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Thesis

Predisposing Causes
of
Epidemic Disease

by

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Predisposing Causes of Epidemic Disease.

Few subjects are of deeper interest, or of greater practical importance, than the investigation of the laws which regulate the development and extension of Epidemics, and the means by which these diseases may be prevented or mitigated; for not only are the ravages which they commit fearful, but the mortality which they occasion is chiefly among persons who are in the prime of life and whose loss is severely felt by families and society. It must be admitted, that notwithstanding many and elaborate researches, no certain conclusion has been arrived at as to the precise nature of the proximate causes of Zymotic Diseases; but these researches have thrown much light on the predisposing causes, and have shown, that it is in our power to remove them, or to lessen their violence.

In this paper, I shall use the terms Epidemic and Zymotic, as synonymous, and as including all diseases, such as Cholera, &c., which spread at particular periods through a community, and which, while originating in some unknown primary cause, derive their fatal power from well-ascertained localizing agencies.

Limiting to a great extent without the fruitless region of uncertainty and speculation.
I shall chiefly, direct attention, to the practical aspect of the subject, and endeavour to investigate the secondary or predisposing cause of zymotic disease. Every violation, indeed, of the laws of health, which a knowledge of the physical laws of nature and of the human constitution has established, would be in itself a predisposing cause of zymotic disease, since it would lessen the tone and vigour of the system, and render the more liable to morbid influences; but I must limit my observations to some of the more general predisposing causes, and with this view, I shall discuss the influence of an impure atmosphere, as produced by overcrowding and decomposing organic matter, of mist and rain; of peculiar atmospheric conditions, of heat and depressuring emotions of the mind; of age, sex, and occupation; of errors of diet and intemperance; of a bad water supply and intravenous infection, in predisposing to attacks of epidemic disease.

The necessity of a supply of pure air has long been recognised as an essential element for the preservation of health. The atmosphere in its normal condition is composed of two gases, oxygen and nitrogen, in the proportion of one part by volume of the former, to four of the latter; these elements form the greater part of its bulk, but it also contains water vapour and small quantities of ammonia and carbonic acid.
The great influence which oxygen exerts on animal and vegetable life, as well as upon organic matter, entitles it to be considered the most important of the elements entering into the formation of the air. This gas supports the two familiar processes of combustion and respiration. The immense quantity of oxygen made use of in the respiration of the countless multitude of animals inhabiting the earth and in the process of combustion, would, in course of time, render the atmosphere incapable of supporting life, were some provision not made for preserving it in a state of integrity. It is in the vegetable kingdom that we find means at work which have the effect of keeping the various component parts of the air in their normal proportion. The carbonic acid produced by animals in respiration and in the processes of combustion and putrefaction is taken up by plants, and, under the influence of light, to by them decomposed, the carbon being retained for the purposes of nutrition, while the oxygen is evolved.

It is calculated that the average amount of carbonic acid given off in the respiration of man forms about 4.48 per cent. of the respired air; in cases, however, where the air contains more carbonic acid than usual, as in an ill-ventilated apartment, the quantity of gas exhaled becomes much less. The atmosphere in rooms, does not appear to be capable of containing more than a certain limited amount of carbonic acid, for it has been ascertained by experiment, that, however often it may have been respired, even until it is no longer able to support life, it never contains
more than 10 per cent of the acid. This gas when breathed into the system by inhalation in the undiluted state, very speedily produces death. As prejudicial, indeed, are its effects upon the system that an atmosphere containing more than one tenth of its volume of carbonic acid, begets a fatal influence when prepared for a small time. The phlogiston present in the atmosphere acts mechanically, diluting the oxygen, and modifying its effects on the system.

Having thus glanced at the constitution and properties of the atmosphere in its normal condition, we shall now take into consideration the chief causes which tend to render it impure and which have the effect of inducing a prevalence to epidemic disease.

I. Overcrowding— as a predisposing cause of epidemic disease.

Wherever a number of individuals live in the same apartment, the atmosphere, which they breathe, soon becomes deteriorated, unless means are taken for its frequent renewal by an efficient system of ventilation. Air, which is respired over and over again, speedily becomes changed, not only with an undue and prejudicial amount of carbonic acid, as already observed, but, also with animal matter, which soon undergoes the process of putrefaction, and, if means are not taken for the frequent admission of pure air, this substance is deposited upon the walls and furniture of the room, as well as upon the clothes of those inhabiting it. The presence of this noxious animal matter...
is indicated by the disagreeable smell observed on entering an apartment, where a number of people are congregated together.

The habitual respiration of foul air by the inhabitants of crowded rooms, by inducing headache, giddiness, sickness, vomiting and general debility renders them peculiarly liable to be affected with diseases, and especially with pestilence. The fatal influence of overcrowding in producing a predisposition to such as the Plague, Cholera, and Fever has frequently led to the belief that such diseases are contagious. But if the habitual respiration of the air of an apartment, overcrowded with healthy persons, where due care is not taken for its frequent renewal, be sufficient, of itself, to induce fever, as some suppose, what must be the danger of breathing the air in a similar apartment where the individuals inhabiting it are diseased and affected with such disorders as Cholera or the Plague? During the presence of an epidemic atmosphere, in a district, at a time when the whole of the persons living within it are breathing a deteriorated medium, giving a tendency to disease, but perhaps too much diluted to produce it unaided; a slight morbid influence such as overcrowding, is sufficient to induce actual disease.

In Almirack, the predisposing influence of overcrowding in the propagation of epidemic—disease, has been observed from time to time. The densely populated parts of the town have seen the death of a larger number of cases of Zymotic disease, than the more sparsely populated sections.
During the prevalence of the Cholera, in 1849, the largest number of attacks and, at the same time, the greatest mortality, occurred in streets where the population was excessive. The influence of overcrowding, with deficient ventilation, in the production of Cholera, was well observed, at Taunton. During the Cholera Epidemic of 1849, this town, with a population of about 16,000 presented fewer of the predisposing causes of the disease than many other towns which were attacked; hence, the prisoners of the Gaol and the inhabitants of the town altogether escaped. Not so the paupers in the workhouse, for, among them, out of 276 persons, the total number of inmates, not less than 50, died from Cholera, within a week; while, at the same time, nearly the whole of them suffered more or less from Diarrhoea. The cause of this fearful mortality was to be attributed to the overcrowding and imperfect ventilation of the apartments, the faulty construction of the place. That the vitiated atmosphere, produced by the overcrowding, was one of the great predisposing causes of the Epidemic outbreak, will be seen from the fact of the disease being most fatal in those parts of the workhouse where the largest number of persons was collected together. The Gaol of Taunton, containing above 1000 prisoners, though doubtless subjected to the same locating, or predisposing cause of the disease, had, nevertheless, not a single case of Cholera or Diarrhoea within its walls. This extraordinary occurrence was due, in all probability, to the thorough ventilation of the cells; the proper distribution of the prisoners with regard
to space, and an efficient system of drainage.

The observation made by medical men, on the development of epidemics in hot climates, go to prove, that their increase is, in many cases, due to overcrowding.

