

Epidemics : their origin & prevention / by J. Foster Palmer.

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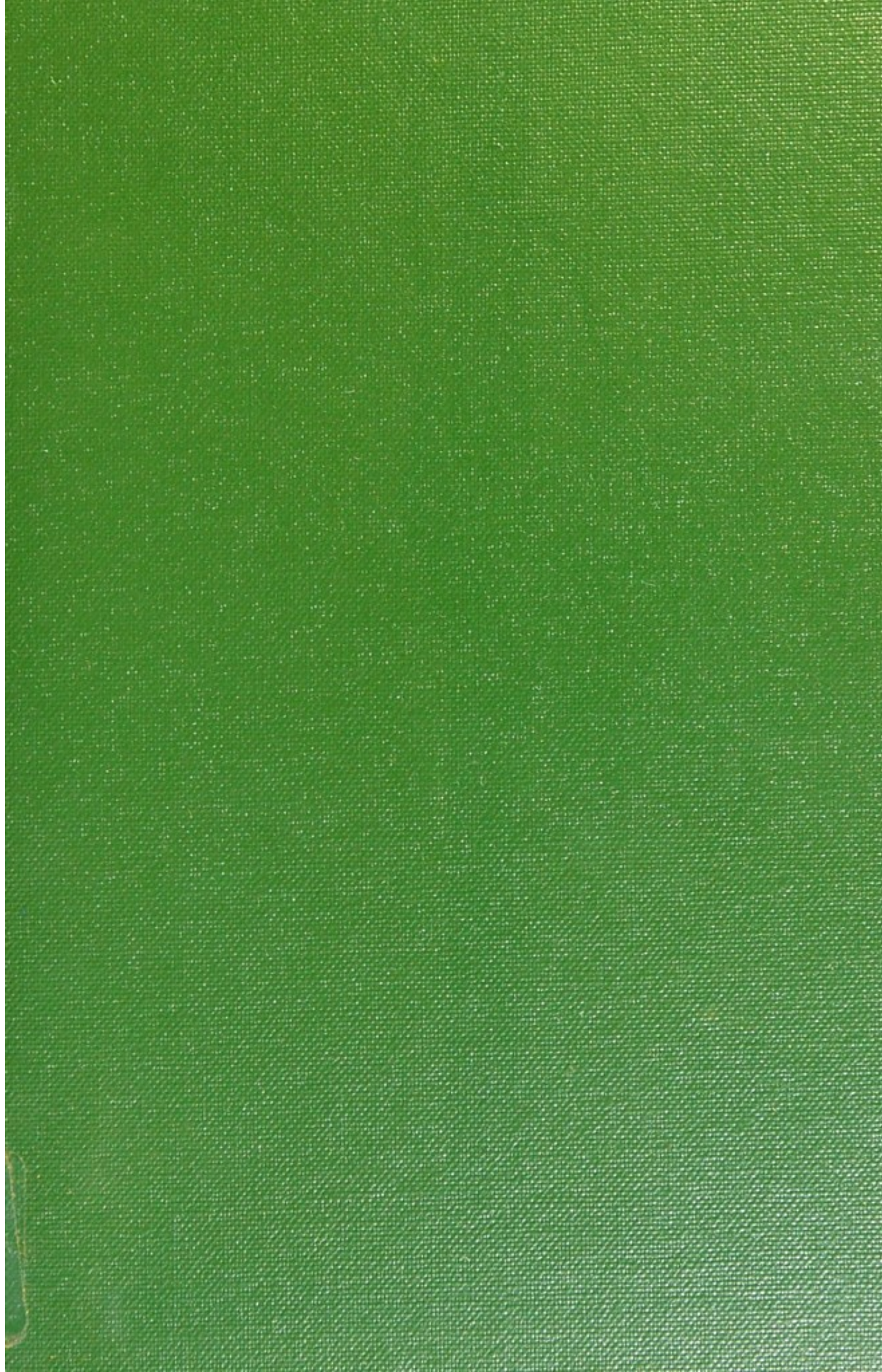
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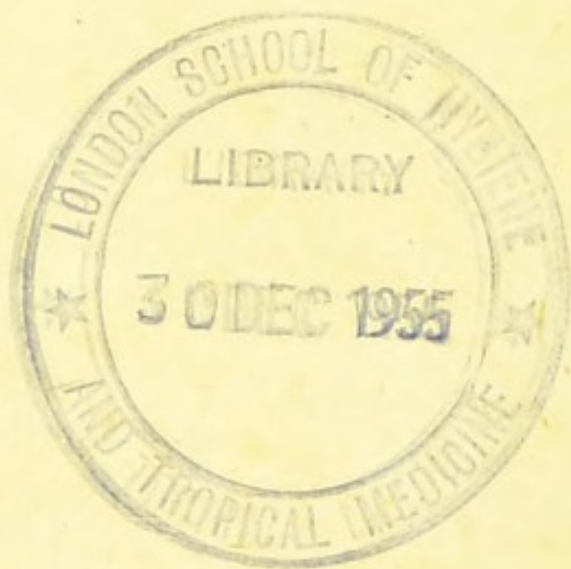
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for review

EPIDEMICS:

THEIR

ORIGIN & PREVENTION.

BY

J. FOSTER PALMER, L.R.C.P., Lond.,
Fellow of the Royal Historical Society.

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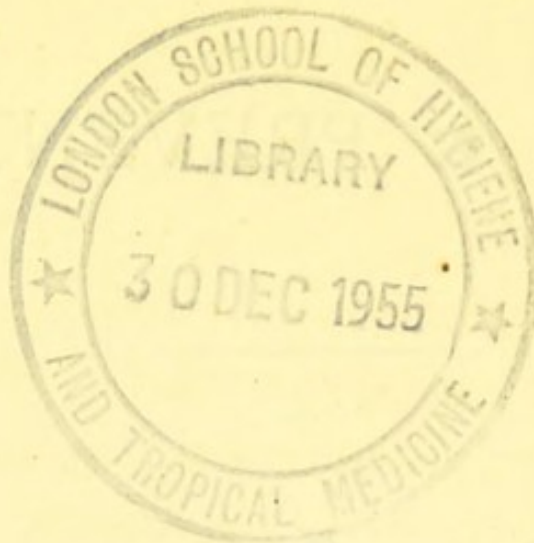
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P R E F A C E.

THE following pages contain the substance of a lecture given some years ago before a London audience, and it was thought that at the present time their contents might be found to interest a larger circle. I have long been impressed with the importance of the study of Influenza as a guide to the origin and development of other epidemics, and in 1883, at the request of the late Dr. Mahomed, I drew out a series of suggestions for a collective inquiry on the subject ("Collective Investigation Record of the British Medical Association" for 1883, pp. 156, 157, 158, 159). The suggestions were not followed up, but the subject has now been forced upon the attention both of the public and the profession by the powers of Nature; and it seemed possible that the observations here submitted might be acceptable, and to some, perhaps, of greater practical utility than a more extensive and elaborate treatise.

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ERRATA.

- Page 8, line 9 from below, for *plan* read *plane*.
„ 17, „ 16 „ above, „ *anyone* „ *any*.
„ 55, heading, for *Earth to Earth Burial* „ *Contagion and*
Infection.
„ 58, line 3 from below, for *defects* „ *defect*.
„ 65, „ 9 „ above, „ *indentify* „ *identify*.
„ 65, „ 13 „ „ „ *indentity* „ *identity*.

EPIDEMICS:

THEIR

ORIGIN AND PREVENTION.

1. **Primitive Man—Struggle for Existence.**—From the earliest times the life of man on our globe has been a constant hand-to-hand struggle against foes whose advantages were so great that his victory, and even his successful defence against them, would have appeared an impossibility. Whether man, as he now exists, is the result, after a countless series of ages, of evolution from a primordial germ progressing ever step by step, or whether he was created in his present state of physical perfection we have no certain knowledge, and perhaps never shall have. Both of these views have their ardent supporters, and there are great difficulties in the way of accepting either. Equally conflicting are the opinions respecting the later origin of the natural order *Bimana* with its single species, *Homo*. Are all the present races of men—black, yellow, white, and copper-coloured—sprung from a single pair of human

beings? And if not, from how many? Are the Caucasian races descended from one ancestor, the Mongolian from another, and the Negro from another? Or is each division the offspring of several primal pairs? The number of original human types has been variously estimated by life-long students of anthropology at one, three, twelve, and fifty, besides various intermediate numbers. On such points it is hopeless to attempt to decide. We can, however, trace, by the observation of buried human skeletons, of the shape and size of the skulls, of the weapons and other implements, and of the remains of other animals found in conjunction with them, the development of man on the earth from a lower to a higher state of civilisation, and can form some idea of the struggles which he had to undergo at this early period.

2. His Earliest Foes.—Whatever his origin, therefore, we know that when man was first placed in this world in an apparently helpless condition, unarmed and unclothed, he was surrounded on all sides by gigantic animals, armed with powerful weapons given them by nature, clothed in nature's clothing, possessed of strength in proportion to their vast size, and prepared to contend with him for the possession of the world. And we know that man was the conqueror. For these giant animals are now known only by their skeletons, found in numbers all over the world, and later generations of men have dug up their bones, studied their physical characters, labeled them, and placed them in their museums—the trophies of a former age. For, though apparently so helpless, man possessed, albeit in an undeveloped condition, what the animal did not—the gift of reason. His powers of reasoning, of providing for future emergencies, called forth as they were by the necessary struggle for existence, made him more than a match

similar theory has been held as to the origin of disease. Is then, this vast array of evidence to go for nothing? Have all the countries in the world united to conceive one great and unaccountable delusion? By no means. The unanimity of opinion is of itself some evidence that the view has a certain foundation in fact, and the history of the epidemics of the world, as well as the extended observation of disease as it exists in the present day, show that by far the greater part if not all the mass of disease which now exists in the world is due either directly or indirectly to some neglect of the laws of nature, justice, or morality.

This explains the close connection that has always obtained between religion and the study of medicine, and the control which the priests of all religions have exercised over the latter. For, after all, if disease is not due directly to the anger and interposition of the gods, is it not due to the causes which might be supposed to give rise to such anger? Is not sin, or more scientifically speaking perverted moral energy, the ultimate origin of almost all the diseases with which we are acquainted? Even the ancient custom of attributing each disease to a particular deity often represents, in allegorical language, a scientific fact, and may have been in many cases a relic of advanced scientific knowledge which had fallen into decay. We still suffer from diseases inflicted by Venus.* Bacchus is still a fruitful source of many dire disorders, while Mars employs the emanations proceeding from the dead bodies of his victims to spread wide the epidemics of plague, typhus, and cholera.† A consistent,

* Herodotus states that the Scythians suffered from a grievous and loathsome disease inflicted by Venus.

† War has always been an important factor in determining the spread of epidemics on account of the contamination of the atmosphere which follows it.

enlightened following of religion, and a sincere, independent pursuit of science, will do much to diminish the influence of these ancient deities.

In view of these relics, or germs, of truth in old-world theories, is it not possible that some races of men in earlier times had attained to an accurate and extended knowledge of science, but that these races have degenerated and given place to lower types? Antiquarian research has shown that this has often taken place, for these earlier races have left their works behind them. The copper-coloured savages who inhabited the whole of America, were preceded by a highly civilised race, whom we know only by their architecture; and what is now the condition of the Egyptians, once, as there is abundant evidence to prove, in a state of the highest learning and culture?

Let us now return to the consideration of primeval man, who has advanced a stage on the slow road towards civilisation. He has pitted his insignificant self, armed only by nature with the germs of mental development, against the antediluvian monsters by which the world was overrun, and has overcome them. They are swept away from the face of the earth, and man has come off victorious in the struggle for existence.

This was man's first education, his first experience of discipline. We have no means of knowing how long this struggle lasted, probably many thousands of years, but it was this that made man what he was at the dawn of civilisation. The constant necessity for concentrating all his powers of mind and body on defending his life against his gigantic foes, and securing food for himself, brought his physical powers to a state of great perfection, and stimulated his mental development. Without this necessity it is probable that, in default of the impetus for commencing a life of activity, his mental and physical powers would both have dwindled away for want of employment.

Man has now acquired powers which are apparently of no further use to him; his only education has been one of war, and his foes exist no longer; he feels his energies, greater than ever, working within him, clamorous for further employment, and, in this dilemma, he turns his hand against his fellow-man.

It is at this point we first come in contact with a condition of things which continues to exist to the present day. We cannot say with certainty that disease and war were contemporaneous in their origin, but there is much to be said in favour of such a statement. It is, at least, probable that the earliest germs of epidemic disease found their nidus in the exposed and ill-dressed wounds received in tribal conflicts during the ages of savagery. In any case, as war increased in the world, disease must have increased also. Not that we have any proof that war is alone sufficient to originate an outbreak of zymotic disease, or is necessarily a precursor of it; but in war all the conditions most favourable to the development of such disease, both internal and external, exist in the highest degree. The atmosphere, impregnated with decomposing animal matter from the bodies of the slain, becomes a fertile soil for its propagation, and it can hardly fail to flourish if it chance to be introduced. At the same time, the individual, whether soldier or civilian, is in the most receptive condition. The soldier, worn down with fatigue and insufficient food, is an easy prey to disease, while the famine, which is so often the consequence of war, makes the rest of the population almost equally subject to it. We may say with confidence that disease germs, whenever they may have made their first appearance in the world, found the conditions most favourable to their growth wherever bodies of men have been engaged in conflict, and that, therefore, if their origin was contemporaneous with that of the human race, they began to make their

formidable inroads as human beings began to concentrate their forces against one another.

From this remote period to the present day, the life of man has been a constant struggle with a foe who works in the dark, a foe who does not depend on size and strength, but who is so small as to be practically unseen, and never manifests himself by visible signs till he has made a partial conquest. Yet even over this insidious foe man has gained and is still gaining immense advantages. This struggle has had much to do in bringing about the development of brain-power in man, and in making him what he now is. It is this which has called into operation that patient observation of nature in which so many men have spent their lives, and which has led to such important results; and it is this which has employed many of the greatest thinkers in the world. The study of anatomy, physiology, pathology, chemistry, and, in a minor degree, of all branches of natural science, is pursued for this one object, viz, to find the latent foe and do battle with it.

4. Theories of its Origin—Ancient and Modern.—

In former times every disease was attributed to the presence in the body of a demon, or invisible spiritual agency. In the present day the agency is held to consist in a microscopic germ whose power consists chiefly in the marvellous rapidity of its reproduction. These two theories have this in common, that they attribute disease to a form of life on a different plan to that usually under our observation, and invisible to us under normal conditions.

I offer no opinion either for or against the germ theory. This only I may venture to say, that in years to come it is possible that a higher power of the microscope may give to the various bacilli and their natural history a different construction to that now in favour, and that the present popular germ-theory, as at present

defined, *may* come in time to be regarded as a superstition as great as the view of demoniacal possession is now.*

As, however, the germ-theory of disease is now the commonly accepted one, we must employ it provisionally until it is either proved or discarded.

In spite of the extensive, prolonged, and patient researches of all the pathologists of modern times, assisted as they have been by so many discoveries in collateral branches of science, in spite also of the dogmatic assertions of some observers, it is not too much to say that at present we are in a state of very complete ignorance as to the origin and causes of epidemics. An observer of great mental capacity and indomitable perseverance will devote his life to tracing the causes of cholera, and will state with confidence that it is both contagious and infectious; another with equal talents and experience will as confidently assert that it is *not*. We all live in fear and trembling at the mere thought of a defective drain. Sewer gas is constantly associated in our minds with all kinds of frightful epidemics; yet the connection is far from being understood. Many of our fellow-citizens spend the greater part of their lives

* If disease germs are conscious beings they must laugh at our impotent attempts to annihilate them by constantly squirting at them with carbolic acid without even having discovered their actual position. Man in the 19th century, firing carbolic acid in all directions on the chance of hitting a stray germ here and there, will form the subject of a farce for future ages. In point of fact, the sphere of utility of disinfectants is extremely limited. In the presence of an epidemic they are almost useless. It is doubtful whether the most potent of them can really arrest infection. They can *never* take the place of comprehensive general sanitary work and individual action. At the same time they often lull people into a sense of false security while they fail to diminish the infection of the atmosphere in any appreciable degree. They may sometimes assist in the isolation of a single case of zymotic disease, but until we can catch all the germs in the air and water and steep them in carbolic acid, we shall not prevent a single epidemic by disinfectants, however potent.

in sewers, and these are among the healthiest people in London. Sewer men often live to a great age, and are particularly free from zymotic disease.*

It has also been pointed out that in July, 1859, when the Thames was in its foulest and most offensive condition, and the weather at the hottest, the public health was steadily improving,† and that though cholera was three times imported in a virulent form, it failed to establish itself.

