

NATIONAL SECULAR SOCIETY

STATE MEASURES

FOR THE ABOLITION OF

Poverty, War, and Pestilence.

CONTAINING THREE ARTICLES, (THE TWO LAST REPRINTED FROM
THE "NATIONAL REFORMER"):

STATE REMEDIES FOR POVERTY;
CAN WAR BE SUPPRESSED?
AND
THE EXTINCTION OF INFECTIOUS DISEASES.

BY

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"Poverty, in any sense implying suffering, may be completely extinguished by the wisdom of society, combined with the good sense and providence of individuals."—*John Stuart Mill*.

"In civil society, either law or force prevails."—*Lord Bacon*.

"Man has it in his power to cause parasitic diseases to disappear off the surface of the globe, if, as we firmly believe, the doctrine of spontaneous generation is a chimera."—*Louis Pasteur*.

STATE REMEDIES FOR POVERTY.

I WOULD here add, to what has been said in previous editions,* a few remarks on a subject of the utmost possible importance. It is a subject which has hitherto been little discussed, but on which many have doubtless, like myself, thought long and anxiously, and which seems to me urgently in need of an earnest consideration. However strongly opposed to the prevailing opinions and sentiments, it will sooner or later, I believe, become the most momentous of practical questions in every country of the world. I refer to the endeavour to extinguish poverty by *direct legal enactment* in the only way in which this could possibly be done, namely, by means of a statute limiting the size of families, and forbidding anyone, whether rich or poor, to have more than a certain small number of children.

Mr. John Stuart Mill, the great thinker whose loss we deplore, was strongly in favour of such a measure. He says in his Political Economy, "It would be possible for the State to guarantee employment at ample wages to all who are born. But if it does this, it is bound, in self-protection, and for the sake of every purpose for which government exists, to provide that no person shall be born without its consent." In another work, in a vindication of the French Revolution of 1848, he says, "The practical result of the whole truth might possibly be, that all persons living should guarantee to each other, through their organ, the State, the ability to earn by labour an adequate subsistence, but that they should abdicate the right of propagating the species at their own discretion and without limit; that all classes alike, and not the poor alone, should consent to exercise that power in such measure only, and under such regulations, as society might prescribe with a view to the common good. But before this solution of the problem can cease to be visionary, an almost entire renovation must take place in some of the most rooted opinions and feelings of the present race of mankind." And, again, he says in his Political Economy, "If the opinion were once generally established among the labouring classes that their welfare required a due regulation of the numbers of families, the respectable and well conducted of the body would conform to the prescription, and only those would exempt themselves from it who are in the habit of making light

* These remarks were first inserted in the edition of the "Elements of Social Science," which appeared in 1878.

of social obligations generally ; and there would be then an evident justification for converting the moral obligation against bringing children into the world who are a burden to the community into a legal one ; just as in many other cases of the progress of opinion, the law ends by enforcing against recalcitrant minorities, obligations which to be useful must be general, and which, from a sense of their utility, a large majority have voluntarily consented to take upon themselves. There would be no need, however, of legal sanctions, if women were admitted, as on all other grounds they have the clearest right to be, to the same right of citizenship with men. Let them cease to be confined by custom to one physical function as their means of living and their source of influence, and they would have for the first time an equal voice with men in what concerns that function ; and of all the improvements in reserve for mankind, which it is now possible to foresee, none would, in my opinion, be so fertile as this in almost every kind of moral and social benefit." I venture to think that even if women were admitted to the suffrage, and other just rights and privileges of citizenship, there would still exist the most weighty reasons in favour of legislation on this subject.

The great reasons for such an enactment seem to me to be that *a law to regulate population, if duly carried out, could of itself with certainty remove poverty and overwork* ; that no other law, or laws, could do this, and that the force of public opinion, and the conscience and self-interest of individuals are not strong enough, without the aid of law, to accomplish so vast an object. What is indispensably needed for the extinction of poverty is a restraint on population so powerful and general as to *remove the excessive pressure on the soil* ; in other words, by diminishing the demand for food, to enable the margin of cultivation to recede to a sufficient extent, the worst soils to be thrown out of tillage, and the land altogether to be less highly and expensively cultivated. In this way the productiveness of labour would be increased, and wages would rise, while at the same time there would be a reduction in the working hours, and in the cost, and, therefore, the price of food. The country would then be placed somewhat in the position of a new colony, for the essential difference between an old country and a new colony is that in the former population is pressing too heavily on the productive powers of the land. Now it appears to me that a reform of such vast extent and difficulty as this, requiring the co-operation of the whole of society, will never be adequately carried out without the assistance and deliberate sanction of the Government. When the increase of population is left solely to the discretion of individuals, the moderation and self-restraint of some are counteracted by the recklessness and improvidence of others, and thus the overcrowded state is constantly kept up. Even in France, where prudence is most general in this respect, there is still immense over-population ; as may be seen by the miserably low rate of wages in many

employments, and the high average price of provisions. It is a fact, thoroughly established by science, that large families are the real cause of low wages and dear food in old and civilised countries, and there can be no doubt that Government has the power, if it only has the will, to suppress the source of the evil, and thereby remove the effect. Anything else which Parliament can do to raise wages must be merely *indirect*, and can only attain its object by the circuitous means of acting on the general intelligence and independence of the people, and inducing them to limit their numbers. Why then should we always be content with indirect and inadequate measures? Why not go at once to the root of the matter, and grapple with the main cause of poverty and pauperism, with the earnest resolution to put an end to them? It seems to me that this question is sure to be asked before long by the working classes and social reformers, when the chief cause of poverty becomes widely known, and is no longer a matter of dispute. The great idea lying at the root of the socialist and democratic doctrines which have spread so widely of late years, especially on the Continent—an idea which I believe to be profoundly true—is that mankind form a community whose interests are bound up together, and who should mutually aid one another, and insure one another, as far as possible, against the ills of life; that society should have an equal care for the happiness of all its members, and should see that all are duly provided for; that therefore it is the duty of society, through its organ, the Government, to take energetic steps for the removal of poverty, and to *guarantee* to every individual who is willing to work, an ample subsistence in return for his labour. Now, a law to regulate population is in reality the *only law* by which it is possible for the State at once and directly to do away with poverty, to shorten the hours of labour, and to raise wages to a satisfactory amount; and if it be true, as was maintained by the Provisional Government of France in 1848, and was inscribed in the project of a constitution, that the State ought to guarantee subsistence and employment to all who are willing to work, such a law is the only means by which the object could be effected. Ought not then the State to adopt this one and only means for ensuring to all a comfortable subsistence? Should we not choose the most direct and certain path to deliver our society from the fearful evils of poverty and pauperism? For my own part, I cannot but entertain a deep conviction that such a law is quite legitimate in the extraordinary difficulties arising from the population principle. I think that it would, if enacted, be the most important to human happiness of all possible laws, and that it will sooner or later be laid down as the very foundation and corner-stone of society, in all the civilised countries of the old world.

It will be said that a measure of the kind described is far too sweeping an innovation, and too despotic an interference with personal liberty to be ever seriously contemplated. But those

who rely on such objections would do well to consider attentively the actual state of the facts. The truth is, that population is *already* so powerfully restrained by prudential motives in this and many other countries, that a little more or less of restraint is a matter of much smaller importance, and would be far less felt, than is often supposed. Immense numbers of people, perhaps the majority of society, are obliged at present by their circumstances to exercise so much caution in regard to marriage and offspring, that it would not make the slightest practical difference to them whether a Malthusian statute were in existence in the country or not. To those who are forced to lead a life of celibacy, the change would bring a positive increase of freedom, for if there were no excessive families, a much greater number could marry. The only persons whose liberty would really be interfered with are those who have large families, and in their case the operation of the law would for the most part be the greatest possible blessing to *themselves* as well as to the rest of society. It is no one's real interest in an old and over-peopled country to have a large family. Children, when too numerous, are a source of intolerable difficulties and anxieties among the rich quite as much as among the poorer classes; and it is a remarkable fact that in France and many other countries it is the rich, and not the poor, who most carefully limit the number of their offspring. We see, therefore, that the question does not really lie between liberty and restraint, but between two degrees of restraint, one of them unjust and partial in its action, inefficient, and attended by the most widespread sufferings, and the other, which would be just and efficient, and which would not be practically felt by most people as any increase of restriction, but only by those who would themselves be immensely benefited by the change. I believe that the abolition of poverty, the mightiest of all social revolutions, could be quietly and peacefully effected by this means, with only such an amount of interference with personal liberty as would be comparatively little felt as a positive evil. Moreover, poverty *cannot possibly* be got rid of without an increase in the preventive check to population. It is in vain to wish that there were no poor, and yet object to a further limitation of the size of families; if we will the end, we must will the means to attain it; and if, therefore, society must of an absolute necessity submit to an increased restraint in order to effect this grand purpose, what real difference does it make whether the restraint comes from law, or from public opinion, or from the conscientious feelings, or the interests, or the circumstances of individuals? Another very important matter to be taken into account is, that legal restrictions on population *actually exist at present* in many continental countries, and even in England. Mr. Senior, as quoted by Mr. Mill in his Political Economy, says that in the countries which recognise a legal right to relief, "marriage on the part of persons in the actual receipt of relief appears to be everywhere prohibited, and the marriage of

those who are not likely to possess the means of independent support is allowed by very few." In Norway, Wurtemberg, Bavaria, Frankfort, several Swiss Cantons, and some other parts of the Continent, no one is permitted to marry unless he can show that he has a fair prospect of being able to maintain a family; while in England, by a provision of the poor-law, husband and wife are separated in the workhouse. Now these laws, however excellent their intention, and however efficacious they may have been in diminishing poverty, do not seem to me strictly in accordance with justice, for two reasons: in the first place, because they prohibit *marriages*, instead of prohibiting (what alone, it appears to me, the Legislature can justly restrict) *large families*; and, secondly, because they apply only to the poor, and not to all classes of society alike. The existence of such enactments shows that a statute to regulate population would not introduce any new principle (since restrictions on marriage are really restrictions on population), but would merely be the extension to the community at large of a law which exists in this and other countries in regard to certain classes, and which, in my opinion, is unjust so long as it is confined to them, and is thus only a law for the poor and not for the rich. Is it just that all the restrictions should be laid on the poor or the paupers, when the whole of society has a share in the production of poverty and pauperism? Again, as to the objection that such a statute could never be enforced, we must remember that it could not possibly be enacted without an immense deal of discussion, and till the majority of the nation were strongly in its favour, and that the majority would not seek to impose any obligations on others which they were not ready to submit to themselves. It may, perhaps, be added that it would be possible to make the limit of families rather a high one—perhaps four children as the maximum—since very many would not reach it, and the penalty could be slight, as the great object of the law would be to guide and strengthen public opinion, and the dictates of individual prudence and conscience, and not by any means to supply their place. The mere discussion of the subject would be of incalculable value, and would spread a knowledge of the population truths over the whole country.

Had the population question been openly discussed, so that all might understand it, we should never have seen that perversion of justice by which two of the most gifted of English citizens have been sentenced to fine and imprisonment for seeking to benefit the poor—for earnestly considering the cause of low wages, as laid down by political economy, and pointing out the means by which, in their belief, poverty could be removed from society. It is the duty of all to meet, and not evade, this question. More especially is it incumbent on those who prosecute others to state plainly their own views on the subject. When a remedy for human miseries is put forward, not as a good in itself, but as *the least of several alternative evils*, one or other of which is necessary

and inevitable, those who condemn it are bound to say which of the other alternative evils *they* think preferable. As there must always exist a most powerful check to population, either positive or preventive, in old countries, the question to be determined is, which of the various forms of the check is most consistent with the happiness and well-being of mankind? This is the real point at issue, and opponents are bound to consider it most carefully, and to show, if they can, that some other mode of dealing with the terrible difficulty of population is better than the one proposed. Now there are several different ways in which the population difficulty may be dealt with by those who disapprove of preventive measures. People may either ignore it altogether, as the vast majority do, and go on blindly striving to remove from society *all* the checks to population, or permanently to diminish any one of them without a proportional increase of some of the others—objects which Mr. Malthus, eighty years ago, showed to be quite unattainable by human effort. Or they may deny the truth of the law of population, and contend that man's choice is not limited to one or other of the checks to increase, and that poverty is not the result of too rapid multiplication. Or they may hold that the existing checks, poverty, prostitution, and celibacy, are preferable to preventive means; or maintain, with Mr. Malthus, that all the other checks ought to be superseded by an enormous increase of celibacy or sexual abstinence. Or, finally, they may see nothing wrong in the preventive measures—nay, may themselves adopt them—but yet hold that the subject ought not to be spoken of or discussed in writing; an opinion which is, I believe, very common, but which cannot be sustained; for if it be morally right to use these means, they *must* be carefully considered by physicians and others, so as to learn their influence on human health and happiness, and to free them, as far as possible, from any injurious consequences. One or other of these views must be held by opponents, and they are bound to state clearly and openly which of them they *do* hold. This, however, has not been done by the prosecutors or their counsel, and hence those who honestly meet and try to solve the greatest of human difficulties are attacked and threatened with legal penalties by those who evade it altogether, and therefore do not give any real grounds to justify their condemnation. For the moment the attempt has been defeated by the heroism and eloquence of Mr. Bradlaugh and Mrs. Besant, and the heart of every true friend of the people is with them, and with Mr. Truelove, in their steadfast defence of the population doctrines and the liberty of the Press—one of the greatest services ever done in any country to the poor and to humanity at large.

CAN WAR BE SUPPRESSED?

How long is war with its countless list of horrors and miseries to continue among us? Every one must feel that war is an appalling evil and blot on civilisation, and must earnestly desire that means could be taken to put an end to it. War is lawlessness; it is an appeal to might instead of right, in which parties decide their own quarrels by force of arms, instead of submitting them to an impartial tribunal to be decided according to reason and justice; and hence it is utterly opposed to civilisation, which seeks to bring all actions under the dominion of law. War stands out alone, as an exception and a fearful remnant of barbarism in the midst of modern civilised life. But war is not merely lawlessness, it is murder. We can see this from the parallel case of duelling, which is absolutely prohibited and treated as murder by the law of England. "According to the law of England," said Sir John Holker, in a recent trial, "a man who kills another in a duel is a murderer and liable to be hanged." No matter what the merits of the quarrel may have been, whether a man be aggrieved or aggressor, if he fights a duel and kills his opponent he is punished by the law as a murderer. But if duelling be murder, what else is war? War is simply duelling on a vast scale, and with this aggravation, that the crime of robbery, in the shape of annexations, indemnities, and other kinds of pillage, is usually added to that of murder. Moreover, in duelling the principals fight their own battles, and an attempt is made to put them, as far as possible, on a footing of equality; whereas in war, the rulers who give the command for it do not usually themselves fight, and every advantage is taken of superiority in number, skill, and military resources between the combatants. Is it not monstrous that now, after all the progress in humanity, one nation is allowed to attack another, perhaps a much weaker nation, to kill the people and seize their land and their goods? How can the people of England, who have shown their respect for law and for human life in putting down the duel, tolerate war?

Few of the great movements of the age are of such extraordinary importance as that for the suppression of war. The most noble efforts have been made of late years for this end by Mr. Bright, M. Victor Hugo, Mr. Henry Richard, Mr. Bradlaugh and others, and the Peace Societies in England already number several hundred thousand members. Various plans have also been put forward for superseding war and supplying its place by inter-

national arbitration, and these plans cannot be too carefully considered and discussed ; for it is not merely by the general advance of commerce and enlightenment and the growing abhorrence of war among thinking minds, but also, and above all, by the adoption in time of peace of active practical measures to prevent war, that we shall ever be able to free human society from this terrible and immemorial evil.

The more deeply the subject is reflected on, the more clearly I think will it be seen that the real cause of wars is the want of a *supreme and irresistible authority*, which could force the nations to conform to law in their dealings with one another and to settle their disputes by peaceable arbitration. The only effectual remedy for war, as has been well pointed out, is the introduction of *law*—or in other words, of positive rules of conduct, applied by a court of justice, and enforced by a competent authority—into the mutual intercourse of nations. At present international relations are in an essentially lawless state ; there is no code of laws governing nations like that which governs individuals ; for what is called “international or public law” or “the law of nations,” as all writers on the subject admit, is not really law at all, in the legal sense of the word, but merely custom or usage, or else engagement by treaty. Nations may disregard these customs, or break their treaties in particular instances, if they choose to incur the risk of so doing, and they have what is called the “right of making war” on one another and deciding their quarrels by violent means—a right which is utterly subversive of the very idea of law. The essence of law is the *compulsory* adjudication of disputes by an impartial tribunal, and if parties are allowed to dispense with a tribunal altogether and settle their differences for themselves by the sword, it is evident that law does not exist between them. But wherever, in any department of human affairs, law is absent, or cannot be enforced from weakness of the executive, the most fatal consequences are sure to arise. Thus in the Middle Ages, before governments were strong enough to coerce the barons and feudal chiefs, private wars between them as well as national contests were so common that, as Mr. Buckle says, “there was never a week without war.” Even in our own day, when opinion is so much more advanced, if there were no laws regulating the succession to property, the fulfilment of contracts, &c., and if people were allowed to fight for their rights instead of having them determined by a court of justice, society would be a scene of continual bloodshed and confusion. War is the natural and inevitable result of the present lawless state of international relations, and the one and only remedy for it is to extend to nations, as well as individuals, the inestimable benefits of law. But how is this to be done? If we examine the matter attentively we shall find that the element which is wanting to constitute a true legal system between nations, is a supreme authority with adequate executive force. There exists already a code of rules or usages commonly called inter-

national law, which has gradually become better defined and more binding, as well as juster and more humane, in the course of ages; an international tribunal could be established, consisting of judges skilled in public law, and chosen from the different States; but the grand difficulty to be overcome is the want of a supreme authority, to approve and, when necessary, add to the code, and strong enough to compel the nations, however powerful, to carry their disputes before the tribunal and abide by its decisions. It is a sanction, or enforcing authority, of this kind that the international code really needs. "The independent societies of men, called States," says Mr. Wheaton, in his work on International Law, "acknowledge no common arbiter or judge, except such as are constituted by special compact. The law by which they are governed, or profess to be governed, is *deficient in those positive sanctions* which are annexed to the municipal code of each distinct society." If there were such sanctions, war between nations could be crushed out with the same certainty and completeness as the civil wars between the feudal nobles have been extinguished by the growing power of the law courts. The question, How is war to be suppressed, seems to me, therefore, to resolve itself mainly into this other question—How is a sufficient sanction, or executive authority, to be obtained for the law of nations?

We may now turn to the various practical proposals which have been brought forward with a view to the prevention of war, and of which the most important seem to be the following: a *general reduction of armaments*,* a *confederation of States*, and *international armies*. The first of these would be an immense boon if it could be obtained, as it would lighten an intolerable burden on the nations, and also make war less probable, since governments would no longer be so fully prepared for it. But there are evidently most formidable difficulties in the way of carrying out this proposal. The disarmament would need to be *general*, for if any of the great Powers refused to reduce their forces, it would be dangerous for others to do so; and some governments would be particularly averse to disarm, either from unwillingness to give up cherished schemes of ambition or revenge or from the vast size of their dominions and fear of disaffection among their subjects. But even if these difficulties were overcome, disarmament would be only a palliative, and not a cure for present evils. It would still leave arbitration *optional*, whereas the object to be aimed at is that it should be *compulsory*, or, in other words, that law should be introduced in international affairs. "We hold," says Professor Cliffe Leslie, "that only a law of nations in the

* A resolution in favour of a general disarmament by the European States was proposed in Parliament by Mr. Cobden in 1849, and again recently in 1880 by Mr. Henry Richard. The latter also, in 1878, moved a resolution, which was adopted by the House of Commons, in favour of the arbitration of international disputes.

strict sense of the term, can terminate war." Without law, there is not only no guarantee for peace, but no provision for securing *justice*, between nations. Disputes between nations, as between individuals, arise on questions of contested right, or in consequence of injuries received; and if one party refuses to arbitrate, the other must either tamely submit to what it considers an injustice, or go to war to enforce its rights. But war, like the barbarous "trial by combat" in use among our ancestors, can never be a proper test of justice or of right, for a war does not show which cause is just, but only which of the combatants is the stronger. So long, therefore, as Governments may refuse arbitration and may go to war, injustice and lawless force are the final umpires in international disputes, and this must have a profoundly demoralising effect on mankind and their rulers. In order to have either peace or justice it is necessary to introduce law, which would compel arbitration, and secure, even to the weakest among the nations, its rights and redress for its injuries. This, too, is the only sure means for bringing about a disarmament, for the real cause of the enormous armies (amounting at present in Europe alone to about ten millions of men) is the state of general insecurity and licence arising from the absence of law. As there is no law to protect or restrain them, nations arm partly to protect themselves and partly to carry out secret projects of conquest and aggrandisement; and we can scarcely hope to see any satisfactory reduction of armaments till there is a real and effective international law.

