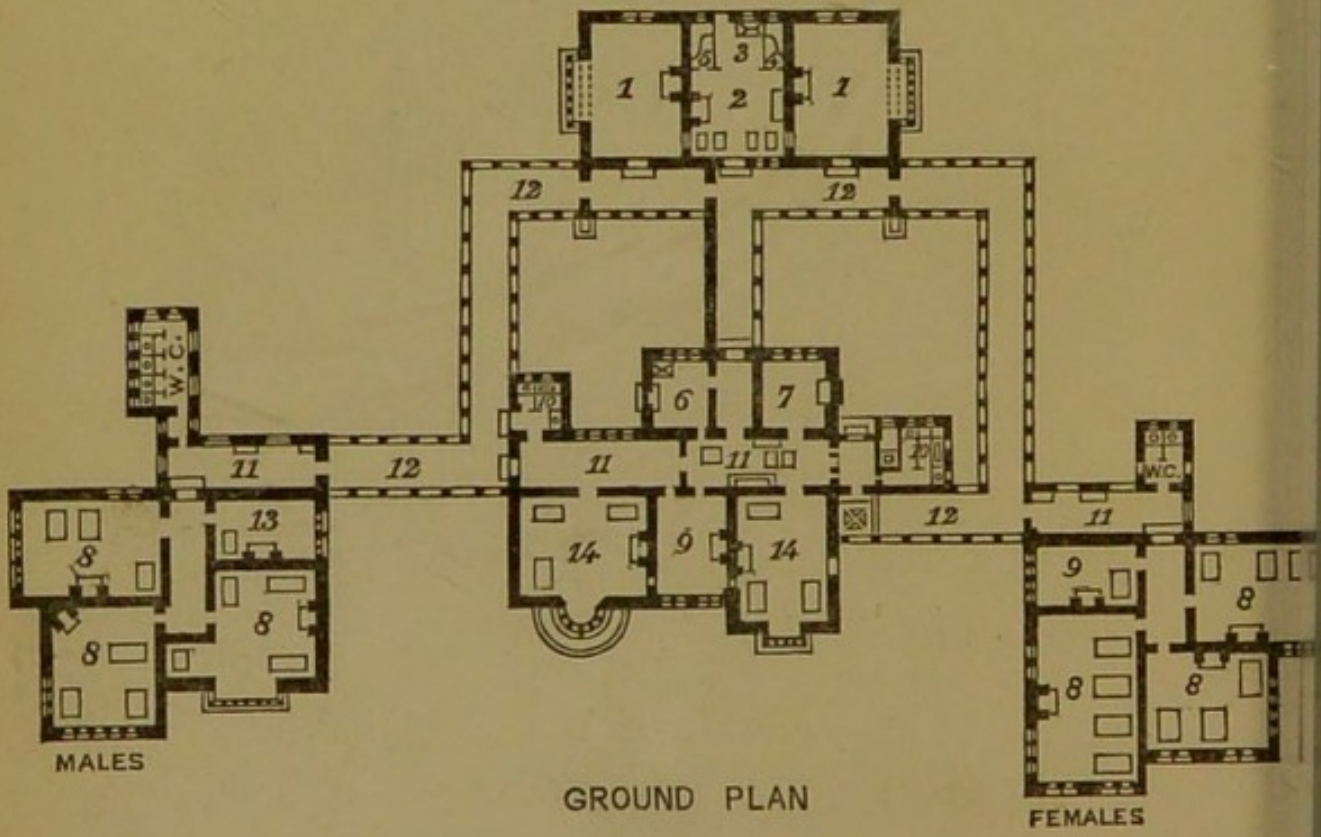
Lectures on public health : delivered at the Royal College of Surgeons / by E.D. Mapother.


ROYAL · COLLEGE · OF · PHYSICIANS · OF · EDINBURGH

PRINCIPAL ELEVATIONS



GROUND PLAN

A Design for Convalescent Hospital, arranged as Cottages.

From Miss Nightingale's "Notes on Hospitals."

1. *Dining and Day Room.*
2. *Kitchen.*
3. *Scullery.*
4. *Larder.*
5. *Stores.*
6. *Dispensary.*
7. *Maid Servants' Room.*
8. *Convalescent Bed Rooms.*
9. *Sisters.*
10. *Bath.*
11. *Corridor.*
12. *Covered Way*
13. *Gardener.*
14. *Sick Wards.*

LECTURES

ON

PUBLIC HEALTH,

DELIVERED AT THE ROYAL COLLEGE OF SURGEONS,

BY E. D. MAPOTHER, M.D.,

PROFESSOR OF HYGIENE, MEDICAL OFFICER OF HEALTH, CITY OF DUBLIN,
AND SURGEON TO ST. VINCENT'S HOSPITAL.

Illustrated by Twenty Woodcuts.

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TO THE

PRESIDENT AND COUNCIL

OF THE

ROYAL COLLEGE OF SURGEONS

IN IRELAND,

These Pages are Dedicated,

IN GRATITUDE FOR CONFIDENCE REPOSED,

AND IN ADMIRATION OF THEIR EFFORTS TO PROMOTE

THE DIGNITY AND USEFULNESS OF

THE HEALING ART.

PREFACE.

At the request of some of those who listened to these Lectures, they have been reprinted from the *Dublin Medical Press*, just as they were delivered during last July, for other engagements have precluded revision. To my friend G. F. Shaw, LL.D., F.T.C.D., Examiner in Literature in the Royal College of Surgeons, many of them owe illustrations and facts which his general scholarship and knowledge of the physical sciences rendered both appropriate and valuable.

E. D. MAPOTHER.

125 *Stephen's Green,*
September 15*th*, 1864.

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LECTURES ON PUBLIC HEALTH.

INTRODUCTORY.

Mr. President, my Lord, and Gentlemen,—The natural pride which I derive from the honourable, but, I fear, too difficult post which you have elected me to, is mingled with a feeling of admiration for the far-seeing wisdom of the governing body of this College, who, in 1844, founded this Chair, and thus anticipated the institution of any similar means for diffusing amongst the community at large, a knowledge of those laws by which health may be preserved and disease diminished. Since that period, in many Continental and a few British schools, professorships of this subject have been founded under the various titles of "Preventive Medicine," "Public Health," "Hygiene," and similar designations, and the directors of army medical education, both at home and abroad, have signalized themselves by the importance they have attached to it. In the great school recently created at Netley Hospital, there are combined, under the able direction of Prof. Parkes, the most perfect appliances for teaching hygiene hitherto realized.

This science, as I understand it, is an application of the laws of physiology and general pathology to the maintenance of the health and life of communities by means of those agencies which are in common and constant use. It is, therefore, a department which the medical profession can share advantageously with the public, who, indeed, through the medium of Social Science Associations, Parliamentary Commissions, and similar organs of inquiry, are advancing rapidly in sanitary knowledge. The audience which I have the honour to address in this and succeeding lectures being composed of both lay and professional persons, I feel the peculiar difficulties which arise from such a circumstance, for I fear that in endeavouring to elucidate many facts, unfamiliar to the former, I shall be reciting what my medical brethren must regard as obvious corollaries from data already in their possession. It seems to me that I shall most readily secure your attention upon the present occasion, and convince the sceptical, if such there be, of the importance of sanitary instruction and organization among the general public, by sketching, though very briefly, the evils which both in ancient and modern times have ensued from neglect of all wholesome precautions, and the benefits which a diffusion of sanitary knowledge has conferred on mankind.

Those of the Mosaic laws which regard bodily health are of the fullest and most positive character, and to people living under similar climatic conditions, none more appropriate could be devised at the present day. In this divinely instituted system, hygienic observances are incorporated with the religious code. Many of the teachings

of the Koran respecting ablutions and other means of personal cleanliness are worthy of our best attention, while the sanitary knowledge of heathen Rome is attested by the stupendous aqueducts and sewers whose very ruins at the present day excite our admiration. A lamentable falling off in the regard paid to public health is observable in the towns and cities of mediæval Europe. Crowded within a narrow compass, hemmed in by high walls, all sanitary laws neglected in the unsettled and disorganized condition of society then existing, the masses were decimated by constantly recurring plagues, fevers, and famines. The plague, popularly known as the "Black Death," which travelled over Europe and Northern Asia during the five years from 1345 to 1350, and carried off at least one-fifth of the population, is now well known to be due to overcrowding and want of cleanliness, and was preventible by their removal, and by quarantine. This pest has always had its starting point and permanent habitat in Egypt, where the Arab, his wives, children, servants, and domestic animals exist huddled together in a state, the distinguished observer Clot Bey describes in the words, "unheard-of filth reigns in their infected haunts." Their strength is destroyed by their precarious supply of food, which they cook over fires made with dried manure. Thousands fell victims to this scourge of the fourteenth century in every town in Europe, and in Paris the number of deaths was at least 50,000, according to Dr. Hecker, the authority above all on the subject, who also records that "in many places in France not more than two out of twenty of the inhabitants were left alive, and the capital felt the fury of the plague

alike in the palace and the cot. Two queens, one bishop, and great numbers of other distinguished persons fell a sacrifice to it, and more than five hundred a-day died in the Hôtel Dieu under the faithful care of the Sisters of Charity, whose disinterested courage in this age of horror displayed the most beautiful traits of human virtue. For although they lost their lives evidently from contagion, and their numbers were several times renewed, there was still no want of fresh candidates, who, strangers to the unchristian fear of death, piously devoted themselves to their holy calling." The plague which produced over 100,000 deaths in London in 1665, and of which we cannot read in the graphic pages of De Foe after such a lapse of time without the strongest feelings of awe and pity, was the last epidemic of its kind which visited Western Europe. Many outbreaks of it, however, have occurred since then in the East, and during the late war a malignant fever arose at Odessa, which, but for the prudence of the Russian Government, desirous to check alarm, should have received its true name, "the plague." Scarcely inferior in virulence, and more disastrous in the prolonged illness which it produces, is the epidemic fever which at closely recurring intervals has depopulated our poor land. I shall mention a few of the most remarkable of these epidemics, the more especially as they convincingly show the very principal dependence of fever upon an insufficiency of food—an evil, I trust, we may consider, at least to a great degree, preventible—and not on climatic conditions beyond our control. 1729—Most severe epidemic, great distress, and want of food; weather not remarkable. 1740—Dearth

of provisions, almost amounting to famine; weather favourable; 80,000 died, or, according to another authority, Dr. Rutty, one-fifth of the population. 1817–18—Corn saved was green in the husks; potatoes scanty, wet, unripe. One million and a half of cases occurred in this epidemic. Early in 1846, just when great anxiety was being felt for the safety of the potato crop, Dr. Corrigan published his famous pamphlet, urging the dependence of fever upon scarcity of food, and advising that all available precautions should be adopted. His anticipations were, as most of my hearers remember, awfully realized, for in the three terrible years following, 579,721 cases were treated in the hospitals alone. The disease usually known as the "ship-fever" which followed, destroyed thousands of the wretched emigrants, scarcely a vessel escaped; and to show its malignity, I may mention that in one, the *Loosthank*, 329 out of 349 passengers caught the contagion, and of these 117 died. The influx of destitute and fever-stricken Irishmen into Liverpool was so enormous that its death-rate was raised to 70 per 1000, more than double its average, and the highest mortality ever recorded in any modern city, so that it well deserved the name of the "hospital and cemetery of Ireland."

As regards the prevention of typhoid or intestinal fever, what can we hope for? I will answer in three sentences from the most recent and very highest authorities: "Every year in England more than 100,000 human intestines, diseased in the way already described, continue each for the space of a fortnight or thereabouts to discharge upon the ground floods of liquid charged with matters on which the

specific poison of a communicable disease has set its most specific mark." "By subjecting the discharges on their issue from the body to the action of powerful decomposing chemical agents they may be entirely destroyed. Typhoid fever ought, therefore, soon to disappear from every return of disease, whether in military or civil life." "The grand fact is clear, that the occurrence of typhoid fever points unequivocally to defective removal of excreta, and that it is a disease altogether and easily preventible." I will not add a word of comment upon these deliberate opinions of three of the most scientific physicians living. When typhus, the other variety of Ireland's epidemic enemy, is most indubitably spread by over-crowding, want of ventilation, miasmatous pools, and dung-heaps at the very doors, bodily filth, and deficient food, may we not hope it is equally remediable. There is little doubt that the susceptibility to epidemics, and the great mortality they have produced in our land, were due to the miserable and squalid state of our down-trodden peasantry subsisting, just at the verge of civilization, upon the potato.

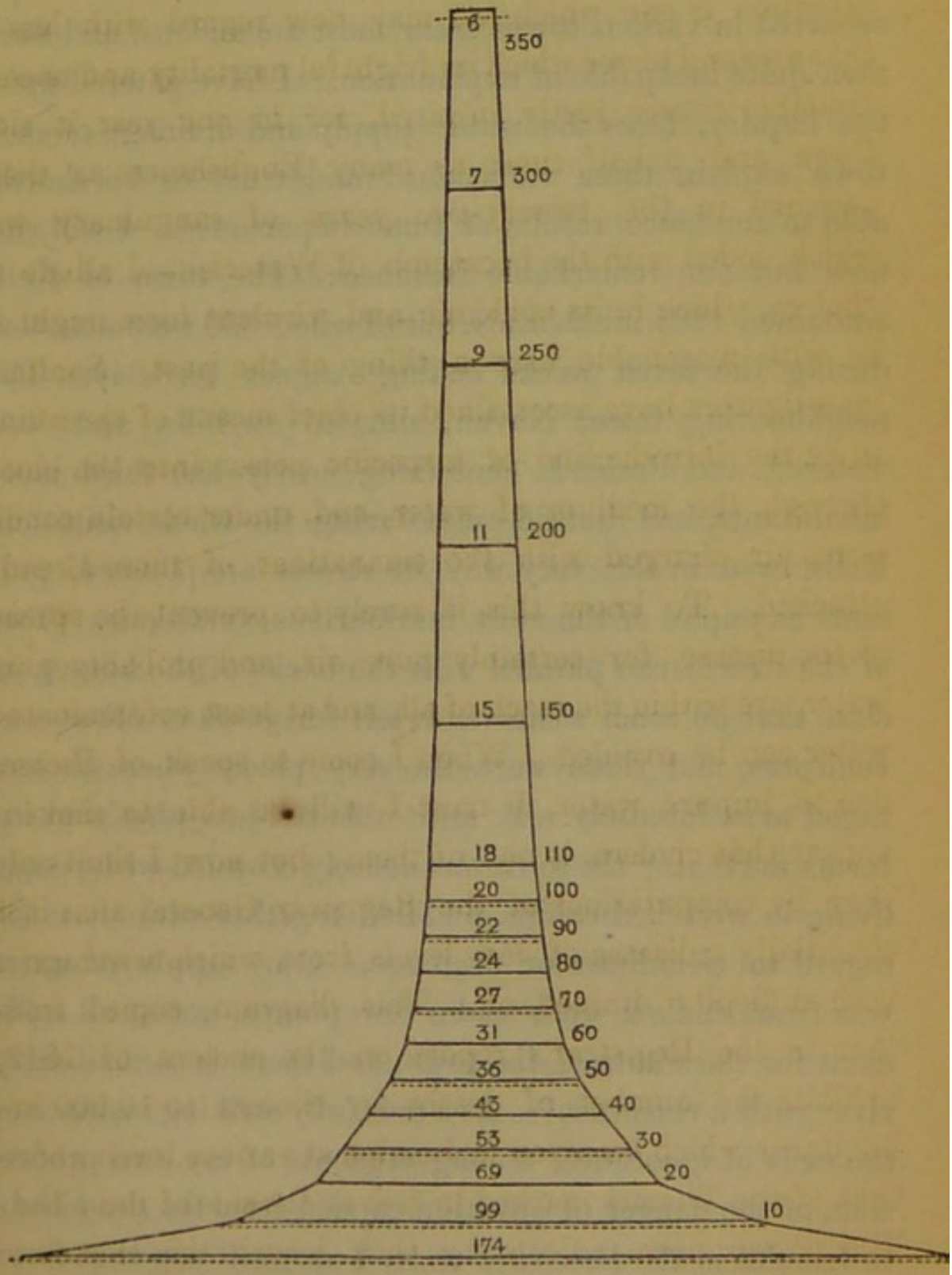
How have Irish physicians acted when pestilence is prostrating their fellow men, and depopulating their beloved country? Most nobly, and their conduct, as set forth in Drs. Cusack and Stokes' well known paper, "On the Mortality of Medical Practitioners in Ireland," cannot be too often held up for admiration and imitation, although it is to be hoped that improved sanitary measures will never allow the recurrence of so costly and unnecessary a sacrifice. There had been attacked with fever during the years from 1819 to 1843, 560, or nearly one-half of the physicians of

public institutions, and nearly 45 per cent. of the deaths amongst them were due to this contagious disease. In 1847, 123, or two-thirds of the entire deaths of medical practitioners were due to fever; or, in other terms, 40 out of every 1000 living, being a proportion more than forty times as great as the Registrar-General's returns show for the English population. Many British towns, receiving our afflicted countrymen with the seeds of typhus upon them, suffered fearfully from the epidemic of 1847, and the labours of one Edinburgh physician, Dr. Gairdner, now Medical Officer of Health for Glasgow, are worthy of record. The infirmary was so over-crowded that it contained twenty times its usual number of cases, and became a huge focus of contagion, and to serve in it certain infection to doctor or nurse. Additional wards were improvised out of two garrets, mattresses and blankets being placed on the floor. One night at ten o'clock, after the harassing duties of the day, Dr. Gairdner had to see over one hundred new patients in these rooms, through which he could not walk without stooping, and in which it was necessary to kneel or sit upon the floor to examine the pulse or tongue of each patient. Of twenty-two resident physicians, twelve took the fever, three having had it before; of nine attending physicians, six had previously the disease, and the three remaining now contracted it. The ranks of these officers lost four by death, and "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." Such services, though they may

not equal the brilliancy of military heroism, surpass it in usefulness, and should meet with adequate public recognition.

The last epidemic disease to which I shall direct your attention is one which we may now regard with less of that awe and terror which its frightful mortality and uncontrollable course justly inspired, for in one year it slew three and a half times as many Englishmen as there perished in the twenty-two years of sanguinary war which ended with the hecatomb of Waterloo—I allude to cholera, which in its epidemic and virulent form ought to be with reasonable care a thing of the past. Sanitary investigators have ascertained its chief means of spreading to be the introduction of a specific poison into the blood through the medium of water, and, under certain conditions, air charged with the emanations of those already attacked. To know this is surely to prevent the spread of the disease, for certainly pure air, and probably pure water, are within the reach of all, and at least contaminated water can be avoided. When I come to speak of diseases due to impure water, I trust I will be able to make it appear that cholera is one of them; but now I shall only show by computations of the Registrar-General that it is essentially a disease of low levels from which sewerage is with difficulty drained off. This diagram, copied from that in the Registrar's report on the cholera of 1849, exhibits the number of deaths by cholera to 10,000 inhabitants which occurred in London at various levels above that of the Thames marked in feet at the side of the pillar. The dotted lines indicate by their length the mortality

observed, and the unbroken ones that obtained by calculation of the level, and you see how closely they correspond.



During the cholera epidemic of 1849, 45,698 cases, and 11,129 in one month alone, were treated by physicians appointed under the Board of Health, and with the fearful mortality of over 42 per cent. The numbers which occurred in various towns seem most anomalous, and were then quite incapable of explanation. I have entered upon the inquiry, Does the water supply and drainage of each town explain these variations? and trust to be shortly able to announce results of some importance. I will cite now but one remarkable instance:—The town of Kells contained 4205 inhabitants, out of whom 330 were attacked during the seven weeks ending August 16, 1849. The neighbouring town, Navan, situated on hills, and well watered and drained, containing nearly one-third more inhabitants, had but 38 cases during the whole visitation. Kells, even in the very way its streets are planned, presents examples of the most insalubrious conditions. Two of the streets run parallel with the backs of the houses, so close that no room whatever is left for yards or other conveniences, and these were the very places where cholera raged most intensely. A most able resident physician informs me that "the town was densely crowded with people living in wretched cabins, huddled together without much regard to cleanliness or drainage. Our supply of water was from shallow wells and a few pumps, not at all sufficient for the wants of the town, and there is a small dirty river with a reservoir." As a painfully striking instance of the evils of ignorance, among students of my own profession, of the danger of infection carried from the dead body to females in the puerperal state, I may tell you that from

four hundred to five hundred deaths in the Lying-in Hospital of Vienna were annually traced to this cause; and so little attention is practically bestowed upon a free supply of pure air in these days, which in our vanity we call "enlightened," and in places upon which one would have thought official wisdom was concentrated, that the Commissioners who lately investigated the cubic space and ventilation of the barracks throughout our country, found that nearly half our soldiers were living in but 400 cubic feet of space each—a condition under which it was impossible for robust health to be maintained, and that some were condemned to almost certain death by having less than 250 feet.

A most gratifying example of the benefits of sanitary reform and scientific construction of dietaries is afforded by scurvy—a disease which some years ago destroyed more of our sailors than every other sickness, the casualties of the ocean and the efforts of our enemies all combined. Sir Richard Hawkins tells us he himself knew over 10,000 mariners to have died of scurvy within twenty years, and it likewise renders other diseases more frequent and fatal by its debilitating effects. By the use of lemon-juice, which Sir Gilbert Blane discovered to be powerfully preventive, fresh animal food and proper ventilation, no such disease now ever appears, except, indeed, where ignorance of these measures, or greed of gain by adulteration, substitutes other acids for the lemon-juice. Thus on board our transport ship *Tasmania*, scurvy raged among our Indian soldiers returning home in 1860, mainly because sulphuric acid had been supplied instead of lime-juice. In America, unsanitary influences are so rife that one of the

rarest things to be seen is a hale elderly man, and Dr. Nicholl, in his recent most able and interesting work, "Forty Years in America," confesses to a degeneracy of the Anglo-Saxon type among his countrymen, and attributes it to their unwholesome food, and on the part of the females, to injurious habits in respect to clothing and domestic arrangements.

The Legislature have done their duty respecting sanitary measures, and in such establishments as prisons, which are wholly under official inspection, disease and mortality have been immensely reduced. I trust on a future occasion, by data afforded by the system of vital statistics now inaugurated in this country, for its returns I will make my text, to interest you with Irish facts and figures, but now I must content myself with the following instance of the superior health and more efficiently checked disease among the inmates of Salford prison than among the neighbouring factory operatives. The former suffer but half as many days of sickness as the latter, and an attack of diarrhœa among the prisoners produced by the bursting of a sewer, was checked without a single death occurring as soon as the cause was ascertained, whereas 248 deaths from this cause were recorded in 1856 in the same district.

The sanitary measures which it will be the business of these lectures to more fully illustrate, may be enforced by the Nuisances Removal Act, and a few others bearing on Public Health. It is to be regretted in this department of legislation that all these acts do not apply to Ireland as well as to our more favoured sister island, and that they

are not consolidated into one act of easy reference. Those admirable enactments, the Local Management Act and the Public Health Act, introduced by our honoured Viceroy, then Lord Morpeth, do not extend their benefits to Ireland. Their regulations apply to towns in their ordinary status of health, but they should be carried on with increased vigour on the threatening or visitation of any epidemic.

In London the duties of the Medical Officer of Health, on whom lies the onus of carrying out these measures, are performed as follows: He receives on Wednesdays from the Registrar-General the weekly returns from the registrars of deaths, who likewise often give immediate information of any which take place by epidemic or preventible disease, and thereupon he orders inspection of the house and locality where such has occurred, directing the removal of any nuisance. When necessary, proceedings are taken under the Nuisances Removal and Diseases Prevention Act; but the directions are in nearly every instance at once obeyed without this step. The ventilation and other sanitary arrangements of buildings, workshops, lodging-houses, &c., is another matter which comes under the cognizance of the medical officer, who likewise directs the inspector of nuisances in the performance of his duties. A complaint-book at the parish office is the chief means by which notice of nuisances is received; and lastly, he draws up a weekly and an annual report upon the sickness and mortality of his district, and the measures he has superintended for promoting their diminution and checking the spread of those due to communicable causes. With regard to the

prevention of over-crowding, the magistrates in London have decided that all rooms which do not allow 500 cubic feet for each adult, and 300 for each child of the family inhabiting them, are "premises injurious to health," and in this way the medical officers can enforce the thinning of the over-crowded habitations.

I acknowledge that there is some difficulty in statistically demonstrating the reduction of deaths which have accrued from these sanitary labours; but all will grant that they have had their share in reducing the death-rate of London generally, from about 26 to 23 per 1000, and of some parts of it to a lower rate than that of the most salubrious rural districts, and in the words of the Registrar-General: "If the mortality of London were confined permanently within the limit represented by the mean rate of the last three years (1859, 1860, 1861), the effect of that reduction in the population as it exists at present, would be that more than 4000 persons would survive annually, whose lives would drop under the mean rate derived from the twenty years 1840-59; and if the measures that have been already adopted are not relaxed, the amount of benefit will be increased as the population that is the subject of it is increased."

But so far from regarding the improvements which sanitary science has already accomplished as having attained so high a perfection as these remarks seem to imply, I feel that they are as yet merely initiatory movements. Many lives are lost from casualties in many cases beyond the control of human foresight, as, for instance, shipwreck, by which 1500 of the picked men of the people

annually perish on our coasts, or are destroyed by such appalling calamities as the recent conflagration of the Santiago chapel. All of these deaths justly excite the sympathy of the public. Will not, therefore, the most strenuous efforts be made to check preventible deaths scores of times more numerous?

Some years since the salubrity of the country, as indicated by the average age and the death-rate, was very much greater than that of towns; for instance, the average duration of life among the labouring population of Wiltshire was 33, while it was but 17 in the manufacturing town, Manchester; but now the death-rates of urban and rural districts are very nearly equal: thus, in St. Giles, London, but 13·6 die out of each 1000 living, and but 17 in the Cavendish sub-division of the Marylebone district—a proportion the same as in Glendale, Northumberland, and the Isle of Wight, which have been reckoned the most healthful places in Britain. But no town surpasses Liverpool in the evidence it affords of benefits resulting from sanitary precautions. In 1842, one-third of its labouring population lived in cellars about twelve feet square, sometimes less than six feet high, often without windows, and only lighted and ventilated by a door frequently below the level of the street. Its death-rate was 38 in 1846, but now, owing to the philanthropic labours of the late Dr. Duncan in carrying out improved sewerage, closing of cellars, preventing over-crowding, especially in the low lodging-houses, and separating contagious cases, it has been reduced to 24, or less than two-thirds its former rate, and thus it may be estimated from the population of

that city that 4000 lives have been annually saved. The Registrar-General's returns show that one-half the deaths of England, and nearly two-thirds of those in ill-regulated towns, occur from diseases which are either wholly or partially preventible, such as typhoid fever, diarrhœal complaints, pulmonary diseases, nervous affections of infants, and the contagious fevers of children. Besides these 50,000 deaths, at least twenty attacks of illness will correspond to each of them, and this gives annually one million cases which the hygienist may strive to prevent.

Most of these deaths are premature, not removing the old and enfeebled, who should have shortly succumbed under any circumstances, but striking down the hale of both sexes, who are productive members of society, and whose loss throws a number of orphans and aged people as a burden on society. Fever is one of the most powerfully pauperizing agencies, being especially apt to remove those of the most valuable, the middle period of life. Thus of 2537 cases of fever collected some years ago by Dr. Southwood Smith, 68 per cent. were between twenty and forty years of age, but 17 per cent. below that period and 15 per cent. above it. Widows and orphans are thus plunged from independence into pauperism, which is rarely recovered from, as they become habituated to idle dependence, and it has been found that even when the children grow up, leave the poorhouse, and marry, their habits are improvident, and they frequently relapse into the conditions under which they were reared. Such premature deaths must in this country of all others be most severely felt by adding to taxes which already are at least sufficiently

high, and still worse, by thinning the labourers for agricultural or manufacturing enterprise, must help to further defer our long hoped-for prosperity.

Among the evils attributed to the condensing of population within towns, which is a striking feature of modern days, I will allude to but one. Consumption and allied diseases slay about 100,000 yearly in England, Ireland, and Scotland, and these deaths are distributed in almost exact proportion to the density of the population. This pernicious effect of the varied evils of overcrowding, I can best illustrate by some figures referring to three divisions of London, borrowed from Mr. Hammack of the Registrar-General's office.

RELATION OF DENSITY OF POPULATION TO MORTALITY FROM LUNG DISEASE.

Three London Divisions.	Deaths annually out of 100,000 living.	
Square yards to each person.	Consumption.	Other pulmonary diseases.
180	375	659
119	405	771
35	485	914

It has been often inferred, on the authority of an eminent statist, that mortality is in direct proportion to the simple density of population ; but this observation is a proof of how fallacious statistics may become if handled unphilosophically. Density of population is very commonly accompanied by impure air, scanty water, insufficient drainage,

and such concurrent evils which may exist and produce the worst effects amidst a sparse population. Condensation of inhabitants, on the other hand, so far from being lamented as an evil, seems a necessity of modern civilization, and to it most of its triumphs are due, but at the same time it devolves on the authorities, and especially upon those whose wealth is amassed by the toil of the poor, that it shall be stript, as far as possible, of evils not necessarily concomitant.

Of successful efforts, under these circumstances, to preserve the health of towns, I cannot give you a more forcible example than those of the Macclesfield Board of Health, cited by Lord Shaftesbury. When they began their labours the death-rate was 33, for the last five years it has been but 26, so that 1015 lives have been saved. 28,420 less cases of sickness have occurred. Three years have been added to the average duration of life; the mortality of children under one year has decreased 16 per cent.; and lastly, there have been 27 per cent. less zymotic diseases.

I will next illustrate the advantages to be derived from health inspection during the outbreak of an epidemic. Small-pox prevailed epidemically in London during the earlier months of 1860, and in order to make vaccination as general as possible, examination of all young persons was determined on, and the zeal with which it was carried out is recorded in the official report to the Privy Council. "The extent to which this examination was carried varied in the different unions; but it was carried to a large extent in all of them, and in the great majority was effected in a very complete manner indeed by the medical officers of health

with a zeal and assiduity of which I cannot too highly express my admiration. 40,000 children were examined in a very short space of time. Infected localities were also visited by the health officers, often house after house, and every adult and child was examined as to their protection." The results of this labour will best appear in the following figures:—The deaths by small-pox at the patients' homes were, in January, 129, February, 136, and in March, 144; but in April and May, when the preventive measures might be fairly expected to tell, the deaths were but 78 and 57, and chiefly occurred amongst the unvaccinated.

Sanitary organization, however, will always be incomplete and very generally inoperative without the aid of the popular educator, for a thorough system of inspection of the circumstances prejudicial to health in individual cases will be always resented by those who do not understand the advantages accruing, and the appropriate maxim of our city, "*obedientia civium, urbis felicitas*" will not be realized. I know I am making a most trite remark when I say that the humblest in the land for whom State education is provided, should be taught something of the structure and functions of the human body and the means for preserving it in health, and I only do so because the subject has never formed portion of the knowledge imparted in our schools. In the Universities founded in our day the matter has received attention, and there are signs of the more ancient ones following in their wake. In America I find they have been in this particular in advance of us, for in some of the States there are special enactments requiring physiology and hygiene to be taught in the public schools.

During the few remaining minutes of my hour I will invite your attention to the present sanitary state of Dublin, as far as it can be displayed with a system of death registration but six months old, and a medical officer of health but a fortnight in office. The first half-yearly report of the Registrar-General will be published to-morrow, but through his kindness I may anticipate it with one fact. During the twenty-six weeks ending July 2nd, there were 3414 deaths registered within the municipal boundary, and this, calculating on the ratio of the first half of the year, would give a death-rate of about 27 for every 1000 living.

I trust the time will come when sanitary statistics will be taken on so philosophical a scheme as to bring home to the mind of the most indifferent or selfish the chances of health or life in every class of street. For three years—1839, 1840, 1841—the death-rate was estimated at 30, and but 17 in the surrounding country, and considering the absence of many manufactures which prejudice the health of English towns, though they enrich them, the impression that mortality is high in Dublin has been very general, and is constantly expressed in the writings of great medical authorities of former days. Short (1750) asserts, "That sickly years are more fatal in Dublin than in London." Rutty (1772) remarks, "That those who know the situation of the poor here can be at no great loss to account for the frequency and mortality, especially of fevers, several families being in one room, which must undoubtedly contribute not only to the propagation, but also to the malignity of these diseases."