5. Environment.—These facts show one of two things; either the sewage theory of disease is erroneous, or else man can adapt himself to live in an epidemical atmosphere. It is highly probable that something may be done in the latter direction. We hear much of removing the sources of disease, of which, after all, we are profoundly ignorant, but may it not be possible to educate ourselves so as to be independent of them. The great leaders of thought and science in the present day tell us that it is the duty of man, and indeed, of all animals, to accommodate themselves to their environment. We are told that when in the process of evolution animals begin to live under water, they gradually adapt themselves to their surroundings, and their lungs are converted into gills. And when man moves from a hot to a cold climate, or *vice versâ*, he endeavours, not to change the temperature of the

* A sewerman in Chelsea parish was pensioned off a few years ago. He had been at work till he was 83 years old. I inquired of a firm of working bricklayers who had been engaged for two generations chiefly in repairing defective sewage work. Neither masters nor men had ever suffered from any of the diseases which are usually attributed to the influence of drains.

† Barnes, Report of the Vestry of St. Leonard, Shoreditch, 1859.

country, but to adapt himself to it by a judicious change in his manner of living.*

These facts seem to suggest that perhaps in the future more attention may be paid to cultivating man's personal power of resisting the evil influences around him than in tracing the ultimate cause of those influences. Whether this will be so or not it is certain that the study of the external source of diseases alone, without reference to man's individuality and his relation to environment, will always end in failure.

6. *Individuality*.—"The proper study of mankind is man" in more senses than one. Man must be studied in his moral, his mental, and his physical aspect, and this not only collectively but *individually*. Nothing is so fatal to true progress as that narrow-minded view which regards man as a being struck out of a mould by the million, and ignores his infinite individuality. To give a few every day examples, a man finds that total abstinence agrees with him, and endeavours to make a universal rule for others; another can live on vegetables, and, ignoring individuality, he unsparingly condemns the use of animal food; an eminent physician finds physical support in eating lobster claws, and he at once recommends the same article of diet to all his patients; another forbids the use of tobacco, tea, or coffee for equally valid reasons. Such arguments, from the particular to the general, are worthy of the Turkish physician, who recorded, as the result of his experience, that pickled onions in typhoid fever were good for bricklayers, but not for locksmiths. I would ven-

* The time may come when we shall be able to live in an atmosphere loaded with germs, and snap our fingers at them. In vaccination we have already made a step in this direction, and it is not improbable that Pasteurism may prove to be another. The immunity of sewer-men can hardly be accounted for except on the theory of slight successive inoculations accidentally produced and in an attenuated form.

ture to suggest that the most fruitful field for research in the present day is to be found in the examination of the conditions—mental, moral, and physical—under which man individually can resist the invasion of disease, or falls before it.

7. **Heredity.**—Not the least important among the individual causes of disease is heredity. It seems at first sight an anomaly, almost a bull, to speak of epidemic disease as hereditary. But epidemics are hereditary, just in the same way as gout and consumption are hereditary. The difference is only one of degree. In all these cases it is not the actual disease which is inherited, but the tendency to it. A man whose parents have suffered from gout or consumption is not necessarily gouty or consumptive, but he has inherited a certain constitution which will render him liable, under certain conditions, to become a prey to those diseases. It is the same with epidemic disease. There are certain persons and certain families which are particularly receptive to the attacks of zymotic disease. Indeed, we may say that every person inherits from his ancestors a certain degree of receptivity or resistance to these attacks, this degree being modified by individual variability. It is a common observation that some children “catch everything.” I have known a family the members of which were especially liable to smallpox. Some of them were attacked twice, and even three times, at intervals of five or six years, and appeared, indeed, to take the disease whenever an opportunity presented itself. Such cases of extreme susceptibility can only be accounted for on the hypothesis of hereditary tendency. This is a factor which can never be disregarded, but which exerts a potent influence, both on the liability to epidemic disease and on the severity of the attack.

for his powerful enemies. Unprotected, he made the vegetable and mineral world subservient to his interests, and built houses of wood and stone; unarmed, he made weapons of the same materials, as well as of the bones of his conquered enemies, and at a later period discovered the use for similar purposes of bronze and iron; unclothed, he wrapped himself in the natural covering of the animals he had killed. And the discipline was a necessary one. The necessity of fighting for his life called into action his nascent *physical* powers, and completed his physical development. It called into action the nascent powers of his *mind*, and commenced the development of those mental qualities which have done so much in the past, and are destined to do so much more in the future.

3. His Later Foes—Disease.—Having now subdued his gigantic enemies, was man's work at an end? Far from it. The very forces which brought about the destruction of the first enemies of mankind paved the way for the appearance of others still more formidable. Two powerful foes—the one mental, the other physical—have, from the earliest times of which we have any record, waged incessant warfare against man, and taxed all his powers to the utmost, having been at times so far successful as to sweep off half the population of the world. One is perverted moral energy, the other disease.

The close connection of these two forces does not always strike the casual observer, but it is in reality so intimate that one can hardly be discussed on any broad basis without the other. It has been observed in all nations from the earliest times, though a different construction has often been put upon it, and a supernatural aspect has been given to a natural fact.

The old Hindoo poem, called the "Mahabarata" shows that in India illness was always looked upon

as a punishment by the gods for some sin committed. This view was held throughout the whole of India as well as China, Asia Minor, and Egypt. The "Iliad" of Homer shows us that it was held by the Greeks. The Old Testament Scriptures and the writings of Josephus show us the firm hold this doctrine had on the minds of the Jews. In the first century we know it was accepted by them as an established fact. "Who did sin, this man or his parents, that he was born blind?" This was their sole theory of the causation of disease; the only question left for discussion was whether it was hereditary or acquired. The same mental connection of cause and effect is shown in the history of the Roman Empire, and in our own country so late as 1665—the year of the Great Plague of London. Dr. Francis Herring speaks of this outbreak as "*Ictus Iræ Divinæ pro peccatis hominum*—the stroke of God's wrath for the sins of mankind. This (he says) is not only the opinion of divines, but of all learned physicians, and acknowledged by the blind heathen in all ages by the light of nature."

I have no wish to see the study of medicine in any way dependent on theology or theological views. On the contrary, I have always insisted that when thus dependent it can make no progress. When medicine has been in the hands of theologians, or under religious control, it has always been in a stagnant condition. The great work of making medicine independent of religion and superstition, and of carrying on its study on inductive principles, was begun more than 2,000 years ago by Hippocrates, and continued in recent times by Servetus, Linacre, Caius, Cœsalpinus, and Harvey. Nothing has been so fatal to its true development as its having been for thousands of years in all countries in continual connection with the religion of those countries.

We have seen that in all ages and in all nations a

8. Starvation.—Another potent predisposing cause of disease on the individual side is insufficient diet, or any condition in which the waste of tissue in the body is greater than the supply of food taken to restore it. An ill-nourished body is almost invariably in a favourable condition for the reception and cultivation of disease germs. We need not suppose that these germs have any especial selective affinity for half-starved bodies. No doubt they try their level best to gain an entrance in all cases, but in an ill-nourished body there is less of that power of resistance, whatever it may be, with which all men seem to be endowed by Nature in a greater or less degree. As the strength fails from want of the necessary supplies, the resisting power fails also. Historical records, as well as modern observation, show that it is so. A prolonged famine has always been, from the earliest times, the precursor of the greater pestilences of the world.

9. Intemperance.—Habitual intemperance is starvation in another form, with this addition—that the system is impregnated with a poison, as alcohol in large doses is, as well as being deprived of its proper nourishment. We sometimes hear of the immunity of drunkards from a variety of evils, including epidemic disease, but it would be a dangerous experiment to rely on such protection. It is possible that a temporary fillip may sometimes be given to the system, but it is certainly not the case that the intemperate are less prone to attacks of zymotic disease than others. In Turkey, which is, perhaps, the most plague-stricken country in the world, abstinence has been from time immemorial, long before the time of Mahomet, a religious duty, and those Turks who follow it are found to be distinctly less subject to the national epidemic than those who neglect it. Both classes of Turks, however, are more subject to the disease than the

average European, who may be said to lie between the abstaining and the indulging Turk, who, when he drinks, drinks freely. The drunkard will be almost sure to succumb, sooner or later, when much exposed to epidemic influence, and when he does, the accumulated effects of alcoholic poisoning will make themselves felt. During the recent epidemic I have found delirium tremens to follow immediately upon the attack when the patient has been for some time past slightly exceeding the standard of moderation.*

10. Fatigue.—The effects of fatigue are seen on a large scale in marching armies, which are found to be much more liable to the invasion of epidemics after excessive exertion. This also is another form of the condition existing in starvation; in this case the waste of tissue being greater than the supply of food which is capable of being assimilated.

11. Licentiousness.—But it is not only by insufficient food, or excessive bodily and mental exertion, that the powers of the system are reduced, and man becomes an easy prey to disease. It has been said that, if drink has killed its thousands, licentiousness has killed its ten thousands. Such statements it is impossible either to verify or to disprove, even relatively. My own observation, however, would lead me to believe that the effects of the latter are far more widespread, and even more fatal, than those of the former; and I believe that the majority of those connected with large hospitals, if not the majority of the medical profession generally, would come to the same conclusion. On the other hand, the members of the

* Dr. Taquet states, as the result of a large number of observations, that the children of drunken parents are more liable to attacks from prevailing epidemics, and sink under them sooner, than other people.—*London Medical Record*, January 15, 1878, pp. 8, 9.

clerical and legal professions, especially those of the latter who are connected with the administration of the criminal law, are usually more impressed with the very obvious effects of intemperance. Immorality, however, is more subtle in its effects, and in rendering people susceptible to epidemic disease there can be little doubt it is the more potent. It is possibly for this reason that the Turks, though abstainers, are more subject to plague than Europeans generally, their religion in this respect not erring on the side of severity and asceticism. In marked contrast to them stand the Jews, whose well-known longevity, unconquerable vitality, and unequalled mental scope and power of endurance, are to a great extent the outcome of their long training under stricter laws and a higher ideal, by following which, however imperfectly, they had become, long before the commencement of the Christian era, distinguished by the greater purity of their morals from the Asiatic nations around them.

12. Mental Shock.—We all know the well-worn fable which relates that the plague, on leaving a certain city, encountered a gentleman who was proceeding towards it with the object, probably, of collecting statistics from all available sources. "Plague," said the statistician, "I hear you have killed ten thousand people in the city; is it so?" "No," said the plague; "I only killed a thousand; fear killed the rest." Few ancient fables, perhaps, have ever had a more slender foundation in fact. Fear has been constantly credited with an amount of disease and death to which it can lay no claim. Not only has its effect been greatly exaggerated, but there is no proof that fear, as a purely mental condition, is by itself capable of influencing the susceptibility to disease. Excessive fear may in some cases be due to a condition of bodily weakness which renders its subject more liable to attacks, but fear as a

temporary mental state is no more a cause of zymotic disease than drunkenness is a preventive against it. Fear, too, is the parent of caution, and we may thus give it credit for some, at least, of the preventive measures which have been in any degree successful in mitigating the spread of epidemics. It is the absence of a reasonable amount of fear, when they appear to be at a distance, which gives the opportunity for their invasion. We find, too, that epidemics spread among the lower animals just as they do among human beings, and without any assistance from the depressing influence of apprehension. Habitual timidity is usually the result of a sensitive nervous system, the subjects of which are not more than usually liable to infection, while its opposite, courage, may arise from utter ignorance and stupidity, or, on the other hand, from an extensive knowledge and experience, from complete self-reliance, or from an entire want of it. *Διχῶς γὰρ ἀπαθεῖς γίνονται οἱ ἄνθρωποι, ἢ τῷ μὴ πεπειρᾶσθαι, ἢ τῷ βοηθείας ἔχειν.* Which of these mental states is it that confers an immunity from disease? We find from the actual accounts of all great epidemics, as well as from our experience of minor ones, that neither those whose apathy amounted to recklessness, nor those who had the utmost confidence in their own preventives, have been exempted. Upon the whole, we may say that purely mental states have but little influence on the susceptibility to disease, but that during attacks of illness they may have a depressing effect on the entire nervous system, by reason of which recovery may be prevented or convalescence retarded.

13. Evolution of Disease — The Germ-Theory.— Leaving for the present the question of man's individuality, let us consider some of the causes, chiefly extraneous, to which outbreaks of disease have been attributed. There are two extreme views as to the

causation of disease standing at opposite poles of thought. One is that every case of disease is directly due to divine anger on account of some sin committed, and, therefore, avoidable; the other is that epidemics form an essential part of the constitution of the world, as independent of causes and as stable in foundation as the world itself, and consequently entirely out of the power of man either to control, modify, or avoid. All other views of the origin of disease may be looked upon as intermediate between these two, at a greater or less distance from one or the other. That neither of these extreme views, nor any of those lying between them, can be looked upon as representing more than a partial and one-sided view of the case will be at once admitted; but we can hardly say with certainty that anyone of the numerous causes to which epidemics have been attributed are entirely without foundation. All these different causes have their enthusiastic exponents, and the theory of the origin of disease held by a particular observer will often depend on the original cast of his mind and the particular training it has undergone. One observer affirms that all epidemics are caused either by excessive heat or excessive cold, and classifies them accordingly.* Another, that they originate in the decomposition of animal and vegetable matter contaminating the air and water. Some attribute them to the emanation of noxious vapours or fogs arising from the earth or from volcanoes or earthquakes;† others to the influence of comets and meteorites; while others again see them only as signs of a certain con-

* Dr. Fuchs. "The Epidemic Diseases of Europe in their Relation with the Phenomena of Terrestrial Magnetism, with Changes in the Condition of the Atmosphere, and with the History of the Civilised Races of this Hemisphere." Weimar, 1860.

† Parkin. "Causation and Prevention of Disease." 1859.

dition of electric tension. With some the idea of overcrowding is always in the van; famine and luxury, drunkenness and abstinence, fatigue and indolence, excess and deficiency of ozone in the air, drought and flood, have all their supporters. More important than all these in the present day is the germ-theory, which looks upon all disease as a living entity, and which is the only rational basis of contagion and infection. Of this theory there are two classes of exponents; one of which considers every germ to have descended from another germ of the same type, while the other believes that the mildest form of disease may, under favourable conditions, and by passing through a sufficient number of subjects, become evolved, by cultivation or natural selection, into the most virulent plagues.

It was formerly taken for granted by those who denied their spontaneous origin that every case of infectious disease arose from another case of the same type—that each microbe or disease germ would reproduce a germ of the same kind, and no other. Recent biological researches, however, have shown that various forms of animal and vegetable life may, by slow gradations, change their type under the influence either of their own inherent variability, or of surrounding conditions, and it is, at least, possible that the form of parasitic life which we call disease may do the same. If the various forms of animal life now existing in the world have been evolved from lower forms, may not the different disease germs, distinct as they now are from one another, have also had a common ancestor? Whether or not such evolution and differentiation is the rule in germ life, its occasional occurrence in a limited degree has been demonstrated. In one series of experiments the inoculation of pigeons and rabbits with swine fever, Pasteur found that each successive inoculation was more potent than the last, and proved fatal in a shorter period. The concurrence of the

various forms of zymotic disease and the precursory epidemics, alluded to later on, which so constantly usher in the more virulent ones, seem to point to the same conclusion. The question still remains to be answered whether each form of disease has a distinct origin, or whether there exists an unbroken line of descent from some mild form of inflammatory cold or local suppuration to the great epidemic diseases which have sometimes played such dreadful havoc with the human race. All such questions as those above referred to—questions as to the causation of disease—cannot be decided by any single set of experiments, nor by any single method of investigation. It is only by a combination of three methods and a comparison of their results that any satisfactory conclusions can be arrived at. These are—first, the historical method, by which the great epidemics are studied as they affect large masses of the population; secondly, the clinical method, by which each individual case is observed as it occurs, with its *personelle* and surroundings; and, thirdly, the experimental method, by which disease is examined in the laboratory, divested of its natural surroundings, and placed under new and artificial conditions.

Meanwhile, whatever may be the causes of epidemics and other diseases, their object is clear. They form a part, and a necessary part, of the education of the world. They come to force upon us the study of natural laws. I have already pointed out how many branches of natural science owe their origin and their existence to their connection, direct or indirect, with the study of disease. It is this which creates the necessity for their pursuit. Without it natural science in its present form would simply not exist, and the grand system of philosophy, of which Francis Bacon is the principal exponent, would be an anomaly, a structure without a foundation, a race without a goal.

We are accustomed to look upon Bacon as the greatest philosopher of the Christian era; but his system exists only to impress upon us as a duty the examination of natural laws. Among the first to apply this system to the science of medicine in England was the physiologist William Harvey, who put into actual practice the methods which Bacon expounded; "who was doing," as Dean Church happily expresses it, "who was doing what Bacon was only talking about."

