Urinary and Nervous systems than was usual for the year. The excess of Nervous cases was as much as 9 p.c. Comparing the figures for the period of the epidemic with those for that after it, we find that the percentage to the total admissions of the Respiratory cases fell from 33·1 p.c. to 22·1 p.c., the mean for the year being 22·3 p.c.; the cases of Pneumonia and Pleurisy fell from 5·8 p.c. and 6·6 p.c. to 4·3 p.c. in each instance; Circulatory cases rose from 6·6 to 7·01 p.c., Nervous from 14·1 to 18·0 p.c.; while the mortality of the first period was 10·9 p.c. compared with 9·59 p.c. for the second.

Only 12 weeks could be taken at an interval of 4 weeks after the epidemic of 1891, owing to the quick return of the disease. During three weeks the total number admitted fell much below the year's average, 7·5 p.c., and cases belonging to the Respiratory, Circulatory, and Urinary systems were all below normal, those of the Nervous and Digestive above it. The mortality was very markedly below the annual mean. Con-

trasting these figures with those for the corresponding epidemic period, the differences become much more accentuated. For instance, the total admissions were 7·5 p.c. up in the one, 7·5 p.c. down in the other, the corresponding figures for the Respiratory system being 21·1 p.c. and 19·3 p.c., for Pneumonia 5·3 p.c. and 2·7 p.c., Pleurisy 4·7 p.c. and 2·9 p.c., the Nervous system 16·2 p.c. and 17·0 p.c., and for the mortality 9·9 p.c. and 7·4 p.c. The after-effects of this epidemic of Influenza were therefore very slight.

A study of the figures for the 16 weeks after the great epidemic of 1891–92 shows that they correspond very closely to those already given, the only points worthy of mention being that cases of Pneumonia still remained more numerous than usual, the Heart cases were much above the normal, while the Nervous cases were practically normal. Contrasting them with the figures for the epidemic period we find the following :—the total admissions were 5 p.c. above the mean during, and 1·2 p.c. below after, the epidemic, the Respiratory cases 29·2 p.c. and 21·2 p.c., Circulatory 9·9 p.c. and 12·7 p.c., and Nervous 13·1 and 15 p.c., the mortality 9·6 p.c. during, and 10·1 p.c. after. The Circulatory system seems, therefore, to have suffered the most in this instance.

The Circulatory and Nervous systems were most affected after the next epidemic also, the other figures calling for little notice. Comparing them as before with the figures for the epidemic weeks, the usual differences are well brought out again. The total admissions were below the normal during each period ; the Respiratory cases 25·2 p.c. and 17·4 p.c., Pneumonia 6·5 p.c. and 3·89 p.c., Pleurisy 3·2 p.c. and 2·0 p.c., Circulatory cases 9·4 p.c. and 12·1 p.c., Nervous cases 14·2 p.c. and 18·9 p.c., while the mortality was slightly below the mean in both periods. The epidemic of 1893 was followed, therefore, by an increase in Cardiac and Nervous affections, the latter very markedly.

The outbreak of 1893–94 is peculiar in that the total admissions during the epidemic were below the average for the year, and for the period after the attack above it, the figures being 96·2 p.c. and 101·4 p.c. respectively. The figures for the different classes of disease do not present much variation from those of the other post-epidemic periods, both the Circulatory and Nervous systems again showing an increased number of admissions.

The last epidemic, that of 1895, was followed by the same conditions, except that the Circulatory system did not suffer much, while the death-rate kept up above the normal. Perhaps the most striking point was the difference between the numbers of Nervous cases admitted during and after the epidemic : 10·7 p.c. to the total admissions during, they rose to 15·9 p.c. after the attack ; or, to put it in a different way, the increase in the actual numbers after the outbreak was 10 p.c., the decrease before 20·6 p.c.

The next table (Table IX.) shows the same figures considered in bulk,—that is, for the total period in which Influenza was epidemic, or 68 weeks, and for the 92 weeks which followed them, beginning 4 weeks after the close of the epidemics. The means taken, with which the numbers were compared, are for the seven years from October 1888 to October 1895. The total admissions of all cases into the Medical Wards were 3 p.c. above the mean during the epidemic periods, 0·6 p.c. above it for the succeeding weeks.