The status of disease in Dublin is shown by the medical tables of the last census, so admirably arranged by Sir William Wilde, for in a population of 254,293 persons, 5646 "laboured under temporary or permanent disease on the night of the 7th April, 1861," and of these 1763, or over one-third, were ill of diseases which were plainly preventible, or to be much diminished by attention to sanitary conditions, such as fevers, scrofula, consumption, dyspepsia, rheumatism, debility, &c.

It has been calculated that out of 100 children of the labouring classes born in Dublin, but 34 live to be 20, 20 to be 40, and only 14 to be 50. These figures applied to the present male population of the city, indicate that about 20,000 men will die between the ages of 20 and 40, and 10,000 between 40 and 50. Such premature deaths cannot be attributed to want of provision of curative medicine, for in no city in the empire are there more skilful and zealous physicians for the poor, but must in a great proportion of instances be assigned to ignorance of, or inattention to the teachings of preventive medicine. Overcrowding, impure air, insufficient water, imperfect sewerage, debility, pauperism, contagious scourges, death, widowhood, orphanage, and high taxation, have been then in this city sequential terms.

In 1844, the death-rate of children under five years of age was estimated to be 40 per cent., and so very great a mortality is a test of their being some most insalubrious agencies at work, such as impure air, confined space for exercise, want of breast nursing, and scanty supply of cow's milk. Such causes and those influences connected

with a city life which induce an early puberty and arrest of growth, have set their mark on the children of the labouring class in the more crowded parts of Dublin, who are remarkable for stunted proportions and scrofulous precocious aspect—characters which will be intensified in future generations, if the causes which produced them be not corrected.

The density of the population and the overcrowding of some of the poorer districts of our city are shown in the following tables:—

DENSITY OF POPULATION.

Census 1861.

	Population.	Houses.	Aver. to each house.	Acreage.	Aver. to each acre.
Dublin City ...	254808	23001	11	3592	71
St. Michan's ...	20085	1417	14	122	165
St. Nicholas' ...	11322	922	12·3	58	195

POORER DISTRICTS.

Streets and Alleys	Houses.	Rooms.	Beds and Straw.	Inhabitants.	Aver. to each room.	Aver. to each bed.
134	2102	11214	14850	40319	3·59	2·71

The second table I give on the authority of Mr. Nugent Robinson, one of the Secretaries of the Committees of the Corporation.

Instances of much greater overcrowding, I could very easily adduce from my own experience, but I prefer to offer you the evidence of others. I have elsewhere quoted

the following extract from Dr. Willis's work "On the Sanitary State of Dublin," but it is so striking, and yet so true, as I have had lately many opportunities of knowing, that I shall again read it for you:—"In some rooms in these situations it is not an unfrequent occurrence to see above a dozen human beings crowded into a space not 15 feet square. Within this space the food of the wretched beings, such as it is, must be prepared; within this space they must eat and drink—men, women, and children must strip, dress, and sleep. In cases of illness the calls of nature must be relieved, and when death releases one of the inmates, the corpse must, of necessity, remain for days within the room. Let it not be supposed that I have selected some solitary spot for this description. No, I am speaking of an entire district, and state facts incontrovertible. I indulge in no theories as to the causes which produce this state of things, but I state the results. They are, that every cause that can contribute to generate contagion exists here in full vigour, and that disease in every aggravated form, with all its train of desolating misery, is rarely absent." An intelligent practitioner has informed me that he attended 5 persons in fever at the same time, and that there were 15 other persons in the same room some years ago in Cole-alley. It is surprising we do not hear of infants being suffocated by overlying, for in the West Middlesex district, London, it is stated that 150 children annually lose their lives in this way, or by inhaling emanations under the bed-clothes.

The air in nearly every one of the rooms of the poor I have visited is most foul, the windows very rarely being made to open above, and are almost never opened at

the bottom, there being in many sleeping rooms no fire-place, and at night, when every crevice is closed, the air is so poisonous that they are only saved from suffocation by the endurance which habit produces. The sunlight, which is most healthful and purifying to the air, rarely enters such rooms, as they are surrounded frequently by very high houses, and the windows are darkened by dust. What has been done to remedy these fearful evils by providing fit habitations for the poor? The Towns Improvement Clauses Act declares, that no cellars less than 7 feet high, without a window, and of which more than two-thirds is below the level of the street, shall be inhabited, and upon this authority our Corporation has done immense good by closing over 3000 such dens. There are many alleys and courts which should be pulled down, for they are too dilapidated and ill-constructed to be repaired, such as Gill's-square, Calford's-court, and many places in the parish of St. Michan's, or at least in the case of courts, they should be converted into thoroughfares by removing the end houses.

The Rathmines and Rathcoole Railway, which will run through Exchequer-street, Fade-street, Stephen-street, Wood-street, Bishop-street, and Kevin-street, will remove many wretched dwellings; but it is much to be desired that benevolent and enterprising men will be found to substitute other more decent houses for the poor, as has been done on so large a scale by the Imperial Government in Paris while the magnificent improvements in that city are being carried out. Should this be neglected the only effect will be to drive the poor from one nest of unwholesoma

dwellings to others in the neighbourhood, and thus make matters worse than before.

The only efforts in this direction in this city which I am aware of have been made by Mr. Thomas Vance, Dr. Evory Kennedy, and Alderman Martin. Mr. Vance has built houses capable of accommodating thirty families in the most comfortable way—baths, lavatories, wash and mangling rooms being provided free of expense, in Chapel-lane, Lower Bridge-street, and he is adopting the same plan in Bishop-street and Kevin-street. Dr. Kennedy has erected admirable houses, now set in rooms, off Summer-hill. I believe that no pecuniary loss has resulted from these most praiseworthy efforts ; and if they were carried out extensively, as by a company, like those in London, where they are commercially successful, the moral, social, and sanitary conditions of the poor of Dublin would be amazingly elevated.

I shall now bring forward the statistics of one disease—namely, fever—because it is an unwelcome visitor from which we are never free, and is most largely preventible by sanitary measures, yet some years ago, within twelve months, 80 cases had occurred in one house, 50 had been admitted into hospital from another, and in a third, at the same time, 15 persons were lying ill of it. At the same period it was shown that, owing to imperfect traps, fever was more rife in places where there were sewers than in those altogether undrained. Last January was not remarkable for any climatic condition likely to promote the spread of fever, yet 229 cases were admitted during that month into the

Hardwicke, Cork-street, and Meath Hospitals. These institutions have received 35,657 patients with fevers during the past ten years, as seen in this table, of which most of the figures are given on the authority of that benevolent nobleman, Lord Talbot, who has given such zealous aid to our medical charities :—

Year.	Admissions.	Deaths.	Mortality per cent.	Proportion of cases to population.
1854	4396	385	8·75	1 in 57
1855	4492	362	8·60	,, 56
1856	3721	266	7·15	,, 68
1857	3534	268	7·58	,, 72
1858	3108	229	7·35	,, 81
1859	3466	226	6·50	,, 73
1860	2848	196	6·95	,, 89
1861	3310	209	6·31	,, 77
1862	3218	220	6·84	,, 79
1863	3564	222	6·23	,, 71
10 years.	35657	2583	7·27	,, 7

These returns only show portion of the cases which have occurred, for many are treated at their homes, or in the poorhouses, and some general hospitals. In the 104 registered lodging-houses throughout the city which are regularly inspected by the Corporation officers, but one case of fever occurred last year, which is a very gratifying instance of the benefits of sanitary efforts. The only remaining subject which I shall in this lecture allude to is the contamination of our atmosphere by impurities from causes which I trust will be soon removed.

The inhabitants of the south-eastern part of this city

have complained that it is infested by certain smells which have been assigned to various causes; thus, the manure works, chemical works, gas works, and creasote factory, have all had their accusers; and others assign the stench to the mist which, with an easterly wind, is blown back up the river, charged with the odour of decomposing seaweed and sewage matters. Yards where rubbish is stored abound in this neighbourhood, and for some months two large sewers have been opened for cleansing, and these may contribute their fetid exhalations. Amidst such a mixture of perfumes you will understand it is not very easy to determine with the nasal organ the real offender. I have examined into some of these alleged causes, and although my investigations are not completed so as to allow me as yet to come to any positive decision, I notice them to show the difficulties which surround the question. Hydrochloric acid and chlorine are the vapours said to be given off from the chemical works, but after a careful examination of one of them, I could not discover any of the former, in the atmosphere, except immediately near the retorts, and that the chlorine must escape to some amount is admitted and recognized by the enactment on the subject passed this session. The acid is, however, under control, yet that it escapes occasionally is said to be shown by injury to vegetation in the vicinity, and the corrosion of metals. Its effects upon animal life I will hereafter treat of. It was shown before the Committee of the House of Lords in 1860 that plants were injured by this vapour for two miles round such an establishment as St. Helen's, Lancashire. I

would not regard chlorine in the air in small quantity as injurious, remembering its disinfecting powers.

In the manure works, blood is dried, and if it be not kept till it decomposes, or be charred, no smell ought to issue; and fish offal is dissolved by sulphuric acid to mix with greaves, coprolites, wool, and other refuse. Upon three separate occasions, when I made the experiment, I have not been able to detect sulphuretted hydrogen or ammonia in the air about this yard, and the smell, which is disagreeable no doubt, depends on some organic matter, probably fatty acid, emitted from the fish under the action of the sulphuric acid. The soil in this neighbourhood seems soaked with sulphur compounds, for some water which I obtained from a shallow well contained sulphuretted hydrogen abundantly, and smelt very badly. This, in my opinion, is due to the lime water charged with sulphur compounds, or what the workmen call "blue Billy water," which has been used for purifying gas, being cast into the sewers. It is certainly to be regretted that the dry purifying process is not adopted in the Dublin gas works, as it is with the greatest advantage in London. In treating this delicate subject, in which equal regard must be paid to the commercial interests involved and the general salubrity of the city, the duty of the medical adviser is concerned with the question, whether this or that establishment is prejudicial to the health of the citizens. The question whether certain smells are nauseous or not, is a very interesting one for those who live in the vicinity, but is one which I do not think the Legislature contemplates, and of which the physician is no better judge than other people.

Undoubtedly most of these evils are remediable by such means as tall chimneys, plans for consuming smoke, and improved chemical appliances; and after some further investigations upon the matter, I shall feel it my duty to advise the authorities to check them by the powers invested in them under the Acts of Parliament bearing on nuisances. With regard to another fertile source of stench I trust we may promise ourselves a most essential improvement in the sewerage of our city—namely, that the refuse shall not be discharged into the Liffey, to decompose upon its shores at low water and emit the most poisonous exhalations, but shall be carried into two main sewers parallel to the river and cast into the sea as far out as practicable. At present, at low water, wind blows up the sewers and forces their fetid gases into our houses, but if the discharging orifices were far down this could not occur. No parsimonious spirit will prevail when it is remembered that the thousands expended will be repaid in scores of human lives and hundreds of sicknesses prevented. Between our unrivalled quays there will then course a pellucid and health-giving, instead of, as at present, a poisonous stream. Our able City Engineer has, however, wisely advised the Corporation to postpone any action in these intercepting sewers till we have the advantage of knowing the results of the similar extensive plan in London, devised by Mr. Bazalgette, by which the sewage will be carried to Barking's Creek, fourteen miles below London Bridge, and being let in during the first two hours of ebb tide, will be carried off to sea. There is little doubt now of the efficiency of this plan, and I may mention the corroborative fact that a

large salmon was lately taken in the river near Greenwich.

I am strongly of opinion that as soon as the new abundant water supply renders the water of the present basins unnecessary for domestic purposes, it should be used to flush the sewers twice daily. I have found the remarkably small amount of two and one-third grains of organic matter per gallon in the Liffey water at the Metal Bridge, and the fact suggests to me the belief that the many large sewers, including the Poddle, which open above this point, do not efficiently carry down the refuse from the districts they are supposed to drain.

If, then, it be true that Dublin has been more unhealthy than needs be, I feel confident that the authorities into whose custody its well-being is entrusted, are determined that it shall be so no longer. Their achievements in improving the drainage of the city, closing uninhabitable cellars, inspecting lodging-houses, slaughter-yards, bake-houses, and other premises, where nuisances are apt to arise, and above all, their labours to procure an abundant supply of pure water, show that they are not at least behind the times in their appreciation of the value of sanitary reforms. I rejoice to say that I am now associated with them in such good works, and if in performing the duties of Medical Officer of Health, I shall attain the same measure of success which has followed the labours of my colleagues in other cities, and become the humble instrument by which discomfort or disease among the citizens shall be diminished, or mortality reduced, I feel that no energy which I can command could be better rewarded.

LECTURE II.

AIR: ITS IMPURITIES, AND DISEASES DUE TO THEM.

THE prime necessity of human life is Air, the first and last act of our existence to breathe it, and the most essential condition of health is its purity, therefore all-sufficient Nature provides the most perfect means for accomplishing these requirements. The atmosphere around us extends to the distance of forty-five miles from the surface, but with uniformly decreasing density, and thus forms a covering for the earth in thickness about 1-160th of its diameter. This medium moderates and diffuses the heating and lighting rays of the sun, which, were it absent, would scorch the living world, and we would be submitted daily to a sudden and painful transition, from glaring sunshine to total darkness at sunset, and the reverse at sunrise. By becoming rarefied by the sun's heat endless motion is produced in the atmosphere, giving rise to winds varying in force from the gentle breeze to the all-destroying tornado. The sun's heat raises water from the lakes and oceans, and steeps the air with moisture, which returns again to earth after washing the atmosphere and charged with the foods of plants as refreshing rain. Without an atmosphere all

would be silence; the thousand cheering murmurs of natural moving objects about us, entrancing music and articulate speech could have no existence.

The physical properties of this fluid are chiefly negative, so that our senses do not readily perceive its presence—a circumstance which accounts for the negligence with which we treat it, taking no care that we shall aid Nature in preserving its purity. It is when pure, transparent, colourless, inodorous, and tasteless, and so elastic that it may be condensed to near the specific gravity of water, or expanded by a dull red heat to thrice its volume, never, however, losing its proper gaseous condition. It is ponderable, 100 cubic inches at 60° of temperature and 30° of barometric pressure weighing 31 grains. The air decreases in density so rapidly that four-fifths of the atmosphere by weight is within eight miles of the earth, leaving but one-fifth for the remaining thirty-seven miles, so that at the utmost limit 1 cubic inch would have expanded to 12,000, and it also loses 1° of heat for each 350 feet of ascent. A still stronger impression of its weight will be conceived when it is remembered that a column of air one inch square will weigh 15 lbs., or will balance such a column of mercury 30 inches, or of water 33 feet high; but the pressure of this great superincumbent weight is unfelt by us, because of its perfect diffusion, the force in one direction being resisted equally in another. Concerning the chemical composition of the atmosphere I shall be brief, and after directing your attention to this table of its usual constituents, I shall one by one explain the uses of those that are healthful and the effects of those that are hurtful.

Composition of Air and its occasional Impurities.

Oxygen		20·61
Nitrogen		77·95
Aqueous Vapour		1·40
Carbonic Acid		·04
Organic Matter Ozone Ammonia Nitric Acid Carburetted Hydrogen Sulphuretted Hydrogen Sulphurous Acid Chlorine Carbonic Oxide, &c.		Variable.

Oxygen has been long regarded as the essential material of air, and as its effects would be too stimulating if pure, it is diluted by four times its volume of nitrogen—a gas whose negative properties admirably fit it for this office. By volume the amount of oxygen in the 100 parts is 20·80, and so perfect is the admixture of gases by diffusion that, at great heights, at the sea level, in open country, and confined city, it varies but little from that standard :—

Paris	20·93	Simplon (6000 feet)	19·98
London sea level	20·92	Snowdon (3570 feet)	20·65
Open country	21·00	Mont Blanc (16,000 feet)	20·96

When this uniformity was first considered, the chemist was almost disbelieved, as every one felt the difference between the bracing country air and that of the crowded city; but we shall see hereafter that these characters depend on far different constituents. Oxygen is the supporter of combustion, and so much is thus used that it is calculated that one ordinary iron-smelting furnace con-

sumes daily over sixty tons weight, or as much as 200,000 men would require in the same time. In the human body oxygen is the great motor power; introduced by breathing into the lungs, it is seized by the red cells of the blood, carried throughout every tissue to combine with its carbon and hydrogen, thereby producing combustion, extricating heat, and is concerned alike in such opposite functions as the contraction of our muscles, or the production of thought. Complete denial of oxygen must, then, prove rapidly fatal, and a diminished supply should be injurious; but so perfect are Nature's provisions for affording an equable supply, that we do not meet with death or disease from this cause unless produced by violent mechanical means. In 1840, Schönbein discovered at the platinum pole of the galvanic battery while decomposing water, a body which, from its peculiar smell, he named "ozone." It is not a new body, but oxygen, either in an allotropic form, or in some peculiar electric state. It is evolved while the electrical machine is being turned, when sparks are transmitted through a confined portion of air, or most readily prepared by placing a clean stick of phosphorus covered by distilled water in a large bottle of air with a close-fitting stopper. When the bottle is kept at about 65° for from twenty to forty minutes, the phosphorus is oxidized, and ozone is set free in the air above it. Its chemical powers are those of producing the most intense oxidation and bleaching of all organic colours; for instance, uric acid is converted into urea, and litmus blue is discharged; but the property which interests us most is that of disinfecting all foul organic effluvia by oxidation, and there-

fore its absence is a fair presumptive test that such matters are being emitted in the vicinity, and *vice versa*. It is Nature's great scavenging agent, and is for this purpose being constantly generated by electrical disturbances. Ozone is contained in the alkaline permanganates, hence, as we shall presently explain, their eminent disinfecting power, and in chlorate of potash, to which fact I would assign much of the remarkable influence of that salt in decomposing the morbid matters in rheumatic fever and other blood diseases.

To discover the presence of ozone in the air, slips of clean calico, about three inches long and one broad, should be soaked in the following mixture:—Dissolve 10 grains of pure iodide of potassium in 2000 grains of distilled water, add 100 grains of starch in fine powder, and gently heat till the solution thickens. One of these slips, when dry, should be suspended in this box of perforated and blackened tin arranged in spirals, contrived by Mr. Lowe, which, while excluding the light, admits a free current of air, and which should be suspended at a few feet from the ground for twenty-four hours, according to this meteorologist. If ozone has been present the slip will be browned, the shades differing according to the amount of the gas present, and they are comparable by a chromatic scale ranging over 10° which has been constructed. When wetted, the colour changes from brown to an iron grey, or the well-known blue tint, due to the action of the iodine on the starch. Ozone abounds in sea air, for Faraday found it readily at the shore at Brighton, while no trace could be discovered in the town: neither could Angus Smith

detect its presence in the air of Manchester, which is so polluted by the smoke of the factories.

In March last I made several experiments in the way above described, and I was unable to discover ozone in many close places within this city; but in Stephen's-green it was abundant, the calico slip being stained in one hour and a quarter. At Kingstown eastern pier three-quarters of an hour produced an equal effect. It is stated never to have been found in the interior of inhabited houses; but I found that when the slip was suspended in my bedroom in Stephen's-green, five feet from the window, which was left open, it was coloured in four hours, but was not at all affected in twenty-four hours when the windows and doors were kept closed. Fixed to the sill the stain was apparent in three hours. I should in candour state that many able chemists have assigned the effects produced upon this test to the action of acids, chlorine, or organic matter in the atmosphere; but it should be remembered that the slips are stained at sea and at high levels, where these sources of fallacy are most unlikely to exist, while they are unaffected in large towns which generate such matters abundantly. Moreover, the production of the most decided effects in cold and wet weather, especially at night, with a westerly wind, and after a fall of snow, and their non-occurrence for precisely one-third of the days in the year entirely set aside these objections.

As regards the occurrence of certain zymotic diseases during the absence of ozone, surmises are plenty, but the following facts, noted by Dr. Herbert Barker, after two years of most accurate meteorological observations, are

reliable. Of 315 cases of diarrhœa, 246 took place during its absence; of influenza, 81 out of 109; of measles, 26 out of 36; of ague, 9 out of 11; of typhus, 6 out of 7; and of erysipelas, 12 out of 13. On the contrary, small-pox and scarlatina were more prevalent while ozone was discoverable.

Mixed but not combined with the atmosphere, there is always a variable amount of watery vapour, 0·35 grains being the utmost quantity which 100 cubic inches at 57° can take up. This is equivalent to about ·017 of its volume. As the temperature increases the air becomes more dry, and is capable of absorbing more water. The spontaneous evaporation which supplies water to the atmosphere varies with the motion of the air as well as with temperature—facts which were demonstrated by Dalton. He exposed a vessel of water six inches in diameter, at various temperatures, to still, gently moving, and briskly moving conditions of the atmosphere with the following results:—

Temperature.	Grains of water evaporated.		
	Still.	Gentle.	Brisk.
40°	1·05	1·35	1·65
50	1·50	1·92	2·36
60	2·10	2·70	3·30
215	120·	154·	189·

While water is evaporating much heat is rendered latent by the vapour, and is abstracted from the wet surface, so that water may be even frozen by producing evaporation around it; thus it is that we are the more apt to take cold with wet clothes the warmer the air about us is, and the danger can be avoided by wrapping round us a dry cover-

ing to check evaporation —a principle the Scotch shepherd follows when he rolls himself in his plaid, kept dry during the shower. The aqueous vapour in the air is essential to vegetation and to animal respiration, and decreased or increased beyond the normal point injury results; and we shall hereafter see that one of the evils of a want of ventilation is that the air of our rooms becomes almost saturated to the utmost by the moisture evolved from the lungs and skin of the inmates and the combustion of our lighting agents.

About 1-2000th of the volume of air is carbonic acid, more in summer, less in winter, and so perfect is the diffusion of gases, that although this gas is one and a half times as heavy as air, there is no more of it on the surface of the earth at sea level than at the summit of Mount Blanc. Indeed, in very high places, from the absence of vegetation which in other situations removes it, there is found the greatest proportion of this gas. Nature's means, then, for distributing this gas are perfect. Are those of Art ? Let the following facts answer : —Professor Roscoe found the amount of carbonic acid in the air of the gallery of a theatre to be nine times, and that of a crowded schoolroom eight times, as much as in the surrounding open air, and Leblanc found it respectively five, ten, and twelve times as abundant in the air of three Paris hospitals, as in the atmosphere outside them. Combustion, respiration, fermentation, and decay produce this gas so abundantly that animal life would be extinguished, did not plants proportionally remove it in performing their function in that organic cycle which has always been regarded as one of the marvels of creative perfection.

The deadly lake of Java, whose borders are strewed with human and other skeletons, and the Grotto del Cane, are well-known natural lurking places for carbonic acid, and brewers' vats and deep wells are artificial ones, due to the generation of the gas being more rapid than it can be removed by diffusion; and death has often occurred from entering them until purified by free airing or the action of slaked lime. It is often said that if air in such situations will support the burning of a flame it will sustain life; but this is a fallacy.

Other sources by which the atmosphere of towns is polluted are the carbonic acid and ammoniacal gases which issue from intramural churchyards and burial-vaults, the air in the latter having been found so impure as to extinguish flame. Legal enactments have to a great extent checked this evil.

Although no one can doubt the poisonous nature of carbonic acid when introduced freely into the lungs, the belief, however, that more harm is done by the organic matter, which in expired air is its constant companion, than by that gas itself, gains support from the fact that it may be freely introduced into the stomach, as we drink soda water and other effervescing beverages with useful instead of hurtful effects. Undiluted this and other irritating gases—as nitric oxide, nitrous acid, chlorine, and ammonia—are instantly refused admission by the ever-watchful muscles which guard the opening of our breathing passages. Ammonia from animal and vegetal putrefaction, and nitric acid formed by the combination of the nitrogen and oxygen after electrical changes, are pretty

constantly to be found in the atmosphere, whence they fall in rain to nourish plants. Upon man we are unaware that they produce influence either healthful or hurtful, and with that selfishness which views as useless all things which do not plainly benefit him, they have been called "accidental constituents."

I now proceed to those constituents of the atmosphere which serve no useful purpose, but, on the contrary, are most injurious to human health; and remember that Man, not Nature, is to be blamed for their presence.

The gases which sewers and cesspools emit into the air are mainly sulphuretted hydrogen, sulphide of ammonium, carbonic acid, and nitrogen. As regards the influence of the first on animals, the experiments of Dr. Herbert Barker are very conclusive. A dog was placed in an atmosphere consisting of 12 cubic inches of sulphuretted hydrogen to 5820 of air, or about 2 per 1000. "Within a minute he fell on his side and was seized with tremors; the action of the heart became irregular, and within four minutes the respiration had apparently ceased. It returned, however, and became very rapid. He was exposed one hour forty-eight minutes. He next became universally cold, jerking of his muscles followed, and he died eight hours after removal. The most frequent post-mortem conditions in this and similar experiments were extreme fulness of the right side of the heart and a crenated and broken up state of the blood cells." In one case "but one was natural." I shall quote another experiment.

"A common hedge-sparrow was put into the box as before with six cubic inches of sulphuretted hydrogen (to

5826 of air). Within two minutes he fell down insensible, and continued in this state for the space of one minute. The respiration then became very hurried and gasping. He rose, but staggered a good deal, and fell again on his back. Six minutes after the commencement of the experiment he vomited, became convulsed, and died in fifteen minutes." Now, the proportion of this gas to the atmosphere in the vicinity of neglected sewers and some manufactories may be quite as great as in these experiments, although imperceptible to the senses.

This gas issues from fissures torn open in volcanic countries, as at Puzzuoli in Italy, and is disengaged when iron pyrites from coal mines is allowed to decompose in the air, or from some ill-arranged chemical factories, and in all these cases effects very similar to those described by Dr. Barker have occasionally followed exposure to it.

The air in sewers is generally strongly alkaline from ammonia, its carbonate, or sulphide of ammonium, which fæcal matters evolve; and in addition to the characters we have mentioned it shows a deficiency of one-third of its oxygen, and a very large amount of peculiar organic vapour. The proportion of sulphuretted hydrogen has been found 6 per 1000, or six times as much as sufficed to kill the animal in the last-quoted experiment. If, then, we are alive to the pernicious character of sewer gases, with what feelings will we regard an untrapped or badly trapped gully!

Suspended impurities include both mineral and organic particles which float through the air usually invisibly, but if a ray of sunlight be let through an aperture into a dark room, such particles will be seen in rapid motion. The

mineral are mainly chalky or aluminous dust, which become deposited in the lungs, although there are millions of little hair-like bodies fixed along the lining of the breathing organs to fan them out, and thus it is, the inhabitants of cities, and of mines especially, are found after death to have much blacker lungs than those who live in a cleaner air. Spectral analysis has discovered—I should rather say exhibited—for ten years ago that delightful writer, the late Prof. Johnston, spoke of, common salt and chloride of magnesium floating about in sea air. But the putrescible organic impurities are those we have most to dread, and they constitute 40 per cent. of the entire, or 46 per cent. of those obtained in the air of a ward of the St. Louis Hospital, Paris. Amongst those that are animal are a variety of *débris*, such as particles of the cuticle, in summer, in towns, finely-powdered horse-dung and the grindings of shoe-leather, germs of minute animals, vibriones, and pus-cells, all demonstrable by the microscope ; and we have the strongest reasons for believing that the poisons of small-pox, scarlatina, measles, &c., are so disseminated. Cotton fibres, starch-cells, spores, and many kinds of fungi, are some of those of vegetal origin, in addition to which there are the odoriferous particles from plants, and animal matters which elude all our senses but that of smell. Ehrenberg asserts that he has distinguished by the microscope some hundreds of organic forms in dust collected from the air, and air deprived of them by being thoroughly filtered is so remarkably altered that it will not support the processes of putrefaction or fermentation.

There are great difficulties in collecting the peculiar

organic matter which emanates from the lungs in expired air. The best method is to suspend a clean and dry glass globe filled with ice in a room as air-tight as possible where a number of people are breathing; or it may be collected by passing the air through the "aëroscope," a funnel with a very small orifice, in which is inserted obliquely, so that the current will impinge on it, a piece of glass moistened with glycerine. The watery vapour containing it is then deposited on the surface. As much as 240 grains has been set down as the daily amount of this animal matter from the lungs and skin of each individual. It contains nitrogen abundantly, as it gives a red colour with nitrate of silver, and produces ammonia when distilled with lime. It is said to fix most easily on black surfaces, and all hygrometric substances absorb it, owing to the water with which it is combined. Unfortunately the amount of carbonic acid in the air which is so readily determined, is no guide as to the amount of organic matter, and until Dr. Angus Smith applied himself to the point we had no means of measuring it. A solution of the permanganate of potash loses colour in contact with organic matter to which it gives ozone or oxygen. From this instability of tint this salt has been long known as the mineral chameleon. Dr. Smith took measured quantities of air and added definite quantities of solution of the permanganate, and the less of this was decolorized the more free was the air from organic impurity. The following are a few of the striking results he obtained with the apparatus, which he named the Sepometer.

In a closely-packed railway carriage, in his laboratory

where the sewerage was leaky, and in a yard behind some filthy houses, there was twenty-five times as much organic matter in the air as on high ground thirty miles north of Manchester; in a bed-room there was three times as much, and the amount was considerably increased after the room had been slept in.

In applying this method to determine the purity of the air in various places in this city, I modified the plan merely for convenience sake. I filled this accurately graduated aspirator with water, and attached it to a set of Ure's bulbs, containing a measured number of grains of a solution of permanganate of potash of strength determined by the effect of oxalic acid upon it. As the water flowed from the aspirator the air bubbled slowly through the solution, and the number of cubic inches which passed before the solution was decolorized was an index of its purity. I quote the three following experiments as affording the best comparative results :—

Centre of Stephen's-green . .	3000	cubic inches.
Dissecting-room, containing about nine subjects	975	,,
Room in Braithwaite-street in which thirteen persons had slept, and before the windows had been opened	350	,,

These quantities of air produced the same effect upon equal measures of the solution; or, in other words, the air of the human dwelling was nearly three times as impure as that of the dissecting-room, and nine times as much so as that of Stephen's-green. A rough estimate of the impurity of the air in any close place may be made by noting the

time which is required to decolorize a few drops of Condy's fluid added to a little water in a white saucer.

The unbearable stench in the houses of the poor in Russia at the setting in of warm weather is due to the decomposition of organic matter emitted from the lungs and skins of the inmates, which has been frozen and preserved during the preceding cold months.

But the most suggestive fact of all that bear on this subject, and the communicability of disease through the air, is the discovery of pus-cells in the air of a ward of the Orphan Asylum of Prague, containing 33 patients, during an epidemic of purulent or contagious ophthalmia.

The poisonous effects of air impregnated with arsenical dust, detached from wall-papers and dresses coloured green with such compounds, attracted much notice a few years ago.

The following are some of the most usual exhalations from factories which have been the subject of legal contention under the Nuisances Acts:—Sulphurous and even sulphuric acids from vitriol and copper-smelting works; hydrochloric acid from alkali works; fumes of arsenic and sulphurous acid from copper and lead-smelting furnaces; carbonic acid and carbonic oxide from cement works; and from negligently conducted soap and candle manufactories, disgusting rancid oil-gases, and even the injurious substance which chemists term acrolein, are emitted, which are equally nauseous and deleterious. Many factories are positive nuisances by the quantity of unburnt carbon they emit in the smoke, and this waste is very often in proportion to the cheapness of coal. Some kinds of fuel are very noxious by the evolution of sulphurous acid—an effect

which might be prevented by mixing a little lime with it in the furnace.

Besides the gaseous impurities and suspended particles which I have heretofore spoken of, there are other matters in the atmosphere too subtile for chemical tests, or for vision assisted even by the most perfect artificial aids; but man is endowed with another sense by which they may be detected —namely, that of smell. There is little doubt that we are made sensible of odours by inconceivably small particles emitted from the odorous body, despite the often quoted experiment with an exposed grain of musk, which, after several years, was found not to have lost appreciably in weight. Another fact which shows the infinite minuteness of odorous particles is, that but a single grain of a compound of the metal tellurium, if swallowed by a healthy man, will render his companionship intolerable for months. Speaking of such disgusting substances, Prof. Johnston remarked: "It may not be impossible to employ them as weapons of offence or defence. Imitating the habits of the skunk in this respect, we might far surpass it in the intensity and offensiveness of our artificial stinks. Squirted from the walls of a besieged city, projected into the interior of a fortified building, or diffused through the hold of a ship of war, the Greek fire would be nothing to them; and as for the stink-pots of the Chinese, they must be mere bagatelles to the stenches we can prepare." For similar objects it has been seriously proposed to fill shells and other projectiles with kakodyle, one of the most deadly of substances, both on account of its inflammability and the arsenic it contains. Many of the noxious gases give us warning of

their presence by their disagreeable smell; but as I have before mentioned in respect to sulphuretted hydrogen, they must not be considered innocuous when so diluted that the mixture with air is inodorous.

