

cos/33

PUBLIC HEALTH

IN RELATION TO

AIR AND WATER

BY

W. T. GAIRDNER, M.D.

FELLOW OF THE ROYAL COLLEGE OF PHYSICIANS, EDINBURGH,
PHYSICIAN TO THE ROYAL INFIRMARY,
AND LECTURER ON THE PRACTICE OF MEDICINE

EDINBURGH:
EDMONSTON AND DOUGLAS.
1862.

P R E F A C E.

THE Lectures which form the larger part of the present Volume were delivered during last summer to an audience partly composed of students of medicine, and partly of persons otherwise interested in the subject of Public Health. The circumstances which made it appear to me expedient to engage in a short course of instruction on this subject, are fully stated in the beginning of the first of these Lectures ; and it has been thought better, on the whole, to preserve in their revision as much as possible of the original form, than by any considerable alteration of plan to aim at removing the peculiarities of oral delivery. I have, however, taken some pains to render all the chapters of this work more complete, as well as more exact in certain points of detail, than was easily possible in the lecture-room ; and the last chapter in particular, though based on the short-hand writer's

notes, has been greatly extended, and almost entirely rewritten.

The remainder of the Course as actually delivered, consisting of five additional Lectures placed between I. and II., was devoted to the more technical and scientific consideration of the various circumstances bearing on the death-rate, and on the application of the Registrar-General's data to sanitary purposes. These Lectures have been withheld from publication for the present, as being less popular, and therefore of less direct practical application than those included in this Volume. I have added a considerable number of Notes, mostly upon subjects of importance to the sanitary reformer ; and although it was impossible to introduce these into the text of the Lectures, I am anxious to bespeak for them the attention of those who desire to see (what is so much wanted in Scotland) an increased amount of practical activity in the improvement of the Public Health.

EDINBURGH, JANUARY 1862.

CONTENTS.

	PAGE
I. Introductory	1
II. Air and Water as Sanitary Agents	59
III. Impure Air	93
IV. Scanty Water	150
V. Impure Water	187
VI. Drainage and Sewerage—Recapitulation	238
VII. Sanitary Organization	291

NOTES.

A. The Sanitary Works of Ancient Rome	38
B. State of the Towns in England in the thirteenth century	44
C. Defoe's account of the Shutting up of Infected Houses in the great Plague of London in 1665	47
D. Tables illustrative of the Science of Death-rates	51
I. Rate of Mortality in England and Wales	52
II. Rate of Mortality in London	56
III. Death-rates of various ages	57
E. Death-rates of the eight principal Towns of Scotland for six years	58
F. Popular Errors in regard to the Origin of Morbid Poisons	89

	Page
G. Money Value of a reduced Death-rate as compared with the corresponding expenditure on Sanitary Im- provements in Liverpool	128
H. Sanitary state of Schools	130
I. Improved Dwellings for the Working Classes	137
K. Connection of Tubercular Disease with defective Ven- tilation	147
K2. Modern Water-Supply of Towns	233
L. Influence of Physical Causes in producing Intem- perance	276
M. Infant Mortality	285
N. Local variations of the Death-rate in Edinburgh	344
O. Mortality from Epidemic Disease in the Medical Pro- fession	352
P. Sanitary Reforms in Leith	360
INDEX	363

PUBLIC HEALTH.

INTRODUCTORY.

I HAVE, in this course of lectures on Public Health, a twofold object—

First, and chiefly, to convey some of the elementary principles of modern sanitary science to those to whom I have taught the science and art of healing ; to complete, as I think it ought to be completed, the cycle of sciences on which that art of healing rests.

Secondly, to establish, if I can, a cordial understanding between the medical profession and the public in this matter of Public Health ; to claim for the noble, open-minded, and generous profession to which I am proud to belong, the rightful influence that springs from its natural position in relation to sanitary matters ; an influence which I am sure will always be willingly accorded to it wherever the true conditions of public health are rightly understood.

To advance in some degree both of these objects, without sacrificing the one to the other ; or rather, let me say, to advance them by calling each of them in its

turn to aid the other, is what I have set forth to my own mind as the thing to be done. I venture to claim your indulgence while I attempt what is a novelty in this school, and with one or two recent exceptions, a novelty in medical education altogether. If I have any right to address you on Public Health, it arises more from the backwardness of others than from my own peculiar claims upon your attention ; more from the fact that inclination and duty have alike prompted me to seek for personal enlightenment in this direction, than from anything which officially obliges me to recognize "Public Health" as a department of medical science. Nevertheless, I venture to believe that, through the kindness and support which have always been most generously afforded me as a teacher of medicine in this school, I shall be able to do something towards gaining for the study of Public Health a distinct position as a branch of medical education.

What is the real scope of the science of public health, or sanitary science, as it has been called ? on what facts is it based ? by what kind of evidence and laws does it profess to be guided ? how does it differ from the science of health in general, or hygiene ? what interest has the physician in studying the health of the public ? and what interest has the public in getting the physician to study the health of the community, in addition to that of his individual patients ? Such are the questions to which I hope to afford some sort of answer in this course of lectures. I shall touch these

questions on this occasion, not with a view to treating even any one of them as it deserves, but only with the purpose of shewing you that there is an answer to them, and that the answer involves matter of the utmost importance, both to the community, and to the medical profession, as the recognized guardians of the community in sickness. I hold, and it is as well here to condense the whole sum of the matter into one sentence, that it is precisely because we are the recognized guardians of the community in sickness, that we are entitled to be their advisers in health also, in all matters bearing upon the maintenance of that first of physical blessings.

If we have, in any degree, neglected our duty hitherto, or if, in some instances, our offered advice has been neglected or set aside (as advice gratis very often is), it is only an additional reason for insisting now on what is evidently right, just, and reasonable, in regard to the place we ought to occupy in future. For depend upon it, that in the end we shall occupy precisely the place that we deserve. The field of knowledge is free, and we can neither make it a monopoly, nor can we long be kept out of it by men in power "armed with a little brief authority." What we have to do is chiefly to take care that we are not placed at a real disadvantage by the advance of the general mind in this direction, and by the immense accessions that are being daily made to the knowledge of mankind at large on the subject of Public Health. We have first to know our duty, and then to do it ; first to seek our position intelligently, and then to fulfil it in the eyes

of all men, and under the critical inspection of a generation taught by blue-books, newspapers, social science associations, popular lectures, inspectors' reports, and last, not least, even by ladies' sanitary associations. I need hardly add that although Public Health may be in part a medical function, it is most effectually secured against becoming a medical *mystery*. And so much the better, no doubt, for all of us. It is a wholesome thing to breathe the air of public opinion, to have to get rid of all old dogmatisms and unintelligible medical pedantries, however imposing, to have to speak to your fellow-men the language of common-sense and experience, and to reach their convictions by means of evidence which they can in some degree appreciate, and correct, if need be.

Public Health is to a great extent a modern science. In a broad and practical sense, it may be described as having sprung into notice, in this country, little more than twenty years ago. Of course the general principles that rule the science had been long known and partially acted upon. There never was a time when the health of the people was absolutely a matter of indifference to their governors. The most ancient code of laws in the world contains most minute directions for the cleanliness of the person, the purification of the dwelling and the camp, the avoidance of improper food, the segregation of persons affected with certain forms of disease, the repression of licentiousness, the regulation of social intercourse generally, with a view alike to physical and moral well-being. So

strikingly superior is the Jewish ceremonial law, in a sanitary point of view, to almost everything that has since been devised or acted upon as a national system, that a very able pleading has been put forth by a distinguished English divine, to the effect that the sanitary code of Mount Sinai ought to become the actual code of our modern cities ; that millenniums of progressive civilization, and nearly 2000 years of Christianity itself, have not destroyed that law, nor yet fulfilled it, but only left it intact as our exemplar and guide. This at all events may be said, and it serves to shew the wonderful character of that law, that in the Jewish polity the care of the body was unquestionably recognized as a religious duty of the individual. The worshipper of Jehovah was to keep himself pure and holy as the God he served,—and that was of itself a sufficiently broad distinction from all the other oriental nations. He was to go up into the holy hill with clean hands as well as a pure heart ; he was to be circumcised, to wash before meals, to eschew commerce with strange women, to purify himself by countless ceremonial acts in every kind of religious observance ; to abstain from unclean meats, to remove and bury in the soil the excrements of his body ; to cultivate, under the most severe penalties, the most absolute purity of demeanour among his kindred, and towards all married persons ; to subdue and repress, by strict and jealous watchfulness, the irregular promptings of lust in every form. In most of these particulars the Jew stood alone among the nations ; they were, in fact,

part of his religion, and that was unique, separating him from all other nations by a "middle wall of partition." We all know, too, how hard was the task of many successive ages to keep the rebellious people within the bounds of their salutary but rigorous laws. Nor can there be a doubt that the Christian faith, while undermining the ceremonial observances of Judaism by its more spiritual and inward devotion to the Father in Heaven, aimed at preserving to the utmost a religious sanction for the care of the body, as "the temple of the Holy Ghost," the gift of God, redeemed in Christ Jesus, not our own, but "bought with a price;" and therefore not to be wasted and enervated in riotous excess, but to be kept pure for the glory of God, who is in the last day to raise it up again by the word of his power.*

It must be confessed, however, to the deep shame of our boasted modern civilization, that this noble idea of respect for the bodily frame as the dwelling-place of the Spirit, has been very slow indeed in penetrating into the legislation of Christian nations. We look in vain for traces of a sanitary code in the legislation of the middle age. Even the Roman and the Greek civilization had assiduously cultivated the body, if not from a religious motive, at least as the raw material of military power. The laws of Lycurgus are not wanting in very pointed enactments on sanitary matters, and the importance attached by all the Greek republics, and in the Platonic ideal polity, to physical culture, is too

* 1 Corinthians, v. 13-20.

well known to require remark. The Roman people, poor and apparently rude as it was in its origin, yet found time, amid its military occupations, to construct the *cloaca maxima* as an indestructible and stupendous memorial of its attention to the drainage and sewerage of the city at a very early period of its history. At a later period aqueducts were made to cover miles upon miles of the surrounding plain ; and their splendid ruins, still partly used for their original purpose, attest the munificence and the abundance with which the first of sanitary requisites was supplied to the imperial city. It is humiliating to reflect, that within the present day even, some of our more considerable towns have no arrangements beyond the primitive ones of water-carts and wells for the supply of the purifying and health-giving, but also dangerous and disease-scattering, element of water ; and that in not one of our great cities has a system of sewerage been otherwise than an after-thought, imperfectly and slowly carried out centuries after the accumulation of men, oxen, pigs, poultry, and their multifarious refuse, had infiltrated the very soil on which our towns were built, and rendered all efficient destruction of miasms a work of the greatest difficulty. Even now, and in the metropolis, the opening of a new street, the alteration of the course of a drain, the laying of a water-pipe or a gas-pipe, is often a service of danger, not only to the workmen employed, but to the inhabitants of a district ; and the infiltration of the city wells with the salts of animal decomposition has become such as to make it a

matter of simple prudence in many cases to shut off these sources of water supply altogether.

Again, all that we know of the construction of private-houses among the Romans, of the temples, of the halls of justice, of the theatres and amphitheatres, shews that the necessity for free ventilation and good drainage was recognised, in principle and in practice, in a way that puts our modern buildings to shame. The Romans borrowed, too, from the Greeks the best part of their sanitary institutions : the bath, the chariot-race, the wrestling-match ; even the bloody sports of the Coliseum might be said to be in one point of view kept up with a view to the physical training of the men of the empire, as the tournament and the bull-fight were at a later period in Christian countries. In addition, there seems to be but little doubt that the mistress of the ancient world received from Athens or from Alexandria the rudiments of a regular code of public health, in which the *Archiatri populares*, or state-physicians having care of the public at large, had some important, though not quite clearly defined function, to perform. In the Theodosian and Justinian codes these officials are represented as chosen by popular election, and although their precise sphere of duty is not well known, it is evident that they must have been generally responsible to their constituents for the care of the public health. We learn that there were ten of them in the largest towns, one in each district or sub-division ; seven in towns of the second order, and five in the smaller ones. The whole assemblage formed a college, and had a

certain power of veto, and of examination and inquiry, in regard to any new member proposed by the municipality.*

All this sanitary legislation, the good as well as the bad, was done away with by the ascetic spirit which grew up early in the church of the middle ages, and which, departing widely from the Jewish model, and overlooking the true spirit of the Christian injunction, sought to glorify God, not *in* the body; *i.e.*, by its legitimate use and careful preservation, keeping it at the same time in subjection, as St. Paul himself preached and practised; but rather by systematically abusing or despitefully using the body, as the great enemy and obstacle to a spiritual faith. The monks and clerics of the middle ages, who were mainly responsible for the peculiar forms of its civilization, cared extremely little for personal cleanliness, and nothing at all for sanitary legislation; when epidemic disease was rife, they betook themselves to prayers, masses, and works of charity; and in many instances, it must be confessed, they most nobly did their duty, at least as they understood it. By and by the ecclesiastics at large, and the monks in particular, grew lazy and luxurious, rich, immoral, and infected tenfold with all the bad habits of the people. "It is no longer true," said St. Bernard, even as early as the twelfth century, "that the priests are as bad as the people, for the priests are worse than the people." Then came the order

* Sprengel, *Histoire de la Médecine*, by Jourdan. T. ii, p. 161, *et seq.* See also Note A, p. 38.

of Franciscan friars, vowed to poverty, and to God's work among the poor ; whose early history and missionary labours in the towns have been so instructively and so feelingly written by Mr. Brewer, in one of the valuable publications lately issued under the authority of the Master of the Rolls. To those early Christian ages, to those much abused, and often unjustly abused, missionaries of the faith, the monks and the friars, we unquestionably owe whatever of broad, humane, generous sympathy with the poor is to be found amid the confusion and oppression of the social system of the middle ages. To them we owe all manner of overflowing charity, feeding the hungry, clothing the naked, comforting the afflicted ; to them we owe, among other great works of this kind, the institution of hospitals for the sick ; but to them we owe nothing like the idea, even, much less the practice, of the prevention of disease. As little did the great barons, under the feudal system, apprehend their simplest duties towards their inferiors and vassals. They were, indeed, mostly rude illiterate warriors ; men of the iron hand, prepared to hold their own, and roughly to protect those who assisted them in doing so ; but in no degree accustomed to study even their own comfort and luxury, and very little disposed to bestir themselves on behalf of what they would have considered as enervating indulgences for the serfs of the soil. Accordingly, when the tyranny and turbulence of the feudal superiors drove multitudes of the artizans to associate in the towns, where they were enabled to pursue their callings in comparative

peace and freedom by enclosing themselves within walls, and fortifying these against all comers, the rapid extension of the population soon led to overcrowding ; all the first wants of humanity were utterly neglected or left to chance, and to the imperfect legislation of civic authorities, limited mostly to deciding disputed cases ; there was no drainage ; masses of filth lay piled about the streets ; water was everywhere procured from wells or from rivers, and was often of bad quality, and insufficient in quantity ; food was frequently salted, long kept, half putrid, and not rarely at famine prices, or not to be procured at any price ; vegetables were entirely wanting during a considerable portion of the year ; the association of vast masses of people under these circumstances could not but be unfavourable to morality, and the commerce of the sexes soon became as debased as it had been in heathen Rome or Greece ; vast epidemics, many of them unknown to ancient times, took firm root among the population, and spread from Italy to the North Sea ; the hospitals of the monks were filled to overflowing, and in many instances, whole towns were depopulated, and the dead left to bury their dead.* Then it was that a terrible idea, unhappily but too well founded, though exaggerated by fear and ignorance, acquired a new ascendancy over the minds of men ; the idea of *contagious pestilence*, walking through the crowded street, kneeling in churches, sitting at the social board, and everywhere dealing indiscriminate death and destruction. It was a natural idea ; it was

* See Note B, p. 44.

not, as some *doctrinaires* of later times have affirmed, an untrue or essentially mistaken idea. It was, on the contrary, essentially true as regards the greater number of these destructive plagues ; and notwithstanding all the attempts made in these latter days to indoctrinate the public mind with the opposite belief, it is now more certain than ever that the sanitary reformer must face this terrible *fact* of contagion, and regulate his proceedings accordingly, as he best may. But in the middle age, the fear of contagion amounted to a frenzy, absorbing all the energies that ought to have been devoted to the removal of the local causes of epidemic disease, into the one consideration, how best to keep it at bay when already formed. The disease itself was supposed to be simply a visitation of God, inscrutable, intangible, unassailable, borne on the wings of the wind, having no relation to diet, drink, habitation, or indeed any purely physical cause ; while the prevention of the most destructive plagues was summed up in the one idea of fleeing from infection, and keeping the sick man, or the sick nation, as far as was possible out of the pale of humanity. Contagion, as the cause of pestilence, when thus exclusively kept in view, gave rise to ideas and practices not only unreasonable, but antisocial ; a vulgar and cowardly fear of approaching the sick took possession of the popular mind so completely, as very seriously to hold in check the active impulses of practical beneficence, and even the promptings of Christian charity, which in all ages has sought, and still seeks, the lowly and poverty-stricken homes

of affliction and disease as its natural sphere of labour. Fear, in truth, is the most selfish of the passions ; it is the death or paralysis of all that is noble in humanity ; and for many ages sanitary legislation was mainly founded on fear. It was not till the progress of science, and the increased comforts of living had diminished again the virulence of epidemic disease ; nay, not even then, until noble-minded philanthropists like John Howard had led the way anew in the path of reform, that the duty of mankind towards their fever-stricken brethren was distinctly recognised as being other than simply to let them die unseen. The physician and the minister of religion, it is true, rarely deserted their posts entirely, even in the darkest ages and worst seasons of epidemic visitation ; but they too often performed their duties in a very formal and perfunctory manner, as is always the case when public services are not duly watched and honoured by public opinion.

At last the well-known horrors of the repressive system, so strikingly pictured by one of the greatest masters of the English tongue, Daniel Defoe,* together with the more careful study of certain epidemic diseases by a few zealous physicians of the public services, and the frightful revelations of the state of our jails by Howard, towards the end of last century, brought about a wholesome reaction in public opinion. It was at this period that many of those controversies as to the contagious character of epidemic fevers in general, which have lasted even to the present day, had their origin ; then

* History of the Plague in London in 1665. See Note C, p. 47.

also began the erection of fever hospitals, especially in Ireland, where the great sufferings of the poor have always been met by a noble and large beneficence on the part of the nation, and by the most unwearied and self-sacrificing devotion of time and money, and of life itself, by the members of the medical profession.

But still there was little advance towards a true general science of public health. Individual diseases were carefully investigated, and in some instances greatly abated ; scurvy was well-nigh rooted out of the navy by improved dietetic regulations ; dysentery and fever were restrained in the army ; diarrhoeal diseases generally, and ague in all its varied forms, declined throughout this country, in consequence of the improved cultivation of the soil, and the higher standard of comfort among all classes ; finally, by the splendid and unique discovery of Jenner, the ravages of small-pox began to be greatly abated. Vaccination, almost the first, as it is undoubtedly the greatest of discoveries in preventive medicine, was the glorious inauguration of the nineteenth century. But no one, physician or layman, had as yet learned to look on epidemic diseases generally as lessons on the large scale of the ordinary providence of God, by which a national breach of the laws of life is marked out for correction. Physicians as yet thought for the most part only of treating the disease when actually present, and of relieving the sufferer from his more obvious symptoms, and from some of the risk of death ; perhaps, also, of removing him from too close proximity to the healthy, or these

again from the dangerous neighbourhood of disease. Of reforming, systematically, the vicious habits of life in which such diseases find their soil, their conditions of existence and diffusion, if not their germinal cause, there was as yet no fixed idea in the medical, any more than in the public mind. This, and the revolution consequent on this idea, is the work of the last twenty years, more or less, to which I referred a moment ago.

I abstain, on the present occasion, from entering at large upon the history of that great revolution. It will come under consideration at the proper time in the course of these lectures. I can only indicate now, in very few words, the leading men who were from the first engaged in it, and the general nature of the ideas by which they were guided.

The good work began in connection with the agitation produced by the great cholera epidemic of 1832. We had then, for the first time in this generation, the public mind strongly and universally directed to the repression as well as the treatment of pestilence. Our other plagues were home-bred, and part of ourselves, as it were ; we had acquired the habit of looking on them with comparative indifference ; with a fatal indifference, indeed, inasmuch as it led us to believe that they could not be effectually subdued. But the cholera was something outlandish, unknown, monstrous ; its tremendous ravages, so long foreseen and feared, so little to be explained, its insidious march over whole continents, its apparent defiance of all the known and conventional precautions against the spread of epidemic

disease, invested it with a mystery and a terror which thoroughly took hold on the public mind, and seemed to recal the memory of the great epidemics of the middle ages. It was in a most emphatic sense felt to be a lesson from on High ; and the very failure of human means to arrest it, or to cure it, raised, in a most palpable shape, the question, What are the causes of its epidemic diffusion ? It was this question, as one equally of scientific curiosity, and of intense practical interest, that for some years occupied the attention of every medical society, and every medical journal, not to say every newspaper, in Europe, to the exclusion of almost everything else.

It must be confessed that the answer was unsatisfactory. But the discussion served to keep alive the feeling that something must be done for our impoverished and degraded masses, as it was impossible to overlook the fact that the poor fell in thousands under the fatal breath of pestilence, while the middle and higher classes were comparatively exempt. The time was favourable for action ; the country had undergone a political revolution ; new counsellors were about the Sovereign ; new materials in Parliament ; all things were become new. The spirit of innovation assailed, among other things, the venerable and rotten old English poor-law, which had interwoven itself with all the institutions of the country from the time of Queen Elizabeth. A new poor-law was passed in 1834 ; and a royal commission was appointed to superintend its working. The secretary of that commission was a man

of vast energy and power of mastering details ; a man, too, of great enthusiasm and force of character, strongly desirous of employing his varied talents in the public service, and not easily satisfied with a limited field of exertion. He conceived the noble idea of instituting an extended inquiry into the physical and moral condition of the poor, especially into their sanitary state and the character of their dwellings, all over England and Scotland ; and the first fruit of this inquiry was the well-known and truly memorable "Report on the Sanitary Condition of the Labouring Population of Great Britain," published in 1842. This was the true starting-point of modern sanitary legislation. To Mr. Chadwick, and his medical coadjutors Dr. Southwood Smith, Dr. Neil Arnott, Dr. James Phillips Kay (now Sir James Kay Shuttleworth), and to one also who is now our townsman, Dr. Lyon Playfair, we owe, unquestionably, in no small degree, the foundation as a separate branch of inquiry, almost, in fact, the creation, of sanitary science in England ; and we may reflect, I hope, with pleasure, and without undue exaltation of our patriotism, that several of these eminent medical men were alumni of this school of medicine, and graduates of this University.

The Report on the Labouring Population was followed by the appointment of a new Commission on the Health of Towns, which gave in two elaborate Reports in 1844 and 1845 ; and this again was succeeded by the Metropolitan Sanitary Commission, which published its labours in the form of two Reports, in the

years 1847-8. These different labours, in the same general direction, and guided mainly by the same ideas, form an imperishable memorial of Mr. Chadwick, and of his school of sanitary reformers ; and not even the failure of some considerable part of their policy at a later period, nor the extreme and reckless one-sidedness of their doctrines on certain disputed points of medical opinion, can ever cancel that immense obligation on the part of the public of this country.

To another zealous and equally indefatigable labourer, a man in a very peculiar sense endowed with genius of the highest order, the soul and life, too, of another great department of the public service, we owe very directly the present position and a large part (perhaps on the whole the largest part) of the existing materials of sanitary science. Dr. William Farr has done for the vital statistics of England almost what Harvey did for physiology or Lavoisier for chemistry. He found the facts of this science in a state of almost hopeless and aimless confusion. He has not only added immensely to the number and value of these facts, but has brought into them light, harmony, order, and, for the first time in the history of the science, a determinate method and an approach to scientific exactness. On the basis of millions of separate details, arranged, on the whole, in a very close and accurate accordance with medical opinion, and with the demands of sanitary science, it has been the great and enduring merit of Dr. Farr (originally a modest country practitioner and licentiate of the Com-

pany of Apothecaries) to build up a body of doctrine on vital statistics, not only unequalled but unapproached in any other country. By the systematic calculation of death rates he has placed an easy and useful method at the service of all inquirers into the public health,—a method certainly not without risk of error in its application, but giving facilities for the elucidation of truth, and the correction of error, which render it of the utmost value to medical science. By the formation of life tables from these data, Dr. Farr has also immensely aided the operations of life-insurance ; and, by the vast extent of his general information, the vigour of his literary style, and the genial current of his human sympathies, he has been able to invest his dry and abstract inquiries with not a little even of a popular, almost of a poetic, interest. Those who have occupied themselves much with the reports of the Registrar-General, or with the most instructive and interesting historical dissertations in the Report on the Census of 1861, will assuredly join me in giving to Dr. Farr the credit of having at last solved the problem of investing large numbers with a correspondingly real interest, and made blue-books, and big ones too, among the most stimulating and suggestive productions of the age.

It is with the results of Dr. Farr's labours that we must begin our studies of public health ; it is, indeed, upon them that we must mainly proceed throughout. I shall therefore confine myself, to-day, to a very brief exposition of the general nature of a death-rate, and the bearing of the investigations therewith connected

on modern sanitary science,—reserving for future lectures the further development of the subject.

The science of death-rates is founded on the important and now well-established fact, that amongst equal numbers of persons, similarly placed as regards the external conditions of health, and containing like proportions of persons of each age and sex, an equal number, or nearly so, may be expected to fall each year under the ordinary causes of mortality. That the equal operation of like causes should lead to a like result, is, indeed, only in accordance with the regular and unvarying character of all natural phenomena, when observed on a sufficiently great scale. Thus, we know that in England and Wales it invariably happens that the male births predominate over the female births, and the male deaths over the female deaths, in a ratio which can in each case be calculated with a near approach to exactness. Quetelet has shewn, from unimpeachable data, that this excess, both of births and deaths, on the side of the male, is not peculiar to England, nor in any degree to be viewed as an accident, but rather as an essential phenomenon of European civilization; and that the degree of the excess is also subject to laws which, within certain limits, may be made the subject of calculation, and expressed in accurate numerical proportions. Nay, the real and apparent exceptions to the law may also, to a great extent, be reduced by the aid of very large numbers to a statistical expression; so that not only the facts of the case, but, to a certain extent, the physiological causes of the facts, may be

inferred with a considerable approach to certainty. Again, it has been clearly established, that we may predicate, within narrow limits of variation, the proportional number of births, deaths, and marriages, which will occur in every country in Europe over a certain term of years ; the number of railway accidents, of suicides, of murders, of crimes against the person and against property, and even of particular crimes and particular modes of accomplishing them. The apparently indeterminate character of some of these phenomena in individual cases, their dependence upon inscrutable motives, or upon the most absolute apparent freedom of the will in those who give rise to them, present no obstacles to the calculation of the probabilities by which their occurrence is ruled on the great scale ; all that is necessary is to have access to sufficiently large numbers, in which case, to use the words of the great Belgian statistician, " individual peculiarities, whether physical or moral, become effaced, and leave in a prominent point of view the general facts, by virtue of which society exists and is preserved."*

This fact of the limited and accurately appreciable character of the variations of almost all social phenomena, and the consequent possibility of investigating their laws upon the basis of numerical proportions, made the subject of accurate reasoning and careful scrutiny, is undoubtedly one of the greatest discoveries of modern science. It is not necessary here to inquire into the

* Quetelet, *Sur l'Homme, et le Développement de ses Facultés*. Paris, 1835. Translated for W. & R. Chambers, 1842.

history of this discovery ; it will be sufficient if I explain, a little more in detail, the mode of its application to sanitary science.

In certain parts of England and Wales it is found, that, with a near approach to certainty, you may predict, that from 15 to 17 persons will die annually out of each 1000 of the population. In certain other parts or districts of the country we are equally certain that the deaths will exceed 20 in 1000 ; in other districts still, they will exceed 25 in 1000 ; in a few districts they will very surely approach or even exceed 30 in 1000,—the variations from year to year being in this case much more considerable than in the first case referred to. What are the causes of this very unequal pressure of mortality ? Why should twice as many deaths take place from year to year in Liverpool or Manchester, Glasgow or Greenock, as are found to take place among a corresponding population in some parts of Wales, Cornwall, Surrey, and Northumberland ?

Such is the first question in figures which the sanitary reformer asks himself. He establishes a scale of mortality for the whole of England and Wales, in which certain large towns occupy the lower end, or the most unfavourable position, and certain rural districts the upper end, or the position in which the pressure of mortality is at the lowest. And having thus constructed roughly what may be called a *barometer of public health*, such as I shew you in this large diagram, the inquirer proceeds to reason upon its apparent results as regards particular localities.*

* See Note D, p. 51.

A little inquiry soon convinces him that the determination of the real sanitary status of particular districts is not so easy as it seems. *Primâ facie*, indeed, a place where the barometric pressure of death is measured by the number 20 is much better off than one where the deaths in a corresponding population number 25 ; and, counting this result over very large numbers, it might appear easy to show, that in the latter place many hundreds, or even thousands of lives in a year, are sacrificed to the neglect of hygienic conditions fulfilled with more strictness by the population of the more apparently fortunate locality. But before this conclusion is finally adopted, it becomes necessary to ask a few additional questions.

We have seen that everywhere in England, or perhaps in Europe, with the certainty of a natural law, the male sex is more exposed to the causes of mortality than the female. What if the more fortunate district owed a considerable part of its better position in the health barometer to a large preponderance of females in the population? Again, infants and very old persons are everywhere, even in the most healthy districts, enormously more exposed to the causes of mortality than persons of middle age. What if the less fortunate, or more apparently fatal district owed a large part of its excess of death-rate to the circumstance of a very great excess of infants or of old persons among its population? That the death-rates of particular districts are largely modified by the peculiar distribution of the population as regards age and sex, is a fact not less certain than

the variations of these death-rates themselves, or the dependence of the variations in some cases upon removable causes. We require, therefore, a statement of the distribution of the population, and a series of death-rates for each age and sex in each place on which we wish to form an opinion, before we finally commit ourselves to a judgment upon its exact sanitary position in the scale.

In like manner, if we require, as it is likely we shall, to determine the influence of season, of occupation, of the social position of the population upon the death-rate of an entire locality, we shall find it necessary still further to extend our researches, and to produce details shewing the mortality per thousand of the population for each quarter of the year in each trade and profession, in each rank of life in the two places compared; and it may probably be necessary to obtain averages drawn for the sake of comparison from the country at large, or from the greater towns, or from a considerable number of the rural districts, or from counties, or from divisions of the country. Most of these data for inquiry are specially furnished, or may be obtained with a little trouble, after more or less calculation, from the registrar-general's returns. Thus we have the most elaborate and detailed researches, conducted over a series of years, into the death-rate per thousand of infants under five years of age, not alone for England and Wales, but, as in the case of the general death-rate, for each great division, for each county, district, and even sub-district of the whole country. We are also enabled, by the registrar's reports,

in many cases at once to refer to the separate death-rates of the sexes, and even of many separate occupations.

Finally, we may desire to know how far the mortality of particular places is due to special causes of death; how far it is, according to the existing light of medical science, due to avoidable or unavoidable disease; how far it is due to epidemic causes, varying from year to year; how far it is due to displacement of the population, or to swarms of immigrants from other places; how far it is due to situation in the bed of a stream, or on the exposed side of a hill; how far it is regulated by density of population, or the number of persons living on a square mile of surface; how far to deficient house-accommodation; how far to restricted water-supply. The graduated scale of death-rates, the first rude barometer of public health, does not answer these questions; it only begins by asking them, and on the basis of facts observed in a great variety of localities, permits some of them to be answered with more or less exactness. But to most of them it is possible to devise an answer founded on the registrar-general's reports—which are so framed as to allow the general laws of mortality from all these causes to be deduced from an immense variety of particular instances, so multiplied as to reduce the chances of error from accidental variations to a minimum. And in this way at last, after a great amount of laborious inquiry performed for us in these reports, we are placed in a position to estimate with more accuracy than before the bearing of the different circumstances which regulate the sanitary status of a locality, on the

particular case to which our attention may have been directed.

By the aid of these magical numbers, modern sanitary science has passed out of the stage of the hypothetical, and become a strictly inductive, and closely reasoned branch of knowledge, resting upon a solid basis of experience. It is no longer a mere dogmatic assertion of the general laws of physiology, or a groping in the dark after the laws of epidemic disease, but a careful investigation of the exact conditions under which such disease arises. But among these conditions two have been found of such immensely wide application, that they may be called the true factors of almost all epidemic diseases, and of a great number of chronic diseases also. Upon these two factors, as the basis of by far the greater part of the modern science of prevention of disease, I will venture a few rapid observations in drawing this lecture towards a conclusion. The two factors of which I speak are *air* and *water contaminated with the effete products of the human body*, or with organic matter in a state of decomposition.

You are probably not unaware (indeed, all my medical hearers, even the youngest, must be familiar with the fact) that by far the largest part of the weight of our bodies, and of all organic bodies, is made up either of air and water, or of their elements in a different state of combination. Probably nineteen-twentieths of the living human body have this composition. Now, it is one of the clearest teachings of modern physiology that

the gases which compose organic matter are never at rest,—never confined to one place, or to one organized body ; on the contrary, they are the common property of animals and plants, and at every moment they circulate from the one kingdom of nature to the other, through the vast oceans of air and water that surround our globe. All nature, considered with reference to air and water, is a perpetual ebb and flow of oxygen, nitrogen, hydrogen, and carbonic acid ; or rather a cycle of restless changes so complete and constant as to have no general ebb and flow. Meteorology and hydrology are but the record of a marvellous series of provisions against stagnation ; physiology is an immense laboratory of chemical reactions commensurate with all the forms of vital activity. Consider now that the very essence of what we call life in our bodies consists in perpetual change, perpetual waste, perpetual motion of atoms ; and you can hardly fail to see in all this the purpose and foresight of the Creator. What right have we in air and water that we can call our own ? what interest, that is not shared by the millions of our own kind, by the countless millions of organized beings besides ourselves ? It is ours to use air and water, and then to pass them on ; but woe be to the man or the community that detains or imprisons these, his servants of the hour, in their further execution of God's endless work ! The mysterious laws of creation are their own avengers ; and the very attributes of air and water that make them the ministers of life, convert them, when abused, into the instruments of death. That very power of dissolving

and decomposing organic matters of all kinds which is inherent in both, and without which we could not live for a moment, renders them the ready recipients and communicators of all manner of noxious influences, the result of partial decomposition ; which morbid influences, or poisons, it is their province ultimately again to destroy and to render harmless. So that by tampering with air and water, by obstructing their course, by causing them to stagnate around us, we inevitably impregnate them with that which in certain circumstances becomes dangerous to our fellow-men.

The illustrations of this great elementary truth, alike of pathology and sanitary science, are endless. First in rank stand great epidemics ; destructive plagues ; consuming fevers. I have already called these, in another part of this lecture, God's lessons ; let me add that they are lessons or practical expositions on a great and startling scale, of facts and laws which might otherwise elude our observation, but which are equally active in our every-day life. We are led by great epidemics to see and know of our own personal knowledge the fact, that the exhalations of our bodies, the products of our vital waste, are dangerous to our brethren ; and that the danger is in proportion to the stagnation of the air we breathe and the water we drink. We are led to reflect that these free gifts of God are, after all, not wholly our own, but are to be used by us with due respect for the rights of others.

In small-pox, for instance, we know with a terrible certainty (and in the case of vaccination with a bene-

ficent certainty) that an all but invisible particle of deadly venom may be conveyed, say on the point of a lancet, from the body of the sick to that of a previously healthy man, and may there work and multiply itself, so that, with an energy far above all numerical calculation, it may not only communicate in the first instance a very deadly disease, but may go on accumulating in a succession of human bodies so as to infect a whole family, a whole village, town, nation of men. What is the channel of communication of this frightfully deadly venom? An imprisoned, therefore a stagnating drop of water. Take the same drop, or a thousand-fold as much, and set it free; in a few hours it will be so decomposed as to be absolutely innocuous. But dry it in a crust, or seal it up in a capillary tube, keep it, in short, out of the general circulation of air and water, and it will keep deadly for years; and from this one drop, at any time, not one man alone, but hundreds of men, may be in danger of losing their lives. From such single communications we know that in some cases multitudes of lives have been lost; by a small number of imprisoned drops of water we are very sure that whole races of uncivilised men have been swept away. Mr. Catlin calculates that out of twelve millions of red Indians, six millions have so perished; and in Mexico it is stated that on the first Spanish invasion, in the sixteenth century, three and a half millions of men, in one single epidemic, fell victims to this terrible scourge of the European races, conveyed by them to the hitherto uninfected conquered race.

It is not for us, in all cases, to justify the ways of God to ourselves. But here, I think, we can hardly mistake the meaning of the lesson to be conveyed. It is to the effect that air and water are at once the feeders and the destroyers of pestilential diseases. Keep them in perpetual movement and you are safe. Let them stagnate about you, and your life is a perpetual danger. But for confined air and water, pestilence could not exist; but for free air and water, pestilence, once created, could never cease to exist.

Take another instance. It is very certain that typhus fever (by which I mean the typhus of Ireland and of our great towns in Scotland) is communicated for the most part through air poisoned by the exhalations of the sick. But so little is the danger if that air be kept in its normal state of perpetual motion (*i. e.*, if there is free ventilation), that one of our most distinguished physicians, a man who has seen more or less of every fever-epidemic for more than forty years, has often told me that, in all his experience, he never knew an instance of its spreading at all in the houses of the better classes in the New Town of Edinburgh. In particular, he states that he has attended upwards of a hundred students of medicine affected with fever, either in their own homes or in the Royal Infirmary, most of whom had caught the disease there or in Dispensary practice. In not one instance out of so many, even while the disease was epidemic, did it spread to any of the other members of the household.

Again, look at cholera. The mystery of this tre-

mendous disease, long apparently inscrutable, seems at length to have yielded to modern inquiry. So much we know—that cholera breeds and propagates itself in and through water, conveyed into the body as drink. But observe the conditions of its propagation. The water must be impure; it must contain (let me state the fact, repulsive though it be) the discharges of one or of many persons previously affected with cholera. In other words, the water must have stagnated; the soil above it must have become infiltrated with the contents of the cesspool or common sewer; and the water so poisoned must have been used for drinking. And do not suppose that in the taste and odour you would have sufficient warning. Dr. Lankester, the medical officer of St. James's in London, records that in the now celebrated Broad Street Pump, which was the undoubted source of a large number of cholera cases in 1854, the water was, to all appearance, of great purity, and was particularly admired for its excellent quality as regards taste; though on chemical analysis it was found loaded with the ultimate products of decomposition. A small, intangible, odourless, tasteless virus sufficed in this case to cause the destruction, in a short time, of hundreds of lives.

I have said enough, I trust, to shew that the imperfect removal of our waste atoms—in other words, the impurity and stagnation of air and water—is not only the main predisposing cause of those diseases commonly called epidemic, but may also be causes, to a large extent, of many other diseases. In reference to this last

assertion, I must in the meantime limit myself to two instances, but they are striking ones, and I think conclusive. The instances I refer to are pulmonary consumption, the great and abiding scourge of the early and middle periods of life, on the one hand ; infantile convulsions, the great source of mortality among very young children, on the other.

In regard to pulmonary consumption, I shall only give you the following facts, stated by Dr. Guy, a most trustworthy and excellent authority, before the Health of Towns' Commission, although many others bearing in a like direction might be adduced, did time permit. Dr. Guy investigated with great care the circumstances attending certain derangements of health in 320 of the journeymen printers of London. He found that he could, after careful inquiry, divide them into three classes, nearly equal in numbers. In the first class, the men were habitually breathing in their workshops an atmosphere of less than 500 cubic feet of air per man ; in the second class, the quantity was between 500 and 600 cubic feet ; in the third class, it was more than 600 cubic feet. Now, taking as his guides, two of the leading symptoms of consumption, which could easily be detected by questions, he found that the difference between the first and the last of these classes of workmen was as follows :—Of the *first* or *worst-off* class (as respects air) $12\frac{1}{2}$ per cent had spat up blood, and a like proportion had been subject to catarrh ; while of the *third* or *best-off* class, only 4 per cent had suffered from spitting of blood, and only 2 per cent from

catarrh. The medium class of workmen occupied also a precisely intermediate position with respect to both these unfavourable symptoms.

Again, as regards infantile convulsions, the following facts are stated by Dr. Collins, formerly master of the Rotunda Hospital of Dublin. At a certain period in the history of that institution, more than seventy-four years ago, of 17,650 children born there, 2944 or 17 per cent died within the first fortnight after birth, and of these 19 out of every 20 deaths were from convulsions. Dr. Clarke, who was at that time master, entertained a strong opinion as to deficient ventilation being the cause of these too familiar "nine-day fits," as they were then called, and accordingly he took efficient steps to secure a much more free circulation of air. The result was, that of 8033 children born subsequently to the wards being ventilated, only 419 died, being at the rate of $5\frac{1}{8}$ per cent, or less than one-third of the previous mortality. Under additional improvements during the mastership of Dr. Collins, the death-rate of these infants became reduced to 1·7 per cent, or about one-tenth of what it was before, while convulsions, as a cause of death, were reduced to a still more insignificant figure.

Can there be any doubt, then, that over the use of air and water by the community, as well as by each of its members, the community is bound to exercise a most jealous guardianship? Can there be a doubt that where epidemic disease rages, or even threatens to become prevalent, the limits of individual freedom have

been reached, and the rights of the community require to be protected? Can there be a doubt that in lodging-houses, factories, workshops, schools, churches, hospitals, railway-carriages, steam-boats, public conveyances, there ought to be a limit to the power of individuals to pack human beings together in a confined space? or that even in some instances in private houses, the more aggravated mischiefs of defective ventilation require to be restrained by authority? Can there be a doubt of the right and the duty of large communities to introduce an ample supply of pure water, to shut up defective and contaminated sources of supply, to regulate the introduction of this beneficent agent of health into private houses, and to see that, when there, it is maintained in free circulation, and does not stagnate and corrupt, to the injury of all? On most of these points I can hardly admit the possibility of a doubt in the mind of the most jealous opponent of centralization. Most of them are in fact embodied as principles in our recent sanitary legislation.

I think we shall find in these truths, if we consider them well, the true sphere of authority in relation to public health. Much of sanitary reform is (as I shall endeavour to shew hereafter) not at all a matter on which legislative or municipal interference is possible; it must be left to the educator, the missionary, the physician. But, in regard to those gifts of God which are the common property of all of us, we have a solemn and indefeasible responsibility, and as every responsibility implies a right and a duty, we have, as a com-

munity, an unquestionable right and duty in this matter. And in the investigation and control of epidemic disease, it is the medical profession alone which can guide the community to the sources of the evil. Drainage and sewerage on a large scale are but an imperfect sanitary reform ; the freest access to pure air and water will be of no avail unless care be taken to check the results of individual thoughtlessness, and to make the lessons of divine Providence available for the good of the people at large. And therefore it is that the community must, as a necessary part of the work of improvement, act under the guidance of the medical profession, and secure their willing service, not only as advisers in actual sickness, but as an essential part of what I have called elsewhere the *home mission* of health.

And now a word, and a word only, to those of our citizens and medical practitioners who have favoured me with their presence on this occasion. I have never been an alarmist or an agitator, and I am not now about to propagate rumours of present danger, or to hold up before you visions of evils that may never occur. But every one knows, or should know, the enormous evils that have actually occurred in the past from the neglect of sanitary regulations ; and these evils, with their proper remedies, I shall make it my duty to explain in some measure in future lectures. In the meantime I confine myself to one remark. A defined and energetic sanitary organization, to some extent at least under medical superintendence, and in harmony with medical opinion, is now-a-days an

acknowledged want in all our great centres of population. In England, wherever such organizations have existed, however imperfectly constituted, and whether voluntary or armed with legislative powers, their results have been seen, after a term of years, in a notable reduction of the death-rate. In Liverpool, formerly the most unhealthy city in England, this reduction of the death-rate has been so great and so progressive as to form the most conclusive testimony that has ever been known to the advantages of sanitary reform. In Ely, in Bradford, in Croydon, in Salisbury, in Durham, in Cardiff, in Newcastle, in Manchester, in London itself, a similar, though perhaps less striking change for the better has been observed ; in some of these towns it is still progressively advancing at the present moment. In Scotland, mainly under the fostering care of my dear and venerated teacher, the late Professor Alison, a really immense improvement was initiated in 1843 by the new poor law, which, aided by the general prosperity of the country at large, and especially of Ireland, has rid us of a vast incubus of epidemic disease, and especially of fever, that appeared to have become a permanent inheritance. Of the consequent lowering of the death-rate, and improvement in the condition of the population, I shall have more to say hereafter. But what I am chiefly anxious to say *now*, is, that in the records of the last six years, during which the registration of deaths has been in operation, I find no evidence of a persistent lowering of the death-rate in any of our eight greatest towns ; nothing, in

fact, in the least degree similar to what has been going on in many, if not in most, of the important places in England during the same time. On the contrary, it appears that in Glasgow, Dundee, Aberdeen, and Leith, the death-rate has been absolutely higher during the year 1860 than during any previous year of the registration ; and the death-rate of the whole eight towns taken together is also higher by fully two degrees last year than in most of the former years.* Considering that in England the year 1860 was one of almost unexampled health, these facts are not without a deep significance. In sanitary matters in the present day, not to go forward is to go back ; and most assuredly at the present moment we are not going forward. Now take that fact in connection with this other, that in no single town in Scotland, with the exception I believe of Leith, where a good beginning has quite recently been made, is there a systematic sanitary organization such as I have alluded to as having been instituted in many large English cities ; in none is there a permanent officer or committee of health ; in none is there a regulated inspection of the haunts of epidemic disease. Is this right, or is it wrong ? It is not the first, nor the second, nor yet the third time that I have raised this question in my native city ; but so long as the want is unsupplied I shall go on saying, on this and every other occasion, what I have repeatedly said before, that the institution of some such organization in every one of our great cities is an imperative and

* See Note E, p. 58.

pressing duty of those charged with authority. Assuredly this is a matter which brooks no further delay ; indeed, the delays that have already occurred are much to be regretted, and form an opprobrium that cannot be too soon removed. I appeal confidently to the facts I have stated in proof of my position, reserving for future lectures all further details upon the subject.

NOTES TO LECTURE I.

NOTE A. Page 9.

THE SANITARY WORKS OF ANCIENT ROME.

Mr. Edward Cresy, author of the "Encyclopædia of Civil Engineering," bears emphatic testimony to the thoroughly scientific principles adopted in the drainage of ancient Rome, as exemplified in the Cloaca Maxima, and in the Colosseum, the greatest of the public buildings. The following extracts are from the evidence led before the Metropolitan Sanitary Commission, "first report, pp. 333-334 :—

"You are the author of the Architectural Antiquities of Rome ; when measuring the buildings there, did you notice the manner in which the engineers drained them ?—This subject naturally attracted my attention, and I took some pains, when the water was not very high in the Tiber, to examine the Cloaca Maxima, now rendered useless from the deposit at its mouth, and the great elevation of the bed of the river

above what it was when this sewer was constructed : it is 14 feet in width and 32 feet in height ; constructed of large and massive blocks of Albano stone called Pepperino, and has a semi-circular vault, formed of three rings of voussoirs. What quantity of land, or portion of the ancient city poured its waters into it, at present it would be difficult accurately to define ; its construction, as well as those remaining at the Alban Lake and that of Fucinus, are ample testimonies of the thorough knowledge of the subject 2000 years ago. Had the river Tiber received its due share of attention, and the discharge of its water into the Mediterranean Sea been properly maintained, the sewage of Rome would have been perfect at this day ; as would also the drainage of the sites of many of our ancient mansions and religious houses, had the Commissioners appointed to examine the several water-courses in this kingdom continued that active superintendence which Dugdale has reported to have been exercised centuries ago. The statutes of Romney Marsh then gave ample power, and the rivers were never impeded in their course by dams or obstructions of any kind.

“Can you describe any large building at Rome, or elsewhere, where there are proofs remaining of what you state ?—The Colosseum itself is the best instance I can adduce. It has often been remarked, that the Roman engineers displayed far superior talents, in the carrying off the waters from the buildings they constructed to those evinced by the freemasons or their successors. Before the foundations of these vast am-

phitheatres were laid, every consideration was given to the best method of draining the vast accumulation of water of every kind which could fall or be accumulated within their area. Not so with the constructions of a later time ; our cathedrals, in particular, shew no evidence of any forethought upon the subject ; they spurt forth from numerous gargouilles the rain-water which falls upon their roofs ; streams which, falling in a parabolic curve on the ground, sap the very foundations, and render damp the thick walls which circumscribe them. If we examine the Colosseum with attention to this subject, we shall find that the Roman engineers employed in its construction thoroughly understood the important question of drainage, and that they have left us an evidence of their acquaintance with the principles which regulate running waters, or at least of their practical knowledge of those laws which mathematicians have taken so much trouble to explain. . . . The Colosseum comprises, within its walls, an area of 249,840 superficial feet, or nearly $5\frac{3}{4}$ acres of land. Every inch fall of rain upon its entire area would therefore amount to 20,820 cubic feet of water. Besides the consideration for carrying off so large a quantity as the above, or, as frequently happens in Rome, the pouring down of sheets of water during a storm, it was necessary to provide urinals and other conveniences for 70,000 or 80,000 persons constantly assembled to witness the shows and games, and who often remained rivetted to the spot for days together. Such a building had the character of a vast citadel or city, and to preserve clean-

liness as well as to effectually drain so vast an accumulation of water and other matter as would be found within it, naturally deserved the most profound consideration ; and upon examining its remains we feel amply satisfied, not only that such was indeed the case, but that the practical development was executed in so ingenious and praiseworthy a manner as to excite our astonishment, and to serve us as a model for operations of a similar kind."

The following brief extracts from a series of papers by Mr. Alfred Haviland, in the first volume of the *Journal of Public Health*, will illustrate still further the statements in the text as regards the supply of water to ancient Rome, and the construction of the private houses, as respects ventilation. I have not considered it necessary to quote the description of the Roman bath, as the information on this subject is now so generally accessible.

The Aqueducts.—"There were several of these magnificent structures, according to some as many as twenty, whilst others reduce the number to fourteen. One brought water upwards of sixty miles : rocks were hewn through, mountains tunnelled, and valleys arched for the purpose of carrying out this gigantic design. Some of the arches were 109 feet high. The date of the first aqueduct, according to Frontinus, is assigned to the year A.U.C. 441. The water thus brought into the city was received into enormous reservoirs called *Castella*, which were divided into *privata* and *publica*. The former were intended to provide private

houses with water, which was raised into a leaden cistern called *castellum domesticum*. The *Castella publica* supplied the Prætorian camp, the ponds and fountains, the circus, naumachiæ, amphitheatres, baths, and certain trades, such as fullers, dyers, and tanners, etc. Government was always very jealous in the preservation of the water, and heavy penalties were inflicted on those who either wasted or purloined it ;—a vigilant police was appointed to superintend the works. The curator and ædiles were appointed curators of these buildings under the republic. Augustus, however, established the office of *curator* or *præfectus aquarum*, who had an efficient staff under him ; for instance, in the time of Trajan, a body of 460 slaves were constantly employed under the orders of the *curatores aquarum*. Some had to take care of the pipes, others the reservoirs. Some were masons and paviors, and others water carriers. The system seemed complete, and connected as it was with the magnificent baths, we may look upon the supply of water in ancient Rome as the most perfect piece of sanitary provision that the history of this city contains. It employed thousands in the constructing of these buildings, hundreds were constantly engaged about them when completed,—it provided thousands with pure water for washing and drinking daily,—it afforded amusement after the toils of war or the fatigues of business ; it flushed the sewers, and thus purified their houses and streets.” Pp. 262-3.

The Private Houses.—“ At first the houses were only one storey high ; but, as in our modern cities, the

land on which these houses were built became expensive, so did the proprietors increase the number of the storeys, until the formidable height of some of the houses was the cause of serious accidents, which induced the emperor Augustus to restrict the height to seventy feet, of all houses built near a thoroughfare.

“ The bed-rooms were generally small ; and as the means of heating houses were very inefficient among the Romans, these apartments were generally built in that part of the house where the sun had the greatest influence. Vitruvius recommended that the dormitories should look towards the east, in order to have the benefit of the first rays of day. Generally, however, the bed-rooms had merely the borrowed light derived from the openings in the upper part of the house, which lighted the atrium—a large apartment, roofed over, with the exception of an opening in the centre (*compluvium*), through which the rain fell from the sloping roof into a cistern on the floor (*impluvium*). This peculiar arrangement must have been highly conducive to the free ventilation of the house ; besides which, the defective windows, which were for many centuries merely closed by shutters, not only admitted of the free ingress and egress of air, but also acted as chimneys for the smoke from portable furnaces or braziers, in which charcoal or coal were burnt. The rooms were sometimes heated by hot water, conveyed from furnaces into pipes. It must be remembered that, at a later date, mica, lapis specularis, and even glass, were used for windows ; and hence their name, specularia. Chimneys seem to have been entirely

unknown, or at least very imperfect. The Romans were eminently fond of being out of doors; and we find that many houses were provided with solaría on their tops, which were intended for basking in the sun. Many facts connected with the social life of the Romans lead us to account for what is remarkable in the construction of their sleeping apartments. Their fondness for exercise in the open air especially attracts attention, for all well know how conducive it is to sound repose, during which the smallness of the bed-room would be forgotten. The atrium was frequently used as a family sitting-room. So far, then, as the ventilation of Roman houses in general is concerned, we may safely assert that their construction was highly conducive to a thorough and continued renewal of the air of the apartments. The compluvium, the open ceilings, the windows, and the means of heating their principal rooms, all conspired to bring about a process which, in our more complicated dwellings, seldom is effective." Pp. 379-80.

NOTE B. Page 11.

STATE OF THE TOWNS IN ENGLAND IN THE THIRTEENTH
CENTURY.

From Mr. Brewer's introduction to the "*Monumenta Franciscana*," mentioned in the text, I quote the following compact and carefully-worded description. For a great deal of important and detailed information on the general condition and municipal regulations of

the mediæval towns, and especially of London, the reader may be referred to another work in the same series—the “*Liber Albus*,” edited by H. T. Riley, M.A., from the muniments of Guildhall, with great care, and rendered exceedingly accessible for consultation by a well-arranged introduction.

