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Address on Public Health

by

E. Lankester

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EDWIN LANKESTER, M.D., F.R.S.

ON PUBLIC HEALTH,

At the Social Science Congress at Sheffield, on the 9th of October, 1865.

SUDDENLY called upon to fulfil the important duties of Chairman of the Public Health Department of the Social Science Association, I do not feel myself at all prepared to do justice to the subjects on which I am this morning expected to discourse. At the same time, I am so fully impressed with the value of the contributions made to our *Transactions* from year to year, by the addresses of the Presidents of our Departments, that I should be sorry to set the example of declining a duty, however unworthily I may perform it, that would lead to the imperfect fulfilment of this part of our annual proceedings. In doing this, I feel that I must rather bring before you the general principles of the various branches of science on which our Department of the Association is founded, than dwell upon details which would have required a larger amount of time and leisure, than I have had at my disposal, to collect and arrange.

In the minds of those who attend the meetings of this Association from year to year, there can be little doubt that the inquiries embraced by the Departments of this Association, are as much based upon scientific principles, and are as amenable to law, as any of those more generally admitted branches of science cultivated by the British Association for the Advancement of Science. It has, however, been the fashion of those who cultivate the natural sciences, to declaim against Social Science, as though it pursued its investigations in a different spirit, or had less satisfactory methods of inquiry. It is very certain, that if our laws, our education, our health and trade, had no better foundations for their existence than the prejudices and opinions of mankind, there could be no more

ignoble and uninteresting work, than for men to meet together and babble about them. But, if I understand this Association rightly, it has been established for the purpose of showing to the world that there is a science of society; that just as we can inquire into the functions of a plant, and discover the laws of its existence, so that we can predict with certainty what will occur to it under certain known conditions; so, with regard to man, even in his most complicated relations, we may hope to discern the laws of his being, and, by predicting what must happen under certain conditions of his existence, constitute the science of society. Nor is this a new idea. The thought that even the complicated phenomena of human life might be reduced to law, was present to the mind of the great thinkers of ancient Greece. Lord Bacon saw that the rational method of inquiring into the properties and laws of natural objects did not terminate with the body of man, but applied to the results of the reaction of his thought and feeling on the external world. The great French philosopher Comte (mistaken, as most English writers believe him to be, on so many points of science and philosophy) was the first to define the limits of Social Science, to give it a name, and place it in a classification of the natural sciences.* But, above all men, we in England are indebted to that great political philosopher and acute logician, John Stuart Mill, for clearing away all difficulties, and, with a philosophical insight and comprehensiveness of thought unrivalled in our day, showing that the science of society could be placed on the same scientific basis as astronomy, chemistry, or physiology. To almost any other mind, the possibility of the reduction of the chaos of facts presented by that wonderful mass of phenomena exhibited in the history and social conditions of man upon the earth, to anything like law and scientific prediction would have presented insuperable difficulties; but he has shown the way, and it is the function of the Social Science Association to follow in the path that he and his disciples have opened up to us.

Fortunately for society, its main facts rest on the branches of science presenting less complicated phenomena than itself, so that as these sciences advance it also is advanced. Let me give an illustration. There is Oersted, holding his magnetic needle on the galvanic current. He is studying the relations of those great forces, magnetism and galvanism. He discovers the laws of that relation. In the hands of others this law is imported into the transactions between men. It becomes the

* Auguste Comte's "Philosophie Positif." Paris, 1830.

Electric Telegraph, and affects the relation of man to man through all time. Our own Department deals with human life —the relation of the laws of life to what we call health and disease. There is no practical hygiene unless we understand the laws of health and the causes of disease. We know not the laws of health but as physiology advances. Physiology is again dependent on the advances of chemistry. The phenomena of chemistry have been understood by the light of the facts borrowed from the sciences of heat and electricity, whilst all its precision has been given to it by the aid of mathematics.

The sciences are bound together by indissoluble links. Man separates them through his feebleness and for his convenience, but there is reason to believe that underlying all the facts and phenomena of the external world, there is one great force, one primal mover, out of which, with unvarying precision, the great phenomena of the universe proceed. Recent researches have shown that heat itself is but a mode of motion, that heat at certain temperatures becomes light. Light, in its turn, as we see in the photographic art, becomes the source of chemical change. Chemical force becomes galvanism; galvanism is converted into magnetism. Motion generates electricity. Galvanism and magnetism produce heat, light, electricity, motion.* This correlation of physical forces is regarded by some philosophers as complete, while others have gone yet a step further. It is but as the heat and light of the sun are poured down upon the earth that plants live. The rays of the sun become more direct, the heat and the light become chemical force in the plant, and now in its secret cells fresh energy is felt, and all the phenomena of plant life are manifest. The rays are now withdrawn, the heat and life diminish, chemical change ceases, the plant life grows sluggish. Some plants die, the majority drop their leaves, and our winter is characterised by a dormant vegetation.† Here we have a correlation of physical and vital forces, but the correlation does not stop here. During the life of the plant there has been deposited sugar, and starch, and gluten, in its roots, its stem, its leaves and seeds. These are the food of animals. Withdraw this food and they die. The chemistry of the sun has formed the starch, the sugar, and the gluten. This chemistry is undone in the animal; it becomes heat—animal heat; it becomes motion—muscular force in the muscles, and in the nervous system, that most

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* Grove on the "Correlation of Physical Forces."
† Draper on the "Chemistry of Plants."

refined of all motions, nerve force, by which the spirit of man becomes cognisant of sensations, accumulates ideas, reasons, and becomes an intelligent, conscious, and responsible being.