TABLE IX.—*Showing the Admissions during the Sixty-Eight Weeks in which Influenza was Epidemic, and their Percentage to the Total Admissions.*

	Totals.	Weekly.	Normal Weekly.	Percentage to Admissions.	Normal Percentage.
Total Admissions,	5289	77·7	75·5	103·0	100
Respiratory System,	1381	20·3	15·96	26·1	21·3
Pneumonia,	316	4·6	3·05	5·9	4·04
Pleurisy,	231	3·4	2·58	4·3	3·43
Circulatory System,	466	6·8	6·87	8·8	9·01
Kidney Diseases,	223	3·2	3·44	4·2	4·5
Acute Rheumatism,	113	1·6	2·04	2·1	2·7
Nervous System,	760	11·19	12·35	14·3	16·34
Digestive System,	701	10·3	10·21	13·2	13·41
Mortality,	540	7·9	7·24	10·2	9·59

Similar Table to show the Admissions, &c. for the Periods of Sixteen Weeks, beginning one Month after each Epidemic, or for Ninety-Two Weeks.

	Totals.	Weekly.	Normal Weekly.	Percentage to Admissions.	Normal Percentage.
Total Admissions,	6989	75·9	75·5	100·6	100
Respiratory System,	1426	15·5	15·96	20·3	21·3
Pneumonia,	273	2·9	3·05	3·9	4·04
Pleurisy,	231	2·5	2·58	3·3	3·43
Circulatory System,	674	7·3	6·87	9·63	9·01
Kidney Diseases,	355	3·85	3·44	5·08	4·5
Acute Rheumatism,	183	2·0	2·04	2·6	2·7
Nervous System,	1186	12·9	12·35	16·9	16·34
Digestive System,	970	10·5	10·21	13·8	13·41
Mortality,	646	7·0	7·24	9·2	9·59

If we take into account, in the first place, only the percentage figures to the total admissions, we find that the Respiratory cases admitted during the epidemic weeks constituted 26·1 p.c. of the whole, after the epidemics only 20·3 p.c., the normal being 21·3 p.c. Cases of Pneumonia were 5·9 p.c. of the total during, 3·9 p.c. after the epidemics, the normal mean being 4·04 p.c. The similar figures for Pleurisy were 4·3 p.c. during, 3·3 p.c. after, with a mean of 3·43 p.c. Cases of Heart disease constituted 8·8 p.c. during, 9·63 p.c. after the attacks, the normal being 9·01 p.c. Kidney diseases varied only slightly: 4·2 p.c. of the whole during the attacks, they formed 5·08 p.c. after them. Cases of Acute Rheumatism were below the normal in both instances. The Nervous system seemed to be less affected during the outbreaks than more affected after them, the figures being 14·3 p.c. before, 16·9 p.c. after, and the normal 16·34 p.c. The

corresponding figures for the Digestive system were 13·2 p.c. before, 13·8 p.c. after, with a normal of 13·41 p.c. The death-rate during the epidemics was 10·2 p.c., after them 9·2 p.c., the normal being 9·59 p.c.

From a consideration of these facts we must conclude that Influenza attacks the respiratory organs at the time, as of course is well known, while it does not seem to cause serious affections of the other systems, especially of the circulatory and nervous, until some time later. This fact is of considerable importance; for by the time these secondary results appear, the patient is generally out of the doctor's hands; and as they may appear very insidiously, they may not be properly treated until the disease has obtained a strong hold on the part affected.

Previous Epidemics of Influenza from 1848.

I have thought that it would be interesting and of value to investigate in a precisely similar manner the previous epidemics of Influenza recorded in the Infirmary books. Unfortunately the books for the period before 1838 were lost at the time of the opening of the present Infirmary building. Only the four epidemics which have occurred since 1848 could be considered. A relic of the past, however, exists in the form of a small register for 1782, in which an epidemic of Influenza can be clearly recognised.

Table showing the Weekly Admissions and the Percentages to Total Admissions for the Epidemics from 1848 *to* 1891.

	Year	1848–49. 23 Weeks.	1851. 18 Weeks.	1855. 18 Weeks.	1857–58. 22 Weeks.	1891–92. 23 Weeks.
Totals,		802	724	614	657	1724
Respiratory,	Weekly,	7·73	10·6	10·94	8·36	19·6
	Per cent.,	22·18	26·3	32·2	28·0	26·2
Pneumonia,	Weekly,	1·52	1·72	1·16	1·18	4·1
	Per cent.,	4·36	4·28	3·42	3·94	5·5
Pleurisy,	Weekly,	0·87	0·68	0·83	0·86	3·7
	Per cent.,	2·49	1·51	2·44	2·87	5·0
Cardiac,	Weekly,	0·65	1·2	1·72	2·36	6·9
	Per cent.,	1·87	2·02	5·04	7·88	9·2
Kidney,	Weekly,	1·21	1·06	1·84	1·22	2·5
	Per cent.,	3·49	2·62	5·37	4·1	3·4
Rheumatism,	Weekly,	0·69	1·88	0·44	1·0	1·3
	Per cent.,	1·99	4·69	1·3	3·34	1·8
Nervous,	Weekly,	2·82	4·7	3·44	3·91	10·7
	Per cent.,	8·14	11·7	10·1	13·1	14·3
Digestive,	Weekly,	5·04	3·5	2·61	2·4	8·9
	Per cent.,	14·46	8·97	7·65	8·06	11·8
Influenza,	Weekly,	5·21	1·06	0·5	0·36	8·7
	Per cent.,	14·83	2·62	1·46	1·23	11·7