“A vast amount of squalor and wretchedness, of ignorance and poverty, existed in the towns without any adequate means for counteraction. Improvement could not keep pace with the rapid increase of population. Fever and plague, strange and destructive epidemics, spread with unexampled rapidity. Whole quarters of the city suffered from the scourge, without adequate means of prevention; without remedy or reparation for the evil when it had occurred. Markets were scantily and irregularly supplied; roads intercepted by a feudal aristocracy or a discontented sovereign; an entire population, as in the industrious towns of the Low Countries, exposed to periodical starvation. The narrowness and intricacy of the streets, serving as a protection against the mounted knight and his men-at-arms, served also a worse enemy, the plague or the sweating sickness, and decimated the population, to whom sanitary precautions were unknown. The lazy ditches and stagnant ponds, into which ran the refuse and garbage of the shambles—a poor protection to the various quarters of the town—sent up their fetid odours, rank with fever and ague, into the stifled chamber and open booth of the artizan. Upon the higher ground, as may be seen in many towns in

England at the present day, stood the Guildhall and the Ward of the Aldermen, distinguished by houses partially built of stone pilfered from the old Roman monuments, forming a striking contrast to the outer circle and the suburbs, where, down to the water's edge, and straggling beyond it, in an uncertain and precarious tenure, rose wooden sheds, rudely plastered or white-washed, on the edge of the town-ditch, sheltering the last new settlers that had flocked into the town for occupation or protection, a mixed race, of whom little inquiry was made ; tolerated, not acknowledged ; of all blood, all climates, and all religions ; permitted to live or die, as it pleased God or themselves, provided only that they yielded due obedience to the proper civic authorities. Here the leprosy and the plague were certain to enter first ; here infection did its worst. In the higher city there might be parish churches and schools ; a skilful leech to look after the welfare, bodily and spiritual, of the inhabitants. In defect of these, the different guilds established in the city proper provided in some measure for the instruction and comfort of the master and his apprentices. The city ponds and rivulets yielded fresh water to those who were willing to fetch it ; the chaplain of the guild, its church or chapel, provided for the common worship and spiritual welfare of its members ; the common purse of the guild furnished relief against sudden misfortune, and paid for the funeral obsequies and masses of the defunct brother. But for the unguilded population, who resided in the suburbs, and increased daily and rapidly in the un-

settled condition of the country, or as the oppression or harshness or stern justice of the feudal baron made the town a more safe and desirable abiding place than the country ; for these there were no such advantages. Imagination can only conceive their condition ; history is silent.”—*Monumenta Franciscana*, p. xv.

NOTE C. Page 13.

DEFOE'S ACCOUNT OF THE SHUTTING UP OF INFECTED
HOUSES IN THE GREAT PLAGUE OF LONDON IN 1665.

Among the numerous descriptions of great pestilences and their social results, there is certainly none that excels that of Defoe in the minute precision of details, and the life-like interest imparted to the narrative ; and the marvellous simplicity and power of the language is such, that hundreds have probably read the painful story under the impression that it was, in fact, a personal experience of the author. Nor is there any reason to doubt that the statements here quoted are, in the main, founded on fact. Assuredly they are in strict accordance with human nature ; and, besides, from their wide diffusion among the English people, they form a document of some importance in the history of public opinion in relation to this subject.

The orders of the magistrates, under which the sick were sequestered, are given at length in Defoe's journal. They enact, that “ the master of every house, as soon as any one in his house complaineth, either of botch, or

purple, or swelling, in any part of his body, or falleth otherwise dangerously sick without apparent cause of some other disease, shall give notice thereof to the examiner of health within two hours after the said sign shall appear." The sequestration is then ordered the same night ; the infected house is to be shut up, being "marked with a red cross of a foot long, in the middle of the door, evident to be seen, and with these printed words, that is to say, ' Lord have mercy upon us,' to be set close over the same cross, there to continue until lawful opening of the same house." The constables are charged to see every house shut up, and "attended with watchmen, which may keep in, and minister necessities to them at their own charge if they be able, or at the common charge if they be unable. The shutting up to be for the space of four weeks after all be whole." No person is to be conveyed out of a house so shut up, and any one going into such a house is himself to be sequestered, even if quite healthy, "for certain days, by the examiner's direction." These and numerous other regulations are given in greater detail than it is necessary to reproduce them here.

"This shutting up of the houses was a method first taken, as I understand, in the plague which happened in 1603, at the coming of King James the First to the crown, and the power of shutting people up in their own houses was granted by an act of Parliament entitled, 'An act for the charitable relief and ordering of persons infected with the plague.' On which act of Parliament the Lord Mayor and Aldermen of the city

of London founded the order they made at this time, and which took place the first of July 1665, when the numbers of infected within the city were but few, the last bill for the ninety-two parishes being but four, and some houses having been shut up in the city, and some people being removed to the pest-house beyond Bunhill-fields, in the way to Islington, I say, by these means, when there died near one thousand a week in the whole, the number in the city was but twenty-eight, and the city was preserved more healthy in proportion, than any other place all the time of the infection.

* * * *

“This shutting up of houses was at first counted a very cruel and unchristian method, and the poor people so confined made bitter lamentations ; complaints of the severity of it were also daily brought to my Lord Mayor, of houses causelessly, and some maliciously, shut up ; I cannot say, but upon inquiry, many that complained so loudly were found in a condition to be continued ; and others, again, inspection being made upon the sick person, and the sickness not appearing infectious ; or, if uncertain, yet on his being content to be carried to the pest-house, was released.

* * * *

“Not far from the same place they blowed up a watchman with gunpowder, and burnt the poor fellow dreadfully ; and, while he made hideous cries, and nobody would venture to come near to help him, the whole family that were able to stir got out at the windows, one storey high, two that were left sick calling out for

help. Care was taken to give them nurses to look after them, but the persons fled were never found, till after the plague was abated they returned; but, as nothing could be proved, so nothing could be done to them.

“In other cases, some had gardens and walls, or pales between them and their neighbours, or yards and back-houses, and these, by friendship and entreaties, would get leave to get over those walls or pales, and so go out at their neighbours’ doors, or by giving money to their servants, get them to let them through in the night; so that, in short, the shutting up of houses was in nowise to be depended upon; neither did it answer the end at all, serving more to make the people desperate, and drive them to such extremities, as that they would break out at all adventures.

“And that which was still worse, those that did thus break out, spread the infection further by their wandering about with the distemper upon them, in their desperate circumstances, than they would otherwise have done; for, whoever considers all the particulars in such cases, must acknowledge, and cannot doubt but the severity of those confinements made many people desperate, and made them run out of their houses at all hazards, and with the plague visibly upon them, not knowing either whither to go or what to do, or, indeed, what they did; and many that did so were driven to dreadful exigencies and extremities, and perished in the streets or fields for mere want, or dropped down by the raging violence of the fever upon them. Others wandered into the country, and went

forward any way, as their desperation guided them, not knowing whither they went or would go, till, faint and tired, and not getting any relief—the houses and villages on the road refusing to admit them to lodge, whether infected or no—they have perished by the road side, or gotten into barns, and died there, none daring to come to them or relieve them, though perhaps not infected, for nobody would believe them.”—*History of the Plague in London in 1665.* By Daniel Defoe.

NOTE D. Page 22.

TABLES ILLUSTRATIVE OF THE SCIENCE OF DEATH-RATES.

I devoted five lectures of the course immediately following the introductory lecture, to the exposition of this subject, with the aid of the following tables, and also of various diagrams intended to exhibit to the eye the pressure of mortality, and of the deaths from various kinds of disease in a great variety of circumstances. Some of these diagrams, which I have used for some years under the name of the “Barometer of Public Health,” shew the rate of mortality for different places, ages, etc., measured upon a graduated scale, which presents to view at once the maxima and minima in each particular case. I have not considered it expedient on the present occasion to enter at large into the subject of death-rates in this publication; but with a view to the convenience of students, and for the more complete elucidation of certain topics

incidentally suggested in this and the succeeding lectures, I trust that the tables here subjoined may be found useful, even without the commentary.

TABLE I.

RATE OF MORTALITY IN ENGLAND AND WALES,

Calculated for the ten years 1841-1850 ; shewing also the total number of districts having each separate rate, and the density of population corresponding to each death-rate.

(*Counties are printed in Small Capitals ; Registration Districts and Towns in Italics. From Returns in the Registrar-General's Sixteenth Annual Report.*)*

For each
1000 per-
sons living,
there die
annually

15 Total number of districts having this rate, 3.
Population to one square mile, 56.

Eastbourne in Sussex ; *Glendale* and *Rothbury* in Northumberland.

* London constitutes an assemblage of districts by itself, and is specially withdrawn from the counties in these calculations ; in all other cases the town districts are included as part of the counties in which they are situated. In comparing this list with the return of Registration districts and sub-districts, it is also necessary to keep in view the corrections applied in pp. 150-153 of the report, in the case of several of the town districts ; as, for example, Hereford, Macclesfield, Lincoln, Carlisle, where the limits of the district do not correspond with those adopted by the Registrar-General as indicating, approximatively, the urban population.

For each
1000 per-
sons living,
there die
annually

- 16** Total number of districts, 14.
Population to one square mile, 106.
Reigate and *Hambledon* in Surrey. *Battle*, etc., in Sussex. *Christchurch* in Hampshire. *Okehampton*, etc., in Devon. *Haltwhistle* in Northumberland.
Builth in Brecknockshire, etc.
- 17** Total number of districts, 47.
Population to one square mile, 144.
Dorking and *Godstone* in Surrey. *Isle of Wight*. Many places in Kent, Sussex, Hampshire, Devon, Cornwall, etc.
- 18** Total number of districts, 87.
Population to one square mile, 149.
SURREY, SUSSEX. Numerous scattered districts and small country towns. *Hastings*.
- 19** Total number of districts, 96.
Population to one square mile, 182.
MIDDLESEX (extra metropolitan), CORNWALL, RUTLAND, N. RIDING of Yorkshire, WESTMORELAND. Numerous rural districts and country towns.
- 20** Total number of districts, 111.
Population to one square mile, 202.
HAMPSHIRE, BERKSHIRE, HEREFORDSHIRE, ESSEX, SUFFOLK, DORSETSHIRE, DEVON, SOMERSET. Very numerous districts and small towns.
Wales. *Cheltenham*, *Swansea*.

For each
1000 per-
sons living,
there die
annually

- 21** Total number of districts, 90.
Population to one square mile, 220.
KENT, BUCKS, OXFORDSHIRE, NORFOLK,
WILTS, HEREFORDSHIRE, SHROPSHIRE, WOR-
CESTERSHIRE, DERBYSHIRE, NOTTINGHAMSHIRE,
CUMBERLAND. *Brighton, Aston.*
- 22** Total number of districts, 48.
Population to one square mile, 324.
England and Wales. NORTHAMPTONSHIRE,
HUNTINGDONSHIRE, BEDFORDSHIRE, GLOUCESTER-
SHIRE, LEICESTERSHIRE, DURHAM, NORTHUMBER-
LAND, *Huddersfield, Halifax.*
- 23** Total number of districts, 26.
Population to one square mile, 485.
CAMBRIDGESHIRE, WARWICKSHIRE, CHESHIRE,
WEST RIDING of Yorkshire, MONMOUTHSHIRE.
Oxford, Cambridge, Southampton, Yarmouth,
Ipswich, Clifton, Wakefield, Lincoln, King's
Lynn, etc.
- 24** Total number of districts, 29.
Population to one square mile, 1216.
STAFFORDSHIRE, EAST RIDING of Yorkshire.
Canterbury, Norwich, Rochester and Chat-
ham, Derby, Northampton, Bury St. Edmunds,
Colchester, Worcester, Bath, Sunderland, Tyne-
mouth, Newport, Gosport, Rochdale, Durham,
Winchester.

For each
1000 per-
sons living,
there die
annually

- 25** Total number of districts, 24.
Population to one square mile, 1262.
London, York, Portsmouth, Plymouth, Exeter, Stockport, Preston, Blackburn, Bury, Bradford, Gateshead, Dudley, Gravesend, Chorlton.
- 26** Total number of districts, 18.
Population to one square mile, 2064.
Birmingham, Gloucester, Shrewsbury, Nottingham, Newcastle-under-Lyne, W. Derby (part of Liverpool), Warrington, Ashton, Oldham, S. Shields, Chester.
- 27*** LANCASHIRE. **Leicester, Wolverhampton, Stoke-upon-Trent, Coventry, Bolton, Sheffield, Newcastle-on-Tyne, Carlisle.**
- 28** **Salisbury, Salford, Wigan, Merthyr Tydfil.**
- 29** **Bristol, Hereford.**
- 30** **Leeds, Macclesfield.**
- 31** **Hull.**
- 32**
- 33** **Manchester.**
- 34**
- 35**
- 36** **Liverpool.†**

* There are 31 districts having a death-rate of 27 and upwards. These have a population of about 2900 to one square mile, or at the rate of 0.22 persons to the acre.

† In this estimate of the mortality of Liverpool, the year 1847 (the year of the Irish famine and immigration) is not in-

TABLE II.

RATE OF MORTALITY IN LONDON, AND IN EACH OF ITS
SEPARATE REGISTRATION DISTRICTS ;

Calculated for the Ten Years, 1841-1850.

*(From the Registrar-General's Sixteenth Annual Report.)*For each
1000 per-
sons living,
there die
annually

- | | |
|-----------|---|
| 17 | Lewisham. |
| 18 | St. George Hanover Square, Hampstead. |
| 19 | Kensington, Islington, Wandsworth. (Several suburban districts, as Kingston, Richmond, Edmonton, Brentford, West Ham, range from 18 to 20). |
| 20 | Hackney, City of London. |
| 22 | St. James' Westminster, Strand. |
| 24 | St. Martin-in-the-Fields, Marylebone, Pancras, Clerkenwell, St. Olave Southwark, Camberwell. |
| 25 | London. St. Luke, Stepney, Poplar, Lambeth. |

cluded. Had it been included, the death-rate of Liverpool would have appeared as 39 annually. But it should not be forgotten that in the case of Liverpool, and probably many other places here referred to, the progressive improvements in the public health have altered considerably their position in the scale; the death-rate of Liverpool, in particular, being now, on an average of a few years past, not more than 26 or 27. See Lecture III.

For each
1000 per-
sons living,
there die
annually

26	Chelsea, Holborn, East London, Bethnal Green, Newington.
27	Westminster, St. Giles, Greenwich.
28	Shoreditch, Bermondsey, Rotherhithe.
29	Whitechapel, St. George-in-the-East.
30	St. George Southwark.
31	West London.
33	St. Saviour Southwark.

TABLE III

Average Rate of Mortality in England and Wales, during the Ten Years 1845-54 ; shewing the Number who Died Annually in 1000 living at all Ages, and in a like Number at Twelve Different Periods of Life, among Males and Females respectively.

	Males.	Females.	
All Ages . . .	23.64	22.05	
0- 5 years . . .	73.56	63.43	} Male rate highest to 10th year.
5-10 years . . .	9.16	8.95	
10-15 years . . .	5.23	5.46	
15-25 years . . .	8.33	8.63	} Female rate high- est from 10-35 years inclusive.
25-35 years . . .	10.15	10.83	
35-45 years . . .	13.09	12.93	
45-55 years . . .	18.95	16.17	} Male rate highest from 35th year onwards to 95th.
55-65 years . . .	32.26	28.55	
65-75 years . . .	67.55	61.04	
75-85 years . . .	149.91	136.52	
85-95 years . . .	302.94	280.76	
95 years and upwards	452.19	452.26	

(From the Registrar-General's Eighteenth Annual Report, p. xv.)

NOTE E. Page 37.

DEATH-RATES OF THE EIGHT PRINCIPAL TOWNS OF SCOTLAND, AND IN ALL SCOTLAND, FOR THE SIX YEARS 1855-60.

(From the Annual Supplements to the Monthly Returns of the Registrar-General.)

In each 1000 Living at all Ages, there died in Years

	1855.	1856.	1857.	1858.	1859.	1860.
Glasgow . .	29.6	27.7	30.3	30.1	27.8	31.3
Edinburgh .	24.7	23.6	21.3	23.2	20.3	22.9
Dundee . .	23.9	27.4	24.7	25.2	24.0	30.2
Aberdeen. .	21.6	21.1	21.8	20.4	21.1	27.2
Paisley . .	27.4	22.7	29.8	26.3	24.5	28.4
Greenock. .	36.2	32.8	33.6	28.7	37.5	33.0
Leith . . .	19.1	23.4	20.8	21.7	18.8	26.2
Perth . . .	23.9	20.5	28.3	25.1	21.1	24.7
Eight Towns	27.0	25.9	26.8	26.5	24.9	28.6
All Scotland .	20.7	19.2	20.2	20.5	19.7	21.5

II.

AIR AND WATER AS SANITARY AGENTS.

You will remember, that on the conclusion of our detailed investigation into the phenomena of the death-rate and its variations,* we passed to the consideration how far these variations might be dependent upon removable causes. I gave you, accordingly, a sort of general or synoptical view of the elements of what is sometimes learnedly called *hygiene*;—i. e., a view of the conditions or laws of health founded on what we know of general physiology and pathology. I purposely avoided details of illustration from those special facts and methods of inquiry which form the domain of the sanitary reformer: and we came to the conclusion, speaking from physiological knowledge only, that the conditions of a healthy life are mainly these,—pure air, pure and wholesome water, plenty of light and warmth, good food, good clothing, a comfortable home, a fitting occupation (including a wholesome condition of the workshop), a proper relation between the sexes, or the right cultivation of domestic habits, and of the natural social affections; and in the last place, a

* See Note D, *ante*, p. 51.

sufficient amount of relaxation and amusement at intervals, including under the item of relaxation, the important one of absolute rest and sleep. I told you that these were the physiological elements of health, and that in future lectures I would endeavour to develop in some degree the consideration of how far these may be said to be within the domain of the sanitary reformer. I also shewed you, by quotations from the health reports, the important relation which these different conditions of a healthy life bear to one another; and in particular, I shewed you the immense extent to which the comfort of the home and of the workshop, as respects the single first element of health, proper ventilation, is found to enter into all the more complex developments of the other essential conditions of health, so that without proper ventilation, and the closely allied conditions of good drainage and sewerage, it is impossible to expect that any of the other great vital necessities can be properly or even moderately well attended to.

Now, to-day, I proceed to a more detailed consideration of the value and importance of pure air and water as elements of health. I said in the first lecture, and it cannot be too often repeated, that in the management of the supply of air and water is included almost the whole sanitary code. When you get air and water systematically purified, you have not only begun, but you have advanced far in the work of sanitary reform. You have indeed done the greater part of all that you can do in the way of legal interference in regard to public

health. It is, therefore, very important that you should thoroughly grasp the ideas connected with the purification of air and water. The health and the morals of the population here hang by the same thread ; for though I am not here to argue that men are moral or immoral simply as the creatures of circumstances, yet there can be very little doubt that the physical circumstances in which men are placed often dominate to a vast extent their moral health. They do so at all events to this extent, that without a certain degree of purity of air, water, and person (and the last is the result of the other two), self-respect, and respect for others, which are the foundation of the moral code as between man and man, become impossible. And therefore literally and truly, as was said long ago in the way of proverb, " Cleanliness is next to godliness ;"—Nay, even godliness itself is not a little dependent upon cleanliness, when you speak of large numbers of men.

What we are to speak of to-day, then, is the purification of air and water—the keeping of air and water *clean* ; for cleanness of air, just like cleanness of water, and person, and clothes, is one of the first requisites of health, and one of the most indispensable. Now, observe another point in which air and water are more important than all the other elements that follow. They not only include all other sanitary reforms to a very great extent—because whenever you have air and water clean, a great deal of the rest follows as a natural consequence ;—but I must here again revert to an idea which I brought out in some degree in the first lecture,

namely, that in the case of air and water there is a peculiar justification for the interference of the authority. Our food, our clothing, our dwellings—that is to say, the walls and the furniture of them—are personally ours in a sense in which air and water are not. Air and water belong to no man,—they belong to all men. We have all a right to use them ; but we cannot confine the use of them, or even of any portion of them, to ourselves ; and just because God has given them in free unstinted measure, but as a common gift, to all the inhabitants of the earth without distinction ;—just because of this, we have all a right to use them, and we have all no right to abuse them. And furthermore, each one of us, as an individual, and the community, as representing the whole mass of individuals—has an indefeasible right to see that no individual of the community does abuse them, to the possible injury of the rest. That, I think, is a point of view that we can take with regard to air and water which we cannot take so clearly with regard to any of the other great elements of health. I deduce from this, then, the right of authoritative interference, if necessary, in regard to air and water. We have a perfect right—it may be a question of expediency in any particular case how far we can carry that right—it may be a question of expediency, or a question of possibility, how far we can carry it ; but we have in theory the right, as a community, to interfere to the full extent necessary to preserve the greatest attainable purity of air and water to every member of the community ; I cannot doubt that at all. I

shall argue afterwards as to the expediency of interference in particular cases ; but that is the principle that I go upon. And I may here allude, in passing, at this stage, to a question that I shall revert to later—the question that has often been raised, and that has given rise to much discussion, and acrimonious discussion too,—the question as between centralisation and the municipal authority, or rather the question as between these three modes of effecting reforms—the action of the central government, that of the municipal or local authorities, and the voluntary action of individuals. I say, then, that in the case of air and water at least, that question is to me not very difficult of solution,—at all events in theory. I solve it in this way, by asking and answering, as far as may be, another question : How far are the reforms that are required to preserve the greatest attainable purity—for nothing less than that will satisfy me—how far are they within the power of the individual ? how far are they not so, but yet within the power of the municipality ? Wherever they are within the power of the individual, and he is both able and willing, it is better that he should do them ; but if he fails, the community must take it up ; and if the community fails, the central authority must take it up. Here, you observe, there is no question of degree as to the object we are in quest of. It is not a question of more or less luxurious living, more or less wealth, more or less comfort or enjoyment, but of the freest possible use of two of the essentials of health, which are free gifts of God to all of us. I ask for

nothing less than the perfectly unstinted use of pure air and water for every member of the community ; and I say, " If we can get that by individual action—good ; I don't want to go further. If we cannot get it by individual action, we next apply to the local community. If we cannot get it through the local community, we apply to the general community. But have it we *must*, and have it for every man, woman, and child among us ;—in every dwelling, in every lodging-house, in every workshop, in every school, church, theatre,—in every place where men do congregate, we must have access, if possible, to a perfectly pure and wholesome air and water before we have done.

Now, I would recall here another point that I insisted on in my first lecture. I said that in this great quest of pure air and water, we must take the help of the medical man ; we cannot get on without him, because at every step he must shew us the way to the abuses we have to correct. We want his help upon this ground, that certain forms of disease, and more especially those diseases that are commonly recognized as epidemic and endemic—a range, however, which is really wider than is commonly supposed—all diseases that are specially recognized as epidemic and endemic diseases, can be viewed in no other light than as being Providential indications of a failure on the part of the individual, or of the community, to secure the great elements of health. I think we are bound, from what we know, to go this full length, that what is called epidemic disease or pestilence is not a necessary thing—it is a

thing which, by care and attention to the conditions of health, we can get rid of to a great extent, if not entirely. We can well believe that pestilence may be rooted out absolutely in the entire community, because we find that in practice many epidemic diseases have been absolutely rooted out for large sections of the community by simple attention to the purity of air and water. And therefore, if it be a possible thing to get rid of epidemic disease, we should not stop short till we have in fact got rid of it. I think, therefore, that I am to a certain extent justified by facts in assuming that we are to look upon the mere existence of these diseases—not, perhaps, in every case, but certainly in the great majority of cases—as the evidence—plain and undeniable evidence—of a violated law; the only kind of evidence, perhaps, which we can fairly act upon without being subject to the imputation of capricious and meddlesome interference. And looking at an epidemic disease from that point of view, we find in the deaths recorded by the Registrar-General from epidemic disease, a series of facts of the greatest importance—facts which fortunately cannot be suppressed or argued away by those concerned—facts upon which the community, knowing them, are bound to act promptly and decisively, without hesitation and without delay.

I look upon epidemic diseases as the awful facts of God's providence, giving the seal of authority—of an authority higher than ours—of an authority higher than that of any earthly power—to a certain amount of interference with private concerns, or with what at first

sight appear to be private concerns. I am not at all disposed, even for ends which seem to me good, to justify any undue or oppressive interference of authority, but I say, that wherever we have epidemic diseases we have what God himself tells us is a violated law, the fatal consequences of which can no longer be limited by private effort ; the consequences of which, not being thus limited, may come to involve ourselves and our friends ; any one, in short, who may be accidentally and unwittingly exposed to the infection. We have, then, no longer to do with a disease which can be regarded as a merely local or private concern. The persons originally affected with such a disease may communicate it to hundreds of others, and from the very fact of the existence of such a disease, we derive an indefeasible right to interfere, and to see that it is extinguished as far as lies in our power. I venture to think that in this exposition of the matter I have not exceeded the long recognized principles of enlightened legislation, even in those communities most jealous of arbitrary interference. There is a principle recognized by all our authorities on jurisprudence, which is embodied in the phrase "*Sic utere tuo ut alienum non laedas.*" "So use what is your own, that you may not injure the property of other people." Now, if that be true of what is strictly ours ; if the law will not permit us to use even what is most strictly our own in such a manner as will injure others, how can it be maintained that we may so employ, or rather abuse, air and water, which are free to all, and which we cannot, if we would, keep to our-

selves alone—how can it possibly be maintained that we have any right to use these so as to injure other people?

Now then, upon that exposition of principles, I wish to found what I have to say of the purification of air and water. I wish to shew you how air and water are vitiated, and how, being vitiated, they are again purified. In making exposition of this, I shall inquire into the natural laws of the purification of air and water. I shall endeavour to expound to you how they are purified on the large scale—how they are purified by the Almighty in the great theatre of the world—and having explained, as fully as may be necessary, the laws of their purification in nature, and on the great scale, I shall endeavour to turn our knowledge to account, and shew you how we are to proceed upon the small scale—how we are to get rid of those impurities which necessarily arise during our use of air and water, and how we are to keep such impurities from becoming dangerous while they last. I shall not to this audience, which is mostly composed of medical persons, go into a detailed demonstration of what air and water are. You cannot fail to remember that air is a mixture of oxygen and nitrogen gases, in which oxygen forms 20 parts to about 80 of nitrogen; and that it contains also carbonic acid gas, watery vapour, that singular element called ozone, nitric acid, a little ammonia, and some other constituents, in smaller proportions than any of these. You also know that water in a pure state is composed of oxygen and hydrogen, and that it, too,

contains, as ordinarily found, many other elements in variable quantity, among which elements atmospheric air in solution is one ; various organic or inorganic substances, which may be said to be almost necessarily present, having been found among these variable elements of the water of which we make daily use. You are aware then, and most of you are doubtless familiar with the fact, that air and water contain one common element, oxygen ; and you know that this substance, oxygen, is one of the most widely diffused, indeed by far the most widely diffused, and also the most active element in nature, whether organic or inorganic. You will doubtless have observed also that air and water mutually interpenetrate or intermingle with each other—that is to say, air in solution enters into the composition of all water, and water in vapour enters into the composition of all air. This mutual intermingling of water and air is a very important agency in the purification of both, as we shall see immediately. Now, when air is vitiated by the products of animal waste, as in respiration, or by combustion, which is a closely similar process, you are aware that carbonic acid is almost always formed. When, in our great masses of population, or in individual cases, air is vitiated by respiration, carbonic acid is a kind of index of the amount of the vitiation. Carbonic acid exists in the air in small quantity naturally, but it goes on increasing in proportion as air is vitiated, either by animal respiration or by combustion, and also in some stages of decomposition or putrefaction. Now, this

vitiating of air by respiration, this formation of carbonic acid out of the tissues of the body, is a very great fact, upon the physiological relations of which I have no time to expatiate. But I will venture to point out to you this instructive table, which shews the great amount of the variation of carbonic acid in vitiated air :—

*Carbonic Acid in the air in different places.**

In the hall of the Military School at Paris	. 1 pt. in 1000.
The same, somewhat later	. 2 pts. "
In a ward of La Pitié	. 3 " "
In an infant school, the door half open	. 3 " "
In a ward of the Salpêtrière	. 8 " "
In the lecture-room of the Sorbonne—35000 cub. feet, audience of 200—doors open	. 10 " "
In the Chamber of Deputies	. 25 " "
In the pit of a theatre	. 23 " "
In the top gallery, at the end of a play	. 43 " "

In atmospheric air which is practically pure, the quantity of carbonic acid has been ascertained to vary from $\frac{1}{1000}$ to $\frac{1}{1300}$ parts by volume; being, according to Saussure, always greater in quantity in the upper strata than near the earth's surface.

Now, you all know well that carbonic acid is a poison; indeed, we are accustomed to hear people speak as if carbonic acid were the chief poison that vitiates the air of overcrowded apartments, and becomes thus the cause of the diseases of overcrowding. I need hardly tell you that this is incorrect. The poisons that vitiate the air in the most marked and dangerous

* Leblanc, in Comtes Rendus, 1842.

degree are not nearly so tangible or measurable as carbonic acid, nor have they anything to do with carbonic acid, except in the sense that they are often associated with it in vitiated air. But although carbonic acid, *per se*, is not the poison that we have chiefly to fear, the accumulation of carbonic acid is an important fact, partly because it is itself a poison, and partly because it is an index of the existence of other poisons ; for wherever you have an accumulation of carbonic acid, there it is possible—there it is even probable—that you may have conveyed into the air other substances, the results of animal respiration, which are even more poisonous than carbonic acid itself. And this leads me to allude, though merely momentarily and in a passing glance, to another subject which has excited much attention and discussion. I refer to the vexed question :—How far is a bad smell necessarily a poison ? How far are “stinks,” to use the rough and ready phrase, to be regarded as sources of disease and death ? A great deal of discussion has arisen upon this question. It has, on the one hand, been argued that bad smells are truly the very seeds of disease ; and, on the other hand, it has been maintained that they are wholly innocuous ; and this view has been supported by references to cases in which persons have been known to work in the midst of putrefying substances, and yet to preserve perfectly good health. I think you will see your way through these confusing labyrinths of discussion, if you will only look at the matter in this point of view :—Neither a bad smell, as such, nor

sulphuretted hydrogen, as such, nor carbonic acid, as such, contains the special poisons which we have to fear particularly as the sources of epidemic disease. But all of these are, to a certain extent, indications, beneficent, providential warnings, plainly given us (to view the matter from the aspect of final causes) to bring before our very senses the circumstances under which dangerous poisons may perchance be present. Such poisons may not be present in ninety-nine cases out of a hundred, where the air is manifestly impure to the senses, or saturated with gases which are the known products of organic decomposition, but in the hundredth case you may have a true morbid poison there present, and then it is a most deadly poison ; and this we can certainly say, that if we had not had the excess of carbonic acid, nor the sulphuretted hydrogen, nor the bad smell, in all probability we should not have had the dangerous element present either. The same law applies to water. Water, as I shewed you in my first lecture, contains, in some cases, those morbid poisons which we have to fear as the causes of disease. It is the medium, for instance, in some cases, of that dreadful poison of epidemic cholera ; and of some other diseases it is probably the principal medium. But we can study the process most conveniently, perhaps, in the case of the smallpox pustule, which contains a very terrific poison in small bulk, and so constituted as to act upon the fluids of the human body by becoming dissolved in water ; or, again, in the cowpox pustule, which is really only another (though a far more benign) form of small-

pox. In these cases we have the whole of the facts in relation to a most virulent and active source of disease under our daily observation and control. We know of a certainty that, in the little, seemingly insignificant, droplet of watery fluid inserted into the arm by the inoculator, is enclosed the specific poison of smallpox or cowpox. We know, therefore, that such poisons exist, that they are specific poisons which cannot be chemically analysed or mechanically weighed or measured; that an infinitesimally small amount of them, in fact, will produce the disease. We know that they may possibly exist wherever water or air contain certain organic impurities, with which the specific secretions or exhalations of persons suffering under disease may have been in contact. We know, on the other hand, that these poisons cannot exist where there are no such impurities; that is nearly all we know about them.* And therefore, although you may not be able to demonstrate that a *particular* organic impurity in water is poisonous, although you may even be able to bring a strong body of evidence to shew that it is not poisonous, yet, wherever you have a considerable amount of organic impurity habitually present in water, as in air, depend upon it you have some of the conditions in which these peculiarly evanescent and dangerous poisons may possibly lurk unseen.

Now, it is well known that the most destructive of these morbid poisons are also the most evanescent. We know that they are very rapidly produced, and

* See Note F, p. 89.

equally rapidly decomposed ; we have good evidence, also, that they are very active, even when present in inconceivably small quantity ; that they act by what is called (perhaps somewhat fancifully) a zymosis, or fermentation in the blood. It is very probable that, with most of these peculiar morbid ferments, a few hours of decomposition will entirely destroy them. We know that they are usually associated with the other more common and gross elements of the impurity of air and water ; and surely that should be enough to teach us that we ought to keep the air and water around us absolutely pure (in the practical sense of the word), for that is the only way to secure our safety.

But how are the air and water to be kept absolutely pure ? or if that cannot be done, how are they to be thus far kept safe for our use as to be rapidly freed from the most dangerous kinds of organic impurities ? for that is the problem which is to be solved. Any of you who have been working in the dissecting room, and have suffered yourselves, or seen others suffer from that dangerous poison generated in the dead body, and introduced by a kind of accidental inoculation into wounds in the living, must be aware that it is not the most putrid bodies that contain this poison—not at all. The human body does not contain this poison while it is yet alive ; the matter in which it occurs must be dead matter. But it is also true that the body does not continue to generate, or even to contain the peculiar poison which produces such terrible effects, after it has been long dead. The really dangerous period is for two or three days,

perhaps in some cases only as many hours ; it ceases, for the most part, when putrefaction has fairly set in. Get over that period, and the danger is comparatively slight. So with air and water, when contaminated with organic impurities. The period at which they contain the most dangerous poisons is before they have begun to putrefy in the ordinary sense. The sulphuretted hydrogen—the bad smell—comes, therefore, almost too late to warn effectually in all cases—at all events, it is to be taken, not so much as proof of a present danger, but rather as indicating a past danger ; as shewing forth a contamination which may possibly have contained dangerous elements, but which has passed beyond the most dangerous stage. Now, what is Nature's process of purification ? It is like a great many of Nature's processes—like most of the processes of physiology—like most of the processes of vital change, in animals, at all events—it is a process of oxidation. Both in living and dead organic matter, oxygen gas is the great transformer—at once the destroyer and the preserver of Nature, the agent that transmutes living matter into dead, and dead matter into living again. To the living it is the elixir of life ; to the dead it is the prime mover in decay. So long as the animal lives, one important product of its vital waste is carbonic acid ; the oxidation of the carbon of the tissues is a necessary condition of life. So soon as the animal dies, another kind of oxidation sets in ; the tissues putrefy, and through the interference mainly of oxygen gas, are resolved back into the realm of inorganic nature. Now, when the oxidation has

gone to the extreme length possible in any given case ; when the higher stages of oxidation are reached, there is generally comparative safety. It is in the intermediate stages that there is danger, and the great object of the purification of air and water is to push on the process of oxidation over the dangerous stage at which the formidable poisons, to which I have already alluded, are generated and maintained active. How is this to be done ? How are air and water purified by Nature ? It is effected by facilitating—hurrying on, as it were—this process of oxidation, by means of the minute diffusion of the particles where they may come in contact with the largest amount of oxygen, and in the form most favourable for that oxygen acting upon the decomposing matter. I need not go in detail into the chemical theory of this process. I need not tell you in detail how ozone, that strange fruit of modern discovery, is believed to take part in it. I need not tell you what are the oxidating processes with the individual organic compounds of nitrogen, carbon, and hydrogen. You know, many of you, something about the chemistry of it ; you know that all these substances pass through successive stages of oxidation until the nitrogenous substances reach the state of ammonia and nitric acid, the carbonaceous substances the state of carbonic acid, and the hydrogenous substances the state of water ; and in these forms are ready to be taken up by vegetables, which reverse the process, decomposing these various compounds of oxygen, these oxides of nitrogen and carbon, and hydrogen, and setting free again the oxygen, to do its work in nature as a part

of the atmosphere. Such is the great law ruling the changes of organic nature—such the stupendous fact demonstrated many years ago by Dumas, and which is so important a result of modern science. That animals are perpetually producing, by respiration and otherwise, carbonic acid and water, with various nitrogenous products, and particularly ammonia; while vegetables, on the other hand, are constantly taking up these substances into their tissues, and returning into the air those substances which animal respiration and vital waste had taken away from it. This grand and wonderful fact is truly one of the highest generalisations of modern physiology, and it is intimately connected with the whole subject of public health.

Now, only look at the magnitude of this operation, as carried on over the whole vast area of our earth's surface, and you cannot fail to realize, in a manner that mere language fails to express, the perfection with which it is accomplished by Nature on the great scale. I have made a rough calculation here, to bring it before you in a distinct form:—A full-grown man excretes from 1000 to 2000 cubic inches per hour of carbonic acid gas, corresponding to 200 or 300 grains of pure carbon per hour, or from 10 to 15 ounces in the course of twenty-four hours. I have purposely taken the smallest of the different estimates that have been made of the carbon excreted. Now, supposing the entire human family and the animal creation upon the globe to be equal to two thousand millions of full-grown men, and taking the lowest estimate (which is certainly too low)

of the carbonic acid evolved, we have two billions (2,000,000,000,000) of cubic inches per hour, or 17,532 billions (say 18,000,000,000,000,000), *i.e.*, eighteen thousand millions of millions of cubic inches of carbonic acid in a year, evolved upon the surface of the earth from animal bodies, to say nothing of a quantity, which it would be difficult even to guess, produced by combustion, natural and artificial. Yet carbonic acid does not increase in quantity near the ground, but, on the contrary, remains permanently less in quantity in the lower strata than the nearly fixed amount which is collected from the air at considerable elevations. This enormous quantity of carbonic acid must be from day to day entirely decomposed, and the oxygen that belongs to it returned to the air, otherwise the balance of nature will not be restored. In order that this decomposition may go on without pause or interruption, it is perfectly clear that the complete penetration of the elements of organized beings by both air and water must be going on at every hour of the day ; for, in this curiously complex and beautiful process, we find that the air plays its part and the water also its part. The air plays its part in virtue of the law which you know as that described by Professor Graham,—the law of the diffusion of gases,—that law by which it becomes impossible for two gases to remain in contact without their elements being intimately, though only mechanically blended. That law is one great secret of Nature's chemistry. Oxidation goes on constantly and inevitably, and oxygen is uniformly diffused,

because, wherever two gases are in contact in Nature's laboratory, they must become intimately blended with each other. Water, again, fulfils its part as a carrier of oxygen, chiefly in virtue of the air which it contains. You will observe, therefore, of what immense importance it is that water should contain air, otherwise the fluid secretions of the animal body might not become rapidly enough oxidized. Water must contain air, that it may perform its part in the work of oxidation. And how is that secured? By the constant movement of water. Need I remind you of the musical and bubbling flow of the running stream,—of the rushing of the mighty river,—of the ceaseless agitation of the ocean, in which water is dashed about by the tides,—of the noiseless ascent of vapours, and their precipitation upon the earth again under the forms of rain and dew? In the course of all these varied movements, the vast masses of water in circulation inevitably get saturated with air, and are thus enabled to perform their part in the work of oxidation. Then there is a third agent which is very important; its true value has only of late years been appreciated, owing, among other circumstances, to the labours of Liebig, and the very interesting and detailed researches of Dr. Angus Smith of Manchester,* that is, the soil. The soil is, in the first place, a filterer of water, as everybody knows,—it filters the water from merely mechanical impurities.

* Report of the British Association of Science for 1851; and in the Second Report of the Metropolitan Sanitary Commission, p. 121.

But it is a great deal more than that. Dr. Angus Smith has shewn, in a very full and complete manner, that the soil is to be regarded, not as a mere mechanical filter, but also, to an immense extent, as an oxidator and purifier,—that the soil has a great tendency to attract oxygen from the atmosphere, and that it keeps a store of that oxygen in constant readiness to be imparted to the water, and to all organic impurities passing through the soil along with the water. And hence it happens that anything of a putrefactive kind that once gets into the ground is very speedily got past the stage of putrefaction ;—in other words, ceases to putrefy, and becomes deodorized by the contact of that greatest of disinfecting agencies. Hence it is also, that, as Dr. Smith has shewn, the subsoil of our towns and villages is preserved, to a considerable extent, from becoming, as it would otherwise inevitably do, one great mass of corrupting organic materials. Hence it is that you can almost always get very pure water by going sufficiently deep ; because, so great is the tendency of the upper stratum of the soil to oxidate matters brought into it, and at the same time to filter them and cleanse them from all impurities, soluble and insoluble, that water, after passing through a certain thickness of this natural oxidizing filter, comes out purer than rain water, because deprived of those carbonaceous, and nitrogenous, and sulphurous elements which rain water usually carries down in the neighbourhood of great cities. Observe, then, that the theory of the purification of air and water is this,—that all the

impurities of our animal bodies must be somehow or other got into the general mass of the air,—having got them there, you may leave the rest to Nature ;—or, these impurities must be cast out into the general mass of the water,—having got them there, too, you may leave the rest to Nature :—or again, these impurities may be discharged through the water into the soil,—where, having got them, and at a sufficient distance from the haunts of men, so that they may not render immediately impure again the water that he drinks,—having got them there, you may safely allow the process of oxidation to go on, and here again the water will come out in the end quite pure.

That is the theory of the matter. Now, let us see how we actually proceed ; and of this I can only give you a few examples to-day, reserving for future lectures the details of the very important subjects, ventilation and drainage.

And first, of ventilation. Do we observe or violate Nature's law here ? Do we take anything like the requisite pains to fulfil that law ? Or do we even take pains that it shall not be violated in the most gross manner possible ? Unhappily, we cannot give a favourable answer to any of these questions. The very valuable Reports upon the Health of Towns, and those other Reports on the Health of the Labouring Population, to which I alluded in the first lecture of this course, furnish a whole mass of details bearing upon the impure condition of the air, from which I must give you only such very few extracts as will enable you,

generally, to apprehend the practical bearing of the subject. The first extract that I will read you is an illustration of the state of certain populations in London. And I will not take what are commonly considered the worst districts in London, I will take the districts that contain a large proportion of the most fashionable population—the districts of St. George's Hanover Square, and St. James' Westminster; eminently wealthy and prosperous districts, though containing, of course, a considerable element of poverty and wretchedness.

“JOSEPH TOYNBEE, Esq., F.R.S., Surgeon, examined.
—You are one of the surgeons of the St. George's and the St. James' Dispensary?—Yes, I am the senior surgeon, and for several years I visited the patients of the Westminster General Dispensary at their homes.

“Is it not part of your duty to visit the out-door patients at their own houses?—Yes it is, I visit cases daily in the neighbourhood of Golden Square and Grosvenor Square, large portions of which are inhabited by persons in the poorest condition.

“In a statistical report made by Mr. Weld, on a house-to-house visitation made at the instance of Lord Sandon to the Statistical Society, it is stated that there were in the parish of St. George's Hanover Square, 1465 families of the labouring classes, who had for their residence only 2175 rooms and 2510 beds. The distribution of rooms and beds was as follows:—

Dwellings.	No. of Families	Beds.	No. of Families
Single rooms for each family	929	One bed to each family	623
Two " "	408	Two " "	638
Three " "	94	Three " "	154
Four " "	17	Four " "	21
Five " "	8	Five " "	8
Six " "	4	Six " "	3
Seven " "	1	Seven " "	1
Eight " "	1	Dwellings without a bed	7
Not ascertained . . .	3	Not ascertained . . .	10
Total	1465	Total	1465

"How far does this state of the occupation of the rooms accord with your own observation?—In the class of patients to our dispensary, nearly all the families have but a single room each, and a very great number have only one bed to each family. The state of things in respect to morals, as well as health, I sometimes find to be terrible. I am now attending one family, where the father, about 50, the mother about the same age, a grown up son about 20, in a consumption, and a daughter about 17, who has scrofulous affection of the jaw and throat, for which I am attending her, and a child, all sleep in the same bed in a room where the father and three or four other men work during the day as tailors, and they frequently work there late at night with candles. I am also treating, at this present time, a woman with paralysis of the lower extremities, the wife of the assistant to a stable-keeper, whose eldest son, the son by a former wife, and a girl of 11 or 12

years of age, all sleep in the same bed ! In another case which I am attending in one room, there are a man and his wife, a grown up daughter, a boy of 16, and a girl of 13 ; the boy has scrofulous ulcers in the neck ; the father, though only of the age of 49, suffers from extreme debility and a broken constitution.

“What do you find generally the state of the rooms which are so crowded ?—Wretched, extremely close, so close that, for self-protection, I am obliged to have the windows open during the visit ; they are not only close apparently from overcrowding, but they contain noxious odours ; the usual source of such odours, so far as it can be detected, is sulphuretted hydrogen arising apparently from the privy, and from the neglected drains. Odours from these sources are frequently to be traced to the top of the house. In certain states of the weather, they are intolerable even to the inmates, who are scarcely conscious of the existence of the ordinary odours.

“One cause of the defective ventilation of the rooms in these districts inhabited by the poor is, that the windows never open at the top. The opening at the bottom frequently gives an inconvenient rush of cold air, which I have known to be productive of very bad results. The clothes of the poor people living in these places often contract such a smell that I have known a patient who has remained a few minutes in the room leave such a taint in it as was only to be removed by throwing open the windows and ventilating it.”—*Health of Towns Commission, First Report*, vol. i. pp. 67-8.

Now here is a very important point. This extreme overcrowding and want of ventilation does not arise from equally extreme poverty. It is found in the case of labourers and others who are often earning good wages, and who certainly could afford to pay for better accommodation if it were there ; but simply because they must live near their work, and because these old rickety houses have been allowed by the community to get into this state, they are living in them at an expense which might, under proper management, afford them much better accommodation.

“ Amongst the families will be found the family of a policeman whom I attended. When he applied for relief the observation which occurred was, ‘ You have, as a policeman, 20s. a-week, regular wages, and other advantages ; you are never out of work, and cannot be considered a proper object of relief from the funds of a dispensary intended for the poorest class ? ’ His reply was, that he paid for his miserable one room, divided into two, 5s. a-week ; that he had 1s. 8d. weekly to pay for keeping up his clothes, which reduced the money he had for his family of four children and his wife to 13s. 4d. ; that he had had all his children ill, and lost two ; that he had during three years paid six doctors’ bills, principally for medicine, at the rate of 2s. 6d. a bottle, amounting to between £30 and £40 ; that two of the children had died, the funerals of which, performed in the cheapest manner he could get it done, had cost him £7 ; the wife and his four children were now ill. They were so depressed and debilitated as to

render them very great objects of the Dispensary and the Samaritan Fund. All this misery was traceable to preventible causes."—*Idem*, p. 87.

Several other similar cases are given, and Mr. Toynbee thus concludes :—

"A man in receipt of 30s. per week's wages, considering his amount of rent, which was 5s. 6d. for one room, for himself, wife, and three children ; having had four deaths after lingering consumptions, and a wife and children never well, I felt that he also was a proper object of the charity. At the time I visited these 100 families, no less than 212 of the members were suffering under disease, manifest in various stages ; they had already had no less than 251 deaths and funerals, and a considerable amount of sickness. It was only in a late stage of my investigations that I began to see the very serious amount of miscarriages they have had, and which in many instances exceed the deaths. Three hundred and fifty of the members of these 100 families were dependent children, whose average age was little more than 10 years."—*Idem*, p. 88.

Here was one man paying 5s., and several others paying sums varying from 3s. 6d. to 5s. 6d. a-week ; sums that might have procured, under proper regulations, an excellent room ; and these extravagant payments were made for dens so abominable, so totally unfit for human habitation, that many of the inhabitants had lost

the half of their families, and had been impoverished and disabled by an entirely preventible amount of illness. I will just read you one other instance, as regards the sleeping rooms, from the evidence of Mr. Liddle before the Health of Towns Commission :—

“JOHN LIDDLE, Esq., examined.—Are you medical officer of the Whitechapel Union?—Yes.

“What number of cases do you visit per annum ? —During the first year, 1838, I had 986 cases ; they have gone on regularly increasing, and they now amount to 2500. The annexed table gives a return of the ages and proportions of death in 1839, in the whole district of Whitechapel, from which it appears that the average age of all who die of the class of artisans is not more than 25 years, and that about one-half of their children born die before 10 years of age. More than one-half of those born, I should say, according to my own observation, and without positive enumeration.

“What, with respect to overcrowding, is the state of the houses which you visit ?—I know of few instances where there is more than one room to a family.

“What is the common size of the rooms ?—About 12 feet by 8 would give a fair average size of the floors of the rooms ; the ceilings rarely exceed 8 feet in height. In many of the garrets I am unable to stand upright. The number of persons living in a room may average about 5. This would average about 153 cubic feet of air for each person.”—*Idem*, p. 103.

That is, probably, at the very best allowance you can make, only about a fourth part of the absolute minimum necessary to secure the health of people sleeping in a room. This evidence shews that 1s. 6d. and 2s. a week are given for the worst description of apartments, and 3s. a week for the better description. Now, all sprinkled through the evidence before the Health of Towns Commission, and the previous inquiry of the Poor Law Commissioners, you have evidence of similar evils. You find them in Glasgow, Edinburgh, Liverpool, Manchester, Preston, and most other large towns ; also, and often to a hardly less extent, in much smaller towns, such as Leicester and Nottingham ; you will find them even in such places as Truro and Tiverton, in the midst of exceedingly healthy districts ; sometimes in small rural villages ; or even in isolated farm-houses in the country. Many of you must have read, some time ago, the revelations in the *Times* of the condition of the agricultural labourers' dwellings in England ; and most of you have probably taken some interest in the discussions that have lately taken place on the condition of the agricultural population of Scotland, especially those that live in bothies, or in ill-constructed cottages, inhabited by great numbers of persons of one sex, as is the case on certain large farms. You see that these evils are not confined to any one class of the population. They are mostly found, broadly speaking, in the labouring and artizan classes, but they are not confined to them. It is well known that in London vast numbers of the tradesmen, and even of the better classes, are living in

rooms which, in a sanitary point of view, are not fit for human habitation,—rooms rendered impure, not only by the immediate effluvia of the people that live in them, but also by their neighbourhood to sewers. It was lately shewn that a large part of the town of Windsor, by no means occupied by the poorest part of the population, had become subject to a severe fever from this cause. The most externally wholesome-looking country towns, and rural districts, have sometimes been subject to epidemics, which have been clearly traced to the imperfect ventilation of apartments, or to ventilation with air already much vitiated through defective drainage and sewerage. And under these circumstances great populations have grown up,—grown up in habits so thoroughly inured and acclimatized apparently to this pestilential state of affairs, that they have absolutely not known of the existence of anything better,—they have never known what good air is,—they have hardly ever had a breath of really pure air in their nostrils when at home ; and therefore, as in all such cases, their constitutions and senses have become partially insensible to the noxious presence of animal effluvia, so that they have literally had no conception, themselves, of the evils under which they are suffering.

I shall enter more fully upon the practical details of this subject of ventilation in my next lecture.

NOTE TO LECTURE II.

NOTE F.—Page 72.

POPULAR ERRORS IN REGARD TO THE ORIGIN OF
MORBID POISONS.

On this much disputed subject, both medical and non-medical authorities have been far too ready, in many instances, to assume *as fact* what is not only not proved, but what cannot, from the nature of the case, be proved, in respect to most of those diseases usually termed *specific*. Thus it is maintained by one party that such diseases arise *necessarily* from poisons generated in connection with the bodies of the sick, and only from like cases to themselves, the poison being, as it were, transmitted by a direct hereditary succession of cases, and not otherwise ; while, on the other side, it is asserted with equal positiveness that they arise in some instances *de novo*—*i. e.*, without any previous case of illness to which they can be affiliated. I believe it will usually be found that extreme dogmatism on these points, whether in medical or non-medical persons, is usually very much in proportion to the lack of accurate knowledge of the facts, and of the possible fallacies that wait upon the facts. To assert, for instance, that small-pox never can arise, in any circumstances, *de novo*, is about as unphilosophical as to maintain, of a particular case of small-pox, that it could not possibly have arisen from any

previous case. Yet, in the following passage from Miss Nightingale's admirable little tract on Nursing, I find these two opposite errors simply pitted against each other in their most unqualified form, without any attempt at conciliation.

"Is it not living in a continual mistake to look upon diseases, as we do now, as separate things, which must exist, like cats and dogs? instead of looking upon them as conditions, like a dirty and a clean condition, and just as much under our own control; or rather as the reactions of a kindly nature, against the conditions in which we have placed ourselves.

"I was brought up, both by scientific men and ignorant women, distinctly to believe that small-pox, for instance, was a thing of which there was once a first specimen in the world, which went on propagating itself, in a perpetual chain of descent, just as much as that there was a first dog (or first pair of dogs), and that small-pox would not begin itself any more than a new dog would begin without there having been a parent dog.

"Since then I have seen with my eyes and smelt with my nose small-pox growing up in first specimens, either in close rooms or overcrowded wards, where it could not by any possibility have been 'caught,' but must have begun.

"Nay, more, I have seen diseases begin, grow up, and pass into one another. Now, dogs do not pass into cats.

"I have seen, for instance, with a little overcrowding, continued fever grow up; and with a little more, typhoid

fever ; and with a little more, typhus, and all in the same ward or hut.

“Would it not be far better, truer, and more practical if we looked upon disease in this light ?”*

No one can possibly respect more than I do the noble character and unique services of Miss Nightingale ; but I wish she had deemed it expedient, before writing these sentences, to consider well whether the facts stated and the opinions expressed are consistent with the modesty and reticence of true science as regards the unknown. When a physician sees that, in case after case, to the number of hundreds or thousands, or even millions of cases, a well-known disease may be communicated by inoculation or vaccination, without becoming in the slightest degree changed in its nature (or changed only within certain known limits), he is compelled by the force of logic, and by all the laws of the human mind, to see in that disease something specifically distinct from other diseases. If he overstrains this evidence, or draws conclusions from it that it will not bear, he is justly open to criticism ; but Miss Nightingale must not suppose that the doctrine of specific contagions is to be settled in the off-hand manner of the passage given above. Admitting that the doctrine in which she was “brought up” was extreme and irrational, or at least devoid of evidence, I must equally withhold assent from her curiously vague statements in the latter part of this quotation. One may readily allow that

* Notes on Nursing, for the Labouring Classes. By Florence Nightingale, 1861, p. 29.