Dr. Ranke, in his report on the Malignant Fever which prevailed to a great extent in Ragpoor hand in the Paris cholera, in 1836, states, that "the decrease and elevation of the sickness is uniformly concomitant with the thinning of the population. The dispersion of the inhabitants is the most effectual measure that can be recommended, for lessening the violence, or stopping the spread of febrile diseases. Off the disturbance arise from a combination of circumstances, of which the principal is the accumulation of four or five persons in a dwelling, sufficient only for one, the preliminary condition of cure, without which others are drawn to the four or fivefold enlargement of the space in which the people breathe always, and sleep at night."

Zymotic diseases are very frequent among sailors, and, especially, among those employed in coasting vessels. In the port of Liverpool, deaths of this class form 25 per cent of the entire mortality among seamen; in London, 25 per cent; and in Hull, 19½ per cent. From an account taken in the Port of London of the deaths, occurring among sailors, both at sea and ashore, during the years 1845, 1846, and 1847, it appears, that the mortality among seamen ashore, from Zymotic diseases, is less, by upwards of one half, than at sea. These facts lead to the conclusion, that, for the production of this increased amount of disease, among men, usually in the prime of life, and engaged in an
occupation conducive to health, some localizing causes must be present in ships. And, accordingly, we find in the greater majority of merchant ships, a sanitary condition as bad as that which occurs in the worst parts of towns. In reference to the sanitary state of ships, in the port of Liverpool, Dr. Duncan, Medical Officer of Health for that town, says, 'I have visited a number of vessels of all classes, now in the Liverpool docks, with reference to the accommodation afforded to their crews, and I find, that in this respect, considerable variety exists; the larger vessels, particularly the Indiamen, being on a better footing than those of smaller size; but in none that I examined was the breathing-space more than one half what would be considered on shore as essential to health. In all the smaller vessels and in the majority of those of every description, the sailors sleep in the forecastle, situated between the decks, where the vessel tapers to the bow, and where the height is often not sufficient to enable a man to stand erect. The only opening for light and ventilation, is the hatchway, by which the sailors descend, and which in stormy weather must frequently be closed. These places might properly be termed floating cellars, although they are by no means equal to the inhabited cellars of Liverpool. Such cellars on shore, indeed, would be condemned, as unfit for habitations, under the provisions of our sanitary act.'

By the attention directed to ventilation and other means necessary for the preservation of the health, by no means have these diseases been nearly so
from the Royal Navy, from well regulated prisons and from well conducted workhouses.

The sanitary condition of London during the time, when Plague occurred epidemically every few years, was bad in the extreme. The city was composed for the most part of streets, which were narrow, close and badly drained; overcrowding of the rooms prevailed to a great extent, and in addition, many other causes were present which had the effect of generating malaria. The Plague of 1665 carried off more than 70,000 persons, or about a sixth of the population, and was followed by the Great Fire which destroyed a great part of the narrow and close streets. The broken portions of the city were replaced by wide and better drained thoroughfares, and from that time to this, there has been no further outbreak of the Plague. This, in my opinion, is a very instructive fact, showing the great influence of well conducted sanitary measures in preventing the occurrence of Epidemics.

One of the great predisposing causes of Fever, occurring among the Pleasantry in Northumberland, is, I believe, the overcrowding of their rooms and the foul air prepared at night in those peculiarly constructed beds. These, among the country people, are, in the majority of cases, formed altogether of wood, and constructed in such a manner as to admit the air on one side only. The open part of the bed can be closed entirely by means of two sliding doors and it is a common habit among the people to draw these doors almost close together after retiring to rest. So an
we be astonished then, under these conditions, to find in villages in the country, cases of fever occurring, where there are few of the predisposing causes of zymotic disease in operation, as compared with those in large towns?

The very great amount of overcrowding, which occurs in the lodging houses, of towns, is the chief cause of the frequent appearance of epidemic disease in such places. In many lodging houses, the beds are placed in every possible direction; a single room of one great size, containing frequently, as many as 10; each filled with from two to four occupants. The complete neglect of the ordinary decencies of life which is produced by the indiscriminate communion of the sexes—blunts all feelings of modesty, and soon undermines that of morality. Not only are lodging houses the frequent seat of zymotic diseases, which in many cases are communicated to those around, but also from the migratory character of their inhabitants, the means whereby infection is conveyed to other towns. Small Pox has frequently been introduced into a town, by vagrants, coming from a lodging house, in another place, where the disease had been present. If the importation of Small Pox, in this manner, were prevented, it is extremely probable, that the disease would become less frequent, if not altogether arrested, in all places, where vaccination was properly and universally performed. In late years, extensive improvements have been effected in lodging houses, and, till to speak, a degree of success, in maintaining the health of the inmates,
have there ameliorated sanitary conditions been attained that, out of 1507 persons, the total population of the model establishment in London in 1850, only one case of Fever had occurred since they were opened. The number of attacks of Fever, occurring in a body of working men, in the town of Liverpool, is about 20 annually. Nothing could better—regardless of the beneficial effects of efficient sanitation—than this important fact.

Even in hospitals, such as that in Edinburgh, where the Fever patients are placed in separate wards, among others, it has been found, that where due care is paid to the proper distribution of the cases with regard to space—and a constant supply of pure air brought into the wards by an efficient system of ventilation, the disease seldom, if ever, spreads. Else, however, the wards are crowded with patients suffering from Fever and others labouring under pulmonary disorders. The zymotic disease soon attacks those not already affected, and its increase is observed to be in proportion to the degree of overcrowding. In reference to this subject Dr. Crichton in the Library of Medicine says, "So far as minute observation of several violent epidemics in Edinburgh, during the last 20 years, can determine the point, moderate precautions will render the infectious atmosphere vest, whilst linen, and ventilation will speedily extinguish any Epidemic."
II Decomposing organic matter as a predisposing cause of Epidemic disease.

In the process of putrefaction in animal and vegetable matter, a considerable number of deleterious gases are evolved. The greater number of these produce injurious effects upon the system when existing even in small quantities in the atmosphere, but when the proportion of these gases, namely, carburetted hydrogen, nitrogen, ammonia, sulphuretted hydrogen and phosphuretted hydrogen is large they speedily exert a fatal effect.

The great influence of the malaria generated in this way, in predisposing individuals to attacks of Cholera, Typhus, Plague, Yellow Fever, and other Epidemic Diseases, has been observed in numerous instances. Some persons, indeed, have gone so far as to suppose, that in the decomposition of organic matter, putitive emanations of a specific nature are generated, which, when introduced into the system during respiration, are capable of producing such diseases aswere smallpox, measles, smallpox, typhus and other of the Zymotic class. A faulty sanitary conditions, of which the accumulation of decomposing organic matter is one, are not, in all probability, the proximate cause of Epidemics, but rather the means whereby the outbreak, progress, and mortality of such diseases, under the influence of an epidemic atmosphere, are determined. The local nature of the Epidemic influence has not as yet been discovered. That neither the malaria generated by putrefying organic matter, nor local sanitary local conditions, are capable of giving rise to an Epidemic outbreak.
without the aid of an influence which is only occasionally present, and, which has been termed the proximate cause of the disease, is rendered in the highest degree probable by the fact, that while towns and countries in a bad sanitary state are sometimes ravaged by pestilence, at other times, their sanitary conditions remaining the same, these same towns and countries continue free from pestilence for an indefinite period. Whatever may be the causes which determine an epidemic outbreak, it is important to bear in mind the well-attested fact, that a bad sanitary condition is, in every case, accompanied by an excess of disease and mortality, and that when epidemics prevail the greatest number of attacks and deaths occur in the most unhealthy localities.