How, then, can such a law be obtained? We have seen that what is mainly needed for this purpose is a supreme authority, with adequate executive force to give effect to the present international code, which, as Mr. Cliffe Leslie observes, has the features of law "in its inchoate or rudimentary form." Now there is evidently only one way in which an authority of the kind can be established, namely, by means of a *combination between different States*. Nothing but the combined strength of many States can force single States to obey the law and to keep the peace. The real sanction of the law between individual and individual is the general community of individuals, and in like manner the sanction of the law between nation and nation can only be the community of nations. It seems to me the clearest and most urgent duty of nations to take measures for introducing positive law between them and putting an end to war. Until provision can be made for the legal settlement of international disputes, the responsibility for war with all its horrors rests in great part on the nations generally; and this leads to the utmost confusion of ideas with regard to the criminality of war. One of the most frightful of crimes is not generally seen to be a crime at all. Thus at present wars are commonly divided into *just* and *unjust*, because, in the absence of law, it is sometimes necessary, and even an act of the most heroic virtue in a nation to fight for its

rights and liberties; but if law were once firmly established, and means of legal arbitration afforded, war would simply be a *crime*, to be repressed and its chief authors punished, as in the case of other heinous offences. There would then be only one kind of lawful and justifiable war, namely, that which is analogous to the action of the police, and consists in putting down by force any resistance to the orders of the supreme authority. Not only can and ought the nations thus to put down war as a crime, but it is their most vital interest to do so. At present any nation is liable at some time or other to be involved in war, and even neutrals during a war often suffer most severely; for their commerce and communications are interrupted by blockades, sieges, and other military operations; and, besides, war has a great tendency to spread, and the best efforts on the part of neutral States are often unavailing to prevent their being dragged into it. Why should neutrals submit to these fearful evils and dangers at the hands of belligerents, who are morally bound to arbitrate their disputes, and are therefore committing a crime in going to war?

These considerations are so immensely important that they must, I believe, before long lead to a combination among civilised States for the purpose of preventing war. But States may combine in different ways, either by *alliance* or by a more or less intimate *confederation*; and the great difficulty of the question is to decide which kind of combination is at once suited to effect the object in view and also capable of adoption by existing States. Professor Seeley, in a lecture delivered before the Peace Society, has held that nothing short of a close federal union, like that subsisting between the States of North America, who are all under a common government, would be sufficient; and a similar view seems to be taken by those who advocate, as a remedy for war, the formation of what they term "the United States of Europe." It seems to me, however, that so vast a change as this is neither practicable nor necessary, and that the form of union to be aimed at is one which, while binding the nations very strongly together, would interfere as little as possible with the sovereignty and independence of each. This could best be done, in my opinion, by means of an *alliance, with mixed or international armies*; a proposal which was brought forward some time ago by Mr. Glasse, in the columns of the *National Reformer*, and to which I had myself independently been led on thinking on the subject. The means which I would venture to suggest as best adapted for the prevention of war are the following:—That two or more nations should enter into a close alliance together, unite their armies, and invite other nations to join them, with the declared intention of arbitrating their own disputes in future, and also of putting an end to war throughout the world and compelling all disputes to be settled by peaceable arbitration, as soon as the alliance was strong enough to effect this. The object of such a league would be to sanction

and enforce international law, and compel all disputes between nations to be settled by it, and not by war ; and if only two or three powerful States were thus to ally themselves, it would probably be sufficient in great measure to effect the object, since the alliance could often prevent a war by threatening, in the event of a quarrel between two States, to assist in hostilities against either party which acted *illegally*—or, in other words, which either refused to arbitrate, or, having arbitrated, refused to submit to the judgment of the tribunal. It is to be hoped, however, that in time all civilised nations would join the alliance, so that it would become *irresistible*, and that single States would as little dare to defy its authority as individuals now think of setting themselves against the civil powers. In this manner war would not merely be suppressed, if it occurred, but, what is infinitely more desirable, would be entirely *prevented* from occurring.

A league of the kind here suggested would bind the nations very firmly together by uniting their armies, and yet would not, as it appears to me, interfere materially with their existing rights of sovereignty and independence. One part of the mixed forces could be kept in each country, and would be subject to the national government, as armies now are ; while in all operations external to the country the troops would be under the joint command of the allied powers, and would never be used except against those who refused to settle their differences in a legal and peaceable manner. This, I submit, is the only true function of an army—namely, to defend and enforce *the law*, and not merely, as hitherto, to carry out the arbitrary will of individual governments. An army should be the guardians of international law, as the police are the guardians of the municipal law. Like the police, too, an army should be strictly *impartial*, having nothing to do either with the merits of quarrels or with the parties concerned in them. It should be as culpable for a soldier to show partiality to his own country, at the expense of international law, as for a policeman illegally to favour his personal friends. This impartiality, so indispensable in all officers of the law, would, I think, be best secured by having armies of mixed nationality. Another great advantage of the league would be that the allies could, if they pleased, at once *reduce their forces*, without waiting for other nations to do the same, and without dangerously diminishing their strength ; for they would be able to draw upon the combined armies and resources of two or more countries, instead of one only, for their protection against foreign or domestic foes. It appears to me that in this manner, or by some similar means, a sufficient executive authority could be obtained for the international code ; while any difficult question that might arise, or amendment that might be needed in the code itself, could be discussed and settled, as is now the practice, by conferences or congresses between the different States.

The extension of law to nations as well as individuals, and the

abolition of the barbarous "right of making war," seem to me beyond all comparison the greatest improvements which could be effected in international politics, and would be a glorious triumph of statesmanship. If statesmen of different countries, and among them Mr. Gladstone, who has already done so much for the cause of international arbitration, and who speaks in one of his works of "the rising hopes of a true public law for Christendom," could do something towards the realisation of these hopes, it would be a priceless boon to a world sick of war and bloodshed, and longing for the advent of a new era of settled peace, law, and real brotherhood among mankind.

[The momentous change in our Constitution which has lately been proposed—the setting up, namely, of a Parliament in Ireland, separate from that of Great Britain—is a change in the opposite direction to those suggested above, and would, I cannot but think, be a calamity and great danger to both countries from the clashing of the legislative wills. It seems to me that the object of reformers, all over the world, should be to strengthen and not to relax the legal ties which now bind nations together. Why not rather do our utmost to conciliate the Irish people and to satisfy their legitimate aspirations, while at the same time enforcing obedience to law and maintaining inviolate the Union? a union which has been the source of incalculable benefits to England and Scotland, and also, I am firmly persuaded, to Ireland itself, in spite of the confiscations and hateful penal laws of bygone ages.]

THE EXTINCTION OF INFECTIOUS DISEASES.

OF all the doctrines recently brought forward in medicine, none seems to me so extremely important as that which has been gaining ground with regard to *infectious fevers*, and has been earnestly urged by the highest medical authorities, in particular by Sir James Simpson and Sir Thomas Watson. I allude to the momentous and startling doctrine that by taking proper measures to prevent them, all the purely infectious or contagious febrile diseases might be, and ought to be, *completely and finally extirpated*. The diseases in question have more and more occupied the attention of Parliament and sanitary reformers of late years, and were a leading subject of discussion at the International Medical Congress held a few years ago in London. They form a peculiar class of affections, having the following very remarkable characters in common. They are fevers of a specific kind, most of them attended with an eruption on the skin; they are propagated by infection from one person to another, usually by breathing the exhalations from the sick, and they occur, as a rule, only once in a lifetime. In all of them the minute poison which communicates the disease is immensely multiplied in the body of the patient, and as in this and some other points the fevers have a resemblance to the action of a ferment, they are often called *zymotic*, or fermentation-like diseases.

The late Sir Thomas Watson, in an article on "The Abolition of Zymotic Disease," which was published in the *Nineteenth Century Review*, for May, 1877, and has since been re-issued with others in a separate form, expresses his firm belief that these diseases "might be finally banished from this island," and observes, that with regard to them, "it is of vast importance that the public, no less than the medical profession, should have the fullest attainable knowledge." He thus enumerates the diseases to which he refers:—"They are not numerous," he says, "these zymotic diseases. There are not more than nine or ten of them. Small-pox, chicken-pox, typhus fever, typhoid or enteric fever, scarlet fever, the plague, measles, hooping-cough, mumps—these belong to, and, I think, constitute, the group of diseases now to be considered." Two of the number, chicken-pox and mumps are slight affections, but the others are among the most terrible and fatal maladies that afflict the human race. If we think of the prodigious amount of suffering and death these diseases have caused and are causing yearly—the millions they

have slain, and the panic they spread around them, the danger which a person affected with one of them becomes to his fellow-creatures, and the broken constitutions and disfigurements they so often leave behind even when they spare life, we can form an idea of the immense and incalculable blessing which their extinction would be to mankind.

The great fact which warrants us in believing that these diseases might be entirely extirpated, or "stamped out," is, that whatever their primary origin in past ages may have been, *they never now-a-days arise spontaneously, but are invariably propagated by infection.* They are not merely infectious diseases, but have no other source than infection. "They are communicated from person to person by contagion," says Sir Thomas Watson, "and, as I venture to maintain, arise in no other way; and this quality, with their non-recurrence, forms the key to their supreme interest." Small-pox, for example, never arises except by contagion from a pre-existing case of small-pox, measles from a pre-existing case of measles, scarlet fever from scarlet fever, and so on with the rest. Moreover, they always, to use a common expression, "breed true," propagating their own kind, and no other, and maintaining their characteristic type and features unchanged from generation to generation. Thus measles always breeds measles, and never scarlet fever or hooping-cough; typhus breeds typhus, and never typhoid fever; and each disease runs the same course in the present day, has the same average duration, and presents the same symptoms as it did when first clearly described by the earlier physicians. In the above respects the infectious fevers bear a close and most striking resemblance to the different *species* of plants and animals. We do not know how these species at first came into existence (though we believe them to have been gradually developed from lower forms), but we know that at the present day the individuals belonging to each species always descend from parents like themselves, and never spring up spontaneously. We know, too, that they propagate their own kind and no other; and that, although admitting of some modifications, they adhere tenaciously through the ages to their distinctive form and characters. From their remarkable resemblance to species in these respects, the infectious fevers are often called *specific* diseases; that is, diseases which are like species in their constant characters, and in the fact that they never originate spontaneously.

Now it follows as a necessary consequence from this single and definite mode of origin, that both the infectious fevers and the different species of plants and animals are *liable to extinction* if certain conditions be fulfilled. As they never arise in any other way than by continuous succession, the fevers from diseases like themselves, and the plants and animals from parents like themselves, if the line of descent be entirely broken through at any time, the race perishes and can never re-appear. Many animal and vegetable species have thus perished in the world's history, as the

geological records show us, and some races hurtful to man have been intentionally exterminated over large tracts of country, as, for instance, wolves have been exterminated in England. In order to extirpate a living species all that is needed is to destroy at any given time every individual belonging to it; and, in like manner, to extirpate a form of infectious fever, it would be sufficient that every existing case of it should be *prevented from spreading to others*; if this can once, and once only, be accomplished, the species, or the fever, will become permanently extinct. We see, therefore, that as regards their *preventibility*, no less than their mode of origin, the contagious fevers are a peculiar class of disorders, separated by a broad line of demarcation from others. They are often called "the most preventible of diseases," but the truth is, that their preventibility is of a very different kind from that of other affections. They are not merely preventible, in the ordinary sense of the word, but *extinguishable*, or *abolishable* diseases. Other diseases cannot be extinguished, and for this reason, that we cannot destroy the causes that produce them. We can only *avoid* their causes by the exercise of constant care and vigilance, and if our efforts were relaxed at any time, the diseases would appear again; but in regard to the contagious fevers, as they never arise but from other fevers of a similar kind, it is possible to *destroy* the only causes known to be capable of producing them. Thus, if every existing case of small-pox, typhus, scarlet fever, and the rest, could be prevented from propagating itself to others, these fevers would be definitively extirpated, and no imprudence on the part of mankind, nor any other circumstance, so far as we have reason to believe, could ever revive them. They would then be extinct forms of disease, like the extinct species of plants and animals, and only the memory of them would remain to posterity.

The two assertions here made—that the infectious fevers have no other source than infection, and that therefore, unlike other diseases, they might be finally extirpated—are among the most momentous conclusions ever brought forward by science, and should be thoroughly known to every one. The first of them is the foundation of the other, and has a bearing on human health and happiness whose importance cannot be exaggerated. If it be true that these diseases have no other source than infection, then we may hope by vigorous sanitary measures to stamp them out completely, so that no further anxiety on their account would ever afterwards be needed; but if, on the other hand, besides being infectious, they can also arise spontaneously, or *de novo*, as it is often expressed (that is, from any other cause than infection), not only would their prevention be far more difficult, since we should have to guard against two or more modes of origin instead of one, but we could never hope permanently to extinguish them. The great question, therefore, is—Have these diseases no other cause than infection? This is a point on which the present medical

opinion has been slowly and gradually arrived at. In former times the infectious fevers were very commonly confounded together, and their mode of origin was not clearly understood, but they were often supposed to be due to some unknown atmospheric influence; as may be seen from the fact that even in the seventeenth century the celebrated Sydenham, who was the first to draw the distinction between small-pox and measles, did not know that small-pox is infectious. Afterwards their infectiousness became recognised, but it was thought that they might also proceed from other causes; and lastly, increasing experience and careful observation and reasoning, especially since the publication of Dr. Bancroft's essay in 1811, have led to the modern view that they never in any single instance arise but from infection. This is now the prevalent medical doctrine on the subject, and with regard to many of the diseases above enumerated it is rarely, if ever, disputed.

Thus Sir Thomas Watson says: "As life springs only from preceding life—as, according to the verdict of exact scientific experiment, there is no such thing as spontaneous generation, so, under similar testimony, there is, now-a-days at least, no spontaneous origin of any of these specific disorders." In like manner, in a "Proposal to Stamp out Small-pox and other Contagious Diseases," published in the *Medical Times and Gazette* for January 4th and 11th, 1868, the late Sir James Simpson says, speaking of small-pox: "We would no more expect this known species of disease or poison to originate *de novo* at the present day, under any combination of circumstances, than we would expect a known species of animal or plant—as a dog or a hawthorn—to spring up *de novo* and without antecedent parentage." Dr. Aitken, also, in his "Science and Practice of Medicine," 7th edition, 1880, says, in discussing the origin of scarlet fever: "On this point Dr. Ballard writes most distinctly (and with him I fully agree) that 'thus much is certain, it does not arise spontaneously—no disease of its class ever does.'"

The most convincing argument against the spontaneous origin of any of these diseases is the great length of time during which they may be *entirely absent* from a district, a country, or even a whole continent, until they are introduced from some external source. Indeed, the contagious fevers, like the animal and vegetable species, seem at first to have arisen in certain parts of the world only, and thence to have gradually spread to others, with the progress of human intercourse and the increased facilities of communication, so that in most countries they are not indigenous but imported diseases. Sir Thomas Watson observes that small-pox, though existing from remote antiquity in China and Hindustan, "does not appear to have been known in Europe till the beginning of the eighth century," and that "there was no small-pox in the New World before its discovery by Columbus in 1492. In 1517 the disease was imported into St. Domingo. Three years

later, in one of the Spanish expeditions from Cuba to Mexico, a negro covered with the pustules of small-pox was landed on the Mexican coast. From him the disease spread with such desolation that within a very short time, according to Robertson, three millions and a half of people were destroyed in that kingdom alone." As to scarlet fever, Dr. Aitken says that "the earliest source of the poison is distinctly traceable to Arabia," and adds that "measles was first noticed at the same time and in the same country as scarlet fever, and the two diseases have subsequently followed nearly the same course. They now prevail all over the world." Of hooping-cough (which is not, like the others, a fever) he says that "its origin is not beyond 1510, when it was endemic in Paris; but its epidemic character was not determined till 1580. That most fatal of all epidemic maladies, the plague, had till within the last forty years its chief home in Egypt and other countries bordering on the Levant, from which it repeatedly spread to different parts of Europe, committing fearful ravages. In the middle of the fourteenth century it is computed to have carried off, under the name of the "Black Death," from a fourth to a third of all the inhabitants of Europe; and in 1665, the date of its last appearance in our country, the "Great Plague of London" was fatal to 68,596 persons out of a population amounting at the time to about half a million. The prolonged absence of a contagious fever is best seen in *islands*, and *isolated places* on the mainland, to which infection is less readily carried; and among many remarkable instances of the kind on record, there is one which has often been cited in the recent history of measles. There was no measles in the Faroe group of islands on the north of Scotland, for sixty-five years previous to 1846, at which date it was imported into them by a man affected with the disease. It spread from him with vast rapidity (as usually happens when measles or small-pox is introduced among a population, few or none of whom are *protected* by having had it before), so that within six months, out of the 7,782 inhabitants of the islands, more than 6,000, old and young alike, suffered from the complaint.

Now, if any of these contagious fevers were capable of arising spontaneously, why did they not show themselves during the long periods just referred to? Why was there no small-pox in Europe till the eighth or in America till the sixteenth century? Why has the plague been unknown in England since 1665, or, since 1844, even in Egypt, which was formerly looked upon as its peculiar home? Why was measles entirely absent from the Faroe islands between 1781 and 1846? It cannot be said that surrounding circumstances were unfavourable—on the contrary, as events proved in regard to measles and small-pox, they were extremely favourable to the existence and propagation of the diseases. Why, then, did the latter not make their appearance? The answer evidently is, that they did not appear because there

was no antecedent case present to produce them by infection, and these diseases are as little capable of arising from any other cause than *infection* as a plant can spring up except from a seed, or an animal except from an egg.

The argument against the spontaneous origin of the infectious fevers, drawn from the great length of time during which they may be absent from particular countries or localities, until introduced from an external source, is so convincing that, when taken along with the results of daily experience, it has led to a very general agreement among medical men with regard to many of these diseases. Thus, of the six principal kinds of infectious fever now existing among us—namely, *small-pox*, *measles*, *scarlet fever*, *hooping-cough*, *typhus fever*, and *typhoid* or *enteric fever*—the first four are almost universally admitted never to arise spontaneously at the present day, but to be propagated solely by infection. On this point I may quote, in addition to the high authorities already given, the opinion of Dr. Karl Liebermeister, who says, in his introductory essay on Infectious Diseases, in Ziemssen's "Cyclopædia of the Practice of Medicine" (1875): "The spontaneous origin of small-pox, measles, and scarlet fever could scarcely find a defender now." Mr. Jonathan Hutchinson observes also, in his article on Constitutional Syphilis, in Reynolds' "System of Medicine:" "Like small-pox, scarlet fever, measles, and the others in this group, syphilis is communicable from the diseased to the healthy, and can be produced by no other means." One of the few who still advocate the doctrine of a spontaneous origin is Dr. Charlton Bastian; but he admits nevertheless, in speaking of "hooping-cough, measles, scarlet fever, and small-pox," that "the knowledge we possess concerning the mode of origin of these, otherwise than by infection, is almost *nil*."