I will now direct your attention to some diseases which we have reason to believe are producible by a want of constantly renewed fresh air; and I regret to say that it is in the records of hospitals some years back we shall find the most plentiful evidence. Some diseases have even had the term "hospital" prefixed to them to indicate their dependence on the atmosphere in which they arise, and which has itself been distinguished as "nosocomial air." I shall afterwards allude to the difficulties which surround the proper ventilation of hospitals, which mainly arise from many of them having been originally constructed for private dwellings, and hence become overcrowded when adapted to a purpose for which they were quite unsuited, and from the conflicting wishes of patients, differing as much in their feelings regarding foul or fresh air as in the nature of their diseases. Restlessness, *malaise*, the slow healing of sores, and tedious convalescence, have been frequent ill-effects of close hospital air, while such horrors as contagious gangrene, erysipelas, and a fearful blood-poisoning we surgeons call pyæmia, positively killed more patients in the hospitals of the eighteenth century than the very advanced surgical skill of their attendants cured. On the curative effects of pure air upon the usually fatal disease which I have last mentioned, hear the opinion of Mr. Paget, perhaps the most scientific surgeon living: "Of all the remedies I have used, or seen in use, I can find but one thing

that I can call remedial for the whole disease pyæmia, and that is a profuse supply of fresh air. In the three most remarkable recoveries I have seen, the patients might be said to have lain day and night in the wind—wind blowing all about their rooms." Air is plentifully required in hospital wards to oxidize the abundant organic matter which is so freely emitted from the bodies of the sick; and if they smell foul when one enters for a moment, what injurious effects must the patients suffer who are confined within them for the whole twenty-four hours.

One of the first medical writers who drew attention to the influence of a want of ventilation in producing scrofulous diseases, including consumption, was our own great Carmichael, who, in 1809, clearly proved that 7 out of 24 of the children of St. Thomas's School, and 6 out of 30 of those in the Bethesda, were affected in consequence of want of exercise and of freely admitted air. The children's wards of the House of Industry were that time so much overcrowded and so ill-ventilated that "there was no enduring the air when the doors were first thrown open in the morning," the cubic space to each inmate being under 120 feet. Although very much has been since then written upon the causation of consumption by impure air, there is ample room for searching investigations upon the subject, entered upon with no preconceived impression. For instance, a full inquiry into the hygienic conditions of the people of the Island of Lewis, west of Scotland, who enjoy so great an immunity that deaths by consumption occur but at the rate of 16 per 100,000, and of the denizens of crowded parts of London, where

they are thirty times more numerous, should lead to conclusive and most salutary results.

It has been fully established that domesticated animals are much more subject to consumption than those in a wild state, and the main difference between these two conditions being the want of free ventilation and exercise of the breathing function to the full extent. Rabbits, the monkey, sheep, and most other animals, can be rendered artificially consumptive by confining them in close and dark places, and without doubt human life is daily being sacrificed by the same experiment unwittingly made. Exposure to air containing mechanical particles produced by certain employments, as needle-grinders, earthenware-makers, stone-masons, bakers, flax-dressers, and cotton-carders, frequently excites this disease, which, amongst some of these trades, is known as "grinders' rot." The deaths by consumption in the army have been alarmingly numerous, but I feel no doubt they will diminish with improved air space insisted on in barracks by the late Commissioners. Dr. Guy, after a most masterly investigation of the circumstances influencing the health of printers, clearly demonstrated that their proclivity to consumption was due to want of ventilation, and among compositors to want of exercise in addition, for they were one-fourth more subject to it than the press-workers. The most enthusiastic support to the argument that foul air is productive and pure air preventive of consumption, will be found in the well-known writings of Dr. MacCormac. Sea air is that which is certainly the most powerfully preventive, but with unsanitary habits, the disease is often as frequent at

sea side places, as we were informed very long ago by Smollett, that authority, even on matters medical, for in travelling through Boulogne, he found scrofula, including rickets, very prevalent, and attributed the fact to the putrid vapours in the lower part of the town, which to my nose, while walking through its streets last summer, smelt even worse than Cologne.

The question of the origin of typhus and the spread of this and other contagious diseases through an insufficiency of pure air, will be perhaps more appropriately considered on a future occasion; but here I must state the advantages of free ventilation during the treatment of this fever so frequent in our land; 1, the comfort and more rapid recovery of the patient; 2, the removal of danger to the attendants; and lastly, the prevention of the spread of the contagion by its lurking in the furniture of the apartment or clothes of the patient or attendants. Consumption is, I am sure, induced, and contagious diseases spread, by the overcrowded and ill-ventilated state of the rooms in which large numbers of tradesmen, tailors especially, work together. Alcoholic stimulants are made necessary by the depressing effects of the foul air, and much of the intemperance of the artisan class has its origin in this way. If these rooms are lit by gas, as they generally are, the ventilation should be most perfect, for it has been found that an ordinary burner consumes about five times as much oxygen as one man.

In introducing the subject of aëriform poisons to your notice, it is important that I should explain some terms by which they are often designated.

Malaria is an Italian word signifying "bad air," and miasm from the Greek, is often used as a synonymous term; but carbonic acid or chlorine diffused through the air would come within the definition founded on these terms. I shall therefore speak of each agent by the name of the disease which it produces, and if any epithet be needed to group together ague-poison, typhus-poison, small-pox poison, and the like, let it be the word "aëriform." Of the first, I will speak especially here, leaving for another lecture the poisons generated by the human body, for they reproduce themselves, and are therefore *communicable* from one individual to another. Ague-poison does not present these features, but is endemic and locally atmospheric. The firmest fact concerning the ague-poison is that it is connected with the decay of vegetal matter, and that the aëriform bodies so evolved are brought down again to the earth's surface by the dew is one of the most favourite theories founded on this assumption. Another fact we may rely on is, that heat is one of the most powerful extrinsic agents, for it favours organic chemical change, and raises the moisture from the earth's surface which spreads the poison. It has been calculated that marsh poison may diffuse to between 1400 and 1600 feet vertically and about 800 feet along the surface. Trees are supposed to act as a barrier to its spread. Chemical examination of the air about marshes promises much towards discovering the ague-poison, but as yet it must be acknowledged that the analyses we possess do not determine the point. The gas most constantly and abundantly present is light carburetted hydrogen, and next in importance to this a slight excess of carbonic acid. Sul-

phuretted hydrogen may be found owing to the decomposition of sulphates by organic matter, especially if the marsh be so situated that the sea can be washed over it. The celebrated Prof. Daniell, finding much of this gas in water obtained off the West Coast of Africa, believed he had discovered the cause of yellow fever, which was some years ago so fatal there. Organic matter to the amount of 8 grains to the 1000 cubic feet has been obtained from the atmosphere of marshes, and it is a suggestive fact that it has exactly the same chemical character as the organic matter exhaled from our lungs, turning red with nitrate of silver, yielding ammonia when heated with lime and blackening sulphuric acid when drawn through it. Chlorine, and not ozone, destroys this matter which some regard as the ague-poison. The only plausible grounds that a disease may arise from the entrance of minute animals from the atmosphere into the animal body, is the statement of a recent French writer that splenic apoplexy in the sheep is due to species of bacteria which, floating in the air, enters the creature's lungs. I have no doubt but that amongst all kinds of suppositions, the theory that the evil of malarious air is the negative one of a deficiency of oxygen, has been advanced, and the constant concurrence of organic matter which in decomposing so greedily abstracts that gas, the frequent concurrence of a ferruginous soil which might absorb it, and some of the peculiar symptoms of ague, certainly support the notion, if one so hypothetical be allowed for a moment. Nor can we explain our immunity from ague in this country where moisture and organic matter are found plentifully together in our bogs.

The striking salubrity of large level spaces, such as commons or flat extensive strands, like that of Tramore, will be perhaps more appropriately submitted to you when I come to speak of climate, and on Saturday, when I trust to have again the pleasure of addressing you, I will conclude the subject of air with a description of the means supplied by Nature, and which Art should imitate for keeping it pure within our dwellings.

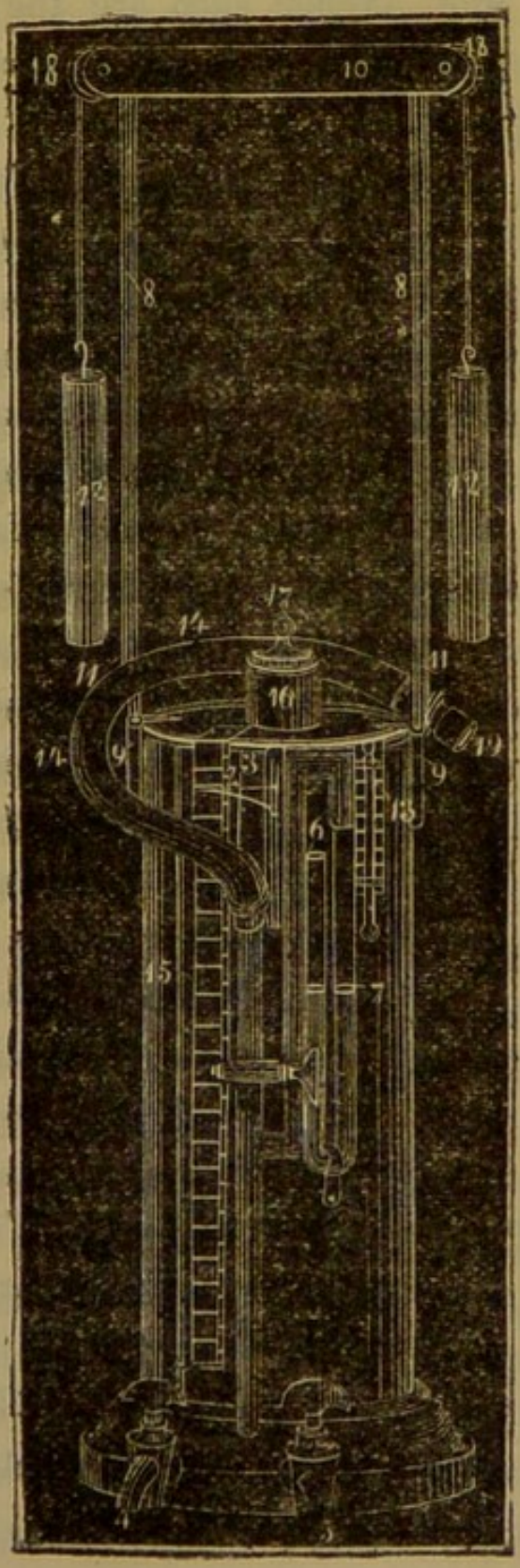
LECTURE III.

AIR CONTINUED.—VENTILATION: DISINFECTION.

The quantity of air we inhale at each ordinary breath we take is most variable, and even an average quantity cannot be positively stated. One peculiar source of fallacy arises from the fact of our breathing more vigorously when attention is fixed on the act. The round number of 20 cubic inches is pretty near the truth, and it is worthy of note what a small proportion this bears to the utmost quantity we can inhale. An ordinary man of five feet eight inches in height and ten stone weight can expire 240 cubic inches from his lungs, as can be shown by this instrument—Hutchinson's spirometer—figured on the next page.

The light dry gas-meter I will now use, which, by the way, was manufactured in Ireland, and displayed in our National Exhibition, makes a much more handy and truthful instrument. The greatest amount ever expelled—464 cubic inches—was by an individual whom I might call a giant, as his height was seven feet and his weight twenty-two stone, and the least—46 cubic inches—from Don Francisco the dwarf, who was but twenty-nine inches high and forty pounds in weight. The instrument is very reliable in examining lives for insurance, as any wide departure from the normal standard is in-

dicative of some obstructive disease of the lungs, preventing their full expansion.



The amount of air breathed in varies remarkably with the dress of the body; thus a man was found to breathe nearly one-third more air when his ordinary clothing was removed from him. When such are the effects of our loose habiliments it cannot be necessary to descant upon the evils of tight-lacing.

The amount of air required depends, then, on physiological data, which are not by any means positively settled. An ordinary man I have stated breathes in about 20 cubic inches of air about eighteen times per minute, but as every fifth inspiration is more vigorous, the round number 400 cubic inches seems to me a fair amount to assign as the quantity each man breathes out per minute, equal to 24,000 cubic inches per hour. Fresh air contains, as we have before seen, but 0·4 per 1000 of carbonic acid; that which has been breathed contains 40 volumes per 1000, or 100 times as much, besides many more noxious ingredients, which we will for the present exclude from consideration, as the carbonic acid is so much more readily measured. Now, to dilute the air expired by one man in an hour, so that it shall contain but its just proportion of carbonic acid, there must be added about 1660 feet of fresh air. The Commissioners who investigated the state of the barracks some years since recommend but 1200 cubic feet per hour for the rooms. The permanent regulations in the military service merely regard space per man, and allow the following:—In barracks, 600, in huts, 400, in home hospitals, 1200, or in those on foreign stations, 1500 cubic feet. The French commission on the subject recommended 5000 cubic feet per man in hospital during any epidemic.

Allowance should be made for the abstraction of oxygen and addition of carbonic acid, which lighting agents produce, and calculations may be made on the datum, that one cubic foot of coal gas produces two cubic feet of carbonic acid, and will require thus about 1800 cubic feet of air to dilute it down to a standard not injurious. An ordinary candle, six to the pound, will produce about an equal quantity of carbonic acid and much watery vapour. I may here mention that the unconsumed smoke of a smouldering candle is as hurtful as it is unpleasant; and a death has resulted from its poisonous effects. Some half-intoxicated fellows, for the purpose of teazing a boy who lay asleep in the corner of a room in which they were drinking, held a smoking candle under his nose for intervals during half an hour, when he became insensible, and he died with convulsions on the third day. Such effects of aërial poisons will not surprise us when we remember the immense surface which our lungs present, nearly 200,000 square inches, which rapidly absorb them, and the sickening and disgusting odour of the concentrated emanations from the lungs of several people will never be forgotten by any one who has had occasion to perceive it while arranging the outlet on the roof of a crowded building.

In approaching the subject of ventilation, I feel by no means confident that I shall not disappoint many of my hearers, for I shall be very brief, thinking that upon no subject has more been uselessly written and more ingenuity wasted. In saying this I do not for a moment undervalue the advantages of fresh air, as will indeed be apparent from my preceding remarks; for the contrary, I

 on

all rooms, hospital wards, &c., as positively injurious to health unless the air in them be as inodorous as that of the free atmosphere about them. I do not, however, anticipate that the contrast between town air and country air, to which Milton alludes, will ever disappear:

> "As one who long in populous city pent,
> Where houses thick, and sewers annoy the air;
> Forth issuing on a Summer's morn' to breathe
> Among the pleasant villages and farms
> Adjoined, from each thing met conceives delight."

We have seen that Nature's provisions for the removal of foul air were among the most perfect and plainly beneficent of her wondrous works, so that in constructing means for the exit of air which has been breathed we have but to endeavour to copy her. And the devices which animals instinctively adopt for the like purpose are equally interesting and instructive. Let us study, for instance, the operations of the bees, to whom the work of ventilating the hive has been entrusted. The air can only enter at the door, as all the rest of the hive is plastered with propolis, a waxy matter with which the bees make their hive air-tight. There are gangs of from ten to twenty working bees each, according to the heat of the weather, stationed at the entrance, who ventilate the hive by vibrating their wings with great rapidity, and each gang is relieved when on duty about half an hour. If a greater need for air be excited, as when they are roused by shaking the hive or letting into it some disagreeable vapour, the number of ventilators and the efforts of each are greatly augmented.

That most appalling of all calamities due to ignorance of the want of fresh air, the suffocation of nearly one hundred passengers on board the steamship *Londonderry*, which must be fresh in the recollection of many of my hearers, is the only instance of the fatal effects of total want of ventilation I shall allude to. This vessel left Sligo for Liverpool on the 2nd of December, 1848, and stormy weather coming on, the captain forced the two hundred steerage passengers into their cabin, which was eighteen feet by eleven, and seven feet high, thus allowing but seven feet of cubic space for the breathing of each person. The captain now battened down the hatches, and lest a breath of air should enter, covered over the entrance with a tarpaulin nailed down. An indescribable scene of horror followed, and when the mate came to the cabin seventy-two were already dead, and several others were expiring with fearful convulsions, and with blood starting from their nostrils, ears, and eyes. They were thus condemned to a death more horrible than if the ship had been submerged, through the captain's ignorance of the value of fresh air, which was separated from them but an inch or two. With a calamity so recent before the minds of ship captains, we would suppose no death from similar cause would ever again occur; but in a schooner lying along our quays last February, a sailor was smothered for want of ventilation in the forecastle. In contrast with such cases remember the beneficial effects of ventilation in the saving of human life, as in the following instance:—During the twenty-five years following 1758, when the Rotunda Lying-in Hospital was founded, 17,650 infants were born alive; 2944 died, or about 1 in 6. The

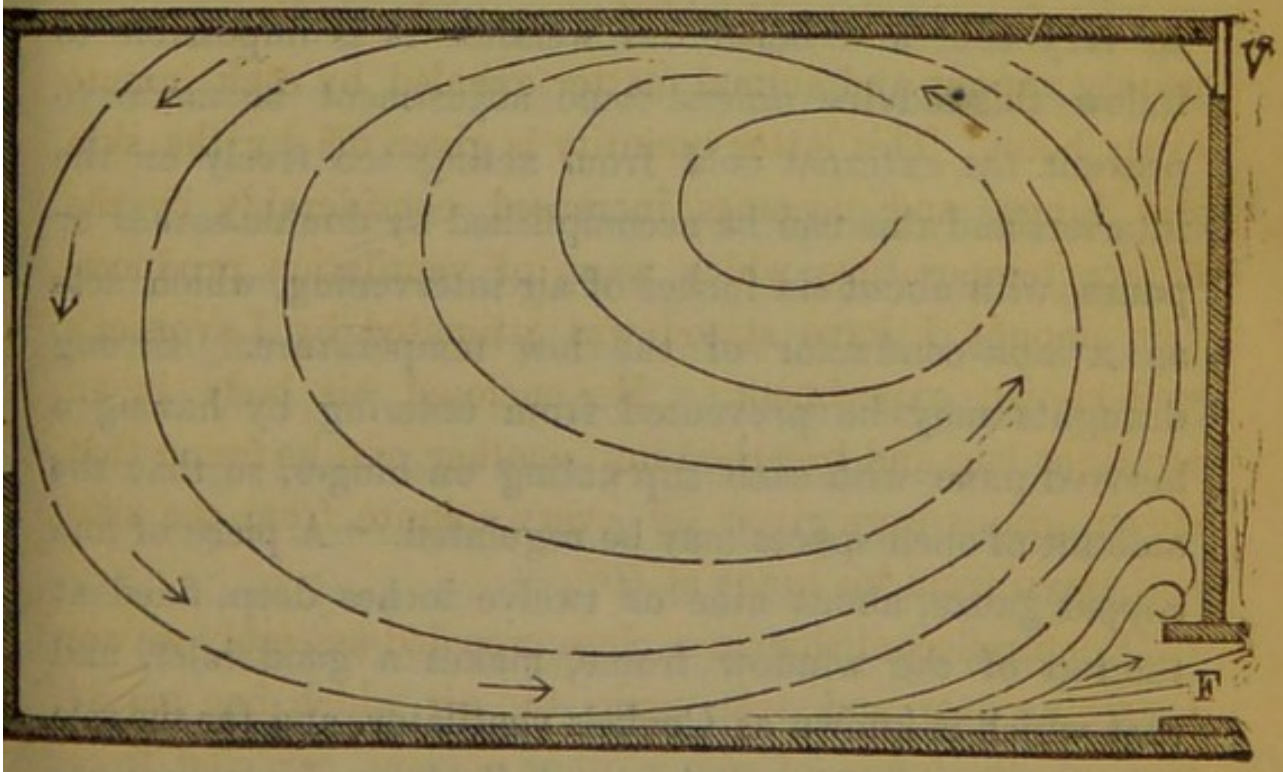
hospital, which up to this time was unventilated, was altered so as to allow a free supply of air; and for the following twenty-five years but 550 out of 57,072 died, or 1 in 104.

The objects which we are to accomplish by ventilation are as follows:—To remove all noxious gases produced by combustion, overcrowded respiration, imperfect sewerage, or by decomposing animal or vegetal matter, from our apartments, and to equalize their temperature and humidity. By ventilation there must be removed entirely, or at least diluted below an injurious degree, the 960 cubic inches of carbonic acid and the two and a half ounces of watery vapour and animal matter exhaled by each inmate every hour. This latter quantity is given off by the skin and lungs, and becomes increased considerably by the higher temperature which want of ventilation produces. The amount I have stated was estimated by Lavoisier's well-known experiment. He enclosed his body in an air-tight bag and breathed into another, and he found that eleven grains were given off every minute from the skin and seven from his lungs at 60°.

If one reflected that in a close crowded assembly we are breathing over and over again the air which has passed through the lungs of many other persons, carrying from each noxious decomposing matter, that fastidiousness which makes us refuse the drinking vessel which the lips of another has touched, would suggest to us the advantages of clean air.

The different density of cold and heated air produces a constant circulation in the atmosphere of any room, and

unless the generation of carbonic acid be very rapid and abundant, as when the space is greatly overcrowded, it will be in this way pretty equally distributed. These currents in a room warmed by an open fire can be demonstrated by weighting a small gas-balloon until it is exactly of the same specific gravity as the air, and when let loose it will move in the circles sketched in this diagram of a room with a ventilator, window, and open fireplace.



It will be remarked that there was a current towards the chimney and the ventilator, and that an eddy was produced above the chimney-piece. These latter rapid movements can be best shown by the fumes produced by

holding a sponge dipped in hydrochloric acid and held over a saucer filled with ammonia.

Having explained a few of the principles on which exchange of air depends, I will bring under your notice a few methods of ventilation, *natural* and *artificial*. Among the first rank, windows, doors, fireplaces, and the permeable structures of which our walls, ceilings, and floors are constituted.

In mild weather there is no ventilator so efficient as the window left open a few inches at top and bottom, especially the former, to allow the heated air to escape. In very cold and boisterous weather it is impossible to follow this advice unless some adjustment be made to prevent the external cold from acting too freely on the interior, and this can be accomplished by double sashes or panes, with about six inches of air intervening, which acts as a non-conductor of the low temperature. Strong draughts may be prevented from entering by having a louvred pane with each slip acting on hinges, so that the amount of open spaces may be regulated. A piece of fine copper gauze, about nine or twelve inches deep, fixed at the top of the window frame, makes a good inlet, and that which is known as Cooke's ventilator, and for the sale of which the "Ventilation and Sanitary Improvements Company" was established, consists of copper gauze fitted to the top of the case and bent at an angle of forty-five degrees. It may be so arranged by hinges along the angle that it will fold up when the window is shut, but it is less likely to go out of order if stationary. The gauze finely divides the current of air, thereby preventing

draught, and excludes the coarser mechanical impurities, as dust or insects. The object of the angular shape of the ventilator is that the upper half shall let out the heated air and the lower admit the fresh; and I have found that there is a difference of about twenty degrees in the air which passes through each when a room is heated. Mr. Thomas Greer of this city has obtained a patent for a ventilator on a similar plan, save that it is stationary, semicircular in shape, and draught is prevented between the sashes by india-rubber pads. I may show you that gauze prevents draught, by blowing through a tube against the flame of a candle, when it is scarcely affected if this piece of wire gauze intervenes. This is a model of Greer's ventilator fitted to a window.

I am an advocate for leaving a small portion of the window of bedrooms open during the night, except in extremely cold or rough weather, and perhaps even then with the arrangements above alluded to, and with a due regulation of the clothing. I know that during night less air is required, as carbonic acid is generated much less freely, and that the body is particularly apt to chill; but I am averse to remaining in such air as the nose perceives, when, in the morning, you enter an ill-ventilated bedroom. Moreover, in large manufacturing towns, the air is less polluted by smoke during night. There are some who object to regarding windows as ventilators on the score of their being constructed for another purpose; but so far from depreciating their usefulness in admitting light I would urge that, we do not enjoy the benefits of light as much as our French neighbours; for although in Dublin we do not suffer like

London from a murky atmosphere, the high ill-constructed houses overshade the humbler ones, the windows of which are so dirty as to act as efficient sunblinds. Light, besides its delightful cheerfulness, is useful in promoting the destruction by oxidation of organic matter in the air; and I believe that the cellar-grown man is blanched by the same unnatural want of light as is the underground plant. The limited window space of English houses is one of the ill-consequences of the tax which reflects no lustre on the name of William Pitt.

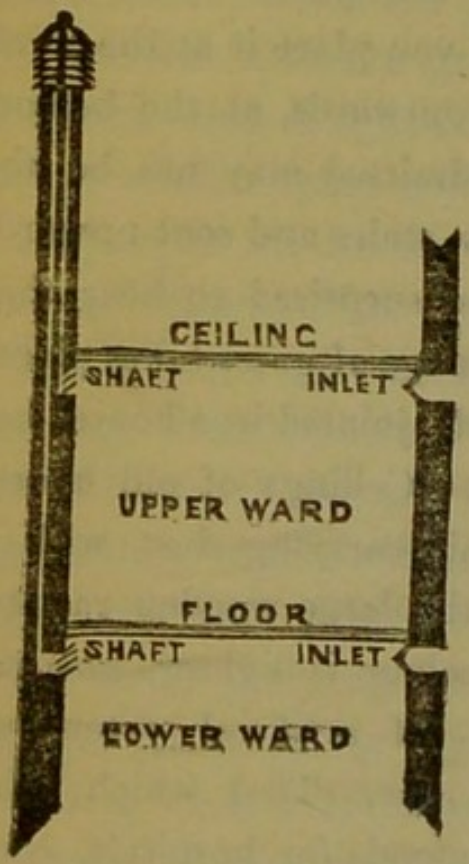
A fireplace is a good ventilator, especially when the fire is burning, when it draws off several thousand cubic feet of air per hour. They are, however, made now so low that they merely ventilate the lower stratum of the air. Their superiority over the hypocaust or hot flue system was tested some years ago in St. Patrick's Hospital in this city, for the mortality was greatly reduced when ordinary fireplaces were adopted with proper guards. It was the celebrated Benjamin Franklin who suggested the insertion of an aperture in the flue, near the ceiling, when describing his famous Pennsylvanian fireplace in 1744.

"In rooms where there is much smoking of tobacco it is also convenient to have a small hole, about five or six inches square, cut near the ceiling through into the funnel; this hole must have a shutter, by which it may be closed or opened at pleasure. When open there will be a strong draught of air through it into the chimney, which will presently carry off a cloud of smoke, and keep the room clear; if the room be too hot likewise, it will carry off as much of the warm air as you please, and then you

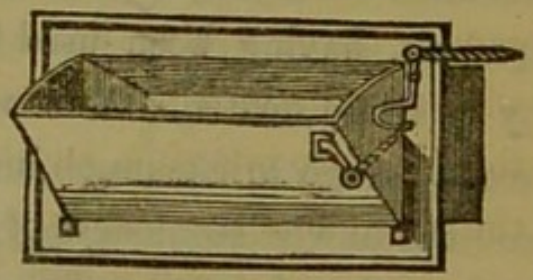
may stop it entirely or in part, as you think fit. By this means it is that the tobacco smoke does not descend among the heads of the company near the fire, as it must do before it can get into common chimneys."

Doors are ventilators, as you can prove by taking a candle in a close-heated room; if you place it at the chink above, the flame will be blown outwards, at the bottom inwards. The air, however, so admitted may not be the freshest, having been used below stairs and sent upwards by its being heated. You will be surprised to hear that even through bricks much interchange of gases takes place; and the unwholesomeness of closely-jointed iron houses has been assigned to the difference. Ceilings of old houses often show that a passage of air carrying dust with it occurs through them, for under the large wooden rafters, where no passage occurs, the colour is lighter, no dust being fixed into the plaster. Of artificial systems of ventilation I shall mention but few. That which Miss Nightingale most strongly recommends for hospitals, consists in shafts built in the walls and opening near the ceiling of the room, where it is louvred to prevent down-draughts, and a turret projects from the roof so as to carry off the foul air. In an opening in the opposite wall should be fixed one of these Sherringham's inlets, which, having one side hinged, can be arranged to let in any quantity of fresh air. This simple plan is here depicted. The sectional area of the shaft should be in proportion to the size of the room, and one inch for each 50 cubic feet on the top floors, and 60 on the lower would suffice. Fresh air might be introduced from a space below the floor of

hospital wards, and admitted into them by fine wire gauze set near the beds.



Section of Ventilated Ward.



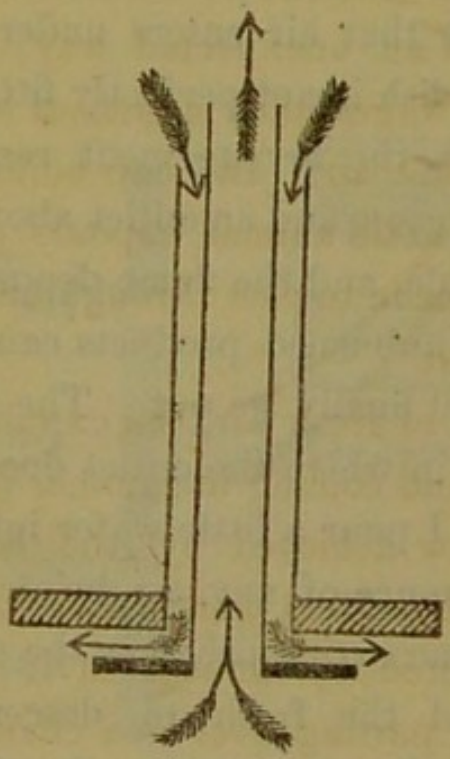
Sherringham's Ventilating Inlet.

The late Dr. Reid advised that air for buildings should be taken from a height, as it would be purer, and this was done at Guy's Hospital, where a shaft ninety-five feet high is erected, and at the bottom the air is warmed by means of hot water. Such air would be free from sewage gases. Of ventilating roofs or ceilings, one of the most beautiful is that of the Alhambra at Granada, into which there are set several exit tubes of graceful shape. In public edifices

the roof, if somewhat conical, should have attached at the highest part, the ventilating outlet. A principle on which many ventilators depend was first illustrated by Prof. Daniell with the experiment I shall now show you. I place this lighted taper upon a flat dish, and I place over it this glass receiver, from the top of which extends a glass lamp chimney. You see that air enters under the receiver as the surface of the dish is not perfectly fitted to it, and the candle burns away, the arrangement resembling a room with air admitted below and an outlet above. Now I turn the vessel to one side, and the flame deposits much soot on the side, and the unburned products causes the flame to get dim, and it will finally go out. The experiment now resembles a room in which the outlet does not occupy the highest place. If I pour a little water into the dish, so as to prevent the entrance of any air below, the candle you will find will become extinguished as the efforts of the hot air to ascend and the fresh to descend through the chimney will mutually counteract each other. Now I will divide the chimney into two by a slip of tin, the hot and cold air will each select a passage, and the taper will burn brightly on. This bit of smouldering paper will show by its smoke being forced upwards that the hot air is ascending through this half, and now by its being drawn inwards that the fresh air is rushing down in this. Watson's, Mackinnell's, and Muir's ventilators are applications of this principle; but as our experiment shows, they cease to act when by an open door or window the air is admitted below.

As an instance of the efficacy of such tubes as Mackinnell's, which is represented in this woodcut, I may

mention that by them the Chapel Royal, St. James', during the marriage of the Princess Royal, though filled with 1500 people, was thoroughly ventilated and kept at a temperature of 58° for five hours.



MACKINNELL'S VENTILATOR.

Small tubes carried from the ceiling of each room in a building, and opening into a larger pipe conducted to kitchen flue, or any larger flue which may be near, are most effectual in ventilating. A building called the "Barracks" in Glasgow, containing about 500 of the poorest lodgers, was so infested with typhus that 57 cases occurred in two months before it was ventilated. Such a system of tubes as I have alluded to was adopted, and but four cases of fever occurred in the eight succeeding years.

