

**The causation of influenza, sometimes called by its French name 'la grippe'  
/ reported by Henry B. Baker.**

**Contributors**

Michigan. State Board of Health.  
Baker, Henry B. 1837-1920.  
Royal College of Surgeons of England

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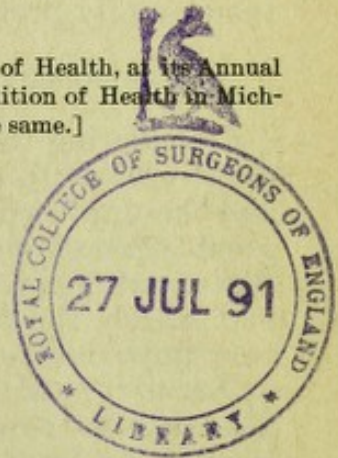
Wellcome Collection  
183 Euston Road  
London NW1 2BE UK  
T +44 (0)20 7611 8722  
E [library@wellcomecollection.org](mailto:library@wellcomecollection.org)  
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# THE CAUSATION OF INFLUENZA.

SOMETIMES CALLED BY ITS FRENCH NAME "LA GRIPPE."

[Reprinted from the Abstract of the Proceedings of the Michigan State Board of Health, at its Annual Meeting, April 14, 1891, consisting of a part of the Secretary's report of the condition of Health in Michigan during the first quarter of the year 1891, and of the discussion following the same.]

[Reprint No. 347.]



REPORTED BY HENRY B. BAKER, M. D., SECRETARY OF THE STATE BOARD OF HEALTH.

*Meteorology,\* and Sickness from all causes, first quarter of 1891, compared with the average for the five years, 1886-1890.*

A Comparison of the meteorological conditions\* of the first quarter of 1891, with the average for the first quarters in the five years, 1886-1890, shows that in 1891, the temperature was higher,† the absolute humidity was slightly more, the relative humidity was about the same, the average velocity of the wind was nearly the same,‡ the day ozone and the night

\*These statements of meteorological conditions are from observations at Lansing only; but, heretofore, such observations, at the central station, have been found to supply a tolerably fair average of those for the State. For the Annual Report, it will be possible to study results of observations at several stations in Michigan. Sergeant Conger, Director of the Michigan State Weather Service, publishes in the "Monthly Report of the Michigan Weather Service," the average temperature, throughout the State, as higher in January and February, and slightly lower in March, 1891, than for the corresponding months in the preceding fifteen years, the average prevailing wind, for the State, for January, 1891, (42 stations) as southwest, for February (43 stations), west, and for March (39 stations), northeast.

†Higher in January and February, and slightly lower in March.

‡The direction of the wind is stated in paragraphs following this.

ozone were more. (For the months of January and February 1891, the day ozone was more, and the night ozone was considerably more. In March 1891, the day ozone was about the same, and the night ozone was considerably more than for the average for the month of March in the five years, 1886-1890.) In the first quarter of 1891, the rainfall at Lansing was .19 inches less than for the corresponding quarters in the five years 1886-1890, and the depth of ground above the water in the well at Lansing was ten inches more than in the corresponding quarters in the five years 1886-1890. Compared with the average in the corresponding quarters in the five years 1886-1890 the reports received from regular observers indicate that membranous croup, cholera morbus, inflammation of brain, influenza and cerebro-spinal meningitis were more prevalent, and that small-pox, whooping-cough, typho-malarial fever and diphtheria were less than usually prevalent in the first quarter of 1891.

*The Causation of Influenza. Sometimes called by its French name, "La Grippe."*

Considering the fact of the unusual amount of ozone\* during the first quarter of 1891, and of the unusual direction of the wind\* in February, and the unprecedented direction of the wind in March,\* together with the great increase and unprecedented occurrence of influenza throughout the State during the last three weeks of January, and the months of February and March, the following paragraphs supply evidence which seems to be very important:—

*January:*—For January, during the twelve years, 1879-90, the prevailing direction of the wind (that is the direction from which the wind blew more times than from any other single point of the compass) was southwest, and for January, 1891, the prevailing direction of wind\* was southwest. But for the week ending January 17, 1891, the prevailing direction of the wind was north, and northeast, an equal number of times from those two points.