14. Experimental Research.—One of the most important and fruitful of the methods of investigation initiated by Harvey, came partially to an end in this country during the latter half of the nineteenth century. The Government of the day, hounded on by a popular clamour, were induced to pander to a wave of fanaticism, and to pass some stringent laws against experiments on living animals. It appears to be a natural law that the grasp of man on important truths should always be tested in the furnace of persecution, and there is no reason why physiologists should claim exemption from this process. The violence of the clamour only shows the importance of the laws they investigate and proclaim. That they sometimes make mistakes is no argument against their method, for man is essentially fallible, and "error" as has been said by Milton "is but opinion in the making." "Those only" said another writer "who observe and experiment make mistakes; those only who do neither never err."* "A man who never made a mistake never made anything else." The present condition *can* only be a temporary one. Persecution has always had the effect of spreading and emphasising the views and the discoveries of those who are persecuted, and the present

* Ogle, Harveian Oration for 1880, page 78.

case is no exception. The outcry which has been raised against physiologists is an infallible sign of the value of their work. The pioneers of truth have always, from the beginning of the world, been opposed by popular clamour, and have had to work their way in the teeth of it. But sooner or later it will prevail. We only want a little more patience, a little more of the enthusiasm of humanity, a little more of the faith that overcomes the world, and true work will meet its full acknowledgement.

I have no sympathy with cruelty to animals. With Cowper,

“I would not enter on my list of friends
(Though graced with polished manners and fine sense,
Yet wanting sensibility) the man
Who needlessly sets foot upon a worm.”

But there is a higher law than that of kindness to animals, and that is the law of philanthropy. And when two interests clash, as they sometimes will, the higher must have the pre-eminence. If we may kill sheep to satisfy our carnal appetites, surely we may kill other animals for the relief of human pain and suffering and the saving of human life. If by killing a thousand dogs we can save the life of one human being, no man who loves his fellow-man can for a moment hesitate in his choice. Our duty is clear. We have no more right to prevent human life being saved than we have to destroy it ourselves. The issue has already been put before the public by Professor Huxley in the strongest terms,* and I would impress upon all English people that if we wilfully impede any of the means by which human life may be saved or prolonged we incur a vast responsibility, and are answerable for the lives which may be lost through our opposition.

We cannot be neutral in this matter. Our position must be clearly defined. Either we love our fellow-

* In a paper on “William Harvey” in the *Nineteenth Century*.

man better than the brute creation, or we love the brute creation better than our fellow-man. The first law of Christianity, the basis of all morality, is love for the human race, and however great may be our love for the lower animals, we are no true Christians, we are no true men, if we allow this love to overcome our love for humanity, even in its worst aspect.

For the present the cause of evil has partially triumphed. The foes of humanity have had their way, and this branch of science has been in this country reduced to a condition of comparative stagnation. But it is possible that during this stagnation an accumulation of thought may take place, which will be brought to bear upon future observations with increased advantage.

In view of the veto which has thus been placed upon original research among some of the causes of contemporary disease it may not be unprofitable to glance at what there is to be learned in this direction by the light of other days.

15. Influenza—A Type and a Precursor.—One of the most important forms of epidemic disease with which we have to deal is influenza; and this for various reasons. Of all diseases it is apparently the most dependent on meteorological conditions. More almost than any other it appears to support the view that epidemics are beyond human control. In the annals of influenza by Dr. Theophilus Thompson there are accounts of 19 epidemics of this disease in England occurring between 1510 and 1837. Of these, 14 were preceded by comets, meteors, volcanic eruptions, or offensive fogs; 8 by comets, 6 by meteors, 8 by volcanic eruptions, 6 by foul-smelling fogs; almost all writers on the subject have connected this disease with cold, wet seasons. Not less remarkable is its impartiality; there is no immunity from its attack. In

some epidemics it spares hardly a single individual, man, woman or child, extending even to animals. Its scope also is unbounded. Though usually considered a disease of cold and temperate climates, it is not unfrequent in India, and in some of its visitations it has spread all over Asia, Europe, and North America. Though not clearly defined until the tenth century, it can hardly have been non-existent, and since that time it has often been extensively fatal. But its principal importance is in its possible ulterior influence. For it is here, if at all, that we shall find the earlier life of those germs which by evolution—or *progressive development*, as it is usually called in this connection—originate the more potent germs of typhus, cholera, and plague.

Almost all the major epidemics of recent times with whose history we are acquainted were preceded by influenza. This has been observed of many of the invasions of plague, including the Black Death of 1349 and the Plague of 1665. But it has been especially noticed in connection with cholera. All epidemics of cholera have been ushered in by influenza, and the one disease has always followed the same geographical course, both in Asia and Europe, as the other. The most remarkable instance of this is in the first epidemic in the present century. On this occasion cholera started from India on a European tour, and entered Russia by the shores of the Caspian. It then quietly waited for *seven* years—from 1823 till 1830—till an epidemic of influenza broke out, and then immediately spread over the whole of Europe. But, in addition to this, there is another fact of great importance in this connection; and this is that when a major epidemic breaks out, influenza and all the minor epidemics which have preceded it give way before it or are swallowed up like the rods of the Egyptian magicians. This was observed so early as the plague of

Athens, 2,300 years ago (430 B.C.), when, though influenza is not definitely described, it was said that all other diseases ended in this.* It has been spoken of as the prerogative of plague and other great epidemics to banish all other diseases during their ascendancy.† “Two stars keep not their motion in one sphere.” This is more fully borne out by the evidence of recent epidemics of influenza. That of 1510 was followed by sweating sickness and the plague. That of 1557 by the plague. That of 1580 by measles, small-pox, dysentery, and plague. That of 1658 by malignant fever in the autumn; then by plague in certain places in 1660; then by a series of continued and intermittent fevers from 1661 till 1664; then by malignant fever in London in 1664; and lastly by the great plague of London in 1665.

The epidemic of 1675 was followed by small-pox and dysentery. That of 1710 by plague (1711). That of 1729 by typhus, then small-pox, and then cholera. That of 1738 by diphtheria. That of 1743 was preceded by measles, small-pox, and whooping-cough, and followed by typhus. That of 1758 preceded by dysentery and small-pox and followed by epidemic scarlatina. That of 1762 followed by dysentery. That of 1775 by scarlatina and diphtheria.

The epidemic of 1803 was still more remarkable. It was preceded by epidemic diarrhœa, concurrent with scarlatina, and followed by typhus. In some places scarlatina prevailed *before* the epidemic, was suspended *during* the epidemic, and broke out again *afterwards*. Many observers also found that an attack of measles or scarlatina was a protection against the influenza.

The epidemic of 1831 was concurrent with dysentery and followed by cholera; that of 1833 was followed cholera, and that of 1837 by cholera and diarrhœa.

* Walford, Chronology of Pestilences, p. 5 (Thucydides).

† Ibid.

I should be far from saying that these facts are sufficient to establish the point at issue, but they are certainly sufficient to make out a *primâ facie* case in its favour. It has been observed of some epidemics of great magnitude that they were *followed*, instead of being preceded, by waves of influenza. If we may still speak in terms of evolution without pre-judging the case, these may perhaps be considered as instances of reversion to the original type.

And lastly, it is in influenza that man's individuality and his power of resisting the onslaughts of disease may best be studied. We have seen that in all probability the external causes of influenza are beyond the power of man to control or modify. They are cosmical and unassailable. But it is far otherwise with those causes which relate to man's personal susceptibility. There is no disease which is so profoundly modified according to the constitution and the previous condition of health of the patient attacked. The attack may be so slight as hardly to require attention, or it may be so violent as to threaten life or even destroy it; and their difference will, *cæteris paribus*, almost invariably depend on pre-existing personal causes. The epidemic itself is dependent on a certain condition of the atmosphere, but the severity of each individual attack depends almost entirely on the constitution of the patient. An east wind, with a few points of north, would appear to be in this country one of the atmospheric conditions most favourable to the development of some of the milder forms of influenza; that this is the sole cause no one would assert; but this wind, coming from those regions which are beyond the influence of the Gulf Stream, is so frequent a concomitant of the causes of catarrh that it may serve to represent them. That every case of catarrh is an offshoot of some more or less severe epidemic of influenza there can be little doubt. The old-fashioned popular theory, which attri-

buted every cold to wet feet or to individual exposure, is not large enough to hold the facts of the case. It is not the wet feet which produce the catarrh, but the moisture in the atmosphere which is favourable to the development of the disease. Nor is it the accidental exposure to the east wind; its presence is only one of the many signals of the epidemic. You cannot escape an epidemic by spending your life in a heated room; many people of delicate constitutions, who never leave the house, will feel an east wind before they are out of bed. This is a case of extreme sensibility to meteorological environment; on the other hand a robust gentleman of sporting habits, with a red face and nose to match; who spends all his time in the open air, will say "east winds, I don't believe in east winds, its all humbug, one wind is just as good as another." This is an equally extreme case of insusceptibility, natural or acquired. Whether alcohol furnishes any special protection against attacks of catarrh and influenza I cannot say, but these very impervious people are usually of the type I have mentioned.* It may be only that they are more dogmatic in their assertions. At any rate, it appears to show that a considerable degree of immunity to the milder epidemics may be acquired, though by what means we are not yet able to say.

The conclusions I would deduce are these:—

1. That, if we could succeed in stamping out influenza, it is possible that many of the greater epidemics of the world would spontaneously disappear.
2. That the sources of influenza epidemics are of cosmical origin and beyond human control.

* One observer of the epidemic of 1803, remarked that those drinking port wine in moderation appeared less liable to this infection. I suppose this meant about three bottles per diem in those days.

3. That man, in his individual capacity, possesses a latent power of resistance, which, under cultivation, may reduce the intensity of the attack; and that in this direction lies a field for future research.

Activity of mind and body and the avoidance of all excesses; in short, a perfect system of moral, mental, and physical education, will form no unimportant item of man's artillery in his campaign against epidemic disease.

The germ-theory of disease has not gained much support from the recent epidemic (January 1890); its cosmical origin has, in this instance, been amply confirmed. Nothing has been more striking than the impartial manner in which it has attacked men apparently in the most robust health, while leaving the more delicate members of the same household. It has not, as a rule, spread to all the members of a family, though no precaution has been taken to prevent its doing so, sleeping in the same room, and even the same bed with a patient, having been constantly found not to communicate it. The disease, indeed, appears to have preferred to attack a certain percentage of the inhabitants of one house and then pass on to another.

In the London hospitals similar anomalies have been observed. The nurses, the resident medical officers, and the students, all presumably in good health, have been attacked in far larger proportion than the patients, who were, most of them, necessarily in an enfeebled state. Among the number attacked, too, those in robust health often seemed to suffer far greater prostration than those of apparently feeble constitution. As in private houses, so in the hospitals, the epidemic does not appear to have spread through the wards as we should expect an infectious disease to do; and as in the case of smallpox, typhus, and scarlet fever, when a certain number of cases are introduced,

and no special preventive measures are taken, it almost invariably does.

Nor are the results of laboratory experiments at present any more conclusive. A variety of microbes have been discovered by different observers in Paris, Berlin, and Vienna, some resembling those found in one disease, some those found in another, but none that can be positively set aside and labelled as the microbe of influenza. Some of them appear to belong rather to the complications than to the disease itself, while others are found in smaller numbers where no disease is present whatever. The present state of the question is, perhaps, best defined in the words recently spoken by Pasteur when asked his opinion on the subject: "Doctors had better distinctly own they do not know anything about it. *Il faut chercher.*"

There has been nothing, in reality, either to prove or disprove the germ-theory; but the impression conveyed by the nature of the attacks led to a comparison rather with the conditions of electrical affinity than with the material selection of a microscopic parasite. It must always be remembered, too, in relation to this subject, that even the actual demonstration of a particular bacillus, or growth in connection with a particular disease, does not prove that the former was the cause of the latter. An association, however constant, may be an effect, and not a cause.

On the other hand, this epidemic has shown more clearly than ever that a certain receptivity in the individual is necessary for the development of the disease. What this condition is there is at present no sufficient evidence to show, but, though difficult to trace in individual cases, it is undoubtedly due either to some defect in the powers of nutrition and innervation, or to a want of balance in the organic functions. As an instance of this it may be observed that the inhabitants of New York, though of the same race as our-

selves, and presumably of a similar constitution, suffered far more severely and fatally. Among other possible causes for this, it is inevitable that the custom of drinking iced water, so prevalent in that city, has had an evil effect on many by depressing, and, in some cases, permanently weakening the powers of digestion.

Indeed, it would appear that, although in some of the more remote districts of the country the cultivation of the physical powers has been carried to a high pitch, yet, upon the whole, especially in the towns, the inhabitants of the United States have undergone a certain degree of physical degeneration. It was recently stated in the *Boston Medical and Surgical Journal*, on the authority of Surgeon-General J. B. Hamilton, of the United States Army, that *not one-third* of the population of the States of a military age could pass the examination of a recruit.

Influenza, whatever it may have been during former epidemics, has, during the recent epidemic in this country, shown itself to be a disease, not, as was supposed, of the respiratory mucous membranes, but one attacking principally the nervous centres. Whether it is the same disease as that formerly known by the same name, but attacking a different part of the system, we are not yet in a position to say with any certainty. If it is the same disease as that which is supposed to have originated in the south of Russia, it has certainly altered its character during its travels westward.

16. Our Means of Defence.—The collective defence of towns and countries against the invasions of disease on a large scale must be left to sanitary authorities and governing bodies generally, and forms one of the most important, if not the most important, of their duties; but the cultivation of the power to resist the attacks of disease by individuals rests to a large extent

with the individual himself, and is, perhaps, even more important than general sanitary precautions. When an epidemic has swept off large areas of population, it has always been because the people have been in a receptive condition, and unable from defective vitality to resist its attacks.

The efficiency of an army depends primarily on the capacity of the individual soldier, and in the same way the health of a town or city depends on the resisting power against disease of individual citizens. There are, no doubt, some epidemics so potent in their influence as to seem irresistible, but the example of the sewer-men already mentioned shows that it is possible to cultivate immunity from disease even in a poisoned atmosphere. The national sports of England have had much to do in sustaining the national vigour and keeping up the resisting power. Since civil war, which is always accompanied by famine and pestilence, has given place to more harmless pastimes, the average duration of life has enormously increased.* The characteristically ardent pursuit by Englishmen of fox-hunting, shooting, cricket, football, boxing, (and even the now discredited prize-fight) have helped to make England what it is, by bringing about that degree of physical endurance without which our mental powers would be of little use to us. If, in these pastimes lives are sometimes sacrificed, the balance is still enormously in their favour; for where one has been killed, hundreds of lives have been saved by the power of resisting the attacks of disease which has been gained by their means. The same may be said of the national love of the sea which we inherit from our maritime ancestors. Occasional sea-travelling, which

* The extent of this increase will be hardly credited, but a reference to early records will show that in the thirteenth and fourteenth centuries Englishmen rarely lived beyond the age of 50.

is almost a necessity for dwellers in towns, to supply the ozone they have been deprived of, must be considered, in spite of dangers and discomforts, one of the causes tending to increase the average duration of life in this country.

In matters of eating and drinking there are no universal laws. Each man of sound reason must judge for himself. The quantity of alcohol that may be consumed with impunity *must* vary with the nature of a man's pursuits and the situation of his residence. There are undoubtedly certain climates and certain kinds of violent exercise which appear to minimise its evil effects ; but we must guard against the assumption that, because our immediate ancestors were able, as already stated, to consume large quantities with apparent benefit, we, their physically degenerate descendants, can do the same. Still, it is incontrovertible that the great backbone of the country which sustains its health and vigour, the solid phalanx of intelligent and powerful men, who have made the England of to-day, and are making the England of the future, is composed of those who, with evenly balanced minds and a sufficient degree of moral control, steer constantly their middle course, equally unmoved by the allurements of intemperance and by the extravagant claims of teetotalism.

To thoughtful students of the past there are two evils liable to attend such exclusive movements as the one here alluded to. In the first place, they have a tendency to divert the mind from other matters of equal, if not greater, moral and physical importance ; and, secondly, they are almost certain, in accordance with cosmical natural laws, to be followed by reaction. Reaction has followed all national movements in the past, and it is found to follow all extreme views and methods in the present. We can hardly expect nature

to make a special exception in favour of the advocates of total abstinence.*

The actual effect of alcohol in excess on the liability to epidemic attacks it is extremely difficult to estimate by statistics, even approximately, unless they are taken on a very large scale, and even then they are liable to fallacy from disturbing influences. Physiological experiments, too, are equally unsatisfactory. We hear the most confident assertions from temperance platforms as to the effect of alcohol on the system, and yet very little is known with certainty on the subject. The experiments that have been made are contradictory. Some observers† have found that alcohol reduced the heat of the body, while others‡ assert positively that it has no effect either one way or the other. In other observations as to the effect on the excretion of urea and other materials from the blood, and the value of alcohol as food, etc., the results have been equally conflicting. It is probable that in this, as in so many other cases, the effect of individual idiosyncrasy has not been sufficiently taken into account.

Statistics are still more fallacious, and sometimes suggest conclusions which are utterly untenable. A committee was appointed by the Harveian Society a few years ago to inquire into the proportion of deaths due to alcohol. Out of 10,000 deaths from various causes, 1,402 were due, directly or indirectly, to this cause. The report showed that there was a much smaller percentage of deaths from zymotic disease among excessive drinkers than among the temperate. This would seem at first sight to indicate that drinking has a protective influence against infection. But

* This was written in 1885. From the Budget of the present year (1890) it would appear that such a reaction is already setting in.

† Dr. Sidney Ringer and others.