It is here, I think, that we get a glimpse of a real connection of the sciences; of a dependence of one upon the other; and of such a connection between the most recondite and practical departments of Social Science, and the most elementary inquiries of the physical philosopher, as clearly demonstrates the claim of this Association to the position of a scientific body, and points the road it must follow, in order to achieve for man the highest triumphs of his intellect in unravelling the deepest secrets of his existence.

But now let us inquire what is the position that the Department of Public Health should take amongst the branches of Social Science. At first sight, it is very evident that there is no sharply defined line between our various departments, and that each contemplates facts and principles which are, more or less, common to all. At the same time, our consciousness of health and sickness is one of the most common facts of our existence, and we have no records of communities of men who are not cognisant of disease as opposed to health, and who do not employ some measures, whether efficacious or not, for the prevention of disease. Our Department, then, contemplates the laws of health and disease, with the object of applying that knowledge to the prevention of the latter.

Herein hygeine differs from medicine—the first prevents, the latter cures. Or, if you like to enlarge the meaning of the term medicine, our Department may be otherwise called that of preventive medicine. Our inquiries, then, must be more particularly carried on by the aid of the science of physiology, which contemplates the laws of life; and, in as far as physiology is connected with the sciences of chemistry, and the various branches of experimental and physical science, we must call them to our aid.

Our object being the discovery of the causes of disease and death, and the means of so averting and altering these causes as to prevent these calamities, it becomes essential to us that we should classify our facts, so as to present them in a simple and comprehensible form. Now the great factors of our life are air, water, food, and heat. To one or other of the relations of these agents to our life can we refer all the varied questions with which we have to deal.

There is no animal existence without air. The humblest monad needs for its existence a supply of oxygen gas. It moves and lives but as that oxygen produces chemical changes in its interior. The law is universal. Man is but an aggre-

gation of monads. Each busy cell, of which his body is composed, contributes to the aggregate of his life, only as it is acted upon by the oxygen of the air. This fact lies at the foundation of a hundred branches of our inquiry. It is the necessity for this oxygenation of our tissues that gives all the importance to our inquiries into the ventilation of houses and workshops, of cowsheds and stables—in fact, of any place where living breathing beings are enclosed. It is this fact which lies at the foundation of all our anxiety about the overcrowding of our dwelling-houses, factories, and shops. By the aid of this great primal fact, we explain the unnecessary disease and death from scrofula and consumption; and by rendering it more and more a first principle of human action, we hope to save the lives of thousands of our fellow-creatures. These inquiries result from the one single fact that man requires oxygen, which he obtains from the air. But the air in which he lives not only supplies him with oxygen, but it is the great repository of all that is exhaled from the earth, and it comes to him and to the lower animals, burdened—alas! too often fatally burdened—with poisons; chemical agents that, swiftly coursing through his blood, work their destructive action on his frame, and either damage the functions of his life or destroy his existence altogether. All the great questions that gather round us of epidemic or endemic, miasmatic and contagious diseases, will find their appropriate place in our inquiries into the nature of impure and poisoned air.

Water is another factor of organic life. Without water no chemical change can take place in a living body. A large number of animals have their existence determined by water. Water enters into the composition of all organic beings. A man weighing 154 pounds contains 111 pounds of water in his tissues.* The oxygen that vitalises his tissues is conveyed by water. The starch, the fat, the protein, necessary to the existence of animals, are all digested, absorbed, and conveyed to the tissues by water. These substances, through whose chemical change life is possible, are decomposed in the presence of water, and the products of this decomposition are carried off by the agency of water. All the higher animals drink water for this very purpose, and the adult human being, on an average, in one form or another, drinks from 70 to 80 ounces of water a day. Water is the most potent of chemical agents; its solvent powers are equal to aqua fortis or oil of vitriol, and it associates itself in nature with a vast variety of compounds with which it comes in contact. It dissolves both organic

* "Guide to Food Museum, South Kensington."

and inorganic matters; hence it may become so contaminated as to be unfitted for the purposes of life. From the inorganic world it may take up the salts of lime, iron, lead, and other compounds, in such quantities that when taken into the human body it is not only unfit for healthy life, but it may become the source of immediate disease or death. Like the air, it may become the medium of introducing those definite organic poisons, which, kindling similar poisons in the living system, are at once the source of disease to others and the death of the individual suffering from their action. Hence our inquiries embrace the means of supplying to every individual a sufficient quantity of pure water for his healthy existence.