All artificial ventilating apparatus will fail if worked by hand, for workmen, not realizing the danger of aërial poisons, will neglect them. In factories, however, where steam power can be applied, some means of producing free currents, like Fairbairn and Lillies' four guinea fan, does immeasurable good. Its effects were illustrated in a mill, near Manchester, in an unexpected way—namely, by the men asking higher wages, their appetites having increased with the use of pure air. In soap-boiling houses, and such places where fœtid animal vapours are emitted, the foul air should be made to pass through and feed the fires, as devised by Sutton.

The introduction of fresh air, the expulsion of foul, the heating in winter and cooling in summer of the Houses of Parliament are now achieved by the following means, devised partly by Dr. Reid and partly by Mr. Gurney. The fresh air, filtered by screens as it enters from the courts, is heated by passing over iron chambers filled with steam, under the floors in the mixing spaces, and then ascends through perforations in the floor, which are covered with horsehair cloth to prevent a perceptible stream. In summer the air is cooled by wet cloths being placed about the iron chambers, and by spray jets, which, by producing abundant evaporation, cool it, supply the proper degree of watery vapour, and free it from much of the putrefactive odour derived from the river during very hot weather. The foul air escapes through the roof, and is thence conducted to an enormous coke-fire and chimney in the Victoria Tower. In 1858, however, the stench from the Thames became so great that canvass, wet with

chlorides, had to be fixed to the windows, and this failing, the air had to be obtained from the level of the belfry, two hundred feet high, and then passed through a large room containing fresh-burnt charcoal, which has such a wonderful power of absorbing gas, and by its powerful oxidizing property the effect of checking putrefaction of organic matter.

Methods of ventilation by propulsion of the air into the building have had many advocates, and one of them has been adopted in that splendid building, St. George's-hall, Liverpool, where, however, the most enthusiastic admirer of fresh air must admit ventilation is excessive occasionally. A gentleman who dined there some time ago on the occasion of some public festival, informed me that the table-cloth was with difficulty kept on the table, and few escaped without colds or toothaches.

The ventilation of coal mines is now managed by a large aspirating shaft, and has become so perfect that the health of the miners is most perceptibly improved. In copper and lead mines most injurious effects are still produced; for as there is no danger to life or property by such explosive gases as are generated in coal mines, the proprietors are more negligent in adopting means of ventilation.

All the modes of renewing the air we have alluded to depend on making a partial vacuum; but a plan which may in contradistinction be called the "plenum method," and which first occurred to the wonderful mind of Robert Boyle, may be mentioned. It proposes to condense by pressure the air in the room, and it was said to increase the facility of breathing and to exhilarate all the functions.

Like many other queer ideas, it has attracted the greedy charlatan, and an establishment in Yorkshire, Ben Rhydding I think it is called, has been got up for the cure of many diseases. I must in candour state that the late Dr. Hunt, formerly one of my most intelligent pupils, was a firm believer in this compressed air for pulmonary symptoms, which he laboured under. The last plan I shall allude to is that described and figured by the Commissioners on the Warming and Ventilating of Buildings, and also in Tomlinson's most excellent manual on the same subjects. The fireplaces are directed to be arranged back to back in a partition wall. The chimney should be made of vitrified clay-pipes, about ten inches in diameter, and outside this there should be another space into which opens apertures from near the ceiling of each room to let out the foul air. Air to feed the fires is to be admitted from without through air bricks and carried along the floor to below each fire. This plan may appear complicated and expensive, but it will not be really so, if arranged during the building of the house.

All means for ventilating public buildings will, however, be abortive if overcrowding be not prevented, especially of those who are inattentive to habits of personal cleanliness. There are few situations more insufferable from closeness than a dense crowd, even if in the open air, and as an engineer once remarked to me when discussing the ventilation of a building which was referred to us, "it would'nt be fully ventilated, even if the roof were taken off, if it be crammed with the great "'unwashed.'"

Until legal enactments were passed to compel the smoke

of factories to be consumed, the atmosphere of London and many manufacturing towns could not be said to be transparent owing to the soot with which it was charged. There is now, however, the greatest improvement in this respect. It was calculated some years ago that the London people had to spend annually two and a half millions more for washing than an equal number of country families. Such improvements will also lead to freer ventilation, for it used to be objected to windows opened, that they deluged the rooms with smuts. The cheap and simple ventilators which I have often urged should be inserted into the outer wall of every room occupied by the poor—namely, plates of finely perforated zinc near the ceiling would have the additional advantage of shutting out much smut or dust.

Although I estimate at the highest Nature's disinfectant, pure air, I think it foolish to decry all others. The distinction between deodorants and disinfectants should be clearly understood, for I feel sure the former are always hurtful. The burning of spices and perfumes to remove the effects of foul air, as practised by the Greeks of old, and by many to this day, seems to me as senseless an act as for the ostrich to think all danger avoided when he puts it out of sight by burying his head in the sand. The enemy is only made more insidious and thereby more hurtful. I must warn you, then, against the error of regarding perfumes or deodorants which disguise smells, as in any way antidotal to noxious vapours. Let me read for you Prof. Johnston's opinion of scents: "They are the only resource of rude and dirty times against offensive emanations from decaying animal and vegetable substances,

from undrained and untidy dwellings, from unclean clothes, from ill-washed skins, and from ill-used stomachs. The scented handkerchief, in these circumstances, takes the place of the sponge and the shower-bath, the pastile hides the want of ventilation, the otto of roses seems to render the scavenger unnecessary, and a sprinkling of musk sets all other smells and stinks at defiance." I have spoken perhaps at sufficient length on the disinfecting power of the air by oxidizing organic matter, especially when aided by sunlight, and heat and cold are two other natural agencies which act in the same direction. Fœtid gases are given off much more freely from decomposing animal and vegetable substances in summer than in winter, for cold, as is well known, has powerful preserving properties. In Siberia, elephants of extinct species and dead for many centuries are found in masses of ice, so well preserved as to afford very acceptable food for the dogs; and, on the other hand, heat is said to be also disinfectant, but it may be merely so by increasing aërial circulation. The contagion of plague is destroyed by a temperature of 120°, and this fearful disease does not infest Egypt during the very hottest months. I will now refer, but very briefly, to some of the most reliable chemical substances for artificial disinfection.

Finely powdered charcoal obtained from animal substances, peat or wood, has great disinfecting influence upon organic effluvia, and it should be hung in bags through the place which it is desirable to purify. Peat charcoal, so readily procurable in this country, is the most inexpensive and efficient, and by Dr. Stenhouse has been applied in situa-

tions ranging from sewer-traps to respirators. Dried earth is said to have similar but much more feeble powers. Lime is useful in removing carbonic acid and the watery vapour which contains the organic matter. Whitewashing is so desirable in point of cleanliness and cheerfulness that I am sorry to have a word to say in disparagement of it; but as many sanitary amateurs place their whole faith upon it, and seem to think that it supersedes all necessity for any other measure, I should impress on you that its sole action is to absorb carbonic acid, which, however, is not so pressingly necessary, as it so readily diffuses, and in small proportion is not very hurtful. I think a little chloride of lime might be added to the lime with advantage. Condy's fluid is a solution of the permanganate of potash of a beautiful purple colour. It rapidly oxidizes organic matter, and many hurtful gases becoming thereby decomposed, the black oxide of manganese being thrown down. Exposed in saucers through a room, or thrown through the air as by a jet, it would very effectually purify the atmosphere, and if sprinkled upon the floor will act in the same way. Sir Wm. Burnett's solution of chloride of zinc is very active for a short time, but it loses its power of absorbing sulphuretted hydrogen, when it becomes acid in reaction. Chlorine gas is a most effectual destroyer of sulphuretted hydrogen, as it rapidly unites with the hydrogen, and precipitates the sulphur in fine powder. The easiest way to evolve it is to mix two tablespoonfuls of common salt, two teaspoonfuls of red lead, and half a wineglassful of strong oil of vitriol in a quart of water. The bottle must be kept

cool, tightly stoppered, and in a dark place. A little of this fluid exposed in a saucer, sprinkled on the floor, or soaked in sheets of old linen and hung about the room, rapidly deodorizes and destroys effluvia. Both for disinfecting solids, and air when it evaporates, iodine has been much made use of latterly; with methylated spirit it can be prepared for about six or seven shillings a gallon. Nitrous acid gas has a powerful oxidizing action on organic matter and on sulphuretted hydrogen, but is objectionable on account of its own fumes, which often excite coughing. It is disengaged by heating nitric acid, to which a few copper slips are added in a retort. It is not used as much as it deserves, and in typhus, for the purpose of destroying the animal emanations which constitute the poison of that disease in rooms, or on clothes, no agent is more reliable. Either this gas or chlorine should be plentifully evolved in foul privies, especially during warm weather, and when dysentery or diarrhœa are prevailing. The frequency of these diseases has thus been often diminished.

LECTURE IV.

WATER: ITS IMPURITIES, AND DISEASES PRODUCED BY THEM: METHODS FOR THEIR REMOVAL: THE DUBLIN WATERWORKS.

Before discussing the hygienic questions connected with water, it may seem unnecessary that I should allude to the physical characters of that fluid, but they are so full of interest, and play so important a part in Nature's great and wondrous cycle, that I cannot avoid recalling to your recollection some such facts.

Water when pure is inodorous, tasteless, and colourless, save in large masses, when its normal tint seems a blue, for instance, in the Grotto Azzura, in the Bay of Naples, where it is, moreover, so transparent that small objects can be seen several hundred feet from the surface. Other shades, as the brown of our bog rivers or the blackness of the Rio Nigro, are always due to organic impurity. Below 32° water is solid; liquid from this temperature to 212°, when it assumes the gaseous form freely, but at all temperatures some vapour is emitted. By avoiding agitation and very gradually lowering the temperature water may be brought to 5° without freezing.

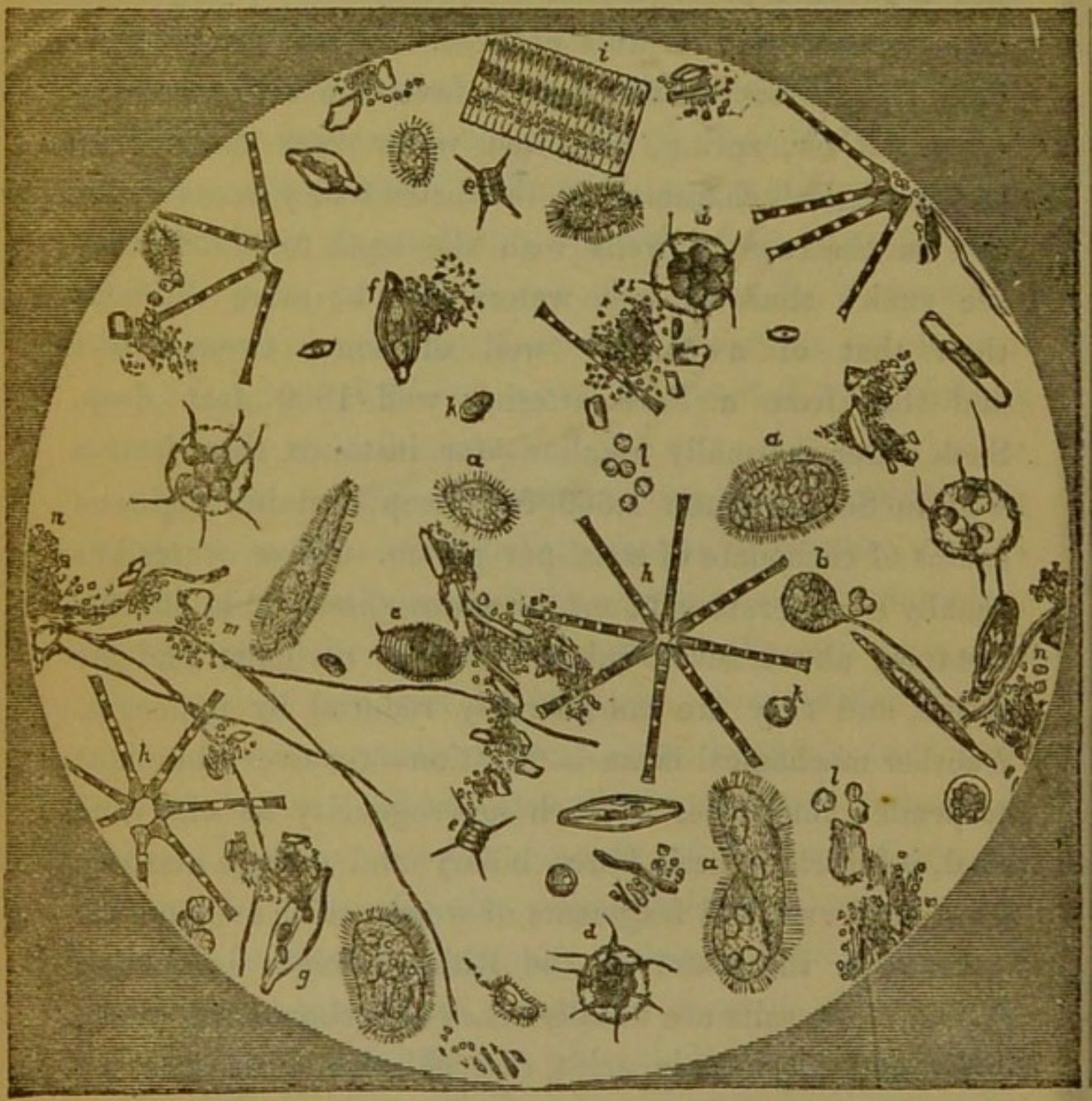
Unlike other bodies which contract or become more dense when changing from the liquid to the solid state, water expands, and decreases in sp. gr. from 1000, at which it forms the standard for all other bodies to ·916 when converted into ice. The sheets of ice which form on our lakes and rivers remain on the surface owing to this fact, and if they did otherwise the layers would accumulate, and not only should aquatic animals cease to live, but, by the abstraction of heat, terrestrial life would also perish. When we assign 212° as the boiling point, we mean that such is the degree at the sea level; but as we ascend, the barometric pressure and therefore the boiling point proportionally lowers; and the fact has been used in ascertaining the height of mountains. The power of absorbing heat, which water so preëminently possesses, gives rise to benefits of vast magnitude; for instance, the vapour is thus raised in countries of high temperature and then distributed in cold and dry regions to moderate their rigorous and arid climates; and again, in our own bodies, water abstracts heat from the parched surfaces, and when afterwards evaporating produces further coolness. But there are many other functions which it performs in the human body—it renders fluid and capable of circulation all the nutriment of the tissues, acts as the great solvent for removing waste matter, and permits that exchange of materials through the membranes which constitutes the processes of nutrition and secretion. Nearly four pounds of water as such, in aqueous drinks, or in solid food, so-called, and the more nutritious this is the more thirsty it makes us, are daily introduced into each human body and

leaving it again by the skin, the lungs, the kidneys, and the bowels, exercise the cooling and cleansing powers of that fluid. It forms about three-fourths of the weight of the body; but, indeed, Blumenbach possessed a mummy which, when thoroughly dried, weighed but seven and a half pounds. The amount of water which analysis reveals in each part is proportional to the quantity of blood it receives, and its consequent activity of function, and in all these respects the brain and the scarf skin, which respectively contain 789 and 37 parts per 1000, are most strongly in contrast. Such essential qualities in human structures, as pliancy, toughness, and elasticity, would be absent if water did not abundantly exist in them.

All water is originally derived from the sea, and being raised from this never-failing source as vapour, returns to the earth as rain, and thus supplies our rivers, lakes, or springs. In percolating through the soil much of the organic and gaseous impurity of rainwater is oxidized, and springwater issuing from depths is most pure and wholesome. The oxygen which exists so abundantly in the soil, serves also the purpose of destroying organic matter, for otherwise the neighbourhood of towns would become intolerable from the soakage of refuse into it. Rainwater abounds in gases, for example, 32 parts of oxygen be obtained from it without decomposition, and in such substances as nitric acid, its salt with ammonia, carbon, and sulphuric acid, if it falls in cities and is collected after having washed over dusty roofs and gutters, chlorides near the sea, and in some situations as Paris, iodine has been detected in it. Its solids per gallon aver-

age three grains, of which half a grain is organic. From its mawkish taste, and the uncertainty of its supply, it is not generally used for drinking, but its comparative purity has been said to check the frequency of diarrhœa and cholera when used for this purpose. Its softness or freedom from limesalts makes it a favourite with the laundress. River, spring, and well water vary much with the geological character of the district they come from, and in the case of wells with the depth to which they are sunk; thus no two waters can be more different than that of a shallow well of some twenty feet and that from a Paris artesian well 1800 feet deep. Such water is usually alkaline—for instance, that from a well in Southampton 1,360 feet deep contains eighteen grains of carbonate of soda per gallon. River water has usually a moderate amount of gases dissolved in it—for instance, about seven cubic inches of carbonic acid per gallon, and they are considerably reduced by exposure. Another mechanical means—filtration—removes abundant suspended impurities of such heterogeneity as clay and sand, infusoria, muscle fibres, biliary and sewage matters, algæ, confervæ, and fragments of wood, which average, for instance, in the water of the Rhine, to eight grains per gallon. The salts are usually those of carbonic, sulphuric, nitric, and phosphoric acids, and chlorine, with lime and soda; and these, together with the dissolved organic matter, escape the filter, notwithstanding the bright and sparkling character of such water. As an example of objects which the microscope discovers in filtered water, I may show those from the water of the cistern of the Grand Junction

Company, London, as represented in the following drawing after Dr. Hassall.



a. Paramæcia, two species. *b.* Vorticella convallaria. *c.* Coleps hirtus. *d.* Pandorina morum. *e.* Scenedesmus quadricauda. *f.* Navicula amphisbæna. *g.* Navicula sphærophora. *h.* Asterionella formosa. *i.* Fragilaria capucina. *k.* Brown active sporules. *l.* Stationary green sporules. *m.* Threads of slender fungus. *n.* Organic and earthy matter.

It must not be supposed, because of the circular shape of this figure, that all these plants and animals are contained in a single drop of water, for the portion they were obtained from was that allowed to settle in a large conical vessel, and the sediment was then placed in the field of the microscope. It is probably a fallacy to regard these little beings as the source of danger in impure water; on the contrary, they are scavengers for removing the organic decomposing matter which their presence indicates. As models of purity in drinking water may be instanced that of the Loka in Sweden, which, flowing over granite, contains but 1-20th of a grain of impurity per gallon, that of Loch Katrine, now supplied to Glasgow, which has but two and one-third, and that of the Vartry which we will soon enjoy, and in which but four grains per gallon exist. On the other hand, pumps produce in large cities the most impure of natural waters; for instance, the water of one in Liverpool contains 417 grains per gallon of solids; and that of Park Crescent, London, which attains the height of filthiness, has, according to that accurate analyst, Dr. Dundas Thomson, forty-three grains per gallon of organic matter, chiefly derived from sewage.

The vegetal matter in river water is chiefly humic acid, and the animal products which are highly nitrogenous and abound in butyric acid, are derived from dead animals and manure and sewage which soak into the river in highly cultivated districts or dense populations. Another source of impurity in shallow well water of cities is gas refuse from the works, or the gas itself escaping from

leaky pipes and impregnating the earth. Even the most impure well waters may be sparkling and cool, and for these reasons have been often reckoned wholesome,—a grievous error, as we shall see hereafter.

The characters of a good drinking water may be enumerated as follows :—1. The temperature should be about 10° less that the surrounding air, and not less than 50° below that of the human body. 2. Freedom from taste, except its naturally saline one, and slight pungency from carbonic acid. It must be remembered that matters most deleterious may escape the watchfulness of this sense; seventy grains of common salt per gallon give no perceptible taste. 3. Absence of smell. 4. Transparency and absence of colour, which latter character is not essential; for instance, many waters in this country are brownish from peat, but not necessarily unwholesome, and on the other hand, water charged with sewage products is often bright and colourless, though most deadly. 5. Alkalinity, usually from carbonate of lime. The Brussels Sanitary Congress fixed the maximum quantity of solid matter which potable water might contain at forty-nine grains and a half per gallon, of which not more than a grain should be organic. This is a standard by which, however, we should not be guided, for few, if any, of the waters supplied to towns approach this total amount, and some of our best have nearly double the quantity of organic matter assigned. I may mention the amount of saline matter which sea water contains—namely, about 2,500 grains per gallon; but great variety occurs, even to such an extent that 40,000 grains per gallon have been found in the water of a small lake

east of the Wolga, owing to enormous evaporation and rare addition of purer water.

In river water the lime salts are always the most abundant, and are derived from limestone over which it flows, giving up some of its substance to the carbonic acid in the water. When such water is boiled, the carbonic acid is driven off, and the lime salts mixed with organic matter is deposited on the insides of the kettles and boilers in crusts, which often become fœtid, and should be removed. The presence of arsenic in some river waters and springs is a significant fact, 1-250th of a grain per gallon exists in that of the Mersey, and 1-166th in that of the Weisbaden mineral water. The advantages of a soft water are briefly :—that it is more economical by the saving of water and soap in ablution and washing of clothes, and it saves fuel by boiling at a lower temperature and by forming no crust, which must weaken the heating power of the fire. Much labour is required for removing this incrustation. Soft water is more suited for most culinary purposes—for instance, the making of tea.

In order to fix on your memories the usual impurities of water, I will add to each of these vessels of pipe-water a reagent which will detect the presence of some substance, certainly injurious if in excess :—1. Carbonic acid is shown by whiteness on adding baryta water. 2. Sulphuretted hydrogen (which I have introduced by adding a drop of this sewage water), brown or black colour, with acetate of lead. 3. Sulphuric acid, by chloride of barium producing a whiteness. 4. Chlorides, by nitrate of silver giving a white muddiness. 5. Lime, shown by whiteness on adding

oxalate of ammonia. 6. Organic matter, by the decolorization of permanganate of potash, and several of the metals might be shown to be present occasionally by the tints they give with sulphuretted hydrogen.

The purification of water before it is offered for human consumption is a subject of the very highest importance, and yet one which in many communities meets very little attention practically. Some useful changes occur spontaneously in water, such as the settling down of a sediment of several suspended impurities and the discharge of sulphuretted hydrogen, and for this purpose the water on the west coast of Africa is exposed in small quantities before being supplied to our troops. Organic matter is chiefly to be removed by filtration through charcoal, exposure, which promotes its oxidation, boiling, the addition of such oxidising agents as permanganate of potash, or of astringents, such as alum or tannin, the former of which is open to the objection of adding to the sulphate, by decomposing the carbonate of lime, but it has the advantage of throwing down all finely suspended particles of clay. Astringents of all kinds precipitate the coagulable albuminous matters, and in this way the nuts of the strychnos potatorum or "clearing nut" act when rubbed upon the vessels in which water is kept in many parts of India. For similar purposes chips of oak are thrown into the drinking water in the country round Bordeaux. Compare these facts with what we read in the Book of Exodus, when Moses used the bark of a tree to render the waters of Mara sweet.

Filtration through sandstone, or various mixtures of

sand and gravel, can only remove the coarse mechanical impurities, and therefore but little reliance is to be placed upon it. Such filters are expensive also, as they require frequent renewal; thus it has cost the 50,000 people of Toulouse £40,000 within a few years for such changes in the filtering apparatus through which the Garonne water is passed. For domestic purposes, water may be freed from mechanical impurity by this little piece of French sandstone, to which is attached a flexible tube, or by charcoal arranged in a similar way.

Finely powdered peat charcoal, tightly pressed down and frequently changed, is a far preferable medium for filtering water on the small scale, as it will purify six hundred times its weight of water; but it must be always borne in mind no kind or amount of filtration will ever render impure water quite pure or even safe for drinking. Boiling removes sulphuretted hydrogen from water; but it also removes carbonic acid and air, hence the flat taste of such water, and carbonate of lime, oxide of iron, and some organic matter is also cast down. Hence water should be so treated where an impure kind must needs be used, and its aëration and consequent palatable and wholesome properties can be readily restored by tossing from one vessel to another, as is well known. Even distilling water does not abstract all its impurities, for if rapidly brought over the organic matter, carbonic acid sulphuretted hydrogen, and even some salts, will be found present, especially in the first and last portions. However, the late Dr. Normandy's plan for obtaining potable water for our sailors by distillation from the sea water was a

real boon, and like many other really useful inventions, was simple and closely copied after Nature, for all our waters are originally had by evaporation from the sea. The addition of Condy's fluid most effectually removes all organic matter, and also lead, iron, and other metals, if present, as peroxides. The antidotal powers of this permanganate in cases of metallic poisons have not been investigated, though they promise satisfactory results. The manganese which would enter the system if water was thus purified would not prove injurious, as it is similar in its actions to iron, and is found plentifully in the bodies of Scotchmen who use oats so freely in their dietaries. If the potash of Condy's fluid be thought objectionable, permanganate of lime might be used, as in presence of organic matter that earth would fall as the carbonate. About two ounces of Condy's fluid will render a hogshead of very impure water safely potable, and at a charge of less than a penny. Its patentee is of course a very enthusiastic advocate; for instance, among many other uses, he advises it for ablution, asserting that soap leaves behind upon the skin some of the fatty acids. The oxidizing powers of the permanganate are much increased by a temperature of 150°.

Carbonate of lime in water, although useful in supplying the materials of our bones and in conferring a pleasant taste, may be in excess, and thus productive of disease, as we shall see presently. It may be removed, as discovered by Dr. Clarke, by means which seem paradoxical—namely, adding fresh lime. The action of the process depends on the fact that much of the carbonate is

dissolved by carbonic acid, with which the additional lime forms a carbonate, and both this and the originally contained carbonate are precipitated. Some entangled organic matter also falls. The plan is adopted in many limestone districts, and will be carried out on a grand scale at the Herbert Hospital, Woolwich. The water with which this city will be supplied from the Vartry will be so much softer than that now used that the daily quantity distributed to the inhabitants will contain ten tons less of lime salts. This will lead to a great economy of soap, for it is calculated that the interest of the cost of the Glasgow waterworks is repaid by the saving in this particular, and each Dublin citizen will save one penny per week in washing when the supply of soft Vartry water is accomplished.

Notwithstanding the vast amount of intellectual labour which is lavished on the study of classics, but little of the sanitary knowledge which the Romans must have possessed has been made apparent: they seem to have been well aware of the superiority of water carried from a distant pastoral district, and hence the magnificence of their aqueducts, of which there were twenty altogether, and one has been traced to a distance of sixty miles. Some of the arches were one hundred feet high. The reservoirs, or *castella*, were of two kinds, *privata* for the houses, and *publica* for the baths, fountains, public buildings, and to supply the requirements of trades. A staff of several hundred men conducted the works, and were directed by a *curator aquarum*. The water was plentifully used in flushing the sewers, the arrangement of which was also on the grandest scale, for the *cloaca maxima* is 14 feet wide, 32 feet high,

and constructed of Albano stone put together most perfectly. Modern engineers by bringing the supply from more elevated sites, have rendered water-works less costly than they must have been in the cities of old. The present water supply of this city is derived from three sources—the Grand Canal, which is stored in Portobello and James's-street basin; the Royal Canal, which fills the Blessington-street reservoir, and to a trifling amount from the Dodder, which is added to the James's-street basin. The position of these reservoirs within the city must make them subject to pollution from dust and smoke. The quality of the water had been long creating suspicion in the minds of medical and scientific men, while its scantiness at all times and total insufficiency on the occurrence of fires was apparent to every one. Some active members of the Corporation determined that, if possible, a purer and more plentiful supply should be had for the citizens, and a Royal Commission was obtained to investigate the subject. Evidence as to its unfitness for drinking was given by such eminent authorities as Prof. Apjohn, the President of the College of Physicians, Prof. Macnamara, Dr. (now Sir Wm.) Wilde. That of the Portobello basin was particularly condemned, being found to deposit a large quantity of organic matter, which Prof. Apjohn described as follows: "I may add that it was of two kinds, a thready or filiform product, which, when examined under the microscope, appeared to be confervæ or fresh water algæ, and a membranous substance of a highly cellular structure, having some resemblance to certain of the spongiæ. The latter exhibited two appearances occur-

ring on the sides of the basin and interior of the mains, partly as an incrustation of slight thickness, and partly as projecting growths of the size and nearly the shape of the human fingers. The organized products just described were penetrated by numerous maggots, which had the faculty of spinning threads like those of the spider, executed rapid movements, and were capable of inflicting bites. When a mass of the mixed organic matter just described was placed in a basin of water, putrefaction rapidly set in, and in twenty-four hours an insupportably offensive odour was evolved." In the field of this microscope you will see several species of minute plants and animals from some of our Dublin pipe-water.

All kinds of filth, such as drowned animals, manure soakage from tilled fields, and the refuse from the boats plying on the canal, which to the boatmen must have been as a house-drain, were added to the water. I am informed that at present the whole of the sewage of the Mountjoy Convict Prisons is discharged into the Royal Canal. The disagreeable flavour of our water is constantly perceived by strangers coming to Dublin, but the sense of taste of the inhabitants is in many cases dulled by habit. More easily demonstrable evils resulted from the scanty supply, for water was not within easy reach of the poor, especially in the Liberties, in part of which the Corporation pipes are not laid down. As an instance, I may mention that Dr. Ryan some years ago ascertained that of the fifty houses in Plunket-street, containing 800 poor, but one had pipes carried to it. Being dependent, then, on fountains, often at a considerable distance, the poor of this

city, numbering over 100,000, have either to do without water, or to get drenched with rain on wet days, or in stormy weather by the blowing about of the water. They have often to wait a long time, amid scenes of contention, for their turn, and from the want of suitable vessels a sufficiency is rarely obtained. The consequence is, that one quantity is put through a round of washing operations, the foul-smelling suds polluting the air of the rooms for many hours, and under such circumstances personal cleanliness or salubrity cannot be hoped for among the poor or labouring class. But better things are in store for us; a magnificent system of water works is being constructed to carry water from a mountainous, granitic, and pastoral district, twenty-two square miles in extent, to collect it in an artificial lake 420 acres in area, and in softness, absence of colour, and purity, even without filtration, the water will not be surpassed by that of any city in the empire. The composition of this Vartry water is exhibited in this table of the analyses of four of our most eminent chemists :—

		Organic matter. Grs. per gal.	Total solids. Grs. per gal.
Prof. Apjohn, T.C.D.	June,	1·70	4·40
Prof. Sullivan, M.I.I.	1855.	1·25	4·00
Prof. Barker, R.C.S.	August,	2·24	4·24
Mr. Plunkett, M.I.I.	1860.	1·24	3·99

As regards supply, it will be brought even into the house of the poorest, the cost being placed on the landlord, and the water will be on constant service and at high pressure—a condition of the utmost moment when a fire takes place. The force will be then increased by turning off the supply flowing to other neighbourhoods. Its con-

stant motion will never allow the water to foul in the pipes. Two great mains will diverge at Leeson-street Bridge, and after encircling the city, will reunite at its western extremity, sending off in their course numerous inter-communicating branches. So far the arrangement resembles the arterial system of the human body, and when house-pipes are adjusted, and a full scheme of sewerage perfected, the analogy to the circulation in its arterial, capillary, and venous subdivisions will be indeed complete. For the inestimable blessings of a free and pure supply of this health-giving element, not only the present generation, but many future ones, will owe much to the zeal of the Corporation and the unparalleled energy of Sir John Gray, M.D., the Chairman of its Water Works Committee.

The material most suitable for cisterns or main pipes is cast iron, or for small vessels, slate or earthenware may be used. All substances which allow permeation of fluids should be never used for storing water, as soakage from refuse would then readily occur, and the tank should be covered to exclude pollution from the air. Iron precipitates organic matter, as was conclusively shown by Medlock, who found the entire of the organic matter, 2·1 grains of the water of the Dune Canal, Amsterdam, was thrown down as a brown deposit by remaining in contact with it for forty-eight hours. The nauseous taste of the water was thereby removed completely. Even water rendered impure by sewage, urine, or sulphuretted hydrogen, can be rendered fit for drinking by exposure to iron and subsequent filtration. The result is due to the production of the powerful oxidizing agent—nitrous acid—from the nitrogenous organic matter

and any of the metal which becomes dissolved can have no hurtful effect.