Miss Nightingale has often seen and smelt small-pox ; but how can we possibly admit, on her simple assertion, that she saw and smelt *a first specimen, which could not possibly have been caught, but must have begun ?* To reason in this way is simply to deprive reasoning of all its force and value in relation to medical experience. If the "origin of species" in natural history is still a question for the learned, we may surely admit of some doubt and difficulty in settling the question of the origin of morbid poisons, without being thereby committed to the preposterous doctrine that they grow up indiscriminately out of mere dirt and overcrowding. I must say, too, that Miss Nightingale's experience of fevers is entirely opposed to mine. Assuredly the experience of the medical profession in general is to the effect that the *degree* of overcrowding has nothing to do with the *type* of fever produced ; nor do these diseases "begin, grow up, and pass into one another" in the manner stated. But I must admit that my nostrils are not yet so highly educated as to be able to distinguish a case of small-pox growing up *de novo*, from one originating in a latent infection. After all, however, the practical conclusions urged by Miss Nightingale have my entire assent and belief ; I only demur to her philosophy of disease, and I trust I shall not be supposed to do so from any desire, even the slightest, of depreciating the value of her labours. It is because they are so valuable, and so justly popular, that I feel it necessary thus to refer to them as the expressions of a too confident and, indeed, wholly untenable medical theory.

III.

IMPURE AIR.

I HAVE to-day to continue the remarks that I made upon ventilation in my last lecture, with the object of showing you more in detail what are the evils caused by a deficient supply of air, and what is the general direction—for that is all we can hope to overtake in this lecture—of the remedies to be employed for the relief of these evils.

At the close of my last lecture, you will recollect I made some extracts from those valuable reports upon the health of the population that have been presented, from time to time, by the various Royal Commissions that have been directed to investigate this subject. My extracts on that occasion were chiefly drawn from the evidence relating to some of the metropolitan parishes. I gave you, in particular, in some detail the statements of Mr. Toynbee, which are among the most valuable of those presented to the Health of Towns Commission. I go on to-day to give you some further illustrations of the evils of overcrowding, from the facts stated in regard to Liverpool, a city which had long, as you know, and justly, a very bad name among sanitary

reformers, but which has of late years been greatly improved as regards the public health—fortunately for itself and for the country at large. I will shew you, by and bye, how much we are all interested in the state of Liverpool, however distant we may be from it in mere geographical position. Meantime, bear in mind that the worst features of the sanitary condition of Liverpool have been largely amended by the care of its municipal authorities, and that their great and praiseworthy efforts since 1846 have been followed, as I told you on a former occasion, by a most striking and apparently permanent reduction of the death-rate. I shewed you, in fact, that a habitual death-rate of about 36 in 1000 of population had been reduced to 29, and latterly as low as 26; nay, in the year 1860 (which, however, was a very healthy one all over England), as low as 24.2 in 1000. We can hardly estimate the gain of life in the large population of Liverpool from this improved state of the public health at much less than from 3000 to 4000 lives a year. Dr. Duncan, the health officer, estimates it for the year 1860 at 3800; and I think this is probably very near the truth.* This diagram illustrates the difference between old and new Liverpool; and, even when set beside the improvements in other places, shews an immense advance in the right direction, and a splendid example of the beneficial effects of boldly and generously grappling with great and admitted evils. But in making the experience of Liverpool, or any other place, subservient to a special

* See Note G, p. 128.

lesson in ventilation, or any single great sanitary reform, we are always met with a difficulty. We can hardly tell how much is due to improved ventilation, and how much to other causes ; nay, we can hardly separate the reforms that have taken place in Liverpool itself from those that have taken place elsewhere ; and especially from the improvement in the condition of Ireland, to which Liverpool undoubtedly owed a large part of its high death-rate previously to 1846. The truth is, that whenever you begin by reforming one thing, you end by reforming a great many more things, in our social organization. The increased attention given to the working of the poor-law in this country, cut off a great many sources of mischief at the fountain head ; but it was only a beginning of great and complex local reforms, which have nowhere been carried out with greater vigour and success than in Liverpool. In general terms you may say that all social reforms hold together, or, as I said in a former lecture, hang by one thread ; and that thread is the *knowledge* in detail of the evils to be reformed. It is, in fact, impossible to give your mind to the reformation of great evils, whether physical or moral, without finding out that there are a very great number of great evils, that they are inextricably bound up with one another, and that whenever you begin to work with one, you must deal more or less with all the rest. It is, therefore, impossible for us to say that this great reformation in Liverpool has been due entirely to the procuring of fresh air in the homes and lodgings of the poor ; but the state-

ments I have to make presently will shew that, to a very large extent, it may be said to be due to this cause—*i. e.*, to the summary removal of the more aggravated and dangerous forms of overcrowding, and the continuous attention of the authorities to all the circumstances that render the air impure, in so far as they have appeared to be at all avoidable by well-regulated sanitary inspection.

In the end of last century, Liverpool had perhaps undergone a larger amount of increase in a short time than any other town in the kingdom. The facts in regard to this stupendous growth and material increase of Liverpool in connection with its sanitary condition, are very conveniently and well put in a pamphlet which has been published by Mr. James Newlands, the borough engineer, as well as in another pamphlet by Mr. W. T. McGowen, the principal assistant to the town-clerk of Liverpool, and also in the various annual reports of the health officer, Dr. Duncan—one of the first, let me here say, who in our profession thoroughly and practically devoted himself, in connection with the municipal authorities, to this work of the reform of public health. From these sources you may obtain for yourselves more full details of the facts than I am able to give you. But the facts are mainly these:—In 1650 Liverpool was but a small place. It consisted of only seven streets upon the northern side of the Mersey, seven narrow streets covering a space of $15\frac{1}{2}$ acres, and with a population, probably close-packed enough in some places, but, on the whole, rather scattered, after

the manner of a straggling village. Even in 1725 we find about 12,000 persons at the most, that being, however, a great advance upon its original population. At that period the evil of overcrowding, of which we are now speaking, had plainly begun ; the space occupied by each individual in the town—streets, open spaces, and all, taking the whole town overhead—was only about 35 square yards ; which, if you will carefully consider it, is plainly far too little, although a very much less form of the evil of overcrowding than existed in the more crowded parts of Liverpool at a subsequent period. In 1785 the population had grown very much denser. The whole margin of the Mersey was now covered over with human habitations to the extent of 272 acres ; and these human habitations had become more and more crowded, so that instead of the too small space of 35, there were only 26 square yards to each inhabitant—hardly enough, indeed, for decent house accommodation, not to speak of streets, markets, public places of all sorts, and room, in short, to move about in. At this time there were no less than 117,890 persons living on a square mile of surface in Liverpool. In other words, from the desire to gain house room at all hazards, from the immense accumulation of people, and from the great apparent commercial necessity of keeping the population as near as possible to the centres of shipping, every available spot of ground within a certain area was covered and blocked up with buildings in which men were—we can hardly say accommodated—but allowed to live and to die in

the midst of everything that was dangerous and repulsive, morally and physically. It was so much more apparently an urgent need to pack population within this comparatively small space, than to procure within that space the requisites of health, ventilation, drainage, sewerage, and everything else that is now known to be indispensable for health, or even moderate safety—that all these essential elements of life were thrown into the background as it were, kept in a secondary position, or rather out of view almost entirely; and the single tendency of the day was towards the crowding together of immense numbers of human beings, without regard to consequences. The consequences were, that while even the original Liverpool had probably too little space for each human being, and while Liverpool in 1725 had certainly far too little—not more than 35 square yards, taken overhead—it came about that, in the end of last century, and onwards to the year 1842, when the matter was publicly investigated, there were large districts of Liverpool where, taking streets, and courts, and everything into account, human beings were living upon a space of less than 9 square yards to each human being; in other words, about 9 feet square for each man, woman, and child, taken singly, to live upon! This frightful state of things is admirably described both in the reports of Dr. Duncan to the first Towns Commission, and in the local pamphlets to which I have referred you. Here was one consequence of it—the creation of an immense mass of population, which was long well known to sanitary reformers as a sort of stan-

dard opprobrium, a sort of exaggerated type of all the evils which take place in all great cities when not under sanitary superintendence ; the degraded and neglected masses known under the name of " the cellar and court population " of Liverpool. Let me endeavour to describe what that cellar and court population was. In the first place, however, let me give you an idea of the immense proportion of the artizan population which was thus degraded by the very conditions under which life was maintained. According to the census of 1841, which came only a few years before the period when the sanitary reforms in Liverpool began—out of between 200,000 and 300,000 of the population of the place, 160,000 (at a rough estimate) may be said to belong to the working class ; and of that 160,000—I am giving you round numbers—about 56,000 might be said to dwell in courts, and about 20,000 might be said to dwell in cellars, which were absolutely below the level of the soil, and in many cases almost entirely without ventilation otherwise than by the door. About half of the working classes were, in fact, dwellers in these cellars and courts. Let us see, then, what they were like. The courts were sometimes new constructions, but more often they were based upon old constructions, which might have been very good at the time they were made. Let us suppose that a street of houses has been built, each house having a little bit of ground at the back, containing a little court, or, perhaps, a bit of green, a cess-pool, and privy. Well, in the economising of space it came about, that they built over the

open space at the back, leaving, of course, a passage communicating with the back door of the original house; thus they made what was originally a vestibule to only one house, a passage to a block of houses, which were built in the ground at the back; these houses were often built back to back with the houses of adjoining courts, so that there was literally no ventilation but what was obtained through the narrow passage left as a mere access to the doors of these separate tenements, in many of which there were rooms that opened, not upon the court at all, but only upon other rooms, which were also occupied with human beings. The original cess-pool and other conveniences for making away with filth, which probably stood at the very end of the garden, was converted into a general cess-pool, ash-pit, and mess of nameless abominations common to the whole of these multiplied tenements; giving off, of course, its most concentrated and choicest effluvia to those which had been built in upon it. Sometimes all distinctions were levelled, and all filth was indiscriminately thrown wherever it was most convenient at the time. In the midst of this confusion, a crowd of human beings—probably six, eight, or ten times the original number planned to live upon this amount of ground, were thrust into that overbuilt and *undrained* locality; for that was a great aggravation of all the mischief; there was absolutely no outlet for this accumulation of refuse and filth into any covered drain or common sewer. Dr. Duncan's evidence is express

and conclusive on this point.* In some cases, absolutely the sole access or outlets to these courts was through the small covered passage in the primary house, as I have already described. Most commonly one end only was blocked up ; sometimes, however, both ends were blocked up (except, of course, the doorway, which might be closed at any time), so that there was literally almost no access of air except from above to any of these houses. That is a description of the more aggravated phenomena of what were called the courts of Liverpool. There were some better, some worse. For instance, Dr. Duncan states in his evidence, from the

* " Where there are means of carrying off even the fluid portion of this superfluity of filth, the mischief would be lessened, as the noxious ingredients would less readily mingle with the air ; but no such facility exists, for I do not know of a single court in Liverpool which communicates with the street or sewer by a covered drain. The fluid contents, therefore, of the overcharged ash-pits too frequently find their way through the mouldering walls which confine them, and spread a layer of abomination over the entire surface of the court. In some instances it even oozes through into the neighbouring cellars, filling them with its pestilential vapours, and rendering it necessary to dig wells to receive it, in order to prevent the inhabitants being inundated. One of these wells, four feet deep, filled with this stinking fluid, was found in one cellar under the bed where the family slept. I may mention also an instance of a cellar belonging to a cow-keeper, not inhabited, but used as a dairy—where milk was kept—and which, from the absence of drains and sewers, was filled with the poisonous fluid in question, and the air of the apartment rendered unfit to breathe."—*Evidence, Health of Towns Commission*, vol. i. p. 128.

report of the corporation surveyors, that about 629, or nearly one-third of these courts, were closed at both ends; 875, or less than one-half, were open at one end; while only 478, or less than a fourth, were open at both ends.

Now the cellars were, if possible, worse than the courts; here is the description of them,—“The cellars,” says Dr. Duncan, “are ten or twelve feet square; generally flagged—but frequently having only the bare earth for a floor—and sometimes less than six feet in height. There is frequently no window, so that light and air can gain access to the cellar only by the door, the top of which is often not higher than the level of the street. In such cellars, ventilation is out of the question. They are of course dark; and from the defective drainage they are also very generally damp. There is sometimes a back-cellar, used as a sleeping apartment, having no direct communication with the external atmosphere, and deriving its scanty supply of light and air, solely from the front apartment.” P. 127.

Now, just recollect that in the year 1842 (to go no further back), there is fair ground to presume that upwards of a half of the working classes of Liverpool were living in this shocking way,* either in places not originally intended for human habitation at all, or packed into holes and corners of new houses, built

* Dr. Duncan distinctly states, that the estimates given above, of the numbers of dwellers in courts and cellars, is under, rather than over, the truth.

without regard to comfort or decency, on ground which was originally intended to give free air and space to other habitations, but which was afterwards invaded—there is no other word for it—by swarms of wretched settlers gradually demoralized, or rather *denaturalized*, by this frightful mode of living. Consider this, and you can have no great difficulty in arriving at a conception of the bad condition of Liverpool at that time. But even this was not all. Another great evil resulted from the aggregation of society on the large scale, without regard to the first conditions of life. In all great aggregates of men, there are, of course, and that necessarily, many persons who have no permanent residence ; who do not possess a house of their own. This is particularly the case in a seaport town, where there is a constant migration of population—large numbers of persons sometimes coming into the town, remaining a few nights, and then dispersing themselves over the country ; and numbers of persons also coming in from the country, remaining for a night or two, and then embarking at the port. The consequence at the time I am speaking of was, that Liverpool became the great seat of another sanitary evil, and that was the multiplication of low lodging-houses ; lodging-houses kept purely and simply for the purposes of gain by individuals who, charging at the rate of twopence, threepence, or fourpence a-night, from the individuals lodging, made in some instances large gains out of them, utterly careless of the consequences as regards the community. The descriptions of these low lodging-houses in Liverpool,

given in the evidence of Dr. Duncan, are of the most revolting kind. I am prevented from reading them at length, partly by the disgusting character of the details perhaps, but chiefly by the want of time. I would strongly recommend you, however, to look into the evidence for yourselves, for although the more aggravated evils there described are probably remedied now, yet these descriptions of them will always be valuable, as illustrations of the consequences of extreme neglect ; of evils, therefore, which may begin to culminate again at any time, and in any place, the moment that the proper sanitary care, in detail, of a great community, is relaxed. I will just read a few words. He says :—

“It is in the ‘lodging-houses’—usually situated in the front streets, but sometimes in the courts—that the overcrowding of inmates is carried to the highest pitch. The worst description of houses of this kind are kept by Irishmen, and they are resorted to by the migratory Irish, among others, who may, perhaps, not remain more than a night or two in the town, as well as by vagrants and vagabonds of all descriptions. In every room of such houses, with the exception of the kitchen or cooking-room, the floor is usually covered with bedsteads, each of which receives, at night, as many human beings as can be crowded into it ; and this, too, often without distinction of sex, or regard to decency. But there are cellars, usually the double cellars I have described, which are used for the same purpose ; and here the overcrowding is carried still further, if that be

possible, and is certainly even more prejudicial to the health of the inmates, from the still more defective ventilation of these dark and miserable abodes. At night the floor of these cellars—often the bare earth—is covered with straw, and there the lodgers—all who can afford to pay a penny for the accommodation—arrange themselves as best they may, until scarcely a single available inch of space is left unoccupied. In this way, as many as 30 human beings, or more, are sometimes packed together underground, each inhaling the poison which his neighbour generates, and presenting a picture in miniature of the Black Hole of Calcutta. Each individual, in the course of the night, vitiates about 300 cubic feet of atmospheric air, rendering it quite unfit for the purposes of respiration, and if we suppose 30 pair of lungs engaged in this process, we shall have 9000 cubic feet of air rendered noxious during the period of sleep. But the cubic contents of the cellars in question do not, on the most liberal computation, exceed above 2100 feet; which is the same thing as to say that 30 individuals are furnished with a supply of air sufficient for the wants of only seven. The Inspectors of Prisons in England recommend ‘not less than 1000 cubic feet’ for every prisoner, ‘as being essential to health and ventilation;’ and yet here we have free agents voluntarily immuring themselves within a space which limits them to a supply of 70 feet, or less than one-fourth of the minimum necessary for the purposes of healthy respiration. I speak, of course, with reference to the imperfect natural ventilation of the

cellars, aided, as this sort of mischief is, by the pains taken to exclude even a breath of air from without. I have described an extreme case, but it is one which every medical man who has practised extensively among the poor must have had an opportunity of witnessing ; and I believe it may be said, without fear of contradiction, that there is scarcely a 'lodging' house or cellar in the town whose inmates are not, as a general rule, too numerous for the breathing space afforded them. The natural consequences follow :—Fever breaks out from time to time, and spreads with rapidity among the inhabitants. Nor is this the worst ; for, from the migrant character of their population, these dens become foci which radiate infection not only throughout the town, but to other towns, and to distant parts of the country."—*Health of Towns Commission*, vol. i. p. 131.

That is the sort of statement I was referring to when I spoke of the great interest we all have, all over the country, in the condition of such a town as Liverpool ; and these extracts shew how thoroughly the details in regard to these low lodging-houses bear out the repeated statements in former lectures, that air and water—air especially—can never be considered as the property of any one of us to be used as we like. Now, this dreadful evil which existed in its maximum condition in Liverpool, was found more or less in almost every town of any size, the sanitary state of which was investigated by the Commissioners. It may be even

said that it is the inevitable consequence of town life, unless it be counteracted by detailed care on the part of the authorities to prevent the health of the population being thus sacrificed. As a general rule, it may be assumed that no one as a casual visitor, sometimes not even as a permanent resident in a town, ever thinks sufficiently for himself of these matters ; he takes, in general, the accommodation provided for him by others ; he requires to have his attention drawn to the evils to which he exposes himself by occupying an ill-provided or unhealthy house ; and I may anticipate what I have to say in a future lecture so far as to say here, that in a very great number of instances, it would be enough to stop many of these evils that attention should be authoritatively drawn to them in good time, or from the first moment of their occurrence ; but that is not enough to cure the accumulation of evils when it has been allowed to go on for a long series of years. There can be no doubt, for example, that Liverpool required the strong and high hand of authority to clear out this immense cellar population, and at the same time to provide the new habitations that were absolutely necessary. Authority became necessary, just because it had been long altogether in abeyance ; and when such authority is manifestly necessary, I think we must submit to its employment. But I venture to say, that had there been from the first such a detailed sanitary supervision as I have been always pointing to in the course of these lectures, the interference of positive and arbitrary authority would not have been necessary to anything

like the same extent. The evil would, in all probability, have been sufficiently kept in check, in the great majority of cases, by the simple knowledge of the facts in detail, and the impressing them upon those who were chiefly affected by them. You cannot suppose, for instance, that even the most ignorant man in the working classes, if he is shewn plainly and palpably that he is walking into a house that is teeming with death to himself, to his family, and to all dear to him, would do so. The consequence of mere knowledge, apart from arbitrary power, in that case is to destroy the gains of those who thrive upon the ignorance and carelessness of the working-man, and thus to open out inducements for the operations of those who have it in their power to befriend him. And accordingly, I believe to a great extent in the mere exposure of evils, in detail, as a means towards their remedy ; if it be systematically and thoroughly done, and never intermitted. I truly believe, for instance, that a system of detailed supervision, without almost any authority, would have kept these evils in most of our great towns to a great extent from accumulating. But the evils having been allowed to accumulate, it became very difficult to deal with them. The inertia of those in power was very difficult to overcome. The attempt to deal with these evils in Liverpool, in particular, began before the end of the last century. It was then that Dr. Currie—whom almost all of you know as the author of the well-known “Life of Burns,” and also as the leading advocate of the cold affusion in fevers

—was induced, along with some of the leading medical practitioners of Liverpool, to direct the public attention to this subject. Just about the time that Jenner discovered vaccination, they addressed the authorities of Liverpool in very much the same terms as I should be inclined to do now, if I knew the same facts. But their statements were coldly and apathetically received, and nothing resulted from their suggestions. The evils ran on unchecked until Mr. Chadwick came down with his scourge, and shewed up Liverpool to all Europe in his unflinching, and no doubt very distasteful reports. It was not until the Registrar-General came forward with his frightful figures ; not until Dr. Duncan was called upon to give his evidence before the Health of Towns Commission, and it became clearly evident that Liverpool was to be the opprobrium of the civilized world, that any real advance was made towards a reform. But here again, as in so many other cases, knowledge became power, so soon as the facts were taken to heart. Then the authorities saw the necessity of taking action, and to their credit be it said, they have since that time—since the year 1846, when they obtained the first local Health Act—proceeded most rapidly and steadily in the work of improvement, and have done more in the way of sanitary reform than has been done in any other town in Her Majesty's dominions, or perhaps in the world. For a detailed account of what has been done, I refer you to the pamphlets I have mentioned ; and although we must still continue to refer to what Liverpool has

been, we may easily pardon the sensitiveness which is hurt at too obtrusive a reference to the past, in the face of so remarkable a series of reforms—reforms which have cost the corporation (including the introduction of water) nearly £3,000,000 sterling, and have been followed by a reduction of the death-rate to the extent of nearly 10 persons in every thousand of the population.

Before I leave Liverpool, I wish to direct attention to one other point about it, because it is also a point in which Liverpool was, and possibly still is to some extent, only a type of other places, and in regard to which we shall find that a great deal of mischief has been, and still is done, by a carelessness which must be termed especially culpable, inasmuch as it affects the lives of the most helpless portion of the community. I refer to the condition of the schools. The state of the schools is important, and very immensely important, because it rules to a great extent the health of the younger population. The life of a child during certain years of its existence is, as you know, spent almost entirely between the school and the home, just as the life of a grown man is spent between the workshop and the home, and the life of a grown woman having a family to look after, almost entirely in the home. If you, therefore, reform these three things, the home first, and then the workshop and the school, you have done probably nine-tenths of the work of reform. Now, the state of the schools in Liverpool, at the time of the Health of Towns Commission, was most lamentable. And, let me simply say, without going into details on this matter, that if

any of you will have the curiosity to look a little into the late report presented by the Commissioners on Education, and published only the other day, you will find there evidence that the evils I am now referring to are not by any means cured in many parts of the country. Crowded and ill-ventilated schoolrooms are still far too much the rule, and the health of vast numbers of children is still sacrificed to the ignorance of those who should be their instructors. But here is Dr. Duncan's account of the dame-schools of Liverpool :—

“Another source of mischief which ought to have been noticed previously, and which I am convinced must contribute its share to the disproportionately great mortality of childhood in Liverpool, is to be found in the state of the dame-schools and common day-schools in the poorer parts of the town. In these schools, where very little is even professed to be taught, and which are frequently held in cellars or in garrets, children are often crowded together for two or three hours at a time, in numbers which soon render the atmosphere of these ill-ventilated apartments most oppressively close, and prejudicial to the health of the scholars—an effect which is evidenced by their exhausted looks and languid air, after having been an hour or two confined. Mr. Riddall Wood, who spent some time in Liverpool, about seven years ago, in investigating the state of education in the borough, found that there were at that time 244 dame-schools with 5240 scholars, and 194 common day-schools with 6096 scholars. In

his report to the Manchester Statistical Society, he says, 'The condition of most of the schools in an extensive and populous district, stretching upwards from the North Shore to Scotland Road, is wretched in the extreme, corresponding in a remarkable manner with that of the population. With few exceptions, the dame-schools are dark and confined; many are damp and dirty; more than one-half of them are used as dwelling, dormitory, and school-room, accommodating in many cases a family of 7 or 8 persons; above 40 of them are cellars. 'Of the common day-schools in the poorer districts' (he states in another part of his Report), 'it is difficult to convey an adequate idea; so close and offensive is the atmosphere in many of them as to be intolerable to a person entering from the open air, more especially as the hour for quitting school approaches. The dimensions rarely exceed those of the dame-schools, while frequently the number of scholars is more than double. Bad as this is, it is much aggravated by filth and offensive odour arising from other causes.'* Mr. Wood states that the masters and mistresses were generally ignorant of the depressing and unhealthy effects of the atmosphere which surrounded them, and he mentions the case of the mistress of a dame-school who replied, when he pointed out this to her, that 'the children thrived best in dirt!' He notices particularly a school in a garret up three pair of

* See Report of a Committee of the Manchester Statistical Society, on the State of Education in the Borough of Liverpool, in 1835-6.

dark, broken stairs, with forty children in the compass of ten feet by nine ; and where, on a perch forming a triangle with the corner of the room sat a cock and two hens ; under a stump-bed immediately beneath was a dog-kennel, in the occupation of three black terriers, whose barking, added to the noise of the children and the cackling of the fowls on the approach of a stranger, was almost deafening. There was only one small window, at which sat the master, obstructing three-fourths of the light it was capable of admitting. In Manchester, so far as I can judge from the Report of the Committee of the Statistical Society, the schools for the working classes, especially the day-schools, are somewhat better than those in Liverpool, although the dame-schools are described as being 'deplorably bad.' 'Neither in Manchester nor Liverpool was there a common day or dame-school where there was a playground, where the children could get the change necessary for young persons.'”*

Is it difficult, looking at such facts as these, to understand what many people consider to be the inevitable spreading of such diseases as scarlet fever, measles, hooping-cough, and even small-pox? diseases which are specially severe and fatal among the infant population, and in regard to which we know, with as clear a conviction as we can have of any fact in medicine, that they are spread chiefly through the influence

* Dr. Duncan's evidence, pp. 146, 7. Compare note H, p. 130, at end of this lecture.

of the air, by the communication of poisonous exhalations from the body. Do not let us consider such diseases as inevitable, till we have practically, over the length and breadth of this kingdom, looked into, and as far as may be cured, the conditions from which you might say prophetically that they would of necessity arise, even if you had not the proof of it before your eyes. Surely these overcrowded schools, through which the seeds of disease are sown at large in the community, are a form of evil very plainly demanding the application of the principles I have already laid down.

Now, in all that I have been saying, although I have chiefly used illustrations from the great towns of England, I do not want to spare ourselves. We are, or were, in Scotland, in some of our great towns, nearly as bad as in Liverpool under its old state of neglect; and I am afraid that if we were nearly as badly off as Liverpool formerly, we have not done nearly so much as Liverpool to remove the conditions in question. We have got rid, certainly, of some portion of our epidemics. We have in that respect been very fortunate—but we have been more lucky than deserving. There can be no doubt that a great deal of our comparative exemption from fever of late years has depended not upon ourselves, but upon the great good fortune, first, that our epidemics have not been fed to the same extent from Liverpool and the other sea-ports; and, secondly, that one great source of the spreading of epidemics all over the kingdom, namely the migrations of the Irish population in the

frightful state of destitution and misery to which they were reduced some years ago, has to a very great degree ceased, so far as we are concerned. All these causes of disease have been removed for us as well as for Liverpool. But give us back anything like an approach to the same conditions as we had then, and the same migration of a destitute population into our great towns as we know took place previous to 1842 and 1843, and again before the great epidemic of 1847 and 1848 ; and though something, I am glad to say, has been done in our Scotch towns, especially in regard to the regulation of lodging-houses, and the erection of improved houses for the working-classes, I fear that we have done very much less than we ought to have done—very much less than the authorities of Liverpool have done, to place these accumulated evils at a disadvantage. I will not read you in detail the facts as regards Edinburgh and Glasgow ; but just in order to shew you that Scotland was not one whit better than England on the whole, I will just read you this single short passage from a visit to some of the wynds of Glasgow by Dr. Neil Arnott, accompanied by the late Dr. Alison and Dr. Cowan, and by Mr. Chadwick ; and we have abundant evidence from the facts laid before the recent meeting of the Social Science Association at Glasgow, that the condition of some parts of Glasgow and Greenock—and no doubt also the condition of some parts of Edinburgh—is still an opprobrium to humanity.

“ We entered,” writes Dr. Arnott, “ a dirty low

passage like a house door, which led from the street through the first house to a square court immediately behind, which court, with the exception of a narrow path around it leading to another long passage through a second house, was occupied entirely as a dung receptacle of the most disgusting kind. Beyond this court the second passage led to a second square court, occupied in the same way by its dunghill ; and from this court there was yet a third passage leading to a third court, and third dungheap. There were no privies or drains there, and the dungheaps received all filth which the swarm of wretched inhabitants could give ; and we learned that a considerable part of the rent of the houses was paid by the produce of the dungheaps. Thus, worse off than wild animals, many of which withdraw to a distance and conceal their ordure, the dwellers in these courts had converted their shame into a kind of money by which their lodging was to be paid. The interiors of these houses and their inmates corresponded with the exteriors. We saw half-dressed wretches crowding together to be warm ; and in one bed, although in the middle of the day, several women were imprisoned under a blanket, because as many others who had on their backs all the articles of dress that belonged to the party were then out of doors in the streets. This picture is so shocking that, without ocular proof, one would be disposed to doubt the possibility of the facts ; and yet there is perhaps no old town in Europe that does not furnish parallel examples. London, before the great fire of 1666, had few drains

and had many such scenes, and the consequence was, a pestilence occurring at intervals of about twelve years, each destroying at an average about a fourth of the inhabitants.”—*Report on Labouring Population*, p. 24.

They give facts relating to Edinburgh that tend exactly the same way. They are not given so much in detail, and therefore I do not read them, especially as I have more to say about Edinburgh by and bye. Now nearly the same thing is reported of Manchester, Preston, and of all the great towns of Lancashire, the same thing in great detail of Newcastle and Gateshead, and very much the same evils in Leeds, and a great many other towns in England ; furthermore, the same evils of overcrowding and deficient ventilation, are reported by the various commissioners to be present, to a very great extent, in many country places in which sanitary evils and high death-rates are apt not to be looked for. There is therefore no class of the population that can be said to be exempt from danger, unless care be taken to obviate these evils as they occur. Now, without reading extracts to justify all these remarks, I will merely mention shortly the effects of overcrowding as shewn forth in these painful but instructive reports, both upon the physical condition and also upon the morals of the population. In respect to the latter, as it is beyond the immediate scope of this lecture, I must of necessity be brief ; but as the subject has a bearing on what we have to say hereafter, and is in itself very important, I will read you a most

striking example of the effect of overcrowding in producing depravity of morals, in a form which reacts again in many ways on the public health. Here is the examination of Mr. Riddall Wood, a gentleman who has given a great amount of attention to this matter:—

“In what towns did you find instances of the greatest crowding of the habitations?—In Manchester, Liverpool, Ashton-under-Lyne, and Pendleton. In a cellar in Pendleton, I recollect there were three beds in the two apartments of which the habitation consisted, but having no door between them, in one of which a man and his wife slept; in another, a man, his wife and child; and in a third two unmarried females. In Hull I have met with cases somewhat similar. A mother about 50 years of age, and her son I should think 25, at all events above 21, sleeping in the same bed, and a lodger in the same room. I have two or three instances in Hull in which a mother was sleeping with her grown-up son, and in most cases there were other persons sleeping in the same room, in another bed. In a cellar in Liverpool, I found a mother and her grown-up daughters sleeping on a bed of chaff on the ground in one corner of the cellar, and in the other corner three sailors had their bed. I have met with upwards of 40 persons sleeping in the same room, married and single, including, of course, children and several young adult persons of either sex. In Manchester I could enumerate a variety of instances in which I found such promiscuous mixture of the sexes

in sleeping rooms. I may mention one ; a man, his wife and child sleeping in one bed ; in another bed, two grown-up females ; and in the same room two young men, unmarried. I have met with instances of a man, his wife, and his wife's sister sleeping in the same bed together. I have known at least half-a-dozen cases in Manchester in which that has been regularly practised, the unmarried sister being an adult.

“During your inquiries were you able to observe any further demoralization attendant upon these circumstances ?—I have frequently met with instances in which the parties themselves have traced their own depravity to these circumstances. As, for example, while I was following out my inquiries in Hull, I found in one room a prostitute, with whom I remonstrated on her course of life, and asked her whether she would not be in a better condition if she were an honest servant instead of living in vice and wretchedness. She admitted she should, and on asking the cause of her being brought to her present condition, she stated that she had lodged with a married sister, and slept in the same bed with her and her husband ; that hence improper intercourse took place, and from that she gradually became more and more depraved ; and at length was thrown upon the town, because, having lost her character, the town was her only resource. Another female of this description admitted that her first false step was in consequence of her sleeping in the same room with a married couple. In the instance I have mentioned of the two single women

sleeping in the same room with the married people, I have good authority for believing that they were common to the men. In the case which I have mentioned of the two daughters and the woman where I found the sailors, I learned, from the mother's admission, that they were common to the lodgers. In all of these cases the sense of decency was obliterated."—*Report on Labouring Population*, p. 124.

More shocking facts even than these are recorded in the evidence of Mr. Baker, in the very next page of the same report; they are almost too horrible for quotation, but are quite clearly guaranteed by evidence brought before the Courts of Law. Now, when I add, as I stated in my last lecture, that this frightful demoralization—of which many instances are given in these reports—is not the consequence of mere poverty at all in many cases, but the consequence of want of decent accommodation—a want which might in many cases be entirely removed by a little well-applied capital; when it is recollected, moreover, that in most instances where decent accommodation has been offered in place of this abomination, it has been found to be eagerly seized, and that it has frequently been found possible to make decent accommodation profitable, even as a commercial speculation, you can easily see that there is absolutely no reason whatever for ever leaving matters in such a state as is pointed out in these extracts.*

* See Note I, p. 137.

Now, as regards the general effect of overcrowding on the physical state of a population, you cannot fail to connect all that I have been saying for some time past, and I might have added a great deal more to the same effect, had there been time—with that which I shewed you in a former lecture to be almost a general law of the death-rate of England and Wales (when very large aggregates of population are kept in view), though with many particular exceptions—namely, that the rate of mortality rises in proportion to the amount of population upon a certain area. I shewed you that, taking the whole of the districts of England, and calculating them generally and on a large scale, the death-rate rises directly in proportion to the number of people upon a square mile.* There are many local exceptions to that general rule, and indeed the rule breaks down altogether, for the most part, when applied to individual localities, and limited populations. Thus, it by no means follows that doubling or trebling the population of a locality necessarily increases the mortality. I fully believe that, with proper precautions, it would be almost as easy to keep healthily 1500 people upon a square mile as it would be to keep 150. There is no doubt, I think, of that, because we have many illustrations of healthy districts where the population is much more crowded than I have mentioned, and of unhealthy localities—villages, or even isolated houses—where the population is exceedingly sparse. It is not, therefore, a law in the sense that it is an inevitable law ; but still

* See ante, note D, p. 52. Table I.

it is a fact—a great, broad and general fact as regards England, and it connects itself at once in the mind with the facts I have mentioned as to the evil of overcrowding, and shews the great extent, and very general prevalence of the physical deterioration which arises from that cause.

Let us now proceed to consider the nature of this physical deterioration, with a view to determine, if possible, what is the general line of conduct we are to adopt, in order to put a stop to it. I have already shewed you, in regard to Liverpool, that the most prominent, if not the greatest cause of mortality in overcrowded districts, is the frequent and irresistible spreading of epidemics, and contagious diseases. I go further, and say, that wherever that form of evil exists, there is either overcrowding or something else, with which we ought, as sanitary reformers, to busy ourselves. And here I fall back upon what I said in my last lecture, that I look upon these epidemics, and particularly these contagious diseases, as the facts which justify the interference of the authorities. Give me proof of a contagious disease, and proof that it is not an isolated instance, but that the disease really is spreading, and I say that the fact of its being there, and the fact of its spreading, are a sufficient justification for me, as representing the authorities, to walk in and say, "This must not be ; somehow or other this danger must be put a stop to if possible. Do it yourselves if you can ; if not, let us interfere to stop it." I say we are all—rich and poor—alike interested in this matter.

No man can say that a spreading fever, or small-pox, or scarlet fever, or even measles, is a matter in which he has no personal interest, and surely no one will now-a-days be so blind to the plain facts of the case as to tell us that these terrible events, these solemn warnings of Divine Providence, are of the nature of unavoidable evils which we are to look at with our hands tied. No man can say that these are matters in which I am bound to leave my neighbour alone, or in which each separate community must under all circumstances be left to govern or misgovern itself. I have shewed you that Liverpool, under its old system of neglect, was not only a source of misery to itself, but a source of infection to the rest of the kingdom. No man can fairly say that the nation at large has not a very good right to interfere with the action of particular communities, where such evils as these are going on unchecked. I don't argue for an extreme amount of interference, simply because we know by experience that an extreme amount of interference does not accomplish the purpose. It leads to the misapplication of arbitrary power, and so to evasion and active resistance. But I maintain the right of interference, and the necessity of inspection ; and on the whole I very much approve the recent constitution of the Board of Health in England, acting, as it is, under the Privy Council. We have in England, in the committee of the Privy Council on Public Health, an authorized medium of communication between aggrieved individuals or communities and their local authorities ; a sort of Court of

Appeal whose decisions on disputed points are remitted to the local authorities to be carried out, if possible, after due consideration of all local difficulties. The Privy Council does not propose to itself the impossible task of interfering in every place where sanitary regulations are not carried out to a perfect ideal, but it invites full and complete information from all quarters; it says—"Give us proofs, or tangible instances of neglect in connection with great evils, and particularly in connection with epidemic diseases, and we take those as the index of a necessity for our interference." And then they interfere, but only by advice. They send down an inspector, they stimulate the local authorities, and if these do not act efficiently, it is then a matter for consideration how far it may become expedient to bring public opinion, or even the authority of Parliament, to bear upon the case.

Now, observe that wherever you have epidemic diseases depending upon overcrowding, there are a thousand ways in which they may spread. When I was looking after some cases of fever some time ago, in Edinburgh, I remember finding in a close in the High Street nearly a whole family of six or seven persons laid up successively in a very small ill-ventilated garret room, with typhus fever, of a most contagious type. Of that family one was living as a domestic servant in a house in my own street, in the New Town, and at the time of my visit the girl was going every night almost to this poisoned close in the High Street, and inhaling the poisoned atmosphere of that housefull of fever patients

for an hour or two, and then returning home to the house in the New Town, where she was in service, and where, possibly, she slept with one of her fellow-servants, or perhaps with one of the children. Is that a fact that I have no right to look at, so as to prevent the probable bad consequences? I found another case, in which a man came in from Galashiels with a fever, and he took refuge—where, do you think, of all places in the world?—in a milk shop. There he was lying in a small back room, six feet or so across, with no sufficient ventilation, and communicating directly with an equally small shop, where a number of bowls of milk were laid out; and this milk, lying in the midst of that poisoned fever atmosphere, was being handed out to the poor of that district in gills and half-gills, without the least suspicion on their part of the risk they were running. Is that a fact that I have no right to know, and to act upon the knowledge of? It is recorded in the Reports of the Health of Towns, to which I have so often referred, that both bread and butcher meat are often sold out of most unwholesome apartments, poisoned by the infected air of common sewers. Consider again the case of hackney-coaches and cabs, used, as they doubtless often are, for the conveyance of sick persons. I am very sure that not in Edinburgh—not, I believe, in Glasgow—not in any town in Scotland, so far as I know—are there sufficient restrictions upon the dangerous practice of employing hackney-carriages for the conveyance of persons suffering under contagious diseases. And, moreover, if there were sufficient re-

strictions, they would not be and could not be attended to so long as there is no other public provision made for the purpose. Persons affected with contagious disease must be transferred sometimes from house to house, and the only way to carry them safely and comfortably is in public vehicles ; but there are no special vehicles provided for the purpose, and we must, therefore, at all hazards, use what we have. You don't take care to provide for the right way of doing, and therefore, make your restrictive laws what you please, the wrong way will necessarily be resorted to.

Well, the great evil that we have to fix upon, as a guide to the purification of the air, is the fact of epidemic disease in connection with overcrowding. But, although that is the form that we must chiefly fix upon, I am not at all sure that epidemic disease is the form of evil that does the most damage to the public health. A vast amount of mischief is caused, no doubt, by the spread of such a disease as typhus fever, which too often cuts off the head of a family. A somewhat less, but still a considerable amount of evil is produced by the diseases of measles and scarlet fever, which often destroy the children of a family, and in many cases where the children are not destroyed, leave them with a weakened vitality, which lessens their value and usefulness as members of society all the rest of their lives. But I am not sure that even a greater amount of physical deterioration is not produced by the tendency of overcrowded apartments, and of a deficiency of free ventilation, to sow the seeds of tubercular disease, and

particularly of pulmonary diseases of all kinds. Upon these points you have multiplied evidence in these reports. I cannot go into detail on this subject from want of time, but there is ample evidence on all of these heads in the earlier reports, strongly corroborated by the late elaborate inquiries of Dr. Headlam Greenhow, at the instance of the Privy Council. It is surprising that these facts (of which I gave you an example in my first lecture) should have been overlooked or neglected up to a late period. I refer especially to the evidence of Mr. Toynbee, and to the no less valuable evidence of Dr. Guy and Dr. Duncan, which I have not time to read, but which you will find of the most convincing kind, as regards the generation of tubercular disease by the deficiency of air in the workshop. There is also a good deal of incidental evidence in the reports on this subject, and I would ask you to consider—knowing, as we do, that from a seventh to an eighth over all England, and probably from a sixth to a fifth, or even a fourth, of the population that die in some of the great towns, probably fall as victims to some form or other of tubercular disease—whether it does not present even a more terrible picture than the other, of the consequences of deficient ventilation.* In the case of consumption alone, we are dealing with a disease which annually destroys more than 50,000 persons in England and Wales; and we are very sure that a large proportion of this immense mortality is an avoidable mortality, inasmuch as we know to what an

* See Note K, p. 147.

extent it occurs in close and unwholesome houses, workshops, schools, and places of public resort. If the prevalence of this one disease could be reduced, say by one-half, or even one-third, through systematic attention to the principles of public health, it would be far more than worth, in mere money value, a sum equal to the interest of the national debt!

NOTES TO LECTURE III.

NOTE G. Page 94.

MONEY VALUE OF A REDUCED DEATH-RATE, AS COMPARED
WITH THE CORRESPONDING EXPENDITURE ON SANITARY
IMPROVEMENTS, IN LIVERPOOL.

THE following curious hypothetical balance-sheet, with respect to Liverpool, is from Mr. M'Gowen's paper read before the Social Science Association in 1858, and referred to in the present lecture (p. 96). The estimate of the value of a productive human life to the community is partly founded on an elaborate inquiry by Dr. Farr into the "Money Value of a Man," and is decidedly moderate. The estimate of the cost of sanitary works, supposed to last for upwards of twenty-five years, is founded on actual data derived from experience.

Sanitary Economy in Liverpool.

1.—Of the 3750 lives per annum saved to Liverpool by sanitary measures, taking half as males, and four-tenths, or 750, as productive, the gain to the community in respect of them, at £300 per life, will be ($£300 \times 750$) . . .	£225,000
2.—And the productive female lives at half the value of the males	112,500
3.—Taking the loss by incapacity to work, and expenses on sickness in 70,000 families, at £4, which in a town made healthful is saved ($70,000 \times £4$)	280,000
Or a total annual saving of	£617,500

Which, at twenty-five years' purchase—(although thirty years is the time estimated for the works to last) would produce the sum of £15,437,500

And deducting the outlay for public works £859,387

And for private drainage 200,000

1,059,387

There would remain a nett gain to the community of £14,378,113

This is irrespective of the value to each person of his own life ; minus the pecuniary value to the community—of young lives saved, which, when lost, cause a dead loss of all the money which each life has had expended on it, because none of such outlay can ever be repaid—of adult lives already saved during the progress of the work, and the mental as well as bodily suffering

prevented, which, though of the greatest moment, are incapable of reduction to a money standard."

NOTE H. Page 113.

SANITARY STATE OF SCHOOLS.

Among the numerous illustrations which might be cited as to the unsatisfactory state of school-rooms in a sanitary point of view, I select the following passages from the account of a survey of the schools in the parish of St. George the Martyr, Southwark, by Mr. William Rendle, the Medical Officer of Health. They form part of a more extended report on the state of schools in the metropolis generally, lately referred to in the *Examiner* newspaper.

"At 59 Webber Row, from 100 to 170 children are said to be regularly taught in the upper rooms. The ground floor enclosed and under cover is a ruin, one part covered with flooring having wet earth underneath, and a still larger space covered with mud and stagnant water, sometimes over-shoe; the soil from a cesspool flows into this space, and a very foul open drain, which, on stirring, yields most offensive gases, is also here. This under space is enclosed, and communicates with the school-room above. There is no water-closet, and I think no water.

"At Moreton Street Ragged School, 120 to 140

children are regularly taught. The ventilation is very imperfect. The window on the side of the rag warehouse (which forms one of its boundaries) is kept closed by reason of the offensiveness of the rags. It is most important that places where so many children, especially unclean children, are congregated together, should be well ventilated. If they escape fevers and the like now, their lungs will no doubt tell the tale in after life. It should be here remarked that the ragged school has not gone to the warehouse, but the contrary. The lights and ventilation on all one side have been stopped up by the rags; not merely stopped, but stopped offensively. Passing from the upper school-room I come to the lower, which is a dark unventilated cellar (I can call it nothing else), lighted with gas, it has no other light, and paved with flag-stones which are black and damp; they do not appear to have been dry lately. In this cellar, some without shoes and stockings, some thirty children, aged from three to six, stood about. The water-closet is in this under place, and has no water; they occasionally fetch a little from the neighbours and throw it down.

“I have with the inspector visited the Church Schools, St. Stephen’s Square, Kent Street. Two hundred children are there educated. A private surgeon reports the death of a child accelerated by the offensive condition of the appliances here. The master and mistress are very unwell, and complain very much. In each school are three privies; they are shoots towards cesspools without traps, two outside the house, and one

more private within. They are so constructed, that whenever the children leave the covers of the outer places off, a current of air passes down the foul shoots inwards, and thence up into the premises through the house privy, always bringing with it offensive privy gases. The sulphuretted hydrogen so blown inwards has completely blackened the paint of the door leading into the master's room. The same effect has been produced on the girls' side. The basement of the schools is much lower than the surrounding drains and cesspools close at hand, and the consequent leakage makes the schools and dwellings still more offensive.

"The managers of the school adjoining, St. Jude's Infant and Ragged School, complain that the condition of the courts is very prejudicial to health, and in the highest degree immoral.

"A large yard by St. Mary's Church Schools, Kent Road, is used as a public depository for dung. All sorts of offensive matter, amounting to cartloads, are lying about, wet, rotting, and so tainting the air as to make it most offensive and unwholesome. Five hundred children resort daily to the school by the side of it. The teachers speak of the place as unbearable and sickening.

"The young in this parish are chiefly indoors, in foul, crowded, and ill-ventilated places, or in schools defective in sanitary requisites."

It may also be instructive in this connection to quote the following evidence of the Rev. Mr. Mitchell,

one of Her Majesty's School Inspectors under the Privy Council system in England. He states :

“There is no calculating the permanent injury that must arise to the health and constitution of children, immured for hours in rooms whose air is poison. The ultimate results must remain unknown. Those which we do perceive are constant recklessness and an impossibility of commanding the attention, a sickliness of look in the instructor, and great exhaustion with weariness. The work of teaching becomes a labour and drudgery ; energy and life cease, especially in the latter part of the day, and the instruction becomes a nullity. As year after year passes away, the derangement becomes more confirmed, and the result is, that the master loses his activity, his school lacks its success, and too often he retires, with spirit broken and health infirm, to seek some other field of labour, and complains of the unhealthiness of school-keeping, when, in fact, he should only regret the uncared-for insalubrity of his ill-ventilated and imperfectly lighted room. I know this to be the case from the sensations constantly experienced after inspecting schools so circumstanced ; the fatigue and weariness consequent on a day spent in some rooms are intense, from no other cause but this ; and medical men, and those who have studied the subject, are well aware of the fact.”

I would most earnestly call attention, in this connection, to Mr. Chadwick's address to the Social Science

Association, printed in their Transactions for 1860. The truly enlightened ideas of this veteran sanitary reformer on the physical training of children have been recently pressed upon the Commission on National Education ; and I think that every physiologist, and every observant physician, if not every practical educator, must feel the force of what he has argued as to the uselessness, and worse, of the long weary hours spent over the tasks, in cramped postures, and in an ill-ventilated atmosphere. The *half-time system*, so strongly recommended by Mr. Chadwick, would be an immense boon to the young, and greatly conducive to public health and to real practical education, which, especially in the middle and lower classes, is at all times far too apt to degenerate into an unwholesome and unprofitable routine. Long school hours, and much book work, are not only inconsistent with the due care of the body, but they are extremely injurious to the activity of the mind, and tend to unfit it for the business of life ; a fact well-known practically to parents, and really at the bottom of much of that unwillingness to keep their children long at school, which is complained of as one of the obstacles to the spread of education among the poor. I may mention, that in the United Industrial School in Edinburgh, the good effects of the opposite system, essentially the *half-time system* of Mr. Chadwick, have been exemplified on a considerable scale since the very commencement of its operations ; the children dividing their time almost equally between the school and the workshop, and their labours of body

and mind being diversified by a daily drill, and by abundance of exercise in the playground. I feel satisfied that the education thus communicated is in reality far better fitted for its purpose than that given in most of our middle-class schools ; and its practical efficiency is very clearly shewn forth in the strikingly large proportion of the old pupils of the school who can be traced into positions of usefulness and respectability very far above their original social position. The facts in detail, as regards the system pursued in this institution, are well worthy of the attention of sanitary reformers, as well as of educational theorists. It has succeeded in solving the problem, of giving a good and sound education in common to children of different faiths, without offence, and without neglect of the religious element. But its claim to the consideration and sympathy of the practical educator is not limited to this ; it has also completely met the difficulty of reconciling school education with preparation for the every day work of life, and the development of the bodily powers with the most efficient mental training possible or expedient in the circumstances of the neglected children to which its operation is confined. Accordingly, the health and habits of the children, although originally taken from the very worst class of the population, and still allowed for the most part to live during the night with their parents or guardians, are a complete contrast to those described by the inspectors, even of government schools, in many parts of the kingdom, and referred to by Mr. Chadwick in proof

of the necessity of the reforms he proposes. Both the studies and the handy-work are pursued with a vigour and elasticity which amply prove the truth and importance of the views set forth in the following admirable passage of Mr. Chadwick's address :—

“ If we observe young children in a state of nature, their peculiar mobility during periods of growth, their incessant changes and activity for muscular exertion—changes short at first, and longer as growth advances, excited by quickly varying objects of mental attention, with manifestations of pleasure when allowed free scope, of pain when long restrained ;—if we ask to what those changes subserve, we receive for answer from the physiologist, that they serve to stimulate the whole nervous and muscular system, and to promote healthy bodily assimilation and development. The theory and the common practice of school instruction, is of five, at the least, or six hours and more of quietude and muscular inactivity, with intervals of three hours each, with only occasional variations of position, and during this bodily inactivity, continued attention and mental labour by very young children, say from six or seven to ten years old and upwards. To ensure this bodily inactivity, and enforce continued mental attention and labour (during periods in which it is difficult to sustain it, and injurious to exceed it, even for adults), the service of the school teacher is made to be one of severe repression, to keep little children still, whilst every muscle is often aching from suppressed activity.

I have the warranty of Professor Owen and other physiologists for saying, that the resistances of children are for the most part natural vindications of the laws of physiology, and I am prepared to shew elsewhere, on the evidence of some of the most experienced and successful school teachers in the kingdom, that they are violations of the laws of psychology and injurious mentally."

NOTE I. Page 120.

IMPROVED DWELLINGS FOR THE WORKING CLASSES.

The reader will find a most comprehensive and valuable statement of details as regards the movements that have taken place to provide better habitations for the working classes in England and Scotland, with references also to the Continent and the United States of America, in two papers by Mr. Henry Roberts, F.S.A., in the volume of the Transactions of the Social Science Association for 1860, pp. 766 and 779. The only great oversight which I recognize in this summary, as respects Edinburgh, is the absence of a sufficiently prominent notice of the very remarkable and successful efforts of Dr. Foulis to improve one of the worst localities in Edinburgh. In a most interesting pamphlet, entitled "Old Houses in Edinburgh, and their Inhabitants, as they are and might be,"* Dr. Foulis

* Published by Johnstone and Hunter; now to be had in limited numbers on application to Mr. Andrew Elliot, bookseller, 15a Princes Street.

has given ample details to shew that a remunerative rent can be obtained, and a very important social reform promoted, by the *improvement* (not the entire reconstruction) of old and decayed property in the worst parts of the town ; thus removing, in a great measure, the only apparently valid excuse for retaining houses unfit for occupation, viz., that their improvement would be a process too costly to be ever adopted with justice to the proprietor, however useful for the tenant. Dr. Foulis has shewn, I think quite satisfactorily, by this most valuable experiment, that the real difficulty is in another direction ; not that improvements fail to be remunerative, when wisely and prudently executed, with due regard to what is really wanted ; but that, partly from the neglect of the authorities, and partly from the want of really good accommodation, enormous rents are actually derived from the existing ruinous and demoralizing haunts of disease, which are often in the hands of small proprietors without capital, and on which, accordingly, no more is expended by the landlords than is barely sufficient to keep them from falling under the condemnation of the Dean of Guild Court. It seems to follow, therefore, sufficiently clearly from the experiment of Dr. Foulis, that the judicious flow of capital towards the older parts of the city, aided by the gradual but sustained pressure of authority upon the points where the duty of the landlord is habitually neglected, is all that is required to furnish the poor with cheap and wholesome, instead of dear and unwholesome, accommodation. The

bad article commands a high price at present, only because the good one is not in the market, or is not adapted carefully to the wants of the consumer.

The close which was the seat of the operations here alluded to was in the Grassmarket of Edinburgh, and was long notorious as one of the worst, if not the very worst, in the whole town. It was not only to a considerable extent a den of thieves, but a well-known haunt of fever and cholera.