The decomposing organic matter, contained in privies, cesspools, and middens, constitutes a laboratory from which poisonous gases are continually emanating. In Munich, at the time of the fearful outbreak of Cholera in 1849, privies, cesspools, and middens abounded in all parts of the town, and, especially, in those localities where the mortality from that disease was greatest. The centres of these receptacles of filth are allowed to accumulate for a length of time, and, in many cases, general matters are allowed to escape previous to the removal of the putrid mass. Exposed to the weather, the organic matter they contain undergoes putrefaction, and gives origin to a malaria, the effects of which upon the people around are pernicious in the extreme. The rain, falling upon the decomposing animal and vegetable matter, becomes impregnated
with organic impurities, and, in places where the drainage
is defective, or altogether absent, this liquid filth pursues
its course either upon the surface of the streets, or finds
a way for itself beneath the houses.

From my own experience in Almsh
I have always found that individuals residing in the
neighbourhood of foul privies and middens, containing
large quantities of organic refuse, are much more
frequently attacked with diseases of the zymotic class,
than other persons, who although enjoying the same
kind of food, clothing and habitation, do not have the
good fortune to live in a locality, where the air is less
subject to contamination.

Other, and more populous places
than Almsh, exhibit the deleterious influence of
collections of decaying matter upon the health, in a
more extensive form. With reference to the sanitary
condition of Etwall, Dr. Rutherford says "On the
Bank side of Etwall there lies a suburb called Batham
in which there is a triangular space of ground, bounded
by the streets called, Batham, Brook Union Street, and
Church Street. This triangle is surrounded by houses,
so as to leave an open space in the centre of nearly
three acres in extent, about two acres of which are used
as a place of deposit for part of the rubbish of the
town and other manure, which is intermixed in heaps
among the houses and close to the doors of the dwelling.
These manures matters are collected by a number of
persons who make a trade of accumulating and selling
them for agricultural purposes, and they have become
so accustomed to live amongst this horrible garbage,
that they not only heap it up against the walls and—
Immediately under the windows of their houses but it is stated they have come to consider the atmosphere of the locality rather wholesome and agreeable than otherwise. The extreme insalubrity of the locality is shown by the fact that whilst the average age of all persons who die in other parts of the town is 23 years, the average age of all persons dying in Wittam is only 18 years.

When cholera broke out in 1852, it raged with a violence, in this same place, scarcely equalled in any other part of this country. On the outskirts of a triangular space measuring little more than 200 yards on the side, no fewer than 41 persons were destroyed by the epidemic. I have never known, says Dr. Alexander, "an open neighbourhood of this size, yield so large a number of deaths."

Piggeries, attached to houses in town, have no slight injurious effect upon the health of the inhabitants. Pigs, when belonging to the poor, are too frequently badly kept; the sty is seldom and imperfectly cleaned, and at the same time, the excreta which are thrown therefrom is allowed in the many instances which have come under my notice, to accumulate for a considerable length of time. An instance of the effect of a badly kept piggery, in predisposing to syphilitic disease, has occurred to me, in my practice within the last few months—Pattensgate Row. This street is composed of houses inhabited chiefly by labouring persons, and is remarkably free from the residence of sick people from many of the causes which deteriorate the atmosphere. In a house, at the back of which the only frag to be found in the street is tepid, three cows
of malignant Scarlet Fever have recently occurred. A woman in the same house, inhabiting a room against the walls of which the pugstye is built, says that the plaster of her apartment has been powdered, in many places, quite rotten by the liquid filth seeping through the walls from the styke, and that the previous tenants of her room were all attacked with Typhus Fever within a month. After coming to her, the woman further observes that the foul stench, arising from the pugstye, especially in Summer, is in her opinion, the cause of the frequent attacks of Diarrhoea, Headache, nausea & Vomiting to which both herself and her neighbours are very subject.

The greatest mortality from Cholera, in Abner, occurred in that part of the town, where, in addition to other Sanitary evils, Pigpen and Stable abounded. In a house containing two rooms in Yeasdale's Yard, situated between a pigstye, privy and midden, one on the one hand, and a midden and privy on the other, three cases of Cholera occurred during the Epidemic of 1849. Lately, in the same house, the five children of the only person inhabiting it, have suffered severely from Scarlet Fever; and one of them, a girl, during her convalescence from the fever, was attacked with Small Pox. The mother of the children informs me, that she is Pearceely, even to this day, suffering much from Headache & Dyspepsia, which she attributes to the Malodour arising from the decaying organic matter in the immediate vicinity. She further mentions, that during the Summer time...
her children are often troubled with repeated and aggravated attacks of Diarrhoea, this she thinks is due mainly to the polluted atmosphere, as previous to occupying her present residence, her family were very healthy and seldom subject to such a disorder. The house in which this family lives, very frequently changes its occupants on account of its extreme unhealthiness.

Manufactories engaged in the fabrication of artificial manure, from the noxious matter employed in the process, are highly injurious to the health of individuals living in their neighbourhood. Numerous examples might be adduced illustrating of the influence of such establishments in producing a predisposition to epidemic disease. The following case, occurring in London, and given at length, in the Report of the General Board of Health on Cholera, will be of itself sufficient to establish the truth of this remark. Christchurch workhouse in Spitalfields is close to a manufactory of artificial manure from blood and night soil. These substances are either dried by means of heat, artificially, or by direct exposure to the sun. Whenever the wind was at all the malaria generated in this place, in the direction of the workhouse, (which contained about 400 children and a limited number of adults,) several of the inmates were attacked with Typhus, and, at the same time, a typhoid was given to small pies and heads. In 1848, when cholera prevailed in the neighbourhood, no less than 60 of the children were attacked with Diarrhoea early one morning. In consequence of this, the owners of the manufactory were compelled to
Close their establishment. The sooner than this was done, the children recovered their health. The works were resumed six months subsequently, and, within three days after, the wind blowing towards the working 45 of the boys were attacked with diarrhoea, whilst the girls, living in apartments further removed from the manufactory, than three of the boys, altogether escaped. The works were again put a stop to and the health of the paupers was restored.

III Improvement Drainage - as a predisposing Cause of Epidemic Disease.

To prevent the accumulation of decomposing organic matter in the neighbourhood of dwellings, it is necessary that there should be an efficient system of drainage; the object of which is to convey to a distance the excreta of man and animals, and at the same time to remove the surplus moisture from the subsoil.

Imperfect drainage instead of tending to abate an evil, has the effect of increasing it, by extending the evaporating surface, and by removing organic impurities from one locality only to accumulate in another. Recent experiments show, that the stone and brick sewers, hitherto so much used in the drainage of towns, have been much larger than was necessary for the purpose to which they were applied; and that their use may be much advantageously superseded, both with regard to superior efficiency and economy, by earthwork pipes of a comparatively small calibre. Drains, constructed with bricks and stone, according to the old plan, were very liable to have the flow through them impeded or arrested entirely, and from
then permeability permitted the escape of liquid pelth and noxious gases, and, in addition, required a very large amount of water to keep them clean. From the facts collected by the Metropolitan Sanitary Commissioners, and also by the Health of Towns' Commission, the superiority of the calton ware pipes over the loose, constructed brick drains, is manifestable. By means of the former the onward flow of the sewage; concentrated and hastened, the escape of fluid and noxious gases is prevented, and flushing is seldom needed, as the tendency to obstruction is slight from the non-accumulation of refuse.