As a short and clear method of presenting the facts about these epidemics, I have drawn up charts which graphically depict their course. A chart for the epidemic of 1891–92 has been added for comparison. The charts explain themselves, the upper parts representing the actual weekly numbers, the lower the percentages to the total admissions into the Medical Wards. The upper parts are not directly comparable, owing to the variations in the number of total admissions; the lower, as percentages of these total admissions, correspond exactly to one another (Charts II. to VI.).

The epidemic of 1848–49 was the most severe of any of those which I have recorded: as many as 14·83 p.c. of the total admissions for 23 weeks were due to this disease. It is interesting to note that in the Infirmary books it is termed "Fever Epidemic"; only in one instance is a case entered as Influenza. At the height of the attack as many as 16 cases were admitted in one week, giving a percentage of 39·2 p.c. In the figures for this epidemic and for the succeeding ones up to 1858 all fever cases were subtracted from the total admissions into the Medical Wards, as in those days infectious diseases were classed with the other medical cases. The most striking point observable in the chart which has been drawn out for this attack is the large number of patients admitted with Digestive disorders,—14·46 p.c. of the total number,—when compared with the numbers admitted during the other epidemics. It may be also observed that the increase corresponds with the height of the epidemic. Although the attack of Influenza in 1848–49 occurred during the winter months, the Respiratory system was not much affected, if we except cases of Pneumonia, which were in excess during the earlier part. Cardiac affections were very small in number—only 0·65 per week.

The epidemic of 1851, which lasted 18 weeks, was a spring attack, and chiefly remarkable for the large proportion of cases of Acute Rheumatism admitted,—1·88 per week, or 4·69 p.c. of the total number. The percentage for the last seven years was, as we have seen, 2·7 p.c., or a little more than half. The Respiratory cases also showed an increase. Nervous and Digestive cases were few in number.

Although the epidemic which occurred in the beginning of 1855 was very slightly marked in Edinburgh, so far, at any rate, as the admission of actual cases of Influenza was concerned, the percentage of Respiratory cases almost equalled that of the epidemic of 1889–90. In 1889-90 the percentage was 33·1 p.c.: in 1855, 32·2 p.c. Cardiac disease showed an advance on the previous attacks, while the number of Kidney affections were much above normal.

The attack of Influenza which occurred during the winter months of 1857–58 hardly merits the name of Epidemic, but the number of Respiratory cases increased coincidently with the admission of a few cases of Influenza,—a remark which also applies to the admissions of Pneumonia. Only 8 cases of Influenza were recorded at this time. Nervous cases show an increase at the time of the epidemic.*

* The weather conditions which preceded and followed these four epidemics do not correspond exactly

A similar chart was constructed for the epidemic of 1891–92, as the most representative of the later outbreaks, the figures in the upper part being represented half the scale of the other four. The percentages for the five epidemics are of course exactly comparable. A glance at these charts shows that Influenza has not changed its character or its ways from 1848 to the present time, and that the popular idea that the results as at present experienced are much worse than they ever were in the good old days when small-pox killed its thousands, and anti-diphtheritic toxin was unheard of, is not borne out by the facts presented to you.

Description of the Large Chart (Chart I.).

The first chart represents in a graphic form all the data from which the foregoing deductions were made. Each division represents a week, the years are separated by red lines, and the quarters by similar but thinner lines. By an oversight, which was not discovered until too late, two weeks were omitted in the chart for the last quarter of 1889; the numbers for these weeks have been ignored in drawing out the chart, but in no case were they of any unusual significance. The first red line represents the actual number of cases of Respiratory disease admitted during each week, each division corresponding to one admission.

The curve immediately below is a representation of the respiratory cases, "Bloxamed" to fives, *i.e.*, the mean of each successive five weeks is entered for the third or middle week of the period, above 15 being shaded in red, below it in blue.