But water has other than this fundamental relation to the life of man. Man is a washing, cooking, and manufacturing animal, and wherever water is used in these relations so as to affect his health, the question raised is one that belongs to the Department of Public Health.

As the animal organism cannot live in air and water, but requires varied compounds of carbon, oxygen, hydrogen, and nitrogen for its existence, the whole question of the relation of the compounds of these elements used as food, becomes the subject of our inquiries. Here our researches are based especially on chemical facts, and we must take for our guides Mülder and Liebig, and the great school of chemical physiologists. The freshest air and the purest water will be no protection from disease and death unless the human system is supplied in its food with the elements necessary for the play of those chemical forces which result in life. Not only must there be food supplying the materials of combustion and nutrition, but each tissue is built up and constituted in its own peculiar way. The blood must be supplied with chloride of sodium and iron; the bones with phosphate, carbonate, and fluate of lime, the muscles with potash, the bile with sulphur, the saliva with cyanogen, the teeth, hair, and nails with silica. A diet deficient in any of these materials may be the source of disease. Our navy was formerly decimated for want of fresh vegetables. Our army was starved on an excessive diet of salt beef. Our children die if fed alone on arrowroot and corn-flour. Those who inhale abundance of fresh air, and have access to infinite stores of pure water, nevertheless fall easy victims to diseases which result from the redundance or deficiency of the compounds which in natural quantities constitute the source of their daily life. The inquiry as to what constitutes the best food for man in all the various conditions of his life is one yet in its infancy, and it is perhaps a question

as to whether the entire ignorance of a great portion of the community on this point is a greater evil than the arrogance with which pseudo-scientific teachers pretend to instruct the public as to what they should "eat, drink, and avoid." In the absence of all consciousness that he knows, man, like the lower animals, is guided by an instinct which is sufficient to preserve and increase his race; but with knowledge comes this danger (which in all cases must be risked), the danger of hasty generalisation. In this frail bark how many of our race have perished before gaining a firm footing on the truths of well-established science! This is the reproach which the student must patiently bear from the crowd whilst he is seeking some higher guide than that which they possess in common with the brutes that perish.

Nor ought we to forget in our Department, as a question of food, the remarkable tendency of man to partake of nervous stimulants. The extent to which substances may be taken with impunity that address the nervous system, is a question that is occupying the attention of some of our most distinguished physiologists,* and whilst at the present moment science cannot be said to have pronounced on the question, there is no doubt of the fact, that one of the most terrible scourges of the human race is the tendency to indulge to excess in drinking alcoholic beverages. The vices of tobacco smoking, chewing, and snuffing, with opium and hemp eating, exert but little evil as compared with the terrible vice of drunkenness. There are many here who will feel that the interdiction of these beverages is not the sound conclusion of Social Science; but all must acknowledge, in a scientific point of view, the value of the large body of facts which have been presented us by total abstainers from alcohol, who have thus demonstrated that the consumption of these fermented liquors is not necessary for the maintenance of health or strength.†

Air, water, and food, are necessary to the naked savage. Not in this climate could civilisation advance, without provision for the artificial maintenance of heat. At the temperature of 32°, water becomes solid, and is no longer capable of maintaining life. In those regions of the world where the temperature never rises above this, there is no life. At much higher temperatures, only plants and animals of the lowest types and feeblest vital powers exist. It is not till we ascend the animal scale, and arrive at birds and mammalia, that we find animals constructed to maintain their own temperature, and

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* Anstie on "Stimulants and Narcotics."

† Lankester, "Lectures on Food."

thus become independent of external sources of heat. This animal heat is maintained by the combination of the carbon of the food in contact with oxygen, and animals living in low temperatures maintain their heat by large supplies of food. Their whole existence is absorbed in seeking food to maintain their heat, against the cooling influence of the external atmosphere. Withhold food, and they perish. So with man; unclothed he barely exists; but he clothes himself with skins, and builds himself a hut. He economises his heat, he consumes less food, his skins are changed for cotton, linen, and fibrous fabrics; his huts for houses, mansions, and palaces; and in this relation of his vital functions to that mode of motion we call heat, we see one of the great causes of his civilisation. No questions that can come before our Department can have a higher or more commanding interest, than this one of heat. Look at the thermometer on your garden wall at this season of the year. Night after night it gets lower, and as it falls degree after degree, the rates of mortality rise. A cold day in winter is the death-knell of thousands. We know this. It is a law. Can we not avert this disaster? Must our intelligence be brought up at this point, and man be told that although he has, by clothing, and warming his dwelling-place, successfully resisted the cold that must have made him a savage, he can go no farther? I do not believe it. Here is a great question for us to discuss and look into—how we can best save the life which is every year destroyed in our climate by cold.*

But high temperature has its perils, though not perhaps so great as low. Diarrhœa, in the summer of our country, is the representative of the chest affections of the winter; and, I believe, is more under the control of the application of known laws for its removal, than the latter diseases. We must then study the laws of heat in relation to the life of man, in order to be able so to construct and warm our houses, and arrange our clothing, as to secure immunity from temperatures destructive of health and life.