A outbreak, during the time of the cholera had a very imperfect drainage. Nearly, the whole of the liquid refuse of the town was carried through the streets in open gutters, or in drains which were in many places partially and imperfectly concealed. During the prevalence of cholera in this town, in 1849, it was found, that a large mortality occurred in those parts where the drainage was bad or altogether absent. A foul and badly constructed river, flowing through soil, from Brook Street and Union Bank, was in the midst of that part of the town where the disease carried off the largest number of victims. In one part of a street, where the sewage passed under some houses, 9 fatal cases occurred, besides a large number of attacks. In the outskirts of the town, two deaths from the epidemic took place beneath which an offensive drain ran. Along the line of an improperly constructed drain, in a part of the town, where there was a small mortality, as compared with other portions, several fatal cases occurred.
Other towns present numerous facts to bear out the truth of the observation that both cholera and typhus carry off great numbers where drainage is absent, or where it has been so improper, applied, as to increase the evil instead of preventing it. In the city of Bristol, the cholera first made its appearance in Wellington Dock, Wellington Buildings, and Gloucester Dock; the homes of these courts, amounting to 65, in all, are small, poorly, overcrowded, and in the neighborhood of a burial yard. The water supplied to the dwellings was deficient in quantity, and rendered impure by the contamination it received from the ill constructed drains which were almost in the condition of cesspools, from the arrest of the flow through them, by the accumulation of refuse-matter. In those parts, where the drains opened into the streets, the stench was so bad, that the inhabitants were obliged to cover the gully grates with canvas to keep down the smell. That the disease prevailed to a great extent, in those courts, will appear from the account read by Mr. Williams, the medical officer of the district, to Dr. Petherard, by whom this case is given at length in the Report of the General Board of Health. In Wellington Dock there were 11 deaths, to 23 attacks. In every dwelling beneath which a tram passed, there was a death. In Wellington Buildings, there were 11 deaths to 33 attacks. In Gloucester Dock, 14 deaths, occurred to 33 attacks. Out of the entire number of homes in Wellington Dock, 14 were atacked, while 7 were free from the disease. In Wellington Buildings, 15 homes suffered, and 7 escaped. In Gloucester Dock, 11 homes were attacked, while 4 were free.
Buch, out of the total number of inhabited houses, 13 presented cases of Cholera, while the remaining 5 were untouched.

In Alnwick, Hexam and other

air cases of the Zymotic class, have always been most
frequent and most severe in type, in those streets

where the drainage and other conditions, necessary for

the preservation of the health, are defective. The

same observation has been made repeatedly, with

regard to other towns.

Cholera, has been noticed to

produce the greatest mortality, in those parts of towns

which are most subject to disease, of the Zymotic

class; the conditions, necessary for their development

were, apparently, similar. This is in Alnwick,

in London, Edinburgh, Leeds, Bristol, Leeds &

other large towns. From a comparison of the number

of deaths occurring in London, from Cholera, in 1832,

as given by the Metropolitan Sanitary Commission,

with the mortality, from Fever, in 1787, a general

coincidence of the habitats of Cholera and Typhus

is observed; for, in comparing, in the thirty-

metropolitan districts, the proportion of deaths to

the population, from Fever, and from Cholera; it

appears that, in the districts where the deaths

from Fever were the highest, Cholera was most

prevalent and fatal.

An efficient system of drainage

not only removes to a distance the liquid refuse

of a town, but also the superfluous moisture

derived from the subsoil. An ample amount of

water in a soil is a frequent cause of stampede in
dwellings. Houses, situated on hill side, are very liable to be damp, if means are not taken to collect the superficial moisture and have it removed at a distance. This is especially the case where dwellings are built across the natural line of drainage, in so much as their foundations act as a barrier to the downward flow of the water which is thus collected in the soil behind. The evil effects of this obstruction to the natural drainage are much increased in cases where the water becomes impregnated with organic matter—derived from collections of putrefying refuse in the neighbourhood.

In Alnwick, the cholera carried off its greatest number of victims in Glassport Street, where, in addition to numerous other peculiar causes of disease, artificial drainage was, in a great measure, absent; being the subsoil, infiltrated with water highly impregnated with organic imprints. Derived from privies and sulleries in the vicinity, and the house damp from the liquid filled, finding a course for itself through, or, under, their foundations. This street occupies a more elevated position than any other in the town and is built on the sloping side of a hill in a manner calculated, in the absence of proper drains, to obstruct the downward flow of the water coming from the high land above.

The beneficial effects of drainage combined with other sanitary regulations, as applied to towns, in increasing their palatability, has been demonstrated in numberless cases. Louisville in America, previous to being drained, was considered one of the most unhealthy towns in the valley of the Mississippi; an
that have so large a number of persons fell victims to Fever, that it obtained the name of the Graveyard of the Leech. During one epidemic, no fewer than 232 persons suffered, out of a population of scarcely 5000. Since the introduction of an efficient system of drainage, together with other sanitary regulations, it has become a healthy town.

Since the introduction of drainage on a large scale, intermittent Fevers have been banished from most parts of this country.

In Egypt, where the Plague occurs at the present day, very little attention appears to be directed to judicious sanitary regulations and, particularly, to an efficient system of drainage. Efficacy affords evidence to prove that Egypt was free from pestilence, during the rule of the last of the Pharaohs, for the space of 194 years, whilst the country was occupied by the Persians; for the 301 years during which lasted the reign of Alexander, the dynasty of Ptolemies and a great portion of that of Rome. It is very probable that this exemption from the Plague was due to efficient sanitary regulations. That the ancients were aware of the importance of drainage can scarcely be doubted; the numerous remains discovered at Nineveh, indicating that the people, in those days, were already aware of the importance of drainage, and, doubtless, of other sanitary regulations as a means of preserving the health of those living in towns.

The town of Hamburg affords a striking illustration of the effect of improved local condition in procuring an exemption from
Cholera, during the presence of an epidemic atmosphere, in its greatest intensity. Ten years after the outbreak of Cholera in Edinburgh, in 1832, nearly one third of the central part of the city was burned to the ground. The streets destroyed by the fire were rebuilt with a due regard to the health of the people. The results of this improved sanitary condition has thus been given by Mr. Brainger. His statistical report says Mr. Brainger, of the epidemic of the present year, similar to that of Dr. Rottenburgh, has yet been published; and, after extensive inquiries among several physicians, I can fully justify in stating that the rebuilt part of Edinburgh has experienced an exemption from Cholera which is as remarkable as it is important. All the medical men, with whom I conversed upon the subject, expressed themselves unqualifiedly as to this effect and, indeed, the thing is so notorious as to be well known to the inhabitants generally. Dr. Rottenburgh stated to me in evidence, that although there had not been time to close the cases, it was clear that the epidemic had not advanced as far towards the East or New part of the town, as in 1832. Other physicians state that it has been particularly confined to persons living near the Clyde. Mr. Walters, whose office enabled him to form a more accurate judgement than other individuals, stated it was his duty to take the addresses of all the applicants who came to the central Bureau, in answer to any inquiries, state, that, from extended observation he had ascertained that comparing the poor residing in the rebuilt part of the town with those living in the old portion, not more than one of the former had been attacked.
with Cholera for ten of the latter. As certainly as the percentage of Typhus decreases with improved drainage, paving and ventilation, so also, with Epidemic Cholera, The proof of this has been afforded on a grand scale at Hamburg. The ravages of the disease have received a marked check in the present outbreak, by the substitution of wide open and well drained streets, for narrow, filthy and damp, thoroughfares, by the removal of high mounds of earth blocking up the streets and overshadowing the houses, and by guarding a large evaporating surface of water from contamination.