The actual number of cases of Influenza which occurred in the Infirmary are shown, per week, by dark blue squares—each square, one case.

Immediately below, blue shading indicates the cases of Influenza in the Post Office —each square, two cases.

As to the type of weather, blue shading of a square represents a week in which anti-cyclones were prevalent; red, one under cyclonic conditions.

The temperature is shown in the following manner. Each square shaded blue represents a week in which the maximum did not reach 60°; shaded red, the maximum exceeded that point. Solid blue squares indicate a minimum during the week of below

to those found in the later. I have to thank Mr Mossman for the data from which the following table has been constructed:—

Period.	Type. Cyclonic.	Anti-Cyclonic.	Mean Temperature.	Mean Rainfall.
24 weeks before the four epidemics.	16	8	45·68	·31
First 8 weeks of epidemics.	6	2	41·59	·47
47 weeks during epidemics.	29	18	42·72	·45
Last 8 weeks of epidemics.	6	2	46·37	·39
16 weeks after epidemics.	6	10	46·25	·37

But it must be noted that the epidemic of 1848–49 began during anti-cyclonic conditions, and when north and east winds were unduly prevalent; that of 1851 commenced during cyclonic weather of not a pronounced type, with a small rainfall; that of 1855 during cyclonic weather, in which north winds predominated; and the epidemic of 1857–58 commenced immediately after or during the close of a very marked anti-cyclone of two weeks' duration.

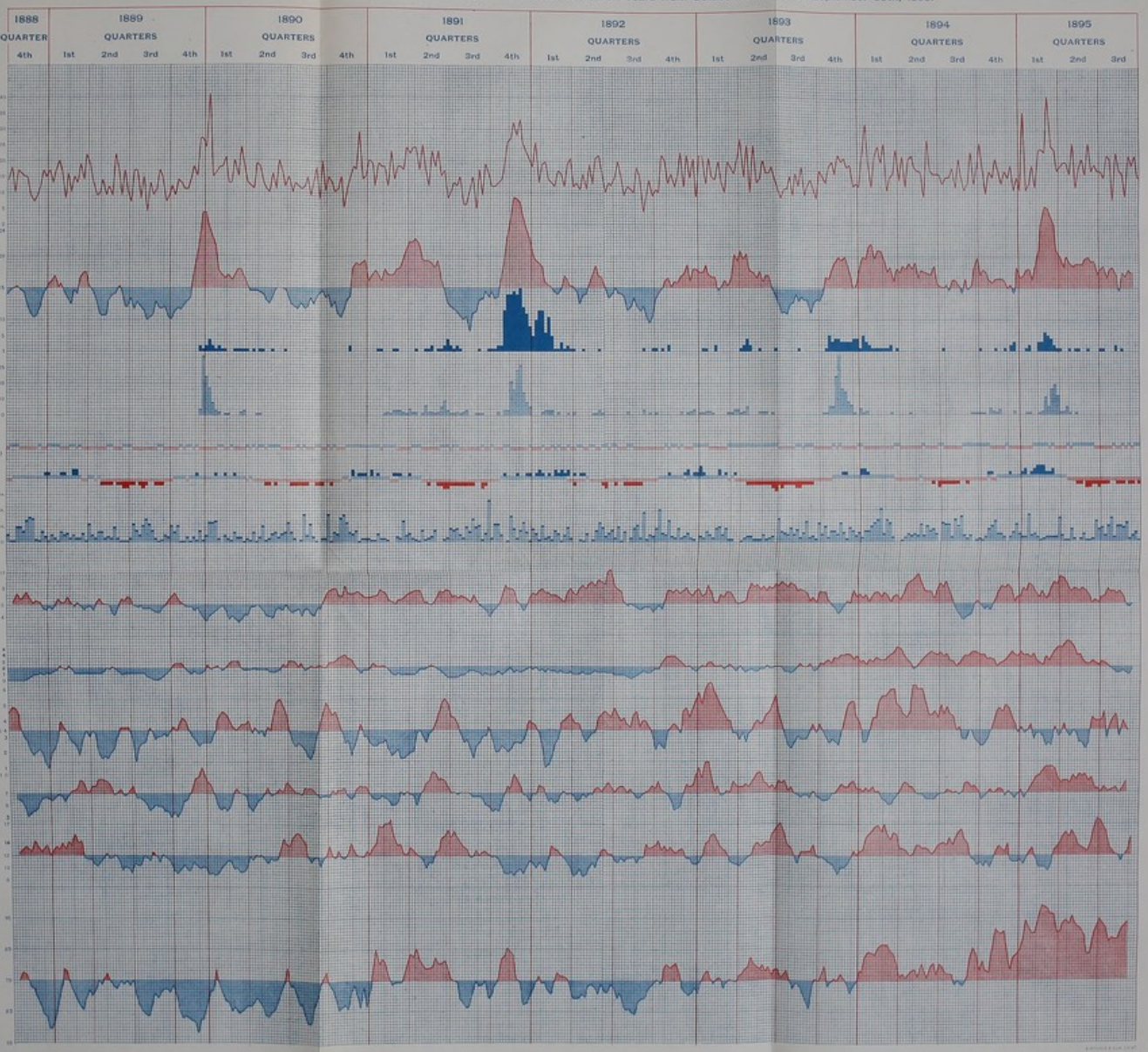
20°, two represent a minimum of below 10°, three of below zero. Similarly, solid red squares show a maximum over 70°, two, of over 80°, and three, of over 90°.