‡ Dr. Parkes and Dr. Wollowicz.

this is by no means the case. It was only the necessary result of the greatly increased number of deaths from pneumonia, pleurisy, and diseases of the liver, kidneys, and nervous system. For as all men die sooner or later, an increase in the number of deaths from any cause must necessarily diminish the number of those due to some other cause.

Nor do the figures, as a whole, give a correct estimate of the proportionate loss of life. Alcohol causes 14 per cent. of the total deaths, but we have no means of knowing how many lives have been saved by the legitimate use of stimulants, in supporting the system during acute illness, in warding off attacks of prevailing epidemics by temporarily sustaining the powers of resistance, and in prolonging feeble lives. These effects, of course, have been denied by some, and so has the existence of the first Napoleon; but the rebutting evidence is not more convincing in one case than in the other. There are few who have had any experience of medicine who have not seen the immediate effect of alcoholic stimulants in certain cases. *A priori* reasoning cannot set at nought the experience of mankind, and even if it is proved that alcohol is not, in the ordinary sense of the term, a *food—i.e.*, does not supply any of the actual organic compounds existing in the tissues of the body—this does not show that it is an unnecessary article of diet. If it assists in the digestion and assimilation of food, or, if it prevents waste of tissue, it equally fulfils a certain part in nutrition. At the same time, there can be no doubt that when the system is in an exhausted and receptive condition, owing to fatigue or insufficient diet, a judicious resort to stimulants will not unfrequently succeed in supplying it for a time with a degree of resisting power which will enable it to tide over the period of exposure to infection, and thus escape it altogether. This is why we occasionally hear of immunity from epidemic

disease attributed to the drinking of port wine. If the human body were always in a natural condition, it is possible that alcoholic stimulants would be altogether unnecessary ; but, on the contrary, it is constantly and inevitably—at any rate, in civilised countries—being reduced to an unnatural condition by the artificial character of its environment and the numerous slight causes that are continually acting upon it. In this respect the variation in individual susceptibility is infinite. Some are so sensitive as to be influenced by the state of the barometer, the direction of the wind, the temperature of the atmosphere, its degree of moisture, the state of electric tension, and by the slightest excess or deficiency in eating or drinking, while some impervious souls are perfectly callous to all these changes, and appear to be able to sustain the effects of frequent intoxication with impunity, and also, if the will is good, to restrict themselves to cold water, and, perhaps, even to a vegetable diet as well, without undergoing any diminution in the powers of mind or body. Between these two extreme states every variety is found. It is as illogical to lay down universal rules of total abstinence, because it suited a certain number of individuals, as it would be to advocate the universal taking of cod-liver oil and inhalation of carbolic acid, because such treatment was adapted to certain cases of chest affection. If all men were alike, there would be no need of the physician. All lives could be regulated and all diseases treated by the book. It is the infinite variety existing in the human species, and that alone, which makes the study of medicine a necessity, and that alone which makes it possible. Running through all these different classes of mankind, from those most susceptible to those most impervious to surrounding conditions, there is another class which forms a constant, but unknown, proportion of the whole, and which demands especial notice. This is the class

known as habitual drunkards, actual or potential, and consists of those who have a morbid craving for drink, and in whom the consumption of any alcoholic stimulant, instead of quenching their thirst, only creates an almost irresistible desire for more. For this class, it need hardly be said, total abstinence is a reasonable position to adopt, at whatever cost it may be adopted. The danger of stimulants, for any object whatever, is obvious. This class, I believe, forms a very small percentage of the population, but it has attracted a degree of attention far outweighing its numerical value. The medical and legal professions have struggled for the possession of it. The doctors claim it as the outcome of a disease, the subjects of which are to be medically treated or shut up in asylums, while the lawyers look upon the class as a criminal one, and would consider the members of it amenable to the law. The parsons and temperance lecturers, too, claim this division of the human race as a subject on which to expend their eloquence, and to advertise the great cause of total abstinence. The first is naturally the view I would advocate. Drink craving is a disease, and an hereditary disease. It is a disease in which medical treatment and restraint, combined with a high degree of moral control in the subject of it, will sometimes be of temporary benefit; but even in the most successful cases the disease is only latent, and will almost inevitably break out in another generation. The question arises whether a man is justified in inflicting so great a scourge on his children. It appears hardly probable that the disease will be entirely stamped out until it is universally recognised as a disease, and celibacy is habitually practised by the subjects of it, as in the case of certain other formidable diseases which are known to be hereditary. This, of course, refers to cases where the disease is uncontrollable. Where sufficient moral control is also present, it

is to be hoped that this power will also become hereditary; yet it is often found that the disease is inherited without the will-power. It is here, I believe, that one of the chief fallacies of the total abstinence principle is to be found. It is far easier to abstain entirely than to refrain constantly. A man who determines to follow strict abstention has, by a single effort of the will, made the rest of his life comparatively easy to him; but he has done nothing to cultivate his will-power, and his disease will probably descend to his children, without the power to cope with it. On the other hand, he who has through life cultivated his will-power by the difficult task of daily restriction may hope to have made it a permanent trait in his character, and one that he may transmit to his offspring.

In these matters it behoves us to be guided by sound reason and experience, and not to be led away by the sentimental enthusiasm of platform oratory and one-sided hyperbole.

The same general principles must be adopted in regard to the quantity and quality of food. All special cut-and-dried systems have their ardent propogandists, but they are adapted to individual and exceptional cases only, and can never be made into universal rules. With a mind and body in sound health, nature is often a better guide than theory. Those who follow too strict an artificial rule will often find in the end that they have made a fatal mistake in withholding some essential article of diet. In fact, it really matters less what we eat than what use we make of it when we have eaten it. A man who eats and drinks largely, and spends his days in an arm-chair, has done all he can to obtain the very worst effects of overfeeding. There is no waste of tissue to need repair, and the materials for repair become the source of disease. On the other hand, food utilised in active mental or bodily

work supplies material for necessary repair, and fulfils its destined functions. It is possible that animal food is often consumed in excessive proportion, especially in towns, though it does not appear that the duration of life is materially affected thereby. Dwellers in towns, indeed, appear to be rather less susceptible individually to epidemic diseases than the inhabitants of country villages, where vegetable food is taken in larger proportion.* Vegetarians, pure and simple, however, are so few in number, that no statistics can be drawn up on a sufficiently large scale to determine their relative duration of life and susceptibility to disease. They always have been, and probably always will be, in temperate climates, a very small minority of the population.

Indeed, it is ever well to remember that disease is the result of a variety of causes; that it is not only "that which goeth in at the mouth" which is the source of physical, any more than of moral evil. There are other causes of disease, and sometimes a too exclusive attention to one tends to divert attention from others equally important. Life and health do not consist solely of eating and drinking, nor do disease and death always arise from errors in this respect. There are other vices besides drunkenness and gluttony which bring men and women to an early grave. But men shirk the trouble of reviewing their entire life, and find it easier to concentrate attention to a particular part of it. They think to cheat the laws of nature by taking some drug or by avoiding some one or two articles of diet, while in all other respects they pursue a vicious course. This has been ably pointed out by an anonymous writer of recent years, whose words on

* This refers chiefly to those coming into town from the country, for in the country the surrounding conditions are more favourable. Yet, when an epidemic does attack a country village, it is often very virulent. I have seen both in Bedfordshire and Cumberland, typhoid fever prevailing to an extent unheard of in London.

the subject are well worth pondering. "The food and fuel of quackery," he says, "are the anxious wishes and deceitful hopes of the many to be enabled to escape the just penalties for the transgression of natural laws, and to commute their legal punishment for an easier sentence. Is there not a drug which will at once relieve me from the accumulated effects of habitual intemperance? Cannot I, by swallowing some medicine, be delivered from the miseries of unstrung nerves, which have been deranged by years of unwholesome excitement? Is there not a tonic which, without any change of my habits, now so fixed that I cannot alter them,—will brace my muscles, permanently weakened by hot rooms, sofas, easy chairs, soft beds, late hours, in which I have habitually indulged and must go on indulging? The quack (advertising or authentic) promises to cure all such by his patent medicine or his prescription; but the scientific physician knows that this is impossible, and that it is for the welfare of men that it is impossible. If a man might set at naught all physical and vital laws, might indulge all his luxurious desires, might use all sorts of forced excitements to stimulate his jaded sensations, might lead a long life of habitual self-indulgence, and, whenever he chose, might reinstate his shaken body in health and comfort by merely swallowing a certain quantity of medicine, it would be bad for human nature, by enabling men to sin with impunity."*

17. Artificial Immunity.—The recent researches of Brieger, Pasteur, Chauveau, and others seem to point to the possibility that individual immunity against epidemic disease may in some cases be conferred by the introduction of an "attenuated" or "sterilised" virus. If this is the case, it will only add another to our present methods of defence; but that it will ever

* "Thoughts of a Physician," Van Voorst, 1868, page 164.

render all other precautions unnecessary is entirely contrary both to reason and experience. It is not yet proved that all diseases are due to a specific microbe, while those in which it can be traced and isolated are comparatively few indeed. Even if the discoveries should in the long run cover the entire field of pathology, human nature will hardly submit to be artificially inoculated with every disease under the sun, even to avoid a possible contingency. Life is hardly long enough to make it worth the while. More useful, practical results are likely to follow from that branch of the inquiry which has shown that the introduction of an "attenuated virus" will sometimes mitigate the severity of a disease already in the system. This process appears to be antidotal, and to be the result of exciting a certain power of resistance in the tissues. The action is, perhaps, similar to that of quinine in some affections, and it is by this line of inquiry that we may hope to obtain a more accurate and definite knowledge of the action of drugs than we at present possess.

18. House Drainage.—I have referred to the *collective* aspect of sanitation, and have endeavoured to lay especial emphasis upon the *individual* aspect as one sometimes liable to be overlooked; but there is another aspect, which holds a middle place between them, and that is the *domiciliary*. The duty of collective sanitation falls upon local authorities, and, perhaps, even in a still greater degree upon the Government of the country. The drainage of the Roman marshes, in the time of Tarquin the Elder, by means of the cloaca maxima, was the work of the Central Government, and no purely local proceedings could ever make Rome healthy again when it had become obstructed. In the work of individual sanitation, as we must call it, everyone has an influence for

good or evil. In house sanitation, it is the occupier, the owner, and the builder who are in reality jointly responsible. The sanitary system of a town may be perfect, so far as the central and local authorities are concerned, and the sewerage works faultless in construction and correct in principle; but this is of little use if the drains in every house are defective. There are large numbers of houses in London in which this, the most important part of their construction, has been left by the builders to people who are utterly incompetent to deal with it. It constantly happens that, when the drains of a house are examined, they are found to be not only defective and full of holes, but entirely disconnected, while, as a natural result, the whole space under the floor of the house is filled with a mass of wet, decomposing sewage—the accumulation of many years. This condition of things is often found where it is least expected, and in houses the construction of which is in every other respect perfect, and it is usually not discovered until a determined effort is made by the occupier to lay bare the defects. In many cases the discovery is for a time delayed and prevented by certain previous operations carried out, probably, with this intent. The defects have been found out, and, instead of the drains being repaired, the whole floor of the basement has been lined with a thick layer of concrete. Thus the drains, with all their imperfections, are covered up, the effluvium for a time is prevented from escaping, and the difficulty of discovering and exposing the defects is enormously increased. In a recent letter to the *Times* (February 10, 1890), some of the difficulties of householders in this respect were strikingly set forth. A clergyman from the country took a house in London. He received an assurance from the landlord (who had built the house), backed by a certificate from the architect, that the house was in perfect sanitary condition. An

outbreak of diphtheria made him doubtful, and he applied to the sanitary authority. The inspector of nuisances came, and pronounced the drainage perfect. A second occurrence of diphtheria within six months induced him to make a second application with a similar result. It was not until the floors had been taken up, and application made to the Sanitary Protection Association, that the very obvious defects were brought to light. This is a fair type of cases which are frequently occurring. A house may be teeming with certificates, and have undergone any number of conventional inspections, and yet not be fit to live in. There is no safety but in a full exposure of the drains, and a thorough examination of them by a competent hand.*

That people continue to live in ill-drained houses, as they frequently do, without suffering in health, is one of those phenomena for which no certain explanation is at present forthcoming; but it does not in any way lessen the obligation of every householder to set his house in order in this respect. In the case above mentioned, as in many others, the immunity did not exist. It is possible that, if the germs of disease have not yet been introduced into a house, the drain-loaded atmosphere, though a fertile field for their growth and development, is not able to originate them; but at the same time we must remember that it is also possible, as already suggested, that the germs of mild forms of disease may, by cultivation under favourable conditions, become evolved into those of more severe outbreaks, and that in a house where sewage has been

* A simple test will sometimes reveal a dangerous leakage. A few drops of oil of peppermint washed into any of the drain pipes at the upper part of the house will, if any flaw exists, almost immediately reveal itself by its well known odour to those remaining on the ground floor. If the drains are perfect, it ought to pass through them unperceived.

long accumulating the conditions are as favourable for such evolution as can well be desired.

19. Epidemics of the World.—Of the numerous major epidemics, there are three which are of the greatest interest to us on account of their typical and representative character. These are plague, typhus, and cholera. Plague, on account of its magnitude and its great antiquity, extending, there is little doubt, over a period of at least 4,000 years, and on account of its always having had a well-defined centre of activity in the vicinity of the Nile. Typhus, on account of its being essentially a disease of our own climate and our own country, being with us, not as an occasional invader, but a constantly present intestine foe; having its centre of activity in our own Continent, and following in the track of all European armies. Cholera, on account of its recent European invasions, of its being apparently a new development of disease (not much more than 100 years old), and having been studied from its commencement by the light of modern science, and having a well ascertained centre of activity on British soil in the region lying round the Ganges.*

20. Plague.—(*a.*) **ITS ANTIQUITY.**—The Plague, there is little reason to doubt, has a history going back many thousand years. There are papyri still in

* Mr Cornelius Walford, in a book called "A Statistical Chronology of Plagues and Pestilences as Affecting Human Life," has compiled a most laborious catalogue of about 1,500 epidemics, many of them of considerable duration, which have afflicted the world during the last 4,500 years. This list, though extremely interesting, it is impossible either to verify or dispute, as the authorities as a rule are only vaguely alluded to, sometimes not at all, and chapter and verse very rarely given. Mr. Walford gives the first pestilence on record as occurring in Egypt. In this I quite agree with him, having independently arrived at the same conclusion with a discrepancy of a few hundred years in regard to dates. But the succeeding epidemics in this list (at least

existence which point unmistakably to the prevalence of plague or some disease resembling it at least 1800 years before the Christian era.

(*b.*) ITS GEOGRAPHICAL ORIGIN.—It appears to have been endemic in Egypt, even at this early period, and to have been connected with the overflowing of the Nile. Nearly 4000 years have elapsed, and still the disease is annually more prevalent during the period following this inundation. These facts point to the decomposition of animal and vegetable matter as being especially favourable to the development of the germs of the disease. In addition to this all great epidemics of plague have been preceded either by wars or by fatal disease among cattle. The decomposition of unburied or half-buried human or animal bodies has always favoured the spread of the disease. The epidemics we read of in the Old Testament, and the Iliad of Homer, which, occurring where plague is endemic, we may consider to have been plague, were all connected with military operations.

(*c.*) ITS MAGNITUDE.—It was during the Peloponnesian war that the great plague of Athens occurred, and it was not till after the universal wars of the Roman Empire that the plague burst its bounds, and in the

the earlier ones) are less obvious to the casual observer. We are informed, for instance, that in 2450 B.C., which according to Biblical chronology was while Noah was engaged in building the ark and Methuselah was still alive, a severe epidemic occurred in Ireland. A little later on, 2311 B.C., the inhabitants were all swept away, and Ireland became a wilderness for 200 years. Many others follow, and in 1614 B.C., three fourths of the inhabitants are again destroyed. I should be far from attempting to throw doubt on these statements, but might venture to wish for more evidence. There appears to be no reason why a pestilence should be recorded at this remote date if it had no foundation in fact. China has a distinct history of 5,000 years from its first conquest by Mongolian races. Egypt has a history variously estimated at from 5,000 to 7,000 years, and India one not much less remote. Ireland was, we know, at an early date, one of the most advanced nations in Europe in learning and theology, and

third century carried off nearly half the population of the world.* From this time till the eighteenth century, a period of just 1500 years, it became a European disease, extending to its extreme limit in the British Isles, where it remained from 664-5 to 1665-7 A.D. Although constantly endemic in Europe during this period, there were periodical outbreaks of greater or less activity. One of the most important of these was the epidemic of the sixth century (554 A.D.) This is the first epidemic of plague which has been clearly defined, and from this time we have little difficulty in tracing its progress. We are told by Gibbon that it resulted in a visible diminution of the human race, which, he says, in many countries has never been repaired. For some time 10,000 people died each day at Constantinople, and he considers that 100,000,000 would not be an unfair estimate of the total deaths.† About a century later (665 A.D.) the plague spread over the British Isles. This was the first time it had ever visited Scotland. It was attributed to the fact that the Scotch had fallen off from their former habits of temperance and virtue. It left them on their return to prayer, temperance, and cleanliness. On the other hand, it is said to have visited Ireland *in answer to prayer*: a famine had taken place, food was scarce,

it is quite possible that this was due to the continuation of an earlier civilisation, and that Ireland, and indeed all the British Isles, had a history extending back into very remote ages, as has now been shown to be the case in so many countries in various parts of the world. That these ancient documents do not exist in Britain is explained by the fact that the Saxons invariably destroyed the relics of civilisation of all countries that they overran, and that Ireland did not come at that early period under their power. In any case, we may assume that wherever man has lived in the past, in a state approaching civilisation, he has been subject to diseases and epidemics.