In Alvarick, since the introduction, under the superintendence of the General Board of Health, of efficient drainage, and a plentiful supply of good water, together with other improved sanitary conditions, Cholera has not again made its appearance and in the opinion of the medical men, fever is by no means as frequent or so extensive a character as formerly, while, at the same time, the general health of the town is much improved.

IV. Atmospheric peculiarities— as a predisposing cause of Epidemic Disease.

Epidemic diseases appear to be influenced, in an inconsiderable degree, by atmospheric peculiarities. On the continent, and in other parts of the world, a relation has been observed to exist, between the progress of Cholera and the temperature, more uniformly than in this country. This is especially the case in the Firth for there the disease usually augments the number of its victims whenever
an increase of temperature occurs. In London, although the cholera did not increase uniformly with the temperature, yet the disease prevailed during the hottest months of the year, namely, July, August and September, and was at its acme from August 15th to September 15th, when the thermometer was unusually high. During the greater part of this time, the atmosphere was very close and oppressive.

In many parts of England and Scotland, the temperature did not appear to have much influence upon the development and progress of the disease. The meteorological conditions, so far as they were noted, at Alnwick, during the outbreak of cholera, in 1849, presented nothing unusual.

In India, numerous instances have been observed in which there appeared to be an undoubted relation existing between outbreaks of cholera and peculiar atmospheric conditions. In Kurnochee, in that country, for some weeks preceding to an extensive outbreak of cholera, the temperature was unusually high, ranging from 90 to 92, during the day, and from 86 to 88, at midnight. The quantity of moisture in the atmosphere was very great; the dew point being at 85, while the atmosphere was unusually still. The prevailing winds were light and weak, in place of the strong and steady breeze which usually blew at that time of year, and which gave to the town a considerable degree of salubrity, during the hottest months. During the actual prevalence of the epidemic, a much larger amount of rain fell than usual. With all of these atmospheric peculiarities, existing in one place, we are not astonished when we learn
from the report, made by Mr. Thom, that among the inhabitants of the town "there was a sense of languor and oppression, a stifling feeling about the respiration, and inability to undergo the slightest fatigue without extreme exhaustion. It was impossible to sleep at night, yet during the day the tendency to be overcome by a torpid state of sleep was universally complained of. The body was bathed in perspiration and the skin was corrugated and thickened as if it had been immersed for a long time in water. The lightest clothing could hardly be borne, or any thing that arrested the free communication between the skin and air... In fact for ten days previous to the outbreak, it was a common remark among "old hands" that it was regular "whaling weather".

Outbreaks of yellow fever have, in many instances, been accompanied with unusual atmospheric phenomena; thus, previous to the appearance of the fever at Baia Vista on the coast of Africa in 1744, there was a long continuance of extremely hot weather, a great fall of rain, at an unusual time, and a still atmosphere. A hot and unusually humid state of the air by distorting to a considerable degree, the secretory functions of the lungs and skin, has the effect of rendering the blood impure, in as much as, under these conditions, substances, instead of being secreted, are retained in that fluid, and thus acts as a predisposing cause of disease.

The outbreak of Influenza in London in 1847, was preceded and accompanied by violent storms of wind and rain; hence Pope
and frequent and sudden alterations of temperature. During the week in which the disease first became epidemic, no electricity, according to the Registrar-General, "stained the air."

The extension and mortality of the Plague seem from the observations made by Dr. Landau, at Alexandria, to be much influenced by the state of the weather. "During the Plague season," says Dr. Landau, "the atmosphere is constantly charged with moisture, and, as much as, that the difference between the dry and wet bulb of the Thermometer is not more than 2 or 3 degrees; the average throughout the year in Egypt being about 8 or 10 degrees. The effects of these atmospheric phenomena are as well known to the Egyptians, that they express their hopes, or their fears, according to indications presented to them by the state of the weather."

Ordinary atmospheric conditions have, at various times, and in numerous places, preceded and accompanied outbreaks of other forms of epidemic disease than those already mentioned; among these may be enumerated Influenza, Scarlet Fever, and the Small Pox.

The relation existing between epidemics and the atmosphere, is further shown by the extreme rapidity with which their extension is effected, and also by their periodicity. Thus, when cholera appeared at Grand Cairo, in 1831, it travelled its ravages over the entire part of Lower Egypt in the brief space of five days. Again, when cholera made its appearance, in London, in 1849, it spread over the greater part of the city, in the course of 24
hours; and such was the extent to which it prevailed, that out of a population of 2, 100, 000, not fewer than 50, 000 persons were attacked by the disease. The Plague as it occurs now in the East, is observed to prevail epidemically, about once in every ten years. Epidemics of Cholera and Typhus also recur, after an interval of time, varying in different cases. Dr. Wilde, in a Report on the causes of death in Ireland, has shown that Fever has raged decennially for the last 150 years in that country. I do not mean to say—observes Mr. Wilde, that it has become epidemic or fatal, exactly, upon the tenth year, but from the eighth to the twelfth, with an interval of from six to eight years; thus, it appeared in 1808; 1718–21; 1728–1731; 1740–43; 1763–64; 1771–75 and 1817–21. In the year 1832, Cholera took its place, but in 1837, it again appeared, and the year 1842 was marked by a more fatal epidemic.

The electric condition of the atmosphere, during the prevalence of Cholera, does not appear to present variations from the normal state—sufficiently uniform to lead to the supposition that outbursts of the disease are in any way connected with it; for although, Dr. Crawford found, at St. Petersburg, during the epidemic of 1842, as mentioned in his report, that the Electric Force was disturbed to such an degree as to prevent the charging of the machine observations, made in this country, have not afforded the same results. Equally unsatisfactory have been the investigations into the magnetic force. In some parts as in St. Petersburg, the result of the inquiry indicated a diminution of the force, while at Berlin and Hamburg it was found to be increased.
V. Fatigue and Depressing emotions of the mind as predisposing causes of Epidemic Disease.

Numerous instances are on record of Cholera and other diseases of the Zymotic class, attacking medical men, nurses and others, who, during the prevalence of an Epidemic, have had their physical powers overburdened by excessive exertion.

The exhaustion produced by long continued marching among the soldiers in India, has had the effect in some instances of inducing a much greater amount of Cholera than occurs in similar bodies of men in garrison. In some cases, indeed, marching regiments have suffered twice or thrice as much from the Epidemic, as those that are stationary.