The rainfall is graphically shown by blue shading, eaeh square = 0·2 inches. The admissions of Cardiac, Rheumatic, Kidney, Nervous, and of the total numbers have been treated in averages of fives, and are all drawn to the same scale except those of Kidney disease and of the total admissions—in the first, 5 squares go to one case; in the second, 1 square represents one admission; in the others, 2 squares represent the admission of one case.

The number of deaths is similarly shown. In all these curves red shading corresponds to an admission over the average of the seven years, blue shading to one below it.

CHART I.—THE WEEKLY ADMISSIONS INTO THE MEDICAL WARDS OF THE ROYAL INFIRMARY, EDINBURGH,

with the Weekly Rainfall, Temperature, and Type of Weather for Seven Years from October 1st., 1888, to September 30th, 1895.



NOTE.—Red shading signifies numbers above the weekly mean; blue, below it. In Temperature record, squares shaded red represent weeks in which the maximum thermometer rose above 60° Fahr.; squares shaded blue, weeks in which it did not rise above 60° Fahr. One solid red square added represents a rise above 70°; two, a rise above 80°; and three, above 90° Fahr. Similarly, one solid blue square represents a fall below 50°; two, a fall below 40°; and three, below 0° Fahr.

All the figures for admissions, save in the first Respiratory and the two Influenza curves, are represented as successive means of five weeks.

Chart II.—Epidemic of Influenza in the Winter of 1848-1849.