“Winter and summer,” writes Dr. Foulis in the pamphlet of which the title is given above, “it was all the same; from the top of the close to the bottom one continuous pool of wet, filth, and pollution; on one side a ruinous wall, on the other a building apparently in the last stage of decomposition, the windows almost utterly destitute of glass; and clouds of smoke issuing from them, indicated a total obliteration of the chimneys. On the right were two or three wretched cellars, which, but for the half-naked children standing at the door, might have been passed unnoticed, and into which the light of heaven never entered beyond a few feet from the door. These cellars, we need hardly say, were inhabited by the lowest Irish, by profession stick-breakers or stick-hawkers, which, in many cases, is a charitable name for young thieves. Farther up the close were three outshot rickety wooden stairs, which served as a means of access to the upper storeys, at least for those to whom practice had rendered them passable. The interior of

this house (which in the sequel will appear under very different circumstances) was in keeping with the exterior. The floors were in the same style of architecture as the roofs formerly alluded to—broken-backed, a curve of three to four inches being no uncommon thing in a room ten feet by twelve ; yet, strange to say, and shewing the tenacity of these old buildings, we were told that a few nights before our first visit, a ball had been held with impunity in one of these very rooms, the musician plying his vocation on a three-legged stool, the only piece of furniture in which the room rejoiced. Passing up the close, large heaps of filth were seen underneath the wooden stairs. But it is needless to particularise these, as the whole close was one midden, the places under the stairs differing from the rest only in the depth of the accumulation. After passing another ruinous building, used as a byre, the visitor carefully picking his steps from stone to stone, reached, at the top of the close, the large tenement formerly alluded to, the ‘Hatters’ Land.’ This building rises to the height of six storeys, and, judging from the living stream which poured down the stair, the population must have been enormous. In one room alone at the top of the house, between sixty and seventy have been known to sleep during the harvest season. Like the rest of the close, the inhabitants, with the exception of two families, were all Irish. This house differs very essentially in its outward appearance from those formerly described. It is a well-built modern structure, which rendered the contrast with the state of its interior all the more

striking. After entering the door—which, if the visitor did without receiving a shower-bath from some window five or six storeys up, he might congratulate himself—the close, damp smell was absolutely sickening. The stair, thickly encrusted with mud, probably some years old, and moistened with water which had trickled down from the flats above, rendered the ascent one of risk, which was very likely aggravated into actual danger by the accelerated descent of some reeling drunkard. The interior of the house was in a great measure destitute of wood, every available piece, with the exception of the doors, having been torn from its fastenings by the stick-breakers, converted into firewood, and hawked about the streets. The glass in the lower half of the windows was replaced by brown paper or a bundle of rags, the upper half bedewed with dust. An inventory of the furniture would have exhibited a rickety table, two or three stools or blocks of wood, a few planks raised off the floor for a bedstead, and one or two articles of crockery ware. Grates there were none—a few loose bricks, with some pieces of old iron hoop placed across them, being the most approved substitute. The rents charged for these, and all such dwellings in Edinburgh, are enormous, £2 : 12s. being the amount demanded for the privilege of living in one of the worst cellars. The whole close produced a rental of about £140, scraped together in silver and copper.”

The improvements which have taken place, are thus shortly described :—

“Burt’s Close no longer exists; the name itself has been changed to that of Warden, which was the original name some thirty years ago. Nor is the alteration one of a partial nature; it is no half-and-half measure, but a change, thorough, radical, and complete. Where wretched cellars were wont to be, now stand a handsome coffee-house and reading-room for the exclusive use of the working-classes. Miserable hovels, hotbeds of fever and filth, are now replaced by an airy, commodious bleaching-green. Dilapidated garrets, at rents of £4, are now occupied by respectable mechanics, who pay £3 for a comfortable house, with water and gas. The process by which this has been effected, consisted of rebuilding one part, remodelling another, removing a third, and repairing the rest. The front house has been entirely rebuilt. In the tenement situated immediately behind, the whole interior has been renewed and laid out commodiously. The large building at the top of the close has been repaired, so as to make the interior worthy of its exterior, and is now occupied as a comfortable model lodging-house. And lastly, the centre of the close, formerly occupied as a byre, has been removed altogether, and converted into a bleaching-green.

“There are four distinct features which characterise the improvements effected on this close :—

“1. The erection of superior houses for the working-classes, situated in the heart of the town, with water, gas, water-closet, and bleaching-green, constructed out of *old property*, and at moderate rents—amply remunerative, at the same time, to the proprietor.

"2. A grocer's shop, where no spirits are sold.

"3. A commodious coffee-house and reading-room, for the benefit of the working-classes.

"4. A model lodging-house, where mechanics can obtain most comfortable accommodation at the same rates as those charged for the worst."

The following are the details given by Dr. Foulis as regards one of the most striking of these improvements; they are of the greatest practical importance, as illustrating the preceding statements; and shewing the importance of a sound judgment, added to an earnest desire for doing good. As the original pamphlet has chiefly had a local circulation, while the principles are more or less generally applicable, I make no apology for quoting from it at considerable length.

"We wish to draw particular attention to the renovated tenement of six houses, as it is, or rather was, the type of a large quantity of house property at present existing in the old town, to all appearance in a ruinous condition, and ready to fall under the condemnation of the Dean of Guild Court. A description of this tenement has already been given above, as that in which the ball was held. The house in its former condition was valued at £70. The rental of the whole, extorted from its Irish occupants, was £31 : 10s., a sum which will appear enormous to one unacquainted with these matters; but a return like this is always required on such an investment. Two circumstances, which

also apply to all houses of the same kind, will explain it.

“*First*, The occupants belong to that class which forms the lowest stratum of society—abandoned profligates and starving Irish. They are totally unable to offer security for payment, and the decay of the house is rapidly accelerated by the treatment it receives at their hands ; moreover, moonlight flittings are readily and often accomplished, by the tenant walking off with the furniture on his back ; hence high rents are demanded as an equivalent.

“*Secondly*, Like all perishable articles, these houses require to yield a large profit. One week the proprietor draws his rents, the next sees his house levelled with the ground, by order of the Dean of Guild Court, which process, as we know to our cost, cannot be accomplished without swallowing up at least a year’s rents in court and other expenses.

“The dilapidated appearance of this house was so apparently irremediable, that we never contemplated any other measure than that of having it taken down and rebuilt. We accordingly took estimates for that purpose, which amounted to nearly £400. This sum was greater than a house of the same size would have cost on an open space, the additional expense being caused by the trouble of taking down and removing the old building ; which circumstance is an argument in favour of renovating an old house when it can be done, instead of building a new one on the same site.

“The estimates being larger than we contemplated,

we began to examine the old building more closely, with a view to its renovation. Having consulted practical men, and satisfied ourselves as to the integrity of the walls, we proceeded to remove the whole interior, alter the height of the floors, and replace the rotten wood with fresh. The house, in short, to use a builder's phrase, was "gutted," and laid out anew.

"The expense of this was as follows :—

Mason Work	.	.	.	£54	0	0
Carpenter's do.	.	.	.	117	0	0
Plumber's do.	.	.	.	24	0	0
Slater's do.	.	.	.	5	0	0
Lathing and Plastering	.	.	.	33	0	0
Sundries	.	.	.	13	0	0
				£247	0	0

The rents amount now to £35, shewing a return of 11 per cent on the whole outlay, including the original value, £70. No doubt this is a great falling off from about 35 per cent formerly obtained. But then, let it be observed, we now possess to all intents and purposes a new house, and one which will insure good tenants. This building, we may also mention, was ill adapted for being laid out commodiously, without incurring additional expense ; and hence the rents are smaller than they might otherwise be in similar cases.

"With the view of shewing the comparative return between building the new house and renovating the old one, we may state it thus :—

Cost of new house	£350	0	0	Cost of old house	£247	0	0
Rent of do.	34	0	0	Rent of do.	35	0	0
Per centage, 9½.				Per centage, 14.			

In this tabular view the cost is given irrespective of the price of the ground ; and the rent of the new house is stated as if it were all occupied as dwelling-houses. Of course, the shop increases the rent £11, in virtue of its being a front land, which circumstance cannot be taken into account in the erection of ordinary dwelling-houses. We arrive at nearly the same result by comparing the old house with itself, that is to say, contrasting the cost of its renovation with the estimate for erecting a new building on its site, —

Estimated cost	£400	0	0	Cost of renovation	£247	0	0
Rent . . .	35	0	0	Rent . . .	35	0	0
Per centage, 8½.				Per centage, 14.			

But it is right to state, that had the house been built anew, increased accommodation would have produced a rental of £40, shewing a return of 10 per cent. But even with this, the renovation yields a larger return."

I will only remark, in conclusion, that the immense displacement of population which has taken place in consequence of the improvements in Liverpool, recorded in this lecture, has led directly to the profitable application of capital to the constitution of new houses, on a scale which leaves no doubt of the vast improvement effected under the pressure of an enlightened sanitary interference. Mr. Newlands thus recounts the result :

“ So adverse now is the labouring class of the population of Liverpool to the old style of houses, and so anxious are they to secure all the advantages of sanitary arrangements, of which they have learned to know the value, that builders find it their interest to give more accommodation, and that of a better description than what the law prescribes. Every day witnesses improvements in structural arrangements, the result of a beneficial competition, urged by the demand for healthy homes.”

NOTE K. Page 127.

CONNECTION OF TUBERCULAR DISEASE WITH DEFECTIVE
VENTILATION.

The very striking particulars quoted in p. 32, from Dr. Guy's evidence before the Health of Towns Commission may serve as an example of the influence exerted by the air of the workshop, on the proportion of cases of pulmonary consumption among the inmates. It would be, perhaps, to encroach too much on the province of a strictly medical inquiry, were I to enter at large upon this subject ; the reader who is desirous of further information, will do well to consult all of the authorities mentioned in the text, and also the last report (1860), of the Medical Officer of Health to the Privy Council, which contains the results of an elaborate inquiry into the special causes of pulmonary

diseases in various parts of England.* The essay of Dr. Baly on the mortality of prisons (*Med.-Chir. Transactions*, 1845), the report of the Commissioners on the health of the army (appointed after the Crimean War), and the reports of the Consumption Hospital at Brompton, are in various degrees corroborative of the idea, that want of ventilation, whether of the residence, or of the workshop (to which may be unquestionably added, in many instances, the school), is responsible for a large amount of the mortality from consumption, and the allied forms of disease. It is now nearly forty years since the germ of this idea was developed by Dr. Alison (*Edinburgh Medico-Chirurg. Transactions*, vol. i., 1824), in a paper in which he endeavoured to shew that confinement, and want of exercise, rather than cold or deficient nourishment, are the causes of tubercular disease. The dependence of these diseases upon vitiated air was also maintained by Baudelocque in a special treatise (*Etudes sur la maladie Scrophuleuse*, 1834), quoted at considerable length by Dr. Duncan in his evidence before the Health of Towns' Commission. The same argument has been recently urged by Dr. M'Cormac of Belfast, with much vigour and earnestness, but without any important novelties of fact or illustration.

As the differences are considerable between the comparative frequency of scrofulous diseases, and that of internal tubercular affections in different localities,

* See also the former valuable report by Dr. Greenhow and Mr. Simon, entitled "Papers on the Sanitary State of the People of England, 1858," especially p. xxii., *et seq.*

there must in all probability be some unknown specific cause of each, to the activity of which a defective air-supply is an essential, or nearly essential condition. In connection with this obscure subject, it should not be overlooked, that the contagious or infectious character of consumption has at different times been a popular belief, and has also found favour with many good medical authorities, although more usually set aside as deficient in evidence. Without wishing to dogmatize on the subject, I think it must be conceded that the frequent occurrence of the disease in connection with bad ventilation, is rather in favour of the view of some degree of contagious property, and ought to inspire reasonable caution as regards the too close approximation of the sick to the healthy. A pure air by day and by night, is the only safeguard against this danger, if it really exist; and considering the lamentably frequent instances of the wide diffusion of the disease in families (though this does not necessarily presuppose contagion), no precaution should be neglected that is consistent with the humane and attentive nursing of the sick.

Mr. Toynbee has observed among the working classes of London, that while scrofulous and tubercular diseases are the result of ill-ventilated dwellings and workshops, in connection with destitution and an imperfect supply of food, gouty and rheumatic disorders prevail among those who are driven by the physical exhaustion of working in an impure air to the use of stimulants. See on this subject his evidence (*loc. cit.*, pp. 80-81.)

IV.

SCANTY WATER.

WATER differs in this respect from air,—as a matter of fact, I mean, for I am not speaking of what *ought to be*, but of what *is*;—water differs in this respect from air, that in some places it has become a *commodity*—it is made an article of *sale* and *barter*—it has a *value* and a *price*. I have already maintained, with respect to the air we breathe, that whatever God gives us freely and at large, so that we cannot confine the use of it to ourselves alone, we cannot justly make our own without due regard to the rights of others ; and I apprehend the application of this same principle ought to limit the absolute right of personal property as respects water. I hold, therefore, that the moment water becomes a *commodity*—an article having a commercial *value* in the ordinary sense of the term—you have reasonable grounds for suspecting that the community has culpably and negligently abandoned its rights, to the great danger if not actual detriment of the public interest. I hope to convince you thoroughly of this before I have done, and also to show you, that the rights of the com-

munity in this matter are absolutely indefeasible—they cannot be abandoned without great injury and suffering ; and therefore they must be maintained inviolate to this extent, that no one shall claim exclusive access to the sources of supply of this necessary of life any more than in the case of air, which we have already discussed. In other words, I hold that water, like air, is originally no man's property. Like air, it has this peculiarity, that to confine it, to restrain its absolute freedom of movement, is to render it useless—nay, to render it positively injurious to yourself and to every one about you, and therefore I cannot but hold, that this surrounding of water with commercial restrictions is a violation of a higher law than any of man's making, and can only be defended on the plea of a temporary necessity.

Let us look, however, a little more closely at this difference in the commercial value of air and water as it exists—for it is a fact, deal with it how we may. You will find, on reflection, that it depends mainly upon this other difference between the two, that we can live a little while—a little while only—absolutely without water, while I need not tell you that we cannot live, beyond a moment or two, absolutely deprived of air. Our dealings with air are instant, unvarying—they are entirely beyond our personal control—our need is so constant and so clamorous, that if not supplied from moment to moment we die. In the case of water there is at least time for negotiation and reflection ; we can wait to settle whether it is worth what is

asked for it ; we do, in fact, however foolishly, sometimes trust ourselves very much to accident and the caprice of circumstances in regard to our water-supply ; and yet a certain amount, at least, of water, is only less instantly necessary than a certain amount of air. A man dies very much sooner if deprived of water, for instance, than if deprived of solid food. In the case of food it is a question of days, in the case of water it is a question of hours—water is, therefore, much more instantly essential to man than food, but it is also much less instantly essential than air. In accordance with this physiological relation is the supply of water, air, and food respectively, by the bounty of the Creator. We find the air of heaven everywhere, literally without seeking it, while water has to be looked for where it lies, and carried from place to place by the labour of man ; and food has not only to be carried, but to be provided and prepared by complex processes, involving much forethought and industry. And in accordance, also, with this physiological law of urgency, we find the peculiar character of the sanitary defects for which we have to find a remedy. In regard to air, it is never, or very rarely, the mere quantity that we have to regulate. We need not interfere to prevent people from suffocating themselves, in the literal sense of the word, and we have very rarely, in civilized communities, to deal with a case like that of the notorious Blackhole of Calcutta. I suppose it never entered into the mind of any man, however stupid or ignorant, to fix his residence or lodging permanently where he had, as regards

mere quantity, an absolutely insufficient supply of air for purposes of respiration. He can bear to have too little, indeed, for a healthy life ; he can breathe an impure air for a certain number of hours, and he can die slowly by inches in doing so ; but he must at all times have some kind of direct access to the air of heaven, and his natural instincts may be trusted to this extent. With regard to water, on the other hand, multiplied experience has shewn that men will settle, nay, must settle, in large communities, where individual access to the natural sources of water is impossible, and where, therefore, an insufficient supply for the purposes of a healthy life is not only very common, but is the very frequent, nay, almost necessary, consequence, of a deficient sanitary supervision, or a deficient sense, on the part of the authorities, of their responsibility in relation to this special matter of water-supply.

I admit, then, at once, that these two facts distinguish, to some extent, the case of water from that of air,—first, that men can be induced, by certain circumstances, to reside where there is a permanent and unavoidable deficiency of water, trusting to an artificial supply from a distance ; and secondly, that water can, in these circumstances, be supplied profitably by the labour of man as a commercial enterprise. But I maintain it is only in appearance that the case of water is thus distinguished from that of air—not as regards the real ultimate bearings of my argument ; for if you look a little further into the matter, you will find that, in reality,

everything that we said of air, as regards the right of the community to interfere, and the grounds of that right, is true also of water. Every fact, every principle, that brings air within the proper province of municipal regulation, gives a right of interference in the case of water also ; and therefore I do not hesitate to go the full length of saying, that wherever and whenever water has become a commodity, in the ordinary, mercantile sense of that term—wherever and whenever water has become a matter of private sale and barter—you have a dereliction of duty on the part of the community. There are three reasons why this is so ; *first*, because a certain supply of pure water is absolutely necessary to the healthy life of the individual. You alone, apart from other people, could not possibly live long, or live healthy, if you had not access to water with a certain degree of freedom as regards quantity, and of at least fair purity as regards quality. Water is in this sense, therefore, one of the absolute essentials of life to you and to every man. *Secondly*—and this is, even more than the first consideration, a reason why it becomes the province of the community to interfere in regard to water,—without an ample supply of pure water each individual becomes a source of danger to all his neighbours. His excretions, the effete matter of his body—the waste of his system—pass necessarily into the water to a large extent, and unless that water is kept abundant, pure, and in motion, the community is poisoned just as effectually as when the air is poisoned through the exhalations of the lungs. Then there is a

third reason, which springs in part from the consideration of the other two—that without an abundant supply of pure water it is absolutely impossible to have pure air. You not only poison the water for your neighbours, if the supply is not sufficiently abundant, but you also poison the air through the exhalation of poisons given off by the water. For in this case we cannot avoid the complications arising from the inextricable intermingling of water and air on which I insisted in a former lecture. Do what you will, water and air will intermingle at every moment and in every place where they are in contact with each other, and the poisons they contain will intermingle also ; and thus a beautiful arrangement, instituted by the providence of God for the most beneficent of purposes, becomes, through the mismanagement and neglect of man, the frequent instrument of his own destruction.

Now, I think that these three reasons justify me in placing water—in so far as regards the interference of the municipal or other authorities—in nearly the same position as air. I maintain, and I shall endeavour to prove, in this and the following lecture, the right and duty of the community to ensure, in the first place, an ample supply of water ; then, to look to it in detail, that every individual is properly supplied ; and lastly, to regulate the disposal of that water when it has served its purposes of drink, cleanliness, and removal of waste. I do not say that the whole of these powers must at all times and in every case be stretched to the utmost ; but in very large communities, with a large

number of poor, you require the full amount of authority I have indicated ; and nothing less than this will in certain cases enable you to carry out efficient and thorough sanitary reforms. I will ask your attention, in what remains of this lecture, to some details on this subject ; and, that we may follow some arrangement in marshalling our facts, I will beg you to observe, that there are two distinct forms of the evil of a defective water-supply. We may have merely a deficiency of *pure* water, while impure water is to be had in comparative abundance ; or, on the other hand, we may have a deficient supply of water as regards quantity—a true famine or destitution of water. It is true that these two forms of evil, though not inseparable, are often very closely connected. Still, they are separable. There are many places where the quantity of water is sufficient, but the water supplied is not pure ;—there are some places, on the other hand, where the quantity of water is insufficient, but where the sources of supply are excellent, and the water is comparatively pure, its only fault being, that there is too little of it. The evil of scanty water is the one I propose to speak of, for the most part, to-day.

A scanty water-supply arises substantially in the same way, and for the most part under exactly the same circumstances, as the evils connected with overcrowding. It is a result of the association of men in large and rapidly increasing communities. Individual men or families might possibly be led to settle in ignorance, or from thoughtlessness, where the water

is not pure enough for a healthy life, and might suffer accordingly ; but hardly any one would think of building a house where there is a greatly deficient supply of water for domestic purposes, if he was left to himself ever so completely. And in point of fact, all great communities have been founded in the beginning with more or less reference to this particular circumstance. The existence of a sufficient supply of water has always been one of the first things that men have looked to instinctively in choosing a place of habitation. Even the solitary traveller takes care to pitch his tent beside the running stream, or close by the living springs of pure water. But you can easily understand, that when, owing to commerce, or for other reasons, there arises a practical necessity for the aggregation of human beings in a certain place, that which was originally a sufficient supply of water will speedily become an insufficient supply. What was quite sufficient for a hamlet, a well or two of pure water, becomes insufficient for a village, and still more insufficient for a great town. As places increase in population, therefore, the inhabitants have constantly to go in search of new supplies of water. Sometimes the original supply has been good and pure, and in groping about for new sources of supply, impure sources are brought into use, and become injurious to the health of the population. Sometimes there is a difficulty in finding new sources at all, and then, in the course of the rapid filling up of a town with human beings, there comes about an absolute deficiency of water, although there was originally an

ample supply. That is the general course of events in the formation of great communities ; it is very much the same process as we have seen already leading to overcrowding, and all its attendant evils. In the case of a deficient water-supply, efforts are soon made to overcome the difficulty ; individual enterprise is brought into play, and unless some better arrangement is made, it very soon comes about that water is bought and sold like any other article of commerce. There are still, unhappily, communities in this great and wealthy country which have not got beyond even that most crude and primitive form of water-supply ; where the water is so scanty, and the public spirit so little alive, that the inhabitants are obliged to have recourse to hand-carriage, at once the most expensive and least efficient mode of supplying themselves with water. In such cases, the people who can afford it are content to pay by the gallon for water, carried by hand from the nearest public well, or other accessible source ; while the poor are often obliged to act as water-carriers for themselves, at great cost of labour and time.* The sources of supply in these cases may be more or less distant. Sometimes the source may be a well perhaps three doors off—the evil is then not very great, that is to say,

* In Sheerness, on the occasion of a recent epidemic, it was found that even the poorest inhabitants of the town were purchasing water by the bucketful ; and persons paying from 2s. to 3s. 6d. a week for lodgings, were often found paying from 6d. to 10d. a week for water. See the second report of the Medical Officer of the Privy Council, 1860, p. 37.

if the houses are not high ; but the evil even then becomes very great if, as in the Old Town of Edinburgh, you build your houses eight or ten, nay, even twelve or fourteen storeys high, and at the same time make no provision for carrying up to them this necessary of life. Sometimes you have to go a mile for water. Then, of course, the labour of carriage becomes enormous ; then carts have to be employed, and in the sending of these water-carts round the streets, the water is jumbled about in the neighbourhood of various kinds of contamination, and it is liable to contract impurities in its transit to the houses where it is to be used ; or again, it may be kept so long in the houses themselves as to contract impurities there before it is used. Then, when the sources of pure water are so distant, there is a constant temptation to endeavour to find out nearer, though, it may be, more impure sources ; the poorer classes especially go in search of water wherever they can get it, and become habituated to the use, for household purposes, of impure water. And observe here, that it often happens that when the rich are tolerably well off—or, at all events, can get pure water by paying for it, the fact that they can get it in this way becomes even a disadvantage to the poor. The rich do not greatly feel the evil. Their wants are supplied after a fashion, and they allow a large poor population to grow up in a state of neglect and helplessness as regards one of the first necessities of a healthy life. This, I am sorry to say, has been too much the case in some of our Scotch towns. In Edinburgh we are deeply to

blame in respect to the water-supply of the poor, and are largely responsible for the filthy and neglected state in which they live. I referred to Liverpool as a type of the evils of overcrowding and impure air. I told you that even as regards these evils Edinburgh has not much right to congratulate herself on her condition. We have had all the evils connected with overcrowding amply illustrated in Edinburgh, and with far less excuse than in the case of Liverpool, inasmuch as we have not had nearly so rapid or so great an extension of the population, and not nearly so great an amount of fluctuating population to provide for. I chose Liverpool from among the cities of the empire to illustrate overcrowding ; but in regard to water-supply, we may just as well begin at home. If we want an illustration and a type of the evils of scanty water—not of impure water, for we have always had, fortunately, access to water which is tolerably pure—we can hardly find a better one than this good and fair city of ours, which was one of the first in this country to bring water from a distance, but is likely to be one of the last, unless we bestir ourselves much more than hitherto, to make a full and free use of the cleansing and health-giving element. “Standing in a rainy country,” writes Lord Cockburn, “Edinburgh has always been thirsty and unwashed.” And although there has been improvement of late years, there are still among us too many illustrations, unhappily, of all the evils of scanty water—water not carried within the reach of the whole population. We have treated water not as a necessary

of life, but as a luxury of the rich ; we have bought and sold it, speculated in it, made money out of it, used it and wasted it to a very great extent. But with all our exertions to get pure water, we have never thought of carrying it into the houses of the poor ; and though the better classes are now (but only very recently) tolerably well-supplied, the poor are very much in the same condition as they were a century ago, with respect to this most urgent and necessary want. Nor have we any excuse for this long-continued neglect ; for the pressure of a largely-increasing population has not been one of the difficulties we have had to contend with, at least within the last two or three generations.

If the statements of Hugo Arnott, Robert Chambers, and others are correct, it is quite clear that the population of Edinburgh has advanced rather slowly for more than a century past, while on the other hand the house accommodation has been enormously increased within the same period. During the seventeenth century Edinburgh seems to have considerably increased as regards numbers without extending its area, and it was during this period that the immense piles of lofty houses which occupy the High Street were constructed. But from the time when the New Town began to be built there has been no want either of buildings or of space to build upon ; and so far as the better classes are concerned, there has been even an excess of house accommodation until within the last few years. A very moderate amount of care and interest in the condition of the poor would therefore, in all probability,

have served in Edinburgh to save us from some of the worst evils of an overcrowded population. Few places of any magnitude, at all events, have had, during the same period, equal facilities, or an equally long time to learn the lesson of improvement. In almost all the other great cities of the kingdom, the pressure of population upon the means of accommodating it has been incessant, and increasing with the growth of the place. In Edinburgh we have built an absolutely new and separate city almost within the memory of very old persons now living, and with the effect of leading to a profusion—almost a glut—of house-accommodation. But all this was only for the wealthy. The poor were wholly neglected and left to themselves throughout. Nay, the removal of a large portion of the better classes from the Old to the New Town seems to have only had the effect of breaking whatever ties of community of residence and kindly intercourse may at a former period have existed between the rich and the poor. The social consequences of this change, according to one of the most accurate and genial of our local historians, Mr. Robert Chambers,* were “only too accordant with that tendency of our present form of civilization to separate the high from the low, the intelligent from the ignorant—that dissociation, in short, which would itself run nigh to be a condemnation of all progress if we were not allowed to suppose that better forms of civilization were realizable.” The more immediate and palpable results were “a flooding in of the humbler

* Traditions of Edinburgh, p. 14.

trading classes where gentles once had been ; the houses of these classes, again, being filled with the vile and miserable." The ultimate outcome, therefore, of the civilization of Edinburgh during the last century has been mainly to set free a host of decaying tenements hardly fit for human habitation even at the best, and to hand these over to a gradually increasing and gradually more and more neglected class of nearly destitute poor, to be occupied at will, without supervision and without restriction as to numbers, in the absence of all that was necessary to make life healthy, or even safe, for themselves and for their neighbours. So it was, absolutely without qualification, till Dr. Alison startled us all with his note of warning in 1841. So it is still to a very great extent, although the worst results have been somewhat modified by improved police regulations, and by the beneficent working of the new Poor Law. But with all this neglect, and all this glut of houses, the increase of actual population has been quite within moderate limits as compared with many other large towns ; shewing that we have virtually spent a whole century in allowing a moderate increase of population to shake down into houses amply provided for them, and yet even now we have not succeeded in providing that those houses shall be properly supplied with the first necessities of life in a sanitary point of view. Only look at the shame and the sin of this—the terrible and persistent neglect of duty which it implies—when considered with respect to water-supply.

Mr. Robert Chambers, in his Traditions of Edin-

burgh, says that at the beginning of George the Third's reign, Edinburgh had already a population probably of about 70,000 persons. I do not know whether that statement can be considered to be founded on rigidly accurate data or not ; for Hugo Arnott makes a calculation of the population in 1775, which would shew that it was even then not much more than 80,000, even allowing six persons to a family, which we know to be a very large allowance. Be this as it may, it is quite clear that Edinburgh has been a large and a densely populous place for very much more than a century (probably nearer two centuries) ; so that we have had plenty of time to learn our lesson, if we were to learn it at all. Moreover, it is quite clear that we have not trebled, perhaps hardly more than doubled, our population during a hundred years ; whereas we know that the entire kingdom, taken overhead, has doubled its population within the last fifty years, and the places that have been most rapidly extending, have grown up from small villages to enormous towns, within a century or a little more. Such places as Liverpool, Manchester, Glasgow, Greenock, may reasonably claim as an excuse for neglect, that they have been taken, as it were, by surprise, in respect to the increase of their population. They have grown up suddenly into the maturity of great cities, and the usual evils have come upon them unawares, before the art of self-government had been learned. But in Edinburgh we have not had this excuse. We have boasted of our old civilization as a metropolis, and our high degree of knowledge and

refinement for a long time past. And these evils have been all the time under our very eyes and noses ; and amid all our boasted refinement, we have not even now summoned up resolution to wash and be clean ; to insist, I mean, that every one shall have ample opportunity to wash and be clean. What makes it more curious that this should be, is, that we were very early in the field of reform in this matter. In 1621, an Act of the Scottish Parliament was obtained, enabling the magistrates to bring in water to the city from a distance. Nothing was done, however, till 1674, when £2950 was paid to a German engineer for bringing pure water from Comiston, near the Pentland hills ; and this supply was afterwards increased under a new Act of Parliament, so that in the next century, old Hugo Arnott had really some cause for the remark, that “no city of its bulk, in modern Europe, is better furnished (with water) than Edinburgh.” At this time, no one had ever thought, probably, of carrying water into the houses, either of rich or poor, as a duty of the authorities. It was enough, and perhaps more than enough, according to the ideas of the period, if they brought water to the town, and placed it to a certain degree within reach of the inhabitants. This the authorities did ; the rest they neglected, and have continued to neglect until now. Moreover, they soon began, according to Arnott, to make the supply of water an excuse for an unnecessary and oppressive amount of taxation ; and thus a great amount of dissatisfaction arose, which hampered them in their future

operations, and ended by transferring the duty of water-supply to a private company, as a means of procuring water at a cheaper rate, and getting it more extensively supplied to private houses. All this time, both rich and poor, with few exceptions, were dependent on the exertions of the regular "water-carriers," by whom water was brought from the public fountains and wells to the doors of the houses, and there, as a matter of trade, sold to those who could pay for it, by the bucketful. And this supply often failing (even as regards the wealthy), there arose a Water Company, a joint-stock speculation, which ultimately took upon itself, under an Act of Parliament passed in 1819, the responsibility of supplying a sufficiency of pure water to the city, a duty which the municipal authorities, in their disgust at the opposition of the citizens, had by this time fairly disowned and abnegated. Now, I am not going to quarrel with our Water Company. Water companies, where they have come to be required, have, I believe, often discharged their duty very fairly as commercial concerns ; and ours has considerably enriched its shareholders, while performing a duty towards the public. It was set up, originally, as the lesser of two evils, as a body less likely to be a source of grievance, less likely to fail in its duty to the public, than the Town Council of that day ; and I believe it really was a useful institution, although a mere commercial speculation, and one which I hold should never have had cause to exist. I am not here to depreciate the Water Company ; but what we have to look at is the fact that a Water Company can

only be set up because the community has overlooked or neglected its duty. The misfortune is, that the authorities were, rightly or wrongly, distrusted by the people, and their duty was therefore handed over to others. But this only shews that we were misgoverned, or believed ourselves to be so; for assuredly we ought to have taken upon ourselves, and never to have resigned to others, the great duty of looking that we were properly supplied with this great necessary of life. The whole process, as regards Edinburgh, is so clearly, and at the same time humorously, described in "Lord Cockburn's Memorials," that I will just take the opportunity of reading you a passage from that curious and amusing book. It refers, I think, to the year 1817. He says :—

"Another loosening from the Town Council occurred about this period. It was one of the earliest of the practical alienations, on matters of mere business, which attested how unworthy of trust our municipal system was believed to have become. Though standing in a rainy country, Edinburgh has always been thirsty and unwashed. At this time the condition of the city, in reference to water, was positively frightful. Our supply depended on a wretched tank of about ten or twelve shallow acres on the north side of the Pentland Hills, which had been considered as far too small when it was made a long time before, but had now become absurd, even if it had been always full, instead of being often and long nearly empty. The Town Council, on which our supply of this necessary of life depended, could or

would do nothing. A joint stock company was formed, and a plan for bringing in the Crawley spring from the south side of the Pentlands was obtained. The danger of leaving a city at the mercy, for anything it cannot do without, of a single private company was foreseen, and has to a great extent been realized. But anything was thought better than the Town Council ; in so much that so long as the absolute exclusion of our civic rulers was doubtful, scarcely any one would risk a shilling in the concern. But they being excluded, the company proceeded, and we occasionally got some water.

“One consequence of this was, that as the supply was steadier than it used to be, it became worth while to put water-pipes into houses. And another consequence of this innovation was, that we were speedily deprived of a set of people fully as peculiar as the City Guard—the Water Carriers, of whom in a very few years there was not one extant. They were a very curious tribe, consisting of both men and women, but the former were perhaps the more numerous. Their business was to carry water into houses ; and therefore their days were passed in climbing up lofty stairs, in order to get into flats. The water was borne in little casks, and was got from the public wells, which were then pretty thickly planted in the principal streets ; and as there were far more candidates than spouts, there was a group of impatient and wrangling claimants who, when not eloquent, sat on their kegs. These encampments of drawers of water had a striking appearance. The barrels, when filled, were slung upon their backs,

suspended by a leather strap, which was held in front by the hand. Their carriage was made easier by leaning forward, which threw the back outward ; and hence stooping was the natural attitude of these sons and daughters of the well. They were known by this peculiarity even when off work. Their backs, which would otherwise have never been dry, were protected by thick layers of hard black leather, on which the barrels lay ; and the leather had a slight curl up at its lower edge, which, acting as a lip, threw the droppings, by which they could always be tracked, off to the sides. Still, however, what with filling, and trickling, and emptying, it was a moist business. They were all rather old, and seemed little ; but this last might be owing to their stooping. The men very generally had old red jackets, probably the remnants of the Highland Watch, or of the City Guard ; and the women were always covered with thick duffle greatcoats, and wore black hats like the men. They very seldom required to be called ; for every house had its favourite " Water Caddie," who knew the habits and wants of the family, and the capacity of the single cistern, which he kept always replenishing at his own discretion, at the fee (I believe) of a penny for each barrel. Their intercourse with families civilized them a little : so that, in spite of their splashy lives, and public-well discussions, they were rather civil, and very cracky creatures. What fretted them most was being obstructed in going up a stair ; and their occasionally tottering legs testified that they had no bigotry against qualifying the water with a little

whisky. They never plied between Saturday night and Monday morning ; that is, their employers had had hot water all Sunday. These bodies were such favourites, that the extinction of their trade was urged seriously as a reason against water being allowed to get into our houses in its own way."—*Memorials of Edinburgh*, p. 352.

From this extract you will observe that the rich, who could afford to pay, by putting water into their houses restricted, and in the end wholly abolished, some of the facilities—such as they were—which had been enjoyed by their poorer brethren to a certain extent up to that time. No doubt, the very poor never made much use of the water-carriers at any time ; still, I think that abolition of the water-carriers by an improved method of supply, which was a boon to those who could afford an annual water-rate and the expense of the necessary fittings, was probably the reverse of a boon to those who did not get the water into their dwellings. So that, by the getting in of water on the part of the rich ; by the institution of a water company, which was pledged to the supply of those who could pay, but which also required to make its profits as a commercial concern, water became more abundant for the wealthy, at the same time that it became even less accessible than before for many of the poor, whose wants were of course beyond the calculations of a speculative company. And after all, it is only the other day, as it were, that we have had water in anything like sufficient abundance for the wants even of those who

can pay for it. We have had many complaints, and occasional scarcities ; often, too, the quality has not been good, considering the immense amount of energy, and money, and successful engineering that have been expended. On the other hand, we have been accused of using too much water—of wasting it, in short. I am not an advocate for waste, even in the matter of water ; but I shall be very slow to admit that we, as a community, use too much water, as has been sometimes asserted. Why, even now, when we who pay think we have only of late got almost enough of it, there is an immense community in the Old Town—quite a town of itself—which is in all probability not any better—perhaps no better, perhaps even worse—supplied than it was two or three hundred years ago. To what extent this evil of scanty water-supply goes in Edinburgh I can only give you a faint idea by words, but those of you who are engaged in dispensary practice must know the facts perfectly well. I will give you a single illustration of the state of matters from some carefully recorded details which I extracted from a leading article in the *Scotsman* some two or three years ago. There is a stair somewhere near the Cross, at the bottom of a true close—that is to say, a narrow alley closed at the lower end—which stair is only the type of a great many others in the Old Town. This stair—a “very common stair,” as the *Scotsman* calls it—leads to seven storeys, and at each landing there are three passages, each passage leading into a certain number of rooms. That single stair is the

access to 79 rooms, extending from the top to the bottom of the building; and these 79 rooms give accommodation, such as it is, to 59 families, that is to say, you have about one room and a third to each family. In the 79 rooms, there were counted 244 persons, in other words, you have more than three persons to each room; and of these 244 persons, 112, or almost one-half are children. Now, in the whole of this stair, there is not one drop of water laid on. Every person has to get water for the commonest purposes of life from the public fountains, either by going to get it, or by hiring a person to bring it; and as a great many families must be too poor to pay any one, they must bring it by going for themselves up and down these seven stairs, probably several times a day. They must either do this, or they must beg, borrow, or steal from their neighbours this necessary of life. Of course this involves various other consequences. Of course there are no water-closets in any part of this building—of course there are no sinks—of course there are no soil-pipes—of course there are none of those conveniences that are practically necessary under

in the neighbourhood. Perhaps a drain runs through the middle of the close. At all events, it runs not very many yards off through the next street. But what is the use of a drain to these poor people? It is not of the least use, so far as they are immediately concerned; and wishing as I do, to give all credit to the municipality for the money they have spent in main drainage within the last few years, I must say, that in this matter, they appear to me to have neglected the larger and more important half of their duty in the matter of drainage, the drainage of private houses, which can only be done by getting water into them in sufficient abundance. It is quite right, of course, and very desirable to improve and extend the main drains of the town; but you forget that draining the Old Town of Edinburgh is simply useless to the great mass of the community, unless you put water-conveniences into individual houses. That which you neglect, undoes the worth of that which you do. You do that which is only useful if you follow it up by doing something else; and you neglect to do that other thing. I am not sure that it might not be even argued that you make the condition of some of the streets worse by putting in main
water-conveniences into indi-

for the purpose of washing out the drains themselves. And in the course of a long dry summer, you have often to wait very many days for rain, during which one part of the refuse lies putrefying on the surface of the streets, while another portion lies putrefying in holes and corners of closes, and stairs, and houses, unvisited by the scavenger; so that even when the rain does come, it is extremely apt to run off directly by the open gully holes into the excellent sewers and main drains you have constructed, so that almost in consequence of your improved drainage, a large part of the accumulated refuse escapes being carried away.

This being the case, although I hesitate to go the length of asserting broadly that you do harm by putting in main drains without attending to the water-supply of individual houses, I would say that it is clearly of no use to go on indefinitely extending the main drainage in streets in which the houses are not supplied with water. You must carry on both improvements at once, or it would be better, almost, not to have begun at all.*

Now, I must draw to a conclusion to-day—for we shall not get beyond this matter of the mere scantiness of water in this day's lecture—by shewing you, from the various Health Reports, some of the bad effects of an insufficient supply of water, as these were observed

* Dr. Southwood Smith, indeed, says, in reference to this very subject, in his evidence before the Health of Towns Commission (vol. i., p. 23), that without an abundant water-supply in the individual houses, "not only is no good done by a drain, but the very evil intended to be avoided is positively increased and extended, it may be, upon a large scale."

in London and other places. We have excellent and trustworthy evidence on this point, which is given in these reports in great detail. I will, in the first place, take the evidence of Dr. Southwood Smith as to the state of the parish of Bethnal Green, which is given very compendiously here. He is asked :—

“Did you find in the district which you personally inspected many houses in which water is not laid on the premises for domestic purposes, and in which there are no privies? In Bethnal Green there are whole streets in which there is not a single house with water laid on the premises ; in some parts of this district, for the use of the houses of several streets, for example, for all the houses in Cranbrook Street, Old Ford Road, Charlotte Street, Grosvenor Place, and Twigg Folly, there are but two pumps : in one crowded part of this district I found the poor inhabitants deprived of water altogether, because the owner of the houses had had some quarrel with the water company, and the water company had wholly stopped the supply of water. It is fortunate that air is more accessible than water, and that its supply does not depend on landlords and water companies ; but water is as indispensable for many purposes of life as air is for life itself, and its supply ought not to be allowed to depend on the cupidity or caprice of landlords and water companies, but ought to be made compulsory on whoever invests his capital in dwelling-houses.”—*Health of Towns Commission, First Report*, vol. i. p. 30.

Then take the evidence of Mr. Toynbee, whose convincing statements in regard to ventilation I have formerly given you. He says :—

“The water is generally laid on in the yard or the lowest part of the premises, and a supply is generally given three times a week, and at each time the water comes on, the film of dust and blacks that has been deposited on the surface is mixed up with the previous accumulations. Even in a more open and less sooty and dirty neighbourhood, as on the surface of the Water Company’s reservoir, in the Green Park, the deposit of soot, or dust or dirt may be at times observed as a dark scum or carpet spread over it. One patient complained very much of the quality of the water taken from an old wooden butt. In respect to it, I learned that this same water is used for making bread by a baker who supplies a great number of the poor. Since attention was directed to the subject by the Sanitary Report, I have availed myself of opportunities of making observations upon it, and the result is, the strong conviction that the quality of the supplies of water, and the mode in which it is received and kept in such atmospheres, influences the diet and health of the population to a much more serious extent than has hitherto been imagined.”—*Id.* p, 82.

Then here is another passage, which touches partly on the impurity of water, but I will read it here :—

“To the mothers who are debilitated, the carrying water up stairs is a very great exertion ; mothers not daring to leave a child in the room, have to carry the child in one arm, and the vessel of water with the other. I have had even sick children neglected and left dirty, and the excuse given has been the inability to fetch the water. Recently I have had a case of this kind. I have attended three children, two of them with scrofulous inflammations of the eyes, the other of them with a scrofulous affection of the throat ; all of them rarely washed, and in an extremely filthy condition. The mother is a poor woman, who has been in a respectable condition, but she is now so far advanced in pregnancy as to be incapacitated from going up and down stairs to fetch water. She continually deplores her condition of having neither the strength to fetch a sufficient supply of water, nor the means of paying for it being brought to her.

“In these cases water is laid on in outer yards ? Yes ; in outer yards principally. A considerable obstruction to the proper cleanliness arises, not only from the inability to bring fresh water up, but from the inconvenience and inability, arising from the want of proper sinks, to take dirty water down stairs. One source of dampness and smell, I have frequently found, is the vessels of dirty water retained in the room. The common excuse for this retention is, ‘We are so knocked up with the day’s work, that the water must wait until to-morrow, when we shall be able to remove it.’ In some cases of accident to the female which I

have had, such as of sprained ankles, or bad ulcers on the legs, which confine her to the bed, there has frequently been no water whatever in the room ; and, after dressing and bandaging the patient, I have been obliged to try and get water in the next rooms ; sometimes there has been none in the next rooms ; at other times, that which the other occupants have had has been so dirty as to be unfit for use ; sometimes I have waited whilst water has been sent for, for me specially, and sometimes I have been obliged to go away with my hands unwashed, and to take the chance of my finding water at a neighbouring patient's. The towels given me to wipe my hands with, although ostensibly clean, yet, having evidently been washed in dirty water, are unfit for use. I frequently find that the water brought and kept standing in these crowded and close rooms retains dust and other impurities ; it no doubt absorbs some of the noxious gas, for it differs considerably from the state in which it is when first obtained. The taste of water obtained from the common companies' supplies I have found to be very different from that in which it was first obtained—very peculiar, and very unpleasant. I have observed that the people use a very small quantity of water in cooking ; that, to save water, they put greens into the pot without washing them, and to save having to fetch more water."—*Id.* pp. 82-3.

There is just another illustration, which I will give you from Mr. Toynbee's evidence. It is an illustration of the fact that the responsibility for this state of

things really lies with the authorities, because, for the most part, these poor people—who absolutely cannot get water in sufficient quantity as things stand at present—would be perfectly willing, in most cases, to pay for it, if the water could be got at a moderate rate. Mr. Toynbee is asked :—

“If an increased rental were requisite for these improvements, instead of there being generally reductions of existing charges, and if they were to fall as new charges upon occupants, such as those whom you have alluded to, do you believe they would defray them cheerfully? I have no doubt of it. Having been informed of the practicability of laying on pure water constantly at a penny a week, I have asked a great number of the patients whether they would consent to pay an additional rent of 2d. a week to have the water laid on in their rooms, and they have expressed warmly their willingness to pay even more ; that such payment would be but a trifle for such a ‘ blessing,’ as they have termed it. They have not complained, because they never imagined the practicability of any amendment.”—*Id.* p. 85.

Now, consider the serious injury done to these poor people themselves, and to the public at large, by allowing such large populations to grow up from childhood to old age under the idea that an abundant supply of pure water is a thing not to be had on any reasonable terms ; not to be looked for, in fact, as even

a possible thing for them. Fancy the consequences of that state of matters—the bad habits, the disregard of cleanliness, the loss of self-respect, the recklessness transmitted from generation to generation, and you will have no difficulty in accounting for much of the vice, much of the crime, much of the physical and moral evil of every kind which you observe among the working classes in great cities. Remember that large numbers of them are brought up, owing to the neglect of the community—to *our* neglect, that is—in circumstances where cleanliness is a physical impossibility, and where, therefore, the mere idea of it, and of all that goes with it, perishes out of recollection in a few years. Apply this to Edinburgh, where we have been unclean for centuries, and think of the result !

Before passing from Mr. Toynbee's valuable evidence, I cannot help saying, and I am sure you will agree with me, that, even in the midst of his prosperity as a man of established reputation in his own department of practice, I think Mr. Toynbee has good cause to remember with gratification the days when he was able, from his unremunerated exertions among the poor of the metropolis, to give these valuable details of his personal experience to the commissioners on the health of towns. Here, however, is another witness to the same effect. Mr. Liddle, whom I quoted before in regard to the overcrowding in Whitechapel district, gives evidence also as to the deficient water-supply, and the rates charged on account of that deficient supply in the east end of London. After saying that his experi-

ence in general is "precisely similar to that of Mr. Toynbee," he goes on to state his belief that the working classes would gladly bear their share of the reasonable expense of a better supply, though they cannot always pay the exorbitant charges of the water companies. He says :—

"I can state a circumstance to shew how much they appreciate the convenience of having water brought into the premises. In a place in Cartwright Street, where there are a number of small tenements surrounding a piece of waste ground, which tenements are occupied entirely by the labouring classes, a well has recently been sunk by the landlord, and a large tank erected over the well. This tank is filled by horse-power. From this tank pipes are carried, and the water is distributed into the several houses. The water is turned on three times a-week from the tank. Some of the houses have a water-butt in the cellar, and the privy is there also.

Are these houses visited by you? Yes, they are visited frequently by me; and I may mention as evidence of their appreciation of the supply, that they now pay 3s. 6d. per week as rent, in lieu of 2s. per tenement, which they formerly paid. It appears that these houses were for many years in the opinion of the landlord underlet, but the tenants consider that the increase of the rent arises from the supply of water."—*Id.* p. 107.

Now, just one more extract to the same effect from

the evidence of a gentleman who actually accomplished on a limited scale the reform here alluded to. Mr. Thomas Ashton is asked :—

“ Are you a manufacturer at Hyde, near Manchester? Yes.

How many labourer's houses have you there? About 320.

Have you introduced water into these houses? Yes, into every house. I was at the expense of putting down the tenants' communication-pipe; the total cost was about £1 per tenement. I charge them 1s. per annum rent for this tap, which is included in the rent of the water, which is 3d. per week, and is charged by me for this convenience. I pay it quarterly to the Water Company.

What was the state of things before you had water laid on? In what way was the water procured? They had to fetch it from various wells and places in the neighbourhood. They had also tubs to collect rain-water for washing; these tubs were continually leaking. The labour and annoyance of fetching the water was excessive. They fetched it in cans. The wells were the continual source of demoralization.

Has the change of practice given satisfaction to your tenants? Very great indeed. I know no alteration that has given so much; there is never any complaint in paying for the water. They say they save money by it; that the saving in cans and tubs, which were continually broken, would almost pay the expense.

You say you have introduced the water into every house ; do you mean even the most humble habitation ?
Yes.

What is the smallest rent paid by such houses ?
About 18d. a-week.

Have you noticed any effect on the health ? Yes, very great indeed ; cleanliness has always a tendency to health, and they are much more cleanly.

You consider that their health has decidedly improved ? Certainly.

As compared to their condition previously ? Yes ; they admit that themselves.

How long has this been in operation ? About seven years from the water being introduced to the completion, but it is about two years since the whole was completed."—*Id.* vol. ii. p. 99.

Without going any further to-day, for we are at the end of a subject, I will merely recall to your minds the purpose of all this evidence. I think we must be prepared to admit that the poor, degraded as they have been by our neglect, are not at all insensible to the value of a proper water-supply ; nay, that, in most cases they will very gladly pay for water if they can get it of good quality, and in abundance, and if they can get it on moderate and reasonable terms. I argue, therefore, that if landlords and capitalists will so far engage their capital as to carry water into every house, and if the community will perform its part, encouraging, and, if necessary, requiring them to do so, there is

no chance of ultimate pecuniary loss. I argue, further, that it is reasonable, if water-supply is provided by the community, that landlords should be compelled to avail themselves of that supply to such an extent as is necessary for the comfort and decent habitation of their tenants ; and this on the ground, that if houses are constructed on the great scale without water-supply, both they and their tenants become inevitably a moral and physical nuisance to their neighbours and to the community at large.

Now, one word more about Water Companies. I have said that I have no quarrel with them, under the circumstances under which most of them were instituted. We are bound to accept them as existing facts ; and we must not roughly over-ride existing interests. Water Companies have hitherto been called on to do what, in consequence of the imperfections of our municipal government, the community has been unable to do for itself ; they are entitled to credit, therefore, for enterprise more or less successfully employed on behalf of the public ; and having used them in our need, we must not unfairly set them aside. But there is, I think, ample evidence in the Health Reports to prove that the community can almost always, under proper direction and good municipal government, provide itself with water through its own representative authorities, both cheaper and better than through a joint-stock company. Recollect that a water company must, in the nature of things, be to a certain extent a monopoly. You must get an act of parliament to establish a water

company, and parliament will not give an indefinite number of acts. Parliament has, under certain circumstances, consented to punish a defaulting company by giving an act to another company in the same place. But the result has not been encouraging where the experiment has been tried. It is not a case of free trade, for the field is not free, and cannot be free. I would merely refer you to the evidence in two places—the evidence in regard to Liverpool, and that in regard to Nottingham in the first and second Reports of the Health of Towns Commission,* to shew, that if water companies fall short of a full and cheap supply, you do not improve matters by introducing competition—you are in the hands of the Philistines either way—either by leaving the matter as a monopoly in the hands of one company, or by getting parliament to set up a limited number of competing companies. In the one case you have the evil of a scanty and dear supply; in the other case you are apt to have a scanty supply still, and while it is not enough for the community, it is also not remunerative to the company.

I say, then, in regard to water, that I think the community would do well to become its own provider, except in very peculiar circumstances. It is one of those cases in which, as in the Post Office and other public departments, the service is best done by being under the management of one authority; and in this case that one authority should be that of the representa-

* Second Report, p. 52; First Report, p. 286. Vol. ii. p. 88, *et seq.*

tives of the community that is to be supplied—in other terms, the public that is interested, and no private company of any kind. I will endeavour to shew you in the next lecture how the impurity of water affects the health of the community, and affords a just reason for the interference of authority.

V.

IMPURE WATER

“SCANTY water” is a serious evil, as I shewed you in my last lecture ; one which leads, in most of our great cities, and especially among the working classes, to no small practical inconvenience. Its results are, however, complicated ; we find a scanty water-supply in connection with so many bad habits, both moral and physical, that we cannot be sure of any particular consequence in detail ; we must be content to infer, and we do infer with a probability almost amounting to certainty, the connection of scanty water and deficient personal and domestic cleanliness, with many kinds of disease. It is not, perhaps, very easy to shew forth in a lecture, by special instances, the proofs of scanty water being connected with disease as its cause ; and I did not attempt this in last lecture. But it will be very easy to shew that impure water—which is the subject of the present lecture, and very frequently associated with a deficiency in the water-supply—is a cause of disease. I do not say that impure water is more dangerous to the health of the community than scanty water ; but the forms of

disease that attend upon impure water are much more directly provable, more capable of being traced to their source, than those connected with mere deficiency in quantity. It is more directly dangerous, apparently, to drink unclean water, than to have clean water for drinking, but not enough of it for washing and purifying. This is the real state of the question. It is quite possible, indeed, that if we knew the whole consequences of a very scanty water-supply, if we could trace the evils therewith connected directly to their source, we should find that the consequences of a scarcity of water are always very serious, as regards the health of the community. We can form some idea from the descriptions of oriental travellers—we can gather, in some degree, from the images and allusions of the Bible—how much distress and suffering are apt to arise in connection with the want of free access to the living springs of water in the rainless deserts of the East; how, without water, all life languishes, how vegetation is dried up, and how the possession of a well of water becomes the very symbol of value in landed property, insomuch that we find, in the primitive ages, that the man who digs a well acquires thereby a permanent right to the water-supply, and to the pasture which it enables him to procure for his flocks and herds. It is difficult, indeed, for us to realize, in this country of ours, which literally overflows everywhere with running streams, the evils of scanty water in their most aggravated form; the intense appreciation of the value of this element in “a dry and thirsty land,

where no water is." But in regard to impure water, we know, unhappily, too much, even in this country. For we must confess to our shame, that in the midst of our abundance—perhaps even, in some cases, by reason of our abundance—we have been so little careful as to leave large populations in contact only with impure sources of supply ; so that they are constantly more or less exposed to those dangers which, as I shall presently shew you, spring on a large scale from contaminated and poisoned water.