I might have prolonged this sketch of the fundamental principles and objects of the Department of Public Health; but I am anxious to dwell a little more at length on some occurrences which, at the present moment, have assumed a gravity that, in point of interest, throws a shade over all other questions. I allude to the presence of cholera on the continent of Europe, and to the extensive prevalence of the Siberian cattle plague in England. In anticipation of the one plague, and in the actual

* Richardson on "Waves of Heat and Death."—*Popular Science Review*, 1865.

presence of the other, there is enough to excite the keenest interest of the most apathetic, and to induce the most anxious inquiries as to the causes of these diseases, and the best means of arresting their progress.

I will not now attempt to settle the question whether these diseases are contagious or not; whether they arise from a special poison which is propagated in one body and is conveyed to another, or whether there are certain general conditions of external agents which engender poisons capable of spontaneously producing them. I need but thus generally to refer to the fact of a difference of opinion, to remind you that amongst our sanitary reformers there are two great schools, one of which maintains that the great mass of zymotic diseases are produced by special poisons, and are called contagionists, whilst another school do not believe in the existence of special poisons, but believe that certain general conditions of sanitary neglect and dirt are alone necessary to produce the group of zymotic diseases—and they are called anti-contagionists. Now, I believe that the extreme views of either school are wrong, and I have a very deep impression that for sanitary measures to be directed by one or other party in the present state of our knowledge of the diseases would be to plunge us into evils as great as those of quiet submission to their unresisted influence. For an officer of health to suppose that cleansing, and draining, and washing, would arrest the progress of small-pox in a house full of unvaccinated persons would be an utter absurdity; whilst the placing a cordon around an ill-ventilated and badly warmed house, expecting to keep off bronchitis and pneumonia, whilst the temperature is 12° below freezing point, would be equally absurd. But whilst all are agreed that small-pox is a contagious disease and bronchitis is not, there is a large class of diseases on which sanitary authorities differ as to their nature, and the best modes of arresting their development. It is on this account that I now propose briefly to examine what is really known of the nature of contagious diseases and their mode of propagation; and if I succeed in nothing further, I hope I shall be able to show you that it is of the utmost importance in all our sanitary operations that we should at least consider the issues of both theories; that whilst believing in contagion, we should act as if all depended on the removal of the general external agencies of disease; or whilst believing in the spontaneous origin of diseases in dirt, we should yet do all to avert the possibility of their propagation by contagion. It is of the highest importance, at the same time, that we should pursue the inquiry into the origin and nature of those zymotic or miasmatic diseases which carry off annually upwards of 100,000 of our population.

In order to do this, I think there are three circumstances that demand our attention. There is, first, the poison that is supposed to kindle the disease; and secondly, there is this medium that conveys it to, thirdly, the person predisposed to take the disease. If we lose sight of any one of these elements in investigating zymotic diseases, we shall most assuredly get wrong, and practically commit great mistakes. Thus, let me take small-pox as an example. In order to propagate this disease, there must be, first, the poison matter from a small-pox pustule; and secondly, a medium of conveyance, either the point of a lancet, or an atmosphere to convey the poisonous germs; and thirdly, there must be a person predisposed to take it. If the poison is not there, no amount of predisposition, that we are aware of, will engender the disease. Again, if the poison is there, and the predisposed person, there must be a medium of conveyance: if a predisposed individual is one side of a bed, and the affected individual in bed, and the current of the atmosphere blows from the unaffected to the affected individual, no poison will pass and no disease be established. Or again, the atmosphere may be so extensive as to dilute the poison to a tenuity by which it becomes powerless; or the atmosphere may be artificially ozonised, or iodised, or chlorinised so as to destroy the germs of the poison. But let the poison be ever so intense, and the medium ever so ready to convey it, if the unaffected individual has had the small-pox or been vaccinated, no disease will be produced. Hence, we must study the poison-makers, the poison-bearers, and the poison-takers.

Now, with regard to poisons, even the anti-contagionists admit that in what they call miasmatic diseases conglomerations of dirt and filth, or matters in their wrong places, do get into the system, and, at one time or another, do upset and damage the healthy working of the machinery; and they ought to state in a scientific way what compounds are produced by dirt, and in precisely what way they affect the system. There can be no doubt that certain inorganic agencies, such as carbonic acid, sulphuretted, phosphuretted, and carburetted hydrogens, ammonia, and sulpho-cyanogen do produce injurious effects upon the system. Continued exposure to such exhalations may prevent a proper oxidation of the tissues, and render it predisposed to take in the diseases of special poisons, but we have no evidence to show that any of these agents—although they will destroy life—are capable of producing alone any of the forms of miasmatic disease.