For the entire month of January 1891, the night ozone increased but very slightly over the preceding month, and was 35 per cent above the average for January in the five years 1886-90. For the week ending January 17, the night ozone was 80 per cent above the average for the month of January in the five years 1886-90; and 329 per cent over the preceding week.

For the entire month of January 1891, influenza increased ten per cent over the preceding month, and was 38 per cent above the average for the month of January in the five years 1886-90.

A marked increase of influenza in Michigan was first shown by the sickness reports for the week ending January 17, being an increase of 18 per cent over the preceding week, and 44 per cent above the average for the month of January in the five years 1886-90.

*February:*—For February in the twelve years 1879-1890, the point of the compass from which the wind blew the most times was southwest; but for February 1891, it was *northwest*.\*

For February 1891, the night ozone increased 16 per cent over the preceding month, and was 27 per cent above the average for February in the five years 1886-90.

For February 1891, influenza increased in prevalence eight per cent over the preceding month. It was 37 per cent above the average for Feb-

\* See footnote on page 6.

ruary in the five years 1886-90; and for February 1891, was the first time in the history of the health statistics of Michigan that influenza was the most prevalent disease reported throughout an entire month.

*March*.—For March in the twelve years 1879-1890, the point of the compass from which the wind blew the most times was northwest; but for March 1891, it was *north*, and next to that *easterly*. During the thirteen-year period, March 1891, is the first March in which the wind is recorded as having been from the north and east more times than from any other point of the compass.

For March 1891, the night ozone was 24 per cent more than the average for March in the five years 1886-90.

For March 1891, influenza continued to be the most prevalent disease reported. It was 41 per cent above the average for March in the five years 1886-90.

*Discussion of the Subject of the Causation of Influenza and the Other Cold-Weather Diseases.*

In presenting the important evidence obtained in the office of the State Board of Health during the first quarter of 1891, bearing upon the causation of influenza and the other cold-weather diseases, the Secretary of the board spoke at some length, and the subject was discussed by other members of the board.

Dr. Baker remarked that epidemic influenza is justly considered with apprehension, because of the fact that many of the most important diseases, in this climate, are increased as influenza increases, some of them increasing coincidently with influenza, others following influenza a month or two later. Thus it is well known that pneumonia is markedly increased by the conditions which exist when influenza is increased. Thus in Chicago recently the total mortality rate has been doubled coincidently with the occurrence of influenza, and a large part of the mortality was from pneumonia. Pneumonia is one of the diseases which cause most deaths in Michigan, standing third on the list, during the ten years 1876-87. Consumption is the disease which causes most deaths in Michigan; and consumption is one of the diseases which increases after influenza increases. Diphtheria has, during the twelve years, 1876-87, caused next most deaths in Michigan; and, in Michigan, diphtheria has seemed to increase under such conditions as those when influenza increases. Scarlet fever has stood fifth on the list of diseases causing most deaths in Michigan, and scarlet fever has increased under those conditions. Small-pox has been rare in Michigan, but that disease has followed influenza.

It will be noticed that the diseases which, by the sickness statistics of Michigan, have been proved to increase with or following influenza belong to a class concerning which propositions can be made, as follows:—

1. Diseases which are most prevalent during or following the cold seasons of the year.

2. Diseases which are known to be caused by micro-organisms or "specific" causes. Among the diseases the specific causes of which are well known to pathologists, and have been propagated outside the body by many investigators are consumption, pneumonia and diphtheria; while scarlet fever and small-pox are known to be due to specific causes, which it has been claimed have been isolated and cultivated, but which claims are not yet verified. Professional and non-professional people generally,

however, accept the fact that those diseases are propagated, the specific cause of each case being derived from a pre-existing case.

3. Diseases which, as a rule, are believed to enter the human body by way of the throat or air passages.

According to the evidence which for many years, has been accumulating in the sickness statistics of Michigan, influenza belongs in the class of diseases concerning which the three foregoing propositions are true.

Absolute proof of the truth of the proposition No. 1, relative to influenza, is given herewith in the Diagram No. 1, on page 10.

Proposition No. 3 is so obvious concerning influenza that no further proof is required, and none is here offered.