Some advise, however, the coating of iron pipes with zinc or varnish, and the mains of our new works will be varnished, both inside and outside, according to Dr. Angus Smith's patent method. The danger of using lead for pipes or cisterns is now well known, especially if the water contains much organic matter, for the nitrogen so supplied forms nitrous acid which dissolves the metal. But very pure water will also act on it; thus the extremely pure water supplied to Manchester will take up the one-fifth of a grain per gallon in twelve hours, and deaths by lead poisoning have thus occurred in that city. Notwithstanding the interest excited by this subject, some facts are as yet undetermined. Thus, we do not know why Thames water will at one time dissolve lead and not at another. One fact, however, is certain; this metal should never be used for the storage or conveyance of drinking water. The means for collecting water in countries where it is scarce and impure forms now a portion of military hygienic instruction, and one of the best means for this purpose is a barrel pierced with holes, and placed inside a larger one, also pierced, the interval being filled with charcoal. Many impurities are thus strained off, and until such plans were adopted the French soldiers in Algiers are said to have often swallowed leeches in drinking. The quantity of water which should be ingested, under the guidance of the sensation of thirst, varies much, and in these countries averages some three pints; but in the tropics, where evaporation is so enormous, eight pints are permitted by military

regulation. For cleansing purposes and flushing of sewers, from fifteen to twenty-five gallons daily per head are said to be requisite, and fully this quantity is supplied to each individual in Liverpool by the new water works. As long as it is ensured that no waste occurs, pure water ought to be abundantly within the reach of all, and it is nearly as unfit that water should become a commodity as that air should. In 1817 Lord Cockburn wrote:—"Standing in a rainy country, Edinburgh has been always thirsty and unwashed, the condition of the city in reference to water positively frightful;" and that matters in that great city are not much bettered even now, would appear from the forcible "Lectures on Public Health, in relation to Air and Water," recently published by Dr. Gairdner. In large cities drinking fountains are always most useful, and that they are largely partaken of may be learned from the fact that 90,000 drinkers daily have been counted at that in Bethnal Green, London. When we get our new pure and plentiful supply, no better means for exercising benevolence, or honouring the memories of our departed great ones, could be adopted than the erection of such fountains, if they can be made at all ornamental, or not allowed to become dry, as most of them in Dublin now are.

If I have succeeded in showing the necessity of a plentiful supply of pure water to the human body, you will not be surprised to hear that many diseases owe their origin or increase to a scanty amount or impure condition of that fluid. The metamorphosis of tissue, or the removal of old material and the deposit of new, which is momentarily taking place in our bodies, is much influenced by the great

solvent, water, and it is found to be unduly promoted by too much of this liquid food, and still more hurtfully checked by too little. The effects of excess of calcareous salts in water are difficult to recognize, as they are insidious and take a long period for their development, but a peculiar form of dyspepsia is now often assignable to this cause, as well as diarrhœa and subsequent dysentery. Horses supplied with water charged with sulphate of lime often lose health, as grooms notice by the roughness of their coat. Bony tumours in cattle and some forms of stone in man, have been said to have been more frequent from impregnation of water with this and other calcareous salts. The diseases, however, which have been shown by recent scientific labours indubitably to depend on such causes, are goitre and the lamentable state of semi-idiocy, called cretinism, which sometimes accompanies it. In Durham gaol goitre was very prevalent some years ago, and it was found that there were seventy-seven grains of lime and magnesia salts in the water they drank. The disease decreased in those affected, and no new cases appeared when the amount of these salts was reduced to eight grains. It has been traced over limestone districts in several parts of England, Switzerland, and India, and in this country the same distribution of the disease has been shown by Dr. Martin of Portlaw, for it was prevalent on the Kilkenny side of the river Suir, where the stratum was limestone, and almost never seen on the Waterford side, where it was old red sandstone and silesian slate.

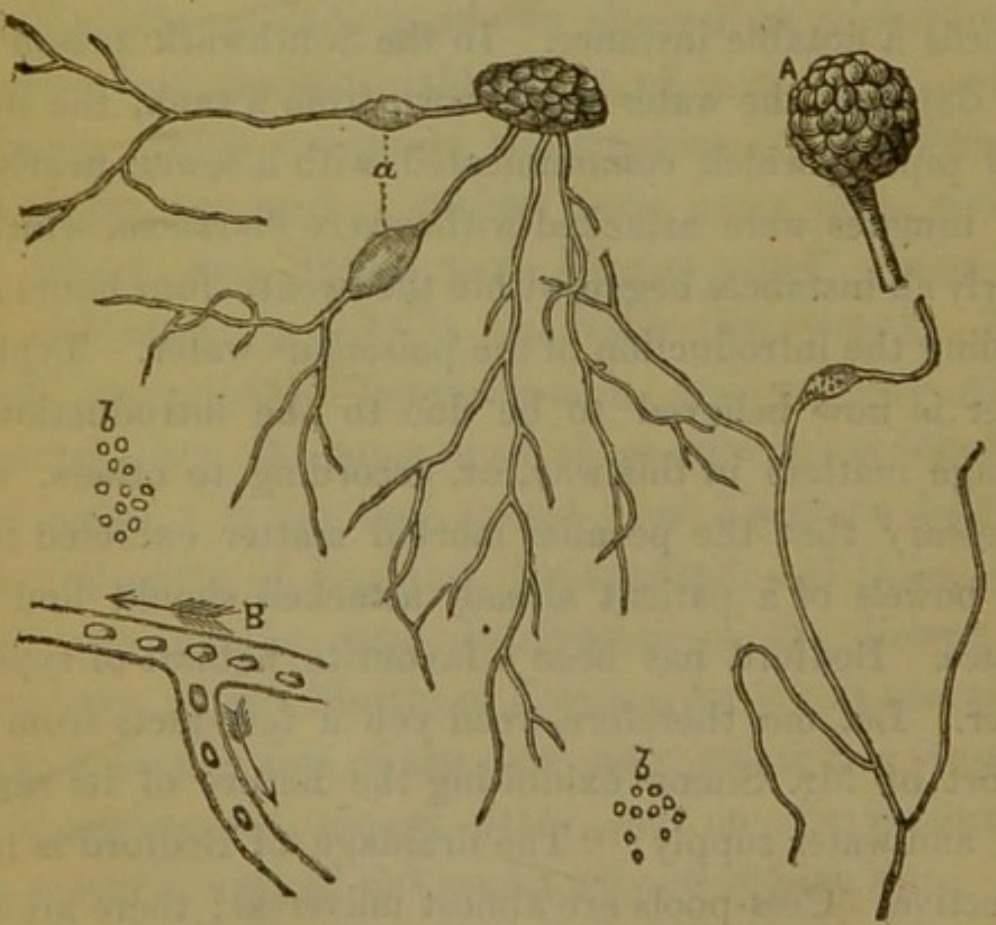
In Gorruckpore the soil upon which many villages is built, is so calcareous, that some specimens contained 25

per cent. of carbonate of lime, and 10 per cent. of the adults are affected with goitre, and about an equal proportion of the children are afflicted with the pitiable state termed cretinism. The dogs and cats are said even to be affected by the lime salts. The bones of the skull are found so altered in shape and their openings so contracted that it is supposed that the lime and magnesia salts are deposited in them, and this condition is believed by some to be the cause of cretinism, by interfering with the circulation of blood in the brain.

Outbreaks of diarrhœa and dysentery are often attributable to organic matter in water, more especially if it be that variety which is derived from sewage. Dr. Greenhow records a notable instance. In the Southwark prison for one day only the water was drawn from a tank, the overflow pipe of which communicated with a sewer, nearly all the inmates were attacked with severe diarrhœa, which in nearly all instances began within the twenty-four hours succeeding the introduction of the poisonous water. Typhoid fever is now believed to be due to the introduction of sewage matters in this way, or, according to others, it is necessary that the peculiar morbid matter excreted from the bowels of a patient already attacked should find entrance. Bedford has been a favourite habitat of typhoid fever. Let me, therefore, read you a few facts from the report of Mr. Simon exhibiting the nature of its sewerage and water supply: "The drainage of Bedford is most defective. Cess-pools are almost universal; there are said to be upwards of three thousand of them. They soak all their contents into the soil, for the Local Act forbids any

drainage of them into the sewers. The refuse of thirteen hundred people thus percolate into the wells from which the water supply is derived."

I cursorily alluded in my Introductory Lecture to the belief that cholera was due to the use of contaminated water, and I now will lay before you some of the facts which seem to corroborate that view; and first, of the famous Broad-street pump. The cholera broke out in this neighbourhood in 1854, and killed five hundred people in less than one week. Dr. Lankester examined the water of it, and found the remarkable fungus, his representation of which I show you.



According to an analysis of Dr. Dundas Thomson, it

contains over six grains of organic matter derived from sewage. The clearest case where cholera was due to it was that of a lady, who, having resided in the vicinity, moved to Hampstead, some three miles distant. The pump-water in Broad-street was so sparkling and pleasant that she sent daily for it. She and her niece were the only persons attacked with cholera in Hampstead, and her servant suffered from severe diarrhœa.

These evils ensue from allowing shallow wells to be used into which sewage matters soak; and although their unfitness has been often demonstrated, it was not until lately generally understood, for we find three chemists, who were appointed to examine the waters of the metropolis, reporting in 1851: "That the shallow wells of London have never been pronounced unwholesome." I know of a well, some dozen feet deep, which supplies abundantly water stinking abominably of sulphuretted hydrogen and decomposing animal matter; and this next figure shows the crowd of plants and animals, and their organic food, contained in water from a surface-well at Sandgate, which Dr. Lankester tells us produced disease. The sewer water also figured is scarcely more crowded.

The dependence of cholera upon impure water has been clearly proven by the admirable researches of the medical officers of health in London. Dr. Dundas Thomson says:

"But, perhaps, the most horrible example on record of the fatal effects of impure water occurred in 1854. I found that the Southwark Company's water was of a different composition from the water of the Lambeth Company. When I applied a piece of muslin over the supply pipe of

the Southwark Company to the cistern in my laboratory at St. Thomas's Hospital, a large quantity of human excrement was detained, and the impurity in solution was much greater in the Southwark Company than in the Lam-

a. Rotifer. *b*. Bursaria? *c*. Paramæcium. *d*. Acineta tuberosa? *e*. Vorticella. *f*. Actinophrys Sol. *g*. Filament of Conferva. *h*. Stems of Anthophysa? *i*. Slender Fungus. *k*. Earthy and Organic matter.

beth water, which contained little or no matter in mechanical suspension. The Lambeth water was obtained from

Sewer Water (*taken from the Sewer in Silver-street*).
a. Anguillula fluviatilis. *b*. Oxytricha. *c*. Paramæcium. *d*. Vibriones. *e*. Filaments of Slender Fungus. *f*. Fragments of Muscular Fibre. *g*. Cells of Potato. *h*. Starch granules of Wheat. *i*. Hairs and integuments of Wheat. *k*. Spiral Vessels. *l*. Dead and Decaying Organic matter, as dotted ducts, hair of animal, grit, and *débris*.

Hampton, while that of the Southwark Company was pumped up from the river near Vauxhall-bridge. These two companies possessed mains in the same streets, and supplied the houses indiscriminately. Analysis alone enabled me to detect the two waters, as the inhabitants, without consulting their water receipts, were unable to state the source of their supply. And although the population supplied by the two companies was precisely in the same condition, except as to water, the cholera deaths in the houses supplied by the Lambeth Company were 37 to every 10,000, and in those by the Southwark Company 130 to 10,000, or as one to three and a half. I conclude from the data supplied that 2,500 persons were destroyed by the Southwark water, who would have been saved if they could have obtained the Lambeth water. It is a remarkable fact that the Lambeth water, in the epidemic of 1848-49, was more fatal in its effects than the Southwark, the Lambeth Company taking their water lower down the river at that time. The mortality in houses supplied by the Lambeth water was 125 in 10,000, while the deaths in houses supplied by the Southwark water were 118 in 10,000."

The same energetic physician records it as a matter of general belief in India, that cholera is producible mainly by water; and he relates the following instances of the way in which reservoirs of that inestimable fluid are treated:—

"One large tank, I recollect, which was used for the supply of water, had located on its banks several faquirs, who had resided there for years; one of these who had made a vow to allow his nails to grow for twelve years attracted my attention particularly by the remarkable ap-

pearance of his nails, which resembled ram's horns in being twisted and indurated to the extent of six inches. I was desirous of getting a specimen of his cast off nails for my museum, but he replied that it was part of his vow to throw them into the tank, where also all excretions were deposited, and where his ablutions were performed, according to his own statement. These waters contained much organic matter in solution, *a considerable amount in suspension.*"

Cholera is peculiarly a disease of low level, because of the difficulty which water charged with its peculiar poison encounters in escaping. This fact was most admirably demonstrated by the Registrar-General in his famous report on the epidemic in 1849, and can be seen at a glance from the diagram which I exhibited at my first lecture. Exceptions, however, depending on the local water supply were numerous.

From the researches of the late Dr. Snow who originated the idea that cholera was spread by the water used for drinking, I select two instances, the one to show the decrease of cholera following improved water supply, the other its increase when the quality of that necessary is deteriorated. The cases of cholera in Exter in 1832 exceeded 1000. The water supply was by carriers from the river, into which all the sewage flowed. Before the next visitation which devastated the country, the water was taken from two miles above the town, and in 1849 but forty-four cases occurred, and in 1854 hardly one. Hull, in 1832, was supplied with pure water, but so scanty, that the poor had to resort to other means to procure it; 300

people, mainly the poorest, died of cholera in that year. In 1844 a supply was abundantly procured for all classes, but from the river; and accordingly, in 1849, 1834 persons from all ranks fell victims to this ignorance or negligence of the poisonous effects of contaminated water. It is remarkable that Sunderland was the first town attacked, both in the epidemics of 1831 and 1848.

What has been proven of cholera may be just as true of many other intestinal and other diseases, and must surely awaken communities to the vital importance of water pure and plenty. I cannot refrain from reading for you Shakspeare's description of blood poisoning, as it is most consonant with the modern view of the action of the cholera poison :—

> "Whose effect
> Holds such an enmity with blood of man,
> That, swift as quicksilver, it courses through
> The natural gates and alleys of the body;
> And, with a sudden vigour, it doth posset
> And curd, like eager droppings into milk,
> The thin and wholesome blood."

That yellow and marsh fevers are due to the water the patients have drunk is credited by many mainly on such evidence as the following :—All on board a ship which had watered at Jamaica, except those who messed at the captain's table, were attacked by yellow fever. The water used by the captain and his friends was brought in the out voyage from Europe. The transport ship *Argo*, which, in returning to Marseilles, took in a water supply at a creek at Algiers, and many on board were seized with ague, while no case of that disease occurred on board a companion ship

which made the same voyage but did not water off Algiers.

Many diseases—for example, yellow fever and boils—were at one time believed to be producible by sulphuretted hydrogen in water, but that gas abounds in the Harrogate and other sulphur springs which give rise to no such effect.

It may be regarded as almost proven that the eggs or embryos of many parasitic worms, such as the guinea-worm and broad tapeworm, the rare one in this country, gain entrance into the human body by means of the water we drink; for as no one believes now in the doctrine that they are spontaneously generated, in either our food or drink they must lie concealed.

The influence of a scanty water supply in promoting skin diseases I will speak of in a future lecture.

LECTURE V.

FOOD: ITS PHYSIOLOGICAL PURPOSES: METHODS OF PREPARING AND PRESERVING: DISEASES DUE TO UNWHOLESOME MEAT.

THE two necessaries of life which I have heretofore considered are within the reach of every citizen, however poor, and it becomes the duty of the authorities to provide them both in plenty and purity. Of food, however, the same cannot be said, for circumstances will always produce a multitude of varieties in the supply to each rank, and when the educator has taught the general principles of alimentation and the legislator has secured an immunity from adulteration, the question becomes one of individual duty, and need not be alluded to further by us. Such considerations must be my excuse for the brevity with which I propose to treat the extensive and important subject of food.

In the physical life of man there is scarcely such a thing as rest, the numberless organs and tissues of which his frame consists undergoing perpetual change, and in the exercise of the function of each some part of it is destroyed. Thus we cannot think, feel, or move without

wasting some proportion, great or small, according to the energy of the act, of the brain, nerves, or muscles, the apparatuses of these endowments. The wasted brain, nerve, muscle, or other substance resulting from the exercise of any of our numerous vital processes cannot remain in its original situation, where it would be not only useless dross, but also obstructive and injurious. Such old material is then being daily removed from our bodies to the average amount of three or four pounds, and that an equal quantity of new should be substituted is the first principle of alimentation. To express it in commercial language, the income must be equal to the expenditure. This tissue change is so complete that not a particle of our present body will be ours some short time hence, and we will be, as I have lately seen it phrased, like the knife which, after having had several new blades, and at least one new handle, was the same old knife to its owner. As the destructive changes are usually from the solid to the liquid, or the liquid to the gaseous state, a constant abstraction of heat must result, and the colder air about is constantly depriving us of heat. Food we will see is then necessary to keep the body at the uniform temperature of 100°, which it possesses, especially in countries where the average temperature is very low. The means for liberating heat which Nature almost exclusively employs, is combustion, and in our bodies it is proceeding constantly and extensively. Its two requirements are fuel and oxygen, and these are supplied by a considerable portion of the food we consume, and by the air we breathe.

According, therefore, to the two purposes which food

fulfils, we may consider it under two divisions—1, tissue-producing; and 2, heat-producing. Our tissues are built out of a great variety of salts, which, although belonging to the mineral kingdom, are served to us by the vegetal and animal, and two organic substances only—fat, and that which, from its close likeness to that typical food white of egg, we call albuminoid. The more important mineral foods are common salt, salts of the alkalies, and lime, with phosphoric and the vegetal acids, sulphur, and iron.

The chief physical purpose which common salt subserves is to alter the density of fluids, so that when two are separated by the animal membranes, the denser and the lighter will interchange through it till they both become of the same specific gravity. On this principle depends the taking up or casting off of every liquid which passes into or from the system. The presence of this salt is also indispensable, for some reason we are ignorant of, when growth or cell forming is taking place. Its abundance in the tissue of the inflamed lung will occur to the minds of my professional hearers in illustration. Chloride of sodium is believed also to supply soda for the bile, and hydrochloric acid for the gastric juice, by decomposition, and if that acid be the solvent of albumen in our stomachs, its powers are quadrupled by admixture with the salt itself. The uses of this substance being then so apparent, you will not be surprised to hear that animals pine when it is excluded from their food, as was conclusively proved by Boussingault, in the case of cattle. Grazing land has frequently improved after having been overflown by the sea. In Abyssinia the prevalence of tapeworm among the inhabitants may have

some connexion with the difficulty of obtaining salt as well as with their disgusting habit of eating raw beef. In that country, we are told, that persons of the higher rank carry in their pocket a piece of salt, which, as a mark of especial favour, they offer to a stranger to lick. It may be said that here the remedy grows beside the disease, for kousso, the most efficient agent in treating tapeworm, is indigenous to Abyssinia. Muscle-juice and yolk-of-egg are perhaps the only animal matters destitute of common salt, and hence their insipidity. The amount in the human body is about four ounces, not subject to increase by introducing more, for the surplus will be rapidly rejected from the blood.

The alkaline phosphates abound in our blood cells and muscle-juice, and are supplied us in the cereal grains, potatoes, and flesh meat, which has not been too thoroughly bled or salted. Vegetables by being boiled lose these alkaline salts and those of the organic acids, and hence the use in soup of the water in which they are cooked, or of such uncooked vegetables as celery, lettuce, cresses, or radishes, is most wholesome. They act as solvents of many constituents of the blood, even so insoluble a substance as phosphate of lime, which otherwise could not be carried to the bones. The phosphoric acid is probably utilized as a solvent in the gastric juice, and the vegetal acids being converted into carbonic, alkalies, or their carbonates, are set free in the blood, which, unless constantly alkaline, could not fulfil its duties as the great medium of oxidation or combustion. Phosphate of soda is believed by Liebig to have the all-important property of absorbing carbonic acid,

according as it is evolved from the dying tissues throughout the body, and thus conveying it to the lungs, where, on coming in contact with air, it at once resigns it for dismissal. I will return to this subject when speaking of scorbutic diseases due to dietetic errors.

The lime salts—phosphate and carbonate—exist to the amount of seven pounds in each of us, especially in our bones, which they render a hard yet elastic framework. During infancy and childhood, when the bones are hardening, they are above all necessary, and therefore abound in milk and in bread, and if these natural foods are not plentifully supplied, rickets and other scrofulous diseases will assuredly follow. Wheat and other grain crops exhaust the soil of phosphates and lime, and if these substances are not replenished by manuring, it will become incapable of producing such food. Yet, although this is one of the truths modern agriculture has taught us, we sadly disregard it, in casting off in the sewage, and thence to the sea, these salts when excreted from our bodies. In many American settlements, as it is easier to migrate to a new district than to carry phosphates to the old one, which, by their abstraction, is rendered barren, the most extensive changes are occurring, and it is probable that the destruction and desertion of the cities of old was due to similar causes. I may allude to the suggestive fact that nearly all the phosphates we are at present using is but the excrement of reptiles who lived thousands of years since, forty thousand tons of which, known as coprolites, have been, within the fifteen years succeeding their discovery, procured from Cambridgeshire

alone. It is not known positively from what source we derive the phosphorus, which seems a necessary constituent of our brains, but it is an interesting fact that its amount is proportional to the mental activity of each individual—scanty in idiots, infants, and extremely old people, and abundant at mature age; and as every thought burns and discharges in the secretions as phosphates a certain quantity, we have a ready method of estimating the amount of brain-work. Dr. H. Kennedy has with great ingenuity argued that it is possible to influence the intellect by the food, and when we see that the muscular system can be increased by the diet suited to it, as in "training," there can be no doubt that the proper food of the brain might be advantageously given to train thinkers.

About one-third of an ounce of iron exists in the human body, or just enough, if extracted from the remains, to make a commemoration medal or mourning ring for the dearest relative, as is said to have been done by some ingenious Frenchman. The chief function of this metal seems to be to carry oxygen, for which it has so powerful an affinity, from the lungs in the arterial blood throughout the entire body. Its deficiency makes itself known by the peculiar pale or greenish hue in females, or sometimes in males, as noted by Shakspeare, who assigns a cause frequent but preventible—"Their drink doth so overcool their blood, and making many fish-meals that they fall into a kind of male green-sickness."

What I have next to speak of are more evidently substantial foods than these meagre stuffs which, with the exception of common salt, are taken unawares by us. The

British is the most flesh-eating, because the most laborious, nation in the civilized world, for meat being above all nutritive and digestible, can be most rapidly ingested, and many a meal is despatched "between two entries in the merchant's ledger." We are by it supplied with musculin—a substance identical with our flesh—with most of the salts which I have shown are requisite for nutrition, and with fat. This fat, as I shall explain hereafter, is most valuable, but is in great and hurtful excess in the meat supplied from stall-fed cattle. The flesh of animals which have been allowed free exercise is far more lean and digestible. About one-fourth of the weight of the carcass is solid flesh, and about one-fifth blood and juices, or fluid flesh, which, by the modes of slaughtering now in practice, are almost wholly wasted, or rather cast into our sewers to putrify and poison. Last year I advocated some methods of killing cattle without bleeding, and I will here, with your permission, briefly recapitulate their advantages—1. Blood and flesh are identical in chemical composition, as is evident from the following analyses :—

	Dry ox-blood.	Dry ox-flesh.
Carbon . .	54·35	54·12
Hydrogen . .	7·50	7·89
Nitrogen . .	15·76	15·67
Oxygen . .	22·39	22·32

And from this fact Pereira, one of the most reliable writers on diet, allows that their nutritive value is equal. 2. The removal of phosphates of soda, sulphates, and iron, and by imbibition from the flesh with the last flowing blood, of the potash salts is injurious, as they are nutritive mate-

rials of vital importance, and one of the best preventives of scurvy is underdone meat, or that in which some blood remains, as my former pupil, Dr. Walker, the Naturalist and Surgeon to Sir Leopold McClintock's Arctic expedition, had many opportunities of observing. 3. Meat from which the blood is most completely extracted, as thoroughly bled veal, is acid and unwholesome. All game, fish, and some other animals are but slightly deprived of blood, and their pleasant and distinctive tastes are due to this fact. The equestrian people of the American pampas kill their oxen in a way which does not extract the blood; and upon their flesh, usually dried in the sun, and constituting their sole diet, they attain the acme of muscular vigour. Contrast with this the well-known destruction of an English regiment from having been compelled to live exclusively on the flesh of tame cattle butchered in the ordinary way. The following modes of killing would retain the blood, and be likewise as rapid and painless as possible:—1. Compressing the lungs with air, patented by Dr. Carson, or with water, as practised at my suggestion. This sketch will explain how readily the fluid can be forced into the cavity outside the lung by a sharp-pointed tube thrust in between the fifth and sixth ribs, and to which is attached a large elastic bag. 2. By blowing air into the jugular vein, the way horses are often destroyed on the hunting-field. 3. By thrusting a knife into that part of the brain known as the fourth ventricle; or 4, as practised in the abattoirs of Paris, dividing the spinal marrow in the neck. Meat killed with blood retained was more delicious, and kept as long as that prepared in the ordinary way. To diminish its acidity,

meat requires to be kept some time before being used, or until it becomes alkaline from incipient decomposition evolving ammonia. Now, it is very hard to determine how far this alkaline putrescence should proceed, and although the gastric juice has undoubtedly antiseptic properties, food may be introduced into the system in a very unfit state. Meat also loses in weight and substance by being kept; and to avoid pecuniary loss, it is often sold and dressed in a condition most injurious or even poisonous. The blood is an alkaline fluid, and if retained in the flesh would neutralize its acidity, and thus render it fit for food much sooner. The muscles of animals stiffen a few hours after death, which is probably mainly owing to the blood becoming solid within the vessels, for it scarcely occurs in the carcass which has been bled. It is well to wait till this stiffening has disappeared, for the meat is then certainly more tender and digestible. It has been proved, however, that no method of slaughtering will entirely remove all trace of blood from animals, for the microscope or chemical analysis will still discover it. Any prohibition, therefore, against partaking of blood will be virtually a prohibition against eating flesh at all. As well might Shylock have endeavoured to remove his pound of flesh without bloodshed, as might the butcher try to drain absolutely all the blood of the animals he slaughters.

The distinguished philosopher, who presided at the scientific meeting at which I brought forward my views, concurred with me, and said the present mode of killing animals certainly abstracted a large amount of blood and other nutritious fluids which were much better left in the

body. The old methods of slaughtering were most accurately described in the Pentateuch, and there was no doubt that hygienic considerations influenced Moses in forbidding the use of blood. But the prohibition, most useful in warm climates, was not necessary in colder latitudes.

A Member present wished to know how the meat tasted when cooked, as the proof of the pudding was the eating.

The Editor of one of our leading journals said, in answer to this query, that he had a shoulder of mutton lately dressed, the animal having been killed in the way described, two days before, and he could only say that he had never tasted anything so delicious in the shape of mutton in his life. [The number of the MEDICAL PRESS for March 25, 1863, contains a report of my paper on this subject.]

Meat will always be a high-priced food, and remembering its great value, I feel strongly that the beef introduced lately into this country from South America and Australia is a boon to the poor, who cannot purchase home-killed meat. At once I must explain that I do not consider it as palatable or digestible as butcher's meat, but in proportion to the nutriment each contains, this Monte Video beef is at least five times as cheap. Its composition and that of an average specimen of corned beef, are shown by these analyses I have made :—

	Monte Video Beef.	Corned Beef.
Water	17·94	62·08
Ash . . . ,	21·66	9·97
Fat	3·05	21·07
Nitrogenized substance .	57·35*	6·88†
	100·00	100·00

* Containing 7·67 Nitrogen, =49·80 Fibrine.
† „ 0·49 „ =3·18 „

The amount of fat in each is not astonishing, when it is remembered that one animal enjoyed free exercise; the other was stall-fed.

It is well suited to the making of soup, some of which I exhibit to you, and eats right well in the form of an Irish stew. It is used extensively in Scotland, and to a small extent in this country, for its preparation requires some little culinary skill, which is possessed less by our poor than by any people in the civilized world. I am glad to hear that efforts are being made to introduce it now into poor-house dietaries. It would be most desirable that some of the meat which is wasted in these countries, and to a great amount also in the Falkland Islands, were boiled down to an extract, which of all foods is the most powerfully restorative. In March last one of our most intelligent young licentiates was sent out to Monte Video to cure some of the beef by Prof. Morgan's patented plan, which I shall presently allude to; and one hundred bullocks' carcases so prepared will be shortly landed in this country. As this process will render it unnecessary to cut the meat into strips or to dry it, I feel certain we shall have good salt beef at one-third its present price. The old plan of salting—namely, placing salt or brine around large masses of the meat—robs it of much muscle-juice, phosphate of potash, albumen, lactic acid—a most important material for the breathing process—and other soluble and flavouring constituents, substituting merely common salt.

Salted meat is objectionable for the following reasons: its soluble salts are extracted with the brine, and as it must be steeped in water before being used,

much of the soluble nutritive matter is afterwards dissolved out, and the covering of the fibres of the meat is so hardened that it takes a long time to be digested, and often disagrees with the stomach. Of such old indigestible over-salted meat two of the best naval authorities remark that it "has no more nutrition than saw-dust or the bark of a tree," and that "ornaments may be cut out of the meat, resisting the knife like wood;" and Liebig tells us: "It is certain, moreover, that the health of a man cannot be permanently supported by means of salted meat if the quantity be not greatly increased, inasmuch as it cannot perfectly replace, by the substances it contains, those parts of the body which have been expelled in consequence of change of matter, nor can it preserve in its normal state the fluid distributed in every part of the body—namely, the juices of the flesh. A change in the quality of the gastric juice, and consequently in the products of the digestive process, must be regarded as an inevitable result of the long-continued use of salt meat."

Now, the brine which is thrown away contains probably one-third of the nutritive materials of the meat, and it has latterly been proposed to remove the salt by dialysis, and to dry down the juice into meat extract, or use it as soup. About 60,000 gallons of brine are wasted annually in the curing establishments of Glasgow alone, and as two gallons produce as much extract as twenty pounds of lean beef, the loss must be equal to two hundred tons of meat, value for at least £12,000. In America the waste is still more enormous, for in eight of the States 4,000,000 pigs were slaughtered and cured last year. The separation can

be effected by putting the brine in skins and placing these in water, which dissolves out all the salt.

Prof. Morgan's plan of introducing the preserving fluid along the course of the circulation has the evident advantages of retaining all the salts and juices of the flesh, and of only adding as much salt as is necessary for preservation. His process is as follows: The animal being killed in the usual way by a blow on the head, is turned on the back, the chest and heart cavity opened, and one cut is made into the right chambers of the heart, another into the left, and the animal being turned on the left side the blood runs out. A pipe with a stop-cock and coupling at the upper end is now fixed in the cut into the left ventricle and up the main vessel or aorta, and a cord is stoutly tied round it and the pulmonary artery. From the outer end a tube of india-rubber or other material three quarters of an inch in diameter and eighteen or twenty feet long leads to a tank raised the height of the tube, ordinary brine with a little nitre is let on; "it directly (under fifteen seconds in most cases) rushes out at the incision made either in the right auricle or ventricle, before mentioned. About five gallons will suffice. This clears the smaller vessels for the next stage, which is the essential one. The brine so used can be recovered if desired by adding a little old brine and heating. The materials to be ultimately used are now put into the tank, taking care that they are strained, and a stout clip or clamp is put on the incision in the right side of the heart. The fluid is then turned on and directly makes its way to the right side, as before, but its exit being now prevented, and

its admission into the smaller vessels being secured by the first process of clearing these vessels, as mentioned, the fluid, by the pressure and the capillary attraction of minute vessels and muscular fibre, percolates through every particle of the animal, and can be seen at the moment diffusing itself in any part, by making incisions in the hide, horn, bone, and flesh, or any other parts. The quantity I use (says Prof. Morgan) is about one gallon of brine to the cwt., a quarter to half a pound of nitre, two pounds of sugar, a little spice, sauce, &c., to taste; also half an ounce of the mono-phosphoric acid, which, having the power of coagulating albumen and forming a compound with it, retains this very desirable element in the flesh, and gives an extra supply of phosphoric acid, which is of course at present denied the sailor, as above stated. The use of boiling brine in the second stage I also advocate, as it coagulates the albumen or gives a set (as it is called by cooks) to the meat. It is needless to remark that the entire animal is cured almost instantaneously."