With regard, however, to the origin of the two remaining fevers, *typhus* and *typhoid*, and especially the latter, there is, unfortunately, not yet the same general agreement; and as these fevers are exceedingly important from their frequency and fatality, they deserve particular attention. In their outward appearance the two diseases are very much alike, being long-continued fevers, with obscure, though different eruptions, and attended with great prostration and delirium—typhus lasting from two to three weeks, and typhoid fever about a week longer. Owing to their external resemblance, they were always confounded together till within the last thirty or forty years, and were thought to be merely modifications of the same disease, as other fevers had been previously; but the labours of several eminent observers, among whom Sir William Jenner holds a conspicuous place, have shown them to be quite distinct. In the Registrar-General's Reports of the causes of death in England they were first separated in 1869. The chief difference in their symptoms is, that in typhoid fever there is always present an inflammation and ulceration of some of the intestinal glands, accompanied by a peculiar

and copious diarrhoea lasting for several days, which intestinal affection is not found in typhus. For this reason, and also to avoid the confusion arising from the similarity of the names, typhus and typhoid, the latter disease is now more suitably called *enteric*, that is, intestinal fever.

But the difference between the two diseases which is most important with a view to their prevention is in the mode of their infectiousness. Typhus fever, like small-pox, scarlet fever, measles, and hooping-cough, is propagated *directly* from person to person by breathing the air which surrounds the sick; but enteric or typhoid fever is very little, if at all, communicable in this way. It is spread, as it were, in an *indirect* manner by means of the discharges from the bowels, not in their fresh state, but some time after they have left the body of the patient, and when they are in the form of *sewage*, undergoing decomposition or putrefaction. These discharges, by oozing from drains or cesspools, find their way through the soil into the drinking water, and are swallowed, or else the effluvia rising from them are inhaled, and thus the disease is communicated. Another terrible epidemic disease, Asiatic cholera, is also held, on carefully considered grounds, to be propagated mainly in this indirect manner by means of the decomposing bowel discharges of the sick. From the obscurity attending its mode of propagation, the infectiousness of typhoid fever, as of cholera, was long doubted or denied, and is difficult to trace in large towns, where the houses are connected together by a network of drains; but in country places it is much more evident. Cases have again and again been observed in which typhoid fever has been imported by persons affected with it into country villages where it had not previously been known for years, perhaps not within human memory, and the disease has spread from them as from a centre—facts which conclusively demonstrate its infectious nature.

Few, if any, now deny that typhoid fever is infectious; but the question has of late years been repeatedly debated, whether infection is its *only* cause, or whether it can also arise spontaneously or *de novo*, that is to say, from any other cause than infection? Dr. William Budd has urged with particular force and ability the former doctrine, and his conclusions have been very widely accepted among the medical profession. He holds the view just explained, that typhoid fever is usually due to poisoning by *sewage*, but that, whenever sewage acts in this virulent and deadly manner, the reason is that it contains the stools of typhoid patients. Ordinary sewage not containing typhoid stools has, he contends, no power whatever to produce the disease. On the other hand, the doctrine that typhoid fever is sometimes generated spontaneously has been advocated by the late Dr. Charles Murchison, in an elaborate and most valuable work on "The Continued Fevers of Great Britain" (2nd ed., 1873). Dr. Murchison gives numerous cases showing that typhoid fever is communicable from the sick to the healthy—a conclusion which, he says, "with such facts before

us, it is impossible to deny;" but he also holds that the disease is sometimes produced afresh by a poison derived from ordinary sewage not containing any admixture of typhoid stools. He says: "It may be generated independently of a previous case by the fermentation of faecal and, perhaps, other organic matter;" and this is an opinion which is shared by many other medical men. According to Dr. Murchison, moreover, the poison of typhus fever, a highly and unmistakeably infectious disease, is sometimes "generated *de novo* in the exhalations of living human beings, by overcrowding and bad ventilation," especially in circumstances of great poverty, dirt, and insufficiency of food; but this view has, I think, met with comparatively few supporters in this country.

In his article in the *Nineteenth Century*, Sir Thomas Watson vigorously combats Dr. Murchison's views on these two points, and endeavours to show that neither typhus nor typhoid fever has ever any other source than infection. The extreme importance of this question can be readily understood. Our power to prevent a disease depends on our knowledge of its *cause*, and it seems to me that the question whether infectious disorders can also arise spontaneously is in reality the most important of all questions relating to the causation of disease, from the vast practical consequences involved in it. In all efforts to prevent and eradicate infectious diseases, the question of their spontaneous origin presents itself, and few subjects in medicine have been so long and so vehemently debated. It was discussed several hundred years ago with reference to the plague, and within the present century the controversy has been renewed again and again, not only in regard to every one of the contagious fevers already enumerated, but also to many other contagious maladies, among which I may mention *Asiatic cholera*, *yellow fever*, *relapsing fever*, *diphtheria*, *syphilis*, *hydrophobia*, *glanders*, and *malignant pustule*. The very same question has been often discussed as regards the principal contagious diseases of the domestic animals, namely, *rabies*, *glanders*, *anthrax* or *splenic fever* (which produce respectively, when inoculated on man, the very fatal affections of hydrophobia, glanders, and malignant pustule), the *cattle plague*, *pleuro-pneumonia* or *infectious lung disease*, *sheep-pox*, *swine plague*, and *foot and mouth disease*. If we take these eight diseases in man, along with the six infectious fevers prevalent among us, and also the plague, which still exists in some countries, they form together *fifteen* affections of the utmost gravity, besides *eight* most destructive disorders of the domestic animals, the cause of almost all of which is held very widely, and of many of them nearly universally, by the best medical and veterinary authorities, to reside in contagion alone, while our hopes of preventing and extinguishing them are inseparably bound up with the question whether or not they can also arise spontaneously. If they are propagated by contagion alone, their prevention is much easier, and their extinction is possible; but if, unfortunately, they can also arise in other ways,

their prevention is far more difficult, and we cannot hope to extinguish them. A few years ago, Professor Tyndall, as chairman at a lecture delivered by Dr. Corfield, pointed out the extraordinary importance of the doctrine that infectious fevers "breed true," and never arise spontaneously. He said that "he entirely agreed with all that the lecturer had stated as to these diseases 'breeding true,' for they never found the virus of small-pox producing typhoid, or *vice versâ*. The subject was one of the most important which could engage the attention of the scientific physician, for in the whole range of medical art and science there was not a subject of equal importance. But in applying to daily practice this question of infectious diseases, the physician must not stand alone—he ought to be aided by the sympathy of an enlightened public." On another occasion Professor Tyndall quoted on this subject the words of the famous French chemist and experimenter, M. Pasteur, who says, "Man has it in his power to cause parasitic diseases to disappear off the surface of the globe, if, as we firmly believe, the doctrine of spontaneous generation is a chimera." The question as to the spontaneous origin of infectious diseases has been so long under discussion, without being yet decided, that there must evidently be something very difficult in its settlement; and as it is a question of such vital interest to human happiness, I may perhaps be permitted here to refer very briefly to the arguments which Dr. Murchison brings forward in favour of the spontaneous origin of typhus and of typhoid fever.

I may remark, in the first place, that in order to prove an infectious disease to be capable also of arising spontaneously, it is necessary to show one of two things—either that in a certain case or cases infection cannot be the cause of the disease, or else that some other influence, such as overcrowding or bad drainage, has produced it. In other words, it is necessary to prove either the *negative* proposition that the disease in some cases does not arise from infection, or the *positive* or affirmative proposition that it does arise from some other given cause.

Now in seeking to establish the first or negative proposition, the main argument which Dr. Murchison uses is that several cases of typhus and of typhoid fever, whose circumstances he relates, could not, on careful enquiry, be traced to any exposure to infection as their source. There was, he says, "no evidence of infection" to be found in the history of these cases. But this argument, which has always been the one most strenuously urged in such discussions, is admitted by Dr. Murchison himself to be quite fallacious in regard to small-pox. He recognises the well-known fact that in certain cases of small-pox, as indeed of all infectious disorders, no evidence of infection can be found, and yet he holds that small-pox never arises spontaneously at the present day. Speaking of infectious diseases, he says: "Some of them, such as Variola (small-pox), are not only extremely contagious, but at the present

day can never be traced to any other cause than contagion. Whole continents, such as America and Australia, have remained exempt from them until they were introduced by an infected person. It is true that now and then we cannot trace even these diseases to contagion." If then the argument is admittedly of no avail to prove that small-pox can arise spontaneously, why should it be relied on in other infectious complaints? How can that be a good argument for typhus or typhoid fever which is allowed to be a bad one for small-pox?

In answer to this obvious question, Dr. Murchison says that there are many more cases of typhoid fever than of small-pox which cannot be traced to contagion. This, however, is probably to be accounted for by the very obscure and indirect mode of propagation in the former disease, and there is reason to believe that the number of unexplained cases will diminish as we gain a fuller knowledge of the different channels or vehicles by which the infection may be conveyed.

We can easily see how unreliable is any argument founded merely on negative grounds like the above when we consider the extremely subtle and insidious nature of the poisons that give rise to the infectious fevers. These poisons are invisible, they can be carried long distances and kept, under favourable circumstances, for an indefinite time, and moreover they can be communicated, not only by the patient himself, both during his illness and his convalescence, but by everything that has been in his neighbourhood. A person suffering from an infectious fever exhales constantly into the air a multitude of extremely minute *infectious particles*, which cling tenaciously to all the surrounding objects and persons, and can be transmitted by them. There are thus three ways in which these fevers can be communicated: either by the *patients*, by tainted or contaminated *objects*, or by tainted *persons*; the tainted objects, or "fomites," as they are often called, acting simply as carriers of the poison, while the "tainted" or "suspected" persons act not only in this way, but also as themselves perhaps infected with the disease and already suffering from it in its latent or incubative stage. When we add to this that the little infectious particles can be transported to a great distance in clothing, bedding, furniture or other goods, drinking water, milk, etc., as well as by persons, and that if kept from the air or dried, they may long retain their virulent properties—a cloak, for instance, having been known to give scarlet fever after being laid by for eighteen months, and the poison of anthrax or the splenic fever of cattle having been found active after keeping for four years—we can understand how little warrant there is for inferring positively from the mere fact that we cannot trace infection in a particular case that therefore infection does not exist. The argument would be well-founded if the case were a solitary one, and occurred in an island or other locality having no communication whatever with adjacent parts; but in a populous country where there are always many

other cases of the same disease to be found, and where more or less intercourse takes place, even with the remotest districts, it is rarely possible to exclude entirely the chance of infection, and unless this can be done the reasoning is evidently inconclusive.

In seeking to prove that typhus and typhoid fever, besides being infectious, can arise spontaneously or *de novo*, Dr. Murchison relies not only on the negative evidence afforded by our inability to trace infection in particular cases of these diseases. He holds that there is also positive evidence to show that typhus fever may be produced by overcrowding and deficient ventilation, especially among squalid, dirty, and ill-fed persons; and that typhoid fever is sometimes generated, independently of infection, by the fermentation of sewage and perhaps other organic matters. The third kind of infectious disease described in his very able work on "The Continued Fevers of Great Britain" is *relapsing fever* (a less dangerous affection, always attended by a *relapse*, and occurring from time to time in epidemics, especially in Ireland); and this disease also he holds to be sometimes generated afresh by famine or prolonged scarcity of wholesome and nutritious food. The reason which he gives is that in cases where infection could not be traced, the above influences were present, and appear to him to have produced the diseases.

Now the causes here assigned by Dr. Murchison are the very ones which have at all times been popularly believed to have a power of breeding infectious fevers. Overcrowding and bad ventilation, dirt and squalor, the concentrated exhalations of numerous uncleanly human beings pent up together in close and ill-smelling rooms, prisons, or ships; the foul effluvia rising from sewers and cesspools, from graveyards, and other collections of putrefying animal or vegetable substances; war, with its sieges and battlefields, and its multitudes of unburied bodies polluting the air and the water; and famine with its wasted victims—to these causes, either singly or combined, it has been usual to attribute outbreaks, not only of typhus and typhoid, but of nearly every other kind of infectious fever, including the plague, scarlet fever, and small-pox. Even the best medical authorities commonly held such views before the publication, in 1811, of Dr. Bancroft's invaluable work treating on febrile contagion. "Most writers on the subject of contagious fever," says Dr. Bancroft, "have either inculcated or believed that it might be generated—first, by an accumulation of those disgusting matters commonly denominated filth; secondly, by the offensive vapours emitted by corrupting dead bodies, or by other matters in a putrid state; and, thirdly, by crowding persons, even when healthy, in ill-ventilated and unclean places." Dr. Bancroft maintained that, although these causes greatly favour the *diffusion* of a contagious fever when once it has been introduced by a person suffering from it, yet of themselves they are utterly unable to *generate* a single case; and his reasonings, with those of others, had so powerful an effect, that this immensely

important conclusion has been more and more widely received as the true medical doctrine on the subject. "Never," says Dr. Murchison, "has any work effected a greater revolution in professional opinion in this country. The doctrine of Bancroft was generally adopted." The chief argument used by Dr. Bancroft was the one to which I have already referred—namely the *complete and prolonged absence* of the contagious fevers till introduced by an infected person, though the other causes alleged to be capable of producing them are in full operation.

Thus Dr. Bancroft showed that, among the Esquimaux and Greenlanders, in slave-ships, and in Continental prisons, there was no typhus, in spite of over-crowding and bad ventilation together with filth, hunger, and squalor, often in the most aggravated degree. Typhus fever, it may be remarked, is the disease which has been popularly known by various names, such as "camp fever," "ship fever," or "gaol fever," from the frequency with which it has decimated armies in the field, and used formerly to infest emigrant ships and the English prisons. Epidemics of typhus have repeatedly occurred in most parts of Europe, especially when imported into them by war; but at ordinary times the disease is not so widely spread as enteric or typhoid fever, which is a prevalent affection in almost all countries. Typhus, on the other hand, has its peculiar abode in some of the large towns of Great Britain, and, above all, in Ireland, where it has always been fearfully common and destructive; while in the rural districts of England, throughout the whole of France, and in many other parts of the Continent, it is very little known. "In the country districts of England," says Dr. Murchison, "typhus is a rare disease; almost all the examples of 'typhus' reported as occurring in small country towns and villages are really cases of enteric fever." He says also: "The disease is at all times so rare throughout France that few French physicians have ever seen it;" and adds: "It is especially to be noted that in many parts of the Continent of Europe where typhus never occurs in time of peace, it becomes epidemic in time of war." But over-crowding and defective ventilation, dirt and privations of all kinds, are exceedingly common in the rural parts and small towns of England, as well as in France, and indeed everywhere among the very poor; and this seems plainly to show that such causes are not of themselves able to give rise to typhus fever.

Again, as regards typhoid or enteric fever, that it cannot be generated merely by the fermentation of ordinary sewage may be seen from the fact that multitudes of people habitually breathe air, or drink water polluted by sewage without ever contracting the disease. In such towns as London, and still more Paris, as Sir Thomas Watson observes, more or less of sewer air almost always finds its way into the houses even of the wealthiest classes; and in country places, where there are no sewers, the drinking water is very frequently tainted, from the dangerous practice which prevails of

having the pumps or shallow wells in too close proximity to the privy and cesspit, and allowing the excremental matters to soak into the soil. The Rivers Pollution Commissioners say in their report that estimating the town population of Great Britain at about fifteen millions of people, "the remaining twelve millions of country population derive their water almost exclusively from shallow wells, and these are, so far as our experience extends, almost always horribly polluted by sewage and by animal matters of the most disgusting origin." Yet in many country villages where such water is used, typhoid fever is entirely absent for years, till a case is imported which gives rise to a local epidemic of the disease. An outbreak of the kind in the village of Nunney, in which seventy-six persons were attacked out of a population of 832, and which was traced to the fact that the bowel-discharges of a typhoid-fever patient had been allowed to mingle with the drinking water, is thus commented upon by the eminent authority on Hygiene, the late Dr. Parkes. "The case," he says in his "Manual of Practical Hygiene," "seems quite clear—first that the water caused the disease; and secondly, that though polluted with excrement for years, no enteric fever appeared until an imported case introduced the virus. Positive evidence of this kind seems conclusive, and I think that we may now safely believe that the presence of typhoid evacuations in the water is necessary. Common faecal matter may produce diarrhoea, which may perhaps be febrile, but for the production of enteric fever the specific agent must be present." Facts such as these seem to show clearly that neither typhus nor typhoid fever can be generated by the causes assigned by Dr. Murchison. How can a disease be said to proceed from a cause which, in numberless instances, over wide areas and during long periods of time, though constantly and powerfully operating never gives rise to a single case of it?

Whenever a cause is given and known, we can try it in the above manner, by observing its action at different times and places, and under a variety of circumstances; and not one of the numerous influences supposed to generate the infectious fevers has been able to withstand this test. Indeed, our belief that these diseases have no other source than infection is mainly founded on the fact that every other cause which we see operating around us fails in countless instances to produce them. But when the cause is not given or known, and it is merely alleged that *some* cause, other than infection, is capable of generating an infectious fever, we cannot entirely disprove this assertion, since we do not know all the causes that may possibly exist in nature. As Mr. Simon observes: "To say that a disease is contagious is not to say that it cannot arise without contagion." It seems to me to be this difficulty in proving a negative which has so long prevented the settlement of the controversy. We cannot show that the spontaneous origin of the contagious fevers is *impossible*, but only that it is *not proved*, and that all the evidence adduced in its favour is inconclusive. We

hold, moreover, that such a mode of origin is not only unproved, but *very improbable*; in the first place, because every known agent whose effects have been carefully watched seems incapable of producing them, so that if they really have any other source than contagion it is an *unknown* one; and secondly, because their prolonged absence from extensive areas where a multitude of causes under a great variety of conditions are at work, renders it unlikely that *any cause whatever*, except contagion, is able to generate them. With respect to small-pox, which has been absent for centuries from whole continents, till introduced by a person suffering from it, the improbability of its ever originating *de novo* is so great as to amount to a practical certainty; and although the question as regards typhoid fever is a much more difficult one, yet if we consider the very significant facts that typhoid fever has no other known and proved cause than infection, that many of the cases formerly thought spontaneous have been shown to depend on infection conveyed in drinking-water, milk, etc., and also that the disease is often entirely absent for long periods from country districts till imported into them, we have strong grounds for believing that typhoid fever has never in reality any other than an infectious source.

Besides the foregoing arguments, which are the chief ones, Dr. Murchison brings forward two others, on which I would like to say a few words, on account of the extreme importance of the questions connected with them. The first is an argument from analogy. He points out that "there are certain contagious diseases, such as erysipelas, pyæmia, and puerperal fever," which are well known to be capable also of arising spontaneously or *de novo*, and infers from analogy that typhus and typhoid fever can probably do so likewise. In order to understand what is the force of this argument, it will be necessary to advert very briefly to the other great leading division of infectious diseases, the *inflammatory* and *septic* group, with which, as well as with those previously mentioned, it is most important that the public should be acquainted.

There is a numerous class of diseases—some of them of very common occurrence, and others terribly fatal—which have the power of arising, not only from infection, but also independently of this source, and which, therefore, we can never hope completely to abolish or extinguish. Among them are *purulent ophthalmia*, *common catarrhal ophthalmia*, *gonorrhœa*, *erysipelas*, *dissection-wound poisoning*, *pyæmia* and *septicæmia*, *puerperal fever*, *hospital gangrene* or *phagedæna*, and *dysentery*. These may be called the *non-specific*, or not purely infectious diseases, in contradistinction to the *specific*, or purely infectious disorders, already considered. I may remark here that the word "specific," as applied to a disease, is often used in a different sense from this to signify merely peculiar or special, as opposed to common or ordinary; but of late years it has been frequently employed in the very important sense here intended, namely, to signify "like a species." A specific

disease, in the latter sense of the term, is a disease which resembles a species of plants or animals, in having singularly regular and unvarying characters, and also more especially in the fact that it has only one kind of cause—in other words, that it always arises by infection from another disease like itself, just as the members of a living species always descend from parents like themselves. A non-specific infectious disease, on the other hand, can arise from other sources as well as from infection.