Again, it seems demonstrated that there arise, during the decomposition of vegetable and animal matters, certain organic molecules which, being taken into the system, will produce

certain definite changes in the system constituting well-known forms of disease. Thus, ague and kindred fevers, called paludal and paroxysmal fevers, do not seem to be produced by poisons formed in the animal system, but by poisons formed during the decomposition of vegetable matter. A certain amount, also, of the diarrhœa of summer is to be set down to the decomposition of animal and vegetable matters. Certain quantities of these matters are directly taken into the stomach and bowels, whilst others appear to come in contact with the mucous surfaces by inhalation. There is, also, one of the endemic and epidemic fevers of our country that is supposed by high sanitary and medical authorities * to originate in the spontaneous decomposition of organic matters in drains and sewers, hence it has been called "drain-fever." It is, however, generally better known by the name of gastric or typhoid fever. That this disease is generated by a specific poison has been demonstrated by Dr. William Budd of Bristol,† and, should it be capable of demonstration that this diease is really generated *de novo* by the matter of drains and sewers, it would be an interesting fact, as showing the possibility of a contagious disease being produced afresh. But, up to the present time, we have no conclusive experiment with regard to the origin of any of the specific contagious diseases. There is no error, perhaps, of more vital importance to the public health than that which was fallen into by some of our early sanitary reformers—a belief in the spontaneous origin of the several forms of diseases produced by specific contagions. The most common forms of contagious diseases in this country are small-pox, scarlet fever, measles, whooping-cough, typhus fever, typhoid-fever, and our occasional visitant—Asiatic cholera.

Of the intricate nature of the poisons producing these diseases we know but little; but recent researches with the microscope, ‡ lead us to hope that we are not far distant from the time when, at least, the form of the poisons of these diseases will be made visible to the human eye. It is a fact known to all, that the blood contains two sorts of cells or globules, one red, the other white. The white cells are composed of matter in a state of vital change. It is these cells which accumulate in inflamed parts, and which form the pus found in vesicles, pustules, abscesses, and inflamed surfaces of the body. These pus cells have a great power of multiplication, and they retain their vitality after they have been removed from the living

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* *See* "Murchison on Fevers."

† *See Lancet* and *British Medical Journal.*

‡ *See* "Lecture on Inflammation," in *Medical Times and Gazette*, by Dr. Beale.

body. We can convey common pus cells from one living body to another, and make them increase. There is a disease of the eye attended with a large formation of these pus cells, and these may be conveyed through the air from one person's eye to that of another, and produce the same disease. In the disease known as pyæmia these cells assume a specific character; and Dr. Richardson informs me that he has succeeded in producing, artificially, pyæmia in animals by introducing the secretions of an animal affected with pyæmia into one that is not. In small-pox we have a disease characterised by pustules over the body. Each pustule contains a secretion abounding with pus cells, and the matter with they are formed. It is the introduction of this purulent matter into the blood, that sets up the dreadful malady of small-pox. In the same way we find the vesicle of cow-pox charged with white cells, and the "germinal matter" of Dr. Beale. The germinal matter here, however, does not possess the vitality and energy of that of the small-pox pustule. It is seldom conveyed through the air; like some other animal poisons with which we are acquainted, it requires contact; but, in being introduced into the blood of another person, it produces the same disease—always the same disease, never another. We may learn much of the nature of these poison-cells by the study of those we know so well. These cells, or germinal elements, retain their vitality long after they have been removed from the body, if you exclude them from the air. The vaccine lymph has been conveyed between pieces of glass, or dried on tips of bone or threads of linen and cotton, all over the globe, and has been found capable of engendering the disease cow-pox. This shows us how all these poisons may be covered over in linen, cotton, and woollen fabrics, how they can be conveyed in letters and newspapers, how they may adhere to inanimate substances of all kinds, and only need the awakening influence of a little moisture to summon them to awake and live anew.

No one, that I am aware, has yet isolated the poison of scarlet fever, of measles, of typhus, of cholera, and of the other diseases of the group of contagious diseases; but, reasoning from analogy, and there could hardly be a better instance of the process, we are driven to the conclusion that these diseases depend on a cause similar to that of small-pox, and that the real form of the poison is the changed white cell of the blood. It is, however, interesting to notice some varieties in the habits of these poisons. Thus, we are not aware that the poisons of small-pox, measles, scarlet fever, or typhus, are conveyed by any means but through air, whilst there is every reason to believe that the poisons of typhoid fever and cholera are con-

veyed by the agency of water. There is an interesting relation between this fact and the seat of the disease, for, whilst one set of diseases manifests themselves by eruptions upon the skin, the other set is characterised by derangements of the mucous membrane of the intestines.

A question of high interest arises here, and it is one that has not at present been settled, and that is, as to whether the poison matter of these diseases is capable of multiplying itself by cell-division out of the body. It does not seem impossible that this should be the case, although at present we have no demonstration of the fact. We know that such multiplication takes place among the lower forms of plants, as the yeast, or ferment-fungus, (*Saccharomyces Cerevisiæ,*) and that it also occurs amongst the vibrios and monads in the animal kingdom.