* Gibbon: *Decline and Fall of the Roman Empire*, vol. I., chap. x., page 456.

† Gibbon: *Decline and Fall of the Roman Empire*, vol. VII., chap. XLIII., page 423.

and a national prayer was offered up that the plague might come and remove some of the inhabitants, that the rest might be fed. The prayer was granted. The plague came, and carried off large numbers of the population.*

The plague reached its highest development in this country in the fourteenth century. This epidemic, the black death of 1348, is said by Hecker to have carried off a quarter of the inhabitants of the known world and *nine-tenths* of the inhabitants of England. This is not without corroboration by other historians, and all the accounts are truly appalling. The plague had now "touched the highest point of all its greatness," and rapidly declined. For 300 years it remained endemic, but with diminished power; at the latter part of the seventeenth century it left this country, we hope, for ever, and then gradually receded towards its original haunts in the dominions of the Sultan of Turkey. The history of the plague, thus briefly sketched, points in many respects to cosmical causes as its origin. The epidemic of 1348 was preceded by vast atmospheric disturbances on a universal scale. Earthquakes were constant throughout Asia and Europe. Meteors and comets were seen in abundance. We hear of floods and torrents of rain so great that mountains were washed down by them. And these were alternated by lengthened periods of drought. Such causes are certainly beyond the control of man, and the length of the plague-wave, 1,500 years in Europe and 1,000 years at its extreme limit, point to cyclical rather than accidental or preventable causes.

(*d.*) DECOMPOSITION.—On the other hand, the constant exacerbations which occur, the great increase both in extent and intensity after all great wars,

* Walford: Chronology of Pestilence, page 10.

after great epidemics among cattle, when they are often left unburied,* and after the overflowing of the Nile, all appear to show that the development of plague-germs is greatly facilitated by the presence in the air of the products of the decomposition of animal matter. Decomposition will not alone produce specific disease, but where disease-germs exist its presence will greatly increase their fertility. This is true, not only of plague, but also of typhus and cholera.

(*e.*) WAR.—Epidemic disease, human and animal, has always followed in the track of war. We may, perhaps, consider this a national judgment for a national crime; but if so, it is brought about by natural causes, and excessive decomposition is certainly one of them. That war is a crime, and one of the worst of crimes, I have not the slightest doubt. One of the greatest, if not the greatest orator who ever spoke the English language, for many years inveighed against war with all the force of his eloquence, and though his words are still unheeded they will live in the future; and I for one, look forward with confidence among the advances of civilisation to a time when war shall be no more. Till this consummation is brought about one of the greatest of the many causes of epidemic disease will continue to be in the ascendant.

Plague, on account of the great length of its history, is the disease of all others in which this connection of events is most clearly shown. In the fifth century B.C. the wars of Pericles were brought to an impotent conclusion by the plague of Athens, and two hundred years later the conquests of Demetrius Poliorcetes in Armenia were also put a stop to by pestilence among his troops. The former outbreak, so far as it affected the army of Pericles, was attributed to overcrowding in the camp, the latter to famine. The wars which

* This occurred at Bengazi in 1858 and in 1874; in Persian Kurdistan in 1863.

made Rome the master of the world were followed by the great outbreak, already mentioned, of the third century. The wars by which she was compelled to defend that position against her northern invaders by another, equally great, in the sixth century, which occurred during the reign of the Emperor Justinian, and was called the Plague of Constantinople. The first outbreak in the British Isles was in 664 or 665 A.D., and took place towards the end of the Saxon invasion, when civil war and massacres had been for a long time the normal condition in every part of the kingdom. This was called the Yellow Plague, and the old chroniclers ascribe the ultimate success of the invaders to the almost complete extermination of the original inhabitants by this epidemic. The outbreak of 1314, followed upon the Scotch and Welsh wars of Edward I. and Edward II., and the greatest outbreak of all, the Black Death of 1348, followed, in this country, civil war, war with Scotland and war with France, besides a long series of struggles in the Holy Land, one of the countries where plague had its origin. In the seventeenth century there were twelve epidemics of plague in this country, and fourteen in Holland. The beginning of the century saw the Thirty Years' War and the civil wars between Charles I. and the English Parliament. Civil war has practically ceased in England since the middle of the seventeenth century, and plague has ceased also. The plague of Copenhagen in 1712 followed the invasion of Denmark by Charles XII. of Sweden. That of Marseilles in 1720 the wars in France and Spain. During the present century it has followed every attack upon Turkish territory by Russia, and it is on such occasions only that it spreads beyond its natural geographical limits. It broke out after the Bulgarian War in 1828, after the Crimean War in 1855, and after the Russo-Turkish War of 1879; nor was it without its effects on the mortality

of the English troops after the more recent operations in Egypt.

(*f.*) DISPOSAL OF THE DEAD.—The importance of animal decomposition as a cause of epidemic disease has been recognised from the earliest times. In all parts of the world the evidence of archæology shows that at some periods the disposal of dead bodies was carried out with a view to their being made as harmless as possible, and though its origin was lost sight of the practice was often continued. The crowded state of our cemeteries and the prevalence of cholera have made the subject an important one, not only for discussion but also for immediate action.

For the same condition of things which occurs on great battle-fields occurs also, in a minor degree, in all large towns. Wherever numbers of bodies are buried in limited spaces of ground, the surrounding air and water are liable to be contaminated by the products of decomposition rendering them favourable to the development and spread of epidemic disease. If this is the case, why should the dead continue to be a source of peril to the living? Why should those great centres of decomposition, the cemeteries, exist at all? Is there not some more sanitary method of disposing of the dead than that now practised? To answer this question, there is no need to tax our brains to invent an original plan, for every possible method appears to have been in use at some period in different parts of the world. Among the numerous methods employed both in savage and civilised countries, past and present, all possessing certain advantages, the only difficulty is to make a choice out of so large a number. Even the lowest savages appear to have given some attention to the subject, not unfrequently in a way that indicates a certain degree of intelligence and foresight. Among the different tribes forming the aboriginal inhabitants of Victoria, consisting of a mixed race, principally of

Melanesian origin, there was a great variety of customs. By some of the tribes the body was always burned on a pile of wood ; by others it was placed in a natural cave, and left there ; by others it was placed in a running stream, by which means the soft parts were gradually washed away ; by others it was covered with grass mats and propped up on a platform of wood or sticks, and gradually dried in the sun ; by others, again, it was placed in a certain position upon the trunk of a tree, and left to be devoured by the various carnivora of the district. The last of these methods, although not quite within the range of practical politics in a country in which almost all the carnivorous animals have been exterminated, is not without its advantages from a sanitary point of view. It effectually prevents the poisoning of the atmosphere with the products of decomposition, and, besides, it has the argument of analogy in its favour. It appears, indeed, to be the natural destiny of the material portion both of the vegetable and the animal kingdoms to become food for some of the other members of them. Man alone, the highest of the organic series, resists it, and not always successfully, for, protected, even in death, from the attacks of the higher animals, he often becomes a prey to the grubs of insects and other still lower forms which pass their lives beneath the surface of the soil.

(*i.*) PLASTER BURIAL.—Of practicable methods of disposing of the dead in a sanitary manner, there are three now before the world. The first is one that was proposed by a German physician, Dr. Von Stenbeis. The plan he suggested was to enclose the body hermetically in a concrete case of Roman or Portland cement. The plan is simple, and, although it has not been received into general favour, is still strongly urged by some who object to cremation. It is open, however,

to the same objections. In both cases the natural resolution of the body is interfered with: in the one it is hastened, in the other it is prevented altogether. If it were universally carried out, the world would be permanently deprived of a certain and increasing amount of organic matter which would otherwise go to form part of the crust of the globe and its organic covering. The plan is not new, though uncommon. In principle, it is the same as that of the ancient Ethiopians, who covered their corpses completely in a casing of plaster or mud, and also of the Cherokees of North America and the aboriginal tribes of North Carolina. The latter employed fire, whether with the object of burning the corpse or hardening the plaster is uncertain. These, I believe, are the only known instances of plaster burial.

(*ii.*) CREMATION.—Cremation has been strongly advocated, and is gaining in favour both in this country and on the Continent of Europe. It is a very ancient custom, and has, at various times, been widely adopted. It was practised by the early inhabitants of Britain, and also, as already mentioned, by the aboriginal Australians, by the inhabitants of Hindoostan, the Greeks and the Trojans, as well as by the Red Indian tribes on the west of the Rocky Mountains. By this method the slow process of natural decomposition, which takes place while other organic compounds are being evolved, is entirely avoided, and the body is at once reduced to its inorganic constituents; that impregnation of the atmosphere which has been found to be so favourable to the growth of disease being thus effectually prevented. This is the sole advantage of the method, and it has its drawbacks. It is only when the products of decomposition are present in excessive quantity, as on battle-fields and in crowded cemeteries, that insanitary results are found to follow

Decomposition, both of animal and vegetable matter, is constantly going on to a smaller extent, not only without any ill effects, but with absolute advantage by increasing the fertility of the soil. If, therefore, cremation were to become the universal practice, the circle of life would be to some extent interfered with. A large quantity of organic matter which, under present conditions, enters sooner or later into the composition of some other form of life, would be artificially deorganised, and rendered useless for this purpose. Taking the population of the world at 1,500,000,000, and the average annual death-rate at twenty per thousand, this would give 30,000,000 bodies to be cremated annually, amounting to about 1,400,000 tons of organic matter destroyed every year, and converted into unrespirable gases.* These gases, which would thus be discharged into the atmosphere, and would consist chiefly of carbonic acid and ammonia and water in a state of vapour, would measure something like 135,000,000,000,000 cubic inches, or about 78,125,000,000 cubic feet.† This amount, if equally diffused through the atmosphere all over the world would not, perhaps, be sufficient to affect its composition in any appreciable degree; but this diffusion would take place slowly, and there would be an accumulation in the lower strata of the atmosphere, especially near those places where cremation was carried on. Whether this deterioration of the atmosphere would in any way affect the health of the

* This is taking an average body to weigh about 100 lbs. The actual figures are 1,334,927 tons.

† The human body being taken to measure, on an average, 2,500 cubic inches. Solid bodies, on assuming a solid form, expand to about 1,800 times their former bulk. In London alone there would be about 4,500 tons of human beings cremated annually, with an addition to the atmosphere of nearly 150,000 cubic feet of unrespirable gases, and the loss of a large quantity of its oxygen.

living it is impossible to say; but at a time when we are endeavouring by every means to keep the air in its natural condition of purity and as free as possible from the products of combustion, it seems unreasonable to increase by the fresh introduction of combustion on a large scale the great amount of impurity in the air which modern manufactures and other exigencies of civilised life have rendered unavoidable. At any rate, it seems not impossible that the destruction of large quantities of organic matter, in conjunction with a large increase in the amount of gaseous matter, would in time destroy the balance at present existing between the organic and the inorganic world.

(iii.) EARTH-TO-EARTH BURIAL.—Free from all the objections which may be urged against the two former methods, and from all the dangers of the present system, is that which has been called “earth-to-earth” burial. The essential parts of this system are that there should be a sufficient space left between the bodies, and that they should not be enclosed in strong wood or metal coffins, but should come freely in contact with the earth. Earth is the best of all disinfectants, and it utilises as well as disinfects; but there must be enough of it, and it must come in contact with the material to be disinfected. In the present system, both these conditions are ignored. When they are present, the disinfection and destruction of all the soft parts of the body, partly by the absorbent qualities of the earth, and partly by those voracious worms and grubs which pass their lives underground, are rendered rapid and complete. Linnæus has said that three flies and their offspring will devour the dead body of a horse as rapidly as a lion will, and this is hardly an exaggeration when we consider the enormous rapidity with which they multiply. The particular fly to which he alludes—the *Sarcophaga*

Carnaria—has, it is said, 20,000 children at a birth.* The underground inhabitants of the earth, as Darwin has shown us in his great work on "The Formation of Vegetable Mould," perform a most important part in making the soil fit for cultivation. By this method, therefore, man becomes, after death, not a danger to the living, as by the present system, nor useless, as by cremation and plaster burial, but of use to future generations, and follows, too, a very general, but not universal law, that the animal body, when life is extinct, serves as food for some other species.

For this plan to be carried out effectually, the body should be left in free contact with the earth. This is practically effected by the light paper coffins used by the London Necropolis Company. These are very rapidly destroyed by the underground moisture, and the process of natural disinfection and change is allowed to go on. It is also essential that there should be a sufficient quantity of the surrounding earth, for which purpose an area of about twelve square feet, at least, should be reserved for each burial. If this plan is thoroughly carried out and generally adopted, all danger of encouraging the spread of epidemics by the decomposition of dead human bodies will be at an end.

As an alternative plan, in case sufficient space is not available, carbonisation or destructive distillation of the body might be effected before burial. By this means it would be thoroughly disinfected, and either wholly or partially converted into charcoal, but not reduced to ashes, as in cremation.† This would be effected by submitting the body to a high temperature (480° F.), without contact of flame.

* Kirby and Spence's "Entomology," pp. 147, 148.

† After cremation, only $\frac{1}{2}$ the weight of the body is left in the form of ash.

There is one other method which requires mentioning, as it is, perhaps, one of the most perfect—and, though it can never be universal, always has been, and probably always will be, employed by every nation in a certain number of cases. The actual results of sea burial are not known with certainty, but it is supposed that, if not eaten by submarine animals as it usually is, the body is disintegrated by the enormous pressure of the water at the bottom of the sea, and rapidly combines with oxygen, which is known to exist there in large quantities.

So much importance has been attached to the disposal of the dead that at one time it was common to attribute the origin of plague to the introduction of Christianity, and the consequent substitution of burial for embalming. That this was not the case is abundantly proved by the history of the plague of Athens (B.C. 435), as well as by the Leyden *papyri*, which were discovered at Memphis, and which distinctly allude to an annual pestilence.* Still, it is probable that embalming was found suitable for a plague-stricken country, and may have been originally introduced for sanitary reasons.

(g.) CONTAGION AND INFECTION.—Is the plague contagious? We are told with confidence that it is not. But, though the disease does not depend solely on contagion for its propagation, the evidence in favour of its absolute non-contagiousness is far from being conclusive. A writer of the early part of the present century† speaks of the non-contagion theory as a periodical mania which breaks out every few years, originating in a desire to repeal the quarantine laws. The establishment of quarantine was certainly coincident with a diminution of plague in Europe.

* "Melanges Egyptologiques." Par F. Chabas. A. Chalons-sur-Saone. 1862.

† Dr. Russell.

Whether they bore the relation of cause and effect must be a matter of opinion. Since plague has been only an occasional visitor, every outbreak in Western Europe has been preceded by the arrival in the place where it originated of a plague-stricken vessel, and in two instances—at Marseilles in 1720, and at Malta in 1813—the first families attacked were those of smugglers. Such persons we should expect to be among the first to visit a newly arrived vessel, and would be under a special necessity not to publish the fact, but would, on the contrary, take every precaution to keep it quiet. When we consider how often, how long, and how successfully smugglers used to elude the practised vigilance of excise officers, it is not surprising that they should be able to mystify a few collectors of statistics*.

Sir James McGregor and Barron Larry appear to have considered plague contagious, but not infectious. Of modern observers, Dr. Cabiadis, of Russia, considers it infectious, but not contagious. Professor Virchow, of Vienna, holds, I believe, the same view. The late Mr. Radcliffe considered it to be neither contagious nor infectious. But all agree that the actual causes are unknown, that starvation and drunkenness increase the liability to the disease, and that therapeutic treatment is absolutely useless.

Thus has the plague, from the earliest times to the present day, been one of the educators of the human race. Few sanitary laws in early times were so per-

* It is said that in the early part of the present century an Italian doctor invented an infallible quack medicine, which he recommended to all his patients. It was composed of scrapings from the skin of plague patients mixed with oil, and was employed as an experiment to demonstrate the non-contagious nature of plague. It failed in its object, for many of his patients died of the disease. The druggist who sold the compound was executed; the doctor, by some means, escaped scot-free. (Works of Dr. Robert Gooch. Edited by Dr. Fergusson. Published by the New Sydenham Society, London. 1859.)

fect as those given by Moses to the Jews in the Book of Leviticus, and these were rendered necessary by the constantly recurring epidemics of plague by which they were being decimated. The result has been that the Jewish race has to the present day greater tenacity of life than any other in the world* Egypt, the home of the plague, has been also the earliest seat of civilisation. And in our own country men have been compelled, from an early period, to direct their attention to these outbreaks; and, though they have long been groping in the dark, side by side with quackery and superstition, gleams of truth have arisen, which have paved the way for a more intelligent study of the principles of practical hygiene. The cold-water cure, once so famous, is now replaced by the use of water for purposes of cleanliness. The tar-water mania, perhaps, led the way to the use of the products of tar as disinfectants; while the old idea of judgments for sin has induced man to improve his physical and mental condition by habits of sobriety and activity. When we compare the later with the earlier manifestations of plague in this country it is evident that sanitary science had made some progress even in the seventeenth century.