Now, there is this wide difference between the infectious disorders belonging to the non-specific class and typhus and typhoid fever, that, in the former the power of or ginating without infection has been *proved*, while in the latter, as we have seen, it is *not proved*. It has been conclusively shown, partly by the observation of the sick, and partly by experiments on animals, that all the ten infectious disorders just enumerated (except the last of them, dysentery) can be generated by introducing into the blood, or applying to a mucous surface, the products of ordinary inflammation or putrefaction. Recent researches have ascertained the fact that inflammatory products, such as pus, are all more or less of a *contagious* nature, and tend to excite a similar inflammation in other parts or persons. Thus one of the highest authorities on infectious diseases, Dr. Burdon Sanderson, who investigated the subject of contagion under the direction of the Privy Council and their eminent medical officer, Mr. John Simon, says: "In a certain sense it has been long familiar that an inflamed part is a focus from which irritating material is distributed to healthy parts by radiating lines of absorption; but it is only of late years that it has been distinctly seen and recognised clinically that every exudation-liquid of an inflamed part carries more or less with it the properties of an inflammation-producing virus." In like manner, Mr. Simon, in one of his Reports to the Privy Council, speaks of the "essential contagiousness" of the inflammatory process. He says: "Inflammatory excitement tends to diffuse itself. Within limits, hitherto not defined, inflammations, both common and specific, are communicable from part to part and from person to person." I may add the opinion of Mr. Jonathan Hutchinson, who says: "Let us accept clearly the doctrine, so essential to the explanation of numerous pathological phenomena, that all living pus is contagious, and is capable of producing an inflammation similar to that in which it originated." Putrid or septic matters also, such as ichorous fluids or putrescent pus, are highly poisonous, and when introduced into the blood, or absorbed into it from the surface of a wound, they give rise to the frightfully fatal diseases, pyæmia and septicæmia. These affections, together with hospital gangrene, are commonly termed the *septic* diseases, and are one of the chief dangers to which patients suffering from *wounds* are exposed, whether the wounds have resulted from injuries or from surgical operations, about a third of the deaths after operations in the London hospitals being due to pyæmia. Another disease often

arising from the noxious influence of putrefying substances upon wounds is erysipelas, which is included by some surgeons among the septic diseases. Puerperal fever also—that fearful malady whose real nature was first pointed out by Dr. Robert Ferguson, and which he describes as “the most fatal of those peculiar to women, as seven-eighths of the total mortality in child-birth are owing to it”—is essentially a septic disease, consisting of various forms of pyæmia, septicæmia, and internal erysipelas, caused by absorption into the blood of decomposing matters from the inner surface of the uterus, which, after delivery, partakes of the characters of a wound.

All the septic diseases are particularly apt to be generated by the *overcrowding* of patients suffering from suppurating wounds, which loads the air with putrescent animal products, and hence they are sure to be of frequent occurrence in close and ill-ventilated surgical hospitals. “*Overcrowding* of patients after operations,” says Mr. Erichsen, in his “*Science and Art of Surgery*,” “is one of the most fertile causes of disease and death; for the overcrowding of wounded people, whether the wounds be accidental or surgical, will inevitably produce one of the four septic diseases—phagedæna, septicæmia, pyæmia, or erysipelas.” When once produced by such means, they are afterwards propagated by infection from one person to another; the infection having this peculiarity, that it can act only on *wounded* people, since the poison apparently cannot affect the system except through a wound. Hence these diseases belong rather to surgery than to medicine, and are often called the traumatic or surgical infections. Before their generation by the overcrowding of the wounded, and their propagation by infection, were clearly understood, the mortality from septic disease in civil and military hospitals and in lying-in institutions was sometimes perfectly appalling. An important fact, pointed out by Dr. Burdon Sanderson and M. Davaine, and which helps to explain the generation of these disorders, is that their virulence is greatly *increased* by transmission from one animal to another; so that from a product at first but slightly contagious there may be developed, after a few transmissions, a most deadly poison. Even without any transmission, however, a contagious poison of the utmost intensity can be rapidly generated, *de novo*, by inflammatory and septic processes in the body; as may be seen from the fact that an unhealthy inflammation of the peritoneum, excited by a purely non-infectious cause, such as a surgical operation, may give rise to an effusion of serum and pus so virulent, that the mere prick of a needle dipped in it is enough to occasion death by septicæmia. Many medical men have lost their lives by blood-poisoning from dissection wounds of this nature.

With regard to dysentery—one of the most destructive diseases of hot climates—its mode of origin is very different from that of the septic affections. The contagiousness of dysentery has only been recognised of late years, and seems to be confined to the

epidemic form of the disease prevalent in the tropics, while the scattered cases which occur in this and other temperate countries are not held to be contagious. As in the case of cholera and typhoid fever, the infection is, in all probability, conveyed chiefly by means of the discharges. The peculiar exciting cause of dysentery appears to be a miasma or malaria, generated in hot, swampy districts, and closely allied to the malaria which gives rise to ague; the word *miasma* or *malaria* being commonly used to denote a poisonous matter bred outside the body, while a *contagium* is one which breeds and multiplies within the body itself. Since dysentery may arise from a miasm as well as from contagion, and since the inflammatory and septic infections can be generated by the products of ordinary inflammation and putrefaction, it is evident that we can never hope to abolish these diseases, however greatly they may be reduced in amount by human skill and energy.

The diseases which can be abolished, and on which above all others, therefore, the attention of society should be fixed, are the *zymotic* diseases, strictly so called. The word *zymotic* signifies "like a fermentation," and is often employed in a looser sense so as to include all infectious diseases, and even some which are not infectious; but Sir Thomas Watson, in his article on "The Abolition of Zymotic Disease," restricts the term to a certain group of infectious disorders, consisting of small-pox, scarlet fever, measles, and others, which in their course and symptoms *nearly* resemble a fermentation. The resemblance between these maladies and a fermentation, as pointed out by Liebig, is in many respects very striking. Thus, for example, when a ferment, such as yeast, is added to a fermentable liquid, there is first a period of quiescence; then follows a period of disturbance, with rise of temperature, during which two periods a great multiplication of the ferment takes place; next comes a stage of subsidence or decline; and afterwards there remains an immunity or insusceptibility to the further action of that ferment. In like manner, when the virus of a zymotic disease, such as small-pox or measles, enters the body, there is first a period of quiescence or incubation; then a stage of disturbance, attended with rise of temperature or fever, an eruption on the skin, and a great multiplication of the virus or infecting matter; then a stage of decline or defervescence; and, lastly, an immunity from the further action of that contagion. The stages not only follow one another in regular order, but each of them lasts a certain time, which varies but little in different cases of the same disease. There is a large group of infectious disorders, both in man and the domestic animals, presenting the remarkable characters here described, and it is these disorders which are *specific*, or, in other words, which resemble species in having only one kind of cause, and in being therefore liable to extinction. Many of them are admitted almost universally to arise at the present day from contagion alone, and not one has been *proved* to have any other mode of origin. On the other hand, the

septic and inflammatory group of disorders have not such regular and unvarying symptoms, and none of them give immunity from future attacks; and these are the *non-specific* infectious diseases, that is to say, the class which can arise from other sources as well as from infection. But typhus and typhoid fever, and the former more especially, have well-marked zymotic characters of incubation fever and eruption, regular stages and lesions, and subsequent immunity, and Sir Thomas Watson includes them among the true zymotic diseases. Their real analogy is to small-pox and scarlet fever and not to pyæmia and erysipelas, with which Dr. Murchison compares them, and this seems a strong argument against their ever originating *de novo*. Dr. Buchanan, the present medical officer of the Privy Council and Local Government Board, says, in his article on Typhus Fever in "Reynolds's System of Medicine," in discussing Dr. Murchison's theory: "The most serious obstacle to the reception of this theory arises from the analogy of other specific diseases, as to the present production of which by contagion, and contagion alone, there can be no question." The argument from analogy, therefore, instead of supporting Dr. Murchison's view, seems rather to tell very strongly against it.

The last of Dr. Murchison's arguments to which I shall refer is of an *à priori* character, and is one which has been repeatedly brought forward in discussing the spontaneous origin of the infectious fevers. It is urged that such a mode of origin is not only possible, but must actually have taken place when the diseases first came into existence, since the first cases must have arisen without infection; and as this has happened once, why, it is asked, might the same thing not happen again? "In the first sufferer from a contagious disease," says Dr. Murchison, "its origin must have been *de novo*, and there is no reason why the unknown causes of the first case may not operate at the present day." But Dr. Murchison himself disregards this argument when he concludes, from a careful survey of the facts, that small-pox and some other disorders never now arise *de novo*; and it is evidently by facts, and not by speculative considerations, that the question has mainly to be decided. Still there is one thing, a knowledge of which would be of immense value, and might aid us in forming an opinion on this and every other point relating to infection. If we knew what the poisons that give rise to infectious diseases *really are*—if we knew their intimate nature, and how they produce the extraordinary phenomena of infection—we might be able to say whether or not it is likely that they should ever be generated spontaneously. This brings us to the great question which of late years has occupied, more than almost any other, the attention of medical inquirers, namely, *what is contagium?* and how do the different kinds of contagia produce their effects?—the word *contagium*, in the plural *contagia*, being used to denote the material substance or poison which gives rise to a contagious disease. When we have carefully considered what the con-

tagia really are, we shall be in a better position to decide as to their modes of origin, and also as to the possibility of their utter extinction.

Till within the last twenty or thirty years the nature of contagion remained an inscrutable mystery and standing enigma in medicine, and more has been done in the present generation than in all past ages to clear up the difficulty. The explanation of the facts of infection now given by the best authorities is contained in the great theory known as "the Germ Theory of infectious diseases," and also called the doctrine of *contagium vivum* and *miasma vivum* (living contagium and living miasm), which Dr. Liebermeister regards as "perhaps the most important questions which have ever busied the medical world." According to this doctrine, the different contagia are in reality different kinds of *extremely minute living beings*, which produce disease by growing and multiplying in the body of the patient, and communicate infection by passing from the body of one person or animal into that of another. These little organisms are generally considered to be plants belonging to the *bacteria*, a tribe of the lower fungi, and they have received various names, such as microbes, microphytes, microzymes (little living things, little plants, little ferments), on account of their vital properties. or else, from their peculiar forms, they have been called bacteria, bacilli, spirilla, micrococci, etc. (that is, rod-like bodies, very minute rods, little spiral filaments, or little rounded organisms). Each kind of contagium attacks by preference certain parts and tissues of the body, and hence the peculiar symptoms and lesions that characterise the different infectious diseases. If this view be correct, it is evident that the contagia are not, properly speaking, poisons but *parasites*; and the reason why certain disorders are called *specific* and never arise but from infection, is that they are caused by distinct species of living organisms which, like other species, are kept up only by continuous propagation. Like other species, too, they might be completely extirpated by human intelligence and energy. In fact, the battle with contagious fevers and specific disorders is nothing else than a war of extermination against a class of excessively minute disease and death-producing parasites, which, though the smallest of living beings, are infinitely more dangerous and deadly to mankind than any venomous reptile or beast of prey.

The truth of the germ theory in its main features seems now to be firmly established, and is admitted by large numbers of the most eminent medical and scientific authorities in this and other countries. On this point I may quote the opinion of Dr. Burdon Sanderson, who, in 1870, in discussing the doctrine that the little particles found in contagious liquids "are organised beings, and that their powers of producing disease are due to their organic development," says: "We have accepted the doctrine as the only one which affords a satisfactory explanation of the facts of infection." Mr. John Simon, in his Address as President of the Public Health Section at the International Medical Congress held in London in 1881,

says: "We have learnt, as regards those diseases of the animal body which are due to various kinds of external cause, that probably all the most largely fatal of them (it is impossible yet to say how many) represent but one single kind of cause, and respectively depend on invasion of the animal body by some rapidly multiplying form of alien life." At the same Congress, Professor Klebs, of Prague, read a paper on the subject, in which he says: "The conclusion which appears to me to follow inevitably from this short survey of the results of modern investigation is this—that specific communicable diseases are produced by specific organisms." In the discussion following the paper, Dr. Virchow, the eminent German pathologist, observed that "the study of pathological anatomy had been greatly changed by the discovery of parasitic organisms." I may quote also the opinion of M. Bernheim, who says, in his article on "Contagion" in the "Dictionnaire Encyclopédique des Sciences Médicales" (1874): "Now we shall see that the results of existing science tend precisely to make the contagia be regarded as animal or vegetable parasites, and that consequently between contagious maladies and parasitic maladies there is perhaps no essential difference." In like manner, Dr. Frankland, president of the Institute of Chemistry, says: "The researches of Chauveau, Burdon Sanderson, Klein, and others, scarcely leave room for doubt that the specific poisons of the so-called zymotic diseases consist of organised and living organic matter." In an address delivered in St. James' Hall during the London Congress of 1881, the celebrated chemist, M. Pasteur, who has done so much to promote the knowledge of this subject, alluded to his own "labours during the past twenty-five years upon the nature of ferments—their life and their nutrition, their preparation in a pure state by the introduction of organisms under natural and artificial conditions—labours which have established the principles and methods of microbism."

It was M. Pasteur's brilliant researches on *fermentation* and *putrefaction* that led the way to the discovery of the true causes of infectious disorders. Fermentation is a process which occurs when a fermentable compound, such as sugar, is placed in contact with gluten, casein, albumen, or other nitrogenous substance, provided air be admitted; and it was held by Liebig that the *ferments* in such a case are the dead nitrogenous substances, which begin to decompose when acted on by the oxygen of the air, and thus induce changes in the sugar. But M. Pasteur showed that in every fermentation, properly so-called, the alcoholic, the viscous, the lactic, etc., *little living beings* are present, which are the real ferments or agents in the process. Fermentation consists, in fact, in the changes arising from the growth and multiplication of a microscopic plant, whose germ is at first brought by the air, but which afterwards lives without air, feeding on the sugar and the nitrogenised substances, and using their elements to build up its own tissues. "When sugar is placed in the presence of gluten, or

casein, or an animal membrane," says M. Pasteur, in a notice of his researches published in 1861, "it is not the nitrogenised matter which is the ferment. The true ferment consists in a microscopic vegetable, the germ of which is brought by the air at the commencement, and which multiplies itself, taking its carbon from the sugar, its nitrogen and its phosphates from the gluten or the casein." In his "Studies on Fermentation," a translation of which was published in 1879, he says: "The essential point of the theory of fermentation, which we have been concerned in proving in preceding paragraphs, may be briefly put in the statement that ferments, properly so-called, constitute a class of beings possessing the faculty of living out of contact with free oxygen: or, more concisely still, we may say fermentation is a result of life without air." Putrefaction also, which is a kind of fermentation accompanied by foul smells, was shown by M. Pasteur to be due to the action of little living organisms, the septic bacteria, whose germs are derived from the air. By a beautiful series of experiments, which were confirmed by the researches of Professor Tyndall, he showed that all ordinary air contains large numbers of these germs, and that if they be totally excluded by boiling, hermetically closing vessels, or other means, animal and vegetable substances can be kept for years without putrefying. As it appeared from these enquiries that little living beings are the real causes of fermentation and putrefaction, the question naturally presented itself whether the infectious fevers, which are so like a fermentation, may not have a similar source. Accordingly this great question was vigorously attacked by M. Pasteur and a number of most able observers in different countries. The methods by which they sought to solve it were chiefly the search for organisms by an examination under the microscope of the contagious products and the blood in the various infectious disorders of men and animals; the endeavour to separate from one another the different parts of which contagious liquids are composed, in order to determine which of them possesses the virulent properties; the chemical analysis of these liquids to see whether they contain any chemical poison; the artificial cultivation of the little organisms or microbes, that is to say, rearing them in some nutrient fluid, such as serum or meat-juice, in which they can grow vigorously, so as to rid them of impurities, and to study their nature and development; and also testing the powers of infectious liquids, and of the little organisms in the pure state, by experiments on animals, which formed an indispensable part of the inquiry. By these means a large amount of evidence was obtained, which seems to show in the clearest manner the truth of the germ theory.

The reasons now usually given in proof of the germ theory, are drawn partly from facts of infection that have long been known, and partly from the results obtained more recently by the examination of contagious liquids. Among the former, the two facts on which Dr. Burdon Sanderson lays particular stress as showing the

contagia to be living beings, are their enormous *multiplication* within the body of the patient, and also their long *preservation* and resistance to adverse surrounding influences outside the body. He holds the germ theory to be "the only one which affords a satisfactory explanation of the facts of infection, and in particular of those which tend to show that within the body of the infected individual the particles of contagium rapidly reproduce themselves, while out of the body they are capable of resisting for long periods the influence of conditions which, if not restrained by organic action, would produce chemical decomposition." The multiplication of the virus or infecting matter which takes place in a contagious disease is extraordinary, and should be carefully noticed, as it is one of the most important points relating to infection. "A quantity of small-pox matter not so big as a pin's head," says Dr. Aitken, "will produce many thousand pustules, each containing fifty times as much of the specific pestilent matter as was originally inserted; and moreover the blood and all the secretions of the body are equally infected with the specific poison of the pustules. The miasmata from one child labouring under hooping-cough are sufficient to infect a whole city." This fact alone would seem almost enough to show that a contagious virus must be organised and living, for living beings are the only things we know of possessing the faculty of reproduction or self-multiplication. No chemical poison, whether of the inorganic or organic class, as arsenic, or snake venom, has any power of reproducing itself, or is ever multiplied in the body. Hence it takes a certain amount of these poisons to produce death, and their effects are proportional to the dose; but the contagia can act in what is termed a *minimal dose*, that is, a quantity quite impalpable and infinitesimal. Thus Mr. Marson says of small-pox that "a single breathing of the air where it is, is enough to give the disease." The reason of this remarkable difference is that a chemical poison is not multiplied in the body, whereas an infectious virus is rapidly multiplied, so that, if once it gains a footing, the amount originally taken into the system matters but little. Professor Naegeli, of Munich, in his work on the "Lower Fungi in their relation to Infectious Diseases" (1877), holds this fact to be conclusive evidence on the question. "The infectious matters," he says, "cannot be chemical compounds or collections of them, but can only be *organised bodies*, because in this case alone is their increase conceivable from the minimal quantity taken in, to the amount in which they become dangerous to the human frame."

Another important fact is the power of the contagia to retain their virulence for long periods, sometimes for many years, outside the body, and to resist changes of heat and cold, dryness and moisture, or other influences which would speedily decompose and destroy any dead organic matters. This accords well with what we know of the bacteria and other minute organisms, which are wonderfully tenacious of life, and moreover are able to exist in two

states or forms—the one an active parent form when they are comparatively perishable, and the other an inactive form, as little buds or *spores*, when they are very indestructible, and can continue in a sort of dormant vitality for an indefinite time. It is on this ground chiefly that Dr. Burdon Sanderson objects to a theory of germs, differing from the one usually adopted, which has been put forward by the distinguished physiologist and microscopist Dr. Lionel Beale, in his work on "Disease Germs" (2nd ed., 1872). Dr. Beale holds as strongly as any one that the contagia are *living* and not dead substances. "The only condition in which matter is known to exhibit these powers of self-multiplication," he says, "is the living state;" and he adds: "Every one will admit that the particular forms of disease now under consideration—the contagious fevers—result from the introduction of living particles of some form or other." Assuming the infectious particles to be living, however, there are evidently two suppositions possible as to their nature; either they are independent organisms or parasites coming from without, or else they are little living cells or portions of protoplasm derived from the patient's own tissues. Dr. Beale adopts the latter alternative, and holds the disease germs to be particles of degraded protoplasm, which are capable of living independently, and can be engrafted on other individuals, in whose bodies they can grow and multiply. This view, however, is objected to by the great majority of observers here and abroad, as purely hypothetical and wanting a real instance to support it, and especially as being inconsistent with the fact that many kinds of disease germs can live for such long periods out of the body. "Considering," says Dr. Burdon Sanderson, "that of all perishable things protoplasm is among the most perishable—so much so that no living particle of our bodies can be abstracted from its place in the organism, even for five minutes, without dying and being disintegrated—it appeared to me quite out of the question to suppose, as Dr. Beale had suggested, that the particles could be of this nature consistently with the astonishing power which they evidently possess of retaining their activity for such long periods, in spite of their being subjected to enormous varieties of moisture, temperature, and all other conditions." "If, then, the doctrine of a *contagium vivum* be true," says Dr. William Roberts, in his Address on Medicine to the British Medical Association in 1877, "we are almost forced to the conclusion that contagium consists (at least in the immense majority of cases) of an independent organism or parasite."