Concerning proposition No. 2, it would seem that the evidence is now sufficient relative to influenza; but few people have had opportunity to study a summary of the evidences; and it may be that influenza should be included, with scarlet fever, among the specific diseases for which the specific cause has not with certainty been isolated. This subject, however, is referred to further on. At this meeting, only a bare outline of the evidence was presented, partly because members of the Board were supposed to hold in mind much that was not mentioned. Dr. Baker referred to the fact that it is now considered established that, as a rule, inflammations are due to micro-organisms, that the cause of ordinary pus ("matter" as it is commonly called) is "specific," that is, a living micro-organism—the *staphylococcus*, and *streptococcus pyogenes*; that all the bacteriologists who have reported results of examinations for micro-organisms in influenza have reported the finding of these pus-generating micro-organisms; as, for instance, Rikert, in Bonn (*Deutsche Medicinische Wochenschrift*, Jan. 23, 1890), in a bacteriological study of five cases of influenza, found the only species constantly present was the *streptococcus pyogenes*. While most of the investigators have assumed that these common pus-generating micro-organisms could not be the specific cause of influenza, because they are so uniformly present, Rikert suggested that the *streptococcus*, "in association with some unknown peculiar atmospheric condition, may cause the disease."\*

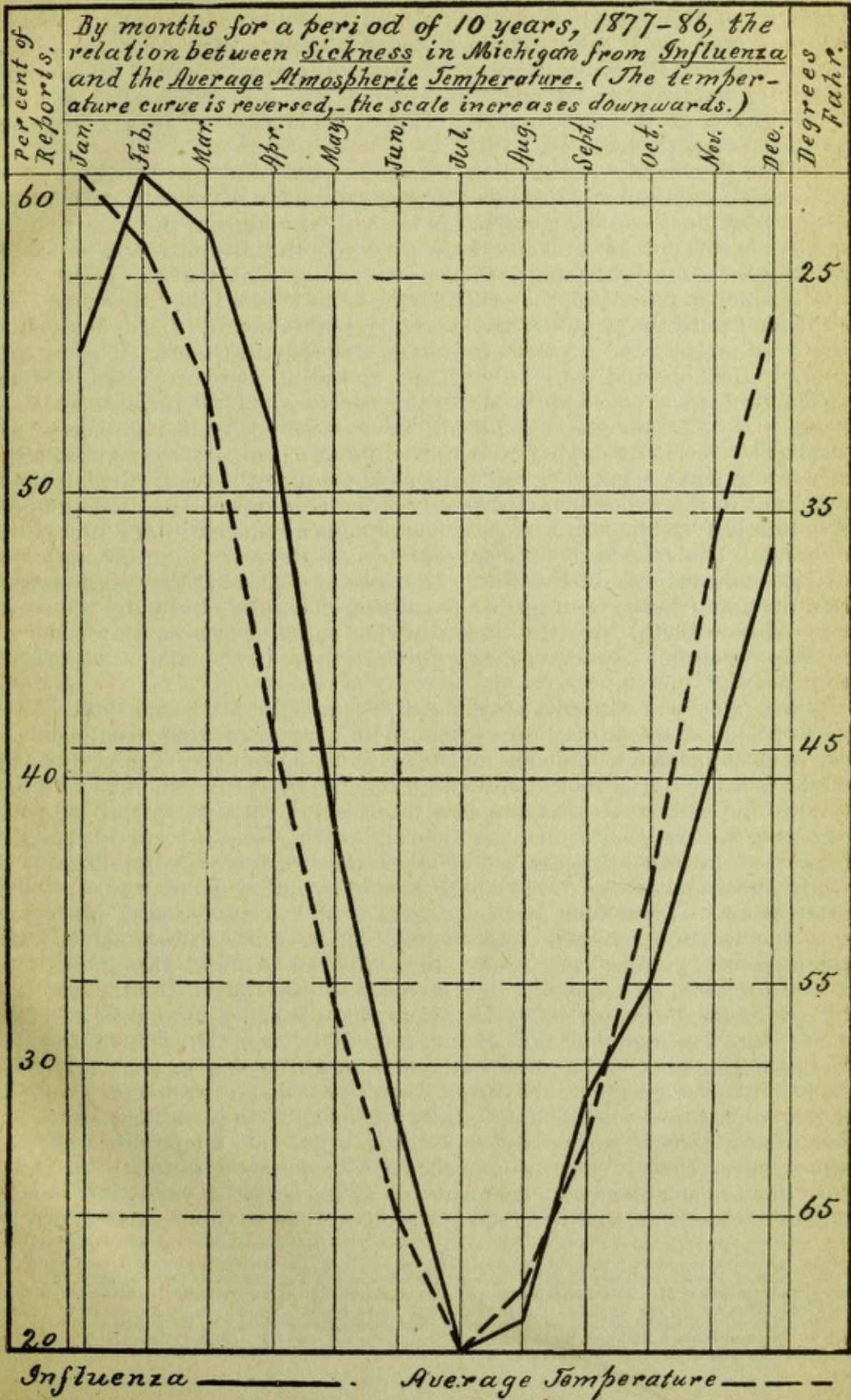
This conclusion by Rikert is the same as was reached in the paper read, by the secretary of this board, at the meeting of the American Medical Association in Nashville, Tenn., in May, 1890, but which paper is not yet published. In that paper it was shown that influenza is present in Michigan in every month of every year; its specific cause, if it have one, must, therefore, be a very common one, present in Michigan all the time. The *streptococcus pyogenes* is a well-known cause of inflammation, and it is such an ever-present specific cause as the circumstances of the case require.