Now, the impurities of water are not all equally dangerous. We have, in the first place, mineral impurities, which give hardness to water. No doubt there are certain dangers attending these ; they sometimes make water very unfit to drink ; but, on the whole, the evils are not so great or so palpable as to induce me to dwell at present on that part of the subject. Then we have organic impurities ; and these, again, may be divided into two kinds—the impurities derived from vegetable decomposition, and those derived from animal decomposition. As regards the impurities derived from vegetable decomposition, we are obliged to speak in the language of probability at present. I do not know that we have any detailed and clear proof as to the existence of any particular disease which can be traced to this source. But there is a very great probability, I think, that the diseases which are commonly called malarious, which are found to be, as physicians call it, *endemic*, and not *epidemic*, that is to say, tied to the soil, not travelling at large through

the air, such diseases of locality, or endemic diseases, are probably connected with poisons generated on the surface of the earth, and diffused through water as well as air ; the specific cause of the disease being derived, we know not how, from the vegetable kingdom. I think there is something like evidence of this in the case of ague, and, perhaps, of some remittent fevers ; perhaps, too, in the case of the well-known yellow fever of the West Indies, and of some other forms of disease. I state this, you understand, as a speculation merely, not as a proved fact ; and I do not mean to dwell upon it. These impurities with which we are chiefly concerned at present—both because they come more across our operations in this country, and because they cause a much larger amount of preventible disease in our large communities than those derived from the vegetable kingdom—are the impurities connected with animal decomposition, and particularly those arising from the waste matter or excretions of the human body, when these are either deliberately cast out into the water sources, or are accidentally brought in contact with them in some way or other.

Now here—to repeat an argument which I formerly used in the case of air—it is not necessary that I should prove that water so contaminated always leads to disease. That is not the way that nature teaches us. Providence has connected these impurities with certain kinds of disease, but not in such a way that, with an organic impurity in drinking water, you must necessarily have the disease. The particular impurity which

causes disease is, as it were, accidental and rare ; but still, without a certain habitual impurity of the water, you could not have the special and accidental impurity which produces disease, and without the special impurity you could not have the disease. Disease, therefore, has the same relation to impure water that it has to impure air. We have seen that the air containing a bad smell is not necessarily destructive to health ; but it may, under certain circumstances, become destructive to health—there is a chance of its becoming destructive to health. It may be in one in a hundred, or in one in a thousand, or it may be not more than in one in a million cases, but there is a chance, whenever air is habitually impure, of its containing the particular poisonous element required to produce epidemic or other disease ; and when it does contain this particular poisonous element, impure air becomes, as I have shewn you, very destructive ; and you never can know, except by keeping out the impurity, when and how it may come to contain this specific cause of disease and death. So with regard to water. You may adduce to me hundreds of cases where persons have drunk water more or less impure, containing more or less organic matter—containing even animal matter, and where no bad consequences have followed ; and you may perhaps argue from that fact that animal impurities are not really injurious to life. But the argument is illogical ; because we are not supposing that all animal impurities are poisonous, but only that animal impurities become the vehicle of poisons, developed in certain circumstances

which we may freely admit we do not fully understand. We know something about the circumstances in which some of these poisons occur, but there is a good deal more of which we know very little indeed. The practical lesson for us, however, is that the poisons of disease are of immense power ; that they act in very small quantities, and reproduce themselves with very great rapidity ; and that when thus developed they naturally escape into the water or air, as the case may be, and by contaminating them, lead to the destruction of those exposed to their influence.

Now it is this danger, after all, that constitutes the most urgent case for the interference of the sanitary reformer. There might be something to answer, on principles of political economy or of free trade, to the charge of neglect on the part of the community, when we are speaking only of a certain amount or degree of water-supply ; you might say that it is a matter of private or individual concern to procure water with a certain degree of abundance, and that it may be safely left to individual enterprise to a certain extent ; but every argument of that kind must be overruled when you come to speak of impurity in the water. You have then to deal with the fact that impure water, like impure air—water rendered impure by the refuse matter coming from the individual—becomes a source of danger not only to him who uses it and who renders it impure in using it, but indirectly to other persons, his neighbours, and to the community at large. And therefore it is that we are led irresistibly to the conclusion

that the community, as a measure of self-protection, must often interfere to secure an ample and a pure water-supply to every individual member.

Now observe further, that in all communities, whether large or small, it is exactly the sources of supply that are easiest of access that are most liable to become dangerously impure ; the most dangerous impurities being, as I have said, precisely those that come from the human body itself, and the danger being generally increased very much in proportion to the increase of the population, and to the nearness of the water supply to the centre of population. Observe, therefore, that whenever a community is imperfectly supplied with pure water taken from a distance, it is driven to exhaust to the utmost the supplies in its neighbourhood ; and if the community is large and the sources of supply unfavourably placed, they almost necessarily become impure. The danger is greater or less according as the sources are carefully selected—according as they are far from drains—far from cess-pools—or very deep in the soil, instead of on the surface. According as the local sources of supply fulfil these conditions, the danger is greater or less of taking water near the habitations of the population ; but the danger always exists, and the very great probability is, that if you do not provide an abundant and pure supply, people will provide badly for themselves, and will simply go to the nearest and the easiest sources for water at all drinkable, using, in many cases, a very impure water which is easily got in preference to a more pure water which is more

difficult of access. I have this very morning received a letter which clearly illustrates this point. It is true that I cannot connect any particular disease with the use of impure water in this instance, and after all, the impurities may not be of a very dangerous kind, for it is the case of a small village with a supply at some distance ; but the case is nevertheless one of grievous hardship, at least, and illustrates strongly the necessity of systematic and authoritative interference in all our communities, large and small, at least to the extent of procuring a fair supply of pure water for the daily wants of the people. I shall adduce the facts without giving any names, or any indications of the place of which I speak ; because my object is not to cause annoyance, or to raise an agitation at the expense of individuals, but simply to shew you how much practical injustice and possible mischief may be done without any evil intention, or rather in spite of the best intentions on all sides, in consequence of the want of a proper authority, and the great difficulty of conciliating the interests of the different parties concerned. This letter tells me of a village containing two hundred inhabitants, in which (writes my friend) “we are so badly supplied with water that the greater number of inhabitants have to carry it a distance (going and returning) of 800 yards ; and the water, when carried, is often not drinkable. I have known as much as a shilling paid upon occasion even for a glass of water ; and I have calculated that my own servants, during the fourteen years of my residence here, have carried as many as 60,000

gallons of water, and have walked nearly the diameter of the globe in their journeys to and fro in quest of water for household purposes! Now, that you may understand our true position, I must inform you that Lord —— has given us access to a spring of very good water about a mile and a half away. It would cost about £250 to bring the water from this spring; and the proprietor of the village is willing to bring it in for us, provided a permanent access could be secured to the spring; but he does not feel justified in doing so at present, because Lord —— is debarred by the entail of his property from making a grant of the water for any longer period than his own life, and reserves the power of resuming the use of it at any time, if required by his property."

Here, then, is a village supplied with water at present by manual labour, and supplied from a rather impure source at the distance of about a quarter of a mile, the nearest accessible source of really pure water being at about six times that distance; the inhabitants are too poor and have too little influence to do anything in the matter for themselves, and they are practically debarred from using the better water because it does not consist with the interests of the two parties who could alone give it, to arrange the matter between them. I do not say that either of these two parties is morally or legally in the wrong, I only say that this is a great misfortune; and that possibly, with the help of a little more public spirit, and a little more intelligence on the part of the community, a little organization, in short, and perhaps

a very slight stretch of authority to overcome difficulties connected with the entail, the difficulty might be got over. I do not venture to blame any one, or even to say that there is any one in particular to blame, but I do venture to say that this community has a right to be, somehow or other, supplied with pure water, seeing that it is to be had ; and further, I think that there ought to be some responsible person to look to this matter, and to bring about, by arbitration or by law, the solution of these difficulties. A great community like Edinburgh or Glasgow, can look after itself ; it applies for an Act of Parliament, and acquires a right to such water-supply as it requires. But a small community is at the mercy of individuals, of proprietors, and of deeds of entail ; to whatever extent it has rights in law, they are practically in abeyance because there is no one in a position to enforce them. Nor can much be done in the way of private arrangement ; for it frequently happens that delicate questions of a personal kind arise in the attempt to do what is right and necessary for the community—and too often, as in the present instance, there is no one so neutrally placed as to be in a position to conduct the necessary negotiations. The gentleman who writes me this letter, for instance, is a person of great influence in the place ; but he is naturally enough, owing to peculiarities in his position, desirous to avoid being led into negotiations which might result in disagreeable feelings or even collisions with influential friends, whom he greatly esteems. We require an official interpreter in these

cases between the wants of the community and the minds of those who have the power of supplying those wants ; and in the case of a want so urgent as this we might even require the assistance of authority, to overcome unreasonable objections and remove legal difficulties.

But leaving this episode, let us return to the general question. I said that the contamination of water by the refuse of common sewers and house drains—in short by the refuse of the human body—is, as we have come to know of late years, a frequent and serious practical evil of city life. It is an evil indeed that exists more or less in all our great communities, where special care is not taken to prevent it. Nay, it is an evil which probably exists more or less in all our small communities too, under the same circumstances. In Scotland we are less exposed to it than in England ; for the varying levels and the rapid subsidence of the land from the mountains to the sea-shore throughout our country, are circumstances exceedingly favourable to the removal of all organic impurities ; they are rapidly washed away by the waters of heaven into the sea and into the rivers. In Edinburgh we are, or ought to be, particularly preserved from impure water by the favourable position in which the place was originally built—built upon hills. But although we are naturally preserved from danger to a certain extent in Scotland, and particularly so in Edinburgh, yet we are not wholly preserved. There are many places in Scotland where the evils of an impure water-supply exist in a

very aggravated form; and of some of these I will give you instances presently, although England will furnish them in much larger numbers.

Now let me mention, in general terms, the circumstances under which water becomes so impure as to become a source of disease; and then I will give you some particular illustrations. Water becomes dangerously impure, chiefly under these conditions—*first*, when some localities in a town or of a village are at low levels as compared with others, and are so situated as to receive the drainage of these other localities. In the *second* place, when the drainage is radically defective, the drains and common sewers being so constructed as to leak into the sub-soil, or to become choked, and to overflow from time to time. In the *third* place, when the drainage, though well constructed, takes place into a river or stream, and the water supply comes from the same river or stream, and within the poisonous influence of the sewage. *Lastly*, when there is no system of drainage at all, properly speaking, but a system of cess-pools; when impurities are allowed to accumulate superficially in the soil, and the soakage from the cess-pools diffuses itself widely through the subsoil, so as to contaminate the wells from which the water supply is derived. This last evil is perhaps the most serious of all; but all these forms of evil are serious and dangerous, and I shall give you ample proof, before the end of this lecture, that every one of them may become, in certain circumstances, a source of disease.

Now let me, before I begin the proof of this in general, hold up to you the illustration of a single place which gives a very aggravated example of some of these evils. The place that I mean is the town of Bedford, which is unfavourably distinguished in the last report of the Medical Officer of the Privy Council (for 1860), as having been the seat of a severe epidemic, or perhaps rather endemic, typhoid fever, during the autumn of 1859. Observe, however, that Bedford had not only been the seat of fever in that one autumn, but on so many other occasions, that Mr. Simon says in his report (founding on a special investigation made under his instructions), that "it was the autumnal habit of the town to have fever." Now, this particular fever which was present in Bedford, is one which in other places has often been traced, apparently, to sewer-gases or to foul air from cess-pools. In Bedford it could not be traced to either cause. It did not correspond with the ramifications of the sewers, and it was shewn to the satisfaction of the inspector that the cess-pools, though numerous, did not give off foul air into the houses. By scrutinising these two facts together, the conclusion was arrived at, that it was not the air that was chiefly at fault, in the case of the Bedford fever. The suspicion then fell upon the water-supply; and accordingly, on procuring specimens of the water within the infected areas, submitting them to chemical analysis, the suspicion was strengthened by the fact that all the specimens judged by their chemical qualities, were derived from sources "largely contaminated with decaying animal matter."

and repute." It now turned out, that, five years before, this special circumstance of the impurity of the water of Bedford had been reported to the Board of Health, when it was under the Presidency of Sir Benjamin Hall. "In the valley of the River Ouse" (so runs the report) "there is a considerable deposit of porous alluvium between the limestone and the surface of the ground; this alluvium contains water, called land-springs, but really only soakage-water, held up by the obstructions placed across the river. A great number of the water-wells only go down into the soakage; and more than 3000 cess-pools are said to go into the same. *The water both in cess-pools and in wells is said to rise and fall with the river, on the gravel substrata in the lower part of the town.*"

It was probably true, then, according to these observations, that Bedford had for years been drinking its own impurity, derived from the soakage of its cess-pools into the porous subsoil, and the diffusion of this matter by means of the overflow of the river water. Mr. Simon, however, was not yet satisfied. He determined to work out this great lesson to the bottom, and at the instance of the Privy Council, an engineer of great special experience in matters of this kind was sent down to inquire into the facts. I think

it worth while to tell you all the details of these proceedings, because the case is an excellent example of the working of the system in England, about which we had some discussion at last lecture but one. I told you that the Privy Council takes no powers upon itself further than to inquire into an alleged evil, and to inform the local authority of the results of the inquiry—not commanding the authorities, but simply telling them what they ought to do. The Privy Council, however, in some cases, avail themselves of circumstances like those I have mentioned, to give great lessons on public health, not only to the particular communities involved, but to the public at large. Let us avail ourselves of this lesson in the case of Bedford, and see how the case was fully worked out. Mr. Austin was sent down to Bedford, and we find him reporting at length the result of his investigations. I give you one or two paragraphs of his report, reading you chiefly the account of the evil, not the details of the new drainage recommended, as that is altogether a matter of local interest :—

“The drainage of Bedford is most defective. The principal outfall for discharge of the sewage into the river is above the town, and in summer-time this outfall is said to be most offensive. There are two main sewers of three feet diameter. The other sewers are described as chiefly built with bricks, laid flat in the lower part, and without any mortar. In some cases, the sewers are at such little depth, that cellars of

houses are accustomed to receive the foul liquid which filters through these defective constructions.

“There are very few water-closets in the town, but they are on the increase. Cess-pools are almost universal ; there are said to be upwards of 3000 of them. The usual course is to construct these cess-pools so that the liquid should soak away from them as rapidly as possible into the surrounding soil. In fact the builders have no alternative, for the Local Act of Bedford forbids the drainage of any cess-pool matter into the sewers.

“The wells from which the inhabitants derive their supply of water, for drinking and other purposes, are frequently in close proximity with those cess-pools.

“Almost the entire system of sewers, drains, and cess-pools in this town is one of percolation and saturation of the subsoil, and it is almost impossible, with the liquid refuse of 13,000 people constantly passing into such a limited body of water as would be upheld in these few feet depth of gravel, that any portion of the supply could escape more or less pollution. Well aerated, cool, and sparkling as the water from the gravel usually is, that pollution may frequently escape detection, but it can scarcely fail to exist throughout the whole of the more thickly populated part of the town.

“A striking example of the distance to which foul matter will travel through this porous subsoil came under my notice. The water from some wells, situated at a distance of 500 feet from the gas-works, was so impregnated with soakage from the gas-tar refuse on

these premises as to be most offensive, and quite unusable for any purpose. The flavour and smell of gas-tar are not readily got rid of, and are easily recognized. It is frequently otherwise with the more dangerous pollution from cess-pools, and chemists agree that injurious matters in solution in the liquid of cess-pools are not removed by filtration through gravel, however bright and free from offence to the senses the water may become.”—*Third Report of the Medical Officer of the Privy Council*, pp. 41-2.

The whole of this inquiry forms a great practical lesson in sanitary reform—a lesson which we shall hope has not been lost upon the authorities of Bedford, to whom it was communicated, with the expression of their Lordships’ desire to see “prompt and decisive measures” adopted, to make up for past delay and inaction. I don’t hesitate to confess that I wish we could now and then, in Scotland, have the benefit of a stimulus of this kind when we fail in our duty. Let me read you a letter which proves how much we require it. I am not sure, indeed, that the case is a parallel one to that of Bedford. But it is the case of a place in which fever is quite an established guest, and where there is evidently much room for reform. I received this letter only a few weeks ago; and, as in the former one read to you, I keep back all names and local allusions :—

“I have the misfortune to live in a small village

which is not properly drained. The consequence is, that during the seventeen years I have known it, it has hardly ever, summer or winter, been free from fever. Out of a population numbering 225, and consisting exclusively of farm labourers, or persons engaged in similar healthful employments, with every advantage arising from situation, we have almost always fever, and every year, I should think without exception, cases of bad typhus, most of which prove fatal—a circumstance which, I should be disposed to say, ought hardly to characterize an agricultural village of 25 or 30 houses, and 225 inhabitants.

“Well, it is about fifteen or sixteen years ago that I first called the attention of the parish authorities to the large average of cases of fever, and pointed out that for the largeness of this average there appeared to be a sufficient explanation in the imperfect drainage of the village. A friend of mine who was then the leading medical practitioner in the nearest market-town, at my request examined the locality, and, with a perfect knowledge of the prevalence of zymotic diseases in the place, gave a strong certificate to the effect of my own representations. Nothing was done at that time; and although, a few years afterwards, some slight changes were made in the sewers on the occasion of a repetition of these representations, and in consequence of the extent to which we suffered from cholera, nothing effectual has been done to this day. Within the last month or two, on the occurrence of one more death from typhus at a cottage situated close to an offensive

pool which I had frequently complained of, I renewed my attempts to obtain attention to the subject, backed by a report from the parochial medical officer, and have been promised active measures, with what result remains to be seen. But what I wish particularly to mention to you is the difficulty of moving in such a case. On this last occasion I applied in the first instance to the surveyor of the Statute Labour Roads, who informed me that he had nothing to do with the sewers in the village, though the statute labour road passes through it; and I was recommended by him to make application to the proprietor of the land on which the village is built. Receiving no satisfactory reply from this second quarter, I then forwarded a petition to the Sheriff, which petition was returned to me as informal; and I was at the same time advised by the Sheriff to apply rather to the chairman of the Parochial Board. I took this course, and was by my friend the chairman of the Parochial Board, in reply to my letter, told that the person to apply to was the surveyor of parish roads—the very official to whom I had first of all complained to no purpose. In the meantime other persons were dying.

“15th May 1861.

“W. T. Gairdner, Esq., M.D.”

It is the old story, “What is everybody’s business is nobody’s business;” and the moral I draw from that is, that we ought to have, not in our large towns alone, but in every village and parish through the length and

breadth of Scotland—we ought to have some person, or committee of persons, to whom such complaints should be made, and whose recognized business it would be to see them carried to a proper result. It is plain that the evils in this case are mainly those connected with want of organization ; they depend on the want of knowledge how to set about a reform. It is not to be supposed for a moment that any of the individuals or public bodies alluded to in the letter would be guilty of so gross a neglect of duty as is here displayed, had they had it clearly placed before them by a public authority that they were fairly responsible for great suffering, and suffering that could be averted ; nay, that from time to time—from year to year—the people of this small village were dying at an inordinate rate through sheer neglect ; this neglect being brought home to the right quarter by the intelligent action of public opinion. The evil is, that while the facts are admitted, nobody feels responsible for them. It is nobody's business, as I have said, to purify this village ; and even although the evil may be plain enough, and the remedy equally plain, we find that in fact nothing is done ; indeed, that nothing can be done with the slightest prospect of success.

To return, however, to the subject of impure water as a cause of disease, we have had, on this subject, a much greater lesson than that of the fever in Bedford—a lesson on a much larger scale, and more crowded with details—a lesson where the details bear much more directly to one result. That lesson is the terrible and

disastrous history of three great epidemics of cholera with which this country—in common with a large part of the habitable globe—has been visited during the last thirty years ; the first being in 1832, the second in 1848-9, and the last in 1854. I told you in my introductory lecture that cholera had been one of the puzzles of the sanitary reformer for a long time. It was, in fact, one of those diseases which had been discussed in blue books and government inquiries all the world over, with little or no tangible result. The discussion, in fact, seemed to produce nothing but an apparently endless amount of irritation and vexation, because different parties, taking different views, and unable to bring them to the proof, became, as usual, so bigotted to their own opinions, that they would not, or could not, look at the other side of the question. “Is the cholera contagious, or not contagious?” We had the whole world divided upon this subject at one time. Most of the continental authorities maintained that it was not contagious ; and many English authorities also maintained the same opinion. At the time of the first epidemic, contagion was in the ascendant ; but at the time when I began to study the subject in anticipation of the epidemic of 1848, the tide had turned, and most of the people in authority, and those who supposed that they were in advance of the age, spoke as if the idea of contagion in cholera was a piece of pure bigotry, an antiquated superstition worthy of the middle ages. The Metropolitan Sanitary Commission had just laid down the law upon the subject :

Mr. Chadwick and Lord Robert Grosvenor had it all their own way there. The Board of Health was ruled by the same idea ; naturally enough, for there was Mr. Chadwick again, with Lord Shaftesbury (then Lord Ashley), and Dr. Southwood Smith. In short, the non-contagionists had possession of the law and of the public ear ; and so very potent, so exceedingly orthodox, so perfectly assured were they of their own infallibility, that the belief in contagion went quite out of fashion, except, indeed, in the medical profession. I remember to have read at this time certain leading articles in several of the London papers—in the *Times* and *Spectator* for instance—wonderfully clever and smart leading articles, shewing, as beyond all doubt, that there was not, and never had been, any such thing as contagion at all ; that it was all a fiction of the medical mind, devised long ago to frighten the people, and embarrass commerce ; in short, that the belief in contagion was passing away like the belief in astrology and witchcraft (these, if I recollect right, were the very illustrations used), an utterly exploded idea, quite unworthy of the advanced intelligence of the age. We heard little or nothing, then, about small-pox ; for the communication of small-pox was an instance rather difficult to dispose of on this theory ; but most royal battles of words were fought over cholera and yellow fever, and the orthodox party would have it that neither of these diseases is in the slightest degree contagious. The truth is, that the quarantine laws had long been very obnoxious, and in many respects unnecessarily obnoxious, to the mercan-

tile interest, and accordingly, the whole literary and political world was easily persuaded by a few crotchety men that the fact by which quarantine was mainly justified was not a fact at all. But, gentlemen, it is not easy to write down the truth. Dr. M'William has convinced most of us, in spite of every kind of misrepresentation, that yellow fever is at least sometimes contagious ; and now-a-days (I believe I am correct in saying), almost everybody who knows anything about the matter believes that in certain circumstances cholera is contagious also. So fashions and opinions change ; the exploded idea, which was fast dying out altogether in 1848, is stronger than ever, and based on a vastly extended range of facts and observations, in 1861. By *contagion* of course you will understand me to mean that attribute of a disease, by which it is communicated from the sick to the healthy ; it may be by direct contact, or it may be through the air, or the water, or some other channel. There is a poison, or other morbid influence, formed in connection with the bodies of the sick, and transferred through their excretions or exhalations to the bodies of the healthy, so as to generate the disease. That is nearly all, I think, that can be usefully included within the meaning of the word contagion ; to restrict or define it further only leads to confusion of ideas. The fact of communication from the sick to the healthy is the great fact that we have to attend to in a practical point of view ; and it was exactly this great fact that the opponents of quarantine, and the leaders of public opinion whom I have alluded

to, wished to explain away. Now the course of inquiry has tended to shew very clearly, that while the fact of contagion remains unquestionable as regards many epidemic diseases in which it has been denied, the channel of the contagion varies, and has often been misunderstood ; and this is one of the reasons why so many doubts have been successfully raised about the fact itself. In the case of small-pox, the poison is communicated either by contact (strictly speaking), or through the air ; in the case of typhus fever, through the air chiefly or exclusively ; in the case of cholera, the channel of communication is, I believe, chiefly the water ; and of this I mean to give you some evidence in what remains of to-day's lecture.

In considering this subject, I shall assume, and would have you keep in view throughout, that what is proved to be true of cholera, may also turn out hereafter to be true of other diseases also ; for the relation of impure water-supply to epidemic disease is one of those points that has been strangely overlooked by authorities, and, except in a few instances, we have had almost no trustworthy data in regard to it. It is quite as likely as not that several of our common forms of disease (and especially those connected with the intestinal discharges—diarrhœal diseases, as they are called) are more or less like epidemic cholera in their mode of communication. But for the sake of comparative exactness, and to read you the lesson of cholera and impure water in its most distinct and decided form, I shall not do more than allude to those less developed

speculations with respect to other forms of disease. If I shall succeed in bringing clearly before you the case of cholera, you will not, I hope, fail to accept it as a lesson and a warning with respect to water-supply in general, and to inquire, when occasion offers, how far there is ground for the suspicion of mischief in other instances.

Now, of cholera, we know, in the first place, this fact, that it is in a very peculiar sense apt to settle down upon the low-lying places of the towns which it affects, and that it is also especially apt to affect towns which lie low upon the banks of rivers, or at the sea-level. The Registrar-General of England has proved beyond dispute, by observations upon the vast field of London, that the great epidemic of 1849 was to a very great extent determined in its operation by differences in level; that it was, broadly speaking, *a disease of low levels*; and of these, you would say at first sight of the evidence, almost exclusively. I shew you here a diagram which the registrar has put into his very admirable report on cholera in 1849 (the most complete and detailed survey that ever has been made, probably, of any epidemic of disease), which represents to the eye in a very clear way the gradual *decrease* of cholera in proportion to the *increase* of elevation above the level of the Thames.

You could not possibly have a more clear display of the fact that cholera is a disease of low levels, than you have in this diagram. You would say that you have here a law of the most general and unquestionable

The figures in the centre express the number of deaths from cholera to 10,000 inhabitants living, at the elevations expressed in feet on the sides of the diagram.

The length of the *black horizontal lines* shews the *calculated* relative fatality of cholera in districts at relative elevations indicated by the height from the base of the diagram. The *dotted lines* indicate the mean mortality *observed* in the elevations given. Thus:—in districts at 90 feet above the Thames, the average mortality from cholera was 22 in 10,000 inhabitants.

; a law based upon thousands of instances, ly noted, and accurately converted into averages. observe, now, that this fact is only true on a very scale ; it is only true when you take a very large surface—when you take the immense field of London, for instance—to operate upon, and thus throw all the minor irregularities out of account. When you come to break down these large figures, these immense averages deduced from the field of London, you find that your law disappears altogether, or becomes subject to so many exceptions, that you are obliged to admit it only with very great qualifications. It is a law, then, that cholera is a disease of low levels, but not of all low places and low levels, even within the geographical limits invaded epidemically by the disease. Even within what may be called the ascertained epidemic field of cholera, the exceptions to this general fact of its relation to low levels are so vast as to shew us that this fact alone does not determine cholera. For example, there were not a few places in London during the epidemic of 1849 (and the same is true of other epidemics), situated as low as possible, quite on the level of the Thames, even below high water mark, which were, nevertheless, nearly exempt from cholera ; and what makes these exceptions the more striking, is, that some of the places I refer to were quite surrounded by the disease during its epidemic prevalence. There was no cholera in Bethlehem Hospital, for instance, nor in the Queen's Prison, nor in Horsemonger Lane Jail, although it was epidemic to a great degree imme-

diately around those localities on every side. And, to take some further examples from the country at large, it is curious to find that some of the very lowest levels escaped almost entirely. In Lincolnshire, for instance, there was hardly any cholera in 1849, except in the neighbourhood of Gainsborough ; there was next to none in the fens of Cambridgeshire, and very little in any part of Norfolk with the exception of Yarmouth, which, as a seaport, was exposed in a peculiar manner to the causes of the disease. I need hardly tell you that Lincoln, Cambridge, and Norfolk, are emphatically counties of low levels. Then we have another and an opposite class of exceptions, for not only were low levels sometimes unaffected, but high levels did not always secure even comparative immunity. There were, in the various epidemics of cholera, many places of considerable elevation in London and elsewhere, which suffered greatly from the disease. There was Brixton, for example, a suburb of London, not much less than 60 feet above high-water mark—in Brixton there were many more cases of cholera than in some of the lowest parts of London. Again, in Albion Terrace, Wandsworth, there was a local epidemic of peculiar severity in 1849, which could not in any degree be due to low levels, Albion Terrace being quite the opposite of a low situation. There were, however, many other cases, both in London and out of it, of this kind. In the Welsh town of Merthyr-Tydfil, a great seat of the iron manufacture, in Glamorganshire, there was presented in 1849 a particularly curious illustration of this

subject. Merthyr-Tydfil, which was severely affected with cholera, and was, in fact, a great focus of epidemic disease of all kinds, is a place both of high and low levels ; it is divided into an upper and a lower portion, and the upper portion of the town is fully 300 feet above the lower portion. Yet, in Merthyr-Tydfil, it is a clearly ascertained fact, that there were, considered in relation to the number of the population, twice as many deaths from cholera in the upper as in the lower portion of the town. Again, there were Salisbury, Durham, Wolverhampton, Dudley, Stourbridge, Newcastle-under-Lyne, Wigan, Leeds—all of them places of a certain degree of elevation, most of them situated high up on the course of important rivers ; some of them, in fact, near the sources of some of the greatest rivers in England ; but all these places were more or less infested with cholera in one or other of the epidemics. Low levels, then, are not essential to cholera, and low levels do not always determine cholera—nay, the lowest levels do not always determine an excess of the disease even when they occur in the midst of an epidemic cholera-field. We must in some way or other reconcile these apparently conflicting ideas before we can be said to have a trustworthy theory of the diffusion of this terrible and devastating disease.

Now, observe another fact or law, resting, like the former, upon a large number of careful observations—the strange preference that cholera has displayed in all countries for the banks of rivers—a fact noticed ever since its alleged first occurrence in India in 1817.

Observe in the progress of cholera, how constantly it is communicated from town to town along the course of navigable rivers, beginning often in the sea-ports, and spreading inwards through the riverports in communication with the place originally affected. This fact has often been appealed to in proof of contagion—in proof of the communication of cholera from man to man—from the sick to the healthy. It is a disease (argue the contagionists) which almost always follows, in its epidemic diffusion the great lines of human intercourse ; it goes with the crowd, and along the beaten tracks ; it is never carried across the desert, nor over the sea, except in the direct line of caravans or ships. There is much in this argument, though I do not say that, standing alone, it would be conclusive. It is at least well ascertained, that when cholera attacks a new country surrounded by the sea, it always seizes first upon the seaport towns, and in the greater number of cases, only after one or more vessels have come into these seaports from the districts affected. There is something very like contagious communication in this ; and we have further reason to suppose, from the facts I have mentioned, that the infectious miasma, whatever it is, has some mysterious attraction from the river-side, and produces there its most virulent effects. Amid these facts, too, pointing vaguely in the direction of poisoned water as a cause of cholera, we meet with the startling idea—a prejudice or superstition you might almost call it—by which the natives of India are often found to be possessed during an

epidemic, that the cause of the disease is to be found in a poisoning of the wells. The ignorant Hindoo almost instinctively looks to a poisoned tank or well as the cause of his cholera ; and it is often difficult to drive this impression from his mind. He either accuses his neighbours of poisoning the water, or he supposes that the well has been rendered unclean by some ceremonial impurity ; in any case, it is the water that he instinctively turns to as containing in it the cause of the disease.* This is a very vague and unsatisfactory evidence, perhaps, but it is at least a striking phase of opinion ; and I think that you will presently see reason to believe that there is a good deal more than mere superstition in that widely extended belief of the Hindoo.

Without going more into these very general arguments, I would have you remark that there is one theory, and one only, which accords well with all the facts alluded to. We want a cause of cholera which acts so as to display a distinct tendency to gravitate downwards to the lowest levels ; yet not invariably, but with so many special exceptions as to shew that other, and opposite, tendencies are sometimes at work in particular localities. We want a cause of disease which is consistent with its communication from man to man, and along the great lines of human intercourse, yet which does not imply a large amount of contagious

* See some facts relating to the supposed origin in a like manner of the first cases observed in the Crimea in 1854.—*Med. Times and Gazette*, Sep. 30, 1854. Snow, p. 36.

or infectious power in the ordinary sense of a disease which is "catching" through the breath or exhalations of the skin; a contagion, in short, which allows of your approaching the sick, or remaining in the same room with them, with little danger as compared with the case of fever or of small-pox. All these conditions are met by the theory of a poison communicated from the sick to the healthy, but communicated chiefly through water, and only to a comparatively slight extent through the air. This, accordingly, is the modern theory of the diffusion of cholera. We have come to believe that it is, indeed, as the Hindoo supposes, a disease dependent upon poisoned water; only the poison is not an extraneous one, but is generated and reproduced in and by the bodies of the sick.

Now, we do not depend for the proof of this theory entirely upon such general facts as I have hitherto cited to you. We have had numerous and careful investigations into the details of particular facts; and by these the theory has received large accessions of trustworthy evidence. For the theory in its present shape, and for much of the detailed evidence on which it rests, I must give the credit mainly to one man—to a man who unhappily has not lived to reap the reward of his labours on behalf of mankind, but who, in the course of the epidemic of 1853-4, undertook very great and laborious duties—unremunerated duties too—in defence of this theory of the mode of communication of cholera. We owe our present knowledge of this obscure subject mainly to the late Dr. Snow, who must

be placed, as regards cholera, in a very high rank among the pioneers of science ; and who prosecuted the whole inquiry in an enlarged and truly scientific spirit, which I think has hardly had the proper meed of justice done to it. You will find the most mature expression of the views of Dr. Snow in a little book on the mode of communication in cholera, published in 1855 ; but this book is a second edition or reprint, with very large additions, of a pamphlet, published in the course of August 1849, during the second great epidemic of cholera, which began in this country in October or November 1848. The origin, therefore, of our more correct and definite information upon the subject of the diffusion of cholera, should date from this very suggestive pamphlet of Dr. Snow ; and as I must necessarily make my remarks very brief, giving you only a glimpse of the evidence, rather than the evidence itself, I will beg of you to make a general reference for further details to the second edition of Dr. Snow's book, and to the reports of the Registrar-General on the epidemics of cholera in 1849 and 1854. Both of these reports, as well as most of what has since been written on the subject, you will find to be largely influenced by the suggestions put forth in Dr. Snow's inquiry, and worked out in the first instance by his personal labour, with the valuable assistance of the Registrar-General and his staff.

Let me endeavour to state shortly the substance of the researches to which I allude. It is stated as the result of careful and detailed observation, that epidemic

cholera occurs chiefly—Dr. Snow says exclusively, but I am willing to suppose that he may have stretched the argument a little too far—let us say that it occurs in the great majority of cases, where the water-supply is from impure sources, and where it may be proved to be either actually tainted, or at all events liable to be tainted by the discharges of the human body, and especially of the intestinal canal. Dr. Snow maintains that the specific virus of cholera resides in these discharges, and is thrown out with the sewage, or the contents of the cesspool, into the sources of the water-supply ; and he argues that the contagious property of cholera is developed then and then only (or let us again say chiefly), when the healthy use as drink the water which is infected with the discharges of the sick, either through the sewage, or in some other, possibly even more direct manner.

It is a shocking, a truly disgusting idea this, of large populations which are in the habit of drinking their own impurities ; and it is rather strange that we should have required so terrible a lesson as cholera to teach us the fact. But a fact it is, nevertheless ; and, if Dr. Snow be right, a fact of the most dreadful significance. We are referred to such cases on a large scale as the towns of Hull, Newcastle, Tynemouth, and Dumfries, all of them places which were severely affected with cholera, and all of them places which had demonstrably a very impure water-supply, into which the sewage entered as a distinct element of impurity. On the other hand, Dr. Snow enumerates several re-

markable instances of local immunity from cholera, such as Birmingham, Bath, Cheltenham, Leicester, etc., towns in which there had hardly been any cholera, and where the water-supply was good and abundant. Then, pursuing the argument further, he finds places affected seriously with cholera during one or two of the epidemics, and yet nearly or altogether exempt in other epidemics; and in these cases he shews in detail, that both the greater and the less prevalence of the disease in these places was apparently directly connected with the water-supply. For instance, we have Exeter, of which a careful account has been given. In Exeter, in 1832, the water-supply was by water-carriers, in carts and pails, and it was taken from the river evidently within the reach of sewage-contamination. In 1832, accordingly, more than 1000 cases of cholera occurred in Exeter, and 347 deaths. Shortly afterwards, I think in 1834, an improved water-supply was got from the river, two miles above the town, and therefore out of the reach of the sewage. And accordingly, in 1849, when the epidemic of cholera throughout the country at large, was quite as severe as in 1832, there were only forty-four cases of cholera in Exeter, and most of these were cases of strangers; and further, in 1854, there were hardly any cases of cholera in Exeter at all. Nottingham is another instance. In 1832, the water-supply of Nottingham, was partly from good sources, and partly from bad, and there were 289 deaths from cholera that year. In 1849 there was an improved supply from the river Trent, a good way above the

town, and in that year there were only thirteen cases of cholera, and seven deaths. Dumfries is another case in point, though it was not fully worked out when Dr. Snow published his book. Dumfries was most severely affected with cholera both in 1832 and 1848; the former epidemic being notorious as by far the most desolating local visitation of cholera in a town of considerable size in Scotland. It was altogether more like one of the epidemics of the middle ages, than any fact of modern experience; and it excited, as you may readily believe, a wide-spread commotion, and much inquiry; but all the inquiries failed to shew the true secret of the disease. The epidemic of 1848 was less severe, but only less severe, than that of 1832;* and it seems therefore almost impossible to doubt that in Dumfries there was some very special localising cause of cholera over and above the country at large. Now in both the years 1832 and 1848, the water-supply of Dumfries was from the river Nith, close to, or within the town; it was, in fact, a supply through water-carriers and carts, very deficient in quantity and bad in quality; taken (as I told you in a former lecture is always the case in such circumstances) from the nearest sources accessible, and, in the case of Dumfries, certainly within the reach of the sewage. After the last of these two severe epidemics, Dumfries took the lesson to heart; a better water-supply was procured, perfectly free from taint or suspicion

* In 1832, the mortality from cholera was one in twenty-eight of the population; in 1848 it was one in thirty-two of the population.

of taint, and in 1854 accordingly, Dumfries was exceedingly lightly visited ; may be said, in fact, comparatively speaking, to have escaped cholera altogether. These are striking facts. Perhaps even these are not altogether conclusive ; but you have still more striking instances in the other direction, inverted instances, as it were. In Hull, for example, the water-supply in 1832 was scanty, but pure. It was thought desirable afterwards to get a more abundant supply, and in 1844 they brought in water from the river within the tidal flow, and therefore, in all probability, contaminated with the sewage. Now mark the history of cholera in Hull :—In 1832, when the supply of water was scanty, but pure so far as it went, the deaths from cholera were 300 in number only, and these almost exclusively among the poor. In 1849 the deaths from cholera were 1834, and it affected all classes. It was one of the most severely affected places in the United Kingdom. There are instances of a rather less definite character given by Dr. Snow, but I will not allude to them, as we have many other facts of a more convincing kind to consider.

Having, by a number of special instances, had the idea implanted in his mind of the dependence of cholera upon the water-supply, Dr. Snow applied himself to the investigation of the cholera as it occurred in London, and I will detain you for a moment or two on the results of the investigation, for London is in truth the stronghold of Dr. Snow's theory, the great magazine of practical information with regard to the connection of

cholera with the water-supply. I have told you, I think, already, that in London there were many very curious instances, both of places affected with an exceptional and strange severity, and of others which had an equally strange exemption in the midst of infected quarters of the town. Dr. Snow applied himself to the consideration of these exceptional instances, and in many cases found them to accord with his theory. Thus he found places situate in the very midst of cholera districts, and almost on the very level of the river, which escaped the disease altogether, owing (as he believed) to their having a special water-supply different from that of the general population ; but I cannot go into these in detail for want of time.

Again, when the local distribution of the supply of the different water companies was looked to, many most curious facts were brought to light bearing on this theory. It was found that in the northern and eastern districts of London, supplied by the East London Company with a tolerably pure water, cholera was less in amount than it was in London at large, with the exception of the districts very near the river, the inhabitants of which could get the river water with greater ease than any other ; where the presumption, therefore, is, that they used that disastrously easy supply in preference to that of the Water Company. It was also found that some of the worst districts in London, as regards their general physical and moral condition — such districts as Bethnel Green, and Spitalfields were comparatively free from cholera, while places not materially different

otherwise, but nearer the bed of the river, were over-run with it; the presumed cause of the comparative exemption in this case being the remoteness from bad sources of water-supply, and especially from the river, while a pretty good water was supplied by the company. In general terms, it was found that, on comparing the water consumed by different quarters of London, there was much reason to suppose that cholera followed the track of the water supplied from contaminated sources, while other districts were comparatively exempt.

But the great experiment was on the south side of the Thames, where the water supply is very complicated. Southwark, or the Borough as it is called, is partly supplied by the Southwark and Vauxhall Company, and partly by the Lambeth Company. Dr. Snow gives in his book a coloured map, illustrating the mode of the supply, which I shew you here. The map shews that one part of the district is supplied by the Southwark and Vauxhall Company exclusively, and another part by the Lambeth Company exclusively, while there is an intermediate part supplied by the two companies in such a way that if you go down any particular street, sometimes if you go even into a particular court, you will find one house supplied by the one company, and the next house by the other company. You will find that many of the most exactly similar houses—houses having all other conditions in common, inhabited by the same class of the community, and entirely alike in most of their sanitary aspects—are nevertheless supplied with water from different sources. It was in

all points what Bacon had called a crucial experiment—an “*instantia crucis*,” as respects the relation of the water-supply to cholera. Now, here are the facts of the case stated generally. The Lambeth Company furnished a much better water than the Southwark and Vauxhall Company, and the advantage of the Lambeth Company’s water was particularly this, that although both were taken from the Thames, the Lambeth Company’s water was taken from a point high up on the Thames, beyond the reach of ordinary sewage contamination, while the water supplied by the Southwark and Vauxhall Company was taken from a much lower point on the river, where it was within reach of contamination. By a most minute and laborious analysis of the facts, it was found by Dr. Snow not only that the district which received water from the Lambeth Company was more lightly visited with cholera than the district supplied by the Southwark and Vauxhall Company, but that in the district of a mingled supply, where the water given by the two companies was used indiscriminately (as it were), you could single out the very houses supplied by each company, and shew that the cholera had affected, not to say exclusively, but to a very great degree more severely and frequently, the houses supplied by the Southwark and Vauxhall Company.* This was assuredly a great though unintentional experiment upon

* During the first seven weeks of the epidemic, Dr. Snow found that in each 10,000 houses supplied by the Southwark and Vauxhall Company there had been 315 deaths, while in a like proportion of the houses supplied by the Lambeth Company there

the laws of cholera—an experiment irresistible in the force of its logic, and all the better and clearer in its result that it was unwittingly performed. To Dr. Snow and to the Registrar-General we owe the working out of the facts of that great experiment, which we may venture to hope will never be repeated, now that we have learned the lesson that it teaches.

But of all the facts bearing on the history of cholera in London, and on its communication by means of impure water, possibly the most remarkable and convincing were those relating to the epidemic in the neighbourhood of Golden Square, Soho, in the autumn of 1854, one of the most truly appalling local pestilences, if not, indeed, the very severest and most fatal, that has been known in this country since the time of the great plague. I will not enter in detail into the history of that dreadful calamity. Even at a period of great and national suffering, it occupied men's minds somewhat after the manner of a great and destructive railway accident, or a devastating fire, or any of the other tremendous crashes involving life, property, or reputation, which appear to baffle all human counsel, and paralyse all efforts at giving relief. The district affected by the extreme severity of this local epidemic was, indeed, extremely limited ; and it is this very limitation which makes the facts so striking and anomalous, until explained by the theory of Dr. Snow, carefully were only 37 deaths. The facts as regards the rest of the epidemic were not so striking, but tended altogether in the same direction.

applied in detail. It is by no means one of the worst, and certainly not one of the lowest, districts in London. It is, on the contrary, pretty high above the river, and in the immediate neighbourhood of the "west-end," immediately to the east of Regent Street, and actually within the district of St. James, Westminster, in which, with this exception, there was no great amount of cholera. The whole circumstances, therefore, point distinctly to some very circumscribed localizing cause of cholera in this district. It was at first thought, when cholera broke out here with so great severity, that it might be connected with some circumstances in the state of the soil—in particular, with the opening of the ground for the purpose of drainage, by the Commissioners of Sewers, which it was supposed might have given vent to noxious vapours long pent up within the soil. It was even supposed that there might have been some connection between this epidemic of cholera and the old story of the plague, inasmuch as this district was said to have been the seat of one of the burial pits during the great plague of 1665. That theory of the matter, however, was most completely overthrown by investigations that were set a-going afterwards. And here was what was proved in the end, after careful inquiries set on foot by the authorities, at the instance of Dr. Snow—that in the very midst of this district, there was a particular pump-well, which I shew you here upon this sketch; that this pump-well had long been a favourite on account of the supposed fine quality of the water.; and that the greater portion

of the water used by the inhabitants for drinking purposes was drawn from it ; that previous to the epidemic, this favourite and apparently fine drinking water had, in all probability, got tainted in some degree with the materials of sewage in a certain stage of decomposition ; that almost everybody round about who drank of this well (and they almost all drank of it more or less) was affected more or less either with cholera or diarrhoea ; that there was hardly a house where the water-supply was exclusively from this well, where cases of severe diarrhoea, or cases of cholera, did not occur. There were, nevertheless, special exemptions, and these exemptions, on being carefully examined into, turned out, in the great majority of cases, to be exactly what was to be expected from Dr. Snow's theory, viz.—persons, or groups of persons, who, for some reason or other, had not been in the habit of using the water of that particular pump, or who had, in fact, not partaken of it at that particular time. There were, on the other hand, several instances of persons outside the ordinary range of supply of this Broad Street pump, among whom cholera had nevertheless been particularly severe ; and upon special inquiry, it was found that these persons were so fond of this water, that they actually took the trouble of sending considerable distances out of their way to get it ; the result of which was, that they, like those who lived within the range of its ordinary supply, were severely, and in large proportion, affected with cholera. There was a very remarkable instance of a lady who had removed from this district

before the disease had begun to be epidemic, to Hampstead, a healthy suburban district, remarkably free from all epidemic disease, and very lightly visited by cholera. This lady having acquired a partiality for the water of the Broad Street pump, was in the habit of having it brought out to Hampstead, where both she and her niece drank of it during the Golden Square epidemic, and accordingly both had cholera, there being, however, one other person who drank of it in that house, a servant, who did not suffer from cholera, but had an attack of diarrhœa.

I have given you a very slight and hasty sketch of an argument of great practical importance, which you will find set forth at considerably greater length in Dr. Snow's book, already referred to, and in the report of a committee appointed by the vestry of St. James's parish, to inquire into the circumstances of this Golden Square epidemic. The details, which I have not been able to overtake, are almost all confirmatory of the general result, which is, that this terrible local calamity had no other cause than impure drinking water, drawn from that single source in Broad Street; and I think any one who follows the general course of the evidence, must agree with me in thinking that Dr. Snow has succeeded in establishing at least a large part of his case in a way which it is impossible to evade or refute.

Have we not reason, then, to look upon cholera in the light in which I formerly placed it, as a lesson of Divine Providence to us all, when we neglect or wilfully violate the conditions of a healthy life; a lesson which,

if we had learned it in time, would have saved the nation many thousands of lives that were needlessly sacrificed in three great epidemics? How far that lesson may be learned in the future, and what may be the consequence of learning it thoroughly, we know not yet; nay, we never can know, except by experience. But this we know, that pure water in every house, pure water at every man's hand as he walks the streets, pure water in such abundance and so accessible as to make the domestic use of impure water simply impossible in our great communities, these are the safeguards, the only safeguards we know, against the greatest and most terrible of modern pestilences. We know that the destroying angel of cholera strikes the houses that have a tainted water-supply, and passes unharmed over those into which no poison can enter through the cistern. The keeping out of this enemy, at least, is in all probability to be accomplished, if we take the means; and the means are, to secure to every member of the community the free use of the purest water that can be had, and at all events of water free from all such impurities as have been indicated in this lecture. If we know this fact, and yet despise or neglect it, are we not as directly responsible for the consequences as if the lesson had been read to us in so many words by its divine author? If we refuse to receive the lesson of *facts*, we may be very sure that words would equally go for nothing, even "though one rose from the dead" to speak them to us.

And let me again, in conclusion, remind you that it

is not cholera alone that we may reasonably dread, if we allow our great communities to drink impure water. Even now we see a great probability—almost amounting to certainty—that enteric fever, or what has been called typhoid fever, *i. e.*, fever with ulceration of the intestines, has often the same mode of origin and propagation as cholera. And it seems highly probable, that certain cases of dysentery, and even of ordinary diarrhœa, follow the same, or a closely similar, law of communication. It has been plausibly argued also—but I do not venture to say, at present, that it is more than a plausible supposition—that the dreadful yellow fever of the Gulf of Mexico is a disease of the same kind ; and that some varieties of remittent, and even of intermittent fever, are, like cholera, diseases having a distinct connection with impurities of the drinking water. If this be true, or even anything like the truth, you see what an immense vista of reform is opened up by the consideration of the *crucial instance* of cholera ; for then we have, not only one most formidable disease, but rather a whole tribe of diseases, of which it may probably be affirmed that they are contagious or communicable from man to man, and therefore diseases dependant upon the intercourse of man with man in communities ; but in which the channel of the communication is not the air, or at least not the air chiefly, but the water. They are the diseases of poisoned water, and the poison grows up among ourselves, and is propagated from one man to another, through the medium of a habitually impure water-supply.

NOTE TO LECTURES IV. AND V.

MODERN WATER-SUPPLY OF TOWNS.

THE object of the preceding Lectures having been rather to insist on the evils of a defective water-supply, than to give details of the efforts made in various places to remedy these evils, the illustrations have been of necessity drawn in part from Parliamentary reports published some years ago, and it may appear that there is a certain measure of injustice in referring to these illustrations of the past state of our great towns, without a corresponding notice of the improvements that have been effected in many of them. The truths which have been placed formally on record in the past, however, are too valuable to be lost sight of by the sanitary reformer, even if the particular evils to which he addresses himself had been completely corrected, and therefore it is that London and Liverpool, Edinburgh and Glasgow, must long continue to be referred to in connection with evils which some of these great cities have done much to remedy of late years. In almost all of our larger towns the supply of water has been greatly improved, both as regards quantity and quality, since the attention of the public was drawn to the subject by the sanitary Commissions, and in some instances, as in Glasgow and Liverpool, engineering operations have been successfully carried

out at the expense of the corporations, upon a scale of truly imperial magnificence. The new water works of Liverpool cost about a million and a half sterling, those of Glasgow about double that sum. In most other large towns similar, though less stupendous, enterprises have been carried out, and it even has been proposed of late by practical engineers to bring the supply of the great metropolis from the mountainous recesses of Wales ! Public baths and wash-houses have been erected in many places, and the millions who have availed themselves of these facilities for cleanliness have fully justified their erection, even considered as commercial speculations. Water is also much more liberally employed than heretofore in the flushing of sewers, and cleaning of streets ; and finally, public drinking fountains have been erected in many of our great towns, in the most crowded thoroughfares. In consequence of the more free supply of water, the average number of gallons used by each individual has enormously increased, being now not less than thirty gallons a day in Liverpool for each member of the population, and in other places even more than this. To some minds, indeed, the fear of waste seems now to predominate over that of deficiency, and the supply is represented as almost too copious for legitimate use. No one can possibly be insensible to the value of these great efforts, both as regards their immediate effect, and as a practical guarantee that the subject has at last taken deep root in the public mind, and is not likely again to fall into neglect. The ultimate good which may be looked

for from such examples as Glasgow and Liverpool is incalculable ; it is to be hoped that a spirit of generous rivalry will possess all our great cities, and spread downwards from them to even the smallest of our rural communities, which are often, in respect of water, nearly as badly off as the most crowded and neglected parts of the greatest cities. With reference to public works in general, however, I may be permitted to insist on the view presented in Lecture IV., that the full result of an ample water-supply cannot be obtained without a certain amount of authority to compel its introduction into every house, and to superintend the work of external and internal purification in detail. A careful regulation of the use of the water, when supplied, is the legitimate sequel of municipal authority directed in the first instance to secure abundance ; and is necessary both to guard against waste, and to secure the full and proper use of water by those who receive it.

From an instructive paper by Mr. Robert Rawlinson, C.E.,* it appears that the complete water-supply of places of moderate size can usually be effected at a cost which is quite inconsiderable when compared with the inconvenience and expense of less perfect methods. Thus, in five towns of the north of England, having an aggregate population of 47,999 in 7962 houses, the total cost of water works, including a constant supply to every house, was £67,196, a sum corresponding to an annual rate, estimated over thirty years, of £3866, 3s. 2d. Thus, the total average cost per house in these

* Social Science Transactions, 1860, p. 675.

five towns was £8 : 8 : 9, and for each individual of the population £1 : 8s., or, commuting the total cost for an annual rate, it may be calculated at 9s. 9½d. per house, or 1s. 7½d. per head ; or, again, according to the rental, an annual rate of 10d. in the pound.

It is curious to compare the mere cost of water so supplied with that of the precarious and scanty driblets furnished by carts and hand carriage. It is shewn in various parts of the Health of Towns' Reports that, under proper arrangements, a practically unlimited supply of water can usually be had for a price varying from 2s. to 4s. a year for each family ; and, even by a private company in Nottingham, it was found remunerative to supply 5000 houses to the extent of 40 gallons a-day, at the rate of 4s. 4d. a year, for each house, or about a penny a week. In Mr. Rawlinson's five towns the charge would be only 4s. 2d. a year on a rental of £5, and of course in some cases much less than a penny a week. According to Mr. Robert Thom (Health of Towns' Report, vol. ii., p. 7), in Campbelltown the charge was 1s. 4d. per annum for each house ; in Ayr, 2s. 2d. ; in Paisley, 2s. 9d. ; in Greenock, 2s. 6d., the supply being practically unlimited, though actually under 13 gallons to each inhabitant. In certain suburbs of London, on the other hand, Mr. Wicksteed stated, in 1835, that water was supplied by carts at the rate of 8d. for 36 gallons, while even under the monopolizing companies which were regarded at the time as obstructing the course of reform, the charge was only about ¾ths of a farthing for the same quantity, and there is little doubt that under a proper

system of management it might have been much lower. At Newcastle, according to the second Health of Towns' Report (p. 49), water was sold in the streets at "sale pants," where the people brought their buckets, and waited for a supply, which was given them at a farthing for 5 gallons, the cost of carriage being in this case of course to be added. In Paris the charge for water-carriage was a penny for six gallons.—See Health of Towns First Report, vol. ii., p. 106.