The results which have been obtained of late years by the examination of contagious liquids with high powers of the microscope, relate in the first place to the physical characters of the contagia. Some infectious diseases, such as small-pox and measles, are propagated through the air by inhalation; while others, as cow-pox and glanders, are communicated by inoculation with liquid products, and hence it is often supposed that the infecting

matters must have the form of a vapour or a fluid. But if this were so, it would follow that they cannot be living, for living beings are always solid, and never fluid or gaseous bodies. A closer scrutiny has shown, however, that the real infecting substance, or contagium, is neither a fluid nor a vapour, but consists in all cases of extremely minute *solid particles*. "As regards the physical characters of contagious liquids," says Dr. Burdon Sanderson, "the fundamental fact is that contagium is *particulate*." This important fact was pointed out in 1865 by Dr. Chauveau, Professor in the Veterinary School at Lyons, after a prolonged inquiry into the virus of cow-pox and other contagious diseases. When vaccine, or cow-pox lymph, is examined under the microscope, it is found to consist of three parts,—namely, first, of corpuscles which are similar to ordinary pus globules, and are sometimes few in number, or even entirely absent in good vaccine; secondly of numerous particles, far more minute and not exceeding $\frac{1}{50000}$ of an inch in diameter: and thirdly, of a clear liquid in which these bodies float. The larger corpuscles were separated by subsidence, and were found on inoculating them to be inert. The separation of the smaller particles could not be effected either by subsidence or filtration, but was at last accomplished by what is termed the method of *diffusion*; that is, by bringing carefully a little water into direct contact with the contagious liquid, when the soluble and diffusible parts of the liquid mix with the water, and the insoluble ones are left behind. In this way the minute particles were separated from the rest, and were found on inoculation to communicate cow-pox, whereas the fluid after being deprived of them was found absolutely inactive. M. Chauveau investigated in a similar manner the virus of small-pox, sheep-pox, and farcy (a form of glanders), and with the same results. It thus appears that when an infectious disease is communicated by means of a fluid, or through the air, it is because the air or the fluid contains little solid particles, invisible to the naked eye, which are the real infecting substances; and this fact is a strong additional argument in favour of the view that the contagia are living beings.

Besides showing the physical characters of infectious liquids, recent investigations with the microscope have ascertained that in some of them little vegetable organisms of peculiar shapes are present; and it is these organisms, and the inquiries to which they have given rise, that most fully demonstrate the germ-theory. "The doctrine that microphytes have to do with the process of contagion," says Dr. Burdon Sanderson, "is based on two sorts of observations, viz., those relating to the physical characters of contagious liquids, and those relating to the existence of organisms of characteristic form in them." "There are four contagious diseases," he says also in 1874, "in respect of which the presence in the contagious liquids of forms of vegetation, differing from those met with after death in the normal tissues or liquids of the body, or during life in the products of primary or secondary inflammation,

has been established. These are small-pox, sheep-pox, splenic fever, and relapsing fever." The first disease in which characteristic organisms were detected was splenic fever or anthrax—a very deadly disorder of cattle, sheep, and horses, common in all parts of the world, and inoculable on all kinds of animals, including men, in whom it produces the rapidly fatal affection called malignant pustule. Dr. Davaine and Dr. Pollender, in 1855, or even earlier, discovered in the blood of animals suffering from splenic fever, a microscopic plant, to which the name of *Bacillus anthracis* has been given, and which consists of little rods or staff-shaped bodies, endowed with the faculty of developing spores. In relapsing fever also, an infectious disease peculiar to man. Dr. Obermeier, in 1872, detected in the blood a little organism or microbe, having the form of minute spiral threads or filaments, and since called the *Spirillum Obermeieri*. The organisms which have been discovered in the matter taken from small-pox pustules, are of the kind called *Micrococci*, that is, little rounded bodies, and exactly resemble the minute particles already described as occurring in vaccine lymph.

Although these little bodies have been found by numerous observers to be continually present in the above diseases, this fact cannot in itself be regarded as sufficient evidence that the diseases are due to them. The organisms might be the consequence rather than the cause of the morbid state of the blood, and might be simply carriers and not producers of the infecting virus. In order to decide this point, therefore, it is evidently necessary to separate the organisms and obtain them in a pure state, and then to try whether by inoculation they are able to produce the disease, and for this purpose a more perfect process of separation is needed than that employed by M. Chauveau, which merely divided the insoluble from the soluble and fluid portions of a contagious liquid. We want to know the vital as well as the physical characters of the organisms, and whether they are the real causes of the disorders in which they occur. This object has been attained by the very important purifying process called the method of *successive cultures*, which is now generally used in these inquiries, and may be briefly described as follows: A little drop of the infectious liquid containing the microbes is introduced on the point of a glass rod into a clear nutrient fluid, such as meat-juice, which is kept nearly at blood-heat; the latter fluid having been previously boiled, and the glass rod heated to redness to deprive them of all other organisms, and the neck of the vessel being plugged with cotton wool so as to exclude any germs from the atmosphere. In a few hours the nutrient fluid becomes turbid from the growth of the microbes, which rapidly multiply and fill the vessel. A little of the fluid from this vessel is then introduced in the same manner into another portion of nutrient fluid in a second vessel, and when this becomes turbid, a drop from it is transferred to a third vessel, and so on for ten, twenty, or any re-

quired number of times. In this way the little organisms are freed from all extraneous matter, and obtained as far as possible in a pure state; and if at the end of this process they exhibit under the microscope the same appearance and power of development, and are found on inoculation to communicate the disease with the same intensity as the infectious liquid from which they were originally derived, it seems evidently to follow that they are the true cause of the disease. M. Pasteur regards this method of inquiry as indispensable, and as affording conclusive evidence on the subject. "In the present state of science," he says, "the proof that a microscopic organism is by its development a cause of disease and death, can only become peremptory on condition that successive cultures of this organism have been obtained, indefinitely repeated in liquids inert of themselves, and that these liquids always show the same development, the same appearance of life, associated with the same virulence, the same power of inoculation, of disease, and of death." The disease in which the organisms have been most carefully studied and most fully proved to be the real cause of the symptoms is splenic fever. On this point Dr. William Roberts observes, in the address already referred to, "That this organism (the bacillus) is the true virus of splenic fever has long been probable; and the labours of Bollinger, Davaine, Tiegel, Klebs, and most of all, of Koch, have removed the last doubts on the subject. Koch found without exception," he continues, "that if the tested material produced threads and spores in the incubator, it also produced splenic fever when inoculated into the mouse; and on the contrary, if no such growth and development took place in the incubator, the tested material produced no effect when inoculated into the mouse. Proof could go no farther; the infection absolutely followed the specific organism; it came with it, it went with it." There are several other infectious diseases in which little organisms have been discovered of late years, as, for example, erysipelas, diphtheria, gonorrhoea, and glanders; while in some others none have yet been found, and we can only infer their presence from the similarity of the phenomena, though they are probably too minute to be visible even with the highest powers of the microscope.

These minute parasitic organisms, which "lie at the root of all infectious diseases," to use Dr. Liebermeister's words, may be divided into two classes, between which there is a most important difference. Some of them are what are called *genuine* or *habitual* parasites, that is to say, they can live only in the animal body, and in many cases only in the particular species of animal which they infest; while others are *occasional* parasites, that is, they live and breed habitually in the outer world, and only enter from time to time, and under peculiar circumstances, into the bodies of animals. This division of the parasites corresponds to the two main groups of infectious diseases already adverted to, namely, the *specific* and the *non-specific* infectious diseases; the former being characterised

by the presence of genuine, and the latter by that of occasional, parasites. The reason why certain infectious disorders are called specific is because, like species, they always descend from other diseases like themselves; a fact which clearly shows that the little organisms found in them are always transmitted from one animal to another, and cannot multiply and develop themselves, though they may live for a season, outside the animal body. The non-specific disorders, on the other hand, can arise not only from infection, but from other sources, and this proves that the organisms associated with them are sometimes derived by transmission from other animals, and sometimes come in from the external world. It is evidently only the genuine parasites and the specific infectious diseases that we can hope to exterminate; whereas the occasional parasites, being able to live outside, cannot be exterminated, and we can only guard ourselves against them, and against the diseases in which they are found, by attentively studying the circumstances which permit them to enter the body.

We have already seen how, according to the germ theory, infection is produced, namely, by the microscopic organisms passing from one animal into another, and we may now briefly advert to the mode in which the non-specific infectious diseases are generated in those cases where they arise spontaneously or *de novo*, that is, from any other cause than infection. The most important and fatal disorders of this class are the *septic* affections, such as septicæmia, pyæmia, and puerperal fever, and the part which the little organisms take in producing or complicating them has been investigated by numerous observers. In the blood and inflammatory products of infectious septicæmia microphytes are constantly found, which M. Pasteur has carefully studied by the method of successive cultures, and has shown to be the true cause of the disease. Dr. Chauvel, after giving an account of these researches in his article on Septicæmia (1880), in the "Dictionnaire Encyclopédique des Sciences Médicales," says: "It would follow, therefore, from the experiments of Pasteur, that virulent septicæmia is due to the introduction and multiplication in the economy of a microbe living without air and a ferment, the septic vibrio." This little organism, according to M. Pasteur, M. Davaine, Dr. Burdon Sanderson, and other authorities, is nothing else than one of the common bacteria, or living ferments, which produce putrefaction, and which live habitually in the air and water around us. Mr. John Simon speaks of it as "the common ferment of putrid infusions," and says that "apparently those 'pyæmic' and 'septicæmic' diseases have their common essential cause in one morbid poison or contagium, which, so far as can yet be discerned, is a particulate ferment of ordinary putrefaction."

I may here mention that the bacteria, the tribe of infinitesimally minute plants to which all the contagia yet discovered belong, have been made the subject of a special study by the distinguished botanist Professor Cohn of Breslau, and are described in his work

"On Bacteria, the Smallest Living Beings" (1872). The principal forms of the bacteria are those already adverted to, micrococcus, bacterium and bacillus, spirillum and vibrio, and they are so excessively minute that the common rod-like bodies are only $\frac{1}{5000}$ of an inch long, or one-third the width of an ordinary red blood-globule, while the micrococci do not exceed $\frac{1}{20000}$ of an inch in diameter. The bacteria live in the outer world, and are universally diffused throughout the air, and especially in water, as they require moisture to bring out their active properties. Their part in the economy of nature is a most important and indispensable one, namely, to cause putrefaction and to break down and remove all dead animal and vegetable substances; and this power of destroying the dead seems nearly related to the disastrous tendency which they so often manifest to become parasitic and prey upon the living animal body.

Since, then, the little organisms found in septicæmia have come in from without, the question to be considered is, What are the circumstances that enable them at first to enter the body, and render them so virulent? or, to express this in other words, how is septicæmia produced when it arises *de novo*, and not by infection from one animal to another? At ordinary times the bacteria are perfectly harmless, as may be seen from the fact that they are continually entering our bodies by the lungs and alimentary canal, and may be detected in some of the abdominal organs, such as the liver and spleen. Into every little cut and wound of the skin also they must constantly find their way, and yet the great majority of wounds heal rapidly and without any ill effects. There are some parts of the body, however, in which bacteria are never found, namely, in healthy blood and muscle, as they are apparently at once destroyed whenever they enter the circulating fluid. What is it, then, that in septicæmia permits them to live and multiply in the blood, and converts a microphyte, harmless and insignificant at other times, into the most deadly of all known poisons? The reason of this, as ascertained by the long-continued labours of inquirers, is that, in the process of putrefaction, the bacteria produce a chemical substance called *the septic poison* (just as, in fermentation, the little yeast plant produces alcohol), and this poison, when absorbed into the system from the surface of a wound, gives rise to fever and inflammation, so as gradually to overcome the vital resistance of the blood and enable the bacteria to enter and breed in it. The septic poison was first discovered in 1856 by Dr. Panum, of Copenhagen, and was shown by him to be the immediate cause of septicæmia. Like other chemical poisons, it is not multiplied in the body, and its effects, unlike those of the contagia, are proportional to the dose. Hence an important distinction is now drawn between two forms of septicæmia; in the one, which is not infectious and is probably of common occurrence in its slighter degrees, the symptoms are due to the absorption of the septic poison from a wound, and the patient recovers, if the dose has not been too

large; while the other is an infectious and most deadly disorder, produced by the entrance and multiplication of the bacteria themselves in the system. The properties of the bacteria are altered, so that they become parasites on the living body, and their virulence, as pointed out by M. Davaine, is enormously increased by transmission through the animal economy. Pyæmia also, a disease closely allied, if not, as some think, identical with virulent septicæmia in its nature and origin, is, like it, almost invariably fatal. Dr. Burdon Sanderson has shown that the intensely contagious products of pus and serum found in these diseases always contain swarms of bacteria, and may thus be distinguished from ordinary healthy pus, which is but slightly contagious.

One of the immense practical benefits already derived from the germ theory is the *antiseptic treatment* of wounds, which was introduced a few years ago by the eminent surgeon Sir Joseph Lister, as a means of guarding against the septic diseases, and was expressly stated by him to be founded on M. Pasteur's doctrine concerning putrefaction. As Pasteur had shown that putrefaction is caused by bacteria, the antiseptic treatment aims at preventing the hurtful influence of these little organisms on a wound. For this purpose, the wound is covered with several folds of gauze steeped in a solution of carbolic acid, whose fumes either kill the bacteria or at least prevent them from decomposing the discharges, and thus giving rise to the septic poison. This method, along with other precautions, has now been introduced in the large hospitals here and abroad, with such admirable results in preventing pyæmia, hospital gangrene, and other septic affections, that Dr. Sanderson lately observed, in alluding to the experience of German surgeons: "We can no longer wonder that it is common to hear the discovery of Lister spoken of in Germany as the greatest improvement in the art of medicine which has taken place in modern times."

There is still another disease of the utmost gravity, which has within the last few years apparently been proved to be contagious, I mean the dreadful malady *tuberculosis*, called pulmonary consumption or phthisis when it occurs, as it usually does, in the lungs. This is by far the most important and widely destructive of all diseases, for statistics, it is asserted, show that one-seventh of the whole population, and as much as one-third of the adult population who die in the prime of life are carried off by it. Until recently, tuberculosis was regarded as a disease which arises chiefly from debility or hereditary predisposition, and as not at all contagious; but in 1864, Dr. Villemin, of Paris, published the extremely important and startling discovery that it can be communicated to the lower animals by inoculating them with tubercular products. The truth of his conclusions was in some respects questioned at the time, but they have since been fully confirmed. Dr. Koch, of Berlin, the high authority already referred to, observes that recent researches "have established the communicability of tuberculosis beyond all doubt, and in future a place must be assigned

to it among the infectious diseases." Mr. John Simon says: "The broad results of modern discovery in regard to ordinary tubercular disease tend to represent it as a chronic locally-originated zymotic process, which, starting under certain conditions in one first spot of the (predisposed) animal body, advances by successive steps in definite anatomical lines to infect the entire system; a process, which by means of its characteristic products is inoculable from part to part, and from subject to subject." It was presumed that a microscopic parasite must exist in tuberculosis as in other communicable diseases, and after a long, fruitless search by various inquirers, it was at last discovered by Dr. Koch, whose observations on the subject are contained in a most important paper read before the Physiological Society at Berlin in 1882. The little parasite as described by him is of a rod-like shape, and has hence been called the *bacillus tuberculosis*. Dr. Koch says that he has found this parasite to be constantly present in the tubercular products of men and animals, and that moreover, by obtaining it in a pure state with the aid of successive cultures, and then testing it by inoculation, he has proved it to be the true cause of the disease. Debility and hereditary tendency have doubtless, he remarks, a most powerful effect in the production of tuberculosis, but they act only as predisposing influences, while the real essential cause is the bacillus. At a meeting of the Pathological Society of London in December last, Dr. Dawson Williams, who had repeated some experiments on the subject at the request of Dr. Wilson Fox and of Dr. Burdon Sanderson, observed that "the evidence in favour of the specific nature of tubercle was now, he thought, very strong, and it was strong also in favour of the view that the bacillus tuberculosis was a necessary part of the tubercular process; further, the recently published experiments of Baumgarten and Arndt seemed to prove that the lesions of tuberculosis depended directly on the growth of the bacillus, and were in fact produced by it."

With regard to the question whether the tubercle bacilli belong to the class of genuine or of occasional parasites, Dr. Koch holds that they are "not occasional, but genuine parasites, and can proceed only from the animal organism," a fact which, he says, would greatly facilitate their destruction. He grounds his opinion upon the circumstance that in his cultures the bacilli would only grow at a temperature between 30° and 40° centigrade (that is, between 86° and 104° Fahrenheit), and such a temperature cannot be obtained continuously in our climates except in the animal body. He holds, moreover, that they may be introduced into the system by inhalation as well as by inoculation, and thinks it probable that they often enter in the former way, judging from the fact that phthisis usually commences in the lungs. The principal source from which the bacilli are derived is, in his opinion, the expectorations of phthisical patients, which are known to be capable of transmitting the disease to the lower animals by inoculation, and whose particles, when dried, may be wafted about by the air.