Fear, and other depressing passions of the mind, by impairing the general health, undoubtedly give a predisposition to the attacks of various forms of Zymotic Disease, and, at the same time, aggravate the symptoms of those that already suffer from them. A striking instance of the influence of fear, on the Development and progress of Yellow Fever, is thus related by Dr. Becton:

"The mental emotions had not only the effect of developing the Disease in the Susceptible, and those who had been exposed to the morbid localities, but also played an important part in the progress of the symptoms, and on the result. During the progress of the Epidemic, it was discovered, that if a sailor affected with fever happened to be brought to the hospital, when the hearse was present, the worst prognosis was to be formed. The intelligence of the arrival of the hearse had also the most injurious
effect on the sick and convalescent within the wards. So much was this the case, that a new dead house had to be built, out of sight of the hospital, and the approach of the hearse so managed that its visi-
ture unknown to the patients. As grief and fear and the after depressing digestive motions acted as
auxiliary causes, so, on the other hand, did confidence and hope abate the tendency to death; and, in
accordance, moral courage and invocation of feeling acted as the most powerful adjuvants of treatment.

In the Bharia Epidemic at Alnwick, personal persons
were carried off whose fears had been for some time
prevailing, greatly excited at the number of deaths
occurring around them; others, again, fell victims to
the pestilence, who, having lost relations, gave way
to execration and long continued grief at their bereavement.

...among the prevalence of an
Epidemic atmosphere. While individuals are constantly
breathing a determined air, impairing the powers
of life, though unable of itself to induce disease, the addition of a very slight predisposing cause will
have the effect of doing so. While Symptomatic Diseases,
such as Cholera and the Plague, prevail in a district,
other diseases are by no means so frequent as at
other times; the epidemic influence, as it were, assembled
them to its own nature. We cannot wonder then, when
we find, that under the influence of such a morbid
poison, the most trifling indisposition, which fatigued,
together with other causes, tending to debilitate the
system, may give rise to, will entice a true disease
of the same type as that prevailing.
Errors of Diet and Intemperance as a Predispensing Cause of Epidemic Disease.

Numerous cases are on record in which individuals have been attacked with cholera, after eating bad meat, crude vegetables, unripe fruit—especially apples, pears and plums; also salted provisions, some kinds of fish and meat, abounding in oil, cheese and bad beer.

During the prevalence of cholera in America, this observation was, in more cases than one, fully verified; persons who had partaken freely of fruit, were, shortly after, stricken with violent diarrhoea, which very soon passed into cholera.

The following instance, of the effect of fruit in predisposing to an outbreak of cholera, was observed on board the Dallas, among the crew consisting of Prussian sailors. These men remained, for a few hours, at Hambrough, where the cholera was raging, and, on their passage to England, partook freely of plums, with which the vessel was laden. On the arrival of the ship in England, several of the crew were attacked with the disease.

At one period, it was commonly supposed, that bad and insufficient food was the great predisposing cause of cholera; but recent investigations have shown that it is only of secondary importance, and, by no means, so liable to predispose to the disease, as the habitual respiration of a foul atmosphere, in a place where the sanitary arrangements are bad. The predisposition, however, is greatly increased, when all of these conditions are combined. Insufficient food and clothing are two of many causes, which tend to weaken the system and render
persons suffering from poverty, and liable to be affected by an epidemic atmosphere, than those who have the means of satisfying the cravings of hunger and of protection from atmospheric inclemencies.

Intemperance has, in numerous instances, been observed to precede these attacks of cholera. Material drunkards have been carried off, in a large proportion, by the epidemics which have, at various times, devastated the country. During the outbreak of the disease, in Alnwick, in 1849, a large number of persons, who were in the habit of indulging too freely in the use of ardent spirits, fell victims. Several cases were noticed, in which violent diarrhoea, and, in some instances, cholera, supervened, upon a single intake of drink. Dr. Sutherland, in his report on Cholera, relates, an instance occurring, on board a vessel, in the roadstead of Sunderland, early in October 1848, in which the influence of intoxicating drink, in predisposing to cholera, is well seen. This vessel, says Dr. Sutherland, had arrived from Hamburg, when one death had occurred on board, shortly after leaving that port. She was, consequently, put in quarantine, and I went alongside of her, in a small boat, for the purpose of making the needed inquiries. I saw all the crew, who appeared to be in perfect health, and one middle-aged man was especially communicative, and afforded a good deal of information in regard to the vessel. I gave the people instructions how to act, in case the disease should again appear, and especially, cautioned them to avoid intoxication, which, I assured them, would lead to certain death. This was about 7 o'clock P.M., and immediately, after I left, the man referred to went down into the
forcastle, where he had received a bottle of Brandy, an
earner, and drank a large quantity. In an hour or two
awake he was collapsed and died the next morning
at 7 o'clock.

In large towns, as was particularly
noticed at Glasgow, Edinburgh and Newcastle more cases
occurred in the beginning of the week than at other times,
this was doubtless to be accounted for by the fact of there
being a greater amount of drunkenness in the Commencement
of the week, due to the payment of wages to workmen
on Saturdays.

Intemperance, of itself, not only tends
to weaken the constitution, but is also the root of a host of
other evils. Thus, a drunken man denies himself
sufficient and suitable food and clothing to obtain the
means whereby to gratify his unnatural appetite; he
is, besides, usually dirty in his habits and seldom takes
sufficient outdoor exercise, and, in addition, Inhabits
the cheapest apartment, which are, usually, the worst in
a sanitary point of view.

VII Age, Sex and Occupation as predisposing Causes
of Epidemic Disease.

From the report of the Registrar
General, for England and Wales, in the year 1848 it appear
that males suffered from cholera more than females. In
London, in 1848, more cases terminated fatally in women
than in men; the number of deaths in the former was 7933
while in the latter, 5957. The reverse of the truth held
during the late epidemic. In Holland during the Epidemic
of 1832, the males suffered more than the females. In
Altona in 1849, the cholera proved fatal to 79 females
and 54 males. From all accounts, the liability to fatal attacks of this disease appears to be pretty nearly equal, in the sexes. A report made by Mr. T. H. B. Edwards, on the mortality of cholera, at different ages, shows that a large number of persons suffered between the ages of 20 and 45; the deaths during this period, forming 32.5 per cent of the total mortality. The greatest relative mortality occurred between the ages of 80 and 85. In Berlin, the great majority of the persons who fell victims to the disease were from 20 to 40 years of age. In the city of Glasgow, out of 2,322 attacks and 1,058 deaths, in which the ages were accurately kept, it was found that, between the ages of 20 and 40, the number of attacks more than doubled those occurring from the time of birth up to 20; between 20 and 50, the number more than doubled those who suffered in all the other periods of life put together; from 50 to 50 per cent of the deaths took place between the ages of 20 and 40. In Barmbek, the greater mortality occurred in persons between the ages of 20 and 40, and the number of deaths between 20 and 50 being doubled those which took place at all the other periods of life put together.

In Broadwood Fever, age has a considerable influence, not only on the number of attacks, but also, on the mortality. From the observation of Dr. Cowan, during the Epidemic of 1830, in Glasgow, it appeared, that, between the ages of 5 and 10, there was 1 attack in 134 of the population living at that period of life; from 10 to 15, 1 in 65; from 15 to 20, 1 in 41; from 20 to 30, 1 in 53; from 30 to 40, 1 in 85; from 40 to 50, 1 in 110; from 50 to 60, 1 in 271 and above the
age of 30, in 929. The above statistics indicate that the liability to an attack of fever goes on increasing up to the age of 30, but that it diminishes from this period as life advances. Age also exerts a peculiar influence on the mortality from fever. Thus, in the Edinburgh Epidemic of 1818-1820, while the mortality was 1 in 22 for all ages, the deaths from the time of birth up to 20 years was 1 in 65; between 20 and 30, 1 in 29; between 30 and 40 1 in 18; between 40 and 50, 1 in 11.4; and between 50 and 60, 1 in 6. This account clearly shows that the liability to a fatal termination during an attack of fever goes on increasing as life advances, and such is the general rule though liable to exceptions. Thus, in the London Fever Hospital, during the Epidemic of 1828-1829, when the general mortality in the hospital was as high as 1 in 7.22, that for children under 15 was 1 in 7.33; between 15 and 30, 1 in 9.5; between 30 and 50, 1 in 7.33; and above 50, 1 in 2.5.