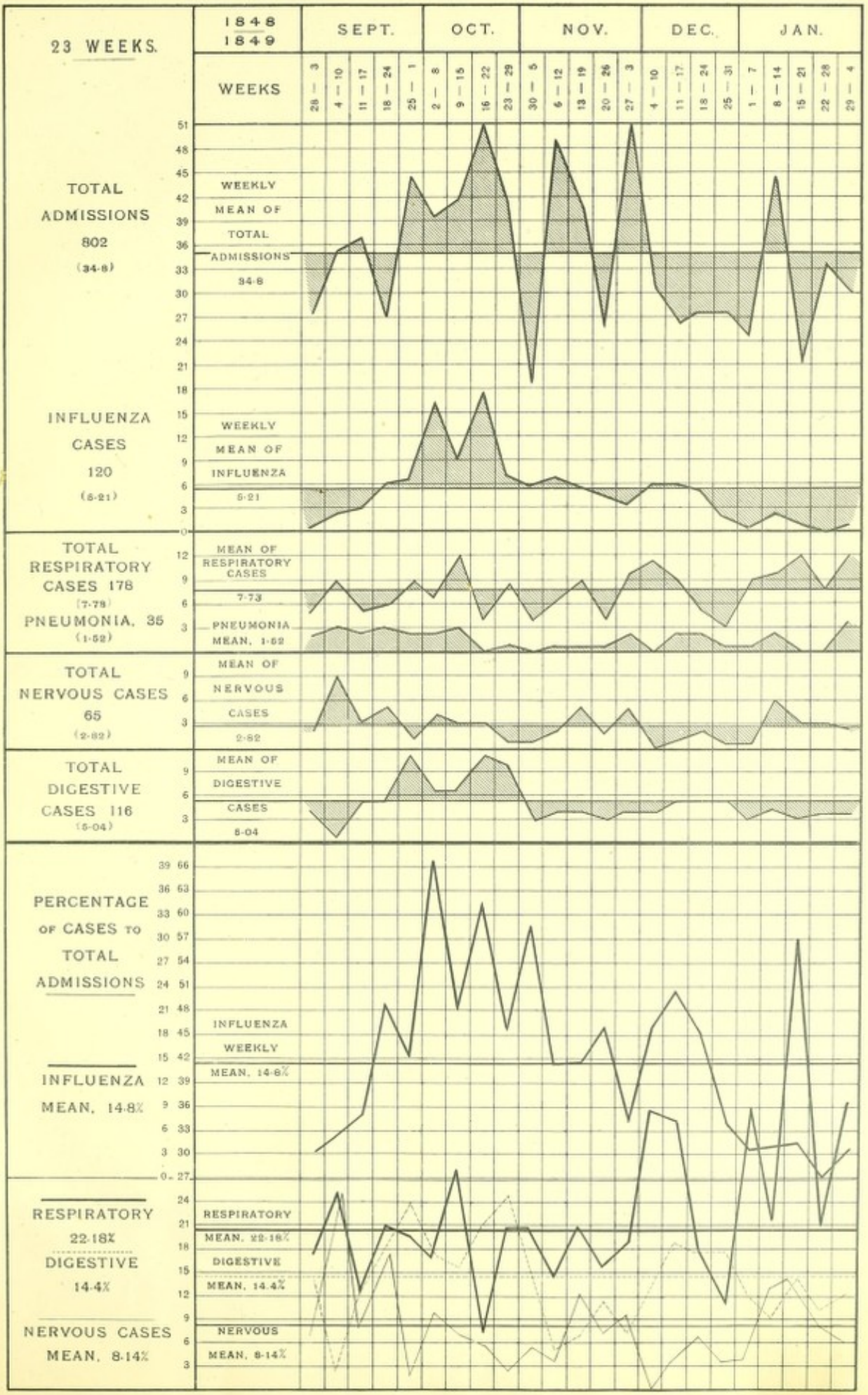


Chart III.—Epidemic of Influenza in the Early Spring of 1851.