Another source, according to him, is the milk and flesh of cows and other animals affected with tuberculosis. Dr. Koch believes that a knowledge of these facts will be of the greatest benefit in the prevention of consumptive disease. "In future," he says, "in the war against this frightful scourge of the human race, we shall have to do no longer with an undefined something, but with an intelligible parasite, whose life's conditions are for the most part known, and can be yet more fully investigated." Efforts to destroy the parasite should, in his view, be combined with the no less important measures needed for enabling the human constitution to resist its attacks. Strong people, who live a healthy life and are much in the open air, never, or very rarely, get consumption, but only the weakly and delicate, who live and work indoors, or those hereditarily predisposed; and if a strenuous endeavour were made to raise greatly the physical powers and bodily development of the community, and at the same time, as Dr. Koch recommends, if the expectorations of the phthisical were disinfected, and the milk and flesh of tubercular animals forbidden to be sold, this fearful disease could, he believes, to an immense extent, be prevented and rooted out from among us. Many high authorities, however, differ widely from Dr. Koch in regard to several of these views, and especially on the question whether or not phthisis is often due to contagion. Thus Dr. Andrew, in one of his Lumleian lectures on "The *Ætiology of Phthisis*" (published in the *Lancet* of May 10th, 1884), holds that the disease is undoubtedly transmissible by inoculation to the lower animals, and also that its true cause is the bacillus, while the other reputed causes act only as predisposing influences; but he infers, from a study of clinical facts and from common medical experience as to the origin of consumption, that the bacillus is an occasional, not a genuine parasite, and in the great majority of cases comes in from the outer world instead of being derived by transmission from another person or animal. Hence he believes that contagion, though possible, very rarely occurs in practice, and has very little really to do with the production of phthisis. He contends that "although phthisis may be undoubtedly produced in many ways experimentally in animals, and also probably in man, there is not sufficient evidence to prove that its prevalence is materially affected by direct contagion." After summing up his views on the subject he says: "From these I may be allowed to make one short practical deduction—namely, that the prevention of phthisis, like that of ague, is to be attained by sanitary works, especially by improved ventilation and drainage, and not by isolation." How different would human life be, if so afflicting and widely spread a malady could be effectually controlled and prevented by a clear knowledge of its cause!*

* The treatment which holds out most hope of a cure in this very fatal disease would seem to be a residence for a time in certain high or alpine districts, where there is an immunity from consumption, or, in other words, where tuberculosis

The germ theory not only explains, as I have endeavoured above to describe, the existing facts of infection, but also enables us to understand how the infectious disorders may probably at first have arisen in past ages. If infectious diseases are always accompanied

never occurs either among the people who live there or in the lower animals. That there are such districts appears to be fully established, and is a most remarkable and important fact. Sir Thomas Watson, in his "Lectures on the Principle and Practice of Medicine" (5th ed., 1871), quotes a passage from the *Westminster Review*, in which it is stated that Dr. Schleissner, who was sent some years ago by the Danish Government to investigate the sanitary condition of Iceland, ascertained that in Iceland "scrofula and consumption are unknown." "This statement," says Sir Thomas Watson, "the accuracy of which had been called in question, has very recently been confirmed by unimpeachable testimony, zealously collected and made public by Dr. Leared. In a letter written by him upon the subject, Dr. Hjaltel n, a distinguished physician residing at Reykjavik, declares that, during a period of fifteen years, he has had more than thirty thousand patients, and has made numerous autopsies, yet not a single case of tubercle of the lungs or of indig-nous consumption has he met with. He adds the corroborative testimony of Dr. Skaptason, the oldest and most experienced physician in Iceland, who says: 'During my thirty-two years' practice in this country, I have not seen a single case of phthisis tuberculosa. I have seen a great many cases of other diseases of the lungs, but phthisis tuberculosa never. In all the autopsies I have made, I have never observed the least trace of tubercle in the lungs.'" A similar immunity from consumption, according to several observers, is found in certain elevated regions among high mountain ranges, such as the Swiss Alps; and it is asserted that in districts enjoying this immunity, not only are the inhabitants free from tuberculosis, but the disease is often arrested, and even radically cured in patients who resort thither for treatment. Professor G. Sée, in his lately published work on "Bacillary Phthisis" ("La Phthisie Bacillaire," Paris, 1884), ascribes the beneficial effects of the air of lofty mountains to the fact that it kills or checks the increase of the bacillus, which he regards as the true cause of consumption. Like many other plants, the bacillus cannot live in an Alpine climate. M. Sée holds that phthisis is uniform in its nature, that it is parasitic, and that the treatment by climate should have for its object either to destroy the bacillus or to prevent the parasite from developing itself," and multiplying in the tissues. He says that, as shown by the researches of M. Pasteur and others, "at a height above 800 mètres (about 2,600 feet) microphytic life is compromised. But the most formal proofs of the incompatibility of these altitudes with the life of the microbe have been furnished by Miguel and Freudenstein; at 1,800 mètres (about 5,900 feet), no more parasites. How or why the microbes disappear matters little; it is a fact, and it is to this incorruptible quality of the atmosphere that high climates owe their anti-bacillary or prophylactic power." Whether it be from the cold or the large quantity of ozone contained in the air, "the tubercular microbe is unable to live in these conditions," and hence M. Sée concludes that "mountain climates must now enter into the warfare of man against the microphytes which endanger our race." The most surprising statements on this subject, however, are those lately made by Dr. Gauster, chief physician to the State Railways Administration in Vienna, in a series of articles commencing April 8th, 1884, in the *Wiener Medizinische Zeitung*, on "the Influence of a High Climate on Tuberculosis." Dr. Gauster affirms that among the Alps there are districts, having a peculiar soil and a height not below 730 mètres (about 2,400 feet), which confer a complete immunity from consumption, the disease never occurring there either in men or animals; while in other districts, though at a much greater height, there is no such immunity. "Immunity from tuberculosis," he says, "is only to be found in regions where, at a height of more than 730 mètres, the soil is composed of the oldest rocks, as granite, gneiss, and crystalline schist formations, and the quantity of ozone in the air is constantly high." He says that the existence of immunity districts, and their wonderfully beneficial effects on imported cases of consumption, especially in the early stages of the disease, have for many years been known. An experience of fifteen years has convinced Dr. Gauster himself that, in patients who reside for some months in these districts, changes occur in the diseased lungs by which the morbid products are gradually eliminated from the body. "The results of these processes," he says, "are, in all the slighter cases, and in most cases of medium degree, a cure; but in the majority of advanced cases, a hastening of the fatal issue." He maintains, therefore, that "tuberculosis in certain stages is curable in the high climate." Dr. Gauster's assertions are so startling, and so opposed to ordinary medical experience

by parasitic organisms, which are either their producers or their carriers, it is evident that the question how the diseases arose depends mainly on the question as to the origin of the little parasites. Whence are these little organisms derived, and how did they become parasitic on the animal body? Their origin must obviously have taken place in one of two ways. Either they arose by what is called "spontaneous generation" from lifeless matter, or else they descended in the usual way from other living organisms. Now the former mode of origin is entirely denied by M. Pasteur, Professor Tyndall, Dr. Burdon Sanderson, and others, who contend, not that spontaneous generation never occurs in nature, but that it never occurs in this class of living beings. Thus M. Pasteur says, in a lecture delivered before the Chemical Society of Paris in 1861: "You will observe I do not pretend to show that spontaneous generation never exists. In subjects of this kind one cannot prove a negative. But I do pretend to demonstrate rigorously that in all the experiments where the existence of spontaneous generation has been believed to be recognised among those beings of the lowest class, to which the controversy is now-a-days confined, the observer has been the victim of illusions or causes of error which he has not perceived or has not known how to avoid." In a report made in 1871 on the origin and distribution of microzymes (bacteria), Dr. Burdon Sanderson observes: "I shall be able to prove in the most decisive manner that, as regards the animal tissues and liquids, and the liquids which will be used as tests for the presence of microzyme germs, no spontaneous evolution of any organic form ever takes place; but it will be quite unnecessary either to deny or assert its possibility under other and different circumstances." Dr. William Roberts regards the doctrine of spontaneous generation or "abiogenesis" as in itself a perfectly legitimate supposition, but holds that the bacteria, humble though they be, are far too highly organised for such a mode of origin, which, moreover, could not be expected to occur among plants subsisting on the products of putrefaction. "Assuming," he says, "that the occurrence of abiogenesis at some time in the past history of the globe is a necessary postulate in science, I see nothing unscientific—looking to the law of continuity in the operations of nature—in the supposition that it *may* be occurring at the present day somewhere or other on the earth's surface, but certainly not in decomposing liquids."

So far as we have reason to believe, therefore, the bacteria are never generated spontaneously or *de novo*, but always descend, like the higher plants and animals, from other living beings. We have seen, however, that what is called "spontaneous generation,"

as to the curability of consumption, that they would need ample corroborative evidence for their support; and M. Sée states that the medical college of Vienna has appointed a commission to inquire into the subject. In any case, however, it seems natural to expect that the influences which entirely prevent consumption among the natives of certain districts must have a powerful effect in checking the progress of the disease when brought into these localities.

or "a *de novo* origin," not unfrequently takes place in some infectious diseases, and this shows that these expressions are ambiguous, and are used in a different sense when applied to a minute living organism and when applied to an infectious disease. In the former case they mean that the organism is evolved out of lifeless matter; but when an infectious disease is said to be generated spontaneously, or *de novo*, the meaning is that it does not arise by infection from another disease like itself—that it is due to some other cause than infection. As regards the little organisms found in the disease, the phrase means, not that they arose from lifeless matter, but that they came in from the outer world, and were not derived by transmission from one animal to another. A spontaneous origin of this kind is not uncommon at present among some infectious disorders, and must at one time have occurred in all, for, as Dr. Murchison observes, "in the first sufferer from a contagious disease its origin must have been *de novo*." In inquiring into the origin of the contagia and of contagious diseases, it is their spontaneous or *de novo* origin, in this sense of the terms, that has to be considered. The view now generally entertained on this subject by high authorities is that all the different contagia have probably descended, at periods more or less remote, from the bacteria, and have been gradually brought to their present type, in the lapse of ages, by means of variation, inheritance, natural selection, and the other laws of evolution so admirably explained by Mr. Darwin in his account of the origin of species. The bacteria are well known to be eminently *modifiable*, and may undergo surprising changes in form and properties from their physical environment, or by passing from one species of animal into another. "If contagia are organisms," says Dr. William Roberts, "they must necessarily have the fundamental tendencies and attributes of all organised beings. Among the most important of these attributes is the capacity for 'variation' or 'sporting.'" In like manner Dr. Wilks observes, in his Address as President of the Pathological Section at the International Medical Congress in 1881, that, if specific diseases be due to a living contagium, "it must be subject to the same laws as other organic matter; and if the doctrine of evolution be true, it must have numerous relations with families of its own kind, and perhaps with others which are now obsolete." Some of the contagia, such as those of small-pox and scarlet fever, are probably derived from variations in the bacteria which took place only in remote ages, so that now-a-days the diseases are never found to arise spontaneously or *de novo*. Others, as those of erysipelas and pyæmia, are apparently due to variations occurring more or less frequently at the present day, and hence a *de novo* origin is common in these diseases; while in some other affections, such as relapsing fever, diphtheria, and (if Dr. Murchison's view be correct) even typhoid fever, the variations may perhaps occur at rare intervals, and under unknown or obscure conditions, so that, as many believe,

these diseases may now and then arise *de novo*. It would follow from this that the first class of little parasites might be totally extirpated, and the last confined within narrow limits; and we have seen how greatly Lister's method has contributed to prevent the entrance into the body and fatal effects of the minute organisms that give rise to septic diseases.

Having examined the questions whether infectious diseases can arise spontaneously, and whether the germ theory is the true explanation of the facts of infection, we now come to the practical inquiry as to the means best adapted for preventing and eradicating these diseases. The immense importance of this subject will be seen if we consider the fearful amount of death and suffering which infectious disorders are causing year after year in our midst. Mr. Simon, whose invaluable Reports as Medical Officer of the Privy Council and Local Government Board, and therefore at the head of the sanitary service, have done so much for the prevention of disease in England, says: "Looking at the ravages which are every day suffered from familiar diseases of the zymotic class, such as typhoid fever, and typhus, and small-pox, and scarlatina, and measles, and hooping-cough; and adding to these the less constant, but occasionally terrible, destructiveness of diphtheria and of cholera; adding further the consequences of venereal diseases; adding again those serious traumatic infections which make the chief common danger of surgical operations and injuries; everyone can see that the field of zymotic pathology is of enormous extent and incalculable importance." The number of *deaths* produced by infectious diseases appears from the Reports of the Registrar-General, which, since 1838, give a tabular statement of the causes of all the deaths occurring throughout the country. Thus if we take the five years from 1876 to 1880 (the last year for which the annual report has as yet been published) we find that during the whole period there were in England and Wales 9,726 deaths from small-pox; 48,294 deaths from measles; 85,208 from scarlet fever; 66,112 from hooping-cough; 4,458 from typhus; 34,651 from typhoid or enteric fever; and 15,243 from diphtheria. This would give as a yearly average of the deaths from each of these seven diseases, about 2,000 deaths annually from small-pox; from measles, 9,500; from scarlet fever 17,000; from hooping-cough, 13,000; from typhus, 1,000; from typhoid fever, 7,000; and from diphtheria, 3,000 annual deaths. In addition to the foregoing there were from the other contagious disorders included in the Registrar-General's reports, 10,268 deaths from erysipelas; from puerperal fever, 7,728; from syphilis, 10,615; from hydrophobia, 246; and from glanders, 24 deaths. That is to say, about 2,000 persons died on an average each year from erysipelas; 1,500 from puerperal fever; 2,000 from syphilis; 50 from hydrophobia; and 5 from glanders. Taking the eleven years from 1870 to 1880, it will be seen that the aggregate number of deaths from the seven infectious fevers mentioned above,

amounted to 639,289, or about 58,000 annually, which is rather more than one-ninth of the total number of deaths from all causes during the same period. Hooping-cough, measles, and scarlet-fever, though liable to occur at all ages, are mainly diseases of infancy and childhood—hooping-cough, according to the eminent authority on vital statistics, the late Dr. William Farr, being most fatal in the first, measles in the second, and scarlet-fever in the third and fourth years. Diphtheria also is most common in children, for one-half of those who die of it are under five years, while in scarlet-fever two-thirds of the deaths are below that age. Typhus and typhoid fever, on the other hand, are chiefly destructive to adults. In Ireland, where typhus is far more prevalent than in this country, no fewer than 222,029 persons, in the period from 1841 to 1851, died of typhus and typhoid fever.

The number of *cases* or *attacks* is not accurately known, for as yet, unfortunately, no provision has been made for registering all cases of infectious disease; but we can form some idea of their amount by considering the average mortality of each disease, that is, the proportion of deaths that usually occur in a given number of cases. Small-pox, that hideous and disfiguring malady, is the most fatal of the contagious fevers, the deaths being estimated by Mr. Marson at about one-third, and by Dr. Seaton at rarely less than 20 per cent., and often 30 and 40 per cent. of the attacks. When the disease occurs in a person who has been vaccinated, it is usually, though not always, of a modified or milder form, and Dr. Seaton observes that the mortality of small-pox after vaccination "is rarely known to exceed 7 per cent., and is more frequently 3, 4, and 5 per cent." In typhus and typhoid fever, according to Dr. Buchanan and Dr. Murchison, about one patient in ten dies, if all ages are taken together, but in adults as many as one in five. Diphtheria (a contagious sore-throat deriving its name from a whitish sloughing membrane or skin that forms in the throat and often spreads to the windpipe) is fatal to one in seven, or even, according to Dr. Aitken, to one third of those attacked by it; while the mortality of scarlet fever is the most variable of all, ranging from one in twenty or thirty in mild epidemics to one in five or six in severe ones, and on an average it is reckoned at about one in twelve. If we take these figures, we may perhaps infer that there occur in England and Wales on an average of years about 12,000 or 15,000 cases annually of small-pox; 10,000 of typhus; 70,000 of typhoid or enteric fever; 15,000 of diphtheria; and 200,000 cases of scarlet fever. Dr. Murchison, judging by the deaths from scarlet fever, estimates that considerably less than half the children born contract that disease (in 1880 the total number of births registered was 881,643). Hooping-cough and measles, though the rate of mortality in them is comparatively low, are so extremely contagious that few children escape them, and hence more than half-a-million cases of hooping-cough, and as many of measles, must annually occur on an average in this country.

In spite of the dreadful ravages committed by infectious diseases, there are no maladies for whose prevention so little has yet been done. Indeed, till very recently, they were regarded almost as necessary and unavoidable evils, and except in the case of vaccination for small-pox and in some other instances, few energetic steps were taken to combat any of the infections current among us, or to prevent their diffusion. "As to contagions already current in the country," says Mr. Simon in his Report to the Privy Council for 1865, "practically any diseased person scatters his infection broadcast almost where he will—typhus or scarlatina, typhoid or small-pox, or diphtheria." In another impressive passage in his Report to the Local Government Board for 1874, Mr. Simon says: "Among the causes which injuriously affect the Public Health of England, considered as a total, certain operate only on particular districts; while others, though no doubt in widely different degrees, appear to be of general, perhaps nearly universal operation. Foremost in the latter class, and constituting therefore in my opinion objects which claim earliest attention in the sanitary government of England, two gigantic evils stand conspicuous;—first, the omission (whether through neglect or through want of skill) to make due removal of refuse-matters, solid and liquid, from inhabited places; and secondly, the license which is permitted to cases of dangerous infectious disease to scatter abroad the seeds of their infection." Much has been done of late years, especially in large towns, for the better removal of refuse matters by improvements in the sewerage and in the water supply, and the next great sanitary effort will probably be for the prevention and extinction of infectious diseases. There are many sanitary reforms which can be carried out by the authorities with little aid, except of a pecuniary kind, from the public; but the abolition of infectious disease can only be accomplished by the cordial and intelligent co-operation of the whole community; and hence the urgent need for an open discussion of the subject, so that all may understand it and agree as to the means that should be adopted for the purpose.

As the contagious fevers have no other source than contagion, the requirements or indications for their prevention can be readily understood, and the only difficulty is to know by what practical and feasible measures these requirements can best be fulfilled. We have already seen that a contagious fever can be communicated in three ways; either by the *patient* himself, both during his illness and convalescence, or by the *persons* or *objects* which have become contaminated by being in his neighbourhood. The patient communicates infection by means of little particles, invisible to the naked eye, which are exhaled in vast quantities from his body, and which according to the modern view are excessively minute living organisms, or microbes; the tainted objects act simply as carriers of these particles; while the tainted or suspected persons may either act as carriers, or may, for aught we know, be really themselves

patients, and already suffering from the disease in its latent or incubative stage. For the purpose of prevention, therefore, all that is needed is that no one who has not previously had the disease should *come near* any patient or suspected person till the period of danger is past, and that all tainted objects should be thoroughly disinfected; in other words, *isolation* and *disinfection* are the essential requisites for the prevention of the infectious fevers. "The isolation of healthy persons from those affected with the disease, and from those who have intercourse with such patients," says Dr. Aitken, in speaking of scarlet fever, "is essential, and is the only rule that promises any good results." Mr. Simon also, speaking of scarlet fever, observes that "at present we have not any other known power of dealing preventively with the disease than such as consists in intercepting all contagious communication between the infected and the non-infected parts of the population. Thoroughly to isolate the sick from intercourse with susceptible persons, and thoroughly to trap and exterminate all contagium which the bodies of the sick evolve, are the preventive feats which have to be accomplished." A complete system of prevention for the infectious fevers would thus include, in the first place, the isolation of the patients during their illness and convalescence; secondly, the isolation (often called *quarantine*) of suspected persons till the period of incubation is over, and it can be seen whether or not they are infected with the disease; and thirdly, the disinfection of clothing, bedding, furniture, and other contaminated articles. A fourth indispensable requisite is the immediate *notification* to the sanitary authorities of every case that occurs, so that means may be taken as speedily as possible to aid the sufferers in their difficulties, and to prevent the extension of the disease.

These requirements for limiting the spread of infection are included by Sir James Simpson—who was the first, in his "Proposal to Stamp out Small-pox and other Contagious Diseases" (1868), to urge the adoption of measures, not merely for the partial prevention, but for the complete and speedy extinction of the contagious fevers by a great social effort—in the following rules, which he calls the "Regulations for Stamping Out." His remarks have special reference to small-pox, but similar measures, as he afterwards states, are applicable, and will, he believes, sooner or later be adopted for the prevention and extinction of all the infectious fevers.

The regulations which he proposes are:—"1. The earliest possible notification of the disease after it has once broken out upon any individual or individuals. 2. The seclusion at home or in hospital of those affected during the whole progress of the disease, as well as during the convalescence from it, or until all power of infecting others is past. 3. The surrounding of the sick with nurses and attendants who are themselves non-conductors, or incapable of being affected, inasmuch as they are known to be protected against the disease by having already passed through cow-

pox or small-pox. 4. The due purification, during and after the disease, by water, chlorine, carbolic acid, sulphurous acid, etc., of the rooms, beds, clothes, etc., used by the sick and their attendants, and the disinfection of their own persons."

The late president of the College of Physicians, Sir Thomas Watson, in his article in the *Nineteenth Century* on "The Abolition of Zymotic Disease" (1877) earnestly urges the same views, and thus enumerates the measures which he regards as necessary for prevention: "To this end," he says, "the requisites are, first, the unfailling and immediate notification to the proper authorities of the occurrence of every case. Second, the instant isolation of the sick person. Third, the thorough disinfection of his body, clothes, furniture, and place of isolation. Fourth, vigilant and effectual measures to prevent the importation of his disease from abroad, and to strangle it should it by mischance return."