Another interesting question, connected with these poisons, is the possibility of transformation or development. In the animal kingdom we have this phenomenon taking place, that an animal passing from its egg to its adult stage is capable at each stage of multiplying itself, so that a number of creatures are produced at each period of its growth, capable of attaining, under proper external circumstances, the adult form. Now it may be, that amongst these cell-poisons, there are stages of development at each of which the cell is capable of propagating its own form and no other, till it meets with the proper external circumstances for a further change or development. Professor Huxley relates that on board the "Rattlesnake," after they had been six weeks at sea, the cook got an attack of erysipelas; this spread through the ship and ceased. After this, one of the sailors had mumps, and this also spread through the ship. There are other interesting facts bearing on this point, but I throw out these hints here as subjects full of practical importance to the sanitarian.*

Let me now say a few words with regard to the means of conveyance of poisons. The most obvious of these means are the atmosphere and water. The air to carry most poisons must be warm and moist. The poison of yellow fever spreads in hot climates; the poison of typhus is arrested by heat on the one side and cold on the other. It prevails, in fact, only in climates having a range of temperature between 40° and 62° Fahrenheit. At the temperature of boiling water all these poisons are destroyed. A most important fact, as we have in every household in Europe the means of destroying them.

But there are other means of conveyance besides air and water. Articles of food, articles of wearing apparel, bedclothes,

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* Paget's "Lectures on Surgery."

curtains, carpets, and all vessels and depositories containing the secretions of human beings, may retain the poison cells in all their integrity. These things may carry the poisons from household to household, disseminate them in our streets, our omnibusses, our railways, steam ships, and public conveyances of all kinds. The drain may carry them into the sewer, and the sewer into the river, but in their course they may escape from our ventilating shafts, our gully holes, and open closets. They may be emptied into our wells and rivers, and conveyed to our bodies by means of spring water or river water. They may be shut up in drawers or in old closets (of which there are many striking instances on record), and, at any moment when brought in contact with the human system, they may start into life and activity again, to renew their ravages on systems predisposed to their action.*

That the poison of a disease may exist, and every possible access to a system be present, and yet the disease be not taken is well known. Instances frequently happen of persons living to old age, without having had any of the ordinary contagious diseases of mankind. It would be well to make a more accurate study of these cases. But we know something of the laws of predisposition to disease. We know, for instance, that persons who have had the small-pox are not disposed to take it again. We know that in nine cases out of ten if persons have been vaccinated they will not take small-pox. This is one of the great triumphs of our modern civilisation. It is the beacon of our hopes with regard to crushing out for ever the poisons that can only be propagated in human systems. But our knowledge of predisposition extends further than this. We know that where the four great factors of our life have been scantily supplied, or vitiated, there predisposition, not only to idiopathic and self-generated disease exists, but to receive the germs of the poison fevers, of which I have been speaking.

So well is this known, that we can point out certain external conditions, which will so act upon the human system as to predispose it to certain forms of disease. Thus, amongst our working men and women who live in badly ventilated and overcrowded houses, we find those who are most ready to take the poison of typhus. Amongst the underfed, the fever called relapsing, and which differs from typhus and typhoid, finds its most ready victims. Hence it has been called famine-fever. But no class or condition of men have been discovered who are

* For instances *see* Dr. Watson's "Lectures on the Practice of Medicine, in the case of Scarlet fever;" and Dr. Shapter's "History of the Plague in Exeter," for that disease.

not susceptible of these poisons. The medical man who lives free from the influence of over-crowding or famine, in his own home is frequently stricken down with these fevers. The anxiety of the student, the statesman, or the prince, may undermine his health, and render him a ready victim for the poison that lies concealed like a snake in the grass in his path. It is not necessarily among the over-crowded and badly ventilated rooms of the poor, and the squalor and filth of our lowest classes, that scarlet fever selects its victims, and commits the greatest ravages. The homes of the rich, and the hearths of the comfortable middle classes of England, are made desolate by this all-pervading scourge, and it is a mockery to say that we know the conditions of those who will be the subjects or the victims either of scarlet fever, or its twin-sister of mischief, diphtheria. That both these diseases depend on a special poison, which can be communicated through the mediun of the air, and preserved in activity on inanimate substances, as clothes and excreta, I have no doubt, but we cannot predict with any certainty who will be their victims.