21. Typhus.—(a.) ITS GEOGRAPHICAL POSITION.—Typhus is essentially the epidemic disease of the British Isles, where it may almost be considered endemic. Like plague and cholera it always follows in the wake of war, and, in temperate climates, is a constant sequence of military expeditions, all parts of Europe being especially subject to it. Though typhus cannot lay claim to any of those vast conquests over mankind which have been recorded of the plague, it has done terrible work, and has, perhaps, attracted

* Jews, on an average, live about five years longer than Europeans generally.

more attention in this country than any other disease. There is consequently a far greater unanimity of opinion in regard to its origin, and greater success has attended the efforts to reduce its power.

(b.) OVERCROWDING.—It is to *overcrowding*, want of ventilation, and dirt, that the greatest achievements of this disease have usually been attributed, and there is a very general agreement that it is spread both by contagion and infection. In former times our prisons were hot-beds of typhus, which would sometimes during the assizes in provincial towns carry off nearly the whole court, judge and jury included.

At one of these "Black Assizes," which took place at Oxford, *all* who were present died within forty hours, including the Lord Chief Baron, the Sheriff, and about three hundred others. The disease, of course, was introduced into the Court by the prisoners who had been long confined in the gaol under the most favourable conditions for its development. At that time, and for some time after, the gaol was greatly overcrowded, and in an extremely offensive condition, while the prisoners were practically almost starved, and personal cleanliness was, under such conditions, impossible.

On another occasion, at the Old Bailey in 1756, the Lord Mayor and two of the Judges died, besides many others. So fatal was typhus in the prisons, and so much neglected, that even when surgeons were appointed, which was not often the case, they were especially exempted from attending cases of typhus.

(c.) ITS DIMINUTION.—This state of things exists no longer, and it is to a layman that the change is chiefly due.* Since the great work accomplished by John

* Howard possessed, no doubt, considerable medical knowledge, and for a time actually practised medicine on the Continent with some success, but he appears to have had no regular medical training.

Howard, the terrible epidemics of gaol fever have become comparatively things of the past. It was typhus which first stimulated into intelligent activity the benevolent mind of Howard, and it was Howard who gained the greatest victory over disease that has ever been accomplished by a single hand. Typhus, by the intelligent interpretation of observations, and the steady application of the principles thence deduced, has become a comparatively rare disease.

It is, indeed, absolutely preventible. Cases may be, and frequently are, introduced into the wards of a hospital, and, if ventilation is properly carried out, it never spreads. A stagnant and impure atmosphere appears to be essential to its development. Where this condition exists, typhus, if present, will never fail to spread; where it does not exist, typhus will as certainly die out. It is by attention to this one point on the collective side, the avoidance of overcrowding and better ventilation in prisons, and, on the individual side, by the precautions against starvation of the prisoners, that this result has been obtained. For even in a disease like typhus, where the external causes are so well known, the cultivation of the personal power of resistance by strictly following a safe middle course must be attended to. The importance of this is exemplified in Howard's own life. He appears, by his own admission, to have carried his abstemious habits too far. In his work on the State of Prisons (page 431) he attributes, and no doubt justly, his escape from infection in the numerous prisons he visited to *temperance* and *cleanliness*, while at the same time he took care never to visit them before breakfast. When, however, at last the infection seized him, he pointed out, not altogether scientifically, what he considered to be defects of his system—viz., its exclusiveness. He says:—"My mode of life has rendered it impossible that I should get rid of this

fever. If I had lived as you do, eating heartily of animal food, and drinking wine, I might, perhaps, by altering my diet, be able to subdue it. But how can such a man as I am lower his diet, who has been accustomed for years to exist upon vegetables and water, a little bread, and a little tea? I have no other method of lowering my nourishment—and, therefore, I must die. It is such jolly fellows as you, Priestman, that get over these fevers.” The starvation treatment here alluded to is now, of course, a thing of the past, but the recognition, at the close of life, of the possible danger of too rigid and unvaried a scale of dietary, is instructive.

(d.) RECENT RESEARCHES.—While, however, the overwhelming potency of typhus in this country was greatly reduced by the wholesome reform in our prison laws, and the altered state of our prisons, even before the disease was fully understood, science has been at work in later years in investigating its causes, and in differentiating it from other diseases to which it bears some resemblance. Although observations have been pursued since the beginning of the present century, it was not till about fifty years ago (1836) that the identity of *Typhus* and *Typhoid* fevers began to be seriously called in question. About this time, Dr. Lombard of Geneva, Dr. Gerhard of Philadelphia, and Dr. A. P. Stewart of Glasgow, each separately commenced a series of observations which induced them all to believe that the two diseases were entirely distinct. These observations, followed up by those of Messrs. Montault, Valleix, Rochoux, De Mussy, Grisolle, and Godelier, of Paris, and Dr. (now Sir William) Jenner, of London, have now definitely decided the point in favour of the non-identity of the two diseases; a discovery, the importance of which has hardly been surpassed in the history of medicine. For not only are

they distinct in their essential characters, but their causes are different. Typhus is extremely infectious, while typhoid is so only to a limited extent, and in a certain manner. Typhus is conveyed through the medium of the atmosphere, while typhoid usually depends on the quality of the water or other liquid used for drinking. In general terms it may be said that typhus enters the system through the lungs, typhoid through the stomach. For their prevention, therefore, drainage is the first consideration in the latter disease, ventilation in the former.

Typhoid is still among us, but its causes are now understood, and can usually be traced; and, if traced, removed, an utter impossibility in former years, when it was constantly being confounded with typhus. Typhus has, as we have seen, been greatly limited in its scope, and may be, by the enforcement of more stringent laws on the construction and habitation of houses in thickly populated districts, almost entirely eradicated; but this will need the co-operation of the inhabitants themselves. All the conditions favourable to the development of typhus may be traced to a single mental condition—sloth. Sloth is the parent of dirt, overcrowding and starvation. When sloth spreads through a community these results follow, and typhus usually follows with them.

Whether typhus ever arises spontaneously, *i.e.*, whether, when all these conditions are present, typhus will break out without the introduction of "germs" from a previous case, no observations have at present been able to determine with certainty; but so potent and subtle are the germs that it would be a dangerous experiment to allow such conditions to continue to exist on the chance that exclusion of the "germs" might be effected. Where dirt, overcrowding, and starvation prevail for any considerable period, the "germs" of typhus may be safely trusted, sooner or

later, to find their way. Where these conditions are absent, the "germs" will not make much progress.

Such are the chief of the proximate causes of typhus, which, before these causes were understood, made, under the name of the "gaol-fever," such frightful havoc in our prisons and the districts about them; and, as the "camp-fever," has for centuries followed the movements of all European armies, and was a more potent factor in frustrating the far-reaching and ambitious schemes of the first Napoleon than the combined power of all the nations in Europe.

Typhus has thus been attacked in its most favoured haunts, and the success which has, during the last hundred-and-fifty years, attended the combined and active attempts to extirpate it may serve to encourage inquirers to trace out the ultimate causes of other epidemic diseases, especially Cholera. At the same time it must be remembered that in these climates typhus is only latent, and might, if the defence is not sustained, regain some of its former potency. It is in large towns that the danger is chiefly to be feared, where the present healthy returns may lead to relaxation of vigilance on the part of the local authorities, and oblivion of that demon of overcrowding which ought to be ever before them. Building has been going on at an unprecented rate, and perhaps over a too limited area. Economy of ground-area involves an increased consumption of oxygen over a given space, together with increased introduction into the atmosphere of carbonic acid and the organic products of respiration, and this is only another form of the condition known as overcrowding, of which it seems to present, though perhaps in a minor degree, all the essential features. This is a point which must not be lost sight of at a time when residences in flats for the well-to-do classes are being raised to the height of twelve or thirteen stories, and when the poorer classes

are being turned out of tenements, admittedly unhealthy in many respects, but with free air above them, and having built for them structures called "model lodging houses," in which, not without certain counteracting sanitary advantages in other respects, families are piled upon one above another in close proximity, and large numbers of human beings are compelled to live over a very limited space of ground. The ventilation and access of air in these buildings may be adequate, but this is a matter on which experience has not yet had time to decide.*

Typhoid, or enteric, fever, on the other hand, is, perhaps, more under control in towns than in the country. In towns the water supply is a known and constant quantity, and can be traced from its source through every step to its consumption, and the cause of its contamination, whatever it may be, removed. In the country the water supply is diverse, as well as the causes of its pollution, and neither it nor the drainage is under any comprehensive system of control. It is, perhaps, for these reasons that typhoid epidemics, as already mentioned, are sometimes so formidable. Each house has to be separately examined, both as to its water supply, and also as to the system of drainage (or whatever apology for such system) it happens to possess. In towns some epidemics have been traced to the supply at its source, but this is rarely the case. The system of supply is now so well understood by engineers, and is carried on upon so large and comprehensive a scale, that there is not often in the present day much danger

* The present administrative county of London is included in an area of about 75,000 acres, containing about 500,000 houses and a population of 4,000,000. This gives an average of 8 persons in each house, and 53.3 to an acre of ground. In the Holborn district, which is one of the most thickly populated, there are 215 to the acre. It remains to be seen whether this degree of concentration can be exceeded with impunity.

of water being polluted at its source. The real purity of the water depends less on any system of filtration than on the constant agitation which is artificially kept up in all large reservoirs. It is doubtful whether any filter can be depended on to remove the germs of typhoid, which may flourish in water having the most tempting appearance from its clear and sparkling character; but where stagnation is avoided by constant motion with access of air, the water, even if it presents a somewhat turbid appearance, may generally be consumed with impunity. It is at a later part of its course, in the pipes and cisterns, that the water is most liable to be contaminated. This is usually brought about by the escape of sewer gas from the drains and sewers. Where the water supply is interrupted, there is danger of sewer gas being drawn into the water pipes whenever the water is shut off. This may to some extent be obviated by a careful attention to house drainage, but the traps at the entrance to the sewers are rarely air-tight, and the power of suction of empty water pipes is considerable. They will draw in surrounding gas even through a small leakage. The only real safety is in the constant-supply system. In many houses, too, the overflow pipe from the cisterns leads directly into the drains. This is a most fruitful source of contamination. It was formerly almost universal in the construction of houses, and is still very widely prevalent. The pipe should, of course, be in the open air, and discharge its contents on the ground. The change has been suggested by most of the water companies to the occupiers of houses, but no steps, so far as I am aware, have been taken by any central authority to see that it was universally carried out. If these two matters were generally attended to, one of the most fruitful sources of typhoid fever would be avoided. The question of the filtration of drinking-water here naturally suggests itself. If water is con-

taminated when it reaches a house can it be purified and rendered fit to drink by the use of filters? Upon the whole, I believe all house filters to be not only altogether useless, but deleterious. It is more than doubtful whether any substance through which water can be passed will entirely exclude either germs or organic matter. Of the latter they no doubt exclude a portion, which gradually collects on the upper surface and in the interior of the filter, and if disease-germs are present in the water in however small numbers they could desire no better nidus for their cultivation than this collection of organic matter in the filter. Water which contained but the minutest possible quantity of organic matter diffused throughout its entire volume would thus in time deposit an amount which would be favourable to the development of disease by its accumulation and stagnation. To destroy this accumulation by placing the filter on the fire every few days, as has been suggested, is a plan hardly likely to be kept up, and only practicable on a very small scale. It is better to depend on a pure water supply, and a good system of house drainage, and to be altogether independent of filters.

For the purity of the milk supply we have to depend in towns chiefly on the Government inspection of dairies. This is now so well carried out that the cases of typhoid traceable to milk are becoming comparatively rare. With ordinary care in the selection of the milk supply the risk is a slight one, and is one which, in towns, must be accepted. In the country, where there is purer air and more natural food for the cows, and the source of the supply is more easily traced, the risk, perhaps, on the whole, is rather less.

22. Cholera.—Plague, the disease of a hoar antiquity, has, after a long and successful reign over mankind, shrunk back in its old age to its original haunts, pre-

paratory, we hope, to its final extinction. Typhus, though probably of much later origin, has also, we may hope, after a lengthened struggle with the activity of the Western intellect, seen its best days.

(a.) ITS YOUTH AND VIGOUR.—During the present century, however, another foe has come among us in all the vigour and activity of youth. Cholera, as an epidemic disease, is probably only about one hundred years old. Some have attempted to indentify it with one or more of the diseases described in the old records of the Brahmins, in the writings of Hippocrates and Celsus, and in those of the English Sydenham, but their indentity is by no means clear.

(b.) ITS GEOGRAPHICAL DISTRIBUTION.—The first clearly defined outbreak occurred in the North-East corner of Madras in the year 1781, spreading to Madras city the following year. It was called in the Persian language the “mordechim” or bowel-death, which was corrupted by the French into “mort de chien.” The great epidemic of this disease broke out in Bengal in 1817 about the mouths of the Ganges after enormous floods in this region. Having devastated a large tract of the country surrounding Calcutta, it spread out into three great streams. One went along the Madras coast to Madras (February 1818), over to Ceylon (February 1819), and thence to Mauritius (November, 1819).

The second stream passed slowly along the Malay peninsula (1819), through Sumatra, Java, Borneo and the Philippine Islands to China, reaching Canton in 1820, Pekin in 1821, and crossing over to Mongolia in 1827.

The third stream passed across India towards Europe, reaching Delhi August 1818, Oodipoor in July 1819, and sending a branch down the west coast to Cape Comorin.

After two years (1821) it broke out all round the Persian Gulf and spread to Bagdad; thence in 1822 to

Aleppo, Erzroum, and Bakou on the Caspian ; then passing along the western side of the Caspian Sea from Bakou to Astrachan it entered Europe in 1823.

It was not till 1830, seven years later, that the cholera passed up the Volga to Saratov, and thence to Moscow, from Moscow to Petersburg, from Petersburg along the shores of the Baltic to Stettin, and from Stettin to Berlin, which it reached in 1831. Another stream came backwards from Saratov along the River Don to the Black Sea, thence to the mouth of the Danube, and along the Danube to Vienna, which it reached in 1831. A third stream passed through Poland. These three met at Hamburg in 1831, and came across to England, breaking out in London and Sunderland almost simultaneously. In 1832 it reached Edinburgh, crossed the Atlantic to New York and Quebec, and the Channel to Calais and Paris. It reached Lisbon and Madrid in 1833, Gibraltar in 1834, Florence and Genoa in 1835, Naples in 1836, and Rome in 1837.

During this epidemic the deaths in England and Wales numbered about 20,000 ; in that of 1849, 53,000 ; in that of 1854, 20,000 ; and of 1866, 14,000.

As to the geographical origin of cholera, therefore, there is not much doubt. As the plague appears to have originated on the banks of the Nile, so does cholera on the banks of the sacred Ganges. In both cases, too, there is greatly increased activity when the river overflows. This being the case, it appears *possible* that, by a comprehensive and intelligent system of drainage, cholera might be attacked on its own grounds, and in the earlier stages of its development. The seat of its origin is under British rule, and a nation which has practically overcome two such scourges of mankind as typhus and small-pox will not rest till some radical operation has been carried out for the prevention of this more recent scourge. Unless

our race has mentally deteriorated, cholera will, sooner or later, succumb before the vigour and energy of the British intellect. For the present, its transit has been rendered easier. The Suez Canal and the railway from Tiflis to Poti have introduced two short cuts which might render unnecessary the slow journey along the shores of the Caspian and the banks of the Volga, and have made it the more necessary that its progress should be arrested, if possible, at an earlier stage. The principal routes by which cholera may now enter Europe are (1) through the Red Sea and across the Mediterranean; (2) through Turkey by the Persian Gulf; (3) overland through Persia, Turkey, and the Black Sea; (4) overland through Persia, Georgia, and the Black Sea; and (5) overland through Persia, and thence by the Caspian Sea to Astrachan

(*c.*) UNDERGOING INVESTIGATION.—At present comparatively little is known with certainty as to the special causes and treatment of cholera. With so young a disease this is inevitable. The whole history of a disease is not learned in fifty, nor even in a hundred years, and it has been under observation in Europe little more than fifty. During this time, however, mens' minds have been stimulated into activity, research is being pursued in all directions, and must, sooner or later, be fruitful of results. We can hardly hope even that cholera has yet attained its full development, but the experience of the past, together with the observations of the present, will enable us to defend ourselves against it more successfully in the future.