In the paper by the secretary of this board, referred to in a preceding paragraph, it was shown that throughout about all recorded epidemics of influenza in past times the chief coincident meteorological conditions had been cold winds, or winds from an unusual direction. It was shown that the great epidemic of 1890, which began in St. Petersburg, followed closely the occurrence of northeast winds at a season of the year when the winds were usually from the south and west. The long-continued northeast winds at St. Petersburg came from the direction of the cold regions of northern Siberia.

Previous to the preparation of the paper just mentioned, the sickness

\* American Lancet, April, 1890, p. 159.

DIAGRAM NO. 1.—Temperature, and Sickness from Influenza in Michigan.



statistics of Michigan had proved, beyond question, that in a long series of years, and as a rule, influenza sustains quantitative relations to the temperature of the atmosphere, the influenza increasing after exposure to a falling temperature of the atmosphere, and decreasing after a rising temperature of the atmosphere. This is demonstrated by the diagram printed herewith, page 10.

It has previously been noticed, however, that the great epidemics of influenza occur, in many instances in years when the weather, for the season of the year, has been warmer than is usual. And, during the occurrence of epidemics of influenza, it has been observed that the atmosphere has, to say the least, not been colder than usual at that season of the year. This discrepancy apparent in the evidence has not, it is believed, been so fully explained until the paper by the secretary of this board, in May last. How the wind might tend to cause influenza, was also suggested. The rapidly cooling effect of wind, especially when evaporating moisture, is well known.

The influence of wind in producing dryness, of all surfaces which it reaches is well understood by all who have observed its drying effects upon washed clothes hung out to dry, which will dry in comparatively wet weather if there is wind. Yet very few persons appreciate the fact, which is made apparent in this office by a close study of meteorological data, that the relative humidity of the atmosphere is usually much reduced by the prevalence of wind. The effects of atmospheric dryness, however induced, upon the delicate mucous membranes lining the nose, throat and other air passages, has, for many years, been made the subject of careful study, by the secretary of this Board, and the results of that study have been published by him in numerous papers, among which are those in the annual reports of this Board.\*

The evidence of the observations of sickness in Michigan, and of the meteorological conditions during the first quarter of 1891, confirms the previous conclusions to such an extent as to leave little, if any, room for doubt as to the causal relation of cold wind, and wind from an unusual direction, to influenza. It also supplies information relative to the influence of ozone, in the causation of influenza, which seems to be exceedingly important, for several reasons, one being that in nature the opportunity to study the influence of ozone apart from the influence of cold does not often occur. It has long been apparent from the statistics in Michigan that the relation of ozone to influenza, and to other diseases of the air-passages and lungs, was close; thus in the Annual Report of this Board for 1888, on page 148, it is stated that "the curve for the rise and fall of atmospheric ozone is, in Michigan at least, almost precisely the curve for the rise and fall of pneumonia." And, Dr. Henry Day, of London, England, claimed several years ago, that his experiments with dogs proved that the inhalation of ozone caused bronchitis, and in larger quantities, pneumonia. But, ordinarily, the residual ozone in the atmosphere is so nearly dependent upon the temperature of the atmosphere, that it has been difficult to separately estimate the influence due to each element. As a rule, in a long series of years, influenza is not more closely related to a cold atmosphere than to ozone, as is shown by