What is true of human diseases is also true of those of the lower animals which man associates with himself. The horse, the ox, the sheep, and the pig are all liable to idiopathic and contagious diseases. Like human diseases, many of them are *sui generis*, and incommunicable to man. The sheep of our country have just passed through a "great epidemic of small-pox." It had all the peculiarities of the small-pox in man, but it was not capable of extension to man. At the present moment, a more frightful scourge is visiting our cows, drying up one of the great sources of the food of our infant population, and rendering scarce the animal food so necessary to the health and strength of the working man. This disease is not new, it is the steppe murrain of Siberia, where it seems permanently to exist. It is well known in Europe. Germany stands in constant fear of it, and by her excellent quarantine arrangements, has for years stopped its introduction into the rest of Europe. It has, at last, escaped her vigilance, and a cargo of affected beasts having found their way to Great Britain, our herds have been already more than decimated by its visitation. There is no mystery about this disease. Warning voices have not been wanting on this matter, and we are especially indebted to Professor Gamgee * for having pointed out years ago, the danger we were incurring in not taking steps for the prevention of the introduction of this terrible disease. It is not for me here to discuss the question of the nature and origin of

* "History of the Cattle Plague." Hardwicke. 1865.

this plague. But should there be any persons who are doubting either that this disease is contagious, or what are the best steps to be taken to arrest it, I would urge upon their attention the facts which have already been accumulated on this subject, for the purpose of removing that hesitation in adopting preventive measures, which is as fatal in cattle as in human diseases. In an able paper* read by Dr. W. Budd, at the last meeting of the British Medical Association, he has clearly pointed out the close similarity of this disease to human typhoid fever, and expressed his opinion that it is quite as nearly related to that disease as the small-pox of the sheep is to human small-pox.

That it spreads and behaves itself as a contagious disease, I have had the opportunity of observing in the parishes of Hampstead and Hendon. In the now celebrated case of Lord Granville's cows at his farm at Golders Green, Hendon, the disease appeared in some cows not belonging to his lordship, but which were kept in a meadow contiguous to his lordship's farm. The disease broke out on that farm in the largest and best ventilated cowshed of three that contained altogether 140 cows. Now this cowshed, which contained at least 1,200 cubic feet of space for each cow, against a much smaller space for the other cows, was the one in which the disease first appeared. If dirt, overcrowding, or want of ventilation had anything to do with this disease it would not have broken out in that shed. But that shed is situate on the common footpath from Child's Hill to Golder's Green, and men, women, and children are continually passing and repassing that cowshed, from the meadow in which the cows were first diseased. Knowing, as we do, that the excretions of these animals must contain the poison germs of the disease, we can have little doubt as to how the cattle plague got into that well-kept and well-ventilated shed on Lord Granville's farm.†

Studying this disease from the three-fold point of view of its poison, the means of its communication, and the predisposition of its victims, we are struck at once with the fact that it is not the calves, or the bullocks, or barren cows that are attacked, but it is the milch cows. We cannot fail to see a cause of this predisposition in the comparatively unnatural condition in which the milch cow is kept for the purpose of obtaining from her milk all the year round, that gives to her, beyond all her congeners, the tendency to take this disease. In such facts as this we may see beyond the law which devastates our flocks,

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* *See Social Science Review* for September, 1865.

† *See* Lord Granville's letter in the *Times*, September, 1865.

—a law maintaining the integrity and strength of the species by the letting loose of poisons to destroy the weak and those which are likely to produce an enfeebled race. Nay, even further, is not this the great lesson that we should learn from the epidemic attacks of these poison fevers, are they not sent to take from us the constitutionally weak and feeble, so that the race may retain its vigour upon the earth? This, however. must be no excuse for indolence in doing all we can to place our race in such a position that it may successfully defy the attacks of poison, and each member of a community be the possessor of all the highest physical qualities of his race.

But I must pass on from the consideration of the abstract principle involved in our inquiries, and invite you for a moment to consider the practical action they involve. Our subject here very appropriately divides itself into two heads; public action and private action. It is the duty of the civil Government, in matters of life and health, to do for the individual what he cannot do for himself; and it is the duty of individuals to do for themselves what the Government cannot be expected to do for them.

If we could place our towns and cities under the governance of an enlightened despot, we should at once gain much from the application of our present knowledge of principles. Could we carry out as severe a code of sanitary laws as those which the ancient Jews submitted to as a divine dispensation, there is no doubt that results of a most astonishing nature would follow. But we must rest satisfied with following the slow genius of our nation, and submit to the government and institutions with which we are surrounded. I cannot here enter into the details of our sanitary legislation. It has been slow, and its action has been by fits and starts, as now and then the public mind has been alarmed, and the legislative mind has sympathised with it. But the fearful death-rate of many of our large towns, the neglected and unsanitary state of our villages, show that whatever our legislation may have been, it has yet failed to produce any great impression on the mass of our population; dirt and filth, disease and death, keep pace with our activity. We no sooner improve than we go back again. Here is a record of our deaths from zymotic diseases (the absence of which is regarded as the best indication of our sanitary activity) for the last twelve years.

ANNUAL RATE OF MORTALITY per cent. from *Miasmatic* Diseases* in England and in London, in each of the years 1851 to 1863.