The animal can in a few hours be cut up into the usual eight-pound navy pieces, and casked in the usual way, or can be dried. It will be seen that nothing is abstracted from the meat, but salt is added, and sugar, lime-juice, or mono-phosphoric acid, which are eminently antiscorbutic; spices, sauces, or any other flavouring agents; various medicines, such as iron, which is contained in proper doses in this ham, although imperceptible to the taste, can be thus readily introduced. The albumen of the meat can be solidified, either by the introduction of phosphoric acid, or by infiltrating boiling brine. The practical

advantages of the method seem to be the nominal cost of the fluid, it can be readily learned by an unpractised hand, no expensive machinery is required, the whole operations take but about six minutes, and the cure is so rapidly accomplished that it might be adopted in the warmest weather, even at any tropical port where a ship might touch, and thus provide herself with wholesome provisions. It is economical, as meat is cheaper in summer months, as well as more juicy from the grass feeding, and the market prices are now raised by the need there is of buying so many animals together. Hide, skins, and every part of the animal, even to the tip of the tail, are preserved, as the fluid follows exactly the course of the circulation. The only step in the process I do not approve of is that of washing out the blood and other juices, which I have argued are nutritive and in no way objectionable, and its omission would in no degree interfere with the efficacy of Prof. Morgan's admirable process, which, I am happy to state, is in a fair way of being adopted by the governments of this and other countries, and has been extensively carried out by several wholesale curers.

In preserving meat and vegetables by the exclusion of air they are put into tin canisters, which are then soldered, with the exception of a small hole in the lid. The canister is then put into a saline bath, and the temperature is raised to above the boiling point, and when steam is issuing from the aperture it is dexterously sealed quite hermetically. If the process has succeeded the ends of the canister become concave by atmospheric pressure; but if decomposition occurs, they are forced convex outwards by the gases

given off. Another method by which meat is preserved perfectly sweet in the raw state is that of exhausting the air by an air-pump, and forcing nitrogen and a little sulphurous acid into the tin, as patented by Jones and Trevethick. A case of Gamble's preserved meat made in Cork and left in Prince Regent's Inlet in 1824 was found in capital condition by Sir James Ross in 1849, and perhaps would have kept sweet for another quarter of a century. At one time the trade was carried on extensively in Australia, for I find that one enterprising Englishman preserved 400,000 lbs. of beef near Sydney in 1852. The preserving of provisions is carried on now extensively by such houses as Hogarth, McCall (by whose process sulphite of soda is added), Fortnum and Mason, and Crosse and Blackwell, and I exhibit to you some specimens of meat, vegetables, and milk so prepared. The principal and perhaps overwhelming objection to such processes on the large scale is their cost, and their requiring expensive machinery. Pemmican, which forms the staple diet of northern climes, is made by drying the beef in the sun, powdering it, and mixing with one-third of fat. It keeps for an indefinite period. Carniset, a somewhat similar food, has been shown to possess great value by Professor Parkes' experiments on some members of the hygiene class at Netley Hospital.

I now present you with specimens of meat, poultry, milk, and vegetables, preserved by these various processes, and I think you will acknowledge when you taste them that no sailor could starve if they were come-at-able. You are doubtless aware that horse-flesh is eaten extensively on the

Continent; in one fortnight alone, in Vienna, in 1854, 32,000 lbs. of it were sold. Its resemblance to beef may be judged of from an anecdote related by Lewes:—A Frenchman, remonstrating against the supercilious scorn expressed for the beef of his country by the English, whose beef he did not, for his part, find so very superior, exclaimed, "I have been two times in England, but I nevère find the bif so supérieur to ours; I find it vary convenient that they bring it to you on leetle pieces of stick for one penny, but the bif is not supérieur." You will guess at once that he had been eating cat's meat. It is generally believed that potted meats, tongues, &c., are often derived from the same source. Playfair gives the following table of the uses to which a dead horse is put—average value 40s., weight 950 lbs.:—

Parts.	Weight lbs.	Value.	Uses.
Hair . . .	1½	£0 1 3	Haircloth mattreses, plumes, seed bags.
Hide . . .	30	0 8 0	Leather.
Sinews . .	6	—	Glue and gelatine.
Flesh . . .	boiled 224	1 8 0	Meat for men, dogs, and poultry.
Blood . . .	60	—	Prussiate of potash and manures.
Heart and tongue	—	—	A mystery.
Intestines . .	80	—	Covering sausages.
Fat . . .	20	0 3 4	Lamps.
Bones . . .	160	0 6 0	Knife handles, phosphorus, superphosphate, and bone dust

Peas and beans abound so much in the albuminoid

named legumin or vegetable casein, that I have urged their consumption by the labouring classes in these countries, and in Germany and Scotland they have long been the poor man's comfort. How perfect a support they afford is attested in Holy Writ; in the Book of Daniel we read that the Hebrews were supported on pulse and water, "and after ten days their faces appeared fairer and fatter than all the children that eat of the king's meat." Herodotus tells us, too, that lentils formed the food of the labourers who built the Pyramids. The following analyses exhibit the composition of peas:—

	Peas dried green.	Dry ripe peas.
Starchy matter	58·5	58·7
Nitrogenized matter	25·4	23·8
Fatty matter	2·	2·1
Cellulose	1·9	3·5
Salts	2·5	2·1
Water	9·7	9·8
	100·0	100·0

Their superiority in composition and greater solubility in water when pulled green suggests that that plan should be adopted, especially as the ground is thus left in July ready for another crop, and insects cannot damage the return. The starchy matter then is sufficiently abundant, and the nitrogenized substance exists in great quantity, and is, moreover, of the most excellent quality, being legumin, which is identical with the casein of milk, and therefore of all aliments the most soluble and most natural. Their nitrogenous element is so abundant that one pound of peas must form as much muscle as fifteen pounds of potatoes. Legumin with lime forms a hard, insoluble, and

rather indigestible compound; and it is well known that in this way peas boiled in hard water are not very quickly or very comfortably digested, but the addition of a little soda, or the substitution of river, or, still better, rain water, in which they should be steeped for a few hours, removes this objection. However, moderate slowness of digestion is not an objection to an aliment for a working man, as hunger then more slowly returns in the intervals of his meals. During a recent visit to the neighbourhood of Mr. Allan Pollok's vast property in the county Galway, I was informed that his labourers, especially during harvest time—the season of greatest muscular exertion—were fed upon pease porridge, and the only objection I heard offered to it was "that it was very stuffing, and that it was a long time before appetite returned." This was a complaint which I wish our half-fed peasantry were able to make; and at any rate it could be easily removed by diminishing the proportion of peas to other food. The sandy, gravelly, and calcareous soil of many parts of Ireland is very fit for the growth of peas, which, moreover, require no manuring, if seeds and not abundant straw, be required; and the more closely farmers and other employers can be induced to assimilate the food of the Irish to that of the Scotch labourer, the higher will be raised his mental and physical capacities. The identity of the principle of peas with that of milk is shown by the excellent cheese or taofoo which the Chinese make from the former. Peaflour or pea-meal makes a wholesome and most nutritive bread, if mixed with wheaten flour, or they are very readily used as soup or brose. As an example of credulity, and the price people

pay for it, I may mention that Dr. Hassall has proved that Du Barry's revalenta, which sells for 2*s.* 9*d.* a pound, is a mixture of Arabian lentil with barley flour, and he gives receipts by which it may be made for 2*d.* per pound.

It has been generally regarded as wasteful to reject the bran in bread-making, for analysis and the microscope show that one-third of the gluten or sole tissue-producing ingredient exists in it. Bran contains more saline matter than the flour, including six times as much potash. Even the cellulose, although not nutritive, is useful in giving bulk and in stimulating the intestines. Dr. E. Smith, F.R.S., in an able paper before the Society of Arts last December, after quoting my opinion and that of other physiologists on this subject, argues that the bran is merely excremental, and as such is discharged from the body, producing by the way purging, which may be injurious, and which can be always better excited by medicines. Dr. Smith stands alone in this opinion, which, however, has great weight from his eminent position as a physiologist. Rye-bread, the pumper-nickle of Germany, is an economical, wholesome, and nutritious food; and that grain might be raised in many parts of this country unsuited for the culture of wheat.

Scurvy, the first disease produced by scanty or improper food which I shall refer to, is one now rather of historic interest, having been the most prolific of all causes of death at sea. While the scientific principles on which the victually department of the navy is conducted have banished the disease from that service, it pretty often appears in merchant vessels owing to the culpable neglect of the owners.

That the seat of the disease is the blood, and that it is due to a want of its proper materials supplied as food, are the two most positive facts concerning it which we are possessed of. That potash is the deficient material was an opinion started by Dr. Aldridge of Dublin, and forcibly supported by Dr. Garrod, who explains the preventive powers of lemon-juice by the fact of its containing citrate of potash, and the efficacy of vegetables by their possession of this alkali. This question I have discussed at more length in my "Manual of Physiology and Disease."

In the Admiralty lemon-juice, Professor Galloway has found 91 grains of pure phosphoric acid, and thus may be supplied the phosphoric acid which is abstracted from meat by the old, and I trust exploded, system of salting. Phosphorus is found in some form in the following components of our bodies—blood, muscle-juice, gastric juice, bones, brain, and other solid organs; and any deficiency in the supply of it must lead to most injurious consequences upon each of these. The blood and juice contained in the flesh are prevented from oozing the one into the other during health by the alkaline state of the former and the acidity of the latter, and both these properties are dependent on phosphoric acid combined in the case of blood with an excess of soda. The oozing out of blood and the muscular debility, which are two most prominent symptoms of scurvy, may be now readily explained. A dusky hue of skin, coldness, palpitation, and other signs of impeded breathing which occur in the disease, may be due to a want of phosphate of soda, which is of essential importance in bringing carbonic acid to the lungs, and even the softening

of bones and the separation of their ends, and lastly, the prostration of nervous power, seem capable of a similar explanation. Such arguments are advanced by Professor Morgan to show the superiority of meat prepared by his process over salted provisions in preserving the health of our seamen.

Some of the diseases which infest the animals we consume as food are capable of producing serious consequences to man if their flesh is partaken of. In the pig the disease termed "measles," and recognized by knowing buyers by small blisters which form under the tongue, is due to an animal—the cysticercus—lodging in the flesh, and it becomes developed in man's body into that formidable tenant tapeworm. Measles was very frequent in Ireland some years ago for reasons which are too disgusting to mention; even three per cent. of the pigs brought to market suffered from it, but an extensive curer tells me it is rare now. They are not by any means rejected as they should be, but as the salt gets in more readily into the holes the little animals make, they are readily cured. By thorough salting and smoking and careful cooking they would be destroyed, and there is more danger of their being introduced in under-done pork. That the measly pork will produce tapeworm in man was shown by inducing a criminal, on gaining a reprieve, to eat plentifully of this food, and in two months his body was infested with tapeworms. Measly pork may be known by white specks scattered very thickly through it. The trichina spiralis is another little creature which may in a similar manner find its way into man's flesh, and there gives rise to, during its

migrations, a fever resembling typhus, but producing awfully severe muscular pains. Till lately we had no case where by the fatal result we were enabled to discover the parasite after death, and the zeal of one naturalist carried him so far, that for the purpose of examining it, he proposed to "harpoon" one of the muscles of the living patient, and in a bit of flesh so procured, the size of a hemp-seed, seven of the animals were found. The flesh of animals which have died of anthrax, malignant pustule, splenic apoplexy, ovine small-pox, and other diseases, would be probably most injurious if partaken of by man, but upon this point positive evidence is wanting.

An excess of flesh-producing food does not give rise to such evident ill-consequences as we shall see an over-amount of heat-producing material does; but if combined with such concurrent influences as sedentary habits, gout, produced by the accumulation of a nitrogenous acid in the blood, is sure to follow. I have not been able to produce any statistics on the point, but I feel sure that butchers are more subject to apoplexy and enlargement of the heart than most other men, unless the ill-effects of over-feeding be prevented by free exercise.

LECTURE VI.

FOOD CONTINUED: HEAT-PRODUCING FOODS: DIETETICS: DISEASES DUE TO SCANTY OR IMPROPER FOOD: CORPULENCE: ADULTERATION.

The first heat-producing food I shall notice is the potato, which, I fear, we must still call our national food. I place it in this category, as the very minute proportion of gluten it contains (one and a half per cent.) cannot entitle it to the higher rank. The value of any aliment may be fairly judged of by comparison of its composition and that of the blood it is destined to make, for this fluid may be regarded as purveyor-general to all the tissues. The following table puts the potato to this test, and even the small amount of nutriment it possesses is so obscured by incorporation with starch in immense quantity, and consisting of particularly large grains, that I doubt if it be all utilized in digestion :—

	Blood.	Potato.
Flesh-producing matter . .	20 .	1·6
Heat-producing matter . .	·15 .	22·83
Saline matter . . .	·63 .	1·56

This bulky matter in their foods accounts equally for

the distended bellies of the potato-feeder and the rice-eating Hindoo, who, however, has been shown to add a considerable proportion of pulse, dried fish, and butter to his diet, or else he loses health. As an addition to other foods the potato is admirable; for instance, its mineral ingredients make it highly anti-scorbutic, but when we find it used as an exclusive food, disease must be rife among its consumers, and it is responsible for much of it directly. Before the direful famine, the dense population of Ireland could scarcely drag on existence except for this crop, for by extreme sub-division of land, the peasant could not raise enough of any other on his little patch to support his family, at least by the primitive modes of culture he was acquainted with. There was no daily employment for many of them by which he could earn money to purchase better food, and I am afraid I must assign as the chief cause of his affection for the potato that it could be raised by a few weeks' exertion out of the year, leaving him at ease for the rest of it. The crop is now so precarious that our countrymen have lost faith in it, and I feel sure this circumstance, and the difficulty of obtaining any food, is one of the main causes of that lamentable emigration which is still proceeding. It is interesting to remark the altered tastes of the Irish peasant of the present day. He has a need for fluid aliment, such as tea, to make up for the water supplied before by the potato, and this beverage also happily is substituted for whisky, to which it is somewhat analogous in action. Indian meal and white wheaten bread, which I would gladly see exchanged for wholemeal bread, forms the staple

food of many counties; in others, dependence is almost wholly placed on the potato. I stated in my last lecture that I believed that the greatest benefits would result from adding some flesh-producing material, as peas or cheap meat, to the dietary. The potato has depressed the prosperity of other places besides Ireland; for instance, a few years ago the peasantry of Somersetshire and Devonshire were living almost exclusively on this faulty food, and they were conspicuous for wretchedness in a land elsewhere of plenty. The industrial, naval, and military greatness of England very chiefly depends on the excellence of the food of her people, and Irishmen when from home excel them in physical power, as they do in mental quickness, because they are better fed. That at home the Irish agricultural labourer is deficient in endurance of toil, and is apathetic to his condition (or as it is perversely called, contented), it cannot be denied. In a new field of exertion how different are his characteristics! In the most cultivated and prosperous of the States of America, the Irish labourer fares right well, as will appear from the following *menu*, which is a very usual one in Pennsylvania:—Breakfast at five a.m.—tea and coffee, fried pork or mutton, pork sausages, curds sweetened, buck wheat cakes with syrup, fried potatoes and onions, and sour kraut. Luncheon at ten, consisting of fruit pies, to which was generally added a pretty free stoup of rye whisky. The dinner at twelve, and the supper at five, were much the same as breakfast, save that there was more meat at the former, and more pies at the latter.

The Privy Council has just published the results of the investigations into the dietaries of Great Britain and Ire-

land, which have been made by Dr. E. Smith, Physician to the Hospital for Consumption. That physiologist reports:—"On the whole there was the most nutriment, the least sum spent upon food, the least variety of food, the greatest economy in the selection of food, the most breadstuffs and milk, the least sugars, fats, meats, cheese, and tea in Ireland. There was the least amount of nutriment, the greatest variety of foods, the most costly selection of food, the least quantity of breadstuffs and milk, the greatest quantity of sugars, fats, and meats in England. The average cost per head of this food was in England 2*s.* 11$\frac{1}{8}$*d.* in Wales 3*s.* 5$\frac{1}{2}$*d.*, in Scotland 3*s.* 3$\frac{3}{4}$*d.*, and in Ireland, 1*s.* 9$\frac{3}{4}$*d.*" As regards this country, these conclusions will excite surprise. The first is, I think, quite a misconception, and for "nutriment" I would substitute bulk.

In November last I drew attention at one of the evening meetings of the Royal Dublin Society to the evils which resulted from the wretched food of our agricultural peasantry, and which as an hospital adviser were daily presented to me. I was much gratified by the practical application of the principles I advocated in the remarks of Captain Henry, a large landed proprietor, who on that occasion said:—"I thought it a pitiable thing to see men, when dinner bell rang, sitting behind a hedge, or crawling into a plantation, to eat their half-cold potatoes, or basin of stirabout, or perhaps a piece of oat cake, brought in their pocket in the morning; and I at once determined to establish a mess, and will now give you the statistics of its working during a period of eight months. The prices charged in the sheet are the regular market price in the district, and the people

can have any provisions they require for their Sunday dinner at cost price. I endeavour to vary their diet as far as possible; and you will see by the abstract that fresh and salt fish, and fresh and salt meat, are provided for the mess, and the allowance served out each day is as follows, which proves amply sufficient:—Twice a week, broth made from ½ lb. of beef per head, thickened with oatmeal, and with seasoning vegetables; twice do., fresh or salt dried fish, with melted butter; and the other days salt beef or bacon and vegetables. The consumption of potatoes each day is 3½ lbs., and milk about 1½ pints, per head, the surplus waste of potatoes and other vegetables turning in for farm use. There was some little difficulty at starting, but all was soon got over. Knives, forks, and plates, have taken the places of fingers and tin cans; and the people enjoy a hot and comfortable meal, which, under other circumstances, would be utterly beyond their power or means. Before sitting down, I would wish to point out some advantages which result from this system:—The wife or child, who formerly lost the day in preparing and bringing the midday meal, is now employed at a profit. If a wife have small children, she can now remain at home, and have the necessaries of life at cost price, instead of getting into the hands of those small dealers who are the pests of every country village; and any of the labourers' children, whether able to work or not, can have their dinner at the mess. The labourers have improved in condition and appearance, and are, I am satisfied, able to do a better day's work." The balance sheet of the transactions is most satisfactory, as will appear on the following pages:—

DR. THE MESS.

The Mess is here charged with the total quantities of provisions supplied from April 4 to November 14, 1863.

Article.	Quantity and Price.			
Oatmeal	191 lbs. @ 14s. per cwt.	£1	4	0
Potatoes	5tons 11cwt. 1qr. 28lbs @ 2s. 7d. per cwt.	17	15	11
Meat	7cwt. 2qrs. 19lbs. @ 3⅝d. per lb.	12	17	10
Bacon	4cwt. 0qrs. 27lbs. @ 3¾d. „ nearly	6	19	10
Dried fish	4cwt. 1qr. 8lbs. @ 12s. 6d. per cwt.	2	15	2
Eels	2cwt. 2qrs. 14lbs. @ 2d. per lb.	2	9	0
Onions	0cwt. 2qrs. 23lbs. @ 1½d. per lb.	0	9	10
Barley	1cwt. 1qr. 13lbs. @ 1½d. per lb.	0	18	10
Butter	0cwt. 0qr. 10lbs. @ 10d. per lb.	0	8	4
Flour	1cwt. 1qr. 12lbs. @ 14s.	0	19	0
Milk		3	8	6
Turnips		0	0	6
Cabbage		1	2	4
Bread	2cwt. 3qrs. 1lb. @ 1½d. per lb.	2	12	7
		£54	1	10

CONTRA. CR.

This side shows the number of persons fed during each fortnight since its organization, distinguishing the number of men and women, and showing the amount of their contributions each fortnight to the Mess Fund, by deductions from their wages at the rate of

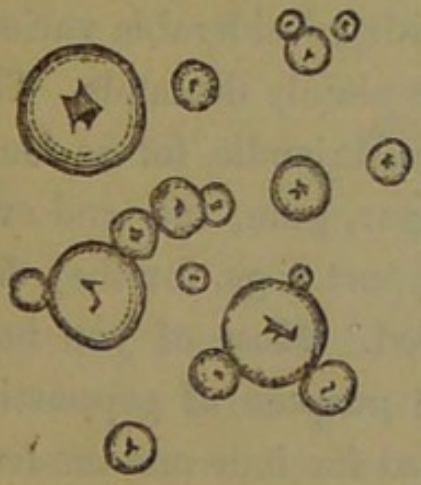
Threepence per day for men.
Twopence per day for women.

Date.	Men. Dinners each fortnight.	Women. Dinners each fortnight.		£ s. d.
April 4	116			1 9 0
18	122	36		1 16 7
May 2	112	36		1 14 2
16	97	36		1 9 11
30	77	36		1 6 6
June 13	22	18		0 8 8
27	175	100		3 0 4
July 11	199	149		3 14 7
25	217	152		3 19 10
Aug. 8	217	123		3 14 9
22	222	164		4 1 1
Sept. 5	194	107		3 6 7
19	282	136		4 13 2
Oct. 3	249	100		3 18 11
17	261	127		4 6 5
31	240	126		4 1 0
Nov. 14	232	110		3 16 4
			Total collective numbers of dinners,— 4590, ...	50 17 10
			Value of the stock in hands, ...	3 4 0
	3034	1556		54 1 10

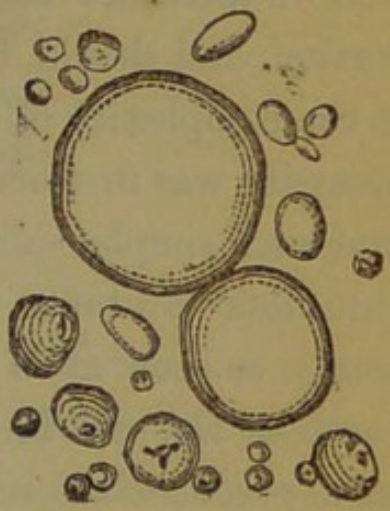
Average number of persons dining for the entire period, 22½

The effects of an improved dietary in increasing the labouring power of man is often strikingly shown along our quays and docks; for the Greek sailors, living previously on fruit, maccaroni, and oil, are able to purchase animal food when they come to port, and their strength and endurance becomes in a short time amazingly augmented. Fatty food has always afforded the best example of a diet being necessarily altered with temperature, and in cold latitudes it is greedily consumed, as related by so many northern voyagers. Some of the Russian tribes are especially voracious, for we are informed one of the Yakuti ate in the twenty-four hours the hind-quarter of an ox, twenty pounds of fat, which he moistened with a beverage, to him luxurious, melted butter, and a calf weighing two hundred pounds is considered a fairly apportioned meal for five. Oil is a luxury greedily devoured by the northern races, as was amusingly proven in a seaport town some years ago. The town was lighted by oil lamps, and the inhabitants remarked that they went out for several successive nights, till it was discovered that some Russian sailors in the harbour climbed the lamp-posts and drank the oil. Starchy foods, such as arrow-root, rice, a large proportion of the potato and of cereal grains, must be converted into sugar before they can be taken into the blood, and as this change takes place in the mouth by the action of saliva they require even more admixture with it by mastication than is generally accorded to them, more I would say than even animal food. The appearances of these foods under the microscope are figured on the following page. That sugar is still further converted into fat is

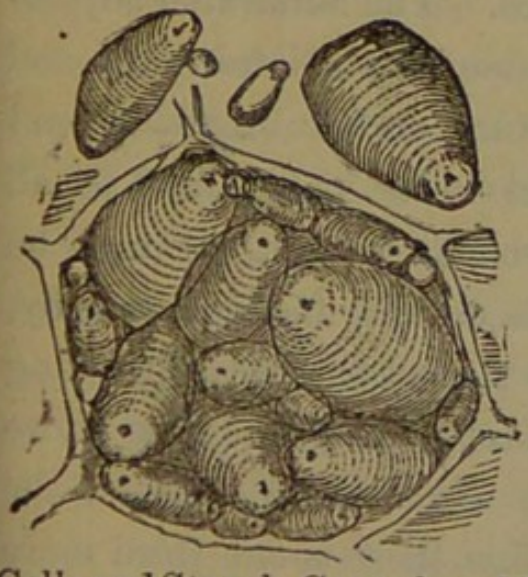
apparent from one fact, the negroes of the West Indian plantations become enormously fat during the sugar season when they partake most freely of that food. The brilliant



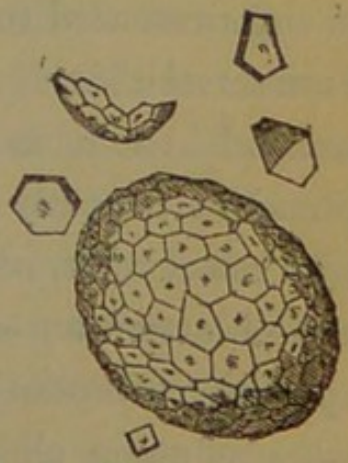
Oat Starch.



Wheat Starch.



Cells and Starch Granules of Potato.

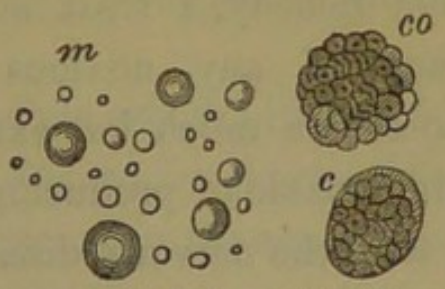


India Corn Granules

white teeth of this race disproves the notion that sugar injures these organs, which may by the way be steeped for days in solutions of sugar without corrosion. In some

countries the females before they enter the connubial state are fattened by sweet foods. Having spoken, though very cursorily, of the two great groups of food, the flesh-producing and heat-producing, the first principle of dietics I have to inculcate is that they shall be mixed in due proportion, and should be supplied with considerable variety, as the complexity of human tissues plainly demands. This necessity was first demonstrated by Majendie, for he found that such simple substances as sugar, gum, fat, and even pure flesh-substance would not support dogs, for they died nearly as soon as if wholly starved. Most of you have heard of Dr. Stark, who, for the purpose of supporting some preconceived notion, abstained for four months from all nitrogenous food. He was attacked with uncontrollable diarrhœa, became fearfully emaciated, and died a victim to his misdirected zeal for science. The admirable adjustment of all nutrient matters in due proportion in milk and the egg presented to us by Nature, and in bread—a food so universal that it may be said to be naturalized to all mankind—teach us useful lessons in dietics. It may be instructive to study one of these natural foods more fully, and I select milk, as it concerns the subject now attracting so much attention—namely, infant mortality. The more important components of milk are four—1. Casein, the flesh-producing element. Of this there is one-third more in cow's milk than in human milk, so that the former to be a substitute for the latter needs dilution. 2. Butter, the main heat-producing material, exists in about equal amount in these two fluids; but in asses' milk, there is but half as much, and it should be enriched by cream if

used for infant feeding. The little globules which constitute the cream are here figured, the large ones being



Globules of Milk.

those of the milk of the first day. 3. Sugar; this heat-producing agent greatly preponderates in asses' milk, and thus in part compensates for its deficiency in butter. It is interesting to remark that the sugar of milk is not readily fermentible, for if it were, the gases evolved thereby would injuriously distend the infant's bowels. 4. Mineral substances; which are twice as plentiful in cow's milk as in the infant's natural food—a fact which also shows the need for dilution. The practical rules we derive from these comparisons are, that cow's milk should be diluted, and then cream and sugar added to make up for the addition of water. The following are the best proportions: Cow's milk, eight ounces; cream, two ounces; water, six ounces; sugar of milk, half an ounce. The addition of some nutritive flour, as corn flour, improves such food for infants, and prevents the milk from souring so rapidly as it often does; but all such artificial mixtures are but poor substitutes for that which Nature designed, and when one reflects on the conditions milk may be subjected to by being kept too long, by adulteration, by the animals which yield it

being unnaturally cooped up in cities, and the difficulties of adjusting its temperature and dilution, mortality among infants, enormous though it be, cannot excite surprise, though it appeals for remedy, I trust not in vain. So susceptible are infants of any noxious influence that impurities of food, to even a much less extent than those I have mentioned, are capable of producing digestive ailments, which, along with the nervous diseases they excite, slay one-fifth of the children that are born. I may mention that in our city such causes seem to be rife, for during the six months ending July 2nd, 239 deaths, or one-fourteenth of the entire, occurred from infantile convulsions, in the production of which want of good breast-nursing is, of all unsanitary conditions, the most powerful. Every effort should be made to remove those impediments to breast nursing which physical conditions produce or social causes seem to justify.

The waste of tissue and growth are so active in infancy that the amount of food required is four times proportionally greater than in adult life. The composition of milk is by no means uniform during all periods of suckling, but is most admirably fitted to the requirements of the bodily functions at each period; thus, for the earlier months, when independent heat is so greatly needed, the fat and sugar preponderate, while in the later months casein increases to feed the growing nervous and muscular tissues. During the later months of lactation starchy foods may be added, but any excess of them is carried off by the bowels and must do harm. Old age being in regard to tissue waste the antithesis of infancy, its requirements

as to the supply of food are just the reverse. This is remarked by Cicero while acknowledging another peculiarity of advanced life, "Habeo senectuti magnam gratiam, quæ mihi sermonis aviditatem auxit, potionis et cibi sustulit."

The same principle which influences the amount of food proper for each of these epochs, teaches us that the supply should be proportional to the expenditure, for the constant labourer, whether bodily or mental, has generally an ample appetite, and yet has rarely to complain of corpulence or the deposit of unused food; but, on the contrary, persons under the influence of strong passions lose *pro tempore* desire for food, and it has been even said that the weakness of such emotions in old age accounts for the improved appetite often observable. That idiosyncrasies or individual peculiarities exist with regard to food is well known, and need not surprise us when we find that many animals obtain nutriment from plants which to others are deadly poison. This may be said even of animals of the same species; for instance, the black rhinoceros greedily eats the *Euphorbia candelabrum*—a plant which rapidly destroys the white variety. Many substances, which, if introduced directly into the circulation, would prove deadly, are innocuous if taken into the stomach, for in passing through the coats of this organ they are decomposed, as can be demonstrated by the following experiment:—Prussic acid, the most virulent of poisons, is generated by a mixture of emulsion and amygdalin, two of the substances obtainable from almonds. Now, if the emulsion be swallowed by a dog and amygdalin thrown into his veins, the poison is not

formed; but if the position of these two substances be reversed, prussic acid results, and death instantaneously occurs. The most remarkable example of complete aversion to animal food is that of the Abbé de Villedieu, who could not be persuaded to touch any till he had attained the age of 30, when, we are informed on reliable authority, he died from the effects of a meal of such food forced upon him.

The principal dietic question is after all the quantity of food, and I may at once say that, as regards England, I agree with the sagacious Cobbett, that for every one man who dies of starvation seven die from overfeeding. Our complaints on this side of the Channel are in the opposite direction. For an ordinary man, say one hundred and fifty pounds in weight and 5ft. 8 in. in height, the quantity of food, solid and fluid, should average daily 110 ounces, of which 70 at least should be water, bearing in mind that 110 of his 150 pounds weight consist of that fluid. The annual quantity of food then required averages about 2500 pounds. So much of our apparently solid food is really combined water, that of the 40 ounces but 18 or 20 ounces of anhydrous new material is thus daily supplied us, and the groups of food which I have spoken of should be apportioned in this amount as follows:—Twelve ounces starchy matter, two and a half of fat, four of albuminoid, and one saline or mineral matter. The composition of some usual aliments is exhibited in the following:—

Table of the Nutritive Value of Food per cent.