With regard to the relative mortality from fever in the poorer class of citizens, Dr. Bowman of Glasgow, after an observation of 2259 cases, has shown that the deaths for all ages amounted to 1 in 6.78 in the male and only 1 in 11.2 among the females.

The large number of deaths produced in London by the cholera among persons engaged in almost every description of trade and profession, enables us with caution to ascertain the relative mortality in the different occupations. Taking a general survey of the whole, it appears that the labouring classes—suffered much more than persons engaged in trade suffered, and in degree, while the gentry, including professional men, were not much affected.
were least affected. The account by Dr Guy of the occupations of 4312 men, who died of cholera in London, contained in the Report of the Registrar General, for the week ending December 22, 1849, shows that among clergymen the proportion of the deaths to those living was 1 in 213; in medical men 1 in 205; and in lawyers 1 in 375. Taking the learned profession altogether, the proportion was 1 in 297. The following table gives the comparative mortality occurring in the different occupations:

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labouring men</td>
<td>1 in 65</td>
</tr>
<tr>
<td>Dustmen and scavengers</td>
<td>1 in 39</td>
</tr>
<tr>
<td>Tanners</td>
<td>1 in 39</td>
</tr>
<tr>
<td>Butchers</td>
<td>1 in 174</td>
</tr>
<tr>
<td>Apothecaries and green grocers</td>
<td>1 in 28</td>
</tr>
<tr>
<td>Hatmen</td>
<td>1 in 143</td>
</tr>
<tr>
<td>Tailors</td>
<td>1 in 233</td>
</tr>
<tr>
<td>Footmen and servants</td>
<td>1 in 1572</td>
</tr>
<tr>
<td>Sailors including Greenwich men</td>
<td>1 in 24</td>
</tr>
<tr>
<td>Ballast bearers</td>
<td>1 in 24</td>
</tr>
<tr>
<td>Watermen</td>
<td>1 in 07</td>
</tr>
<tr>
<td>Fishmongers</td>
<td>1 in 20</td>
</tr>
<tr>
<td>Paper makers</td>
<td>1 in 15</td>
</tr>
<tr>
<td>Egg, fish, cattle, and tallow</td>
<td>1 in 6</td>
</tr>
<tr>
<td>Paddlers</td>
<td>1 in 250</td>
</tr>
<tr>
<td>Shoemakers, goldsmiths, &amp; silversmiths</td>
<td>1 in 583</td>
</tr>
<tr>
<td>Watchmakers</td>
<td>1 in 369</td>
</tr>
<tr>
<td>Typewriters</td>
<td>1 in 390</td>
</tr>
<tr>
<td>Auctioneers</td>
<td>1 in 205</td>
</tr>
<tr>
<td>Cooperers</td>
<td>1 in 124</td>
</tr>
<tr>
<td>Cork cutters</td>
<td>1 in 174</td>
</tr>
</tbody>
</table>

From this list, it will be seen that as a general rule,
the greatest mortality has occurred among persons exposed to the effluvia generated by decomposing animal and vegetable matter. The men employed on the river thames, especially the sailors and bargee sailors, have also suffered severely from the same cause.

The cholera, as Knivock, carried off its victims almost entirely, from among the labouring classes; for out of 136 deaths, only 17 occurred among those engaged in trade, while among the better classes there was not a single case.

VIII A bad water supply as a predisposing cause of epidemic disease.

From the fact that, in nearly every town where cholera has prevailed to a large extent, the water has been either bad or insufficient in quantity, we must consider this necessary article as one of great importance in a sanitary point of view. The importance of a p sufferers supply of pure water in towns is almost, when we remember the variety and number of purposes to which it is applied.

Perfectly pure water is not found in a natural state, but can be obtained by distillation. Distilled water, from the absence of carbonic acid, has a flat and insipid taste and contains neither organic nor mineral matter. By some individuals, it is considered to be the best food for drinking, but experience has shown that its habitual use is most attended with any advantage over that of water of a moderate degree of purity.

In supplying a town with water, care should be taken to select the purest in the neighbourhood, and, until this is done, when it has to be
brought from a distance, and while various sources are
available, springs should be looked for arising from—
Primitive rocks, or sandstone, as the most likely, to furnish
a water containing a small amount of saline impregnation.
In all situations, whether obtained from springs arising
from Primitive rocks, sandstone, or the leucocratic granite,
water always contains a variable amount of mineral and
organic matter. The salts of most frequent occurrence,
are the Carbonate of Lime, Soda, and Magnesia; the
Nitrate of Lime, Soda and Magnesia; and the Sulphate
of Lime, Soda and Magnesia.

Water, containing a considerable
amount of carbonate of Lime and other salts, is termed
hard, and is comparatively, unfit for domestic purposes.
When habitually drunk, it is liable to produce, Dehydration,
travel, and other disorders. For washing, a much greater
quantity of soap is required, and the wear and tear
of the clothes, during the process, is greatly increased.
In addition, many culinary operations are less easily and
satisfactorily, performed with it than with soft water.

Various means are used to render hard
water soft. If the hardness is due to the presence
of an undue amount of Bicarbonate of Lime, one of the
best methods of correcting this is to add an amount of
Lime water, proportionate to the degree of hardness. The
Lime water, in this operation, combines with one of the two
equivalents of Carbonic acid in the Bicarbonate and the
Carbonate of Lime thus formed being insoluble, falls to the
bottoms of the liquid and is easily removed.

Springs water seldom acts upon lead,
unless it contain a small amount of a metallic matter,
and is kept, for a length of time in contact with the metal.
In this case, the oxygen contained in the water, combines with the lead into an oxide which, on the addition of muriatic acid, derived from the air, quickly becomes the soluble carbonate.

Numerous cases are on record in which the habitual use of hard water has seemed to predispose to the occurrence of cholera and other epidemics. During the cholera epidemic of 1832 in Glasgow, the parish of Gorbals, and other parts of the city, suffered very severely. In the late epidemic, Gorbals parish suffered very little, while the disease was very prevalent in other parts of the town. The comparative immunity was, in the opinion of the Medical Society, of that place, to be attributed to the introduction of soft water. The epidemic was more destructive in places in the west of Scotland, where the water contained a large amount of mineral impregnation, than in those districts where it was soft and arose from rocks of the primitive period; thus, in Charleston—a district of Paisley, containing nearly 4500 inhabitants, the cholera carried off a much larger number of persons in houses where the water was hard, than in those which were supplied with a pure water.