Years.	Deaths Annually to every 100 Persons living.	
	England.	London.†
1851	·49	·53
1852	·52	·50
1853	·47	·54
1854	·61	1·07
1855	·45	·53
1856	·41	·50
1857	·47	·49
1858	·55	·58
1859	·52	·57
1860	·36	·43
1861	·42	·52
1862	·43	·59
1863	·56	·67

You see we have made but little, if any, progress. In 1860 it looks as if these diseases were at bay, but how fearfully it rises in 1863. My conviction is, that our legislature wants earnestness. All our acts are so constituted that they may be defied with impunity. They, in fact, give the power of action to those who are either interested in maintaining sanitary abuses, or are ignorant of the dangers which arise from their toleration. The Metropolitan Management Act was, undoubtedly, the largest instalment that the legislature ever made towards correcting the sanitary abuses of London, and in the creation of the office of medical officer of health, has laid the foundation of future sanitary legislation. That this office has worked well, in London, and has contributed to a large amount of sanitary action, there can be no doubt. But, from the fact of the medical officer of health being entirely dependent on the vestries of London for his appointment, his duties have in many districts been interfered with, and his ability to act for the public good reduced almost to a sinecure. So much has this been the case, that persons have suggested that he should be appointed by the Government, and respon-

* The class of cases coming under the term of "miasmatic" are typhus, dysentery, diarrhœa, cholera, scarlatina, &c.

† The results for London were derived from the deaths in the Weekly Returns embracing 364, and in some cases 371 days in a year; the above rates have been corrected for the difference between those numbers and 365·2422 days in a year.

sible to the Government alone. The objection to this plan is, that he is at present paid by the parishes requiring his services, and that Government appointments are not always free from the objection that Government does not monopolise all the intelligence of the country, and is not free from the charge of favouritism in its selection of officers. The great bar to sanitary action in our vestries and local boards is their parsimony; and if they could be once made to see that disease and death are the most costly luxuries in which man can indulge, they would possibly give more scope to the action of their medical officers of health. Perhaps one of the greatest improvements that could take place in the London system would be the appointment of the medical officers of health for life, and reducing their numbers, giving them larger districts to superintend, and appending salaries which would render it unnecessary that they should attend to private practice.

The same system should be extended to districts beyond the metropolis. It is almost impossible under our present laws to initiate sanitary improvement in the villages and small towns of the country. The most gigantic nuisances are allowed to grow up without let or hindrance, and it is only when some terrible calamity visits a place, that any action is taken. The Metropolitan boundary is studded with villages that the Management Act does not reach, and which are a disgrace to our civilisation. Such a village exists at Childs Hill, in the midst of a farm belonging to the Lord President of the Privy Council. I mention this to show how defective our sanitary legislation is at the present moment, so that the representative of all sanitary authority in Her Majesty's Government is helpless to remove nuisances at his very door. It is most necessary that medical officers of health should be appointed to large districts in the country, with power to remove, and compel owners of property to remove, the most common and obvious sources of death and disease. In all great public improvements, which have for their end the health of the people, the law should act with more certainty, and the rights of property should not be allowed to interfere with the higher claims of health and life.

In thus commenting on what appear to be the defects of the law, I am aware how fully the laws represent the opinions and feelings of the people of this country, and if the law is inefficient or unacted upon, it arises from the want of knowledge on the part of the people themselves. Not only does this ignorance tell upon the legislature, but even were it possible for the legislature to provide all the conditions of a healthy existence, this object could not be obtained unless the people were sufficiently instructed to avail themselves of the rights thus con-

ferred upon them. I have alluded to some of the great facts upon a knowledge of which our healthy existence depends. It is in vain that the Legislature enacts a plan upon which houses shall be built to ensure ventilation, unless the inhabitants of those houses understand the worth of fresh air. In vain is fresh water brought to our doors, if in our indolence and ignorance, we refuse to use it. There must be intelligence both in the legislator and those for whom he legislates, if we are to take advantage of our present knowledge of the laws of life to secure us from disease and death.

When one sees how little is the effort made to introduce into our general system of education a knowledge of those great laws of physics, chemistry, and physiology, on which our life depends, one is filled with dismay at the prospect before us. When the leading educationists in our country are carrying on a controversy as to whether in our examinations the highest rates of marks shall be given to classics, mathematics, history, or modern languages, one feels that they are quarrelling over dry bones, and forgetting all that which gives life and reality to our existence. It is not till the great facts of the natural sciences shall take a proper position in the studies of our universities, where the majority of our statesmen are instructed, that we can expect them to be taught in the middle class schools, where our vestrymen gain the elements of their education. It is only when those who instruct weekly in our pulpits, and influence the education of our lower class schools, are themselves taught the great laws by which the Creator governs the life of the world, that we can expect our working classes to exercise that judgment and self-control with regard to their health, the want of which causes the sacrifice of holocausts of victims amongst them every year.

When I consider the sacredness of human life, when I know how sacred we all regard it, I feel as if it were a bathos which I ought to avoid, to remind you how costly a thing is disease and death. But it is true the gain of 100,000 lives annually would pay ten times over the cost of all the exertions that would arise to secure them for life and for their country. But I will not pursue the subject. I leave now the question of the public health in your hands, to work out its great problems, as amongst the most patriotic and the noblest to which the human mind can be devoted.