	Nitrogenized.	Starchy.	Fat.	Salts.	Water.
Arrow-root .	...	82	...	...	18
Potatoes .	2	23	0·2	0·7	74
Cow's Milk .	4·5	5	4·1	0·7	86
Rice .	7	76	0·3	0·3	14
India meal .	9	65	8	1·7	14
Wheat-flour .	11	70	2	1·7	15
Oatmeal .	12	62	6	3	15
Eggs .	14	...	10·5	1·5	74
Beef .	19	...	5	2	73
Peas .	22	58	2	8	13
Beans .	24	44	1·4	3·6	14
Lentils .	29	44	1·5	2·3	14

As an example of the quantities of food and their mixed characters, which should be apportioned to men under different circumstances, I quote for you the daily quantities in the Low, Half, and Entire Diets of the military hospitals :—

LOW.		HALF.		ENTIRE.	
Meat .	8 oz.	Meat .	8 oz.	Meat .	12 oz.
Bread .	14 "	Bread .	16 "	Bread .	16 "
Salt .	½ "	Potatoes	8 "	Potatoes	16 "
Tea .	¼ "	Barley .	1⅓ "	Barley .	1⅓ "
Sugar .	1½ "	Salt .	¾ "	Salt .	¾ "
Milk .	6 "	Tea .	¼ "	Tea .	¼ "
Butter	1 "	Sugar .	1½ "	Sugar .	1½ "
Rice .	2 " } Pudding.	Milk .	6 "	Milk .	6 "
Milk .	¼ pint }	Vegetables	4 "	Vegetables	4 "
Sugar .	½ oz. }	Butter .	1 "	Butter .	1 "
Egg .	1 " }	Flour .	¼ "	Flour .	¼ "

Mr. Chadwick mentions a remarkable instance of the combined effects of prison dietaries with improved sanitary conditions. Among soldiers in barracks the death-rate is seventeen in a thousand. Some of the worst-conditioned were put into military prisons in Ireland, and the death-

rate declined to two and a half, and sickness in proportion. They had no meat, tea, beer, tobacco, or their usual stimulants, and were fed on half a pound each of oatmeal, Indian meal, and wheaten bread per day, with half a pint of milk, and their general health and strength greatly improved. The difference of condition was very extraordinary when we compare the dietary in the Irish military prison with the barrack ration, which consists of three-quarters of a pound of beef or mutton without bones; one pound of bread—same of potatoes, with tea and coffee for breakfast and supper. Mr. Frank Buckland, ex-surgeon of the Guards, found Irish recruits, apparently strong and muscular, after being put on regimental rations, broke down in going through their duties. He thought the potato did the mischief.

Less food is required in summer, both on account of the temperature about us then requiring less internally produced heat, and as less exercise is taken the tissue material need not be so abundant. These facts account for diarrhœa being frequent in summer, for habit being still our guide, too much food is eaten, and the bowels discharge the surplus. There is no daily act in which greater variety occurs than in the hours at which meals are partaken; for instance, every hour between noon and eight at night is the habitual dinner hour of various ranks, regulated sometimes by other engagements, sometimes by mere fancy. Although I allow that much variety is imperatively demanded by circumstances, I feel sure that any dinner hour later than six o'clock is contrary to all principles of healthy digestion. I have an opinion upon

the order in which foods should be taken at this meal, and I will mention it, though some will call it a crotchet. It is that soup should never be taken at the beginning of dinner. I think by its being rapidly absorbed, it removes appetite, prevents the flow of gastric juice, and interferes with the pressure of the stomach upon solid food. At proper times, however, no food is more nutritious or rapidly digestible than well made meat-soup.

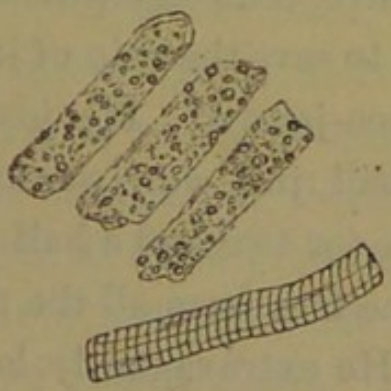
With respect to breakfast, I think it should be made, in the case of delicate persons, at once after rising, and by all at no much further interval, as it should be remembered the system has been for twelve or more hours without food, and any prolonged exercise under such circumstances must be exhausting. Breakfast is notoriously a wholesome meal, and its amount indicates in most cases the degree of health which the individual enjoys. It accelerates the pulse most remarkably, whereas a late evening meal has in most cases no such effect—a circumstance which informs us that food is then less easily digested.

The alimentary value of various articles of diet is too extensive a subject to be even broached here, and indeed it is one on which we possess very little positive information, if we except that which Dr. Beaumont obtained by his experiments on the person of Alexis St. Martin. The tables of the digestibility of various foods which he prepared as the result of these trials has been quoted into every popular manual, so that I do not think it is necessary to reproduce them here. The case of Katherine Kütt, who had an opening in the bowel leading from the stomach, was even more instructive, as the effects of that organ on

various food could be readily ascertained. In Glasgow and London working men's dining rooms have been most successfully established, and if their systems were adopted in this city, it would influence most beneficially the health of the humbler inhabitants.

The relative solubility of various aliments is a field of inquiry recently laid open to us by means of the new analytical process contrived by Graham, and by him termed dialysis; and some investigations of my own conducted in this manner I hope shortly to publish. At the conclusion of my last lecture I alluded to some effects which were due to the introduction of too great a quantity of tissue-producing food, and I stated that such results were rare, as we are soon made aware of, at least any sudden excess of such food. The same cannot be said of heat-producing food, for if it be used in excess of the requirements of the system, it becomes stored up under the skin and in the abdomen, and the evils of corpulence follow. Fat is so bad a conductor of heat that, in being deposited under the skin, it fulfils the same purpose as if it were submitted to combustion—namely, the preservation of the body at an equable temperature of 100°, one nearly always above that of the surrounding air. When heat-producing food is supplied in excess, the surplus not being burned off, is loaded at first under the skin, and by the unwieldy condition it gives rise to, exercise becomes difficult and fatiguing, and thus from disease, and the fat which the bloodvessels pour upon them, the muscles become infiltrated with oil—a condition most readily seen in the flesh of the over-fed and stall-fed ox. There is a muscle on which life is more dependent than

almost any other organ in the body, I allude to the heart; and if fat is laid upon it, it becomes so encumbered that its healthful action is much impeded; but the more dangerous condition—fatty heart—a professional term which has become to a great degree popularized, is often found in the leanest, and depends on a morbid conversion of its substance into fat and not on a mere deposition. Three fibres of the heart so spoiled are here represented, and in



Fibres of a Fatty Heart.

contrast a healthy fibre of the organ. It is curious that the deposit of fat at the edge of the transparent coat of the eye indicates this serious disease. The subject of obesity or corpulence has become so "fashionable," and so constant a matter of consultation and of table-talk, that I must discuss it for a few moments, and in doing so, I

cannot avoid analyzing Mr. Banting's profitable, though but sixpenny, pamphlet. This person, a retired cabinet-maker, some 68 years of age, 5 feet 5 inches high, and 202 pounds, or 14 stone 6 pounds weight, not being, as he says, "quite insensible to the sneers and remarks of the cruel and injudicious in public assemblies, public vehicles, or the ordinary street traffic; nor to the annoyance of finding no adequate space in a public assembly if he should seek amusement or need refreshment;" and not being able to "stoop to tie my shoe, so to speak, nor attend to the little offices humanity requires without considerable pain and difficulty, which only the corpulent can understand; I have been compelled to go down stairs slowly backwards to save the pain of increased weight upon the ankle and knee-joints." He joyfully tells us that by the regimen I shall just now quote to you he reduced thirty-five pounds (or two and a half stone) in thirty-eight weeks, and became free from all the troubles he so bitterly complained of. He extravagantly lauds the surgeon who suggested the remedy to him, urges all fellow-sufferers to consult him, and that they may have need to do so he mentions that some medicine, or, as he describes it, "the balm of life, in a wineglass of water—a most grateful draught, as it seems to carry away all the dregs left in the stomach after digestion," is part of the cure. The name of this miracle-worker was at first only to be learned by letter, but in a subsequent issue he gives the name in full, and it is one which is very familiar to the readers of the advertising columns of the daily newspapers, and notwithstanding Mr. Banting's anxious endeavours to show the con-

trary, the whole affair seems very like a "doctor's puff." His generosity, however, seems profuse, for he has issued an appeal to the public for the erection of an hospital, to be named the "Middlesex County Convalescent Hospital," and as a thank offering for himself, Mr. Banting heads the list with the very handsome donation of £500. I shall quote his dietary *verbatim*. "For *breakfast*, I take four or five ounces of beef, mutton, kidneys, broiled fish, bacon, or cold meat of any kind, except pork, a large cup of tea (without milk or sugar), a little biscuit, or one ounce of dry toast. For *dinner*, five or six ounces of any fish but salmon, any meat except pork, any vegetable except potato, one ounce of dry toast, fruit out of a pudding, any kind of poultry or game, and two or three glasses of good claret, sherry, or madeira—champagne, port, and beer forbidden. For *tea*, two or three ounces of fruit, a rusk or two, and a cup of tea without milk or sugar. For *supper*, three or four ounces of meat or fish, similar to dinner, with a glass or two of claret. For *nightcap*, if required, a tumbler of grog (gin, whisky, or brandy, without sugar), or a glass or two of claret or sherry." Now, you will see that in this generous bill of fare, which, almost ignoring the question of quantity, aims at excluding heat-producing food, there is nothing new, and that a similar one would have been prescribed by any scientific or judicious practitioner for similar circumstances. I will not criticise the style of the pamphlet, for its author lays down all pretensions to elegance of diction at an early page, but I think after two or three editions it might have been freed from such palpable errors as talking of the saccharine matter of

butter, &c. Although from sudden, ill-advised, and excessive adhesion to the plan injury has resulted, for remember great loss of weight must indicate the removal of some heavier material than fat, I think, on the whole, good has been done by this *brochure*, for it has drawn attention to the hygienic questions connected with food. The cure of corpulence is then easy, if the obese be not infirm in will, as has been asserted, and depends on forcing the system to burn off the heat-producing food or fat already accumulated, by denying any further supply of starchy, saccharine, or fatty matters, such as potatoes, turnips, sugar, and sweetmeats, fermented liquors, fat meat, or butter. Such a regimen is surely easier than taking large potations of vinegar, from which bad results have followed; but *embonpoint* is too greatly dreaded even by the softer sex, and with Lewes I would say, "Young ladies be boldly fat; never pine for graceful slimness and romantic palor; but if Nature means you to be ruddy and rotund, accept it with a laughing grace which will captivate more hearts than all the paleness of a circulating library." One more hygienic remedy I would insist on—namely, cleanliness, so as to engage our third lung, the skin, in the removal of fat. Some persons who have been using such an altered dietary as I have detailed, remark that they can bear hot oppressive weather much more comfortably.

In looking for examples of diseases produced by scanty food, deficient especially in nitrogenous ingredient, I regret to say we need not to go from home, for many ailments of our agricultural peasantry depend on their unvaried and very starchy diet. You have been, perhaps, in the

habit of regarding dyspepsia as the rich man's torment, but every dispensary physician will tell you that half his cases consist of that unpleasant malady. The digestive organs become deranged by the great bulk of potatoes, which must be used in order to extract sufficient nutriment from it—thus ten or twelve pounds was considered a fair average daily quantity for a working man. Acidity is readily produced from so much starchy food, and heartburn, or waterbrash dependent on this cause, is very frequent among the potato-fed poor, as was also dropsy of the abdomen. When the annual reports of the Registrar-General are published, I feel confident we shall find consumption more frequent in this than in most other countries. I think poor diet most strongly promotive of this disease. Scrofula was scarcely known among the New Zealanders till the potato became their staple food—it is now most prevalent. Rickets, another scrofulous disease, consisting in a want of lime salts, must be a frequent consequence of potato diet, as that root contains but a trifling quantity of lime and magnesia. Ophthalmia is very frequent in this country, producing a large proportion of blindness—namely, 1 in every 843 of the population; in the United States, where the food is highly nitrogenous, the ratio is but 2·489; and in Norway, where it is very oily and starchy, 1 in 540, the greatest proportion of any country which we are aware of by having a system of vital statistics. Females and children are more subject to ophthalmia than males, and this, as well as the high general ratio, I think can be explained by the very unnitrogenous food of our peasantry, and the very unvaried dietaries of our

poorhouses. It should never be forgotten that in Magendie's dogs thus fed, or the Hindoos subsisting on rice and rancid butter, the transparent coat of the eye was always the first to die, being itself very highly nitrogenized and not freely supplied with blood. I have before mentioned the dependence of fever upon insufficient food, and I believe that it acts as follows:—It depresses the stamina, and as the introduction of new tissue material expels the old, the waste matter will accumulate in the blood of the ill-fed man who becomes from these two conditions more susceptible of the contagious diseases, and less able to bear their exhausting effect. So convinced was Dr. Graves of the curative effects of food in such cases, that he said the most suitable epitaph for him would be "He fed fevers."

I accuse the potato, or any starchy food which may be substituted for it, of being promotive, along with some concurrent causes, of one other disease—rheumatism, which is very frequent, especially in its chronic form, among the poor of this country. This disease is believed to be due to some acid in the blood, lactic it was supposed to be by Dr. Prout, but I have for a long time seen reason to believe it was carbonic acid, but either of them would be yielded by the over-abundant ingestion of starchy or saccharine food.

I have not time to tell you of the influence of food upon the prosperity, physical energies, or mental capacities of communities, nor the degeneracy which an impoverished national dietary will produce, not only in those who are subjected to it, but in their descendants. The effects of food upon the passions and feelings is also a tempting

subject; but I could never express these truths about the stomach as forcibly as old Prior :—

"From hence are sent out those supplies
Which make us either stout or wise;
The strength of every other member
Is founded on your belly-timber.
The qualms or raptures of your blood
Rise in proportion to your food—
Observe the various operations
Of food and drink in several nations.
Was ever Tartar fierce or cruel
Upon the strength of water gruel?
But who shall stand his rage and force,
If first he rides, then eats his horse.
Salads and eggs and lighter fare,
Turn the Italian spark's guitar,
And if I take Dan Congreve right,
Pudding and beef make Britons fight."

It has been well remarked that of all evils which afflict us, those that are cumulative or gradual are the most dangerous, because they are insidious, and therefore less preventible, their cause being obscure. Such an evil of vast magnitude is the adulteration of food and drugs, which, by excluding nutritive or medicinal substances or introducing those that are injurious, does harm both negatively and positively. "*Caveat emptor*" is, however, the spirit of most of the earlier legislation on this subject, and to many the motto seems to convey a sufficient remedy; but when it is remembered that most of these adulterations cannot be detected with our unaided senses, but require considerable scientific knowledge, some legal protection is indispensable, especially in the case of the poor. As an

example of the universality of adulteration, I shall quote a paragraph from the work of our countryman, Dr. Hassall, who has made the subject exclusively his own. After giving a list of deleterious articles used for adulteration, he says :—

"It may so happen, and it doubtless does sometimes occur, that the same person, in the course of a single day, receives into his stomach some eight or ten of the articles above enumerated. Thus, with the potted meats and fish, anchovies, red sauces, or cayenne, taken at breakfast, he would consume more or less bole Armenian, Venetian red, red lead, or even bisulphuret of mercury. At dinner, with his curry or cayenne, he would run the chances of a second dose of lead or mercury ; with the pickles, bottled fruits and vegetables, he would be nearly sure to have copper administered to him ; while if he partook of *bon bons* at dessert, there is no telling what number of poisonous pigments he might consume. Again, in his tea, of mixed or green, he would certainly not escape without the administration of a little Prussian blue, and it might be worse things : if he were a snuff-taker, he would be pretty sure to be putting up his nostrils from time to time small quantities of either some ferruginous earth, bichromate of potash, chromate of lead, or red lead : finally, if he indulged himself with a glass or so of grog before going to bed, he would incur the risk of having the coats of his stomach burned and irritated with tincture of capsicum or essence of cayenne. If an invalid, his condition would be still worse ; for then, in all probability, he would be deprived

of much of the benefit of the skill of his physician through the dilution and sophistication to which the remedies administered for his relief were subjected. This is no fanciful or exaggerated picture, but one based upon the results derived from the repeated analysis of different articles as furnished to the consumer."

The addition of water to malt liquors was so great in London that the late Dr. Normandy found beer sold at the publicans 50 per cent. weaker than that at the brewers with which it was professed to correspond. Some of these foreign substances which are found in so many foods are plainly deleterious, but on the other hand, the public mind has been often needlessly alarmed by chemical analyses announcing the presence of poisonous agents, which, however, were present in such infinitesimal quantity as to be entirely harmless. It is the duty of the authorities in charge of the department to fix some standard beyond which extraneous matters become positively hurtful, and from the physician who has witnessed the injurious effects of these hurtful matters in many instances, can alone reliable data be obtained for instituting such a legal criterion. The great attention paid to the subject of adulteration for the last few years has had the beneficial effect of improving the quality of such articles as confectionery and sweetmeats, and may have had something to do with the vast increase which has occurred in their manufacture. The quantity of such products made in the United Kingdom in 1855 was only 8,000 tons, it now exceeds 25,000 yearly.

LECTURE VII.

HEALTHY SKIN: BATHS: CLOTHING.

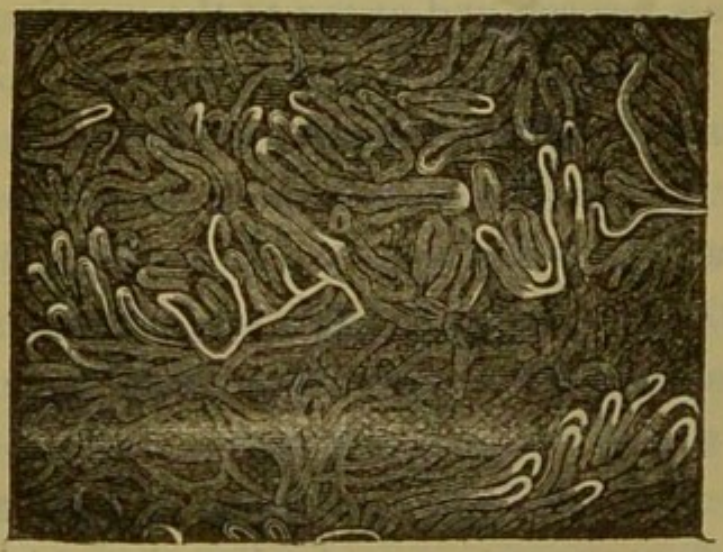
The most appropriate introduction to what I shall have to tell you of baths and clothing will be, I think, a sketch of the structure and function of that much neglected organ, the skin. It is composed of two principal layers, the scarf skin, which you readily peel off, or which is raised by a blister, and the true skin, containing the means by which we feel, and the glands which throw off perspiration and other matters. The scarf skin is quite devoid of feeling, as you perceive when testing the sharpness of a razor upon your hand, and therefore is placed over the sensitive layer to blunt this property. It is very impervious to water likewise, and thus prevents the escape of that fluid from the tissues of the body, and being a bad conductor of heat, it prevents the injuries which would result from sudden changes of temperature. The scales of which the scarf skin is composed are being constantly renewed by the true skin, and those of the surface are cast off, as can be most readily perceived on the scalp, where they go by the name of "dandruff," which I may parenthetically tell you is derived from two Saxon words signifying "itch" and "dirt;" but after fever the rest of the

body throws off its scarf skin abundantly. The scarf skin is composed of albumen, and thus it is that the soda of which soap is composed is capable of dissolving part of it, and thereby removing the dirt which may have been fixed in it. The thickness of this covering varies with the pressure to which it is subjected, the palms of the hands, and soles of the feet, and that of the face being the extremes in this respect, and owing to the scantiness of hair, man's skin is thicker than that of most other animals.

It is in its deepest layer that the colouring matter which distinguishes various individuals and races is situated. The colour of the dark races is of use in tropical climates by absorbing the heating rays of the sun, by which perspiration is increased and its evaporation cools the surface, and the skin in such climates is very active, and aids the lungs and liver in their purifying operations. The true skin has upon its surface numerous projections, in which are contained nerves, and which are the organs of touch, whereby we are made acquainted with the conditions of external objects, and much danger is avoided. The elasticity of the skin, and the softness of the cushion of fat beneath it, prevents these tender projections from receiving injury when even strongly pressed on. The skin is permeated by an immense number of bloodvessels, so that the finest needle cannot be thrust in without wounding some. The capillaries of two ridges of the skin are figured on the next page.

This great vascularity is promoted by heat or moisture applied to the surface, and diminished by the contrary, so that you will readily understand how the circulation of

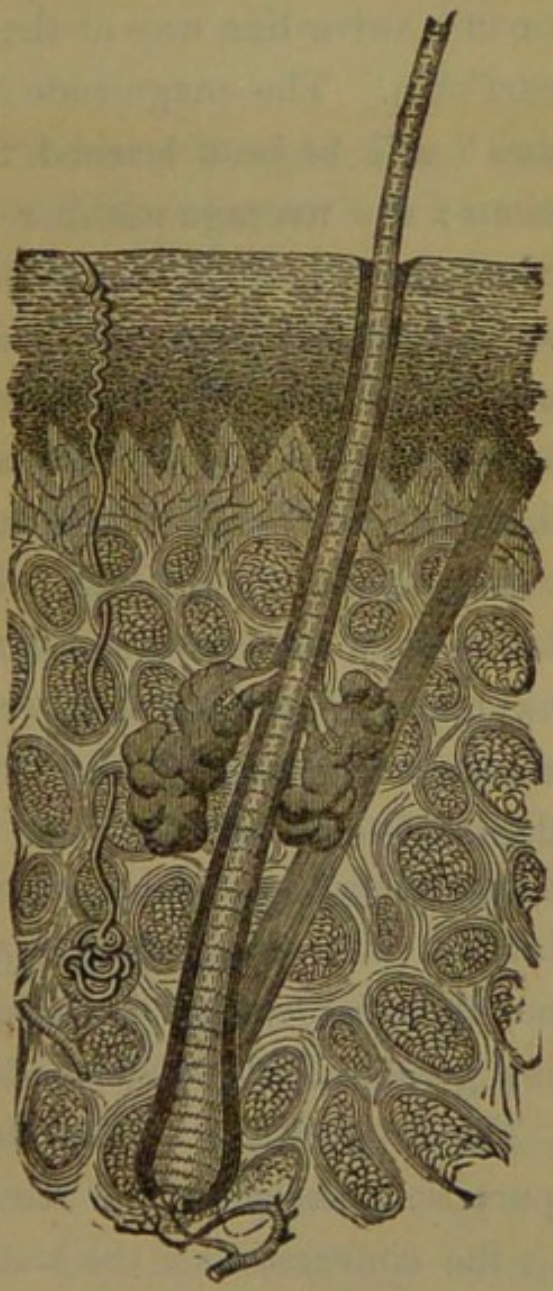
internal organs can be affected by changes in this outer one. The occurrences, blushing and pallor, show that emotions created in the brain are capable of influencing the circulation in the skin. The glands or twisted tubes which we find in the skin are the structures which are most closely connected with the preservation of health.



The Vessels of Skin.

They are of two kinds; first, those short ones, which you see represented by the sides of the hair in the centre of the next diagram, a little animal, which nearly always exists in them, being also seen. They open into the hollow in which the hair is set, and pour out a fatty matter, very like ordinary tallow, when it has become solid from its flow outwards being prevented by the blocking up of the orifice. They are large upon the face, and when the contents of a tube is squeezed it assumes a spiral form, and being tipped by black dirt has been popularly believed to be a "flesh-worm," but is rather a nest of worms, for as many as twenty of the little creatures I have just mentioned may

be found in it by the microscope. The unctuous matters serve many important offices, it renders pliant the skin, obviates the vicissitudes of heat and cold, and it prevents the injuries which would result from the rubbing together



Sectional Diagram of Skin.

of contiguous surfaces. It must from its highly nitrogenous composition be regarded as waste tissue-matter, from

which the blood is purified, and which cannot be retained without injury to health.

The longer and more spiral tube to the left of the diagram is that through which the perspiration is expelled. You see it is rolled up into a circular ball at the deeper end, and opens obliquely or in a valve-like way at the pores on the surface of the scarf skin. The magnitude of this system of "drainage tubes" will be best learned from Erasmus Wilson's calculations: the average number to the square inch of skin may be stated as 2800, for upon the palm of the hand there were 3528, and even on the heel, where they are least numerous, 2268. Taking the surface of an ordinary man as being equal to 2500 square inches, the number of perspiratory tubes will be seven millions, and as each is about one-quarter of an inch long, there will be about twenty-eight miles of this tubing throughout the entire skin. No one will deny that serious results must follow if this drainage system be obstructed, and I will presently offer you abundant evidence of the fact. From these pores there is constantly issuing vapour, which is known as insensible perspiration, and occasionally upon increased exercise, or when chemical change in muscles is more abundant or during greater heat, becomes condensed into drops of sweat. The evaporation of this fluid serves the useful physical purpose of keeping the temperature uniformly at 100°, as the conversion of the water into steam plentifully abstracts heat; but waste matters, the products of the chemical changes of the body, are also got rid of by the perspiratory tubes, as will be seen by the following analysis of sweat:—

Water	995·00
Animal matter, including urea . .	0·10
Sulphates	1·05
Chlorides	2·40
Acetic, lactic, and formic acids, fatty matters, &c.	1·45
	1000·00

The Rev. Professor Haughton has found no urea in it.

The daily quantity of sweat has been computed at three pounds at ordinary temperatures; but in such employments as gas-makers and stokers that quantity has been given off hourly without exhaustion, as they are given gruel to drink plentifully. Of solids, including putrescible animal matter, it is computed that 100 grains are daily got rid of when the skin is performing its functions healthily, or much more by the action of a Turkish bath, and the worst results must ensue from its retention in the blood. Even disease illustrates the purifying nature of the skin, and the eruptions which follow the introduction of small-pox and other contagious poisons are but efforts of Nature to free the system from them.

The skin is also a great respiratory surface, and gives off the products of its combustion as carbonic acid, the amount of which is greatly increased by a vegetable diet. If the skin of any animal be coated with an impermeable varnish, the breathing through it ceases, and the animal dies in an hour or two as effectually suffocated as if his windpipe had been stopped. The compensating action in this regard which exist between the lungs and skin is best illustrated in disease; for instance, when the

lung is injured by inflammation of its texture, the combustion and consequent extrication of heat by the skin becomes excessive. As it is quaintly, but not inaccurately, phrased by an old writer, the skin serves to "discharge the fuliginous recrements of the blood, with the steams arising from the subjacent parts, and to ventilate the flame of the circulating blood that it may not be oppressed or suffocated."

The last faculty of the skin I shall allude to, is its power of absorbing various substances placed in contact with it; painters, mirror-silverers, and the victims of cancer-quacks, have been often poisoned by the lead, mercury, or arsenic introduced through this channel. The scarf skin, and the oily matter with which it is smeared, is, however, a very effectual guard against the absorption of injurious matters and contagious poisons, which would readily gain entrance, as they do through the lungs, if it were not present. However, that such matters may penetrate, it has been shown by Mr. Ceely, for he has often vaccinated without scratching the skin, by merely leaving the lymph upon the surface covered with a little blood, and patients who, from diseases of the food-passages could not be fed in the ordinary way, are said to have been supported by baths of milk and soup. The palms of the hands and the soles of the feet allow absorption readily, as no oily matter is spread over these situations. The skin is also the great medium of sensation; but I will not further allude to this function than to say that we are made aware of changes of temperature, so frequent in this variable climate, and of any hurtful physical condition of surrounding objects by this endowment

of the surface. I trust I have convinced you of the prime necessity of carefully attending to the functions of this all-important organ, for I believe that health would be preserved and life prolonged, if we ourselves were, as Sir Astley Cooper phrased it, as assiduously "groomed" as our horses.

The very numerous matters which I have stated the skin itself discharges, and the extraneous particles which the friction of our clothes or the dusty city atmosphere, including all those dirts which Lord Palmerston defined as but misplaced matter, will soon form a crust upon this organ which blocks up its openings, and otherwise interferes with its all-important functions. The salts which form a considerable portion of this crust attract moisture, so that an unclean skin will be always kept damp, and the waste matters may in this way undergo solution and be reabsorbed into the system. Such animal matters will seek removal by the kidneys, which, however, will fail after a time in fulfilling this work superadded to their own, and that most frequent and fatal disease which depends on the obstruction of the tubes of the kidney, may really often result from a neglected skin, or from the rush of blood to the organ by reduced temperature and suppressed perspiration, as was first shown by the late lamented Dr. Osborne. I cannot help remarking here that I think the time will come when, by the improvements of chemical science, the most useful of all the branches of knowledge accessory to medicine, the quality and quantity of the cutaneous exhalations will be investigated with some of that zeal which has largely added to our knowledge of morbid states of the secretion of the kidneys.

Water, especially that which is soft, as its solvent power for saline matter is greater, removes the crust upon the skin of which I have spoken, with the exception of its fatty matter, and this requires the addition of soap, the alkali of which saponifies it. Well made soap can never be injurious to the most tender skin, even that of the new-born infant, and all wash powders are hurtful, for in the words of Mr. Wilson, the greatest living authority on the preservation of the skin, they cannot "follow the innumerable apertures of the skin, nor enter the mouths of the pores otherwise than to obstruct them. A skin cleaned in this manner may always be detected by a certain kind of shining, not to say greasy polish, and the whole complexion looks mellowed into a kind of *tone*, as we say of pictures, in which dirt and time have softened and chastened the tints." The same able writer, in his admirable treatise, "Healthy Skin," to which I have to acknowledge many obligations, says: "As regards the frequency of ablution, the face and neck from their necessary exposure to the atmosphere and the impurities which the latter contains, cannot escape with less than two saponaceous ablutions in the twenty-four hours; the feet, from the confined nature of the coverings which are worn over them, require at least one; the armpits, from their peculiar formation in reference to the detention of secretions, and also from the peculiar properties of the latter, at least one; and the hands and arms so many as nicety and a refined taste may dictate. No harm can arise from too frequent ablutions, much evil may result from their neglect." I believe the insusceptibility of the face and hands to the influence of

chills depends on the frequency of their ablutions. Miss Jane Porter, the novelist, who was always catching cold on the slightest exposure, once remarked to her brother, a physician, "How I wish that my skin were all face." "Try and make it all face," he replied. But, in truth, the most beneficial of all methods of ablution is the general one easily accomplished by the sponge-bath, the water being at first suited to the season, or cutaneous activity of each individual, and no single hygienic observance has perhaps done more to prolong life or preserve health. The ruddy cheek, full pulse, and muscular activity; in a word, the hale old age of many has been justly attributed to the continuous use for years of daily cold bathing. The sponge bath may be made more stimulating by adding common salt, or Tidman's artificial sea-salt, to the water. The first effect of cold bathing is to make the muscles of the hairs, which are depicted in the diagram of the skin, on a previous page, passing obliquely to near the root of one of them, contract, and this is evidenced to us by the goose-skin appearance they produce by erecting the hairs. By the contraction of the bloodvessels of the skin much blood is thrown upon the internal organs, which excites these in their return to act more energetically, and what is known as "reaction" takes place. This consists in a freer circulation, the skin becoming redder and hotter, and the breathing and other vital functions being exercised with greater ease, and unless it follows, health cannot be perfect or the bath suitable. In very cold weather, or in the case of chilly persons, the upper part of the body may be only uncovered at first, washed and clothed with

woollen, and then the lower half may be treated in the same way.

The warm bath is a valuable means of cleanliness, but is relaxing and oppressive, as very little, if any, perspiration or breathing by the skin can occur in water. The temperature should range about 96°, and is unendurable beyond 104°. Of the vapour bath, that is one in which the air is charged with an opaque mist, I have no experience; but as it would impede cutaneous transpirations, my impressions of it are not favourable. The hot air bath, arranged with a spirit-lamp under a cradle, is very serviceable; but if the more carefully constructed bath which I have next to speak of can be procured, it should be preferred.