These statements fully demonstrate the real economy (apart from all other considerations) of a well-regulated supply of water, and the inexcusable character of the neglect when the community fails to secure such a supply.

VI.

DRAINAGE AND SEWERAGE. RECAPITULATION.

I HAVE to-day, for the last time, to call your attention to some of the great evils that have to be corrected in connection with air and water ; after which, I intend to conclude this course by a lecture on the organization required in order to devise and carry out practical remedies for these evils. The subject I have to take up to-day is that of drainage and sewerage, as a part of the general programme that I laid before you in a former lecture ; for it is essential to public health, not only that air and water should be abundantly supplied, but also that they should be rightly used—used for the removal of all those effete matters which nature and experience alike teach us to look upon as injurious, and which, therefore, we always instinctively put away from us where we can. In great communities, unhappily, it is not easy for individuals to follow out the instincts of nature in this respect ; and it is, therefore, but too common for these natural instincts to become deadened or lost to a great extent, so that persons not only injure themselves by neglect, but injure one another. The

duty of the community, however, is not the less plain, or rather, it becomes more plain in proportion as individuals fail in their duty to each other, or in proportion as the fulfilment of the great duties of personal and domestic cleanliness become difficult for the individual, be he ever so willing. In the sanitary economy of most of our towns, and even of many country places, I have shewn you already that these great obligations of the community to its individual members have been, to a great extent, lost sight of until of late years. We have had, and still have, but too ample evidence of the deleterious consequences of living amid filth and refuse of our own creating. We know but too clearly, as a scientific fact, that the waste matter of our own bodies, when accumulated on the great scale, becomes, in certain circumstances, a source of wide-spread and terrible disease. You have seen that this waste matter may become a source of fever, and consumption, and cholera, and countless forms of impaired health among infants and young persons ; of danger through the air, in cases where the air is contaminated by habitually deficient ventilation ; of danger through the water, in cases where impurities are habitually thrown out into wells or into cess-pools, filtering through an insufficient amount of soil to purify them, and getting into the water-supply either of the places which have themselves created the impurity, or of other places, and in this way rendering one of the first necessities of human life absolutely unfit for the use of man. These two departments of the subject have been, perhaps, sufficiently enforced for

what you will. But they may remain long enough in your neighbourhood to absorb your poisonous excretions, and carry them to your neighbour, or to destroy you in return by implanting in your body the seeds of disease derived from the bodies of your fellow-men. And you can only avoid these consequences by taking care to receive air and water practically pure ; transmitting them again, when used, into the general circulation of air and water all over the earth, so that nobody may be the worse, until they become practically pure again.

It is on these grounds that I have argued in former lectures, that in addition to access to the air of heaven, on the one hand, and in addition to a supply of good water, on the other hand, we must see to have the right application of the water and of the air to the removal of the impurities which necessarily arise where men congregate together. Now, the most perfect system of the removal of impurities (at least of such as are not gaseous), would unquestionably be to transfer them, soon after being deposited, far from the dwellings of men, and then carefully and judiciously to apply them

to the culture of the soil ; because you are well aware that our impurities, and the products of our decay, nay, the very materials of our bodies when we have done with them, are nothing less than nature's great provision for the support of the whole vegetable kingdom, as I explained in a former lecture ; thus affording the most thorough and extended application in the world of the old adage, that " what is one man's (or one living creature's) meat, is another's poison !" Certain it is, that an improved art of agriculture, or what is called " high farming," founded at once on a wide basis of experience, and on the highest generalisations of modern chemistry, is teaching us more and more every day, that what is poison to man is meat for vegetables ; teaching us, through the prodigious results obtained by a lavish use of manures, that the waste of our great cities is capable of being made the source of almost indefinite production, and that the *debris* of our bodies, by passing in their appointed course around the cycle of organic nature, may not only be rendered harmless, but highly profitable to us ; may be so altered and transformed, as to become, instead of a poison and a nuisance, the very material of our reconstruction. Many of you must remember the extremely neat and humorous expression given by Lord Palmerston to this high philosophical truth, when he said (some years ago) that " dirt is nothing but matter in a wrong place ;" in other words, that what we call impurity, the waste of our bodies, and our bodies themselves in the end, are simply what is required to fertilize the

fields, and so to come back to us again in the shape of the food of nations—cereal grains, and green crops, and luxuriant herbage, and sheep and cattle reared and fattened upon these. Beyond all doubt, therefore, this question of drainage, and the removal of impurities, is a serious question in more than one sense. It is much more than a mere sanitary question, though, no doubt, it is in the first instance a sanitary question of the greatest importance. It is not at all doubtful, that owing to the imperfection of our means for ridding ourselves of our impurities, and securing the proper application of them to the soil, we are casting away great supplies of our own food into the sea and into the rivers. It is an enormous waste—an extravagance which it is almost frightful to think about, in connection with the gradual exhaustion of the soil with which Liebig threatens us in some parts of Europe. It is pitiful, surely, for a great nation to be dependent upon the excrements of tropical birds brought in ship-loads from Peru, and retailed at £12 a ton, while in her helpless ignorance of the ways and means of living, she is devoting millions upon millions of tons of the richest and most fertilizing manures to the cultivation of sea-weed in the Atlantic Ocean ! But we are a long way yet from such a consummation as we may reasonably have in view, when everything in our refuse at all available for the agriculturist will be applied to its proper use in the cultivation of the ground. We must, in the meantime, keep before us an object considerably short of this. We must, in the first instance as sanitary re-

formers, try to displace, and effectually to remove from our neighbourhood the accumulations which day by day threaten our very existence; we must rid ourselves, as best we may, of a great and pressing danger; and I fear we must do this for a while without regard to the ultimate settlement of the agricultural question—"How far can what we throw away from us be profitably utilized?" It is satisfactory, however, to know that a great deal of attention is at present directed to this question; which we may safely leave in the hands of the enlightened and energetic men who have taken it up both theoretically and practically. I have, indeed, no doubt at all in my own mind, that the time will come, when much of the refuse of our towns will be consumed by the agriculturists. But seeing that it is a question so much of detail, in which it is so difficult to arrive at conclusions generally applicable, I think we must leave it for the present to the agriculturist, and not attempt to interfere here between Mr. Mechi and his antagonists.

Now leaving to the scientific agriculturist, in the meantime, the vast and immensely important questions connected with the ultimate disposal of the sewage of towns, you will observe that we have to deal with a question of much less complexity, though still not devoid of great practical difficulties. In every case, however, we shall approach that question with much greater ease as a matter of detail, if we keep in view the main principles involved. The sanitary point of view from which all our modern authorities in public health

are accustomed to act, is simply this ; that *all* refuse matter, without exception, must be put away as speedily as possible from amongst us. All refuse matter, I say ; for though all is not alike dangerous, yet none of it is safe ; it is the natural abode of poisons, which arise, you cannot tell when or where, and which, once generated, are fearfully and indefinitely capable of destroying human life until they, in their turn, are destroyed and decomposed by nature's chemistry. We must manage, then, somehow or other, to keep all refuse matter at arm's length ; we must require, as the Jewish law required ages ago, that it be deposited, once for all, *fairly outside the camp* ; we must invent and apply some sort of mechanism for carrying it clear away from among the haunts of men, and from all possible risk of doing present or future mischief ; and then, if the agriculturist shall say, " This is valuable to us ; we offer to give you value for it, and to take it away ; only give us facilities for carrying it to our fields ; " then, undoubtedly, it will become our duty to adapt our proceedings to the requirements of agriculture ; but in the meantime we cannot afford to wait ; valuable or not, away it must go. Now the taking away of the refuse matter of a large town, is, I need not say, a very complicated affair, and we are suffering in most of our towns at present under the evil that the thing has been in many cases *only half done* ; done in such a way, in some instances, that it were almost better it had been left undone. We have had most of our great towns growing up, in the first instance, probably for centuries, without any

drainage at all. We have in this way had enormous accumulations of filth and garbage within these towns, the results of the waste matter not only of our own bodies, but of large animals, of oxen, pigs, and poultry, and the remains of smaller animals, in short, every conceivable sort of abomination ; we have had these retained in the towns until they were carried away, very partially, and often almost accidentally, by the hands of men, by the labour of scavengers, or by contracts made with certain farmers, in some instances, to carry off the refuse of certain favoured localities in order to apply it to the fields. In short, the whole thing has been too often left to chance and to private enterprise, as in the case of the water-supply, which I discussed in a former lecture. In most of our towns, however, we have now got to some extent beyond this stage of civilization, or rather of barbarism. We have arrived—perhaps some dozen, perhaps some hundred years ago—more or less perfectly at the conclusion, that it is the business of the authorities of a town to provide facilities for the carrying away of the refuse. But, unfortunately, this has almost never been done upon a defined plan, and still less has it been done upon the best plan. It has been a series of small or great experiments, and often of very unsuccessful experiments, this art of removal of the refuse. We have been learning as we went along, and often at enormous cost, the first principles of mechanical philosophy ; because vestries and municipal authorities, with strong prejudices and narrow views, have been generally content to do a little bit here and a little bit

there, rather than face the whole difficulty ; have been content, like the Antiquary in his chamber of curiosities, to let the dirt lie in peace, so long as it was not disturbed and flung in their faces by the remonstrances and the scrubbing-brushes of the cleanly and the querulous members of the community. And the consequence is, that although there can now hardly be found, perhaps, a large town in which there is no drainage at all, it is still too true, or at all events was true, till within the last dozen years or so, that in not a single town in this country was the drainage constructed upon even the most moderately correct or comprehensive principles.

Now, do not be afraid that I am about to deliver to you a long and detailed lecture on the construction of drains. You will readily understand that this is to a great extent a matter of practical engineering, into the full details of which I cannot enter with advantage to you here, even were I at all competent to do it any kind of justice. I can only endeavour to shew you some of the general principles upon which it rests, or rather, perhaps, to shew you, by way of warning, some of the great evils that have arisen from an imperfect system.

The first great evil is this, that the drainage of almost all our great towns was, in the first instance, constructed all but entirely as a surface drainage only. It was no part of the intention of the authors of our older systems of drainage that the public drains, or common sewers, should carry away any of the refuse of individual houses ; it was intended only that they should

remove the surface-water of the streets, and whatever the rain-water falling on the streets could carry along with it. Common sewers were universally constructed, therefore, in the first instance, without any distinct view to the fact that large quantities of decomposing matter might be expected to get into the drains, and might possibly accumulate, to our annoyance and hurt, *below* the ground as well as *above*. The dust of the streets, indeed, might chance to be washed down, but all the more stable and more offensive impurities, and particularly the impurities of the private houses and public necessities were left out of consideration, or left to be dealt with entirely by the scavengers and night-men. That was the first rough idea of a system of drainage. One fact, which shews to what an extent this was so, is, that in many of our old statutes in regard to the drainage of towns, and in particular in the statutes that apply to the drainage of London, dating from the time of Henry VIII., it is positively forbidden in some instances to cause the house-drains to communicate with the common sewers ; and when it is not absolutely forbidden, it is made a matter of favour ; the permission is put in such a form as to make it always a very difficult and expensive operation. In short, we may say that in all the earlier systems of drainage introduced into our towns, the carrying off of human refuse is looked on as quite a secondary object, if indeed it was even contemplated at all. Here is an extract from the Report of the First Health of Towns Commission, upon that subject :—

“On an examination of the state of the existing law respecting drainage, it appears that the Statute of Sewers, 23 Henry VIII., c. 5, under the provisions of which the principal Commissions of Sewers for the metropolis are issued, chiefly contemplates the drainage of surface waters. This statute, with other general laws applicable to the drainage of parts of the metropolis, has given rise to a difference of opinion in regard to the powers conferred by them for the extension of new sewers. By some Commissions it is considered that, even for the above limited purpose, the authority is restricted to the repair or diversion of drains and sewers already in existence.

“The provisions of subsequent local Acts, even of a late date, which give the power of forming new sewers, both in the metropolis and other towns, still contemplate chiefly the construction of works for the drainage of surface waters. The evidence shews that of the works hitherto executed, the greater part have been constructed only on demands for the removal of pressing inconveniences, and for the drainage of particular places.

“The witnesses state that for the most part the usages at present prevailing, and the bye-laws in force under the authority of these statutes, have been (until two or three of the Commissions in the metropolis adapted their sewerage to the house drainage) framed with a view to the maintenance of the drainage of surface water only, and without reference to that system which is now admitted by all the medical witnesses to

be of the greatest importance to the public health, to the condition of the poorer classes, and the salubrity of their dwellings, namely, house-drainage and sewerage, and the constant removal of all decomposing vegetable or animal refuse, much of which might be effected by means of the proper application of water.

“In some of the larger and most crowded towns, all entrance into the sewers by house-drains, or drains from water-closets or cess-pools, is prohibited under a penalty. In other places, including a part of the metropolis, the entrance of house-drains is commonly deemed the concession of a privilege, subjected to regulations and separate proceedings, with attendant expenses, tending to restrict the use of the sewers for these most important purposes, or to confine the advantage to the wealthy.”—Vol. I., pp. xiii, xiv.

That, then, is the first evil, or great omission, connected with our older systems of drainage. But another, and perhaps a worse evil is, that the sewers are not properly constructed, even for the purpose of surface-drainage. You will find in the reports of these various Commissions—and I may particularly refer to the evidence of Mr. Phillips before the Metropolitan Commission—multiplied evidence to the effect that the sewers are almost universally ill-constructed ; they are so large, so flat in the bottom, and with such an imperfect declivity in a great many instances, that it is impossible for the amount of water that flows through them to carry off the solid refuse that is necessarily

deposited in the course of time in sewers so constructed. There is a little rivulet trickling slowly over a broad flat bed, in a preposterously large vaulted chamber which even in the greatest storms has never more than enough of water just to cover the bottom ; there is accordingly no impetus, and no flow sufficient to carry away obstructions ; and thus it happens that from day to day solid matter is deposited, and accumulates more and more, until the very outlets of the house-drains are choked up, and the sewers themselves require the cleaning operations of the scavenger, even more than the street. Such sewers as these are described as quite of ordinary, indeed of universal, occurrence ; their great size having been regarded as a necessity of the case, to allow of cleansing operations within them from time to time ; and thus much of the drainage of our great towns, instead of a system of constant and thorough removal of impurities, has simply become an underground accumulation of impurities of every kind, in every stage of decomposition, concealed from view, and therefore rarely visited by the scavenger.

Now, cesspools in towns are bad enough, and belong to the very infancy of civilization as regards sanitary matters. You have already had an example of the evils connected with the soakage of fluid poisons from cesspools, in the case of Bedford ; and no doubt the poisoning of the air by them is also most offensive and dangerous. But an underground cesspool (for a badly constructed sewer is nothing better) is often a far more serious evil than even a cesspool near the dwell-

ing ; for when the latter becomes very full, the remedy is within the power of the individual ; while the overloaded and poison-generating sewer is beyond the reach of remedy, unless you can get at the authorities ; and even then, the remedy is often quite inadequate to the occasion, and may leave matters little better, if not actually worse than before. For if these too large and therefore obstructed sewers are not completely impervious (and they never are so), they will leak both upwards and downwards, diffusing poison into the air above, and the earth beneath, and all the more when their contents are rudely disturbed. And again, you can easily understand how the communication of the house-drains with such receptacles of underground filth becomes a mischief, instead of a benefit, to the houses. In the first place, the house-drain is often completely choked by the accumulated refuse in the common sewer, which gathers so high up as to obstruct its mouth ; and, secondly, to whatever extent the house-drain is free, it is apt to become a poison-conductor both ways ; carrying forwards, no doubt, to the common sewer the impurities of the individual house ; but also carrying backwards into the very heart of the dwelling the reflux sewer gases, the produce of the decomposition of the impurities of a whole neighbourhood. This is a shocking fact, but it is nevertheless amply borne out by experience, which shews that a common sewer containing elements of decomposition, and communicating with an imperfectly trapped house-drain, is much more injurious than useful to a house ; the tide of air from

the vault of the sewer being almost invariably not in the direction of its outlet, but upwards into the houses through the private house-drains, and also into the air of the street. Upon this subject I will submit to you an extract from the evidence of Mr. John Phillips, the Chief Surveyor to the Westminster Court of Sewers, one of those too actively and obstinately cleanly persons whom I alluded to before, whose differences with his superiors on this account were brought to light by the Metropolitan Sanitary Commission.* Mr. Phillips is asked :—

“Have you, in passing along the sewers, ascertained which way the currents of air were flowing, either into or out of the sewers? In going along the sewers, I have been always anxious to ascertain that fact. The light which I had in my hand I have placed immediately by the side of, and into the house-drains, and I found almost invariably the flare carried into the mouths of the drains, so that there must have been direct currents from the sewers through the house-drains, and so into and through the houses themselves. I rarely met with any instances where there was not a current from the sewer into the house-drain, and also from the sewer through a large number of the gully drains into the streets. Of course, some gullies have a down draught.

“Then it is to be presumed that your experience

* See particularly his evidence in p. 166, *et seq.*, of the 8vo edition of the Report.

justifies the general description given of the existing sewers in the Sanitary Report of 1842, as retorts with necks carried into the houses for the conveyance of the gases there? Yes, unfortunately, such I have found to be the case. The sewers are in a very great degree ventilated by the house-drains, which are badly trapped. It was in consequence of finding that to be the fact, by repeated observations and experiments in the sewers, that I was induced to lay before the Court their real and absolute state, in order that so grievous an evil might be remedied without delay.

“What was done upon your representations? I cannot say that any steps were taken to remedy the defects; but I can say that it was considered that I was too bold, and that I said too much.”—P. 48 of Evidence.

Add to all this, that, according to Mr. Phillips, a large quantity of refuse matter is retained in the house-drains themselves, from their defective construction :—

“It would seem from their form, arrangement, and construction, that they had been built expressly for retaining matter rather than carrying it away. More than two-thirds of the existing house-drains in old localities require to be periodically broken into to clear out the soil. I am of opinion, that not one half of the entire filth produced in the metropolis finds its way into the sewers, but is retained in the cesspools and drains in and about the houses, where it lies decomposing, giving

off noxious effluvia and poisonous sulphuretted hydrogen and other gases, which constantly infect the atmosphere of such houses from bottom to top, and which, of course, the inhabitants are as constantly breathing. In thousands of cases, I have no doubt, fevers and a large class of diseases result from this cause."—*Ibid.*

But enough of these repulsive details. I will not go further into this branch of the subject at present, than to shew you these practical illustrations of it in the drawings submitted by Mr. Phillips and others to the Metropolitan Sanitary Commission, which you can turn over after the lecture.*

You are now in a position to understand thoroughly how it is that imperfect drainage may have even worse consequences than no drainage at all; and that if the work is to be half-done or ill-done, as I said before it too often has been in our great towns, it often becomes so injurious in particular cases, that it had better not have been begun. I have shewn you, that even in Edinburgh, where the main drainage has been done in the most modern and improved manner to a consider-

* See Metropolitan Sanitary Commission Report, pp. 40-44, and especially the drawing of the sewer in Langley Court, Long Acre, p. 50, to which public attention was attracted by a case of sudden death caused by the reflux of foul gases into a house in the court. Compare with these defective constructions, the egg-shaped sewer and gully drain, with accessory apparatus, figured in pp. 217, 218.

able extent, we have partly failed in our purpose, for we have constructed our main drains in advance of the water-supply to individual houses ; and however good the drainage, it must necessarily fail to clear off the refuse of those unwatered houses and courts. We are therefore dependent, in Edinburgh, on the scavenger alone for the removal of the filth of an immense population in the Old Town ; and to this extent we have forfeited the good which we might have looked for from our extensive system of main-drainage. This is a great omission, and has grave social consequences ; for it is very certain that the proverbially uncleanly habits of our poorer populations can never be rooted out until a proper system of drainage is supplemented by a complete and plentiful supply of water sufficient to carry off all impurities. But it is not in Edinburgh that we have to look for the most glaring evils of imperfect drainage. Our natural advantages here come to our rescue, and wherever drains exist at all, they are kept tolerably clear by the abundant rain-fall, and the rapid fall of the ground towards the sea ; though we still commit the immense error of casting half the sewage of the New town into the Water of Leith, which has thus become an intolerable nuisance, and grows worse and worse every year. Yet even here the frequent floods, and the rapid declivity, combine to save us from the worst evils of a permanently open sewer ; and although we have bad smells enough, there is perhaps less than in most places of disease directly traceable to defective drainage.

It is otherwise in England. There, the difficulty of obtaining proper outfalls is much more felt than with us*; and accordingly, with populations far superior to ours in habits of personal cleanliness, there is much more disease, and especially much more epidemic disease, than with us, clearly traceable to emanations from the sewers. The disease called typhoid or enteric fever has been again and again shewn to have been brought about in this way; while in other cases, as in that of Bedford (to which I formerly referred), it has appeared to be communicated through the water chiefly or exclusively. And while cesspools in Bedford were the chief or only source of the evil, it has sometimes happened that this fever has spread altogether independently of cesspools, and in close connection with a defective system of under-ground drainage, having affected most of the houses which were directly in communication with the sewers, and spared those which were not. The case of an epidemic of enteric fever at Windsor was in this respect precisely the converse of the Bedford epidemic. This Windsor epidemic occurred in 1858, and was carefully investigated by Mr. Simon,† and also by Dr. Murchison, who has done much to elucidate the

* In fifty towns in England visited by the Health of Towns Commission, it was found, that in scarcely one place was the drainage complete and good; while in seven, it was indifferent, and in forty-two, decidedly bad as regards the districts inhabited by the poorer classes.

† First report of the Medical Officer of the Medical Office of the Privy Council, 1858.

connection of this form of fever with the poisons of decomposition.*

The story of the Windsor epidemic was this—It occurred in the autumn, at the end of a long drought. It affected rich and poor indiscriminately in those parts of the town which were attacked ; and a rather remarkable fact was, that the poorest part of the town, that which had been the most severely infested with cholera, was scarcely attacked at all. The parts of the town chiefly involved in the epidemic were on two quite distinct levels, and inhabited by two distinct populations. The lower level suffered most severely, and was on the whole the inferior population of the two ; but then that other population to which I have referred as remaining almost exempt from the epidemic, occupied a much worse and older class of houses than either of the populations chiefly attacked, and was, besides, inferior in every respect to both of them. All these three districts, the *one exempt*, as well as the *two attacked*, derived their water-supply in part from wells, and in part from the Thames ; but there was no room for supposing that the water-supply of the population not attacked was better than that of the others ; and the prevalence of cholera among them at a former period would appear rather to tell in the opposite direction. All the three districts got rid of their impurities mainly

* See Edinburgh Medical Journal, October 1859, as regards the Windsor epidemic ; and on the general subject of fever, Dr. Murchison's elaborate and excellent paper in the Medico-Chirurgical Transactions, vol. xli.

through the town sewers, which had a common outfall into the Thames ; and *in the neighbourhood of this outfall the attacks of fever were very numerous.* But the chief peculiarity of the case was this—in the two districts to which the epidemic was almost exclusively confined, and in which it raged apparently without distinction of classes, the communications with the main drains were *directly from the interior of the houses*, while in the poorer district, which escaped, the private drains were almost all *outside the houses* ; or, in the words of Mr. Austin, the inspector on behalf of the Privy Council, there were (in the district referred to) “no sinks or other openings from the drains within the houses themselves. With two exceptions,” he adds, “I found no complaint of smell from the sewers of this neighbourhood. One woman, whose child had died of fever, complained bitterly of constant smell from the gully immediately opposite to her door ; and another woman complained of the smell from a gully opposite her house, whenever the sewers were flushed.” I ought to have told you, that in the districts chiefly attacked, the complaint of bad smells had been very general, and it was unquestionably the case, that the sewers had been in a very foul state, owing to the long drought ; while the want of proper exterior ventilation of the drains, and the defects of the trapping, favoured the escape of the sewer-gases into all the houses which communicated with the common sewers.

Here, then, was a strong presumption established in favour of the view, that the people of Windsor, in the

autumn of 1858, were being poisoned by sewer-gases; and the details of particular cases within the localities affected, and also of a few within the district remaining exempt, were found to favour remarkably the same idea. But the most marked corroboration of this idea was derived from the observation of the facts connected with Windsor Castle and its dependencies.

In the first place, the castle itself was, happily, entirely exempt from fever; and this exemption was in accordance with the fact, stated by Mr. Austin, that the drainage of the castle "is abundantly ventilated, and appears to be scrupulously kept in working order; it is quite distinct from the town sewers; and apparently quite safe from any contamination arising from the present great defect of these works."

In the second place, a few of the houses in the Royal Mews (which are in the immediate neighbourhood of the castle proper) were connected with the private sewer constructed specially for the castle, and participated in its exemption. But the greater part of the Mews, though separated only by a road-way from this favoured portion,* was severely attacked by the epidemic; and the houses so attacked were in direct connection with the town sewers, and therefore subject to the escape of foul gases from them.

In the third place, Mr. Simon tells us that the collegiate residences connected with St. George's Chapel were in communication with the town sewers; and in

* Murchison, *Edin. Med. Journal*, *loc. cit.*

them, accordingly, cases of fever occurred, although not to the same extent as in the Mews. 3

It is difficult, if we adopt the statement of facts here presented, to avoid the conclusion, that the defective construction of the drains in Windsor, and the neglect of flushing during the dry autumn of 1858, were responsible for the fever which affected the town so severely at that time, as directly as the poisoned water-supply was responsible for the fever of Bedford, or the cholera of Dumfries.

Now, a complete and effective system of drainage can only be obtained either by the zealous and cordial co-operation of all the parties concerned, or by the exercise of municipal authority ; and in the case of places of considerable size, where there are many conflicting interests, the latter is practically the only way of proceeding. At a former lecture I read to you a letter* descriptive of certain difficulties which arose even in a very small village, in which the prevalence of disease, to an inordinate amount, was an almost constant occurrence. It is lamentable to think, that in Scotland there should be no sufficient authority to over-rule such difficulties, or at least to suggest the right way of meeting them, and to stimulate public opinion on the subject. But wherever there is a municipal authority, it is plain that considerations both of real economy and of efficiency require that the whole question of main-drainage should be taken up in liberal spirit, and arranged upon a scientific plan, with a view

*. See p. 203.

to completeness. To do and to undo again has been found to be miserable work, and, moreover, is no less extravagant than unsatisfactory. In reading over the report of the Metropolitan Sanitary Commission, and the reports of the previous Commissions, you will see instances of persons, sometimes of considerable wealth,* who have been unable to secure the advantage of proper drainage in their own houses, owing to the defects of the common sewers, or the absence of a proper outlet. So that the negligence of the authorities, or their stupid obstructiveness, may become a source of positive injury, not only to the community at large, and to its poorer members, but to individuals perfectly willing to pay liberally for health and cleanliness, and yet obliged to live according to the low standard of their neighbours. In such cases, justice to the individual requires that the municipal authority itself should be subject to some higher control, or at least should be brought emphatically before the bar of public opinion. In short, I hold that it is the simple *right* of every man to have the necessary facilities for the removal of impurities, as it is also his *duty* to contribute whatever of personal labour or money is necessary for that object. And the function of the authority is to see that the right and the duty are alike fulfilled.

And now, we have very nearly touched the boundary-

* See especially the evidence of Sir George Phillips, Metropolitan Sanitary Commission, p. 222.

line of the province of authority in regard to public health. We have discussed pretty fully the principal questions that arise to the mind in connection with pure air, pure water, and what is necessary to both, efficient drainage. I believe, in general terms, that although in regard to all the other hygienic circumstances, to which I alluded in a former lecture, there is a possibility of interference with advantage in some cases, you must act upon the general principle, that these things are to be left to the individual to a great extent ; and that only very great abuses—only abuses which are clearly proved to involve the interests of the community at large—shall be touched by the community, the rest being left to the gradual force of enlightenment, and the improvement, through voluntary influences, of the condition of the people. We cannot, in accordance with sound principles of government, take up the position that the State is to do everything for us. It is contrary to the genius of legislation in this country, which assumes that people are to act, to think, and to work for themselves. We cannot, therefore, have the State feeding us, clothing us, looking carefully after the minute and individual details of our private morals. We are habitually, and I think not unfairly or unreasonably on the whole, jealous of interference with what appears to us to be the private duty of the individual ; and wherever public and private duties come into close connection, this feeling of reasonable jealousy, fortified by the unhappy experience of foreign governments which have acted differently, comes into play to baffle authority. And

therefore it is only to a very slight extent that the interference of authority can be maintained, or even justified, beyond the boundary-line that I have prescribed to myself in the lectures that I have already delivered to you. We can, however, at least avoid making bad laws; and there is little doubt that we have sometimes made very bad laws in matters which concern the public health. There can be no doubt, for instance, that the operation of the Window Tax, imposed by Pitt in the first flush of his popularity in 1784, and not repealed till 1851, has been most injurious to the comfort of a large portion of the people; and I suspect that the persistence of this impost, during more than half a century of unexampled increase of the population, and therefore of house-building, must have tended to no small extent to aggravate a great many of our sanitary evils. But in general, I say that the best thing that the State can do for us in regard to such matters as fuel, food, clothing, general comforts, and all the rest of the elements of hygiene, is to leave us with our energies unfettered by bad legislation; at most, to defend us all, as a nation, from injury, and to prevent any one among ourselves from doing another any palpable and serious injury. But there can be no doubt, that whenever a population gets to be so placed as to be beyond the power of procuring for itself air and water in a moderate state of purity, it has become the clear duty of the authority, whether central or municipal, to interfere; and when the State or the community gets its hand in, it is generally good

policy to run a little bit over the line on the other side, and to do something to "raise the standard of comfort" (as my dear old master, Dr. Alison, used to express it), in those neglected and helpless populations for which it has to perform sanitary duties. We in Scotland long laboured under what I think is a great delusion—viz., that it is proper, in the administration of the Poor Law, to keep down the comforts of those who are relieved to the lowest possible pitch. Dr. Alison was one of the first who pointed out to us, in a very clear manner, the fallacy of this idea, and shewed that the proper way was to guard, undoubtedly, against abuse of the comforts afforded, but to administer freely comforts, to those who required them from destitution of means, in such measure and in such manner as may tend to raise, and not to depress, their idea of comfort; and so, by improving somewhat the standard of their habits, without affording them anything like injurious or inaccessible luxuries, to give them the notion of something higher—to plant in them ideas to which they and their neighbours may look up with somewhat of ambition, and without the despairing sense of utter destitution and neglect. I cannot, however, enter into the whole of that large question just now, and simply throw out here a hint upon that point, which I may have occasion to touch upon at some other time.

Now, what I have insisted on hitherto is simply this—that we ought to have both pure air and pure water, and that we ought to have these in every home in the country. But I cannot close this lecture, and with it

the review of the consequences of our neglect of the first elements of public health, without pointing out to you, once more, how many of the other evils, that affect the lower classes of our population, are connected more or less directly with the want of a sufficiency of pure air and water in the home ; and with the consequent serious difficulty, or rather absolute impossibility in many cases, of procuring the ordinary means of external decency, to say nothing of the comforts and refinements of civilized life. The effect of this one grievous want—the want of personal and domestic cleanliness—is felt through every part of our complex organization, moral as well as physical. We may say, in general terms, and speaking of considerable populations, that civilization, virtue, religion, the control of the passions, the cultivation of the higher emotions—all things that are implied or expressed in love to God and love to man, become practically unattainable wherever we cannot attain to pure air and water. Pure air and water, then, are necessary to much more than health and mere physical comfort ; they involve in themselves inextricably the first elements of almost all the social virtues ; because, where you cannot have cleanliness you cannot long have either self-respect or respect for others, without which none of the social and practical virtues can get soil, so to speak, to take root. And accordingly, it is the inevitable consequence of leaving a large population in a permanently impure and unclean state, that habits are created, destructive of the social virtues ; and in the course of a few gene-

rations the very germs of these virtues, the germs of morality and decency, of all the little charities and graces of social life, and finally, of all the attributes that lift man above the brutes—die out in the infected atmosphere of physical degradation. This is a hideous, perhaps an extreme, but hardly an exaggerated picture of the condition of the worst classes in some of our great cities. The illustrations of this extreme degree of demoralization are not, indeed, common on the great scale, because it is extremely difficult, as you may well believe, to root out the last traces of humanity ; but the reports of the various sanitary commissions reveal, as I have already shewn you, the most frightful and almost inconceivable depths of barbarism, the most utterly *dehumanized* state, so to speak, of families and of individuals brought up in the very midst of our most advanced civilization. It is but too plain, for instance, from these reports, that insufficient ventilation, and the crowding together of human beings—the want, in short, of a sufficiency of space, and therefore of pure air, has a terrible associated tendency to degrade and disorganize society as regards the relation of the sexes. The evidence of this is too hideous and disgusting to repeat in detail ; but I must, nevertheless, touch upon it again so far as to remind you, that the indiscriminate heaping together of human beings in those shocking dens of impurity, the common lodging-houses of our great towns, is shewn to have been the cause, in various instances, not only of sexual demoralization, but of the most dreadful kinds of sexual demoralization. Even

when the family relation is in some degree preserved, it is given in evidence that those who ought to cultivate towards each other—and who in all other circumstances do actually maintain towards each other—the most special feelings of modesty and mutual respect, have been found so utterly perverted in their sense of what is modest and fitting, that in some instances it was considered not at all shameful for the father to sleep with the grown-up daughter, for the mother to sleep with the son, for the married couple to sleep with the sister or the brother of one of them, in the same bed. Of course, I need hardly remind you, that in the lodging-houses the thing is still more indiscriminate—you have the packing together of men and women by the dozen; and in these circumstances, as Dr. Southwood Smith expresses it, it is not too much to say, “that the women become common to the men;” so that adultery, and even incest, are the results of this unnatural relation of the sexes; and in this way, by the simple circumstance of the want of decent accommodation, you strike at the root of every form of social virtue, by absolutely destroying the ideas upon which all human society is founded. The naked cannibals whom Mr. Petherick has lately described in his explorations of the Nile, living in utter ignorance of the existence of civilized man, are less degraded than some of these outcasts of our modern civilization. To use a strong expression of Dr. Southwood Smith, we have men and women among us who, owing mainly to our neglect, are no longer *human*; who have descended,

as regards the relation of the sexes, almost to the level of the monkeys in the Zoological Gardens ; men and women so little apparently responsible for the good or the evil one finds in them, that in the worst cases they seem to have hardly any sense of shame and of propriety more than the brutes. And under more or less of these influences generations have been brought up, family after family, the parents living and dying in the midst of uncleanness, and bringing up children (if indeed they can be preserved alive for more than a year or two) in the midst of conditions which imply an almost necessary degradation of all their appetites and feelings, and a serious derangement of all their ideas of moral, as well as physical, well-being.

Let us, however, pass from this most terrible and repulsive aspect of the subject, to inquire for a moment what is the effect of deficient means of purification upon the inmates of the family, supposing the family relation to be still preserved ? What is the effect of enforced or involuntary uncleanness upon the character of the woman, who ought to be the light of the home, and the chief source of all its most real and permanent attractions ? You have a very important and striking piece of evidence upon this subject in Mr. Chadwick's first report on the Condition of the Labouring Population ; and to save time, I will give you little else than this one example in detail. The facts quoted in the report are part of a statement made to Mr. Chadwick himself by a lady (not named, but evidently of good social position) with respect to the

condition of a former female servant of hers ; first before, and then after, marriage :—

“ Her attention to personal neatness,” so runs this lady’s evidence, “ was very great ; her face seemed always as if it were just washed, and with her bright hair neatly combed underneath her snow-white cap, a smooth white apron, and her gown and handkerchief carefully put on, she used to look very comely. After a year or two, she married the serving man, who, as he was retained in his situation, was obliged to take a house as near his place as possible. The cottages in the neighbourhood were of the most wretched kind, mere hovels built of rough stones, and covered with ragged thatch ; there were few even of these, so there was no choice, and they were obliged to be content with the first that was vacant, which was in the most retired situation. After they had been married about two years, I happened to be walking past one of these miserable cottages, and as the door was open, I had the curiosity to enter. I found it was the home of the servant I have been describing. But what a change had come over her ! Her face was dirty, and her tangled hair hung over her eyes. Her cap, though of good materials, was ill-washed and slovenly put on. Her whole dress, though apparently good and serviceable, was very untidy, and looked dirty and slatternly ; everything indeed about her seemed wretched and neglected (except her little child), and she appeared very discontented. She seemed aware of the change there

must be in her appearance since I had last seen her, for she immediately began to complain of her house. The wet came in at the door of the *only* room, and when it rained, through every part of the roof also, except just over the hearth-stone ; large drops fell upon her as she lay in bed, or as she was working at the window : in short, she had found it impossible to keep things in order, so had gradually ceased to make any exertions. Her condition had been borne down by the condition of the house. Then her husband was dissatisfied with his home and with her ; his visits became less frequent, and if he had been a day labourer, and there had been a beer-shop or a public-house, the preference of that to his home would have been inevitable, and in the one instance would have presented an example of a multitude of cases.

“She was afterwards, however, removed to a new cottage, which was water-tight, and had some conveniences, and was built close to the road, which her former mistress and all her friends must constantly pass along. She soon resumed, in a great degree, her former good habits, but still there was a little of the *dawdle* left about her ; the remains of the dispiritedness caused by her former very unfavourable circumstances.”—*Report on Labouring Population*, p. 128.

There is another instance given in this report of a woman “who had been brought up as a servant in a well-ordered house, and who, for her station, had received a very excellent religious and moral education. Before

her marriage she had been distinguished by the refinement with which she sung national airs, and for her knowledge of the Bible, and of the doctrines of her church. Her personal condition had become of "a piece" with the wretched stone undrained hovel, with a pigsty before it, into which she had been taken. We found her with rings of dirt about her neck, and turning over with dirty hands Brown's Dictionary, to see whether the newly-elected minister was "sound" in his doctrine. In this case no moral lapse was apparent, but the children were apparently brought up under great disadvantages."—*Ibid*, p. 129.

I quoted in the beginning of this lecture a saying of Lord Palmerston on the subject of drainage; and some of you may probably remember an incident stated by him to the Romsey Agricultural Association some time ago, which has an equally appropriate bearing upon this part of my argument. In this instance, as in the former, nothing can be more happy, or more to the purpose, than the pithy remarks of the Prime Minister in his character of a practical, as well as theoretical, sanitary reformer :—

"When a cottage is in such a ramshackle state," he said, "that it is impossible for the wife to keep it clean, she becomes a slattern, everything goes to ruin, the man is disgusted, and flies to the beer-shop. If, on the contrary, the wife feels that she can, by a little exertion, make the cottage decent and respectable, she does so,

and then the man enjoys the comfort and happiness of his home, stays away from the beer-shop, and the sum of money he would spend in liquor goes to the benefit of his wife and children. I had an example of that in a double cottage of my own. It was in a dreadful state ; the walls were not air-tight, it had a brick floor, a bad roof, and everything uncomfortable. The people who occupied it were slovens and slatterns, and quarrelsome ill neighbours. At a small expense it was made tidy ; boarded floors were put down, a little porch erected, with a wood-house and other conveniences, and from that moment these people altered entirely their character, altered entirely their conduct, became well-conducted people and good neighbours, which they had never been before."

Observe, then, the complicated effects of physical impurity, or even the neglect of comfort in the home. Besides the bad effects upon the health directly, it creates a lowered tone of feeling and of personal delicacy ; in the worst cases, it almost obliterates the sense of shame, and leads to an indiscriminate and shockingly depraved commerce of the sexes ; when the evil falls short of this, it makes the home untidy and wretched ; at first, in spite of the struggle after better things. Then the character of the household deteriorates ; the woman gradually loses her feeling of satisfaction in her home ; she feels that it is impossible for her to make it what she ought, an attraction and a pleasure to her husband ; then quarrels occur, and the home becomes unbearable

at times ; and then the evil extends to the husband, in a far more pernicious shape still, making him permanently careless and negligent, unfond of his home, unfond of his wife and of his children, and in too many instances, fond of some deleterious substitute for the enjoyments of home, and the tranquilizing influences of a virtuous family life. It is here, beyond all doubt, I believe, that we must look for the source of much of the drunkenness, and other vices, of the labouring class. Give them healthy and comfortable homes, or the possibility, even, of these, and the public-house will go to the wall.*

One other consideration and I have done. Need it be said that the terrible evils of a disturbed family relation, and a disordered home, tell with fearful force upon the health, the morals, the habits, and the lives of the rising generation, and especially of the very young children ? It would be marvellous, indeed, if it were not so. I should not know what to believe, if I found that a disorderly home did not tell upon those exquisitely tender, delicate lives ; which, as I shewed you in a former part of this course,† are three or four, or five or six, in some cases even ten times, more subject to destruction than the lives of members of the community at other ages. But we are not left to

* See Note L, p. 276.

† The part of the course here referred to, is not included in this volume ; but the reader may be referred, as regards infantile mortality, to the tables accompanying the paper referred to at p. 285.

speculate on this matter. We know, as a fact, that the lives of young infants are not only very fragile, but are actually sacrificed to an enormous extent, wherever the home is neglected. In a former part of this course, I shewed you that the variation in the death-rate of very young infants is not less than enormous, as compared with that of adults ; so that while the difference between the healthiest and the most unhealthy district of England, as respects the death-rate of the whole population, is not more than about 15 in 1000 living, the difference, in respect to children under five years, is nearly 90 in 1000, and the difference as to children under one year is, I have reason to believe, more than 200 in 1000 living. There are, indeed, not a few places in which (counting over large numbers of the population) the children are thus mismanaged ; where the domestic relations of the population, taken as a whole, are so bad, that not less than a third (probably, indeed, much more than a third in some places) of all the children born fall victims to disease, or are in some way or other destroyed, before they are even one year old ; before their little limbs have learned to walk, or their tongues to speak, and while they yet are, or ought to be, drawing their food from the breasts of their too careless, or perhaps yet more unhappy, mothers. I hardly know a fact in the long story of human guilt and misery more deeply impressive than this. It is in the most pathetic and awful sense a lesson, to the effect that the sins of the parents are even to this hour visited upon the children, in the ordinary providence of God. No doubt

the same causes of disease and death that operate on the adult, take effect also directly upon the child ; but the immense differences between the proportion of the adult and the infant mortality in many places, shew that a great deal of the latter must be due to negligence, or worse, on the part of the parents ; and in particular to breaches of maternal duty, often brought about by some of the anti-social and anti-domestic tendencies pointed at in this lecture.*

Such, then, is a rapid sketch of some of the evils due to habitual or accidental neglect of the health of the people ; it now only remains for me to try, in another lecture, to block out to you such a system of sanitary supervision as will, I think, tend to the abatement or correction of most of these evils. You can easily see already, that although I have talked a good deal about authority all along, and have carefully maintained, on grounds which I think unimpeachable, the right and the duty of the authority to interfere in certain cases, I am not about to rely on authority entirely. We want authority, it is true, before we can effect certain beginnings of reform ; but we want a great deal more than that before we can arrive at a satisfactory care of the public health, on the part of the community.

* See Note M. P. 285.

NOTES TO LECTURE VI.

NOTE L. P. 273.

INFLUENCE OF PHYSICAL CAUSES IN PRODUCING
INTEMPERANCE.

WITHOUT entering into this large and difficult question at any length, I may be allowed to add to the remark in the text, of which it is difficult, from the nature of the case, to obtain much direct proof, the following curious and valuable evidence of Mr. Thomas Brownlow before the Poor Law Commissioners, in their first inquiry into the state of the labouring population. Whether entirely correct or not in its inferences, it is most important as a testimony to the injurious effects of ill-ventilated workrooms on the journeymen; and shews forth an evil of great magnitude, still very imperfectly corrected in many places.

“Mr. Thomas Brownlow, tailor, aged 52.—‘It is stated that you have been a journeyman tailor, and now work for yourself. At what description of places have you worked?’ ‘I have always worked at the largest places in London; one part of my time I worked at Messrs. A——’s, of —— Street, where I worked eight years; at another part of my time I worked at Messrs. S——’s in —— Street, where I worked four years. At Messrs. A——’s, they had then from 80 to 100

men at-work ; at Messrs. S——'s, they had, when I worked there, about 250 men.'

“‘Will you describe the places of work, and the effects manifested in the health of the workmen?’ ‘The place in which we used to work at Messrs. A——'s, was a room where 80 men worked together. It was a room about 16 or 18 yards long, and 7 or 8 yards wide, lighted with skylights ; the men were close together, nearly knee to knee. In summer time, the heat of the men, and the heat of the irons, made the room 20 or 30 degrees higher than the heat outside ; the heat was then most suffocating, especially after the candles were lighted. I have known young men, tailors from the country, faint away in the shop from the excessive heat and closeness ; persons, working men, coming into the shop to see some of the men, used to complain of the heat, and also of the smell, as intolerable ; the smell occasioned by the heat of the irons, and the various breaths of the men, really was at times intolerable. The men sat as loosely as they possibly could, and the perspiration ran from them, from the heat and the closeness. It is of frequent occurrence in such workshops that light suits of clothes are spoiled from the perspiration of the hand, and the dust and flue which arises, darkening the work. I have seen £40 or £50 worth of work spoiled in the course of the summer season from this cause.’

“‘In what condition are these work-places in winter?’ ‘They are more unhealthy in winter, as the heat from the candles and the closeness is much greater. Any cold currents of air which come in, give annoy-

ance to those who are sitting near the draught.. There is continued squabbling as to the windows being opened ; those who are near the windows, and who do not feel the heat so much as the men near the stoves, objecting to their being opened. The oldest, who had been inured to the heat, did not like the cold, and generally prevailed in keeping out the cold or the fresh air. Such has been the state of the atmosphere, that in the very coldest nights, large thick tallow candles (quarter of a pound candles) have melted and fallen over from the heat.'

“ ‘ What was the effect of this state of the work-places upon the habits of the workmen ? ’ ‘ It had a very depressing effect on the energies ; that was the general complaint of those who came into it. Many could not stay out the hours, and went away earlier. Those who were not accustomed to the places generally lost appetite. The natural effect of the depression was, that we had recourse to drink as a stimulant. We went into the shop at six o'clock in the morning ; but at seven o'clock, when orders for the breakfast were called for, gin was brought in, and the common allowance was half-a-quartern. The younger hands did not begin with gin. ’

“ ‘ Was gin the first thing taken before any solid food was taken ? ’ ‘ Yes, and the breakfast was very light ; those who took gin, generally took only half-a-pint of tea and half a twopenny loaf as breakfast. ’

“ ‘ When again was liquor brought in ? ’ ‘ At eleven o'clock. ’

“ ‘What was taken then ?’ ‘Some took beer, some took gin again. In a general way, they took a pint of porter at eleven o’clock. It was seldom the men took more than the half-quartern of gin.’

“ ‘When again was liquor brought in ?’ ‘At three o’clock, when some took beer and some gin, just the same as in the morning. At five o’clock, the beer and gin came in again, and was usually taken in the same quantities. At seven o’clock the shop was closed.’

“ ‘After work was there any drinking ?’ ‘Yes ; nearly all the young men went to the public-house, and some of the others.’

“ ‘What were the wages they received ?’ ‘Sixpence per hour, which, at the full work, made 6s. a day, or 36s. a week.’

“ ‘Did they make any reserves from this amount of wages ?’ ‘No ; very few had anything for themselves at the end of the week.’

“ ‘How much of the habit of drinking was produced by the state of the work-place ?’ ‘I should say the greater part of it ; because when men work by themselves, or only two or three together, in cooler and less close places, there is scarcely any drinking between times. Nearly all this drinking proceeds from the large shops, where the men are crowded together in close rooms ; it is the same in the shops in the country, as well as those in the town. In a rural place, the tailor, where he works by himself, or with only two or three together, takes very little of the fermented liquor or

spirits which the men feel themselves under a sort of necessity for doing in towns. The closer the ventilation of the place of work, the worse are the habits of the men working in them.'

" 'You referred to the practice of one large shop where you worked some time since: was that the general practice, and has there been no alteration?' 'It was and is now the general practice. Of late, since coffee has become cheaper, somewhat more of coffee and less of beer has been brought in; but there is as much gin now brought in between times, and sometimes more.'

" 'What would be the effect of an alteration of the place of work—a ventilation which would give them a better atmosphere?' 'It would, without doubt, have an immediately beneficial effect on the habits. It might not cure those who have got into the habit of drinking; but the men would certainly drink less, and the younger ones would not be led into the habit so forcibly as they are.'

" 'What is the general effect of this state of things upon the health of the men exposed to them?' 'Great numbers of them die of consumption. 'A decline' is the general disease of which they die. By their own rules, a man at 50 years of age is superannuated, and is thought not to be fit to do a full day's work.'

" 'What was the average of the ages of the men at work at such shops as those you have worked at?' 'Thirty-two, or thereabouts.'

" 'In such shops, were there many superannuated

men, or men above 50 years of age?' 'Very few. Amongst the tailors employed in the shops, I should say there were not ten men in the hundred above 50 years of age.'

" 'When they die, what becomes of their widows and children, as they seldom make any reserve of wages?' 'No provision is made for the families; nothing is heard of them, and, if they cannot provide for themselves, they must go upon the parish.'

" 'Are these habits created by the closeness of the rooms, attended by carelessness as to their mode of living elsewhere?' 'I think not as to their lodgings. The English and Scotch tailors are more careful as to their places of lodging, and prefer sleeping in an open place. The men, however, who take their pint of porter and their pipe of tobacco in a public house, after their hours of work, take it at a place which is sometimes as crowded as a shop. Here the single men will stay until bedtime.'

" 'Are gin and beer the only stimulants which you conceive are taken in consequence of the want of ventilation, and the state of the place of work when crowded?' 'No; snuff is very much taken as a stimulant; the men think snuff has a beneficial effect on the eyes. After going into these close shops from the open air, the first sensation experienced is frequently a sensation of drowsiness, then a sort of itching or uneasiness at the eye, then a dimness of the sight. Some men of the strongest sight will complain of this dimness; all eyes are affected much in a similar manner. Snuff is much

used as a stimulant to awaken them up ; smoking in the shops is not approved of, though it is much attempted ; and the journeymen tailors of the large shops are in general great smokers at the public houses.'

" 'Do the tailors from villages take snuff or smoke as well as drink so much as the tailors in the large shops in the towns?' 'They neither take so much snuff nor tobacco, nor so much of any of the stimulants, as are taken by the workmen in the crowded shops of the towns.'

" 'Do their eyes fail them as soon?' 'No ; certainly not.'

" 'With the tailors, is it the eye that fails first?' 'Yes ; after long hours of work the first thing complained of by the tailors is that the eyes fail ; the sight becomes dim, and a sort of mist comes between them and their work.'

" 'Judging from your own practical experience, how long do you conceive that a man would work in a well-ventilated or uncrowded room, as compared with a close, crowded, ill-ventilated room?' 'I think it would make a difference of two hours in the day to a man. He would, for example, be able, in an uncrowded or well-ventilated room, to do his twelve hours' work in the twelve hours ; whereas in the close-crowded room he would not do more than ten hours' work in the twelve.'

" 'Of two men beginning at twenty years of age, what would be the difference in extent of labour performed by them in town shops or in the country?' 'A man who had begun at twenty in these crowded

shops would not be so good a man at forty, as a man working to fifty in a country village ; of the two, the country tailor would be in the best condition in health and strength : in point of fact he is so. The difference may be set down as a gain of ten years' good labour. There are very few who can stand such work as the town shops twenty years.'

" 'The eyes then become permanently injured, as well as fail during the day, in these crowded shops ?'
' Yes ; they do. After forty-five years of age, the eyes begin to fail, and he cannot do a full day's work.'

" 'Supposing a workman to work in a well-ventilated room, and to be freed from the nervous exhaustion consequent on the state of the place, might he not save at least all that he drinks in the times between his meals, or be enabled to apply it better, if he were so disposed ; and, perhaps, the value of the two hour's extra work in the twelve, when he is working piece-work ?' ' Yes, certainly he might.'

" 'Taking your account of the average loss by nervous exhaustion and bad habits to be two hours' work for twenty years, and twelve hours daily work for ten years in addition, supposing him to be employed full time, it would be a loss of the value of 50,000 hours of productive labour (of the value at 6d. per hour of £1250) ; or, if he were only in work half-a-year, at a loss of 25,000 hours ; so that if he were employed the half time at the full wages, or full time at the half wages, such workmen will have lost the means of putting by a sum of not less than £600 to maintain

population at large. The following extracts are from a paper on this subject,* in which a somewhat extended attempt is made to deduce a general law of proportion between the death-rate of all ages, and that of infants under one year. The tabular and statistical data on which the conclusions are founded, are necessarily omitted here.

The Agricultural Counties of England.—"I have been greatly startled to find, in the great corn-growing counties of England, evidences of a flaw in the well-being of the infant population, which must necessarily exert a deleterious influence on the health of these counties, and through them on the English race in general. Not only is the infantile death-rate in many of them high (absolutely higher, for instance, than that of the country at large), but in many cases where this is not so, the infantile death-rate is much higher than it ought to be, considering the amount of the general death-rate; and higher also than it ought to be, considering the eminently rural character of the population, the small size of the towns, and the small number of persons to each acre of surface.

* * * * *

"The evil is least (indeed, hardly apparent) in Wiltshire, Berks, and Herefordshire; in Essex, Suffolk,

* "On Infantile Death-Rates, in their bearing on Sanitary and Social Science," by W. T. Gairdner, M.D. In the Transactions of the National Association for the Promotion of Social Science for 1860.

Bucks, and Oxfordshire, it is unequivocally present, and to a still greater degree in Hertfordshire. In Northamptonshire, the high infantile rate also exists, but may be due in part to the towns of Northampton and Peterborough, which have a character quite distinct from the rural population. In Huntingdonshire, Cambridgeshire, Bedfordshire, Lincolnshire, and Norfolk, the infantile death-rate reaches its maximum, being considerably above that of England and Wales ; and the proportion between the infantile and general death-rate is more than 9 to 1—being in Norfolk 9.38 to 1, and in Lincoln 9.36 to 1. The case of Lincolnshire is peculiarly striking; for * * Lincolnshire has no considerable and generally diffused industry, with the exception of agriculture ; the density of its population is remarkably small, being only 147 persons in one square mile (not much greater than the density of Wales, and much less than that of Cornwall ; it has few large towns to enhance the death-rates, and the largest of its town districts, has an average, as regards infantile mortality, considerably below that of the whole county.