The strange connection which appears to exist between cholera (as well as other epidemic diseases) and influenza has already been referred to. This is a point on which accurate observation is especially needed. Once more influenza has visited Europe, and again we hear rumours of cholera. The sequel is not

a constant one, and we have no statistics on which to base any definite opinion. We have only vague statements that influenza preceded or followed cholera. Whether the same patients suffered from both diseases, or whether those who were attacked by one escaped the other, and *vice versâ*, are points on which there is not sufficient evidence, but to which observation ought to be directed in those countries which may be attacked by both. In the former case it would point to the conclusion that the connection of the two diseases lay simply in the fact that a patient whose powers of resistance had been reduced by the debilitating effects of one disease was rendered more liable to be attacked by another. If, on the other hand, they are found to be mutually protective, it would seem to show that the two diseases have a common origin, or, at any rate, a common ancestor, and that one is only a more highly evolved form of the other. A series of observations on this point would throw a more important light on the possible prevention of the greater epidemics than has yet been thrown upon any branch of preventive medicine.

(*d.*) USEFUL SANITARY RESULTS.—Meanwhile cholera has taught us many useful lessons, and has resulted in a great saving of life in this country, far exceeding the number of its victims. Since the epidemic of 1854 the sanitation of the metropolis has been established upon a new basis; the drainage has been almost entirely reconstructed, houses have been built on better principles, inter-mural burials have been done away with and cemeteries made general.* The example thus set has been followed by other large towns. London is now, in spite of its large and increasing

* This, in large towns, is only a temporary measure, and must shortly be superseded by some further change; such change will be either cremation or earth to earth burial at a greater distance from town.

population, its accumulation of dust and smoke, and all its facilities for promoting the spread of disease, one of the healthiest cities in the world. Activity is life, stagnation is death. The constant activity, mental and bodily, of the population of London, the incessant traffic, which prevents the stagnation of the air, the railways underground, which keep in a continual state of agitation the lower layers of the atmosphere, have all assisted in bringing about this important result.

(e.) PREVENTION, SO FAR AS AT PRESENT UNDERSTOOD.—Can we, by any means, prevent epidemics of cholera? *All special nostrums for this purpose are useless, and worse than useless, as might have been supposed beforehand by the analogy of plague and other great epidemics.* So much has been learned with considerable certainty. We cannot avoid cholera by shunning proximity with cholera patients, by innoculating ourselves, by living in an atmosphere of carbolic acid, nor by swallowing all the drugs in the Pharmacopeia or out of it.* Cholera in its origin is undoubtedly due to cosmical causes, shows a decided preference for certain geographical situations, and is beyond human control; but the extent of its develop-

* The list of remedies that have been employed in cholera with greater or less success (generally less) since its introduction into Europe is almost appalling. Truly, the subjects of cholera during the present century, especially the earlier part of it, have "suffered many things of many physicians." During the earlier part of the first epidemic *blisters* were applied. This appears to have been soon discarded in favour of a more rational treatment by opium. Then the alkaline treatment was held in high repute. Chlorine was used as a disinfectant and also as a remedy, and among other drugs bismuth, antimony, juniper oil, salines, oxygen, peroxide of nitrogen, huaco, and small doses of calomel. The last form of treatment appears to have been one of the most successful. At a later period of the epidemic this plan fell out of favour, but was replaced by the same remedy in *large* doses—a change which was not attended with success, for in Malta, where this method was tried in 1837, more than half the patients died. Chlorine, carbonic acid, fumigations, potash (liquor potassæ),

ment may be considerably modified by individual and collective effort.

All the investigations as to the origin and course of cholera have only served to intensify the importance of the two influences I have already so often alluded to—decomposition and overcrowding. By attention to these two matters in all their details, we shall do nearly all that can be done by collective action to diminish the power of the epidemic. War and superstition have done all they can to increase it. The first great impetus to the epidemic is always given by the crowds of pilgrims at the shrines of Hurdwâr and Mecca; the second, by the battlefields of Oriental nations. But for the pilgrimages of Hindoo devotees which take place yearly* on the banks of the Ganges, cholera might never have acquired sufficient intensity to spread beyond the limits of its native country. But for the Turko-Persian war of 1822 it might never have entered Europe. In view of the major pilgrimage to the cholera district, which will probably take place in 1891, it is to be hoped that special measures will be taken by the Government of India to limit the spread of the disease, and that our towns and cities, by a greater

quinine as a preventive, *platanus orientalis* (the oriental plane), and hachisch (*cannabis indica*) were also resorted to without much benefit. In the next epidemic the lessons of the former appear to have been forgotten, and depressant remedies again employed, of which camphor must have been one of the most fatal. Camphor, I believe to be almost equal to aconite and veratrum, and that now fashionable depressant, antipyrin, in reducing the vital powers, and retarding — and, perhaps, altogether preventing—recovery from an acute disease. Remedies which reduce the temperature reduce the strength also, and will sometimes remove the chance of recovery which Nature has left. During this epidemic the hydropathic system was employed, not very successfully, also tannin, sulphur, oxygen, chlorine, nitrate of silver, ergot, sumbul, alkalies, and purgatives. Then we find copper extolled both as a preventive and as a cure. Huaco,

* In addition to the yearly pilgrimages there is one upon a much more extensive scale every *twelve* years, viz., 1783, 1795, 1807, 1819, 1831, 1843, 1855, 1867, 1879, and 1891.

attention to the results of advanced sanitary science, by a more perfect system of sewerage as well as attention to house drainage, which is still in a very deficient state, and by prompt and decisive action with regard to the state of the cemeteries and the disposal of the dead, will be able to present a united front to the enemy, and to resist the invasion of cholera should it again attempt to come down upon us.

It is utterly useless in the presence of a rapidly spreading epidemic to attempt to carry out any works of general sanitation. All this must be attended to before the outbreak comes. Fortunately, in this country, much has been done in this respect during the thirty odd years which have elapsed since the great epidemic of 1854. During this period in London alone, *exclusive of the City itself*, more than a *thousand miles* of sewers have been constructed at a cost of nearly three millions* The entire cost of the sanitary work

strychnia, sulphuric acid, sulphur, valerianate of zinc, chloroform, and ether were also in vogue. Water in the form of large draughts, and also of hot fomentations, became fashionable, saline injections into the veins, and acids vegetable and mineral, were considered by some to be both preventive and curative, on the assumption that habitual cider-drinkers were exempt from the disease. About the time of the last epidemic carbolic acid was coming into general use, and was employed both internally and as a disinfectant. Quinine again found its way to the front, sometimes combined with mustard plasters. The salts of iron were used, and those of mercury, arsenic, copper, saline injections, and, among the depressants, aconite was the favourite. Among these numerous infallible remedies there are very few which have stood the test of being in any degree serviceable, and among the shoals of new drugs, or old drugs with new names, which are being poured in upon us from across the Atlantic, we may safely say there will be none of any greater value, or that will in any way take the place of general and individual hygiene.

* Besides this, about six millions have been spent by the central authority in the completion and construction of main sewers (about 250 miles in extent), and in carrying the metropolitan sewage a certain distance down the river, instead of having it discharged within the limits of the metropolis to poison the water.

during this time has probably exceeded five million (£5,000,000). Upon the whole the actual results upon the health of the population have been satisfactory, though there is much still to be done. It remains to be seen whether the new machinery of local sanitary government will do its work better than the old.

When cholera has once burst its bounds, and there is real danger of its approach, there is only one method of national defence which can be carried out with any chance of success, and that is to resist the invasion by an intelligent system of short quarantine at all our ports.

This, of course, is a last resource, and is, at best, only an insular and self-defensive precaution, and, perhaps, a delusive one. If quarantine is to be any real use, it must be international, and must be carried out at the ports through which cholera enters Europe—viz., those of the Red Sea, the Persian Gulf, the Black and Caspian Seas, and the Mediterranean. Not only this, but a strict system of inspection should be carried out at all the Indian ports to prevent the cholera leaving the country; and this is a matter which we have in our own hands, and on which we need not consult any other nation. The principal difficulty in the case is the religious one. A large proportion of the inhabitants of Hindoostan profess the same religion as those of Turkey, and it is from the pilgrims travelling between these two countries that the greatest danger is to be feared. On the subject of sea quarantine generally, it is useless and absurd to dogmatise. There is not at present sufficient material at hand for a positive opinion, although both sides of the question have repeatedly been asserted with the utmost confidence, and the authorities appear to have been by this means swayed to and fro, and to have been continually changing their minds. Whichever view is taken, therefore, cannot long continue to be the unorthodox one. Land quarantine has of recent

years been pretty generally condemned by the profession, yet if we are to prevent cholera from trespassing beyond its original haunts, it is difficult to see how it can be dispensed with. At any rate, the question will have to be reconsidered. It seems doubtful whether the "germs" of cholera can be conveyed by means of the atmosphere alone, and the disease has never been known to advance "more rapidly than can be accounted for by the communication between one place and another."* This, at first sight, seems to point to the conclusion that it is by the various means of communication that the disease is conveyed, and that by the inspection and control of these means of communication the spread of cholera may be prevented. This conclusion has been accepted by many minds, but it is by no means a necessary one. It is possible that cholera, or any other epidemic disease, may travel slowly along a certain geographical area without any reference to material means of communication, and even independently of atmospheric infection. What are the causes and limits of its periodical extensions we do not know, but Nature is not limited to the above-named means of transit, and it may arise in separate centres from similar atmospheric conditions. There is no absolute proof that the recent epidemic of influenza was brought over from the Continent. It has even been suggested that it arose independently, evolved from an epidemic among the lower animals, and there are facts which give some support to this suggestion. The disease certainly assumed a different form in many respects to that prevalent in Berlin and Petersburg, though it resembled

* "Report of the International Sanitary Conference at Constantinople in 1866, and in Vienna in 1874." Abstract in *London Medical Record* for 1874, vol. ii., page 477, and "Biennial Retrospect of Medicine and Surgery" for 1873-4, page 502.

the one in Paris. If quarantine is to be again attempted, it will have to be done effectually and experimentally by sea and by land, with reference to cholera alone, and with the object of ascertaining with greater certainty the means by which the disease travels from one place to another. For such an experimental measure to be conclusive it must be undertaken by minds unbiassed, devoid of all preconceived ideas and theories, and unswayed by precedent and authority, ancient or modern. We must admit that the exact mode of transit of cholera is unknown, that it may travel by one method, or by several, only one of which may be affected by quarantine ; or, that, on the other hand, it may be entirely unaffected by it. There is at present no proof that the spread of cholera from one country to another can be prevented by any means whatever, but there is abundant evidence that the magnitude of the epidemic will very greatly depend upon the sanitary preparations which have been made for its reception in any country or region into which it has effected an entrance.

Modern theories of the spread of disease give no support to any system of quarantine, but we must be guided by experience, and not by theory, and we cannot yet be certain that these diseases do not travel by more than one method. The cyclonic theory, which is now the prevalent one, asserts the existence in the atmosphere of certain cyclones extending to a considerable height. The germs of disease are said to be taken up by the cyclones, from the centres of which they ascend in large columns until they reach the upper strata of the atmosphere. Having arrived at the summit of the cyclonic columns, they are again dispersed, and are carried about by the atmospheric currents above. Here they become attracted to other cyclones, or anti-cyclones, in the centres of which they move downwards to another part of the earth's surface.

By this theory the slow and steady march of such epidemics as influenza and cholera is accounted for, in spite of quarantines, in spite of *cordons sanitaires*, in spite of all precautions, in spite of contrary winds, in spite of intervening seas, in spite, even, perhaps, of perfect isolation.

While admitting as proved all that is said about the movements of the cyclones and atmospheric currents, we must know something more than we do about the history and development of germs before we can dogmatise as to their mode of progression. If germs exist as organic entities, it is certainly conceivable that they may be carried from one place to another in the manner indicated; but if so, it is only the more certain that they can be carried equally well by favourable surface winds, by persons travelling, and even by certain articles of commerce. It has been suggested, as an extreme measure, to entirely depopulate the whole of the cholera district in India for ten years, guarding every possible entrance by military cordons; yet even such a radical plan of prevention would, if the cyclonic theory be correct, be by no means certain to extirpate the disease. "Germs" would surely remain in the atmosphere about the mouths of the Ganges, even after all the population had departed, and, if a favourable cyclone occurred, would not have much difficulty in eluding the British bayonets, and breaking out in an epidemic form far away on the other side of them.

Meanwhile, as individuals, we can by constant attention to two important duties, both during epidemics and in the intervals of their appearance, do much to lessen the chance of an outbreak and to mitigate its intensity if it comes. These duties are:—

1. To dispose immediately of all superfluous animal and vegetable matter, whether meat, fish, fruit, vege-

tables or leaves; this should either be cremated or utilised as manure.*

2. Personally to cultivate our resisting powers, by activity both of mind and body, while avoiding excessive fatigue of either; and by supporting the physical strength with a sufficiently liberal diet, avoiding all excess of eating and drinking on the one hand, and starvation and (if it is not high treason in the present day to say so) total abstinence on the other.

(*f*) SPECIAL MEANS OF PREVENTION.—There remains the important question: Can communication of the disease from the sick to the healthy, within an infected area, be controlled by special means? Arising out of this, and equally important, is the question whether the disease in any individual case can be recognised in its preliminary, incipient stages, and, if thus recognised, be nipped in the bud before it attains its full development? With certain reservations, the present state of our knowledge appears to show that both these questions may be answered in the affirmative.

(*i*.) THE SPHERE OF DISINFECTANTS—Notwithstanding the doubt existing as to the actual means by which cholera is spread, it is fairly certain that if it is ever directly conveyed from one person to another it is usually by means, directly or indirectly, of some of the excreta of the patient. If disinfectants are any use at

* It has been observed in India that cholera is often preceded by a plague of locusts. There is probably some relation of cause and effect here. The decomposition of myriads of these insects would produce a state of the atmosphere highly favourable to the spread of the disease, and it has been found that where they are collected in heaps and buried or burned, instead of being left to decay on the ground, as is usually the case, the disease does not assume the same degree of intensity. Another common observation is that, when the water of the rivers reaches a certain temperature, a temperature supposed to be favourable to the decomposition of the animal and vegetable matter contained in it, cholera ensues.

all, it is here that they find their legitimate function, and it would appear that when thus used in sufficient quantities their employment has been attended with good results. They must, however, be employed thoroughly and unsparingly, and only the most powerful disinfectants should be used. The milder disinfectants, such as chlorinated lime (chloride of lime as it is commonly, but incorrectly, called) and other preparations containing chlorine, Condy's fluid, and the various permanganates, sanitas, and other patent compounds, are useless for this purpose, and only serve to lull people into a state of false security. Strong solutions of the mineral acids (hydrochloric or nitric), the chloride of zinc (of which Burnett's fluid is a convenient form), of sulphate of iron and carbolic acid, or the two latter combined, are most to be depended on. Carbolic acid should be employed, mixed with not more than fifty times its bulk of water, as solutions of this strength have been found to be fatal to bacteria when the latter have been introduced into them. All that passes from a cholera patient, therefore, should be at once placed in such a solution, either alone or mixed with a strong solution of sulphate of iron, and poured into the drainage system followed by a copious current of water. In addition to this some of the solution should be passed into the drains at frequent intervals, in the proportion of about half a pint daily for every person in the house. In the country the excreta, having been disinfected in the same way, ought to be buried in the soil, as far as possible from the house and from any water supply. If, for any reason, carbolic acid is not at hand, the best substitutes are sulphate of iron dissolved in about three times its weight of water, or the chloride of zinc, or the strong hydrochloric, or nitric acids, dissolved in about fifteen times the bulk of water. This method of disinfection is, of course, also applicable in cases of typhoid fever.

That the germs of disease can be thus actually destroyed is more than doubtful. The organisms which accompany disease, and seem to favour the spread of it, have been found by experiment, as already mentioned, to lose their vitality when immersed in certain powerful disinfectants. It is probable, however, that the benefits of the above plan consist not in the destruction of germs, but in the prevention of decomposition. The latter view is the one most consistent with sound reason, and the accumulated mass of evidence. Decomposition is a great practical fact, the effects of which are known to us by the experience of ages, while germs are uncertain in their results, unknown as to their origin and development, and, if not altogether creatures of the imagination, are, at best, but a plausible and speculative interpretation of certain unexplained natural sequences. The evil effects of decomposition in favouring the spread of epidemics have been already insisted upon, and if we can apply this lesson, and prevent decomposition by any means in our power, we shall have done something towards removing the conditions which we know to be most favourable to the development and infection of disease.