It will be observed that the above proposals omit one of the four measures which have been already adverted to as needed to constitute a complete system of prevention against the infectious fevers, namely, isolation of the patients, isolation of suspected persons, disinfection, and notification. The measure omitted is the isolation of suspected persons, or *quarantine*, as it is often called, a word used to signify the seclusion of persons apparently healthy, but who have had intercourse with patients, till the period of incubation of the disease is past, and it can be known whether or not they are infected. This has always been felt to be the most vexatious and harassing of the preventive regulations, and therefore it may be dispensed with wherever there is reason to believe, either that the other means would without it be found sufficient, or that society would not willingly consent to its adoption. Still, such a measure is often of the utmost value, and is, indeed, indispensable to success when the disease to be combated is of a particularly infectious or very fatal nature, so that the strongest means are required to suppress it. All the fresh cases, we must bear in mind, arise among the persons who have been exposed to contagion, and in this way, by isolating the latter for a few days, we obtain an immense power of preventing the disease. If, on the other hand, the suspected persons are left at large, those of them who are incubating the disease will sicken in the midst of other healthy people, to whom they may probably communicate infection before there is time to isolate them. For these reasons the isolation of suspected individuals, or quarantine, has been very frequently resorted to, though hitherto almost solely as a means of defence against *foreign* infectious diseases, such as the plague, yellow fever, and cholera. It is by strict quarantine regulations, as well as improvements in hygiene, that the plague has been expelled from Europe, and that New York and some other American seaports have been long preserved from the inroads of yellow fever; and our exemption of late years and until recently from that fearful scourge, Asiatic cholera, is largely owing to the system of quarantine which has been established against it in the Red Sea and

on the frontiers of Russia, the routes by which cholera entered in its former visits. The isolation of persons who have been exposed to contagion is commonly effected in one of two ways; either by their seclusion in separate buildings, for a number of days not exceeding the usual period of incubation of the disease; or else by surrounding the infected places with what is called a *sanitary cordon*, or a line which no one is allowed to pass without permission of the authorities, and by which the sick and those having intercourse with them are kept apart from the rest of the community. In several towns in the north of England the local authorities have very recently applied for and received from Parliament powers to erect shelter-houses, in which the healthy members of infected families can be received while their homes are being disinfected, and also to impose certain restrictions on the residents in houses in which infectious disease has broken out; compensation being given for any loss that may be sustained by compliance with the sanitary regulations.

But by far the most important and essential of the preventive measures is the isolation of the *patients themselves*, and the main difficulty in the whole subject is to know in what manner this can best be effected. Sir James Simpson, as we have seen, proposes that the patient should be secluded "at home or in hospital;" but he, and all others who have carefully considered the facts, point out the utter impossibility of effectually isolating a contagious fever in the homes of the poor, on account of the overcrowding and the want of a separate room or of any adequate means for preventing frequent intercourse between the patient and his friends both during his illness and his convalescence. Mr. Simon says, with reference to the overcrowding of labourers' cottages: "Again and again, in phrases so uniform that they seem stereotyped, reporters on the spread of epidemic disease in rural districts have insisted on the extreme importance of that overcrowding as an influence which renders it a quite hopeless task to attempt the limiting of any infection which is introduced." Dr. Aitken observes also, in treating of scarlet fever: "When, however, we look abroad at the actual condition of the people among whom the disease works its ravages, we see at once that, with regard to very many of them, and especially with regard to the very poor in towns, isolation and disinfection are no more than idle words." To avoid the risk of transmitting the disease, those who have any intercourse with the patient should as rarely as possible, and only after disinfection, come in contact with healthy susceptible persons; but how totally this is disregarded in numberless instances may be gathered from the following account, quoted in Dr. Aitken's work from a communication by Professor Bell to the *Lancet*, of a case of severe scarlet fever which was seen in a small crowded room. Upon inquiry Dr. Bell found the following facts: "The father had charge of an extensive society's bread-shop; the mother was a washerwoman, taking clothes to her home to wash; the eldest girl attended, throughout

the day, the children of a lady's family, and came home to sleep at night; the other children attended, some an infant-school, some a large mixed school, where hundreds of other children met. The youngest played with young children in a house on the other side of the passage." How can we hope, in such circumstances, to prevent the spread of a dangerous infectious disease?

Even in the houses of the rich, where all the advantages of a separate room and trained nurse, with disinfectants and other necessary appliances, can be had, the isolation of an infectious fever is by no means easy, and very frequently fails in spite of the most conscientious efforts. There is a wide difference in the infectiousness of different diseases, and some of them are much harder to isolate than others. Thus Dr. Jones Gee observes, in his article on Scarlet Fever in "Reynolds' System of Medicine," "In degree of contagiousness scarlet fever takes its place between measles and hooping-cough above, and typhus fever below, diphtheria being very far below." Measles and hooping-cough are so extremely contagious, and so difficult to isolate, that it seems needless for the present to think of their extinction, and we should rather at first confine our efforts to the other infectious diseases. Of these, small-pox and typhus are much less common in the rich than the poor; indeed, typhus, though very dangerous, and often fatal, to the medical men and nurses who attend it, is usually found only among the poorest classes of society; while enteric or typhoid fever, as previously remarked, is propagated mainly by the bowel discharges of the sick, and needs, as its essential preventive, the thorough disinfection or destruction of these discharges immediately on their issue from the body. The diseases which most frequently require to be isolated in the houses of the rich, therefore, if we omit measles and hooping-cough, are scarlet fever and the much rarer affection, diphtheria; and to show how little reliance can be placed on the usual preventive measures in so highly infectious a disease as scarlet fever, I may again quote from Dr. Aitken's work the following remarks by Dr. Davies, the medical officer of health for Bristol. In writing of an epidemic of scarlet fever at Bristol in 1875, Dr. Davies asks the question: "Are we doing any good with our present preventive means?" and observes: "I feel certain that we increase the anxiety of the domestic and social troubles of the public by our preventive measures; and I feel doubtful of the answer to the former question." "I have never," he continues, "used disinfectants so extensively as during the present epidemic; and yet our failure is complete. The doubts I have expressed do not in any way extend to typhus and enteric fever, small-pox, and Asiatic cholera." From the remarkable tenacity of the virus of scarlet fever, disinfection is more difficult in this disease than in measles or typhus, and the power to infect continues longer, lasting altogether during illness and convalescence for two months or more; and it is evident that the long presence of a fever in an ordinary dwelling-house, full of susceptible persons, not only gives great

facilities for contagious intercourse, but must so thoroughly load the bedding, walls, and furniture with virulent particles as to render much more difficult the process of disinfection.

The above facts show clearly that the real cause of the enormous prevalence and fatality of the infectious fevers is that they are treated *at home*, where they cannot, in the great majority of cases, be properly isolated; and hence the best authorities have of late years come more and more decidedly to the conviction that these diseases ought not to be treated at home, but in *hospitals* set apart for the purpose, and so arranged that each different kind of disease may be isolated in a separate building or a separate ward. The hospital treatment of the infectious fevers seems to me one of the most immense improvements ever introduced in medicine, and the means which, in combination with others, will lead in time to the complete and final extinction of all these disorders. In an infectious disease the objects of medical treatment are not only to cure the malady, but also to prevent its extension to other persons; and the latter aim can only be secured, in the case of the contagious fevers, by treating them in hospitals where their extension can be effectually prevented. A large number of infectious hospitals have lately been provided by the local authorities in the towns and villages throughout the country, partly by erecting new buildings, and partly by adapting private houses and cottages for the purpose, at the earnest instigation of the Local Government Board and their medical staff. "For a long time past," says the late Dr. Seaton, in his report for 1876, "the Board have been strenuously urging on local authorities the provision of such hospitals." Another indispensable means of prevention consists in hospitals or homes in the country air where *convalescents* from the contagious fevers can be isolated till their power of infecting is past; and a few institutions of the kind have recently been provided, in great part through the admirable efforts of Miss Mary Wardell and Mrs. Gladstone, though hitherto chiefly by voluntary contributions, and not by public funds.

The immense utility of fever hospitals and convalescent homes as a means for stamping out zymotic disease, will be seen if we consider for a moment their advantages, not only to the public, but also to the infected families and to the patients themselves. To the public the treatment in hospital affords a complete protection by at once removing the patient, the centre and source of contagion, from the midst of susceptible people, and placing him in circumstances where his disease cannot extend. In a well-regulated hospital, where the nurses and other attendants are carefully chosen as having had the disease, and do not come in contact with the public outside except on rare occasions and after disinfection, there is little likelihood that any fresh case should arise; and even if it did, it would be promptly isolated, so that the mischief would spread no further. Thus Dr. Broadbent, the senior physician of the London Fever Hospital, observed lately, at a

drawing-room meeting at Mrs. Gladstone's, that "from the moment when a scarlet-fever patient was in an ambulance or in a convalescent home, all danger to the public ceased." In like manner Dr. Buchanan, the present medical officer of the Local Government Board, says: "In regard to some infections, notably those of scarlatina and diphtheria, there are no means at all to be compared with isolation in hospital for preventing the spread of a limited number of cases into a formidable epidemic." "There are," he says again, "four infectious diseases—small-pox, scarlatina, diphtheria, and continued fever—which more particularly require to be treated in hospital, when they attack persons who cannot be properly isolated in their own houses"; and he adds that "small-pox, as well as other infections, is capable of being wonderfully limited by isolation in hospital." Particular care should be taken in any outbreak of disease to isolate as quickly and effectually as possible the *first cases*; for a fever is in some respects like a fire, which at first can be readily extinguished; but afterwards, when it has had time to spread and gather strength, becomes difficult if not impossible to control. In a Memorandum issued a few years ago by the Local Government Board, it is pointed out that the separation of the sick from the healthy "is comparatively easy, if means to attain it are taken early, while cases of the disease are very few; but any interval of delay allows the cases to multiply, and perhaps at last to become so numerous that endeavours to isolate them cannot succeed." If all the existing cases of an infectious fever, and especially the first cases, were promptly removed to hospital, and the convalescents afterwards transferred to suitable homes, epidemics could be arrested at their origin, and the number of patients needing isolation would soon be surprisingly reduced. The only other sources of contagion which would then remain to be dealt with are the persons and objects contaminated by the patients *before* their removal to hospital; and if the suspected persons were secluded for a few days during the term of incubation, and the tainted objects thoroughly disinfected, it is not too much to assert that the disease might in a short space of time be radically and completely extinguished.

To show how rapidly a contagious fever can be extirpated when adequate means are employed for the purpose, Sir James Simpson points to the instructive example afforded by the *cattle plague*, a terrible disease of horned cattle, which has its home in Siberia, and was imported into England from the Continent in 1865. This is the most fatal and most highly infectious of all the spreading disorders of the domestic animals, the mortality being estimated by Professor Fleming at about 90 or 95 per cent. of the attacks, and during the two years which elapsed before it was subdued in this country it destroyed nearly half-a-million of cattle. At first the disease was allowed to gain ground through division of opinions; but when a stringent law for its prevention was passed by Parliament and put in force, it immediately began to decline, and was

soon entirely stamped out. The measures adopted were of such a nature as to deal effectually with all the sources of contagion, and consisted in the compulsory slaughter, with compensation, of the sick and also of the suspected animals, the burial of the diseased bodies, and the disinfection of tainted objects; due notification of every case to the authorities being likewise made compulsory. These are the means which have repeatedly been employed on the Continent against inroads of the cattle plague, and invariably with success. "Whatever be the place into which it penetrates," says M. Léon Colin, "the cattle plague can be arrested, for we have always the same resource, a resource absolute and radical, for suppressing the contagion, by causing to disappear the sick, the animals which they have contaminated, and the objects which they have soiled." Now, Sir James Simpson holds that small-pox and other infectious fevers in man might be just as successfully eradicated as cattle plague, since we possess in *isolation* strictly carried out, a means no less powerful for preventing them. "We could, in my opinion," he says, "as surely and as swiftly stamp out small-pox as rinderpest (cattle plague) has been stamped out." After proposing his preventive regulations, he says: "The measures which I have suggested would probably, in my opinion, stamp out small-pox in Great Britain within six months or a year, provided they were carried out as faithfully and universally as the Legislature can command." It seems to me that these views are in principle undeniably true, and that if society would only consent to the effectual isolation, or, in other words, to the isolation in hospital of all cases of infectious fever, whether in rich or poor, these dreadful disorders, which have lasted from time immemorial and destroyed millions of human lives, could in a very few years be completely rooted out and banished from among us.

The objection which has been so often urged against fever hospitals, that they separate a patient from his friends and relatives, seems to be really an objection not to hospitals merely, but to *isolation* itself in any form. Even when the patient is treated at home he must, if we would prevent infection, be kept entirely apart from his friends and relatives. In both cases isolation is equally essential, and is the real difficulty that has to be met and surmounted before we can hope for success. Doubtless it is a most painful necessity to have to separate from a beloved relative—from a child, or parent, or husband, or wife when they are stricken down by an infectious fever; but if the separation is indispensably needed for the extinction of these dangerous maladies, and for the good of the whole human race, ought we not willingly to consent to it? It appears to me, moreover, that fever hospitals are in reality an inestimable boon to the family and to the patient, no less than to society at large. They prevent, in numberless instances, the spread of disease to other members of a household, and they save the family from all the troubles and difficulties attendant on isolation at home, which are particularly

harassing at such a time of anxiety and distress. There is another danger connected with the home treatment of contagious fevers which should be mentioned, and of which the public is not sufficiently aware; namely, that if a woman who is pregnant or recently delivered contracts one of these diseases, and especially scarlet fever, it is almost sure to prove fatal. "Fever during the pregnancy," says Dr. Aitken, "most certainly ends in abortion and death. If the woman be recently delivered, the disease will be of the most malignant type and almost always fatal." "If scarlet fever can be prevented," he says also, "the number of puerperal fever cases would be diminished one-half; and every possible step ought to be taken to remove the pregnant female alike from the influence of scarlet fever and from erysipelas." Besides these great advantages of hospitals, they enable the patient in very many cases to have better food, nursing, and other accommodations than he could find at home, while the richer classes may, if they please, be treated in private hospitals or in separate wards or rooms to which admission is obtained by payment. Conveyance to hospitals, it may also be remarked, can be readily effected by means of ambulance carriages, provided with a moveable bed, which is taken into the sick-room and into the ward, so as to avoid, as far as possible, any risk or inconvenience to the patient. The benefits which a patient derives from a *convalescent home* are obvious, for unless he has access to an institution of the kind, he cannot for some time after his recovery go anywhere to seek a change of air, and to recruit his strength without endangering the lives of others. Indeed, the Public Health Act of 1875 expressly forbids any person suffering from a dangerous contagious disease to expose himself "without proper precautions against spreading the disorder, in any street, public place, or conveyance," so that it is difficult to see how a convalescent patient who is still capable of infecting others, can travel, change his residence, or even leave the house without infringing the law and rendering himself liable to a penalty.

A question of the utmost importance is, whether the isolation of persons suffering from a contagious fever should be made *compulsory* and enforced by the State, and both Sir James Simpson and Sir Thomas Watson plead earnestly in favour of a measure for this purpose. "If," says the former, "by a law which no one thinks harsh or severe, lunatics are prevented from destroying the lives of their fellow-men, why should it be thought harsh or severe that people affected with small-pox should be prevented from dealing out destruction and death to all the susceptible with whom they happen to come into contact?" The force of this appeal will not be disputed, and it seems to me that a law making obligatory the isolation of all cases of infectious fever, whether in rich or poor, if it had the cordial approval and co-operation of society, would be incomparably the most effectual means that could be taken for the prevention of these diseases. Such a law would be no real in-

fringement of liberty, for the principle of liberty, as Mr. Mill points out, requires only that acts which do not injure others should be left free. On the contrary, acts which injure others may rightly be controlled by the State, and surely there are no acts more highly injurious to others or more likely to be followed by disastrous consequences, than to communicate the seeds of a dangerous infectious disease. To extirpate these maladies, moreover, a most vigilant and united action on the part of the public and the local authorities is absolutely necessary, and this cannot be obtained without the aid of the law; indeed, without stringent laws to prevent them, the extinction of infectious fevers either in man or the domestic animals seems an utterly hopeless task.

Hence a large number of enactments have recently been made by Parliament for the prevention of infectious disease, and one of them deals expressly with the subject of isolating the patient. A clause in the Public Health Act of 1875 directs as follows: "Where any suitable hospital or place for the reception of the sick is provided within the district of a local authority, or within a convenient distance of such district, any person who is suffering from any dangerous infectious disorder, and is without proper lodging or accommodation, or lodged in a room occupied by more than one family, or is on board any ship or vessel, may, on a certificate signed by a legally qualified medical practitioner, and with the consent of the superintending body of such hospital or place, be removed, by order of any justice, to such hospital or place at the cost of the local authority; and any person so suffering, who is lodged in any common lodging-house, may, with the like consent, and on a like certificate, be so removed by order of the local authority." That is to say, the law permits the compulsory removal to hospital of any fever patient whom the medical practitioner may certify to be without proper lodging and accommodation. But the radical defect and injustice of this enactment seem to be, that it is a law for the *poor* only, and not for the rich; it permits the removal to hospital, and compulsory isolation, of the poor, but lays no similar obligation on the rich, although the complete isolation of a fever patient is quite as necessary among the latter, and is in very many cases inadequately carried out. To be just, the law should enforce isolation equally in all classes; and if this cannot practically be done in any other way than by treatment in hospital, it seems in fairness to follow that such treatment should be impartially enjoined in all. Another defect in the enactment, which, as pointed out by Mr. Murdoch in his "Remarks on the Necessity for further Suppression of Infectious Disorders," has greatly diminished its efficacy, is that it imposes on the medical practitioner the difficult and unpleasant task of interpreting the phrase "without proper lodging and accommodation," and thus makes him the agent in compulsorily sending patients to hospital. The only law which, I venture to think, would be both just and effectual, is one making obligatory the isolation in hospital of all

cases of certain specified diseases, whether in rich or poor. The diseases which should be included in the measure, and should always, unless for some special and urgent reason, be treated in hospital, are, I think, small-pox, typhus, scarlet fever, diphtheria, and perhaps also, under certain circumstances, typhoid or enteric fever; although the prevention of the last-named disorder requires rather that the discharges should be thoroughly disinfected, and that complete security should be given for this being done, than that the patient himself should be isolated. All cases of the foreign infectious diseases, such as yellow fever or the dreaded pestilence. Asiatic cholera, should also, as it seems to me, for the public safety, be treated in hospital. With regard to measles and hooping-cough, they are affections of a less dangerous nature, and moreover they are so extremely prevalent, so highly contagious, and so difficult to isolate, that it seems better to defer for a time any attempt to extinguish them by means of legal enactments, and they might continue, as at present, to be usually treated at home.

But, besides the isolation of the patients, the other leading measures of prevention should also, in the opinion of the highest medical authorities, be made compulsory: namely, the disinfection of tainted articles of clothing or furniture, the notification of all cases of infectious disease, and, in certain instances, the isolation of persons who have been exposed to contagion—or *quarantine*, as it is commonly called. It is often thought that quarantine is chiefly applicable to infected ships, or to a line of frontier between neighbouring countries; but one of its most important and valuable forms is the quarantine of *infected houses*; for the house on land is in many respects analogous to the ship at sea. Infection spreads most readily to persons who are in the same house, and especially in the same room, with the patient, and seems very seldom to be propagated directly from one house to another, since the virulent particles are quickly dispersed and rendered harmless by mixing with the outer air. Thus Dr. Buchanan says, in speaking of infectious hospitals: "As regards the distance which, on medical grounds, it is right to secure between adjacent inhabited houses and an infectious hospital, I know of no evidence as to what proximity, if any, can be a danger to persons not actually under the same roof; but there is abundant evidence to show that very short distances suffice to prevent direct infection." This fact shows the great benefits which may be derived from a quarantine of infected houses; for when a case of fever occurs in a dwelling-house, if the patient is removed to hospital, and if the other members of the household are isolated for a few days either at home or elsewhere, during the term of incubation and while the premises are being disinfected, the disorder may very often be prevented from spreading any further. These means would, I think, be specially valuable if applied to the *first cases* of disease appearing in a locality, when every possible care should be taken to

guard against the sources of contagion, and at once to stamp out the malady at its commencement. As previously remarked, compulsory powers have lately been granted by Parliament to the local authorities in several towns in the north of England enabling them to order the quarantine of infected houses, which if combined with the removal of the patient to hospital, seems to me the most complete and effectual system that could be adopted for rapidly stamping out zymotic disease.