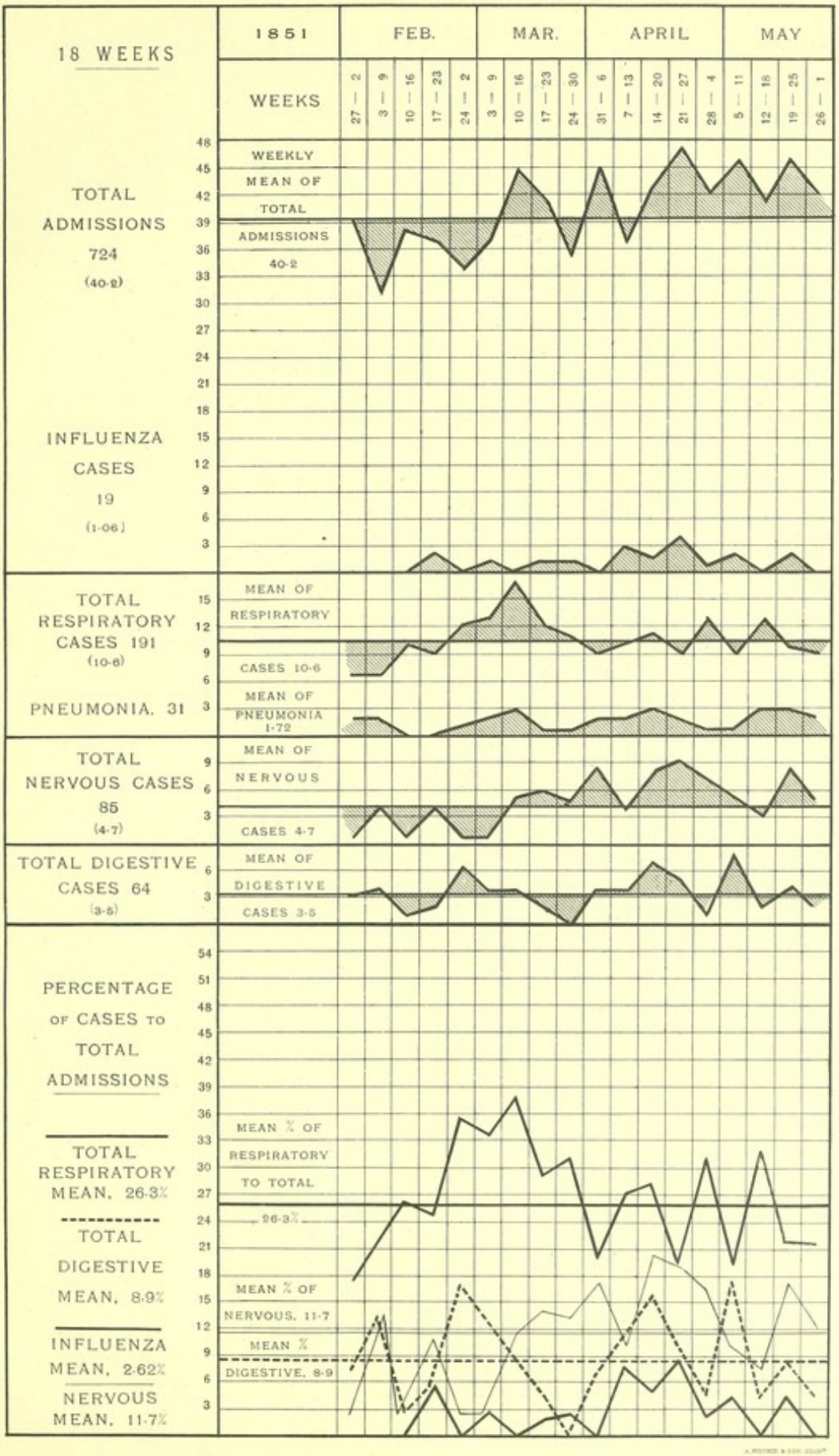


Chart IV.—Epidemic of Influenza in the beginning of 1855.

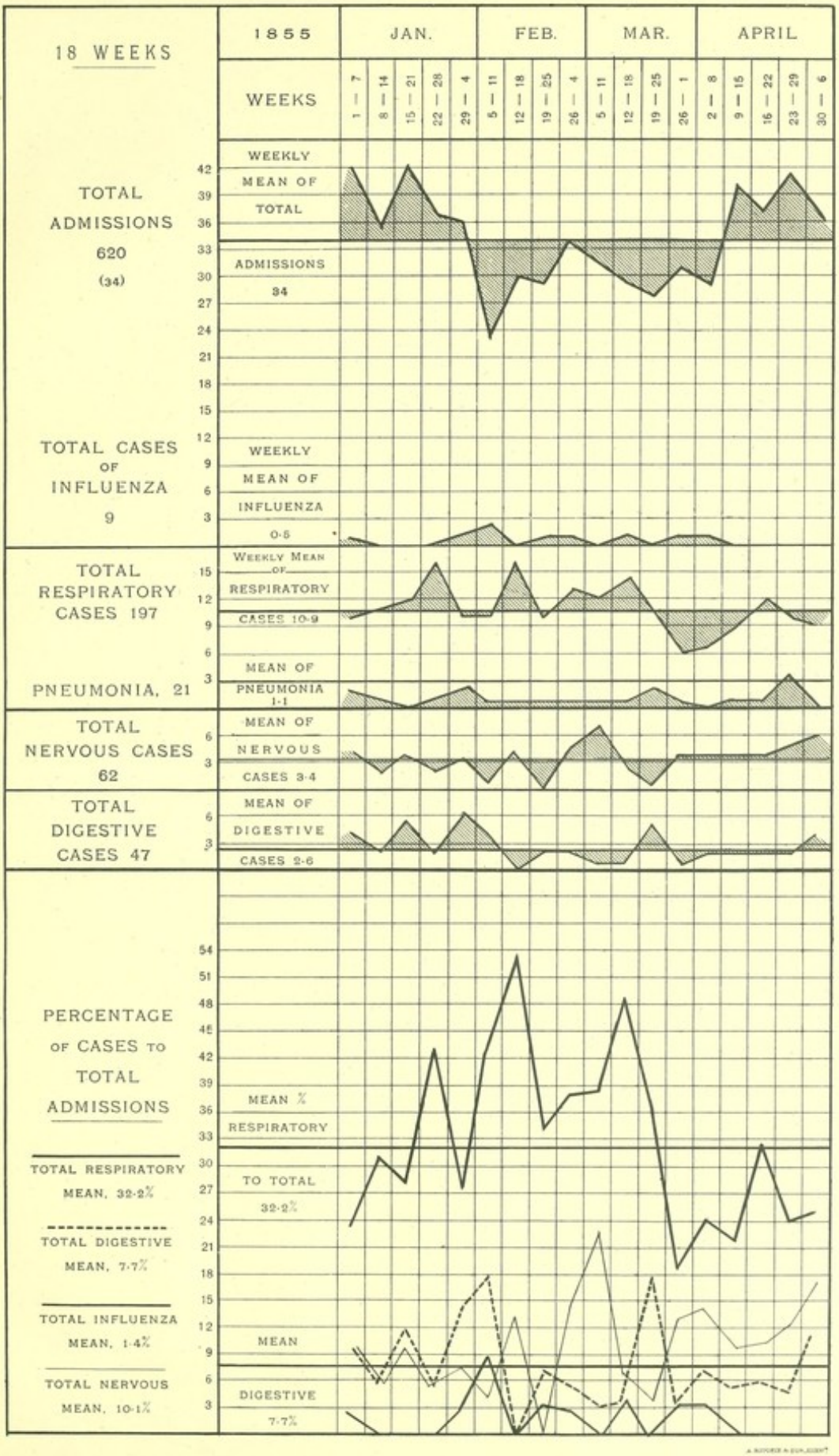


Chart V.—Epidemic of Influenza in the Winter of 1857-1858.