\* The principal papers on this subject are: "The causation of pneumonia," Annual Report Michigan State Board of Health, for the year 1886. (This article was reprinted in pamphlet form being reprint No. 268.) "The causation of cold-weather diseases," Annual Report Michigan State Board of Health, for the year 1887. (This article was reprinted in pamphlet form, being reprint No. 282.) And, "Relations of certain meteorological conditions to diseases of the lungs and air-passages as shown by statistical and other evidence," Annual Report Michigan State Board of Health, for the year 1888. (This article was reprinted in pamphlet form being reprint No. 290.)

comparing the two diagrams, on pages 10, 13 of this pamphlet. The evidence during the last quarter, however, is such as to permit of this separate study, and it seems to leave no doubt that in the causation of influenza, and probably also of the other diseases of the air-passages and lungs, and of the diseases which enter by those surfaces, ozone is at times more powerful than a cold atmosphere, and the evidence, therefore, indicates that at all times when these diseases are apparently caused by cold atmosphere, ozone is probably one important factor in the causation.

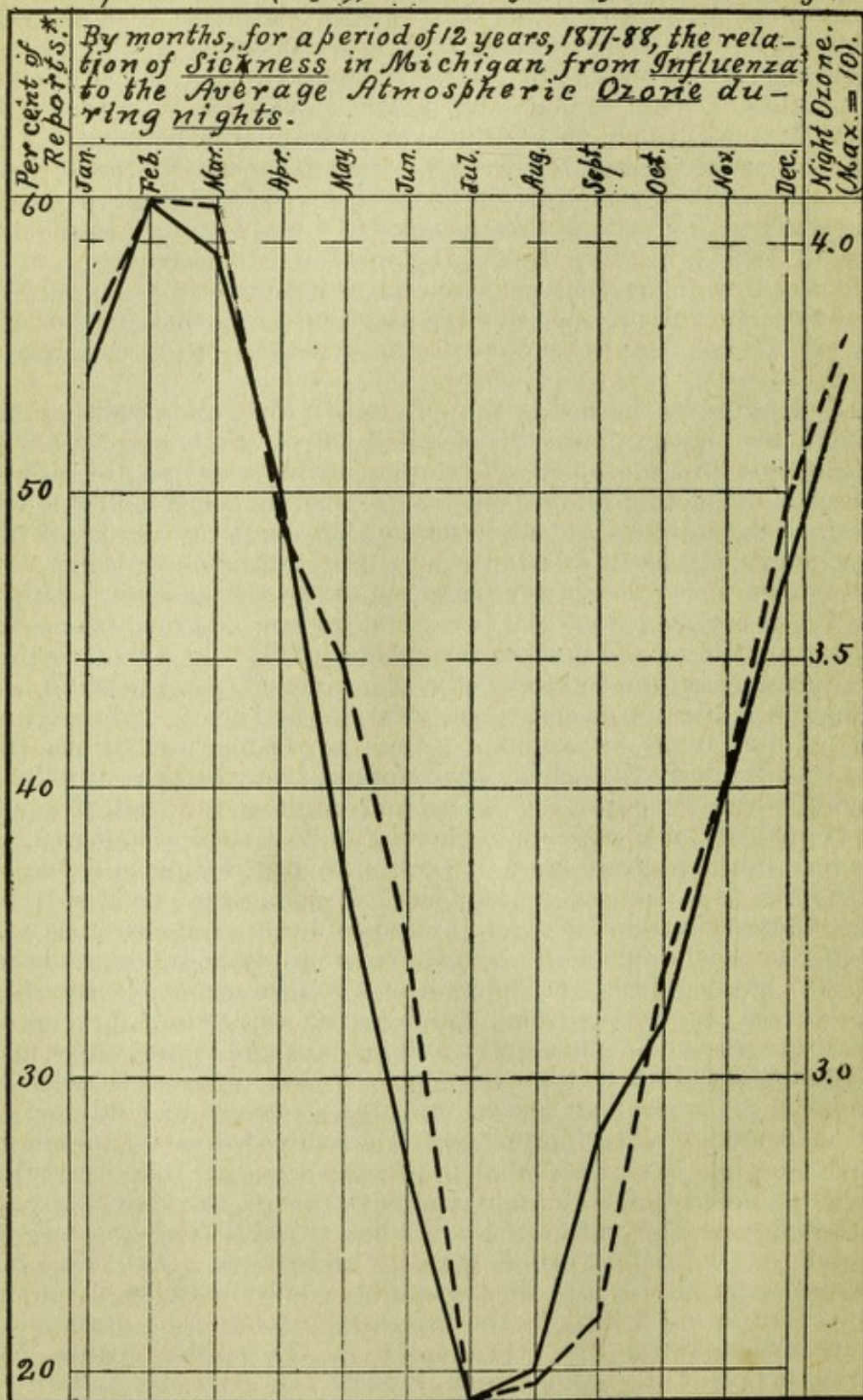
The relation which atmospheric ozone bears to influenza as a general rule, as is proved by statistics for a series of years, is shown in the diagram on page 13. It is possible that if the method of measuring ozone were as perfect as that for measuring temperature a more steady curve would be found to represent the ozone; but the diagram shows that the curve is not very irregular, and that it bears a very close relation to that representing influenza.