* * * * *

“ I can arrive at no other conclusion for the present than this—that the habits of the great agricultural populations of England, probably of slow formation, and transmitted down from generation to generation, are, in some way or other, apt to give rise to neglect of the family relation, or of maternal duty, or of the general sanitary laws bearing on the health of offspring ; and that the extensive employment of the women in

some counties in special industries is one consequence of this habitual neglect ; while the imperfect rearing of children is another, and a still more widely spread consequence of it. It remains for the local social inquirer, and especially for those who are the natural guides and instructors of the agricultural population, to detect more in detail, and to remedy as far as possible, this deplorable evil.

* * * * *

The West-End of London.—" We might naturally expect that the infantile mortality (of the different districts of London) would bear some appreciable proportion to that of all ages. But the fact is far otherwise. * * The proportion, in fact, between the infantile and the general death-rate, seems at first sight so purely anomalous and arbitrary as to defy interpretation. Thus, in the Strand district, with a general death-rate of 24 in 1000, the infantile death-rate is little more than 19 per cent, while in St. Martin-in-the-Fields, it is nearly 24 per cent, and in Kensington and Chelsea, upwards of 23 per cent, with nearly the same general death-rate. Again, in Greenwich, with a general death-rate close on 23 in 1000, the infantile death-rate is as low as 16.5 per cent, while in Marylebone it is as high as 22.9 per cent, for the same general death-rate. Or to take, if possible, a more extreme instance of variation, in Hampstead the general death-rate is 20 per 1000, and the infantile death-rate 14.6 per cent, or about seven times the former ; in St. George's, Hanover Square, the general death-rate is lower than in Hamp-

stead, being about 18 per 1000 ; but the infantile rate is more than 20 per cent, being no less than eleven times the general death-rate, and between 5 and 6 per cent more than the infantile death-rate of Hampstead.

These facts hardly admit, as yet, of being reduced to any general form of expression. But a careful consideration of them has led me to the discovery of a phenomenon which lies, indeed, on the surface in the Registrar-General's returns, but which I do not remember to have seen stated in the distinct form in which I shall now bring it under your attention. It is this : that all the West-end districts of London, without exception, are fatal to children, in a proportion which is really enormous, when we consider the favourable state of the general death-rate, and the many advantages which these districts have over the others. Let us take, for example, St. George's, Hanover Square, which, with the exception of Kensington, has the lowest infantile death-rate of all these districts, and which has very nearly the lowest general death-rate of all London. The district of St. George's, Hanover Square, with all its wealth, its splendour, and really English comfort, is only a little less fatal to infants than Shoreditch, Bermondsey, or Lambeth ; it is more fatal than the Strand district, or Stepney, which have a general death-rate of 24 per 1000 ; far more fatal than Greenwich, the general death-rate of which is nearly 23 ; and in a still more striking proportion more fatal than Wandsworth, Camberwell, and the outlying districts in general.

“St. James’, Westminster, has an infantile death-rate almost precisely corresponding to that of the river district of St. George’s-in-the-East, and exceeding that of Poplar, Clerkenwell, and Bethnal Green ; Marylebone, tested by the infantile death-rate, must submit to be ranked as less healthy than the Surrey river-side districts of St. Saviour, and St. Olave, and also than St. Luke’s ; while St. Martin-in-the-Fields actually exceeds Whitechapel, and approaches St. George’s, Southwark, in its infantile mortality.”

It is, perhaps, requisite to add, that although the returns from which these deductions are made are somewhat antiquated (being founded on the census of 1841 and the deaths from 1838 to 1844), I have ascertained that in at least two of the West End districts, a similar high rate of infant mortality is still prevalent. The materials for an exact statement, however, do not exist, as, in the publication of the census of 1851, the ages of the very young infants were not reported.

VII.

SANITARY ORGANIZATION.

THE subject of lecture to-day is the organization of the public health movement. If you have rightly understood what I have said up to this period, you will be already aware that a considerable portion of the evils that exist depend upon popular ignorance. These evils depend upon the fact, that the great importance of certain indispensable conditions to the health of masses of population has never been thoroughly and practically brought under the notice of those chiefly concerned. It can hardly be supposed possible that intelligent men would live in the immediate neighbourhood of the foul gases from a bad drain or from a common sewer, if they were properly informed of the evils that in certain circumstances arise from that cause. If men could actually see with the bodily eye epidemic disease arising out of a mass of corruption, and thence stealing into their houses, and cutting off their wives and children, it can hardly be supposed possible but that they would rise up in alarm to leave those dangerous neighbourhoods and those infected houses ; or, at least, they would

insist upon all such places being made fit for human residence. Although, therefore, I have been particularly studious all along to maintain the rightful exercise of authority, in respect to the simplest elements of public health, I am very anxious also to impress upon you, in beginning to speak of sanitary organization, that a very large portion of the work to be done lies beyond the scope of authority and command, while, on the other hand, it lies within the scope of instruction and advice. I am, indeed, fully persuaded that much more is to be done by the latter than by the former ; at all events it is clear to me, that while authority and instruction must in the first instance be carried forward together—authority on the one hand to do away with great and pressing dangers, that cannot be mastered otherwise ; instruction on the other, to deal more thoroughly and permanently with the insidious forms of evil which are beyond the scope of authority—I am, I repeat, fully persuaded that in the end authority will give way to instruction ; that the education of the public mind will prove to be the best, and, in some cases, the only antidote to most of the evils that affect the public health. But I must beg you to observe that the instruction of which I speak is not only what is commonly so called—not only the dogmatic teaching of lecturers and schoolmasters for instance—but also the much more practical lessons of experience, and especially of personal and present experience, carefully conveyed to those that are most immediately interested. The facts connected with our sanitary evils must be unshrinkingly

exposed in detail, in order that those who are to blame, and also those who are sufferers without being to blame, may learn them at the very moment when the lesson comes most directly home to them, from its being associated with the results of neglect. That, I believe, is the only way in which the lessons of public health will ever be taught to the people of this country, so as to touch their practical sense of duty, and to influence permanently their character and conduct.

I have said that ignorance is at the root of most of our sanitary evils ; and I know not how I can more clearly exhibit to you the extent of the ignorance that has to be removed, than by a reference to certain disclosures that have come to light only the other day, as regards the accommodation of our soldiers in barracks and in hospitals. From the facts I have to mention presently, I think you will clearly perceive that the forms of ignorance I have been referring to are not to be found only among the low and uneducated masses in our large towns ; not only among those who have themselves been brought up in the midst of filth and neglect ; but also, and to a most formidable extent, among those who have been charged with the organization of great public departments. For how, if not through the most deplorable ignorance, can it be explained that in the army, the very seat and centre of authority, where power can do everything, and where the very object of power is to keep the whole machinery of war in fighting order, we have nevertheless allowed our soldiers, year after year, to dwell, to sicken, and to

die in places that in reality are totally unfit for the habitations of men? Yet so it is. We have done this through ignorance, and through ignorance alone; for it is not to be supposed either that the authorities of the army would have declined to require, or that the nation would have refused to afford, the means of life for the soldier, had the true state of the case been generally known. You are all aware, probably, that a Commission was appointed at the close of the Crimean war, to inquire into the events of that disastrous, though in the end successful, campaign. Now, the result of that Commission was simply to shew, that in consequence of the neglect of well-established principles, and the absence of a proper organization for the remedy of errors of detail; in consequence, among other things, of the complete subordination of the medical department of the army to the other departments, the army had ceased to be a serviceable machine at the time when it was most wanted; it had been so badly cared for in time of peace as to be totally unable to bear the first strain of a great war; and hence arose the calamities of that terrible winter of 1854, when we lost so many of our brave soldiers, not through the accidents of war, but through gross neglect of the ordinary conditions of a healthy life. It was shewn, moreover, that almost every great war in which we had been engaged had found us equally unprepared; and that the state of the army, in times of the most profound peace, was such, that merely to be a soldier was to live in the midst of premature death, whether in action or in barracks,

whether at home or abroad. The picked lives of the community (for a soldier's is always a picked life) were found to be in fact among the most rapidly destroyed ; and some of the finest and most select regiments in the army itself (as, for instance, the Coldstream Guards) were found to die, in London, and in time of peace, at a rate far beyond that of the general population at the same ages ; a rate comparable only to that of the most sickly and degraded populations. It was further shewn that this great mortality was chiefly due to diseases depending on overcrowding, and that overcrowding and deficient accommodation of various kinds in barracks were, in fact, the most probable causes of the greater part of this excessive mortality. These painful revelations led almost immediately to a new Commission, which was charged to inquire into the state of all the barracks and military hospitals in the United Kingdom. It is from the report of this second Commission that I extract the details which I now submit to you.

It appears, then, that for a considerable time past, 450 cubic feet has been understood to be the minimum allowance of space proper for each man in a barrack. This minimum allowance is, indeed, as we have good reason to believe, far too low ; we may well suspect that it is so, and that it is difficult for a high state of bodily health to be preserved among full-grown and robust men with a minimum of 450 cubic feet of space, when we find that this allowance is pretty nearly the actual minimum adopted under the Common Lodging Houses Act, in the lowest parts of our towns,

because of its being hopeless to get any more under the circumstances. The Commissioners, accordingly, have no great difficulty in arriving at the conclusion that this minimum is decidedly too low, and that the absolute minimum that ought now to be allowed is 600 cubic feet per man. I think every one who knows the real state of the case, and who calculates what 600 cubic feet are, will agree with the Commissioners. But what do they find to be really the facts as to the state of our troops in barracks? Why, that out of 76,813 men lodged in barracks, only 2003 have more than this same minimum of 600 cubic feet of space; that about 65,271 have less than 500 cubic feet; that 34,882 men, or nearly one half, have less than 400 cubic feet; less than the minimum fixed years ago, after inquiry into the subject; that 15,195 men have less than 350 cubic feet; and, terrible to say, that 1335 men have less than 250 cubic feet of space, *i. e.*, little more than a third of the free space considered to be absolutely necessary for each man, for keeping him in a state of high health. The Commissioners, accordingly, conclude, that in order to make our barracks reasonably healthy, it would be necessary to extend the accommodation for the whole of our army by not less than one-third. In the military hospitals, again, the state of matters is equally bad, or even worse. It is now pretty well understood, in all well-conducted civil hospitals, that less than 1000 cubic feet of air, per patient, ought not to be thought of for the sick; and there should even be more room, in most hospitals, in case of any

infectious or epidemic diseases becoming prevalent, and especially in wards occupied by acute diseases, where the inmates are of necessity confined to bed all day long. Now in the barrack hospitals which were the subject of inquiry, out of 7167 beds, only 264 had anything like this amount of space, and those which had sufficient space were generally not those in the ordinary wards. These facts shew, and many more of the same kind might be adduced from this report to shew, that the ignorance existing as regards the nature and causes of the most serious sanitary evils, is not confined to any one class of the population, and that the most ample authority, exercised under the most favourable conditions for complete organization of the health of communities will fail to secure its end, unless care be taken that the persons entrusted with the working of the system are properly instructed in the matter.

This evil of popular ignorance, which is at the root of so much injury to the public health, is also to be found among the most apparently enlightened members of the civil community. Dr. Neil Arnott, in his evidence before the Health of Towns' Commission, gives a very strange instance of this. He says :—

“In the Zoological Garden in the Regent's Park, a new house was built to receive the monkeys, and no expense was spared which, in the opinion of those intrusted with the management, could ensure to these natives of a warmer climate all attainable comfort and

safety. Unhappily, however, it was believed that the objects would be best secured by making the new room nearly what an English gentleman's drawing-room is. For warming it two ordinary drawing-room grates were put in, as close to the floor as possible, and with low chimney openings, that the heated air in the room should not escape by the chimneys, while the windows and other openings in the walls above, were made as close as possible. Some additional warm air was admitted through openings in the floor from around hot water-pipes placed beneath it. For ventilation in cold weather, openings were made in the skirting of the room close to the floor, with the erroneous idea that the carbonic acid produced in the respiration of the animals, because heavier than the other air in the room, would separate from this, and escape below. When all this was done, about sixty healthy monkeys, many of which had already borne several winters in England, were put into the room. A month afterwards more than fifty of these were dead, and the few remaining ones were dying. This room, open only below, was as truly an extinguisher to the living monkeys as an inverted coffee-cup, held over and around the flame of a candle, is an extinguisher to the candle. Not only the warmth from the fires, and the warm air that was allowed to enter by the openings in the floor, but the hot breath, and all the impure exhalations from the bodies of the monkeys, ascended, first, to the upper part of the room, to be completely incorporated with the atmosphere there, and by no possibility could escape, except as a part of that impure atmo-

sphere, gradually passing away by the chimneys and the openings in the skirting. Therefore, from the time the monkeys went into the room until they died, they could not have had a single breath of fresh air. It was necessary only to open, in the winter, part of the ventilating apertures near the ceiling, which had been prepared for the summer, and the room became at once salubrious.”—*Report of Health of Towns’ Commission*, pp. 52, 53.

It is worth while to mention here, without going into detail, that Mr. Chadwick gives a remarkably instructive instance, in the first Sanitary Report, of a similar piece of stupidity, applying to the human subject. In the construction of a large lodging-house in Glasgow, he found that absolutely no provision had been made for ventilation ; and the result was, that in that lodging-house, there was almost constantly an appalling amount of typhus fever ; which, however, Mr. Chadwick assures us, disappeared completely and permanently from that house, so soon as a simple and effective ventilation was introduced into the roof of each room. And here is another instance from Dr. Arnott’s evidence of the same thing in a school :—

“The day after I saw the monkey-house just mentioned, I was sent for to visit a young gentleman at a respectable school in the neighbourhood of London, where there were about forty boys. The boy I went to see was thought to be falling into consumption, and I

learned that others of the boys also were ill. On examination, I found the cause to be only a less degree of the error which had destroyed the monkeys. The two cases struck me forcibly, as illustrations of the little knowledge on the important subject of the essentials to health possessed by persons otherwise highly accomplished.

“ ‘Then the school was neglected in the same way?’
‘Yes ; a new school-room had been built at the back of the dwelling-house, in which room the forty boys spent much of their time, and there was no opening by which their breath could escape from the room, except through the low fire-place. There was, indeed, a skylight above with sashes, which might be opened ; but the school-master told me that he took care never to open these when the boys were present, because, having done it once, a boy got severe inflammation of the lungs, in consequence of the cold air rushing in upon him. This gentleman had gone to great expense to secure, as he thought, the health and comfort of his scholars ; but, from want of knowledge on the subject, had missed his aim, just as had happened in the case of the monkey-house.’

“ ‘Was not that monkey-house constructed, as it was believed, with the aid of the best available knowledge on the subject?’—‘It was ; persons were employed whose special profession it was to manage such matters.’ ”—*Ibid*, pp. 53, 54.

Dr. Arnott further tells us that a very large pro-

portion of the houses of the lower classes in London and elsewhere, have the windows so constructed as not to come down at the top ; which, with small rooms, is a quite certain method of securing that there never can be fresh air in the room by day or by night. He argues most reasonably and justly, that the very fact of the construction of such windows is a clear proof of lamentable ignorance, both on the part of those who build the houses, and of those who live in them.

You will observe, then, that wherever we go in the endeavour to carry out our sanitary reforms, whether among rich or poor, among professional and scientific persons, or among the general public, nay, even within the sphere of the public services and of authority, we find a great amount of ignorance as to the first principles of the preservation of health ; and the enlightenment of this ignorance by a display of the practical consequences of neglect, is really the first and the best thing that we can do towards a permanent improvement. My idea, therefore, of an efficient sanitary organization is founded on this double relation of it to authority and to instruction. It must be able to summon authority to its assistance in cases of emergency ; but it should keep itself before the public chiefly as an instructor and an adviser ; it should find its chief business in watching and controlling those evils which authority cannot reach directly ; which can only be reached through the power of public opinion.

Let me now endeavour, in accordance with the views

presented throughout these lectures, to bring before you, a little more in detail, the method and objects of sanitary organization, as I understand them. Of course, I am fully aware that the details of such an organization as I contemplate, are far beyond the scope of a single lecture ; and would involve, besides, a great deal on which I am not prepared to advance a matured opinion. The working machinery, so to speak, of such a scheme must be the growth of time, and must be carefully adjusted in accordance with experience, and in harmony with that enlightened public opinion, to which we have appealed as the power by which the work of reform is mainly to be effected. It is, therefore, not desirable, even if it were possible, to prescribe the exact form, or anticipate too much the details of our organization. But we may fairly keep in view that there are certain great objects, or leading principles, which must of necessity be carried out, whatever form the organization may ultimately assume. It may even happen that the local machinery may vary with advantage ; that the objects to which I refer may be carried out better in one place by one method, and in another place by another method ; but carried out they ought to be, and, indeed, must be (if we are to have a real reform of the public health) in every town, village, and even hamlet, all over the country.

The first object of sanitary organization is to obtain detailed information as to the mortality of the population, and as to the special incidence of that mortality upon each sex, and each age, on separate places, on

various occupations, and so on ; in fact, to present a detailed account of what may be called, in commercial phrase, *our transactions in human life*. The account-current of our local, as well as national, mortality should be so kept and so *balanced* from time to time, as to give us, at each moment, a correct idea of our expenditure in this matter of human life—a matter, surely, at least as important to our prosperity and to our safety, as all the cotton of Lancashire, and all the gold of the Bank of England. This single object would be enough of itself to justify us in instituting a complete sanitary organization, extending all over the country in detail. I need not tell you that the Registrar-General presents a great many most valuable summaries of vast masses of facts of this kind ; but they extend over too large an area to enable them to be applied to the case of reforms demanded within a comparatively narrow range. If you tell the inhabitant of a large town, for instance, that the death-rate of that town is too high, he says, “That may be so, but it does not greatly concern me ; it touches somebody, no doubt, but not me. The people this increased mortality affects are here, there, and everywhere ; I know nothing about them, among so many thousands.” The phenomena of the death-rate, as noted by the Registrar-General, though beyond all price as a scientific basis for further inquiry, are very difficult to bring home to the conscience of the individual man. But calculate the rate of mortality over a series of years so as to approximate, even, to the truth as respects particular

districts or streets, or even houses and groups of houses ; take, for example, the workmen of a particular factory, or the inhabitants of a particular lane, the occupants of a few of our ill-drained closes, the neglected tenants of some of our picturesque, old, rickety houses ; take the inhabitants of even a dozen or two of over-crowded flats, or "lands," containing a population large enough to calculate death-rates upon, and of tolerably uniform appearance ; shew these people palpably, clearly, and as matter of positive fact, that they are dying, for some reason or other, at twice the rate of the population in general ; and I imagine you bring home to them a truth, with which even the most passive among them will not easily rest satisfied. We want, then, not only death-rates, but detailed death-rates. We want such returns of mortality as shall shew clearly the variations of the death-rate, both from epidemic disease and other causes, among certain limited classes of the population, in certain limited localities ; and also any permanent excess in the death-rate of these classes and localities, as compared with that of the general population. I have tried this to a certain extent, and therefore I know that it can be done, though not without a good deal of difficulty and expense, when done by individuals. I endeavoured some years ago, to make out a statement of a few such detailed death-rates for different parts of Edinburgh, and the result was to shew a most remarkable difference in the mortality in various parts of the town. Thus, in certain selected streets of the New Town, I found a

mortality not exceeding sixteen or eighteen in each thousand living ; while in certain closes in the Old Town, the death-rate amounted to thirty-three in a thousand ; and for males, it was more than forty in a thousand.* I am quite certain, moreover, that these were by no means the most neglected populations, nor the worst closes that could have been found.

But the difference in the death-rate of these localities was a very great deal more striking, and probably also more trustworthy as a deduction from the facts, in the case of young children, than of the population at all ages. Thus, in the best quarters, the death-rate of children under five years was less than fifty in a thousand ; while in the worst of those examined, it was apparently not less than 173 in 1000. And here I must remark, that I believe, in the end, the infantile mortality will be found the truest and the best test of the sanitary state of a district. You may estimate the death-rate either for infants below five years old, or for those below one year old ; take it either way, it forms a most admirable test of the condition of the household ; of the habits, morals, and physical condition of any limited population that you wish to observe. It is especially a good test, because it is capable of being applied with a degree of limitation, and of being pressed home with a degree of force that can never be attained in the case of the general death-rate. You can shew variations in it that you cannot shew in the other ; for while the death-rate of all ages

* See Note N, p. 344.

varies at the most from fifteen to something upwards of thirty in a thousand, you will find that the death-rate of infants under one year varies in a much more remarkable manner ; being in very healthy districts from 77 to 100 in a thousand, in medium districts from 100 to 200, and in very unhealthy districts from 200 to 300, or even more. Now, it is quite an attainable object to ascertain the infantile death-rate of even a very limited district. You can in any such district (say in a few dozen houses, inhabited by a few score, or at most, a hundred or two of families) even in such a limited number, you can get at valuable and instructive facts, and so bring home to the personal feelings, as it were, of the inhabitants, and especially of the mothers, that their helpless infants are dying at an undue rate ; a fact that appeals at once, not indeed to the gross instinct of self-preservation, but to feelings quite as valuable for purposes of good, if they can only be called into active operation.

Some time ago it occurred to me to apply to a number of my medical brethren, with the view of finding, in their separate spheres of practice, what were the variations in the mortality of infants under one year of age in the entire population, and also among different classes of the community. The results were so far interesting, that I think it right to submit them to you, although the numbers are too small to afford permanent and fixed conclusions, and they are therefore only an index to what might be done by a more extended inquiry. You see them here in a condensed form :—

Table exhibiting the number of deaths under one year of age, among given numbers of children born in several districts of town and country, according to returns furnished by medical practitioners having personal knowledge of the facts.

	Born.	Died under one year.	Per cent.
District (A) (country) .	277	11 =	3.97
„ (B) (country) .	288	22 =	7.64
„ (C) (country) .	267	23 =	8.61
„ (D) (country) .	257	32 =	12.5
„ (E) (town) .	406	29 =	7.14
Legitimate children .	977	73 =	7.32
Illegitimate do. .	92	15 =	16.30
Farmers' do. .	100	7 =	7
Farm servants' do. .	111	8 =	7.2
Labourers' do. .	115	16 =	13.9
Artizans' do. .	146	9 =	6.85

REMARKS ON THE TABLE.

The following briefly stated particulars may serve to make the tabular statement more useful, the reader being referred for more full details, if required, to the *Edinburgh Medical Journal* for November 1860, p. 437:—

(A) is a pastoral and rural district, occupied chiefly by sheep farmers, with their shepherds, farm-servants, and labourers; the principal country town being also a summer resort of the better classes, and reputed eminently healthy.

(B) is an almost purely agricultural district, with a small town of 1000 inhabitants, having an endowed school for boys. Population chiefly farmers, labourers, shop-keepers, and a few of the professional class or gentry.

(C) is a populous district in the neighbourhood of Edinburgh, mostly agricultural, but with a certain amount of male and female population employed in mills, and also with one or two collieries.

(D) is a purely agricultural district, with the exception of some collieries and a little hand-loom weaving in the principal village, which is almost exclusively inhabited by artizans and agricultural labourers, and is remarkably well kept. Another village, partly inhabited by colliers, suffered severely from cholera in 1854; but the rest of the district was exempt.

(E) is formed by the combination of the facts rendered by two family practitioners of the highest respectability, one in the New Town, the other in the Old Town of Edinburgh. The results are so nearly similar, that it has been thought better to combine them, the numbers being rather small. In both cases the *lowest* class of the population may be regarded as excluded from the returns, the practice of these gentlemen being entirely among the middle and respectable working classes.

The illegitimate births are in largest proportion in (B), in which they form upwards of 12 per cent of the births; in the other country districts they were from 6 to 8 per cent; in the two town practices they were insignificant in number.

The class of farmers includes tenants and occupiers of farms, living by the cultivation of the soil. The class of farm-servants includes ploughmen and all other *male* servants living on the farm. Labourers, on the other hand, includes, as nearly as possible, the wage-receiving class that is hired from week to week without a fixed engagement or residence. The class of artizans includes all manner of skilled labourers and journeymen. In all these cases the aggregates are formed out of all the returns of districts indifferently. The other classes of the population were in too small numbers to afford any approach to trustworthy conclusions. The children were placed according to the *fathers'* occupation in all cases except in that of illegitimate births, which form a class by themselves.

You may take these results with any degree of qualification you think right, on account of the limited numbers from which they are derived ; and it is certainly desirable to increase the basis of observation, as regards the number of individual facts, before founding conclusions upon them. But you see that in this table you have apparently very considerable differences in the proportion of deaths at that early age, and this even among infants born under the care of medical men. Now, remember that the children born under medical care are very often not the lowest or the most neglected class ; for these are commonly brought into the world by midwives, or by any neighbours that happen to be at hand.* It is particularly striking to observe the great difference here between the mortality of all the other classes of children, and that of the children of "labourers." The deaths among the artizans' children, *i.e.*, among those of men who live by skilled labour (as it is called) are less than half those among the children of the common labouring man ; and the mortality of the labourers' children is also nearly double that of the children of farm-servants. It is also very interesting to observe that the mortality of illegitimate children appears to be more than double the mortality of legitimate chil-

* The employment of medical men as accoucheurs is to a very different extent in different districts. One of my informants is certain that most of the mothers of illegitimate children are attended by the midwife ; while another assures me that "there are no births in this neighbourhood not attended by a medical man, except a very few cases of rapid delivery."

dren ; and although, as I have fairly confessed, the numbers are too small to allow of a fixed value to be attached to them, yet they are the indications of truths which might probably be obtained without much difficulty upon a larger basis, and so be rendered practically certain, and turned to good account in future. The mode in which I procured these calculations was this. I asked a number of friends, whom I was sure I could trust as to details, to go back upon the books in which they recorded the births under their care, and to make exact inquiries with regard to two or three hundred of them as to the number of children that had survived the first year. This mode of inquiry might be pursued in many places, and might be so managed as to furnish an admirable test of the sanitary condition of a locality, and of the different classes of the population.

I affirm, then, that the first great object of sanitary organization should be *to watch the death-rate* ; to watch it not only over a city or a parish, but in detail ; to watch it with due regard to differences of age, sex, place, and circumstances ; to watch it from month to month, and even, if possible, from week to week ; to watch it as affected by different diseases, particularly what are called epidemic diseases, and such diseases as we have reason to believe to be in a great degree preventible ; and this done, to make known the result from time to time, especially to those who are chiefly concerned in sanitary evils, and their removal, so as effectually to bring home to the dwellers in darkness,

ignorance, and disease, the immense significance of the facts taught by these figures.

Another kind of information which would be most valuable to the sanitary reformer, and which is therefore a legitimate object of a thoroughly efficient inspection, is that which bears on the amount of sickness, and especially of epidemic disease, in the community. I need hardly point out to you that by far the greater number of cases of disease end in recovery; and yet the amount of positive suffering and loss to the community through such cases may be not less than through those that prove fatal. In the case of epidemic diseases, indeed, an immense amount of privation, and of positive danger to the public, springs from cases which may be of comparatively little danger to the individual; for such diseases being very often infectious, and their infection being communicated quite as easily from a mild as from a dangerous case, it is clear that for every death in the registrar's books there is a vast amount of truly avoidable sickness which never appears there at all.* We

* From facts brought forward some years ago as regards Provident societies among the working classes, it may be inferred, that for every death among the members, there were not less than 465 days of sickness so severe, as to lead to successful applications for relief. Thus, among 7,180 members of Provident societies, whose average age was under 35 years, the average annual amount of sickness experienced by each member was 7.046 days; while the rate of annual mortality was only 1 in 66. It is clear, therefore, that in this community of hard-working and careful men, each man that died represents a loss to the community of more than a year and a quarter of more or less produc-

require, therefore, under a well-organized sanitary inspection, some information, regularly rendered from time to time, as to cases of acute and epidemic sickness occurring, especially among the poor, so that the first traces of serious danger may be noted, and everything done to give warning in the proper quarters. And this information, I need hardly say, can only be derived from medical men; from the physicians of hospitals,

tive labour through sickness, independent of the ultimate loss by death, in so far as that may have been premature and avoidable. But if the causes of mortality are avoidable, the causes of sickness are also in all probability avoidable to a corresponding, or even a yet greater degree. Thus consumption, one of the diseases shewn in the preceding lectures to be to a considerable extent avoidable, is commonly, though somewhat vaguely, estimated as running a course of from one to two years, on the average of cases, previous to its fatal issue; and most cases of this disease certainly involve the loss of many months of labour in the productive period of life. Even the most rapid and the most fatal epidemic fevers involve a large extra charge to the community on account of sickness, over and above the loss by death. In the most fatal period of the most severe epidemic of typhus I ever witnessed, about 1 in 4 of those admitted to hospital died. It would certainly not be too much to calculate the average loss of time in each case at more than an entire month, including the convalescence of those who recovered; for their average residence in hospital amounted to little less than this, and few cases were allowed to remain longer than was absolutely necessary. For every fatal case, therefore, there must have been at least *four months* of serious illness. In other less fatal epidemics, the proportion of sickness to mortality would of course be much greater.

dispensaries, refuges, asylums, schools, etc. ; from parochial and infirmary surgeons ; and from all such medical men as may be willing to communicate facts from their private practice, under proper regulations, for the public good.

Now let us see what can be done with this information, supposing we can obtain it through our sanitary inspector, acting in concert with the medical profession. We must suppose the sanitary inspector, or medical officer of health, to be a man of tact and good judgment, able to act on his own responsibility, and so as not to give offence. The moment he observes the death-rate to rise anywhere, or the moment that an increase of sickness is reported anywhere, he should be on the spot to make inquiries in a friendly spirit, and to see what can be done by personal influence, by the power of knowledge, by good advice, and by the offer of assistance wherever it may be required, to remove or abate the danger. It is very clearly desirable that immediate action should be taken upon these facts, when once clearly ascertained, and that we should by no means wait until the public is alarmed, and epidemic disease has become unmanageable through neglect. The action, however, must in the first instance be *within the homes of the sick*, and of those that are threatened with sickness. The sanitary inspector, or officer of health, must be a practical missionary of health, only thus far differing from the physician, in respect that he anticipates the function of the physician ; he goes where disease is *impending*, as well as where it actually exists ; he goes

to avert and warn, rather than to cure existing disease. His function is to watch the first germs of disease, and to prevent their development. He therefore places himself in contact with the entire neighbourhood of disease as much as possible ; and if his friendly advances are resisted, he may even call in the aid of the authorities at this stage. At all events it is his business to report to the proper quarter all nuisances requiring immediate correction, all deficiencies of water-supply, all cases of gross over-crowding, of evidently defective drainage, of unwholesome food distributed to the population. But while intimating such facts to the authorities, it should be at the same time his duty to do all he can towards their remedy, by means short of the exercise of authority. He should use arguments and remonstrances with individuals ; he should point out to those who were chiefly affected the dangers they were incurring, and he should teach them the most simple means of avoiding these dangers. If by such efforts as these he could not succeed in accomplishing the desired results, it would then be time to call in the aid of authority. All this, I need not say, would require to be done with great discretion and judgment ; but we have the great experience of the metropolis to shew us that it may be so done without offence, and with very great practical advantage. In fact, a well-organized sanitary inspection is in every respect a great boon to the poor, and sometimes even to the rich. It is a security against neglect and indifference—a warning to the thoughtless and to the erring. In cases of difficulty, also, an officer of

health becomes a neutral and impartial, and therefore a most useful medium of communication, in the interest of the public, between individuals or parties having conflicting views and interests. I shewed you, when we were speaking of the water supply, the great importance of some arrangement of this kind, even in small places; for I gave you an instance in which the inhabitants of a village were greatly stinted of water, chiefly because there were private interests which could not be rightly adjusted; and although complaints were made, there was no one in a position of authority and influence sufficient to overcome the obstacles, or even to give due guidance and expression to public opinion in the matter.

In diffusing information about the public health, as well as in carrying out reforms with the aid of public opinion, we require to act in a twofold manner; we must, in each particular locality, bring the facts of experience to bear immediately and directly upon the question of local reforms; and we must, at the same time, not lose sight of the larger lessons to be learned from combining and comparing the experience of many different districts. The general doctrines that arise from the accumulation of particular instances, gathered from an extended field of observation, require, as much as the particular facts themselves, to be kept before the attention of the community; and there should accordingly be persons whose duty it is to investigate these general doctrines, and press them into the service of the local inquirer. And such persons, the central managers of our sanitary organization, are in a favour-

able position for aiding the weakness, or controlling the errors, of local officers, provided always they are not allowed to arrogate too much power, or to subject the whole system to the caprice of two or three irresponsible persons at headquarters. To avoid this danger, which past experience in England has shewn to be not unreal, it has been found expedient in practice to limit the power of the central board to that of inspection ; leaving to the local authorities all real exercise of positive power, if required, for the removal of particular abuses ; and of course, with the power, leaving to them also the ultimate responsibility. This plan is, no doubt, in accordance with our general system of government, and with the habits and feelings of the people. It is the plan at present in operation in England, and I have already told you that its operation has been hitherto extremely satisfactory.

We need, then, a general or central board to advise and inform the local authorities ; to guide the course of local inquiry, and throw light upon its difficulties ; to stimulate apathetic or culpably negligent municipal bodies by inspection and exposure of their neglect ; to secure observations upon a uniform plan in certain cases, so as to arrive at results valuable for the whole community ; and to form a court of appeal in doubtful matters involving legal considerations, which may require to be brought before the courts of law, or even before Parliament. And we need, also, local officers and inspectors of health to do the whole work of local sanitary organization, as I have explained it, whether

by inspection alone, *i.e.*, watching carefully over the facts requiring interference, and diffusing information about them ; or by the use of personal influence ; or, finally, by calling into operation the powers of the law to reform inveterate and intolerable abuses.

So much should be done, I think, in the way of sanitary organization by the authority or authorities charged with the general interests of the community. By appointing such officers as I have described, you have not, indeed, acquired a complete organization, but you have made a beginning. You have taken security that the subject is not to be dropped out of view, or to be left to the caprice of individual judgment ; that the interests of the public at large are to have everywhere an official interpreter ; that the wants and sufferings of the poor and weak are to be considered, and their ignorance in some degree enlightened. But a properly constituted sanitary authority is only the beginning of a true sanitary organization. The officer of health has not only to execute the decrees of public opinion ; he has also to form and guide public opinion. He is officially the friend and help of the helpless, and he will consider all the voluntary agencies engaged in this good work as so many tools to work with. Whatever individuals, societies, churches, missions, etc., have already acquired the confidence of the poor, he will gladly call to his aid, without distinction of sect or party. By prompting and stimulating all of these, by furnishing them with facts to work with, and principles to apply in detail, he will lay the foundations of a

great and permanent reform, without any additional charge upon the public ; and thus we shall have in every place the first elements, at least, of what I have proposed to call a "home mission" of health, engaged in visiting the dwellings of those that are most exposed to the causes of premature death ; and in teaching the poor and ignorant, by the diffusion among them of the facts elicited by sanitary inspection, such lessons as will lead them to help themselves, as well as to claim the assistance of others, in the work of their own physical and moral improvement.

There are certain contingencies, and certain objects of great importance, which may probably require, at least in large communities, the services of a distinct and special visitation by instructed persons, and generally by medical men—a truly medical "home mission," in fact, attached to the department of sanitary inspection. In the immediate presence of great epidemics, for instance, it has been found desirable to extemporise a thorough system of "house-to-house visitation" in the districts threatened with attack ; and the aid of medical men, and also of medical students, or of those who have just completed their studies and not yet settled in practice, has been employed with great advantage in this double function of giving warning of the approach of disease, and treating it when it has occurred. In some of the worst districts of the metropolis, as well as in Liverpool, Hull, Dumfries, and several other places, the cholera was so met ; and the testimony of all concerned is to the effect that the pre-

monitory symptoms of the disease were often checked, and therefore, in all probability, many lives were saved by this precaution. Now that we know so much more accurately than before the causes of cholera, it is probable that much more might be done in this way ; and in the case of other epidemics, also, when serious disease is known to be impending, there is little doubt that a medical house-to-house visitation should form a part of every scheme of sanitary inspection. It is certain, at least, from the experiments that have already been made, that the presence of medical men in such critical circumstances—the knowledge that they are at hand, as it were, even to anticipate the emergency—gives a feeling of confidence to the poor that can be given in no other way ; and it is equally certain that the education of the medical profession, and especially the younger members of it, to their duties under the pressure of epidemics, is best accomplished by placing them in contact with the field of duty as early as possible, and thus allowing a defined plan of action to be carried out under special instructions, and with the best information that can be procured on the spot. And I beg you to observe, that medical men themselves—though they rarely complain, and still more rarely desert their posts in the hour of danger—have much reason to feel aggrieved when this precaution is neglected ; for the result of the neglect is simply to throw an intolerable and perilous burden on the shoulders of a few, who are sure to be overworked and exhausted long before the crisis is over, if indeed they do not fall victims to their

zeal and sense of duty, as has happened to too many of them on such occasions in the past. I need not say that work so done, under excessive pressure, is sure to be but half-done ; I would say *ill-done*, but that it is usually performed up to the very limits of the power of those engaged, in the face of difficulties and dangers, which it is not too much to call overwhelming, and which have, in fact, at times caused the irreparable loss of the most valuable lives at the very moment when they were most important to the community. Dr. Stokes has, in a melancholy but most instructive paper,* shewn forth the terrible tribute paid by the medical profession to epidemic fever in Ireland ; and even here, in Edinburgh, there are few of us of some years' standing in hospital practice, who cannot recall many dear companions in duty, and personal friends in trying times, that have paid the fatal forfeit of a sincere and most disinterested devotion to the claims of their art and the concerns of the poor. I study to avoid the language of exaggeration ; the facts, I hope, need no artificial colouring to give them their due effect. The simple truth is, that we are too often entirely disabled and overcome in the presence of great epidemics, because, in general, it happens that no adequate precautions have been taken by the public to anticipate the danger, and to prepare for it by increased medical assistance. In Dumfries, for instance, in the epidemic of cholera in 1848, the services of the nine resident medical practitioners were at first accepted by

* See Note O, p. 352.

the Parochial Board, and were, as Dr. Sutherland wrote to the Board of Health on December 9, "afterwards dispensed with, on account of some pecuniary consideration, and apparently without a thought as to the probable result to the poor. Two (he adds) were eventually employed, and two strangers from neighbouring parishes were brought to the town. A great amount of work was thrown on these four individuals, and as a consequence one of them became dangerously ill with cholera at Dumfries, and another was seized at Lockerby." Now, in this case of Dumfries, it appears that up to the time of Dr. Sutherland's arrival no additional assistance had been sought, and on the very morning of his letter there were only two medical men on duty, while the others who had at first been employed had "suffered more or less from the epidemic, with two exceptions." I need not say that by such gross neglect as this on the part of the public, we of the medical profession are the sufferers ; but the poor are sufferers still more. On the part of the poor, therefore, as well as of my own profession, I claim all due consideration for those who are to have the duty of treating epidemic disease. It is a very grave responsibility, a very serious and dangerous duty ; we cannot afford to have it trifled with, even although we should incur the suspicion of speaking in our own interest. But in truth, we have absolutely no interest in this matter which is not really that of the public in another form. We, certainly, are more than others liable to be placed, by the sheer necessity of the case, in positions of danger and difficulty in the

presence of epidemic disease. Is it too much, then, for us to ask that this service be considered a special service, and that some pains be taken to foresee the coming necessity, and to provide for it in good time by a preventive, as well as a curative, organization? To deal adequately with epidemic diseases, we require to have at our disposal time, and men, and means; and surely none of these things ought to be left to chance in a civilized community. Yet it would not be too much to say that, in Scotland at least, the medical arrangements in epidemic seasons have hitherto been left to voluntary and extemporaneous associations, or to the precarious, and often very inefficient, preparations of parochial boards; and these have, as a rule, resolutely shut their eyes to the coming danger till it was too late, from the mistaken impression that to know the truth was to minister to a panic, and to incur needless expense. I need not point out to you, after what has been said, that it is only through systematic sanitary inspection in ordinary times that the necessity for extraordinary exertions can ever be justly estimated, without either exaggeration or remissness. The existence or non-existence of such inspection is, therefore, so far as the public are concerned, simply the question whether epidemic diseases are to be well or ill managed in detail; while to us of the medical profession it is the question whether, at every serious crisis, we are to be placed by the necessity of the moment on a service which may be likened to a "forlorn hope;" or to be fairly confronted with our enemy, disease, upon the

conditions of ordinary and legitimate warfare. It is whether we are to fight under accomplished generals, and with all the known means of attack and defence, or each man for himself, amid confusion and darkness, not knowing either the strength of the foe or our own power of resistance.

Let us look, for instance, at a single example. There is one epidemic disease of which we have long had the means of control to a great extent in our hands ; and that by a proceeding so simple, so inoffensive, so easy of application, so unquestionable in its results, that not to have used it to the utmost limit consistent with good government is, in effect, to have incurred the needless sacrifice of multitudes of lives. What have we done with vaccination, since its early trials in 1798 proved an epoch in the history of the medical art ? The answer must be, unhappily, that of all the European nations we have availed ourselves most sparingly of this great protective agency ; and have reaped our reward in the much greater frequency and mortality of small-pox among us than among the people of almost any other country in Europe. And yet the fault has assuredly not lain, as clamorous zealots constantly affirm, on the side of the medical profession ; for never before, in the history of the world, was a great discovery so cordially welcomed and so rapidly carried to the ends of the earth through the sheer force of medical enthusiasm. It was not, then, because Jenner's discovery was unappreciated among us that we have failed to enjoy to the full the immunity to be derived from it ; but because

we had long accustomed ourselves to consider that the prevention of disease, even when epidemic, was a matter chiefly of private concern, and therefore not to be brought within the plan of a regular organization or of a legal enactment. Hence it happened, that, while the despotic and centralizing governments of the Continent found no difficulty in securing a large measure of effective vaccination among the people at large, our own constitutional and municipal systems, resting upon public opinion as their basis, seem to have failed, by comparison, in this matter ; or rather, have made no serious attempt to succeed, and have left the vaccination of the people to be carried out entirely by individuals, or by voluntary associations subsisting on the precarious charity of the rich in the great towns. The practical result of this entire neglect on the part of the authorities has been that the interest which the public at large have in the general diffusion of vaccination has been too much overlooked. All men accessible to instruction have indeed been taught to regard this little operation as an important measure of protection for themselves and their families ; but it has comparatively seldom been presented to view as a duty which good citizens owe to the community. An important argument has been lost sight of, a valuable lever for moving the ignorance and apathy of the people in this matter has been thrown away, in consequence of the neglect of Government to display an enlightened interest in vaccination, and to plead for it on behalf of the community. The poor have been led to suppose that the

adoption of this security was a matter entirely between themselves and their medical advisers ; perhaps, indeed, a mere crotchet of the medical profession, got up with a view to business. The weight of public opinion has never been fairly and decidedly cast into the scale, to carry the day against prejudice, apathy, and caprice. Even now, in Scotland, no public provision whatever is made for vaccination, except through the parochial boards, and even with these there is no machinery for *carrying the means of vaccination down to the homes of the poor and ignorant* ; the only way in which the thoughtless indifference of the masses can be properly met by the pressure of enlightened public opinion. For it must be evident enough to all who know the habits of the poor, or indeed who understand human nature, that a mere general invitation to attend at a certain hour and place for the vaccination of infants, can never succeed in overcoming the real difficulty. What is wanted is an organized and *aggressive* system (to use a word of Dr. Chalmers) by which the importance of vaccination shall be made plain to every one, and the performance of it systematically urged upon the careless and indifferent at the very moment when the means are within easy reach. And here, again, we are driven back to the idea of a special service in connection with a system of sanitary inspection.

Of late it has become fashionable to look upon "compulsory vaccination" as the only effectual cure for popular apathy and prejudice in this matter ; and across the Tweed legislation has for some years taken

this direction. Instead of the absolute inaction of the authorities, of which we have had to complain in Scotland, they have in England gone at once to the other extreme, and have carried two Acts of Parliament, by which it is proposed to fine and imprison all persons who fail to have their children vaccinated within a certain term after birth. I am not at all sure that this is a wise step, or that it is likely to accomplish the end in view better than a less despotic mode of interference. It would lead me too far to explain to you in detail the grounds of my convictions on this point. I will only say, therefore, that legal compulsion is plainly thus far an improvement on the absolute indifference of the Government, that it implies care, forethought, energy, and the systematic employment of means for vaccination ; and in all these respects the present English system is likely to do a great deal of good, as compared with the former no-system. But I am by no means convinced, either by the English or the Continental experience, that legal compulsion can really be maintained for any length of time, and carried into effective operation on a large scale, especially in countries accustomed to free institutions. It is an experiment of which we shall see the results by-and-bye. Meantime, I will only observe that compulsory vaccination, to accomplish its object even in the most modified form, must be accompanied by a system of inspection, and of free offering of the means of vaccination ; for it would be monstrous to enforce penalties without taking care that the fulfilling of

the law is rendered possible, and even easy, to the poor. So that we are once more brought round to a "home mission" of vaccination as the one thing needful, without which legal compulsion, and every other remedy for neglect, will assuredly break down in practice. And I will add that, by the diligent prosecution of such a scheme of home vaccination under authority, together with certain requirements as to the necessity of vaccination (and re-vaccination in certain cases) previous to admission to all schools, factories, and other establishments under government inspection—by these means alone I should hope to be able to dispense with the offensive formulary (for I think it will be little more) of legal compulsion. But of all ways of dealing with the subject, the worst is to leave it entirely to voluntary effort on the one hand, and the caprice of individuals on the other, without any attempt to bring into prominence the duty of the community towards its members, and of these again towards the public.

I have now, in conclusion, to submit to you some considerations bearing on the entire subject of Public Health, and involving a brief retrospect of our whole argument. In carrying out great social reforms, it is an ever-recurring question, How far the burdens of the individual should be shifted to the shoulders of the community, or even lightened by the co-operation and sympathetic aid of voluntary associations? That charity so-called is liable to enormous abuses—and most of all the charity of the wealthy to those much

below them in the social scale—is an old and hackneyed remark. That great powers, wielded even for good ends, have often been wasted or abused through excessive centralization, is another well-known fact which is often pleaded, and pleaded not without ample justification, as a serious obstacle in the way of the too eager social reformer. But besides the positive abuses of charity and of arbitrary power, there is room for distrust as to the effect upon the individual man, even of the best directed efforts to improve his condition by extraneous means. It is rightly argued that he had far better help himself than be helped by others—that the most real charity consists in quickening the desire for self-help, and that the true use of power is to furnish the material for independent exertion, leaving every man in fact to work out his own salvation, physical as well as moral and spiritual, as far as may be.

Now, all these doubts and difficulties, about which whole volumes have been written to little or no purpose (in so far as solving them finally is concerned), have to be encountered in the course of any investigation into the health of great communities, with a view to proposing measures for its improvement. It would be extremely absurd and inconsiderate, not to say impossible practically, in a country like this, to make light of the difficulties which attend the application of means to ends amid the free expression of discordant opinions. On the other hand, to open up and fully discuss the really immense questions here suggested in their relations to each proposed measure of sanitary

reform, would be obviously far beyond the scope of a single lecture, or even of a whole course of lectures, and would indeed involve us in an interminable controversy. For my own part, I have long ceased to believe in any absolute and general solution of these questions of political and social organization ; I recognise in the central government a good thing, time and place being considered ; in municipal and local government an equally good or better thing ; in Christian charity, guided by prudence and enlarged views of duty, a better thing yet ; in self-help, fortified and confirmed, in case of necessity, by personal charity and sympathy, aid to the weak, advice to the erring, remonstrance with the vicious and abandoned, by far the best thing of all. I believe that each of these principles is good and necessary ; but I equally believe that any of them, developed in such a way as to strike at the root of the others, or materially to circumscribe their operation, becomes an abuse. Centralization, for instance, is good, when the object to be accomplished can be well done by centralization only, as in the case of the Post Office, the Army, the Navy, the enumeration of the people, the registration of births, deaths, and marriages, the superintendence of the lunatic and the pauper, for whose welfare the State is responsible. But if the central government transcends its proper sphere of action—if it undertakes to do what you and I can do, and ought to do, for ourselves, it becomes an abuse. For, in this case, the far more valuable principle of self-help is paralysed ; the independence of the citizen is infringed ; he is taught

to rely upon the State for the supply of his personal wants, and in all probability has learned the first lesson of a "paternal despotism."

On the other hand, although self-help, as a general theory, is good, and good always, we must also of necessity admit, in dealing with a complex social organization, that there are cases where self-help, even aided by charity, breaks down so entirely as to require the interference of the strong arm of power. This was precisely the question raised at the time of the agitation for the new Scottish Poor-Law in 1839. Is it right for the State to help those who cannot help themselves? who, either by their own fault or that of others, have practically become unprofitable members of the community? and who, if unassisted, must necessarily either perish, or fall to be relieved by the precarious and often injudicious overflow of private beneficence? Without entering at all into this old controversy, in which, as in many others, the attachment to particular institutions and modes of thought appears to have shut the eyes of many excellent men to very plain and patent facts, let me bear a passing tribute of gratitude to my dear and valued master in the healing art, the late Professor Alison, to whom, under God's blessing, it is mainly due that we have been lifted out of the slough of despond, in which we had been plunged by a too hard and relentless theory of self-help. We owe it to him, in no small measure, that society in Scotland has at last fairly looked its obligations in the face, as regards its necessi-

tous, dependent, and even vicious members ; that the strong arm of power now intervenes between the disabled or unemployed workman and blank despair ; that starvation and sheer destitution have become rare among us, and, indeed, in ordinary course of things, can hardly occur. Other agencies, no doubt, have been at work in the physical and moral regeneration of our people. The Corn Laws have been abolished ; work has become plentiful, and wages high ; capital has been beneficially employed in improving the condition of the workman ; education has been much extended, even under the questionable system of the Privy Council grants ; ragged schools have been instituted to overtake the deficiencies of the more regular methods ; emigration has taken place to an enormous extent ; Ireland, under a great variety of social changes, and among them a Poor-law, has become prosperous almost for the first time in her long history, and has ceased to throw over her surplus and destitute population, teeming with epidemic disease, upon Glasgow, Edinburgh, and Liverpool. But I cannot forget, and none of us ought ever to forget, that in 1839, when for twenty years fever had been becoming continuously more frequent and more fatal ; when starvation was ever impending over large masses of the population in Scotland and Ireland ; when the outcast class, as it might well be called, was grovelling in anarchy, Chartism, drunkenness, and degradation worse than that of the brutes ; when the ministers of religion, to whom the charge of the poor had been committed, were, with a few grand excep-

tions, paralysed and helpless ; when medical men themselves, decimated by fever, had almost come to look upon it as a normal condition ; when society at large had become callous at the sight of suffering, and the contributions of the charitable were almost proverbially misapplied, besides being utterly insufficient to deal with the emergency—there was found a man who had the boldness to say, in opposition to the prejudices of almost all Scotland, that to care for the destitute was an imperative and indefeasible function of the central government. I shall not discuss Professor Alison's theory, or enlarge upon his work ; but I may be permitted to say, that, if we would any of us attempt to do good, it should be in his spirit. If we apply our hearts to the remedy of great evils with a like single-mindedness, and with anything like his knowledge of details, and firm grasp of principles, we shall no doubt soon begin to see our way, as he did, to a sound and practical conclusion.

To apply these ideas to the subject of sanitary reform. I apprehend that the ultimate question, with regard to all proposed measures for the improvement of the health of great communities, must be simply this—Are the proposed measures fitted to accomplish the object in view in the best attainable way ? The improvement of the public health being a matter about the desirableness of which there can be no reasonable dispute, we may fairly assume that all real and demonstrable evils affecting the physical condition of the people are proper objects of solicitude to those who repre-

sent the people. How far the causes of these evils are known? how far they are remediable? and how far the public authorities are justified in interfering for their remedy?—are questions to be determined by the exigencies of the particular case, and the possibilities of remedy otherwise than through the control of authority.

Now, a very little consideration will teach you that, while the evils that affect the public health are often but too notorious, the causes of them are commonly very complex, and the remedies of correspondingly difficult application. Nay, more, it is very certain that among the causes of deteriorated health, a great number are almost, if not altogether, beyond the scope of legislation. You cannot, except within very narrow limits, control directly the bad habits, the debased morals, the unruly appetites which engender so many of the ills that flesh is heir to. The tenderest and most helpless age of humanity—that at which the seeds of disease are most easily implanted, and at which mortality is largest—is hardly at all within your control, otherwise than in a roundabout and indirect manner. You cannot enter by law the household at all hours, and keep watch over the mother at her daily task of love and duty; nor can you permit her, even in her greatest disgrace and necessity, to devolve upon the community her divinely-imposed and necessary function. To do so is simply to take a responsibility which you have no means of fulfilling; for the disastrous statistics of Foundling Hospitals, in almost every coun-

try in Europe, prove conclusively that there is no good substitute for the maternal instinct, even where it is most defective, and where the legislative substitute is most completely organized. Again—I say it advisedly and with full consideration of what has been attempted of late years—you cannot by law restrain the drunkard, unless in the most aggravated cases ; you cannot by law suppress, or even materially control, the prostitute. To arm the law with arbitrary powers against these terrible vices, is too often only to drive them into yet darker recesses of our social organization. You lay hold of the grosser forms and more obtrusive manifestations of the vicious propensity ; but the sad and incorrigible facts of erring human nature remain as they were. Need I say that you cannot control the overworked brain of the scholar, or restrain the appetite of the glutton, or give peace of mind and exercise of body to the careworn man of business ? And still less can you regulate by law the caprices of fashion, which still demands its annual tribute of victims to late hours, crowded assemblies, and disastrous, though not always guilty, dissipation. All these causes of ill health in great communities, and many others equally important, are within the field of the preacher, the educator, the social reformer, the physician, exactly in proportion as they are removed from the department of the legislator ; and for a long time to come they will probably furnish abundance of occupation to all these workers together for good.

But while the limits of the sphere of authority in

relation to public health may be a matter of doubt in many cases ; no such difficulties surround the question of an *organized sanitary inspection*, having for its object to ascertain facts and to press home the consequences of them upon the conscience of those chiefly concerned. Where we cannot legislate, we can still teach ; where we cannot command, we can still warn. And neither the existence nor the absence of arbitrary power, neither the expediency nor the in expediency of interference by the authorities, can exempt us from the duty of knowing what is amiss, and diffusing that knowledge far and wide. For this is a case in which literally, and in the most tangible and indisputable sense, the people “are perishing for lack of knowledge.”