With regard to the *disinfection* of houses, furniture, or other articles, this should always, according to Mr. Simon, be done under the direction of the sanitary authority, who would ensure its proper performance, and at the same time relieve the public from a troublesome and expensive task. It should, he says, "be made a legal obligation, that every health authority of the country should have all disinfectant processes necessary for the protection of the public health done under direction of a skilled officer, and, as far as necessary, at a public establishment, and at the public cost." The means commonly employed for disinfecting purposes, it may perhaps here be remarked, are heat, free ventilation, and also certain chemical substances, such as carbolic acid or chloride of lime. Of these the surest disinfectant is great heat, whether by fire or boiling water, or by the hot air of an oven, as it at once kills the virulent germs. The most generally useful agent, however, is free ventilation and a copious supply of fresh air, which dilutes and disperses the poisonous exhalations, so that they have no longer the power to infect. As observed in a memorandum issued by the Privy Council: "The great natural disinfectant is fresh air abundantly and uninterruptedly supplied." In disinfecting a room which has been occupied by a fever patient, the usual plan is to fill it, all apertures being closed, with chlorine gas, or with the fumes of burning sulphur, and after it has been thoroughly fumigated, to throw open doors and windows, and allow the freest ventilation for several days; then to whitewash the walls and ceiling, and, at the end of a week, the room may again be safely inhabited. In Asiatic cholera and typhoid fever the virus is contained chiefly in the bowel discharges of the sick, and these should always be thoroughly disinfected immediately on their issue from the body. Another precaution, which was introduced by Dr. Budd, and has lately been recommended by Dr. Cameron as in his opinion the best of all preventives against cholera, is to flood the drains and closets frequently with disinfectants during the presence of the disease in the country, so as to prevent the little germs, or microbes, from living and multiplying in the sewage. By careful disinfection and isolation, we may hope that cholera, like plague and other scourges, will be effectually combated, and may, in the end, be entirely overcome.

To enable the sanitary authorities to ensure due isolation and disinfection in cases of infectious disease, it is evidently necessary that every such case should be *notified* or reported to them, and

that this should be done as speedily as possible ; for the sooner preventive means are taken the less time is allowed for the spread of contagion, and the more easily can the outbreak be arrested. The prevention of these disorders, it may be observed, has been immensely facilitated by the new sanitary organization introduced by the Act of 1872, according to which the whole country has been divided into districts, governed in matters relating to public health by sanitary authorities ; each of these bodies having its medical officer of health, while all of them are under the superintendence of the Local Government Board, aided by its medical officer. Mr. Simon describes "the new sanitary organization of the country" as consisting of "the Local Government Board, viewed as a Central Board of Health, and the more than fifteen hundred district authorities which, each with its medical officer of health, locally administer the health laws." In the notification of infectious diseases, every case should at once be reported to the medical officer of health for the district. This system of notifying disease has lately been adopted with excellent results in upwards of thirty towns, some of them among the largest of the United Kingdom, and has there been made compulsory by special Acts of Parliament obtained on the application of the local authorities themselves ; and Mr. Hastings has more than once introduced into the House of Commons a Bill for extending the same principle of compulsory notification to the whole country.

Although the highest authorities agree in thinking that the notification of infectious diseases is indispensably needed for their prevention by the State, and should be made compulsory, there is much difference of opinion in regard to the question, Who is to notify? In the infectious fevers, the duty of giving intimation must be performed either by the occupier of the house where the disease has broken out or by the medical attendant ; and a strong feeling exists among large numbers of the medical profession that the legal obligation to notify, and the penalties for neglecting it, ought not to be laid on them, but on the householder. Thus, in an important debate on the subject which took place at the annual meeting of the British Medical Association in 1882, a resolution was carried to the effect, "That this meeting earnestly desires compulsory notification of infectious disease, but it wishes to express its opinion that the compulsion to notify should be placed upon the householder as his duty as a citizen, and not upon the doctor." In the course of the discussion, the President, Dr. Alfred Carpenter, observed that "There could be no doubt that it was the duty of the patient, or his legal guardian, to notify the existence of any infectious disease to the local authority." This seems to me a truth of the utmost importance, which should be carefully considered by the public. The real person on whom the duty of notifying infectious disease naturally rests is, I think, the patient himself, and in some diseases, which do not impair the faculties, he may be legally called upon to fulfil it. But in the contagious

fevers the proper person on whom the obligation should be laid seems to be the householder, as he is the patient's natural guardian, and, moreover, it is he, and not the doctor, who has an early knowledge of the existence of the disease. The assistance of the medical man will doubtless be needed in most cases to diagnose the affection, and he will also usually be the one to fill up the certificate, though the householder may afterwards forward it to the sanitary authority. But supposing that the householder, after being informed of the infectious nature of the disease, *refuses* to notify it, from a fear of injuring his business, or other reasons, I cannot but think that it would then become the duty of the medical man, and that he should be legally required, to make the notification himself; for he could not justifiably refrain from interfering, and see a breach of law committed, which might lead to the most deplorable and even fatal consequences to many persons. The Bill of Mr. Hastings proposes, I believe, to make the obligation to notify binding on *both* the householder and the doctor conjointly; and this, as it seems to me, would be the true principle, if it were made clear that the duty really and in the first instance rests on the householder, and only when he refuses to discharge it, is incumbent on the medical practitioner.

There is one of the contagious fevers in which, besides isolation and disinfection, a third preventive measure of a totally different nature, and which appears to me of immense value, has been very extensively used; I mean *vaccination* in small-pox. In disinfection the object is to destroy the germs of a disease after they have left the body, while isolation deals with them at their source in the patient himself; but vaccination may be described as consisting in this, that after the virulence of the germs has been weakened by certain processes, such as their passage through a different species of animal, inoculations are made with the *weakened or attenuated virus*, in order to protect the system against the action of the *same virus in its stronger form*. It was shown by Dr. Edward Jenner, in 1798, that inoculations with cow-pox matter have the power of protecting the constitution against the virus of small-pox—a fact which the late Mr. Marson, who for forty years had charge of the London Small-pox Hospital, regards as “the greatest discovery in relation to disease ever made by man for the preservation of human life.” It was also thought probable by Jenner that cow-pox is nothing else than small-pox modified or mitigated by passing through the cow; and Mr. Ceely, and Mr. Badcock afterwards, succeeded in producing cow-pox by inoculating heifers with matter taken from a small-pox pustule; but as this is an experiment which very frequently fails, doubts still continued to exist, till in 1881 the truth of their opinion was completely established by Dr. Voigt, the superintendent of the Vaccine Institute at Hamburg. By inoculating a calf with small-pox matter he produced cow-pox, the lymph from which, after being further weakened by transmission through several calves, has been habi-

tually used at Hamburg in vaccination, for the last two years, with the most satisfactory results. "Vaccinia and variola (cow-pox and small-pox) are derived originally from the same contagium," says Dr. Voigt, "and give to those affected by them an immunity one against the other." Again, the eminent discoverer, M. Pasteur, by an invaluable series of researches, has lately shown that vaccination in small-pox is by no means a solitary fact, and that the virus of many other infectious diseases can be weakened or mitigated in a similar manner, so as to furnish a protective material, or *vaccine*, as he terms it, against the diseases. The two methods by which he has succeeded in diminishing the power of an infectious virus and converting it into a vaccine are, either by transmitting it through an animal of a different species, or by allowing an interval of several weeks to elapse between two successive cultures of the little organisms or germs that produce the disease, during which period they are acted on by the oxygen of the air and gradually lose their virulence. By these means M. Pasteur has already obtained the vaccines of several infectious disorders, the most important of which are rabies (hydrophobia) in the dog, and anthrax, or the splenic fever of cattle. Of the second method for weakening the power of a virus he says especially, "We may hope to discover in this way the vaccine of all virulent diseases," and he holds that "we have here a proof that we are in possession of a general method for preparing virus vaccine based upon the action of oxygen and the air."

The close affinity between cow-pox and small-pox, which are really the same disease in different species, explains why the one protects from the other, and according to the best authorities the power of vaccination during childhood, especially when followed by re-vaccination later in life, to prevent small-pox, or render it milder if it does occur, is most remarkable. "One thoroughly good primary vaccination to start with," says Dr. Seaton, in his article on Vaccination in "Reynolds' System of Medicine," "and one careful revaccination at puberty, so conducted as to give evidence that the lymph was absorbed, are all that is necessary for the complete protection of the population against small-pox." The facts which seem to prove most clearly the great efficacy of vaccination are that, as shown by Jenner, inoculations with small-pox matter (which used formerly to be practised, but were made illegal in 1840) produce no effect on a person who has had cow-pox; that the nurses who attend upon small-pox patients, and are constantly exposed to the effluvia, very seldom contract the disease if they have been previously revaccinated, not one of the nurses in the London Small-pox Hospital having become infected during Mr. Marson's long experience; and that the death-rate from small-pox has been enormously diminished in every country where vaccination is in general use. "The present average death-rate from small-pox," says Dr. Seaton, "is scarcely, in any European country, one-tenth part, and in those countries in which vaccination has

been most carefully carried out it is much less than one-tenth part what it was at the end of last century." In England and Wales the total number of deaths from small-pox in 1879 and 1880 were 536 and 648 deaths respectively, which, according to the Registrar-General, are the lowest rates yet recorded. These figures show how vast has been the reduction in a disease formerly more dreaded in Europe than even the plague itself. They show, too, the immense assistance which may be derived from a vaccine in the final extinction of an infectious disease; and they inspire the hope that by careful isolation and disinfection, aided by vaccination, we may succeed before long in completely stamping out and abolishing small-pox, which Sir Thomas Watson describes as "the most hideous, loathsome, disfiguring, and, hydrophobia excepted, probably the most fatal also of the various diseases to which the human body is liable."

There still remain two classes of infectious disease, on whose extinction I would like, before concluding, to say a very few words, namely, first, those derived from the lower animals, the most important of which is hydrophobia; and secondly, the venereal affections, and especially syphilis. With regard to the terrible malady hydrophobia, besides the vaccine lately discovered against it by M. Pasteur, it has been earnestly urged by Sir Thomas Watson, in the *Nineteenth Century Review*, that a means for its complete extinction could be found in subjecting all dogs to a quarantine of six or seven months (which might perhaps be done by muzzling them), as recommended by Mr. Youatt and Sir James Bardsley, for in this period every case of the disease which was in process of incubation would show itself, and the animal might be destroyed. "By destroying every dog in which the disease should break out during strict quarantine," says Sir James Bardsley, "not only would the propagation of the malady be prevented, but the absolute source of the poison would be entirely suppressed."

As regards the venereal affections, their extinction is a subject of enormous importance, for there are very few diseases which give rise to such a fearful amount of human misery. The Acts for their suppression, commonly known as the Contagious Diseases Acts, which were so deeply unjust to women, have been virtually annulled by the resolution of the House of Commons, in 1883, condemning compulsory examinations, and a better system of prevention is most urgently needed. The high authority, M. Mauriac, holds that of the three venereal affections, gonorrhoea, syphilis, and simple contagious sore, the first cannot be extinguished, but that the two others admit of complete extinction, though the last of them, being a slighter and merely local affection, could be far more easily eradicated than the formidable malady, syphilis. It seems to me that the true object to be aimed at in the prevention of syphilis by the State, is to deter individuals from spreading the disease by the fear of being detected and punished. This object

could, I venture to think, be best attained, in the first place, by making the communication of syphilis a punishable offence in both sexes, as is strongly recommended by Mr. Berkeley Hill, and other distinguished writers; and in the second place, by making compulsory the notification of every case of syphilis and of simple contagious sore to the sanitary authority, or in other words to the medical officer of health for the district; and also, in addition to these two enactments, by instituting a most careful and searching inquiry into the origin of every case of syphilis, so as to discover who has been guilty of spreading it. Syphilis differs from the contagious fevers in this most important point, that the patient in a multitude of cases knows perfectly well by whom he or she has been infected, and therefore the origin of the disease can very often be traced. All these inquiries, as well as the notifications of disease to the authorities, should be kept strictly private, so that no names would ever be divulged except those of individuals who, knowing themselves to be diseased, assist in the spread of infection. Whether an individual had acted in ignorance or from culpable negligence would often appear from the circumstance that his disease had been notified and he had been warned of its contagious nature. With regard to notification, which seems to me in syphilis, as in all other dangerous infectious disorders, of immense importance for its prevention, the legal obligation to notify should, I think, be laid upon the patient himself, and not upon the medical attendant; although the latter could voluntarily give intimation in cases where he desired to do so, and would doubtless very often perform the duty at the patient's request. By notification the amount and distribution of syphilis in the country would become known, its increase or diminution could be tested, and the disease would be rescued from the fatal secrecy which, more than any other cause, promotes its ravages. It appears to me that these measures would be just to both sexes, and, though sometimes attended with very painful disclosures, would be no real burden on any but those who wilfully or recklessly communicated disease to other persons; and they would also, I venture to think, be found in the end more effectual than the previous Acts in stamping out syphilis, which has so long been the scourge and terror of mankind in all parts of the globe.

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In the place of aims-giving which humiliates, in the place of charity which caresses an evil that it does not know how to cure, there will be substituted a preventive philanthropy, which by studying want and suffering in their most hidden and deep-seated springs, will be able radically to remove them. Jurisprudence, medicine, and morality follow the same movement, are aiming at the same end—to prevent rather than to cure."

"The motto of the work: 'The diseases of society can, no more than corporeal maladies, be prevented or cured, without being spoken about in plain language' (John Stuart Mill), and its dedication to the poor and suffering, are sufficient to show the tendency of the author. He uses, indeed, a directness of expression, an outspokenness, which is seldom met with in our times, and will probably in most circles of so-called refined society be styled *very shocking* if not *cynical*, though in reality it is not so. The author only calls by their names things which we medical men also have to discuss openly among ourselves and with patients, but which are treated by polite society according to the Parisian proverb, 'cela se fait, mais cela ne se dit pas.' The author, as appears from the title and from his professional knowledge, is a medical practitioner. He merits, therefore, the attention of his colleagues, the more so because, in the first place, they would scarcely guess from the title that this is a book for medical men—and secondly, because his medical colleagues alone possess the education which permits them to estimate without prejudice the aims and efforts of the author, to try the truth of the facts which he lays down as premises, and, after due consideration, either to accept or reject, or to limit and amend, his conclusions and proposals. . . . The author's remarks on the social questions in general are among the best and most deeply-felt we have ever read."—*Schmidt's Jahrbücher der gesamten Medizin*. Band 152, Heft 1.

"This is one of those books of which little is spoken, but which nevertheless are wont to produce a quiet lasting effect, while finding their readers at length in this way that under the influence of peculiar circumstances one person confidentially tells another that in such and such a work there is something to be found. . . . The author is, as a natural inquirer, what one must perhaps still call a materialist and a Darwinian; as a political economist—and he is by no means an insignificant political economist—he belongs to the left wing of the free trade school, to which, in spite of some differences of opinion, he lends on the whole a great impulse, anticipating with confidence its ultimate and complete victory throughout the whole cultured world."—*Vierteljahrsschrift für Volkswirtschaft und Culturgeschichte*, edited by J. Faucher. XII. Jahrg.

"One must first accustom himself to the openness with which the author treats his themes; but the work is unquestionably most instructive and interesting, and is written with great knowledge of the subject."—*Hessische Morgenzeitung*, Dec. 24th, 1871.

"No one, who has turned his thoughts to the solution of the most burning of all questions of the day, the social question, and who wishes to devote to it his mental and practical energies, will be able to leave unread this book, whose anonymous author, basing himself on the Malthusian essay 'On the Principle of Population,' deduces from it with keen logic a peculiar and most striking theory on the cure of the three primary social evils—poverty, prostitution, and celibacy. . . . Whatever may be said against this fearless laying bare of the most intimate relations of social life and against his whole theory, purely and undisguisedly materialistic as it is—even the opponent of the daring socialist will be unable to deny him the merit of scientific closeness of reasoning, and what is quite as important, of warm and zealous philanthropy; he will rather honour the moral courage and mental energy which the author must have had to work his way out of the bewildering maze of hitherto unsolved problems and conflicts, to a conviction so logically consistent, so luminous, and yet so opposed to established institutions and to the moral sentiments in which men have been brought up."—*Knigsberger Hartungsche Zeitung*. December 4th, 1871.

"The author treats, in an open and unreserved manner, the diseases of the human frame, as well as those of society, because he is convinced, with Stuart Mill, that they can only in this way be prevented and cured. In truth we have learned

from many years' experience that such is the case. We bring therefore to the notice of our readers, and recommend them to procure, this excellent book." *Sonnwags-Blatt, Organ für die Freidenker Deutschlands*, edited by Dr. Aug. Specht. January 26th, 1873.

"Many of the author's views are diametrically opposed to our own, but we cannot refrain from describing the book as in very truth an epoch-making one, whose perusal must interest in the highest degree, both the professional man and the educated general reader. Nothing is gained by a prudish avoidance of the subjects treated in the work; they *must* be discussed, and mankind might congratulate themselves if this were always done in so candid and disinterested a manner as by the author of 'The Elements of Social Science.'"—*Hanoversche Anzeigen und Morgenzeitung*. November 14th, 1871.

"A very remarkable book. . . . A regard to the nature of the subjects treated forbids us to enter further into its contents—an exposition of the inner conditions of social life which, for obvious reasons, lie outside the sphere of the daily press. Suffice it to say that we have here to do with a work which differs widely from the common-place productions of the book market, and which will very probably go through no fewer editions in philosophic Germany than in England."—*Reform*, Hamburg, 28th October, 1875.

"There must come an end to the ignorance of the laws of physiology. Every one ought to *know*; and it must be left to his own requirements and his own judgment what use he will make of his knowledge. We must cease to regard as God's will, as destiny, as the inevitable, what is not so. We must cease to look upon that as a duty, which can be defended on no single ground of humanity or social interest. Herein lies the great merit of Owen, when he already, in 1830, published in America his 'Moral Physiology;' of the anonymous author and the translator of the 'Elements of Social Science,' and I may add of the publishers, Truelove, in London, and Nijgh & Van Ditmar, in Rotterdam."—From an article by Mr. Van Houten (member of the Dutch Parliament) in the Dutch Monthly Review, *Vragen des Tijds*, October, 1876.

"This large book is written by a man of science and of feeling; it is pervaded with the life, strength, and earnestness of a deep conviction. Politico-economical and medical theories are set forth so popularly that a child could understand them. The author lays down as the foundation of his work the doctrines of Malthus and Ricardo. . . . The injunction to abstain from marriage roused against them all humane and liberal people, while the momentous truth at the root of their teachings lay buried as it were, and was long trodden under foot and covered with bitter ridicule; but scientific truth never dies, it rises again unexpectedly arrayed in all its armour, and often at the very time when whole councils of physicians are predicting its inevitable decease. The author of the 'Elements of Social Science' examines Malthus's work, rigorously verifies its propositions, and comes to the conclusion that Malthus was unquestionably in the right; he does not, however, rest satisfied with Malthus's remedy, but proposes his own universal means of relief. . . . We have here, doubtless, merely glanced at the views expressed by the author; this is a large work, requiring attentive perusal, and we confidently recommend it to the enlightened Russian public, since only through them can the ideas therein contained find their way to the world of labourers; the book is a great intellectual acquisition; it is admirable not only for its strictly scientific, logical, comprehensive and liberal views, but for its deep humanity and warmth of heart. The author stands on practical ground, he advocates things possible and capable of introduction in every country at a given moment; his ideas, without doubt, do not exclude a social revolution, but in their clearness and definiteness they lie nearer to actual life."—*Общее Дело* (Russian Monthly Journal), September, 1877.