All attempts to poison the germs in the *atmosphere* of the sick room during illness are a delusion and a snare. If aerial disinfectants were introduced in sufficient quantities to choke the patient, it is possible that the bacteria and some of the "germs" might fare badly also. In smaller quantities they are only a discomfort, and an injury by deteriorating the quality of the air, and are very little use in reducing the number of organisms it contains. One of the most essential aids to recovery is a plentiful supply of fresh air, and the chances of a favourable result are certainly not increased by the introduction of noxious vapours into it. Fresh air, however, is not necessarily cold air, as some people seem to think. Air may, in cold

weather, be warmed by first passing through a warm room, and, in any case, a fire should be kept burning in the sick-room to ensure a constant current through it. In some of the Paris hospitals, where the system of ventilation is perhaps the best in the world, the air is heated by passing through a furnace before being introduced, and is raised to various degrees of temperature according to the requirements of the different wards. It is upon the constant supply of fresh air, and upon that alone, that we must depend for the prevention of atmospheric infection. For every cubic foot of air introduced an equal quantity must make its escape, and the concentration, and consequently the potency, of the infecting influence becomes proportionately less.*

It is in disinfecting the room after the patient has left it that the poisonous aerial disinfectants have their place. Of these there are only two worth mentioning—chlorine and sulphurous acid gas, of which the latter is in almost every respect the best. It is formed by burning sulphur in the room to be disinfected, all

* The disinfectant value of fresh air is well and tersely set forth by Dr. Barnes, "How to Arrest Infectious Diseases," Churchill, 1883, where the whole subject of disinfectants and their relative value is also gone into. Dr. Barnes says that, in addition to the effect of fresh air in diluting the infection, the oxygen of the atmosphere enters into chemical combination with the infecting material and destroys its power, and refers to certain experiments of Drs. Braidwood and Vacher to confirm the statement. If this is actually the case, it appears to me the most convincing proof that disease germs are not organic entities. Dead bodies, we know, decompose and enter into combination more or less rapidly with the oxygen of the atmosphere; but we do not expect to see living organisms quietly combining with oxygen to their own destruction for no better reason than that they happen to be brought into contact with it. The experiments seem to show that infection co-exists with a certain stage of decomposition, and that by the access of a greater quantity of oxygen resolution into simpler forms is hastened, and the dangerous stage more quickly passed. What the actual decomposing matter in the air is we do

crevices through which the gas might escape being pasted over with paper.* Disinfectants, however, at their best, can never take the place of efficient sanitary measures, should always be employed with a definite object, as, for instance, to prevent decomposition or to destroy certain atmospheric media after disease, and not with the object of supplementing a possibly defective system of drainage, and thus preventing the discovery of its weak points.

(*ii.*) WARNING SYMPTOMS.—The possibility of recognising and treating a case of cholera in its earlier stages depends, of course, upon the nature of the attack, whether it is sudden or gradual. Fortunately it has been found by the experience of most epidemics that in about two-thirds or three-fourths of the cases the attack is gradual, and is ushered in by certain pre-

not know, but we know that it exists, and its presence explains the action of oxygen, whatever may be the nature of the bacteria or other organisms found in the air, whether they form a *nidus* for the reception of disease germs, or are only an accidental concomitant—whether they possess independent vitality, or are only the results of the preliminary stages of decomposition. With ozone the destruction of infective vitality is found to take place much more rapidly than with oxygen, and it has been suggested by the same writer that it might—especially in towns, where it is usually absent—be artificially generated during infectious disease. Ozone is evolved during the formation of electric and galvanic currents when sparks are not produced. By electric sparks it is converted into oxygen again. It is also formed by the presence of a piece of phosphorous in the air, but this plan is objectionable, as, when formed, it shortly begins to attack the phosphorous, and oxidises it.

* Further details of this plan of disinfection are given in the work last quoted; the sulphur should be burnt in the proportion of one pound to every thousand feet of cubic air in the room. Chlorine is formed by mixing strong hydrochloric acid with chlorate of potassium, or with black oxide of manganese in the proportion of one part of oxide to four of the acid. The amount required in this case is half-a-pound of the oxide to every hundred cubic feet of air. With regard to the bed and bedclothes of a choleraic patient, the only safe plan is to burn them.

monitory symptoms. The important symptom in all these cases is *diarrhœa*. During an epidemic of cholera an attack of diarrhœa so slight as to be, at ordinary times, hardly worth noticing, may develop, and constantly does develop, into a severe attack of cholera. This is the symptom which must be watched and attended to in its earliest and slightest manifestations, and when this is done there is no doubt that many cases of incipient cholera may be cut short before attaining their full growth. But the treatment must be carried out with thoroughness. Warmth, rest, and light nourishment are essential to it. The patient must go to bed, solid food must be for a time avoided, and warm poultices applied to the abdomen. Up to this point there is a pretty general agreement; but on the question of drugs there is the widest possible divergence. There are, in fact, two opposite systems. Some physicians appear to be constantly on the lookout for some definite morbid material, and see in all disease but the manifestation of a particular poison which can be driven out of the system by main force. Those who hold this opinion (and among them are included some of the most eminent members of the profession) naturally resort in these cases to powerful aperients in order to drive out the disease, of which calomel has been one of the most favoured. With this view I have no sympathy. I have already expressed a certain degree of scepticism even with regard to the universal application of the germ-theory. This theory is entirely based on assumption, and there is at present nothing to show that cholera depends on the presence of any self-existent material either in the body or in the air. If asked to give any hypothesis as to its pathology, I should incline to the view that it is primarily a disease of the *nervous system*, and that all the prominent symptoms, the various lesions, and the numerous bacilli and other microbes

found in the course of the disease, are secondary manifestations. Just as palpitation of the heart is the result of a disturbed balance between the two sets of nerves which control its functions, so does cholera depend on a disturbed relation of the two sets of nerves (sympathetic and spinal) which control secretion in the alimentary canal. This, I am aware, is entirely opposed to the generally received opinion, but it is consistent with all that has yet been ascertained with certainty as to the causes of the disease, and it is the only one which will explain the value of opium in its treatment, especially during the preliminary stages. Opium will not drive a poison out of the body, nor destroy a germ, but it will reduce to a quiescent condition a disordered set of nerves. It may, at first sight, be objected that we cannot explain the epidemic character of nervous disorders; but difficulty of explanation does not do away with facts, and no one who has studied medicine will deny the epidemic character of many nervous affections. To prove it we need not go back to the epidemic "dancing mania" of the Middle Ages. That diseases of purely nervous origin are occasionally epidemic is proved by numerous instances. It is probable that we see a minor form of this phenomenon in the epidemic susceptibility to hypnotic suggestion which appears to be again among us, and which has, under different names, broken out periodically for many centuries. But more light has been thrown on the subject by the recent epidemic of influenza than by any disease of modern times. We used to consider influenza to be a contagious and infectious disease, and to be spread by means of certain particles given off by the diseased respiratory mucous membrane. But in this epidemic, in a very large proportion of cases, there has been no disorder of the mucous membrane whatever, and the disease has

attacked the nervous system exclusively, and yet it has retained its epidemic character. As to the exact manner in which such diseases are spread, we have only at present to confess our ignorance, but I would strongly protest against the idea that epidemic disease necessarily implies the existence of a living germ which can exist separate from the body in an independent form. My observation of the spread of influenza led me to compare it to the conduction of electricity, and I believe that of cholera to be of a similar nature. The term "animal magnetism," if it were not already so hackneyed, would perhaps serve to convey some idea of the process. Electricity would seem to be its analogue in the inorganic world. As electricity is conducted by certain materials and not by others, so has the cholera influence its conductors and its non-conductors, among the best conductors being decomposing animal matter and certain organic particles in the air. Disinfectants act, not by killing germs, but by preventing decomposition and by hastening the resolution of these organic particles.

By whatever means, however, the disease reaches the nervous system, its effects are sufficiently obvious. In general terms it may be said that the cerebro-spinal nerves increase the supply of blood in the arteries, and cause secretion, while the sympathetic nerves control and diminish the blood supply.* In cholera, therefore,

* The experiments of Ludwig and Heidenhain seem to show conclusively that those branches of nerves from the cerebro-spinal system which supply secreting organs have two distinct functions—(i) that of increasing the supply of blood by causing the blood vessels to dilate, and (ii.) that of actively promoting secretion, and that these two functions are by no means necessarily dependent on one another. These nerves may be called the "vaso-dilator" and "secretor" nerves; those acting in opposition to them, the "vaso-motor" or "vaso-constrictor" nerves. The latter term is, perhaps, the more definite. By employing these terms we may avoid any expression of opinion as to the actual share taken respectively by the sympathetic and cerebro-spinal nerves in the various functions referred to—a subject not yet fully worked out.

it would appear that in the first place the vaso-dilator and excretor nerves supplying the alimentary canal are unduly stimulated, and overpowering the vaso-constrictor nerves cause an abundant and morbid secretion. The "algide," or cold stage, of cholera would be due to an equally violent action of the vaso-constrictors, either primary or as a result of reaction from the former condition, or rather of an attempt to overcome the opposing action of the vaso-dilators, the extreme coldness of the surface and extremities being due to the absence of blood in them on account of the powerful contraction set up in the blood-vessels by the vaso-constrictors. This view is confirmed by the appearances after death, for the arterial system and capillaries are usually found almost empty, while the whole nervous system is gorged with blood.

In any case, whether it be primarily or secondarily affected, it is the nervous system that we have to deal with, and it is only by controlling the nerves of secretion and dilatation in the first stage, and those of constriction in the second, that we can hope to exercise any influence on the disease. It is evident that in this disturbed condition of the nervous system everything which tends towards its further stimulation or excitement, whether through the mucous membranes, the skin, or the muscular system, must be avoided. Perfect rest, abstinence from solid food, and keeping up the temperature of the body are, therefore, indicated both by experience and common-sense. These measures, however, are not directly curative, but will, perhaps, in some cases, give Nature the opportunity to shake off the disease. And they can be taken before medical assistance arrives, which should be at once applied for in all cases of diarrhœa, however slight and painless, during a cholera epidemic. For the actual control of the diarrhœa we must depend upon opium. This is the only drug equal to the

emergency, and all remedies which have gained any deserved reputation for checking cholera have opium for their basis. Chlorodyne, which contains morphia mixed with stimulants and with other sedatives, is better suited to some constitutions, but is far less certain in its action. We are now in the borderland between *prevention* and *cure*, beyond which we must not pass, but the preliminary stage of cholera is debatable ground; for we cannot say with certainty whether these symptoms indicate the actual commencement of the disease, or only a condition favourable to its reception. In any case the above measures may be taken. But what besides? It has been recommended by some that opium should also be at once resorted to in large doses.* But so dangerous a drug is opium in inexperienced hands, so much watching does its action require, so differently does it sometimes act with different people, and so especially poisonous is it to young children, that it seems almost preferable, except under very unusual circumstances, to wait a little longer and have recourse, as soon as possible, to Abernethy's well-known remedy, viz., "advice." In remote districts valuable time may thus be lost; but in towns, if the first symptoms be watched for and attended to as above indicated, medical assistance can usually be obtained in time to apply any further treatment that may be necessary. The danger above alluded to does not apply, of course, to those addicted to eating opium or injecting morphia, but in these cases the drug would probably be entirely useless, if not harmful, stimulating the nervous system instead of quieting it. In the second or cold stage, too, of cholera, opium is positively injurious. The application of heat and of cold to the spine are remedies which have been shown to exert a considerable effect on the nervous system.

* *i.e.* thirty drops (half a teaspoonful) of laudanum for adults, and for children the equally strong dose of one drop for each year.

The latter appears to have some effect in diminishing secretion, but it acts chiefly as a sedative to the vaso-constrictor nerves, and may, therefore, possibly, if my view of the pathology of the disease is correct, be found of service, in conjunction with other more direct methods of restoring the temperature, in the cold stage ; but this is beyond the province of *prevention*, and the remedy, though worth a trial, seems hardly so well adapted to the treatment of the preliminary symptoms. The important point for all to remember is not to neglect, during an epidemic of cholera, those insidious attacks of diarrhœa which are so often warnings of the graver disease.

23. Conclusion.—In discussing this question of the origin and prevention of epidemics, I have confined myself almost exclusively to the three great scourges of mankind—plague, typhus, and cholera—as these may be considered types of epidemic disease generally, and their various causes will include the causes of nearly all other diseases which assume an epidemic form. The knowledge of such causes is the great aim of the study of preventive medicine. If the causes are known, the means of prevention will readily suggest themselves. That epidemics still prevail so largely is partly due to the fact that their causes are still to a great extent unknown ; but it is also partly because there are causes which are beyond the power of man to control or modify. There are, no doubt, assailable and unassailable causes ; but if the assailable causes only were known, it would make a vast difference to the mortality of the human race. The history of plague appears to show that some, at least, of its causes were beyond control. The history of typhus, on the other hand, shows that it can be almost entirely stamped out, and that its causes are to a very large extent assailable ones. The history of

cholera has yet to be written; but its geographical origin is known, its causes are being traced, and some progress has already been made towards its prevention. The same may be said of the more familiar diseases, diphtheria and scarlet fever, the principal causes and the exact geographical distribution of which in our own country can now, it may be hoped, by means of the information resulting from the Act for the Compulsory Notification of Infectious Diseases, be traced with considerable accuracy. In small-pox no such result is to be looked for. This disease has been largely shorn of its terrors; not, however, by the discovery and removal of its causes, but by a compromise and a substitution. Beneficial as vaccination has been in saving and prolonging human life, it has, by artificially preventing or masking the disease, also prevented the possibility of ascertaining its ultimate causes. The causes which produce small-pox may be still constantly in existence, but they are unable to bring about their natural results, and it is therefore impossible to trace them. We can hardly expect to discover the actual causes of small-pox while vaccination continues, and perhaps, if the latter is efficiently carried out, there may be no necessity to do so. It appears more scientific to trace and remove the causes of an evil, but perhaps we must sometimes be contented to leave the causes alone, and endeavour to minimise the results.

The spirit of Positivism, of Materialism, and of Utilitarianism permeates to a large extent the whole field of modern science and literature. Especially is this the case with medical science and literature. The tendency is to ignore all that cannot be examined by the light of recent observation and weighed in modern balances, to limit the field of research to the field of vision. Individual facts, individual cases, individual specimens, are the objects of attention, and even collec-

tive investigation has failed for want of support. Pure experimental science claims all our devotion: the worship of the practical is the order of the day. Yet there are certain directions in which the study of disease, conscientiously and comprehensively pursued, traverses the bounds arbitrarily set by the systems above referred to. The origin of disease, like the origin of life, is still enfolded in mystery. Not only are there, as Shakespeare says, more things in heaven and earth than are dreamt of in philosophy, but there are more things in earth alone than can be explained by modern science. Physical science will sometimes, however much we determine to avoid it, verge upon the metaphysical.

(a) FINAL CAUSES.—In the first place we are met, whether we will or no, by the consideration of Final Causes. It is not the part of the student of medicine, like the natural theologian, to employ the teleological argument to prove the existence of a First Cause. But the former, although he may not admit it, even to himself, constantly employs the teleological argument *backwards*. He does not argue from adaptation to design, but from design to adaptation. Many of the great discoveries in physiology and pathology, perhaps even including that of the circulation of the blood, have been brought about by this method of reasoning. It is certainly not uncommon for the physiologist or the pathologist to *assume* design before formulating any hypothesis on which to form a basis for his researches; and if he does this he has stepped outside the limits of the positive philosophy. The old-fashioned watch-argument, as it is called, *may* be a fallacious one, but its converse has before now led observers to right conclusions. It is part of a true scientific method to search for the object and adaptation of organs and functions, and to pursue the inquiry into the ultimate causes of phenomena, wherever it may lead us, unde-

tered by the artificial boundaries set by exclusive systems. It is as unscientific to be restrained in the search for truth by the dogmata of positivist bigotry as by those of religious bigotry.

(b) FINAL ENDS.—There remains, too, in the study and treatment of disease, notwithstanding all our professions of practical utilitarianism, a spirit of striving after an unattainable ideal, which rises superior to all human experience, and thus transcends the bounds of all purely experimental systems. Especially is this the case in relation to the subject now before us. This optimistic spirit is essential to the existence of the healing art, and, though often not conspicuous in individuals, exercises, collectively, a very great influence, and carries us beyond the limits of the present to the possibilities of the future, keeping alive the ardour of research and the hope of progress.

The final object of those engaged in the study of epidemiology and preventive medicine is to sweep off epidemic diseases from the face of the earth. This they will never succeed in doing. But the ideal must be kept constantly in view, and it is by the search after this unattainable ideal that the mind of man is kept in a state of health and vigour. The ultimate aim of the study of medicine, said the late Dr. George Wilson, "is the realisation of immortality for man." And although this end is never attained, and is being daily defeated by the death of patients we had hoped to save, the true clinical observer does not give way to despair, but continues to pursue the struggle against death with increasing earnestness. Thus, alone, will real progress be gained. It is the personal search for truth which keeps alive man's intellectual being, as it is the personal struggle for food which keeps his physical being in health. If all our aims, physical and intellectual, were attained, we should soon sink to the condition of mere animal

parasites from stagnation of mind and body. "I dread for humanity," says M. Renan, "the day when knowledge shall have penetrated all its strata. Whence, then, would come the instructive sentiments—bravery which is so essentially hereditary, that noble love which has nothing to do with reflection, all those thoughts which are not to be accounted for, which are in us and yet independent of us, and form the best part of the appanage of a race and of a nation?"

M. Renan's dread for humanity is a purely visionary one. There is certainly no immediate danger of knowledge penetrating all its strata. Whatever it may accomplish in other branches, we *know* that in *one* its end is unattainable. Had Monsieur Renan entered upon the field of pathological research, his fear of human omniscience would soon have disappeared in view of the magnitude of the inquiry, and the incompleteness of the results which the human mind, during a period of more than 4,000 years, has been able to bring about.



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