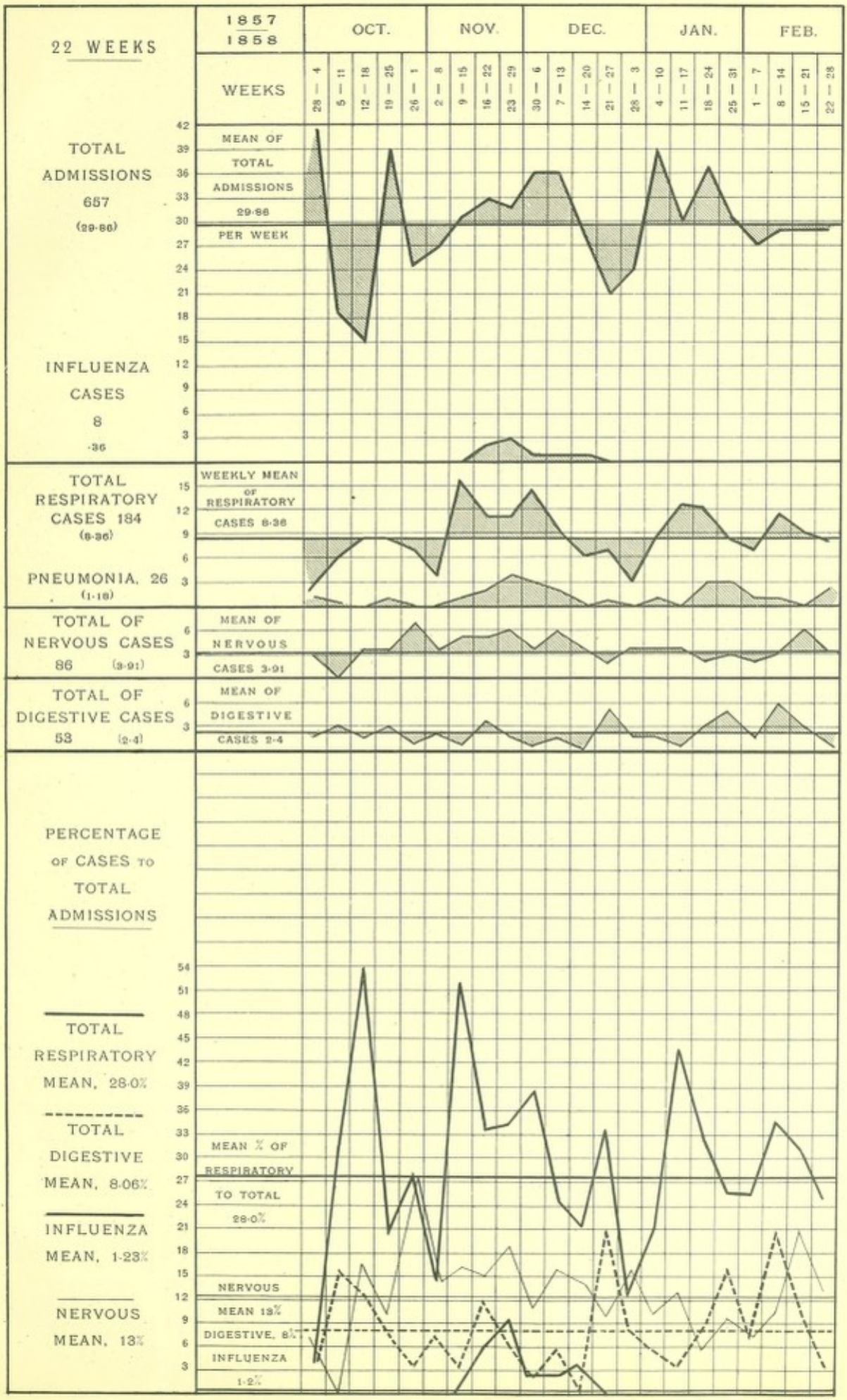


Chart VI.—Epidemic of Influenza in the Winter of 1891-1892.