At this meeting of the board, the nature of ozone, and of its action upon the human air-passages, was discussed by Prof. Fall, and by Dr. Baker. Ozone is oxygen in a more active form than ordinary oxygen. It is believed that ozone is oxygen the atoms being so grouped that each molecule consists of a group of three atoms. Its action on the air-passages is very much like that of chlorine gas, although its odor is not so unpleasant as chlorine. In concentrated form, it is exceedingly irritating to the air-passages. In a recent publication it is stated that "All investigators concede that ozone in condensed form irritates the mucous membrane of the organs of respiration, and produces, according to its density and time of administration, active inflammation, salivation, bloody expectorations and death. Binz found also oedema of the lungs in animals killed by ozone inhalations, but he claimed that the irritative effects were not as severe as those produced by chlorine, bromine or iodine." It being proved, however, that, if present in sufficient quantity, it is capable of causing immediate death, evidence as to its presence in the atmosphere is important, and it is especially important, when we have, as in the diagram on the following page, positive and conclusive evidence that in Michigan, the atmospheric ozone sustains constant and quantitative relations to the sickness from influenza, influenza increasing when the ozone increases, and decreasing when the ozone decreases. It is known that the micro-organisms which cause pneumonia, are (not very infrequently) present in the mouths and air-passages of persons who do not have pneumonia. Experiments have proved that exposure to cold alone is not sufficient to cause pneumonia; and that exposure to cold and coincident inoculation with the "germs" of the disease does cause pneumonia.

The increase of pneumonia at such times as people are exposed to an atmosphere which is cold, and which thus depresses the resisting power of the part exposed to the germs of the disease, at such times as the atmosphere contains the irritant ozone, is easily understood. The three important factors seem to be, (1) the microscopic specific cause of the disease, (2) the irritant ozone which, by the increased exudation of nutritive fluids which it causes, favors the reproduction of the specific cause, (3) the depressing action of the cold which lessens the resisting power of the exposed surface. This last influence is better appreciated if one holds in mind the experiments by Pasteur when he caused fowls, which ordinarily do not contract anthrax, to contract the disease by inoculating them with the germs of anthrax, and lowering their temperature by causing them to stand in cold water.



*Atmospheric Ozone (Night), and Sickness from Influenza in Michigan.*



*Influenza* —————. *Average Night Ozone* - - - - -  
 \*Which stated that Influenza was under the observation of the physicians who made reports.

During the discussion, Dr. Hazlewood asked Dr. Baker "are there not more than three factors in the causation of specific diseases?"