Not only has the habitual use of hard water predisposed to attacks of cholera, but also that of water highly impregnated with organic matter. This has been noticed in many towns, and perhaps, in none better than in London, in a park called Jacob's Island. In this place, a large number of the houses have no water supply, and the inhabitants, one and all, the fishmongers, of using that obtained from a foul ditch, in the immediate neighborhood, which receives the sewage from a number of the dwellings, and often contains the putrefying
cases of animals. In the Epidemics of 1832 and 1849, the earliest fatal cases occurred close to the docks and, at the same time, peacefully a house ward free from Diarrhoea. The town of Brackley, during the outbreak of Cholera, in 1849, was insufficiently supplied with water of a very high degree of purity. Recently, an ample supply of good water has been brought to the town from a distance of three miles, under the superintendence of the General Board of Health. The beneficial effect of this improvement upon the health of the inhabitants has in the opinion of the medical men, already begun to shew itself.

IX. Intramural Decomposition as a predisposing cause of Epidemic Disease.

That the interment of the dead in large mounds, close to the dwellings of those living in towns, is highly injurious to the health, is proved by numerous facts. The few feet of earth placed over dead bodies in burial grounds do not prevent the escape of the gases produced during their putrefaction into the air above. The generation of the gases of decomposition takes place with so much force that they frequently expand and burst the stone casket, the coffin in which the corpse is contained; and whereas in an ordinary grave, these gases slowly permeate the surrounding earth, they are only partially absorbed, the greater part issuing from the surface to contaminate the air around. Dr. Byron Playfair, in reference to this subject gives the following evidence. "I have examined," says the Doctor, "various churchyards and burial grounds for the purpose of ascertaining whether the layer of earth above the coffin is sufficient to absorb the putrid gases evolved. The
slightest inspection shows that they are not thoroughly absorbed by the soil lying over the bodies. I knew several churchyards from which most putrid smells are evolved, and gases with similar odours are emitted from the sides of sewers, passing in the vicinity of churchyards, although they may be thirty feet from them. If these gases are thus evolved laterally, they must be equally emitted in an upward direction.

Among the various gases, generated in the putrefaction of dead bodies, barbotanic acid is one which is only sparingly absorbed by the soil. Yet so abundantly is it produced, that in old and overcrowded churchyards a deep grave can scarcely lie long without considerable danger to the workmen. In confirmation of this statement, I may mention the result of Dr. Rush's investigation into this subject. "On making a pit," says the Doctor, "in the earth, near which a number of bodies were interred, the pit, in a few hours, became filled with such an amount of barbotanic acid gas, arising from the decomposition of the neighbouring bodies, that the workmen could not enter it without danger."

When we bear in mind the fact that putrefying organic matter is capable of inducing the same process, in matter of a similar kind with which it may be brought in contact, we can readily understand why the emanations proceeding from graveyards as well as from other sources of impurity, should be productive of pernicious effects. Thus putrefying flesh is capable of inducing decay in another piece of flesh. Putrefying gases, given off by foul sewers, are the occasion of the speedy putrefaction of meat.
hung in the neighbourhood of the place from which they arose. Putrid meat and other articles of diet, when taken into the system as food, are absorbed in like manner, to induce a change in the constitution of the blood; and in this way, predispose to the occurrence of various diseases, and especially those of the typhonic class.

Not only do churchyards in towns deteriorate the atmosphere, but also the water made use of by the inhabitants. Whenever a smell is sunk into the earth, in the neighbourhood of a burial ground, the water soon becomes impregnated with the impurities proceeding from the decomposing organic matter, as evidenced by the sense of smell, and by the more accurate test of chemical analysis.

Numerous instances are on record, in which the inhalation of an atmosphere, charged with the products of the decomposition of dead bodies, speedily proved fatal to life. Thus, in 1841, two gravediggers in Boston died, immediately, on descending into a grave in St. Bathelmus's churchyard, in Aldgate. A remarkable case of a similar kind, occurred among the crew of an American vessel anchored in Whampoa Roads near Canton, in China. One of the sailors having died of dysentery, four of the crew went ashore to bury him; the place chosen for the purpose happened to be the beach upon where a corpse had been interred two months previously, as was afterwards ascertained. The sooner had the spade broken through the coffin, than a dreadful effluvium arose, and two of the men fell down nearly lifeless. Shortly afterwards the symptoms of malignant fever were developed, which
proved fatal in both cases, on the fifth and sixth day after the attack.

The effluvia evolved by decomposition, being, having been thus shown to be productive of the most fatal consequences when existing in a concentrated state, we cannot doubt but that the gases produced in crowded graveyards, although present in a more diluted state, operate very injuriously upon the health of persons living in their vicinity.

In London, epidemic diarrhoea has always occurred in large proportion in the neighborhood of graveyards. In the streets surrounding the burial grounds of St. George the Martyr, Southwark; New Brompton Fields, St. Luke's; Finsbury Fields; Rotches Place, Holborn; St. Mary's, Newington; St. Anne, Blackfriars, besides many others, both cholera and typhus were very frequent. A surgeon in London, who lived in a house overlooking a graveyard, fell a victim to cholera; the case is thus related by Mr. Graninger in the Report of the Board of Health: "It is known," says Mr. Graninger, "that a man, distinguished as a surgeon, Mr. Key, whose valuable life fell a sacrifice to the late epidemic, resided in a house the back windows of which looked directly into a graveyard; that he was much in the habit of sitting at these windows when opened; that he had complained to his servant several times, shortly before his attack, of the offensive smell proceeding from the burial ground, in which some cholera corpses had been interred, and that, on the very day of the fatal visit, a gnat had been seen which attracted his attention as having increased the noxious effluvia."

A remarkable instance of the influence
of graveyards in pandemic, passing to the attacks of cholera was
witnessed at Bristol. In that town an overcrowded burialsground was closely surrounded by an irregular square containing 33 houses, and termed the Rackay. In this place, the cholera broke out with great severity, and carried off no less than thirty-three persons. That the epidemic outbreak was due in a great measure to the
emanations proceeding from the grave-yard, and will be perhaps considered probable by the fact that, at that period, no other part of the town was affected with the exception of one district of limited extent, close to another graveyard,
and at no great distance from the Rackay.

The formation of extra-urban burial grounds as a means of preserving the health of the inhabitants of towns has been of late years the subject of considerable attention. In many towns the old and overcrowded graveyards have been closed and new cemeteries opened at a moderate distance from the houses. The beneficial result of this improvement has already been witnessed in numerous places.

The history of epidemics presents a melancholy picture, in which a vast amount of misery and death is seen to spring from our own ignorance, selfishness, folly and neglect; but the preceding pages will have shown that these scourges of the human race are not
inevitable calamities, and that by improved sanitary conditions, Plague has been extirpated from this country; fevers have been banished from
well conducted jails and workhouses; and wholesale asylums have been established, leaving countless those towns and parts of towns, where the localizing causes of disease have been removed.

Doubtless, much of the time of the medical practitioner will always be required for the cure of disease, but the spirit of modern times is not satisfied with the cure of disease. It would seek its prevention; and in accordance with that spirit, it must form one of the highest duties of the physician to understand the nature and causes of epidemics and the means by which they may be prevented, and to urge, as the guardians of the public health, upon the legislative and upon families, the adoption of all sanitary measures which science may discover, for preventing epidemic outbreaks, or for lessening their violence.

George R. Tate
Resident Surgeon

March 27th, 1856
Aluminius, California