I have maintained in this course of lectures the duty of the community with respect to some plain and simple matters of sanitary legislation. I have argued that it is not less the duty than the interest of the community to see that the means of personal and domestic cleanliness, the free use of the commonest and most indispensable of God's gifts, air and water, are within the reach of all, and that they are within certain limits properly applied. Further than this, I have hardly attempted to go into the matter ; and I have pleaded the right of the community to interfere, chiefly on the ground that the interests of *all* are endangered by non-interference ; that destructive pestilences are the consequences of the misuse of air and water, and of the accumulated impurities consequent on their stag-

nation. This truth appears clear enough to me ; I trust it appears clear to you ; but to make it thoroughly an engine of improvement among the poor, who want it most, we must take care to impress it upon *their* minds, as well as on our own. We must carry the lessons of sanitary reform into the cottage of the rural labourer, and into the courts, lanes, and closes of our great towns. We must carry these lessons home in detail, if we would have them properly understood and acted upon ; into the house, into the workshop, into the school, into the factory, into the warehouse : backed by the law and by authority so far as they can be shewn to act usefully and beneficially ; but backed, in all cases, by the facts of Nature, the direct teaching of experience, the sad and terrible example of neglect.

For this purpose we must have an *authorized sanitary inspection* ; and we must have it, to a certain extent at least, *under medical superintendence*. This is the first step, and this taken, all the rest will surely follow. What new legislation we need, I care not to inquire at present ; indeed, so far as the medical inspector of health is concerned, I am very sure that he will generally find it best to refrain from personally wielding the powers of the law, except in very extreme cases. The great function of the medical officer of health is to know and to teach ; it is the function of others to compel. It is as the healer that the medical man is welcomed in the houses of the poor ; and every one knows how gladly he is commonly received. I would not have him armed with such power

as should present him essentially under another and a less pleasing aspect; only with so much as may prevent his injunctions, when in accordance with the law and with obvious necessity, from being treated with contempt. And although we shall require, no doubt, a considerable amount of new legislation to accomplish the important objects of sanitary reform, let us not forget that we are without excuse if we do not fully avail ourselves of the powers we have, which are not small. The provisions of the Nuisances Removal Act, alone, furnish a most important machinery for the removal of sanitary evils, which only requires, in most places, the presence of an authorized official to set it in motion, with great advantage to the public.*

* The remarkable improvements instituted under the Liverpool Health Act of 1846, fully detailed in the annual report of Dr. Duncan, the medical officer of Health, and shortly alluded to in a previous lecture, form a model in many respects for local legislation in large cities, where the evils to be corrected are of the most aggravated nature. This was the first sanitary act passed in the British Parliament, and it is fairly entitled to the credit of having been one of the most effective; it was based on the recommendations of the Health of Towns Commission, but was entirely the result of a local movement, and was framed on the principle of local administration. A few months afterwards, the Baths and Wash-houses Act was passed, and the Nuisances Removal and Diseases Prevention Act also became law. In 1847, the Towns Improvement Clauses Act was passed; and in 1848, the first General Board of Health for England was established under the Public Health Act of that year. This act was revised in 1858, in accordance with the experience gained in the interval,

But while I argue for an authorized and official inspection of public health, I am far from believing that

which shewed that the large powers entrusted to the central board had been in some respects injudiciously exercised ; and the more limited functions of inspection and advice, contemplated under the Act of 1858, were lodged in the Privy Council, which immediately appointed Mr. John Simon as its medical officer. The annual reports of Mr. Simon have furnished valuable contributions to the preceeding pages, and are in all respects worthy of his high character as a man of science. It is also chiefly to Mr. Simon that we are indebted for the organization of public health in the metropolis. Having been appointed, in 1848, Officer of Health to the City of London, he brought into operation a scheme of gradual reform in detail, which, aided by the willing co-operation of the authorities of the city, soon commended itself to public opinion as capable of much more extended application. Accordingly, in 1855, an act was passed entitled the "Metropolis Management Act," by which, among other provisions, a medical officer of health was directed to be appointed in each of the districts into which London was divided ; the control of these appointments, and in general of the working of the act being placed in the vestries, as representing the local authority. Under this administration, which has, on the whole, worked well and smoothly, large reforms have been effected ; a regular system of inspection has been established ; the medical officer of health is everywhere readily received in the homes of the poor, and even among the wealthier classes he has often been instrumental in pointing out serious sanitary evils. In several districts, the death-rate has been materially reduced ; and good promise is afforded of further reduction. More than 50,000 cesspools are stated to have been abolished during the time the act has been in operation ; and a large amount of useful work has been done of a

voluntary and less systematic agencies are to be excluded from this good work. The very fact that sanitary reform is to so large an extent a domestic matter, shews that to a large extent also private and personal influences must have their share in any permanent improvement. Good precept, backed by good example, and by thorough knowledge, can hardly fail of their effect in this any more than in other personal reforms ; and the more that such agencies are concentrated upon the physical and moral improvement of the people, the more may we expect public health to be improved. It would be a clear duty, I think, of an official inspector, to lend his influence in every way to such private efforts as were guided by judgment and knowledge ; as well as to check the unwary and inform the ignorant when in positions of influence.

And, in our multitudinous "home mission" of health, shall we find no place for the educated women miscellaneous kind, of which a report is rendered annually in each district. The reader will find in a paper by Dr. Lankester, in the *Social Science Transactions* for 1860, a very suggestive popular account of the working of the *Metropolis Management Act*, in relation to Public Health.

Scotland has hitherto had no share in sanitary legislation, with the exception of the *Nuisances Removal and Common Lodging Houses Act*, alluded to in the text. Under this act, however, certain improvements have been effected, and a great deal more might be done under a proper system of inspection. Inspectors of Nuisances have been appointed in several places, but they usually do not act unless a complaint is made. I am not aware that a medical officer of health exists in any town in Scotland.

of this country? In some instances, indeed, they have already chosen their place, and chosen it well. The function of nursing the actual sick, which has always been theirs, has received a new accession of dignity through the noble exertions of Miss Nightingale, and her devoted band of associates in the Crimea. I cannot sufficiently express my sense of the immensity of this thorough practical reform, or rather revolution, in which, through the power of Christian love, guided by knowledge, a whole department of "woman's work" has been lifted up out of the dust. We of the medical profession should, above all, be grateful, for we have felt the elevating influence of this heroic example unobtrusively pervading our hospitals and sick-rooms, and giving an improved tone and a higher value to the services which we have derived from our female assistants. The profession of a sick-nurse is now rescued, let us hope for ever, from contempt; it remains, to make it thoroughly deserving of public confidence; and for this result we must look to the training institutions which have been organized mainly through the personal influence of Miss Nightingale, and to the gradual diffusion of the principles so clearly and popularly expounded in her "Notes on Nursing." But the voice and influence of woman are required not only in the presence of actual sickness; they are greatly needed also in the homes where sickness is ever impending, and where young lives are being destroyed by hundreds from the absence of proper nursing. I rejoice to see that the formation in the metropolis of a "Ladies'

Sanitary Association," promises to give scope for the energies of philanthropic and devoted women in this direction. The frightful mortality of little children at the breast, in itself a most terrible source of disaster to the community, calls aloud for the aid and interference of those who are qualified, by personal experience, to form the minds and temper the hearts of the mothers of the working classes to the right performance of the sacred duty of rearing their infants ; nor can I imagine a nobler field for "woman's mission," than to seek out the dark places on the map of infantile mortality, and to carry there the lessons of maternal love, along with those of physical health, and moral and spiritual regeneration. But in this case, again, it is only a proper system of sanitary inspection which can adequately point the way to the evils to be redressed.

And here I must remark, in passing, how greatly all the existing religious and charitable associations might increase their usefulness, even in their own chosen domain, by carrying along with them the intensely practical lessons of health into the homes of the poor. By adopting as a part of their programme the instruction of the household, upon proper occasions, in a few simple physical principles bearing on the health of the community, they might render inestimable services, at least until such time as a special sanitary mission has been organized, as I believe it will ultimately be organized, extending to every wynd and close in our great towns, and to every neglected and wretched hamlet in the country. Nor do I believe

that a special sanitary organization would find its province thus interfered with, any more than I believe that Faith would lose in dignity by thus stooping to the work of this world, as a means of illustrating and enforcing her own higher lessons. On the contrary, it seems plain that a large part of the work of reform of the public health can only be effectually done through the agency of the religious and moral instructors of the people ; while, on the other hand, the missionary of religion will always find his advantage in co-operating with the inspector of health.

Such is, then, the scheme of work I have to submit to you. You observe that it partly depends on legislation ; but in great part also it depends on ourselves, and needs not wait even for legislation. And now, in conclusion—Which of our great towns will begin ? Which of our rural districts will lead the way in this reform ? Something has been done, I freely admit : Glasgow has nobly distinguished herself in the matter of water supply ; Edinburgh has done something of late years as regards the regulation of lodging-houses and the abatement of general nuisances, as well as in improvement of the main drainage and superficial cleansing of the closes ; but not one of our great towns has hitherto determined, like Liverpool and London, to look her evils fairly in the face, and remove them one by one in detail. That there is an immense amount of work to be done in our filthy wynds and closes, we know ; we as yet hardly know how much. That we may possess

this indispensable knowledge *we must have inspection* ; that we may organize remedies, we must have inspection ; that we may quench the embers of epidemic disease, always smouldering among us, we must have inspection ; that we thoroughly vaccinate our poor, we must have a thorough sanitary inspection extending to the homes of the poor. Surely this question of a thorough sanitary reform is entitled to a precedence over some of those petty local questions which so greatly agitate the minds of our authorities, especially in consideration of the fact that the eight principal towns of Scotland had a higher death-rate last year (1860) than at any period since the commencement of the registration ; higher than either London, Liverpool, or any of the leading towns in England. *

* See Note P., p. 360.

NOTE N. P. 305.

LOCAL VARIATIONS OF THE DEATH-RATE IN EDINBURGH.

The following statement of facts as regards the death-rates of Edinburgh, presents many points of great interest to the local inquirer besides those more particularly referred to in the text ; and I think it well, therefore, to reproduce the document here. It was prepared by me some years ago, and was the result of much laborious investigation, part of which had to be conducted in London, among the enumerator's books of the census of 1851, and part in Edinburgh, at the Registrar-General's office. The trouble involved in procuring the data for this statement was certainly out of all proportion to what it ought to have been ; and as the very basis of sanitary inspection consists in securing the utmost possible facility of access to the particulars of the death-rate, it is very desirable that the local authorities of all populous districts should charge themselves with the duty of making a very full and detailed analysis of the census, with a view to such an use of it as is indicated in this statement.

The very large proportion of domestic servants in the better parts of the New Town (See No. 1), and the great preponderance of female over male servants, explains the comparatively low death-rate of females in such localities ; for I need hardly point out, that servants rarely continue in place for any length of

time when seriously ill, or when disabled by age or infirmity ; they are sooner or later replaced by others, and many of those so disabled find their way into other districts of the town, where they ultimately die, and thus increase the death-rate of such districts on the female side. This circumstance may perhaps tend to explain the curious excess of the female death-rate in Nos. II. and III., and perhaps also in No. V.

It would be very desirable in all future operations on the census for purposes similar to those shewn in this statement, to keep in view the population below one, as well as below five, years of age. This has been carefully followed out in Leith, where the zeal of Provost Lindsay has already secured a very complete analysis of the census of 1861, to be used in accordance with the views presented in these lectures.

No. I.

Three Streets in New Town ; viz., Heriot Row, Abercromby Place, Northumberland Street (First Class).

Total population, 1270	{ of whom died in 3 years }	46
Males . . . 410	„	25
Females . . . 860	„	21
Under 5 . . . 105	„	15
Domestic servants, 497 ; 43 males, 454 females.		

Males, per cent of total population . . .	32.3
Male deaths, per cent of total deaths . . .	54.3
Females, per cent of total population . . .	67.7
Female deaths, per cent of total deaths . . .	45.7
Under 5, per cent of total population . . .	8.3
Deaths under 5, per cent of total deaths . . .	32.6
Annual death-rate per 1000 living . . .	12
Do. of males	20
Do. of females	8
Do. of children under 5	48

Proportion of domestic servants 1 in $2\frac{1}{2}$ of population.

Male servants 1 in $9\frac{1}{2}$ of male population.

Female servants 1 in $1\frac{9}{10}$ of female population.

No. II.

Five Streets in Stockbridge District ; viz., Dean Street,
Allen Street, Bedford Street, Cheyne Street,
Hermitage Place (Second Class).

Total population, 1872 $\left\{ \begin{array}{l} \text{of whom died} \\ \text{in 3 years} \end{array} \right\}$ 109

Males . . . 898 „ 47

Females . . . 974 „ 62

Under 5 . . . 259 „ 42

Domestic servants, 31 ; 28 females, and 3 males.

Males, per cent of total population . . . 48

Male deaths, per cent of total deaths . . . 43.1

EDINBURGH DEATH-RATES.

347

Females, per cent of total population . .	52
Female deaths, per cent of total deaths . .	56.9
Under 5, per cent of total population . .	13.8
Deaths under 5, per cent of total deaths . .	38.5
Annual death-rate per 1000 living . .	19
Do. of males	17
Do. of females	21
Do. of children under 5	54

Proportion of domestic servants 1 in 60 of population.

Male servants 1 in 299 of male population.

Female servants 1 in 35 of female population.

No. III.

Jamaica Street (Second Class).

Total population, 1276	{ of whom died }	102
	{ in 3 years }	
Males 593	„	45
Females 683	„	57
Under 5 149	„	73
Domestic servants	12 ; 5 males and 7 females.	

Males, per cent of total population . .	46.5
Male deaths, per cent of total deaths . .	44.1
Females, per cent of total population . .	53.5
Female deaths, per cent of total deaths . .	55.9
Under 5, per cent of total population . .	11.6
Deaths under 5, per cent of total deaths . .	36.3

Annual death-rate per 1000 living	.	.	26
Do. of males	.	.	25
Do. of females	.	.	28
Do. of children under 5	.	.	83

Proportion of domestic servants, 1 in 106 of population.

No. IV.

Potterrow (Second Class).

Total population, 1383 { of whom died } 100
 { in 3 years }

Males	.	697	„	56
Females	.	686	„	44
Under 5	.	193	„	39
Domestic servants,		6, all females.		

Males, per cent of total population	.	.	50.4
Male deaths, per cent of total deaths	.	.	56
Females, per cent of total population	.	.	49.6
Female deaths, per cent of total deaths	.	.	44
Under 5, per cent of total population	.	.	14
Deaths under 5, per cent of total deaths	.	.	39
Annual death-rate per 1000 living	.	.	24
Do. of males	.	.	27
Do. of females	.	.	21
Do. of children under 5	.	.	67

Proportion of domestic servants, 1 in 230.

No. V.

Bristo Street (Second Class.)

Total population, 744	{ of whom died in 3 years }	50
Males 360	„	19
Females 384	„	31
Under 5 79	„	22
Domestic servants, 15 ; 2 males, 13 females.		
Males, per cent of total population		48.4
Male deaths, per cent of total deaths		38.0
Females, per cent of total population		51.6
Female deaths, per cent of total deaths		62.0
Under 5, per cent of total population		10.6
Deaths under 5, per cent of total deaths		44.0
Annual death-rate per 1000 living		22
Do. of males		18
Do. of females		27
Do. of children under 5		93

Proportion of domestic servants, 1 in 50.

Male servants, 1 in 180 of male population.

Female servants, 1 in 30 of female population.

No. VI.

Blackfriars' Wynd (Third Class).

Total population, 1101	{ of whom died in 3 years }	89
Males 524	„	41
Females 577	„	48
Under 5 years 123	„	51
Domestic servants, 12.		

Males, per cent of total population	47.6
Male deaths, per cent of total deaths	46
Females, per cent of total population	52.3
Female deaths, per cent of total deaths	54
Under 5, per cent of total population	11.2
Deaths under 5, per cent of total deaths	57.3
Annual death-rate per 1000 living	27
Do. of males	26
Do. of females	28
Do. of children under 5	138

Proportion of domestic servants, 1 in 92 of population.

No. VII.

Toddick's Wynd (3d Class).

Total population, 504	{ of whom died in 3 years }	39
Males	258	25
Females	246	14
Under 5	53	23
Males, per cent of total population		51.2
Male deaths, per cent of total deaths		64.1
Females, per cent of total population		48.8
Female deaths, per cent of total deaths		36
Under 5, per cent of total population		10.5
Deaths under 5, per cent of total population,		59

EDINBURGH DEATH-RATES.

351

Annual death-rate per 1000 living	.	.	26
Do. of males	.	.	32
Do. of females	.	.	19
Do. of children under 5	.	.	145

Domestic servants, *none*.

No. VIII.

Three Closes ; viz., Stevenlaw's Close, Bell's Wynd,
Old Assembly Close (3d Class).

Total population, 1053 { of whom died } 105
 in 3 years }

Males	.	494	„	66
Females	.	559	„	39
Under 5	.	114	„	59
Domestic Servants		8		

Males, per cent of total population	.	.	46.9
Male deaths, per cent of total deaths	.	.	62.9
Females, per cent of total population	.	.	53.1
Female deaths, per cent of total deaths	.	.	37.1
Under 5, per cent of total population	.	.	10.8
Deaths under 5, per cent of total deaths	.	.	56.2
Annual death-rate per 1000 living	.	.	33
Do. of males	.	.	45
Do. of females	.	.	23
Do. of children under 5	.	.	173

Proportion of domestic servants, 1 in 132 of population.

NOTE O. PAGE 320.

MORTALITY FROM EPIDEMIC DISEASE IN THE MEDICAL
PROFESSION.

As this subject has seldom been brought before the public in the light of exact investigation, or with the prominence which its real importance demands, I may be excused for giving a few facts from the elaborate papers of Drs. Cusack and Stokes,* illustrative of the very special sufferings entailed upon the medical profession by fever, when occurring as an epidemic among the population at large. To avoid even the appearance of exaggeration, I must premise that typhus fever, of all diseases now known, is probably the one most apt to take effect upon the attendants of the sick ; and also, that the very extensive diffusion of typhus fever among the poor in Ireland, before the days of her comparative prosperity, led to a much greater risk to the medical profession in general in that country than in any other. It appears from researches made by Dr. Guy in 1849, that cholera is comparatively little apt to affect the medical practitioner, and this is probably true also of enteric or typhoid fever (commonly called gastric fever).

The investigations of Drs. Cusack and Stokes, just referred to, shew that during twenty-five years prior to 1843 (when the returns on which their results were

* On the Mortality of Medical Practitioners in Ireland.—*Dub. Quarterly Journal of Medical Science*, vols. iv. and v.

founded were first made up, and were undoubtedly deficient), 560 out of 1220 medical practitioners in charge of public institutions had suffered from typhus fever ; that 28 of these had fever twice, and 9 three times ; and further, that about one-fourth of the whole number of medical men so engaged had died from various causes during these twenty-five years, although many of the names reported were appointments of recent date.

It further appears, that of 743 deaths of medical men furnished in reply to a circular issued specially to obtain the exact facts, 331, or 1 in every 2·24 (nearly forty-five per cent) were due to fever, the proportion varying in different years from 1 in 3 or 4, to 1 in 1·55 during the epidemic of 1847. At all times, and even during years of comparative exemption, such as 1844 and 1845, it seems clear from the returns that fever bore an enormous proportion to all other causes of mortality. Thus, to compare the fever deaths with those from consumption (by far the most frequent single cause of death in ordinary communities), we find that in 1843, there were among the Irish practitioners 17 deaths from fever to 7 from consumption ; in 1844, 11 deaths from fever to 10 from consumption ; in 1845, 18 deaths from fever to 3 from consumption ; in 1846 (a commencing epidemic), 30 deaths from fever to 7 from consumption ; in 1847 (an epidemic year), 123 deaths from fever to 13 from consumption, and 191 from all causes (making the proportion of 1 to 1·55 above mentioned). During the great epidemic here referred to, Drs. Cusack and Stokes calculate that no

fewer than 500 Irish medical men must have been affected with fever ; and as the deaths from all causes, as reported during the year 1847 alone, amount to 191 (or deducting pupils and army surgeons, 178), 123 of these deaths being from fever, while the entire number of medical men in practice in Ireland was in all probability not more than 2650, it seems quite legitimate to conclude that "about one-fifteenth of the entire medical community of Ireland have died during the year 1847," and that the excess of mortality was almost entirely due to the results of epidemic disease, of which typhus fever formed by far the largest proportion.

Now, on comparing these startling details with any series of facts exhibiting the ordinary mortality from fever in a miscellaneous population, we find, as might be expected, an enormous difference. Thus, in the returns of the Registrar-General for England, we find that epidemic continued fever (registered as typhus) appears as accounting for not more on an average than 4 per cent of the deaths from all causes ; and even in Ireland, in ordinary years, according to Mr. Wilde's Reports, the deaths from fever among the general population are less than 10 per cent of the whole mortality ; while among the medical profession of Ireland (according to the returns of Drs. Cusack and Stokes), the deaths from fever are rarely under 30 per cent, and in a severe epidemic may considerably exceed 60 per cent of the whole mortality.

Again, we find from the Registrar-General's eighteenth Report (p. 182) that typhus fever in England,

in ordinary years, is fatal to the population at large at the rate of less than 1 in each 1000 living. But in Ireland, in the year 1847, according to Drs. Cusack and Stokes, the medical profession died of fever at the rate of more than 40 in each 1000 living; and even in the year 1844, in which the smallest number of deaths is recorded, the mortality from fever in the medical profession in Ireland was at the rate of at least 4 in each 1000 living, or more than four times the ordinary rate of death from typhus amid the population at large in England and Wales.

As it seems possible, however, that the words "fever" or "typhus" may in England and Ireland bear a different signification, it may be useful to subject these returns to yet another comparative test. The rate of mortality for the whole population in England and Wales varies from 22 to 23 in 1000 living, and in Scotland (so far as hitherto ascertained) from 19 to 21 in 1000. In Ireland, from the absence of a general registration of deaths, there are no sufficient data for fixing the general death-rate. Now, in England and Wales, there were in the year 1851, according to the census of that year, 17,469 medical practitioners, of whom 349 died during the year; the deaths were, therefore, at the rate of rather less than 20 in 1000 living, or somewhat less than the ordinary mortality of the population at large. In the years 1843 to 1845 the rate of mortality of Irish medical practitioners, according to the returns of Drs. Cusack and Stokes, was not very different from that of their brethren in

above 30 in 1000. I have reason to believe, indeed, that in ordinary seasons a death-rate of 40 is hardly ever exceeded to any great degree even in the most degraded populations of the closes and wynds of Edinburgh. Even in Liverpool, so often referred to by sanitary reformers in the days of its neglect and overcrowding as the type of an extremely high death-rate, the death-rate never exceeded an average of 36, or at most 39, over a series of years, even including great epidemics of fever and cholera. But on two special occasions the Liverpool death-rate greatly exceeded this ; and one of these was this very epidemic of 1847, which more than doubled the ordinary annual sum of deaths by the influx of destitute and suffering Irish, and produced the frightful death-rate of 70 in 1000 living for the whole population.

From all these separate comparisons, therefore, it appears that *the rate of mortality of Irish medical*

practitioners during the epidemic of 1847 was much higher than that of the most neglected town-populations in ordinary seasons, and nearly equal to that of Liverpool during the period of its greatest sanitary neglect, under the special pressure of the severest epidemic from which the town has ever suffered.

I will conclude this note by the narrative of some personal experience in regard to this same epidemic of 1847, as it occurred in Edinburgh. The following remarks formed part of a letter addressed by me some years ago (December 1857) to the surgeon of police, and by him submitted to the Lord Provost and Magistrates of Edinburgh, with the view of bringing under their consideration the desirableness of some kind of sanitary organization for the observation and prevention of epidemic disease :—

“During the last great epidemic of fever in 1847-1848, the demand upon us at the Infirmary was so much in advance of our preparations, that we had, day after day, and that for weeks together, to turn away twenty, thirty, or forty miserable, fevered, and poverty-stricken applicants from the open doors of the Royal Infirmary. No one who served in the house at that time can have forgotten what a harassing duty this was. I have often spent as much as four hours a-day in ‘making beds ;’ that is, in driving out homeless and hardly convalescent wretches, to make room for other more miserable creatures who had made application four, five, or six days in succession, and who had all

this time and more been a source of contagion to a whole neighbourhood as poor as themselves. And, after all, the duty was so imperfectly performed that hundreds of applicants lost heart altogether, and died or recovered at home after having made fruitless efforts to obtain admission ; while our wards were all the time so overcrowded that to serve in them was almost certain infection to doctors and nurses ; and the whole Infirmary, indeed, was a huge focus of contagion to all who approached it, either as physician, patient, or visitor.

“ To give an idea of the work done at this fearful time, I will mention one fact. It happened that the managers determined, in order to relieve the flood of destitution and distress, to open two large garrets which had never been used for accommodating patients before, but which, by placing mattresses and blankets upon the floor, were made to do duty as additional wards. They were almost instantly filled ; but in the overworked condition of the hospital staff, the inmates were in some danger of being neglected ; and I well remember being urgently entreated by Mr. M'Dougall, the Superintendent, late one evening, to take charge of the patients in those attics. On that evening, after ten o'clock, and after all the ordinary or rather extraordinary duties of the day, I visited upwards of one hundred fever patients in all stages of the disease, and whose faces were all new to me. To visit them I had to walk along a narrow footpath-way, between crowded beds, in a room in which I could not walk without stooping ; to

feel their pulses and to look at their tongues, I had to kneel or to sit down on the floor ; and all the attention of the nurses had to be administered after the same fashion.

“ The ordinary service of the Infirmary at this time was certainly not quite so perilous as the above instance would suggest ; but it was only a few degrees less perilous. To give an idea of the danger, I may mention that in no single instance known to me did a nurse who had not had fever previously remain for six weeks attached to a fever ward without catching the disease. Moreover, of sixteen resident medical officers, who officiated along with me during three months of the spring (some of them for not more than a few weeks), only two who had not had fever before escaped it ;* and this state-

* These numbers are not quite accurately stated ; the facts are as follows :—Of the 16 resident medical officers, medical and surgical, 8 were seized with fever in the course of a few months ; and 2 of these had typhus and relapsing fever successively. But of the 8 who were spared, 1, at least, took fever afterwards ; and 4 had previously had typhus from attending fever in dispensary practice or otherwise. Moreover, among the 16, there were 6 who were comparatively little exposed, either from serving exclusively in the surgical department, or from having acted for a very short time. Excluding these, there remain 10, of whom 6 took fever during service in the hospital ; 3 had passed through fever previously, and 1 only escaped. During the whole course of the epidemic, 22 resident medical officers were engaged in the fever wards ; of these, 3 had previously had fever ; 12 were seized when on duty in the hospital ; and of these, 3 died. There were also 9 physicians who, without being resident, served in

ment includes the surgical as well as the medical resident officers. I was fortunate in escaping ; but then I had passed through fever two winters before. So much was this danger known at the time, that in the end no nurse was ever appointed to a fever ward unless she had passed through the disease ; and even with this precaution many were infected. So far as my recollection serves me, about one in four of those who were infected died ; and we have all of us a most melancholy recollection of our comrades who paid this heavy tribute of the medical profession to the unduly severe pressure thrown on them by the carelessness of the community, in not anticipating and providing for the approach of disease."—*Scotsman*, January 1, 1858.

NOTE P. P. 343.

SANITARY REFORMS IN LEITH.

It is simply an act of justice to the Provost and Town Council of Leith, to declare that they have displayed a large amount of enlightened activity on this subject, and are fairly entitled to the credit of "leading fever wards ; of these, 6 had previously passed through fever ; the other 3 were all seized, 2 with typhus, and 1 with relapsing fever, and of the two cases of typhus 1 died. I have been enabled to add some of these particulars by comparing my own notes with the statements of Dr. Paterson, in the *Edin., Med. and Surg. Journal*, October 1848.

the way" in the matter of sanitary reform for the last year. Observing that the death-rate of Leith, though not on the whole high as compared with other towns in Scotland of its size, is subject to great variations, and that these are obviously due to the intermittent prevalence of epidemic disease, Provost Lindsay has not shrunk from the responsibility which this fact involves, but has prevailed on the Town Council to grant a considerable sum of money for the purpose of preparing a complete analysis of the census of Leith, so as to procure a monthly statement of the death-rate in selected districts, according to the plan indicated in this lecture. These monthly statements are now regularly in operation, and an inspector of nuisances has been appointed at a liberal salary, one of whose duties it is to place himself in communication with the medical men, and with their aid and that of the monthly returns to watch the incidence of sickness and death in the town, with a view to prevention. There is no *medical* officer of health, but Provost Lindsay has probably judged correctly in thinking that the field of operations is too small to justify him in recommending so important an appointment for Leith alone. If Edinburgh and Leith could concur in making such an appointment, it would no doubt be for the advantage of both places. But up to the moment at which I add this note, there seems little appearance of any practical response on the part of the authorities of Edinburgh to the numerous appeals which have been made to them from various quarters on the subject of sanitary reform.

I must not omit to notice the great services rendered by the Leith Sanitary Association, which originated the movement of reform in Leith, and has procured a legal decision as to the working of the Nuisances' Removal Act, without which it could not have been brought into operation.

Provost Lindsay's attempt to consolidate the interests of towns and populous places in Scotland under one Improvement Act, is also deserving of careful consideration ; and his vigorous and praiseworthy effort for the complete purification of the Water of Leith from the sewage of Edinburgh, appears to me to have had scanty justice done to it on the part of our authorities.

The able and complete official analysis of the Glasgow census by Dr. Strang, the city chamberlain of Glasgow, also demands notice, as a most important step towards a proper system of local death-rates. I believe a somewhat similar analysis has been made in Greenock. In Edinburgh it is still wanting.

INDEX.

- ACCOUNT-CURRENT of human life, 303.
 Acts of Parliament, sanitary, 337.
See Legislation.
 Age and sex, in connection with death-rates, 23, 24.
 Agricultural labourers' cottages, 271, 272.
 Agriculture and public health, 241-244.
 Air and water; contaminated, the true factors in epidemics, 26; perpetual circulation of, 27; danger of obstructing their course, 27, 28; this danger illustrated, 29, 30; viewed as sanitary agents, 59-88; natural laws of their purification, 67, 73-80, 240; both absolutely essential to life, 151, 152, 154; comparison between, 153; right use of, 238; efficient drainage essential to their purity, 262.
 Air, Impure, 93-128; evils of, illustrated in the case of the cellars and courts of Liverpool, 98-102; in towns in Scotland, 114-117; from overcrowding, 117-122, 124-128; from ill-constructed sewers, 250-254; results of, in a monkey-house, 297-299. *See* Overcrowding.
 Alison, Professor, 36, 148, 163, 264, 330-332.
 Animal bodies, excretion of carbonic acid gas by, 76, 77.
Archiatrum populus in ancient Rome, 8.
 Army, health of the, 148; overcrowding in barracks and hospitals, 293-297.
 Arnott, Dr. Neil, 17; evidence given by, 115, 297-300.
 Arnott, Mr. Hugo, on population of Edinburgh, etc., 161, 164, 165.
 Asceticism of the middle ages, 9.
 Ashton, Mr. Thomas, on supply of water, 182, 183.
 Austin, Mr., report on drainage of Bedford, 200; of Windsor, 258, 259.
 Authority, sphere of, in reference to public health, 33-35, 62-64, 66, 106-110, 122, 261-264, 292, 327, *et seq.*; facts justifying interference, 124, 126, 154, 155, 184-186, 194, 195, 241, 245, 263; want of, deprecated, 206; function of, 260, 261, 275; how far to be relied on, in sanitary organization, 292, 301.
 BAKER, Mr., his evidence on overcrowding, 120.
 Balance-sheet, a sanitary, 129, 130.
 Baly, Dr. on mortality of prisons, 148.
 Barometer of public health, 22, 51.
 Barrack accommodation, evils of defective, 293-297.
 Baths, public, 234.
 Bedford, fever in, 199; consequent on defective drainage, and tainted water, 200-203, 250, 256; similar case in Scotland, 203-205.
 Board of Health, 208, 337.
 Body, the care of, a Christian duty, 6; cultivated by Greeks and Romans, 6; neglected in the middle ages, 9.
 Brewer, Mr., 10; quoted on English towns in thirteenth century, 44-47.
 Broad-street pump, in London, in connection with cholera, 81, 228-230.
 Brownlow, Mr. Thomas; evidence before Poor Law Commission, on workshops in London, 276-284.
 CARBONIC acid, 68-70; excretion of, by animal bodies, and decomposition of, by vegetables, 76-78.

- Cellar and court population of Liverpool, state of, 99.
- Centralization and Self-help, 329.
- Cesspools, system of, a serious evil, 198, 250.
- Chadwick, Mr., his "Sanitary Reports," 16, 18, 109, 115, 136, 208, 268, 299.
- Chambers, Mr. Robert, on extension of Edinburgh, 161, 163.
- Chemistry, lessons of, as to the application of refuse matter, 241-244.
- Children, mortality amongst, 111, 273-275, 285-290; contagious diseases of, 113, 114; physical training of, 134-137. *See* Infant Mortality; also Schools.
- Cholera, epidemic; its influence on the advance of sanitary science, 15; conditions of its propagation, 31, 71; the lessons it teaches, 206, 230-232; question as to whether it is contagious, 207-210; the laws of, 211; a disease of low levels, 211-213; theories as to the diffusion of, 215-220; mortality in, 220-224; illustrations of its dependence on water-supply, 219-230; epidemic of, in Dumfries, 320, 321.
- Christianity and the care of the body, 6.
- Cities, defective sanitary arrangements in, 7; contamination of water incident to, 197.
- Clarke, Dr., on infantile convulsions, 33.
- Cleanliness, public facilities for, 234; how much depends on, 265.
- "Closes" in Edinburgh, condition of, as to supply of air and water, 138-142, 171.
- Cockburn, Lord, quoted, 160, 167-170.
- Colosseum, sanitary arrangements connected with, 8, 40, 41.
- Commission, Army, facts elicited by, 295-297.
- Commissions, appointment of, on Health of Towns, 17; extracts from. Report of, 81-83, 86, 248.
- Common-stairs in Edinburgh, description of, 171, 172.
- Communities, duty of, in sanitary matters, 154-156, 245, 262. *See* Authority.
- Composition of air and water, 67.
- Conditions of health, 59, 60, 261-265.
- Confinement, bearing of, on tubercular disease, 148.
- Construction of sewers, prevalent defects in, and their consequences, 249-254.
- Consumption, pulmonary, 32, 127, 128, 147-149; importance of purity of air in, 149; in crowded workshops, 280.
- Contagion in the middle ages, 11, 12; of cholera, and other diseases, 207-211.
- Convulsions, infantile, how affected by defective ventilation, 33.
- Cost of water supply, 235-237.
- Cresy, Mr. Edward, on the buildings of ancient Rome, 38.
- Crimea, the, cholera in, 217; disasters of the campaign, 294, 340.
- Currie, Dr., his early attempts at reform of overcrowding in Liverpool, 108.
- Cusack and Stokes, Drs., their inquiries on medical mortality from fever in Ireland, 352, 357.
- DEATH, premature, in the army, 295-297.
- Death-rates, calculation of, 19; science of, 20-26; influence of sex and age, 23; of social position, 24; and special causes, 25; overcrowding, 11; illustrative tables, 51-58; death-rate among infants, 274, 285-290; importance of detailed information on, 302-311; local variations in, in Edinburgh, 344-351.
- Defoe, Daniel, 13; his account of the shutting up of houses in London during the Plague, 47-51.
- Demoralization consequent on overcrowding, 117-120, 266; on deficiency of water, and other physical causes, 265-268.
- Diagram illustrative of the mortality from cholera, 212.
- Diffusion of gases, law of, 77.
- Dirt, Lord Palmerston's definition of, 241.
- Diseases of children, 113, 114.
- Dissecting-room, poison of the, 73.
- Drainage, importance of the question of, 11, 60, 80, 88, 242; illustrated in the case of Liverpool, 100-102; of Edinburgh, 173, 174; importance of the application of right principles to, 245, 246; defects of early systems of, and their consequences, 247-249; evil results of defective construction, 250-255; imperfection of, in Edinburgh, 255; in England,

- 256; Windsor epidemic attributable to ineffective drainage, 257-260; efficient, essential to the purity of air and water, 198, 262.
- Drinking habits, how they begin, 279.
- Dumas, on the balance of organic nature, 76.
- Duncan, Dr., of Liverpool, his evidence before Sanitary Commissions, 94, 96, *seq.*, 109, 127, 148; his reports on the health of Liverpool, 337.
- Dwellings of the labouring classes, condition of, 87, 88, 115, 137-147.
- ECCLESIASTICS of middle ages, and sanitary arrangements, 9.
- Economy, sanitary, in Liverpool, 129.
- Edinburgh, sanitary condition of, 117; old houses in, 137-147; scanty supply of water in, 160, 161; progress of population, 162, 163; neglect of the poor, as to house accommodation and water-supply, 161-166, 170-173; drainage of, 255; local variations in death-rate of, 344-351.
- Education, Report of Commission on, 111.
- Endemic diseases may be connected with impure water, 189.
- England and Wales, progress of sanitary organization in, 36; rate of mortality in, 52-57; infant mortality in England, 286-289.
- Enteric fever, cases of, traceable to emanations from sewers, 256; epidemic at Windsor, 257-260.
- Epidemics, 13; light in which they should be regarded, 14, 122, 123; the two most important conditions of, 26; lessons taught by, 28, 30, 31; existence of, evidence of a violated law, 65, 66, 88; connection of, with migrations of the Irish, 114, 115; connection of, with overcrowding, 126; relation of, to water-supply, 210, 221; question as to their contagion, 209, 210; desirableness of information as to proportion of sickness to mortality, 311, 312; medical aid in, 319, 320; parish relief in, 321; mortality in the medical profession during, 320, 352-360.
- Exercise, want of, a cause of tubercular disease, 148.
- Exposure of sanitary evils, a means towards their remedy, 108.
- FAMILY, effect of sanitary neglect on the, 268-272.
- Farr, Dr. William, his contributions to sanitary science, 18, 19, 128.
- Fear, influence of, during pestilence, 12, 13.
- Feudal system, state of the towns under, 10-12.
- Fever; typhoid, and defective drainage, 256; attributable to escape of sewer gases, 258, 259; typhus, mortality of medical men from, in Ireland, 320, 352-357; in Edinburgh Royal Infirmary, 357-360.
- Food, poisoned by infected air, 125.
- Foulis, Dr., his efforts in connection with improved dwellings for the working classes, 137, 138; quotations from his pamphlet on "Old Houses in Edinburgh," 139-146.
- Fountains, public drinking, 234.
- Franciscan friars, 10.
- Free trade in water, impossibility of, 184-186.
- GASES, noxious, from ill-constructed drains, 250-254; illustrated in the epidemic at Windsor, 257-260.
- Glasgow, sanitary condition of, 115-217; water-supply in, 234.
- Golden Square epidemic of cholera, 227; its distinctly traceable connection with an impure water-supply, 228-230.
- Graham, Professor, his law of the diffusion of gases, 77.
- Greek republics, importance attached by them to physical culture, 6-8.
- Greenhow, Dr. H., his reports referred to, 127, 148.
- Guano *versus* Home refuse, 242.
- Guy, Dr., on health of journeymen printers, 32; on medical mortality in cholera, 352.
- HACKNEY-COACHES, danger of conveying the sick in, 125.
- Haviland, Mr. Alfred, on the aqueducts and private houses of ancient Rome, 41, 42.
- Health and morals, 61, 95, 117-120, 180, 265-268.
- Health of Towns Commissions, Reports of, and evidence before, as to ventilation, overcrowding, etc., 81, 83, 86, 101, 102, 104-106, 111-113, 147; as to supply of water, 175-188, 236, 237; as to drainage, 248, 249, 252-254. *See also* Reports.

- Hindoos, opinion of, as to poisoned wells during cholera, 216, 217.
- Home mission of health, 35, 313, 317, 318, 325-327.
- Home, neglect of comfort in the, its consequences, 272-275.
- Home vaccination, 327.
- Hospitals of middle ages, 10; for fever, 14; army hospitals, 295-297.
- House accommodation, defective, evils arising from, 81-88, 269-272; illustrations of, in Liverpool, 97-102, *seq.*, 118-120; renovation and rebuilding compared, 145.
- House and surface drainage, 246-249, 251, 258.
- Howard, John, an early sanitary reformer, 13.
- IGNORANCE on sanitary matters, widespread, 291-293; proofs of, 293-300.
- Imperfect drainage, evils of, 251-256. *See Drainage.*
- Impure air, 93-128; *see also Air.*
- Impure water a cause of disease, and how, 187, 191; comparison between effects of, and vitiated air, 190-192; conditions of danger, 198; the chief agent in cholera, 220, 239.
- Impurities in water, various kinds of, 189, 190; how they arise, 193.
- Individual duty *versus* that of the community, as to sanitary arrangements, 262, 327, *et seq.* *See Authority, Communities, Legislation.*
- Infant mortality, 273-275, 285-290. *See Children.*
- Inspection, sanitary; how action is to be taken, 313, 314; central and local machinery, 315, 316; light in which it should be regarded, 317; medical superintendence necessary, 336.
- Instruction, necessity and importance of, in regard to health, 291-297, 301.
- Intemperance, influence of physical causes in producing, 270, 273, 276-284.
- Ireland, fever hospitals in, 14; mortality of medical men in, from typhus fever, 320, 352-357.
- Irish in British towns, state of their dwellings, 104-106.
- JENNER, Dr. Edward, 14, 109, 323.
- Jews, their sanitary code, 4-6.
- Justinian code, its sanitary regulations, 8.
- KAY, Dr. J. P. *See Shuttleworth.*
- LADIES' Sanitary Association in London, 340, 341.
- Landlords, duty of, in respect to water-supply, 183.
- Lankester, Dr., on water in cholera, 31.
- Leblanc, on carbonic acid in the air, quoted, 69.
- Legislation, sanitary; in the Mosaic code, 5; among the Romans, 7; starting-point of, in Great Britain, 17; proper sphere of, 262, 275, 292; sanitary laws and their administration in England, 337; in Scotland, 339.
- Leith, sanitary reforms in, 360-362.
- Lessons taught by epidemics, 28, 30, 21, 206, 230-232.
- Levels, low, dangers attending localities in, 198; cholera, a disease of, 211-213; exceptions to the rule in regard to, 213-215. *See Windsor.*
- Liddle, Mr. John, evidence of, before Health of Towns Commission, as regards supply of air, 86, and of water, 181.
- Liebig, 78; referred to, on exhaustion of the soil, 242.
- Life-tables, 19.
- Liverpool, sanitary reform in, 36, 55; past and present sanitary condition, 93-130; new water-works of, 234.
- Lodging-houses, state of, in Liverpool, 103-106.
- London, water-supply in, 175-181; cholera in, 223-230; infant mortality in, 289-290.
- Lycurgus, laws of, 6.
- M'GOWAN, Mr. W. T., on sanitary state of Liverpool, 96, 128.
- M'William, Dr., on yellow fever, 209.
- Malarious diseases, 189.
- Male births and deaths, excess of, a phenomenon of European civilization, 20.
- Manchester, schools in, 112, 113.
- Medical profession, position of, in regard to public health, 3, 4, 35, 64, 312, 313, 318, 336; mortality in the, from epidemic disease, 320, 352-360.
- Method and objects of sanitary organization, 302, *et seq.*
- Metropolitan Sanitary Commission, 207.
- Middle ages, neglect of sanitary arrangements in, 10, 12.

- Migratory Irish population, and epidemics, 114.
- Mineral impurities in water, 189.
- Mitchell, Rev. Mr., Inspector of Schools, evidence of, on effects of vitiated air in schools, 133.
- Money and health, 283.
- "Money value of a man," 128.
- Monkey-house, results of a faulty construction in a, 297-299.
- Monks, their neglect of the body, 9.
- Morals and health, 61, 265-268.
- Mortality; differences in, in different districts, 22-26, 51-58; in prisons, 148; proportion among infants as compared with adults, 273-275, 285-290; importance of detailed information as to, 302-311, 344-351.
- Municipal authority, necessity for exercise of, in sanitary matters, 260, 261. *See* Authority, Communities, Legislation.
- Murchison, Dr., on connection of fever with filth, 256, 257.
- NATURE, sanitary processes of, 67; chemistry of, 74-80.
- Newlands, Mr. James, on improvements in Liverpool, 96, 146.
- Nightingale, Miss, 90-92, 340.
- Noxious effluvia from drains into houses, 251-254.
- Nuisances Removal Act, 337.
- ORGANIC impurities in water, 189, 190.
- Organic nature, law ruling the changes of, 74-80.
- Organizations for sanitary purposes, enforced, 35; their success in England, 36; comparative neglect of, in Scotland, 37; necessity for their existence, 196, 197, 206, 291-343. *See* Sanitary Organization.
- Overcrowding, evils of, 83-85, 87, 88; illustrations of, 93-106, 111, 117; effects of, on morals, 117-120; proportion of death-rate to, 121, 122; epidemics depending upon, 124, 125; in army hospitals, 295-297. *See* Pulmonary Diseases.
- Oxidation, process of, 74-80.
- Oxygen, the great transformer of organic matter, 74.
- Ozone, 75.
- PALMERSTON, Lord, 241, 271, 272.
- Parish relief in epidemics, 321.
- Parliament, Scottish Acts of, on water-supply in Edinburgh, 165. *See* Legislation.
- Pestilence and plague in the middle ages, how regarded, 12.
- Phillips, Mr. John, evidence of, on drainage in Westminster, 249, 252-254.
- Phillips, Sir George, evidence of, referred to, 261.
- Physical culture and modern civilization, 6, 95.
- Plague, the, in London, 13, 47-51, 117. *See* Pestilence.
- Plato, ideal polity of, 6.
- Playfair, Dr. Lyon, 17.
- Poisoned wells, supposed a cause of cholera by the Hindoos, 216, 217. *See* also Wells.
- Poisons, morbid, 71-73, 209; popular errors in regard to the origin of, 89-92, 113, 114.
- Poor-law; English, working of, 95; administration of Scottish, 264.
- Poor, the, how supplied with water, in Edinburgh, 161-173; in London, 175-181.
- Prisons, mortality in, 148.
- Proportion between the death-rates of various ages, law of, 286-290.
- Pulmonary diseases, often generated by overcrowding, 127, 147-149.
- Purification of air and water, 67, 79, 80, 240.
- Purity of air and water necessary to health, 60, *et seq.*; efficient drainage essential to both, 198, 262.
- QUARANTINE Laws, 208.
- Quetelet, M., on invariability of vital phenomena under certain conditions, 20, 21.
- RAWLINSON, Mr. Robert, on the cost of water-supply, 235.
- Reform, sanitary, modes of effecting, 63, 95; instances in Liverpool, 109, 110; in Scotch towns, 114-117; the first step in, 301; personal and domestic, 339.
- Regulations, sanitary, among the Jews, 4-6; among the Romans, 7, 8. *See* Legislation.
- Removal of impurities, 240. *See* Drainage.
- Rendle, Mr. William, on the state of metropolitan schools, 130-132.
- Reports on public health, official, referred to, 17, 18, 80, 115-120, 174-183, 185, 199-203, 236, 237, 247, 252-

- 254, 256-260, 269-272, 276-284, 294-300.
- Rivers, dangers attending water-supply from, when impure from drainage, 198; banks of, haunted by cholera, 215, 216.
- Roberts, Mr. Henry, his papers on improved dwellings referred to, 137.
- Rome, sanitary legislation of, 7; sanitary works of, 38-44.
- Romsey Agricultural Association, 271.
- SANITARY laws and their administration.** *See* Legislation.
- Sanitary organization;** evils of ignorance on the conditions of health, 291-293, 297-301, 337; spheres of authority and instruction respectively, 292, 301; necessity for, in the army, 293-297; the first step in reform, 301; method and objects of, 302, *et seq.* (*See* Mortality, Sickness); how action is to be taken, 313; necessity for inspection, 314-318; medical aid in epidemics, 319; sphere of duty, as regards the individual and the community respectively, 327-336; personal and domestic reforms, 339; woman's work, 339-341; who is to begin? 342, 343. *See also* Authority, Board of Health, Economy, Legislation.
- Sanitary Reports.** *See* Reports.
- Sanitary Science,** what, 2; to a great extent modern, 4; tardiness in the advance of, 14; beginning of reforms, 15; application to, of death-rate calculations, 22-26; its solid basis, 26; sphere of authority in relation to, 33-35 (*See* Authority); progress of, in England, 36; Scottish neglect of, 37; popular ignorance on the subject, 291-301.
- Scanty water,** evils of, 150-186.
- Schools,** sanitary condition of, 110-114, 130-137, 299-301. *See* United Industrial School.
- Scotland,** neglect of public health in, 37, 115-117; death-rates in principal towns, 58; configuration of, favourable to purity of its water, 197.
- Scrofulous diseases,** 148, 149.
- Self-help versus Centralization,** 329.
- Sewage of towns,** importance of, to the agriculturist, 241-244.
- Sewerage,** 7, 60, 88, 100; defective, dangers arising from, 198; ill-constructed sewers, 249-254. *See* Drainage.
- Sex and age,** to be taken into account in estimating death-rates, 23, 24.
- Sexual demoralization** produced by sanitary neglect, 266-268.
- Shaftesbury, Lord,** 208.
- Shuttleworth, Sir James P. Kay,** 17.
- Sickness,** the amount of, to be ascertained, as an object of sanitary organization, 311-313.
- Simon, Mr.,** 148, 256, 338.
- Sleeping-rooms,** evils of overcrowding, 86, 87.
- Smallpox,** 28, 29, 71, 89, 208, 323.
- Smells, bad;** how far poisonous, 70, 191; caused by defective ventilation, 83, 101; by defective sewerage, 250-254, 258.
- Smith, Dr. Angus,** on the purifying effect of the soil, 78, 79.
- Smith, Dr. Southwood,** 17, 174, 208.
- Snow, Dr.,** researches of, on the cholera epidemics, 218-220, *et seq.*
- Social phenomena,** calculation of the probabilities by which their occurrence is ruled, 21.
- Social Science Association,** 115, 128, 133, 137, 235.
- Societies, Provident,** proportion of sickness to death in, 311, 312.
- Soil, the,** oxidation by, 78, 79.
- St. Bernard,** 9.
- Stagnation of air and water,** dangers attending, 28-31, 240.
- State physicians in ancient Rome,** 8.
- Statistical Society,** 81.
- Stimulants,** use of, 149. *See* Intemperance.
- Stokes, Dr.** *See* Cusack.
- Study, work, and play,** the proper amount of each, in schools, 134-137.
- Supply of water;** duty of a community in respect to, 154, 155, 166; how a deficiency arises, 157; scanty, dangers attending, 158, 159, 170-173, 175-183; relation of, to epidemic diseases, 210, 221; connection of cholera with, in London and elsewhere, illustrated, 219-230; modern water-supply of towns, 231-237; cost of, 235.
- Surface drainage,** imperfections of, 247-249.
- TAILOR, evidence of a,** on the state of the workshops in London, 276-284.
- Tax, the Window,** 263.
- Theodosian code,** sanitary regulations of the, 8.

- Thom, Mr. Robert, on cost of water-supply, 236.
- Town-Council of Edinburgh and water-supply, 166-170.
- Towns, state of, under the feudal system, 10-12, 45-47.
- Toynbee, Mr. Joseph, evidence of, before Health of Towns Commission, on ventilation in certain districts of London, 81-85, 127; on the water-supply, 176-180.
- Tubercular disease, connection of, with defective ventilation, 126-128, 147-149.
- Typhoid fever, in many cases traceable to defective drainage, 256; epidemic at Windsor, 257-260.
- Typhus fever, how generally communicated, 30, 126, 299; medical mortality from, 320, 352-360.
- UNITED Industrial School, in Edinburgh, a practical illustration of the "half-time system in schools," 134-136.
- VACCINATION, 14, 323, 324; a public concern, 325; duty of the Government with respect to, 326.
- Vegetables decompose carbonic acid and ammonia, 76.
- Ventilation, importance of, 26-34, 60; defective, causes of, 83, 87, 88; improvements in Liverpool, 95; want of, in schools, 111, 133; in workshops, 127, 148, 276-284; diseases generated by ill-ventilated apartments, 124, 128, 299-301; by ill-ventilated drains, 258.
- Villages, water-supply in, 194, 195; difficulties sometimes connected with, 196.
- Virtues, the social; exercise of, impossible, in the absence of physical comforts, 265.
- Vitiation of air, by carbonic acid, 69; by sewer gases, 250-260.
- WASH-HOUSES, public, 234.
- Waste matter, dangers of, 239; uses of, 241; application of, to the soil, 241-244.
- Water (See also Air and Water), not property, 150, 151; duty of communities in regard to, 154-156; how a deficiency arises, 157; evils attending it when dealt with as an article of commerce, 150, 151, 158, 159; scanty supply of, in Edinburgh, 160-166; in London, 175-181; free trade in water impossible, 185, 186; impurities of, *see* Impure Water; importance of an abundant supply in a pure state, 230, 231.
- Water-carriers in Edinburgh, 166; description of, by Lord Cockburn, 168-170.
- Water Company, in Edinburgh, 166; in London, 224-230; water-companies *versus* communities, 184-186.
- Water of Leith, state of, 255; effort for the purification of, 362.
- Well-being, relation of moral to physical, 265-268; illustrative cases, 269-272.
- Wells, city, impurity of, 7, 8, 200, 202, 228, 230.
- Wicksteed, Mr., on cost of water-supply, 236.
- Windows and their proper construction, 300, 301.
- Window-tax, the, injurious operation of, 263.
- Windsor, epidemic of fever at, 257-260.
- Woman's work, in sanitary reform, 339-341.
- Wood, Mr. Riddall, 111; evidence of, as to demoralization consequent on overcrowding, 118-120.
- Working-classes, houses for the, 115, 137-147.
- Workshops, crowded, evils of, 127, 148, 276-284.
- YELLOW fever, 208, 209, 232.
- Young, mortality amongst the, 111, 273-275, 285-290. *See* Children.
- ZYMOSIS, 73.