Dr. Baker replied, yes. The three prominent ones I have just mentioned, and the one mentioned, a few minutes since by Dr. Avery,—the condition of the blood. But it now seems that the theory put forth by Metchnikoff that the white corpuscles of the blood are phagocytes, and destroy the germs of disease,—must be modified so as to consider that the condition of the blood serum—more especially the albuminous constituents of the blood, is of most consequence, the life of many of the micro-organisms which cause disease being destroyed by the albuminous portion of the blood, when that is in its best condition.

Dr. Hazlewood—"A weak solution of sugar, hermetically sealed, will remain sweet for years, but when opened, and exposed to the access of germs, will spoil. Will not the same principle apply to the human system and to these specific diseases?"

Dr. Baker—"Yes, I think so. Of certain diseases, enough germs put into the system of any person will cause the disease. Probably that is true of pneumonia; yet, under all ordinary circumstances, the amount of pneumonia is absolutely controlled by the atmospheric conditions, as is proved by the statistics in Michigan, and as has been demonstrated by the diagrams which have been carefully constructed from those statistics, and which have been published in the annual reports of this board.\*"

*The prevention of specific diseases.*

Dr. Hazlewood to Dr. Baker—"Do you believe that there is any consumption without the tubercle bacilli?"

Dr. Baker—"Leading pathologists say there is not; and I believe they are right."

This, of course, bears upon the subject of the prevention of specific diseases, many of which are controlled by atmospheric conditions. Much can be done to avoid exposures to atmospheric conditions, but if the specific causes are not present the disease does not occur. And there are many things which can be done to lessen the presence of the specific causes of diseases, as has been demonstrated in Michigan within the past few years. Consumption is the one which now causes most deaths in Michigan—and this Board has published methods which, if generally observed, as it is hoped they may be, would go far toward entirely doing away with the specific cause of that disease in this State. For the prevention of pneumonia, methods similar to those recommended for the prevention of consumption would undoubtedly be useful. For the prevention of influenza, and the numerous other important diseases which accompany or follow it, similar methods would probably be useful; but the ordinary micro-organisms which cause inflammations are exceedingly generally disseminated, in all thickly-settled places. Much could be done to lessen them through improved systems of ventilation of residences and public buildings; and much through more care for the destruction of all sputa, and for the disinfection of all handkerchiefs, more care in sweeping and dusting, and in the beating of carpets.

For further suggestion of effort for lessening all inflammatory diseases, Dr. Baker referred to his address on "Sanitation in 1890," in which occurs a paragraph as follows: "Since nearly all suppurative inflammations are breeding-places for micro-organisms which, when they gain entrance into

\* Pages 252, 286, Report for 1886, pages 155, 166, Report for 1888.

another living body (or into another weak or injured spot in the same body), are capable of again starting the inflammatory process, therefore, *should not all purulent discharges, and all pus which is accessible, be destroyed or disinfected?* Should not the aim be thus to restrict the spread, and eventually to stamp out all inflammations?"

At this meeting of the Board, Dr. Baker mentioned the fact that whereas on a free surface the common pus-generating micro-organisms cause simply inflammation, with what was formerly known as "laudable" pus, the inflammation sometimes leads to pain, as is the case in boils; that whereas inoculation of the healthy human or animal body with these micro-organisms sometimes leads to no result, and a fracture of a bone in the healthy human or animal body frequently is followed by immediate recovery, yet inoculation with these micro-organisms and the coincident fracture of a bone causes osteo-myelitis; that in osteo-myelitis the pus contains the pus-generating micro-organisms, and when pus from that source is rubbed into the skin, it causes boils. Thus that circle of causation is complete.

Cerebro-spinal meningitis is another disease which seems to belong in this same class. (Mentioned first on pages 8-9).

Rheumatism is another disease which, in Michigan, causes much sickness. That, so far as it is an inflammatory disease, it belongs in the same class with these other diseases, which have been mentioned, is proved by the sickness statistics of Michigan, in connection with what is known to pathologists and bacteriologists. These same pus-generating micro-organisms have been found in the inflamed areas in rheumatism. How closely rheumatism is associated with influenza is indicated by the weekly and monthly bulletins of "Health in Michigan" during the first quarter of 1891. A portion of one of these bulletins is shown herewith. It is printed on this page.

HEALTH IN MICHIGAN.—Reports to the State Board of Health, Lansing, by observers in different parts of the State, show the diseases which caused most sickness in Michigan during the week ending April 18, 1891, as follows:—

Diseases arranged in order of greatest area of prevalence.	Number of regular observers heard from, 54.	
	Per cent of Observers who reported the disease present.	For preceding week.
Influenza .....	96	98
Rheumatism .....	80	77
Bronchitis .....	72	75
Neuralgia .....	70	73
Tonsillitis .....	59	63
Consumption of lungs .....	57	60
Pneumonia .....	44	46
Intermittent fever .....	39	25
Measles .....	31	31
Pleuritis .....	30	29
Diarrhea .....	26	19
Remittent fever .....	26	13
Inflammation of kidney .....	17	8
Erysipelas .....	17	21
Scarlet fever .....	9	10
Inflammation of brain .....	7	2
Inflammation of bowels .....	6	13
Membranous croup .....	6	8
Typho-malarial fever .....	6	2
Cerebro-spinal meningitis .....	6	0
Diphtheria .....	4	0
Whooping cough .....	2	4
Typhoid fever (enteric) .....	2	4
Puerperal fever .....	0	4

It seems to be proved that pneumonia is generally caused by a lanceolate coccus, a *mizzo-organism* first discovered by Dr. Sternberg, in his own sputa, in 1880, though a form of pneumonia is, less frequently, caused by the so-called pneumo-coccus discovered by Friedländer. It seems to be proved that the causation of pneumonia is favored by whatever causes an inflammation of the bronchial tubes, and that, very generally, that inflammation is caused by these same pus-generating micro-organisms—the *staphylococci* and *streptococci pyogenes*, of which there are three varieties the *aureus*, *albus* and *citreous*. That these micro-organisms are uniformly present in influenza has been the uniform testimony of bacteriologists. There is, therefore, no difficulty in understanding how all the great and important class of diseases which generally enter the body by way of the throat or air-passages should be increased, as they are known to be, coincidentally with, or following influenza. That some of them, like small-pox and consumption, follow later than the influenza, depends, apparently, upon the fact that in those diseases the period of incubation is longer than in some of the other diseases.

Dr. Baker remarked that we now have the facts to answer the question—“What are the diseases which cause the most deaths in Michigan?” We are now able to answer the question—“What are the conditions which prevail, when most of these dangerous diseases increase?”

The prevention of influenza, and of the coincident rise in some of the other more dangerous diseases, has not been possible, because some of the factors in their causation were unknown. Now the causes are known, and the study of the measures for their prevention can be proceeded with more intelligently.

That it is possible to prevent specific diseases which ordinarily increase when influenza increases, is proved by the facts now on record in Michigan. We know from the statistics in Michigan that in times past diphtheria and scarlet fever have been increased under atmospheric conditions, similar to those which prevailed when influenza increased; we also know from the statistics that, in recent years, the contagion of those two diseases has, in a great number of instances, been destroyed by systematic disinfection, that in Michigan these diseases have been greatly restricted. If nothing of this kind had occurred both of these diseases would now, according to experience in former times, be unusually prevalent. The fact is that both of these diseases were less prevalent, during the first quarter of 1891, than the average for a long series of years. In times past small-pox has, as a rule, increased in months following those in which influenza increased; yet thus far in this year it could not possibly increase from a local source because there has not been in Michigan any case, to supply the specific cause, from which it could spread. Of course the present time is recognized by the State Board of Health as one of danger of the spread of small-pox, if it should gain an entrance into the State, and this State Board has taken action, to warn every local board in the State; but the fact of the present complete immunity is here mentioned in order to demonstrate the possibility of the complete prevention of one of the most dangerous specific diseases, and one which, when preventive measures are not enforced, increases following influenza.

What has been done in Michigan in the case of diphtheria, scarlet fever, and small-pox, should encourage the people of Michigan to coöperate more thoroughly for the prevention of those diseases which now cause the most deaths in Michigan. The one which is the most dangerous of all—that is, which causes the most deaths—consumption, would seem to be about

the easiest one to restrict. Some of the most important measures for its prevention have been pointed out by this Board.

In order to do the best work for the prevention of these diseases, the Board should have increased facilities. The work is immense. Its appropriations are small. It should be enabled to employ at least one expert to visit and aid localities in the proper measures for the restriction of these dangerous diseases.