The baths introduced into this country in 1856 from the East, under the name of the "Improved Turkish Bath," has been regarded as more analogous to the old Roman bath than to the Oriental hammâm. Although a description of it may seem unnecessary, as there must be few, if any, of my hearers who have not undergone its operations, yet that will be the readiest method I can offer my opinions on the subject, making any comments I think suitable at each step. The first room you enter is as cool as the outer air, and here you undress, and afterwards dress again, so that from these circumstances the Romans termed it the *frigidarium* or *vestiarium*. Swathed round the waist by a light cloth, and with clogs to prevent your feet being burned by the heated tile floor, you enter the second room, or *tepidarium*, heated by flues carried under the floor to from 110° to 120°, as the thermometer in it

informs you. The admission of pure air and the expulsion of impure is accomplished by ventilators in the opposite walls near the ceiling. The windows, fitted with stained glass to produce a tinted twilight, are in the roof, which partakes of that Saracenic character of architecture on which the whole building is constructed. There is a central seat and several couches of marble with mattresses on which you spread the sheet given to you. Although there is no direct method for charging the air with moisture in this apartment it must enter from the inner room, and basins of water, with which you are advised to wet your hair, the only part which feels hot, are usually left in it. The sensations in this room are agreeable to nearly every one, and those to whom they are not, are probably those to whom, as I shall tell you, the bath is unsuited, and they should retire to the cold room, at least for awhile. My pulse usually rises four beats here, and often twenty, in the warmest room, and the respiration becomes a little hurried; but these effects diminish when a general perspiration breaks out in some twenty or thirty minutes, and you are thereupon fit to enter the *sudatorium*. The air in this last chamber is heated to about 140°, and is charged with moisture, though not visibly so, from the washing-places which adjoin. I do think it would be well to have vapour equably distributed by a spray jet of warm water and regulated by the aid of the hygrometer. I am very anxious to make some other investigations on this and other physiological points in connexion with the bath, and will seek the leave of the proprietors as soon as I can find leisure. It appears from the writings of Galen that

the Romans took care to have the air of the sudatorium moist. The heat in this room feels to many oppressive, and with others sweating becomes profuse. The curious operation of shampooing is performed here. You are stretched on a couch, and every part of your body is kneaded, squeezed, rubbed, or pulled till your joints crackle, and become so flexible that you feel they are really being dislocated. So relaxed is the system that these operations which, under ordinary circumstances, would be intolerable, are really agreeable. A surprising quantity of scarf skin, which no washing could remove, peels off, especially if a glove of camel's-hair or goat's-hair be used, as they are in the East, where also the soles of the feet are scraped with pumice. The deposit of this skin of only a week's date when collected is often as large as one's fist. You are then dashed with warm water and lathered with soap applied with a wisp of lyf, the woody fibre of the Mecca palm, and finally washed clean by tepid water issuing from a vose with a flexible tube. Adventurous bathers often take a cold douche, or even some, closely copying the Romans, try immersion in cold water "to close the pores." From this *lavatorium* you are rapidly conducted to the first room, where, wrapped in your sheet, you recline on a couch or duretta, shaped like a spread out W, till quite cool, when you slowly dress, for any hurry or exertion is apt to bring out perspiration, and thereby make you liable to catch cold—a properly conducted bath, however, having no such effect.

I would advocate the use of the bath as a social custom and preventive of disease, for I believe it is the most per-

fect means of ablution we possess, and therefore keeps up a cleanly and vigorous condition of the body, and braces the person against the vicissitudes of temperature and the liability to catch contagious diseases. There is no doubt also that large evacuations can be accomplished through the skin more safely than by any other secreting organ. Nothing escapes through the skin save what is noxious if retained. It should never be used in advanced lung diseases, great debility, acute inflammations, or persons who labour under any form of heart disease; but on the contrary, I think its influence is directly curative in rheumatic, gouty, and scrofulous affections, skin diseases, and the earlier stages of feverish colds and ague.

By the freer action of the skin, especially of its aërating function, I feel sure it is preventive of consumption, and curative perhaps in the earlier stages of that malady. It is a substitute, to a certain extent, for active exercise, which the circumstances of some prevent them from enjoying, and in Rome the baths formed part of their great *gymnasia*, those institutions which had so much to do with the training of that hardy and manly race. The importance of baths among the Romans is evidenced by the number and magnificence of such establishments, that built by Diocletian was capable of accommodating three thousand persons at a time; and so highly valued were they, that those who sought power at the hands of the populace could find no more effectual way of winning their favour than opening such establishments gratuitously for a day. In Eastern nations the bath has been, both in ancient and modern times, held in equal estimation, for in the words

of Disraeli: "The East is the country of the bath. Moses and Mahomet made cleanliness religion." The Hammam in Jermyn-street, London, managed by a company, is the most perfect bath now existing, and corresponds most closely with that of the Turks. One of its striking features is a douche, constructed of small tubes, with minute apertures, which take the form of a case, in which the body is enclosed, and the water is jetted gradually from the lower to the upper part. It was in favour of this establishment that Dr. Goolden, Physician to St. Thomas's Hospital, gave the following laudatory evidence:—"This has opened a new era, both for man healthy and man diseased;" and a similar one has been added to the Newcastle Infirmary, through the interference of Sir John Fife, M.D.

You will then remember that I am an advocate for the use of the bath by those in health, and with proper medical advice in the treatment of a few diseases, and in saying this I express no sympathy with the hydropathic practitioner who introduced them into this country. He has done good, for which I believe he has been repaid pecuniarly by their success, and if he be not insensible to ridicule, he should restrain his pamphleteering friends from committing the absurdity of comparing his doings to the unselfish and glorious achievements of Harvey, Hunter, and Jenner, as they have done.

The hot air bath is of very ancient origin, and is a frequent antiquarian relic in this country, especially in the island of Rathlin, where they are constructed like a beehive, with a small opening, and the air inside is heated by

a turf-fire. They are known as Tig Allui, or sweating-houses. Hot dry air is, however, very injurious by drying and congesting the membrane of the lungs, throat, and eyes, producing also turgescence of the little vessels of the brain and liability to hæmorrhage by their rupture. Time will not allow me to speak of the lamp bath, gaseous bath, or medicated baths, nor of such oddities as the mud bath, or that constituted by the reeking skin of a recently slaughtered animal; but the subject of sea-bathing is so important that I must devote a moment to it. Sea water is more stimulating to the skin than fresh water, and reaction is therefore more abundant after it, and its shock, increased by the impulsion of the waves and chilling effects are soon obviated if such active exercise as swimming be carried on while in it. The fresh and bracing air and exhilarating prospects are much concerned in increasing its beneficial effects.

Soon after the first immersion, which give rise to breathlessness and even giddiness, a glow, accompanied by a buoyancy of the limbs and brave joyous feeling of the mind succeeds, and so long as they continue, the bather may remain in the water; but on the first hint of depression which will succeed, he should leave it, as the worst consequences will follow from the great abstraction of the heat and the congestion of the lungs. During the present month one of our lately qualified surgeons has been attacked with most severe inflammation of the lungs, owing to such incautious prolonged sea-bathing. Languor, sleepiness, and weariness often follow from the depression so produced, especially if the redness of the surface, which

is so essential, be not attained by friction of the surface with a towel.

You will, then, perceive how highly I value baths of every kind, and I must express my deep regret that there is but one institution in Dublin which brings them within the means of the poor and labouring class. It has, however, performed its duties, as far as possible—I allude to the baths and washhouses connected with the Mendicity Institution, Usher's Island. About 18,000 is the annual number of bathers, who, for a few pence, obtain every comfort. There were given last year forty-eight baths to the poor gratuitously; but it is much to be deplored that more numerous opportunities for cleanliness cannot be afforded in this way. I feel sure the Corporation, as soon as we have an adequate water supply, will erect baths and washhouses for the poor and labouring classes of our city. Such has been done by municipal authorities elsewhere, and with pecuniary profit, as regards the baths. There are many waste plots in the heart of the city which might be devoted to this necessary purpose.

Clothing, as every one knows, is of use in preserving the proper heat of the body, and in preventing the injurious action of sudden changes of temperature upon the skin of man, who is, of all terrestrial animals, the most scantily supplied by natural protectives. Between the layers of clothes there are also strata of air kept at an equable temperature, and which but slowly conduct alterations of it from within or without, and which, by being confined by the dress above, does not freely allow of the admission of colder air from below. It is for this reason

that in going from a warm room into the cold we should put on our extra clothing some time previously, so as to heat this protective stratum of air. Linen, which is so great a favourite in temperate climates, is objectionable on account of its high conducting and bad radiating powers, so that it feels cold, and does not freely distribute heat, and is also attractive of moisture, which it retains and keeps a damp instead of dry medium around our skin. Such reasons have caused the entire substitution of cotton or thin woollens for linen garments in warm climates, and the only objection to them is their rougher surface, which occasionally irritates sensitive skins. Notwithstanding another objection occasionally made to woollens—namely, that they disturb the electric state of the skin when rubbing against it—I really believe that no other medium is fitted for this variable climate to preserve the heat of the body during great cold, or prevent the conduction of intense heat, and the wearing of flannel or merino shirts during winter and summer, is now so usual as to realize Boerhaave's maxim, that you should take off your winter clothing on midsummer's day only to put it on the following morning. The only change I would advise would be to wear the flannel inside in winter, out in summer, and to have another dress of the same material for night. We can perceive that since the very general adoption of flannel inner clothing, the number of deaths in the Registrar-General's report by bronchial complaints is very much lessened. You may have heard John Hunter's receipt for rearing healthy children; it was "plenty of milk, plenty of sleep, and plenty of flannel."

Even the colour of dress is not unimportant, as was first demonstrated by Benjamin Franklin. He placed pieces of various coloured cloths on the surface of snow, and found in a given time that the snow under the black was most melted, that under the white the least. Even from this we get hints as to the shades proper for winter and for summer gear. The primary importance of such functions as perspiration and respiration, which I have told you the skin possesses, teaches us the necessity for having our garments made of textures permeable to moisture and air, and I never see an india-rubber coat or galosh without being forcibly reminded of Breschet's experiment, which I think I before mentioned to you. He shaved rabbits and coated them with impermeable varnish, and found they perished in an hour or two of cold and suffocation. For similar reasons I have often recommended persons who suffer from tender feet to wear the cloth known as pannuscorium instead of leather, especially the enamelled kinds, in their boots. I think the reason gout attacks the feet so often is, that their natural cutaneous action is impeded, and among the Romans they were less often affected than the hands, as the sandals only partly covered them. Dr. John Brown, the well-known author of "Rab and his Friends," remarks:—"It is amazing the misery the people of civilization endure in and from their shoes. Nobody is ever, as they should be, comfortable at once in them; they hope in the long run and after much agony, and when they are nearly done, to make them fit, especially if they can get them once well wet, so that the mighty knob of the big toe may adjust himself and be at ease.

For my part, if I were rich, I would advertise for a clean, wholesome man, whose foot was exactly my size, and I would make him wear my shoes till I could put them on, and not know I was in them. Frederick the Great kept an aide-de-camp for this purpose, and, poor fellow! he sometimes wore them too long, and got a kicking for his pains. Why is all this? Why do you see every man's and woman's feet so out of shape? Why are there corns, with their miseries and maledictions? why the virulence and unreachableness of those that are 'soft?' Why do our nails grow in and sometimes have to be torn violently off? All because the makers and users of shoes have not common sense, and common reverence for GOD and his works enough to study the shape and motions of that wonderful pivot on which we turn and progress. Because Fashion—that demon that I wish I saw dressed in her own crinoline, in bad shoes, a man's old hat, and trailing petticoats, and with her (for she must be a *her*) waist well nipt by a circlet of nails with the points inmost, and any other of the small torments, mischiefs, and absurdities she destroys and makes fools of us with—whom, I say, I wish I saw drummed and hissed, blazing and shrieking, out of the world; because this contemptible slave which domineers over her makers, says the shoe must be elegant, must be so and so, and the beautiful living foot must be crushed into it, and human nature must limp along Princes-street and through life natty and wretched."

Upon the necessity of frequent renewals of inner garments, I need make no remark, save that with our present scanty supply of water, this and other cleanly observances

are almost impossible among the poor, unless with the advantages which an extension of the washhouses I have before alluded to would supply.

In the extremes of life, when heat-producing power is most feeble, additional warm clothing is clearly demanded, and we see but seldom now half-dressed poor children exposed to all weathers under the erroneous notion of making them hardy; and just as hurtful are chilling cold baths, which are occasionally given under the same mistaken notion to children. I have alluded incidentally, while describing the functions of the skin, to various diseases which interference with them promotes, and the remaining subject of diseases of the skin itself being more within the province of special medicine, I will not further allude to; but there are few, if any, of them which cannot be shown to depend on the contact of specific matter from without, or the presence of morbid products within, which the skin makes efforts to remove.

LECTURE VIII.

MENTAL AND PHYSICAL EXERCISE: OCCUPATIONS.

In all my previous lectures the sources of ill-health against which I had occasion to caution you were such as met with no natural support in our own inclinations; nobody likes bad air, *per se*, nor impure water, nor adulterated food, nor unwashed skins; but there is a powerful principle in man which leads him to neglect wholesome exercise of mind or body—a principle of indolence or love of ease, so constant, so strong, and so obvious in its operation, that political economists have been led to assume it, in conjunction with the love of gain and of pleasure, as the three great mainsprings of human conduct. There is, no doubt, a natural pleasure attached to exercise, mental or bodily, but it is only discovered as a result, and is not the initiatory cause of exercise. We experience the benefits in some particular case of labour, and then sometimes work systematically with a view to these benefits. But that it is often a strain upon our natural inclinations is proved by the facility with which we relapse into idleness, and the pain and difficulty with which those habits are reacquired is expressed in the aphorism "*dolce far niente*," which has its

analogue in every language. The only exception to this statement is the restlessness or love of exercise which seems natural to children in their sports and gambols, and which seems either a temporary provision of Nature, ceasing when reason asserts its sway, or one which a vicious or neglected physical education suppresses in adult life. There is no more fatal opponent of the health of any organ than its disuse, for it leads to its decay or extinction by conversion generally into what would seem the vilest of our components—fat. The removal of the womb when its functions are over is an example of this degeneration. The Author of our being has indeed placed many of our organs beyond our power to injure them ; thus we must use our lungs, and even any inattention to the act leading to an insufficient supply of air is compensated for by a sigh.

The onward movements of the bowels and the action of the heart must, to a certain extent, go on independent of our will, and it is interesting to remark that they are supplied by a separate nervous system from that which controls our voluntary acts, but many other organs are left to our own care, and in the long run a neglect of these leads inevitably to the ruin of all. So unfavourable to longevity is mental or physical idleness that it may be asserted no great idler ever attains old age.

The benefits of exercise may be perhaps considered as a subject belonging to the lecturer on physiology than to a lecturer on public health ; but there are some points to be observed respecting exercise which commonly escape notice, and which I am doubly anxious to insist on because of their connexion with sanitary provisions. One of these

is, that exercise to be most profitable ought to be as far as possible not systematic, and taken for its own sake, but spontaneous, and incidental either to business or amusement. So intimate is the connexion between mind and body, that it is hard to benefit the latter unless while relieving and pleasantly occupying the former. A man who takes the same walk every day, and meets the same people, does not derive half the benefit from it that he would from the same amount of exercise amid new and interesting scenes. In fact, his mind not being occupied along with his body naturally reverts to the thoughts which engross him in the counting-house or the study, and thus the intellectual part of his nature derives no relaxation, and the body suffers as a consequence. A hard-reading friend of my own was daily in the habit of walking three times round the College-park, but that he derived no benefit from this monotonous routine was evident from his morose and melancholy expression. This mental condition is the secret of the marvellous efficacy of a Connemara, Highland, or Swiss tour to the jaded lawyer, merchant, or student. Even if by a violent effort he banishes his business from his thoughts and fasten them on the exercise itself, he derives but little advantage. The exercise becomes a toil, and the most depressing of all toils, because it is unaccompanied by a sense of that which sweetens all toil—the sense of progress and useful work done. I have heard that that benevolent nobleman, Lord Rosse, during the famine years, anxious to relieve distress, and equally anxious not to encourage habits of pauperism, paid men so much a day for digging holes in his demesne, and paid them again for

the filling of them up. The labourers are said to have manifested the most extreme disgust at the occupation, although the work was not harder than some useful labour. It is this sense of the inutility of the work done by the labour in some of the military prisons which constitutes much of the severity of the punishment. And this remark is as true of mental exercise as of bodily. Who can bear to sit down to a hard mental operation, the learning of a new language suppose, or the acquisition of a science, merely for the sake of sharpening his intellectual faculties. We must be animated with the hope that when we have learned the language or mastered the science we shall be possessed of somewhat that we had not before, and that we shall be more richly furnished for the enjoyment and appreciation of the system of things around us, or else the labour will be intolerably dry and repulsive, and will fail to afford even that discipline which we seek, for all good discipline involves an element of pleasure. The kind of intellectual exercise which is most beneficially stimulating is that in which the mind is not merely receptive, but partly, at least, creative. In studying any work, if we merely receive the author's statements, feelings of lassitude will much sooner supervene than if we make efforts to judge, methodize, or investigate. The wholesome effects of original mental work are not confined to the intellectual powers alone, but extend to the nutritive and other corporeal functions. Of course, excess of this or any other labour is hurtful, and original work is peculiarly exhausting.

Another observation is, that as each kind of business

and employment exercises a particular set of organs of the body or faculties of the mind, so our amusements ought to be so contrived as to afford rest to those sufficiently worked organs or faculties, and call into play those others which ordinarily lie dormant. Nature herself does this for us in some remarkable instances; if the eye has been continuously looking at any particular bright colour, and is then transferred to a black surface, the complementary colour of the same figure appears to be delineated on that surface—a spontaneous effort of the organ to restore the balance of its powers. To apply this to recreations and exercise. To many, whose ordinary business is of an active kind, involving no intellectual operations save routine or clerk-like ones, yet whose mental powers are superior, chess is a most suitable relaxation. Billiards, on the other hand, is found to be a better game for those who have much head-work and not enough of exercise. Poetry, history, or philosophy are the natural reliefs to a mind which has to plod through dry statistics or legal arguments. The last remark I wish to make on this subject is as to the nature of the stimulus. There is a healthy stimulus which puts the whole mind and body into tone, and an unhealthy one, which is followed by depression, and puts the whole mind and body out of tone. Gambling, for instance, excites the mind, or rather the passions, and in such a manner (not unlike dram-drinking) that each impulse leaves a craving for a still stronger impulse.

So close is the connexion between mind and body, especially in children, that any over-taxing of the former in early life will injure irreparably the latter, which up to the

seventh year or so is growing, and should not be wasted by the act of thought. A precocious mind and preponderance of the nervous over other systems is often the accompaniment of a puny scrofulous body, and both are the results of a too early and too close application of the mind, while the body is kept confined in the school-room, which, from want of ventilation, is often a direct excitant of disease. In mild weather I have thought it most desirable that children should be taught their tasks in the open air, and amid the beauteous natural objects. If a child survives after such ill-timed mental forcing, hypochondriasis, dyspepsia, or even epilepsy or hysteria, will be their burden. I can fully appreciate the advantages which will accrue to the young of this generation and to future ones from the adoption of that plan of education which is known as "the half-time system," chiefly advocated by Mr. Chadwick, and which, applied to the children of the poor, means half the usual time now allotted to instruction to be divided between study and light manual labour. This system continued for three or four years—say from the tenth to the thirteenth or fourteenth year—would rear up more healthy, docile, and sensible youths than if the whole time had been devoted to either study or labour alone. Such a system has been carried out in many English districts, especially in the case of the children of factory operatives, and it has been found that while the school work has been better done, the sanitary state of the pupils improved, and money was earned by their labour. In one school connected with Akroyd's great factory, 761 children were in this way being reared up to

the time when, under the Factory Act, they could become regular labourers.

So far from civilization being in itself repressive of the perfect development of the human body, its continuance in health, and the prolongation of its existence, as has been asserted, I feel that its influence is the contrary. The uncultivated savage rarely attains to old age; physical life-shortening influences from without, as changes of temperature, hunger, or accident, and such exhausting ills as unrestrained passions from within, exerting their full power on him, who is unblessed with the many resources which education and art have given to cultivated society.

With regard to the time for mental exercise, there is no period when the acquiring or reflecting powers are so active as in the early morning, and study can therefore be indulged in more profitably. The silence, the cool refreshing air and brightness of the morning, have a most effectual calming effect on the mind. In Dublin I am sure that later hours at night and laziness in the morning are more habitual than in most other capitals. As examples of the evils of excessive mental labour, I shall briefly allude to those diseases which affect men whose brain is overworked. The fact that there are such has been forcibly told us in the writings of Dr. Richardson, yet the danger to be apprehended in this respect is not fully realized, although it is becoming a matter of national importance because of the eminence of the victims of such errors. Mere muscular work seems rarely to be injurious, for the recuperative power of that system seems illimitable, and nought but increase of its powers supervenes; but from

excessive brain-work fatal and prolonged diseases arise, and its victims are thus made to pay the forfeit of their ambition. Men of intense and original thought, whether centred upon letters or commercial speculation, men ambitious of power, are those we lose in this way, for their brains have not merely to work for their own bodies only, but perhaps to guide a hundred other brains or human machines, through whom their great schemes are carried out. To adopt Dr. Richardson's appropriate *simile*—"An electric battery works a single wire from the city to Brighton, and does its work well, and goes on for some months before it is dead or worn out. Can it do the work of a hundred wires? Oh! yes it can; but it must have more acid, must wear faster, and will ultimately die sooner. We may protect the plates, make the battery to an extent self-regenerative, as the body is, but in the main the waste is in excess of the supply, and the wear is as certain as the day." Men with over-worked brains suffer very similar consequences, and induce such fatal diseases as aggravated dyspepsia (attended with great loss of that remarkable element of brain composition, phosphorus), paralysis, apoplexy, softening of the brain, insanity, or premature old age. They also suffer from ordinary ills more severely, so that they can bear no pain or depressing curative measures, and often acquire a morbid sensibility, which converts activity into irritability, and seclusion produces nought but moroseness. Self-dislike follows, and suicide—that lamentable blot on the civilization of the nineteenth century—too often ends this train of preventible misfortunes. It is thus that the diseases to which the frame succumbs pre-

maturely from mental over-work must be regarded as constituting a kind of "chronic suicide," the sacredness of the body and its claims for support from its in-dwelling master, the mind, not being fitly recognized. An eloquent President of the Public Health Section of the Social Science Association declared, "When people say we should think more of the soul and less of the body, my answer is, that the same GOD who made the soul made the body also. It is an inferior work, perhaps, but nevertheless it is HIS work, and it must be treated and cared for according to the end for which it was formed—fitness for HIS service."

The physiological system which is most fully influenced by exercise is the circulation. The contraction of the muscles is due to chemical change of their substance, which the blood feeds with oxygen and with reparative material, and moreover withdraws the waste matter, the result of the muscular action. Thus, there is created a necessity for more blood. The pressure of the muscles upon the deeper veins is their chief means of circulation, for they are not freely provided with valves as those near the surface are. This muscular activity gives rise to greater action in the digestive and blood-making organs, and likewise in the lungs, liver, kidneys, and skin, by which the waste matter is thrown off, and those organs which may have been lying partially dormant are stimulated into healthful vigour. Exercise promotes the breathing process especially, ridding the blood of a greater quantity of carbonic acid, as is shown by the respective amounts emitted during the following exercises:—If 1 represent the quantity evolved during complete rest, 7 will be given

off in a person running at the rate of 6 miles an hour, 5 if walking 4 miles an hour, and 4 if trotting a horse. Exercise also urges that neglected, though much talked-of organ the liver, to remove biliary matters from the blood, and the want of it is readily apparent in the sallow skin, dulled brain, and torpid bowels of the lethargic; and lastly, the skin is brought into healthful play, for its temperature is increased, its secreting function exalted, and its breathing process is encouraged by fresh ever-changing air. Heated skin, quickened heart, and rapid breathing, are also produced by fever; but in this case, these effects are due to excessive waste without corresponding reparation. I may mention that in standing several muscles are exercised, and the quickening of the pulse over its rate when lying shows this, for if the body be kept vertical on a reclining board without exertion, no such acceleration occurs.

The muscular system is of all perhaps the most important; most of our daily acts and avocations are performed through its agencies, and the noblest bursts of eloquence or sublimest thoughts could not be communicated for the improvement or enlightenment of man without its aid. Will we, then, not exercise and perfect this great endowment? What are the effects of disuse of muscles? Their rapid destruction by conversion into fat. When the pregnant womb has accomplished its functions, terminating with the forcible expulsion of its contents, it undergoes reduction to 1-24th its size.

When any set of muscles are prevented from being called into play by the destruction of their nerve, owing to injury or disease, they rapidly waste, and even disappear;

the only means of preserving their properties being to supply, instead of volition, that wonderful and still mysterious agent, electricity. Hysterical girls have been known to lie down and remain for months without any motion, believing that they suffered from spinal disease, and they have occasionally paid the severe penalty of utterly wasted muscles or stiffened joints. A somewhat appropriate cure would be to persuade them that the suitable adviser in their case resided in some distant and inaccessible place, and the exercise in travelling to it would probably remove the hallucination which prevented them from relying on their muscles.

Another interesting example of the removal of an organ, if long disused, perhaps in successive generations, is afforded in all the blind animals found in the Mammoth Caves of Kentucky, and it would be interesting to find whether eyes would be restored to them, if for two or three generations some of them were transferred to the light. On the other hand, of all tissues the muscular is the most susceptible of increase, or hypertrophy, as we call it, by augmented exercise; witness the blacksmith's arm or the opera dancer's leg.

Concentration of bodily or mental efforts on one object for a length of time is always injurious, as extreme exhaustion of the strained organs will follow; but the ill-effects will react upon others, and the only mode of attaining anything like perfect exercise is to engage all the mental faculties and groups of muscles in performing it. The proper kind and amount of bodily exercise is so variable with the circumstances of each, that general rules

are with difficulty laid down, but the following seem to me judicious:—1. During ordinary health, some part of each day should be spent out of doors, even in weather apparently unsuitable, for clothing supplies a means of obviating all ill effects. 2. It should be as active and general as possible, and carried to the point of slight fatigue. 3. It should be taken at the best time of the day, which I consider the morning, if the precaution of taking some food, such as a cup of milk or coffee and a biscuit before going out, a substantial breakfast being taken afterwards, or if this meal be taken early, exercise may be commenced an hour or so afterwards. Among methods of exercise, it is believed that horse exercise, if attainable, is superior to all others. Such manly vigour is in this way acquired that Frederick the Great is reported to have said, "When I consider the physical structure of man, it appears to me that Nature had formed us rather to be postilions than sedentary men of letters." The greater variety of scenery it brings before the mind, the agreeable way in which the attention is fixed upon guiding the movements of the horse, and the rapidity of motion it confers without fatigue, make it most desirable. So important are gymnastic exercises and games of agility or strength, and so necessary to preserve the vigour and manly development of our youth, that the hygienist must look with great satisfaction on the extension of cricket as an ordinary game in this country, while the volunteer movement, which, it appears, must be on account of our reputed pugnacity denied us, has done a vast deal to augment the robust health of the English nation by the regular and systematic exercise in

the open air which it entails. The emulation it gives rise to supplies that mental stimulus which I have argued should be associated with every kind of bodily exercise. We learn also much hygiene from the rules of the pedestrian when training. He rises early after sleeping on a hard bed, takes a small quantity of food—for example, an egg—and takes a moderate walk for an hour, when he bathes and breakfasts afterwards. This meal consists mainly of underdone meat, with perhaps tea; butter, sugar, and much milk being excluded. Half an hour after breakfast he begins his hard walk of ten or twelve miles, after which he is rubbed down, and takes a cold bath. His dinner consists of bread, meat, and a little vegetables. A little tea is taken instead of supper, and the day is wound up with a small walk just before retiring to rest. Even in the hottest parts of India bodily exercise is necessary, and the much greater prevalence of disease among the privates than among the officers of our regiments there, is due in a great degree to want of suitable exercise. Of all means of exercising none is more beneficial than the use of the gymnasium. In it time is economized, the companionship and rivalry is encouraging, and it is available during the short or wet days of winter.

With respect to railway travelling, which may be considered as a method of exercise, a few remarks seem necessary. You may be perhaps aware that the *Lancet*, that vigorous paper which we have to thank for much exposure of adulterations, undertook to investigate this question a year or two ago. Evidence as to the liability to cold was given by Dr. Williams, and he traced many cases

of sore throat, ear, and toothache, pleurisy, rheumatism, and sciatica, to this cause, for which the remedy is simple—proper ventilation without draught, and warm clothing. Dr. Forbes Winslow detailed most graphically the mental and physical fatiguing effects which result from the anxiety to catch the train, hurried breakfast, too rapid efforts to be in time, &c.; and lastly, Mr. White Cooper, the eminent oculist, avers that much injury to the sight results from the efforts to follow the ever-moving print, which, in railway literature, is not of the best. So that I think a fair case has been made out against too constant railway travelling, and as much less oxygen is inhaled or carbonic acid exhaled by such passive exercise than by walking or riding, its evil effects should be compensated for by freer exercise, or it will be necessary to set it down as one of the unsanitary influences which may degenerate the race in this nineteenth century. The provisions that may be made for the exercise and recreation of the public are various; but foremost among them stands the institution of public parks, gardens, and walks, ornamental in appearance, healthy in situation, well drained, and easily accessible to the working classes. In every respect, save the last, our Phœnix Park is unrivalled, but its great distance from the heart of the city limits its utility to those who have much idle time on hands, or else to those who can have horses and carriages at command. Excepting on general holidays the Park is but sparingly resorted to by the humbler classes. How to remedy this is a problem worthy of our best attention. Perhaps a penny omnibus running on rails, and capable of holding fifty passengers,

would be found to pay; but if not, I see no reason why it should not be partly aided by the authorities, as is the case with the two-sou omnibuses running to all the parks about Paris. If the line of quays be too narrow for such a tramway, why not devise a new approach, and if the day ever comes when we will have our river's sides embanked, as they are doing now with the Thames, we will have room to spare, and then perhaps by the narrowing of the river, the water might become deep enough to allow such small steamers with jointed chimneys as ply from bridge to bridge in London to be adopted by us. During the summer and autumn months, resort to the sea-side, if it were only for a few hours, is a great boon to the over-worked and ill-lodged artisan, and to his too often ill-fed and sickly family. Railways have made the sea on all sides, and the beauteous hills of Bray, Killiney, and Howth, most accessible; but they have, at the same time, made these neighbourhoods so commercially valuable that property has laid its iron hand upon every bit of rock, sand, and shingle, on every breezy hill and every pleasant common near this metropolis, and forbidden the poor man the purest and best of pleasures, the health and refreshment afforded by the face of Nature. As to field-walks they are gone from us long ago. In England, there is nothing of which the people are more tenacious, and they have preserved them in plenty. Our humbler fellow-citizens have been, by one means or another, year after year, I will not say robbed of, but certainly ousted from, every field-walk in the neighbourhood of Dublin, and the roads lie between stone walls, which

cannot be overlooked save when on horseback, so that the mental concomitant which I have maintained is necessary to give value to exercise is lost. There should be an organized movement to restore some of our field-walks, whether by purchase, litigation, or the pressure of public opinion. A few years ago Prof. Jukes, who, with other Englishmen visiting our land, was astonished at the selfishness with which such places are kept private, put himself at the head of a committee for the opening of the passes round Bray Head.

On this subject I may be excused for quoting the words of one of Scotland's most gifted writers, himself a journey-man mason. Speaking of a very dismal period of his life, Hugh Miller says:—"I threw myself, as usual, for the compensatory pleasures on my evening walks, but found in the enclosed state of the district, and the fence of a rigorously administered trespass law, serious drawbacks, and ceased to wonder that a thoroughly cultivated country is, in most instances, so much less beloved by its people than a wild and open one. Rights of proprietorship may exist equally in both; but there is an important sense in which the open country belongs to the proprietors and to the people too. All that the heart and the intellect can derive from it may be alike free to peasant and aristocrat; whereas the cultivated and strictly fenced country belongs usually in every sense to only the proprietor, and as it is a much simpler and more obvious matter to love one's country as a scene of hills, and streams, and green fields, amid which Nature has often been engaged, than as a definite locality in which certain laws and constitutional

privileges exist, it is rather to be regretted than wondered at that there should be often less true patriotism in a country of just institutions and equal laws, whose soil has been so exclusively appropriated as to leave only the dusty high roads to its people, than in wild open countries in which the popular mind and affections are left free to embrace the soil, but whose institutions are partial and defective."

Alluding to the same spot, John Stuart Mill says :— "For instance the exclusive right to the land for purposes of cultivation does not imply an exclusive right to it for purposes of access, and no such right ought to be recognized, except to the extent necessary to protect the produce against damage and the owner's privacy against invasion. The pretension of two Dukes to shut up a part of the Highlands and exclude the rest of mankind from many square miles of mountain scenery to prevent disturbance from wild animals is an abuse ; it exceeds the legitimate bounds of the right of landed property." It is gratifying to record that many of our great landed proprietors, Marquis of Conyngham, Mr. Lambart, Earl of Howth, and others, have acted in a more generous spirit.

Among all the trades which are carried on in this city, I do not think there is one in which the rules of health are more violated than by tailors. From a large experience of out-patients at dispensaries, I may say that there is no more unhealthy class. They are accustomed to work at their sedentary employment for twelve or more hours daily in the closest and most ill-ventilated rooms, and they are urged on to crave for the stimulus which

drink gives them with so heavy a penalty. Consumption, diseased liver, shattered nervous system, and other ills which intemperance produces, are most frequent among tailors. We hear very much of shop improvements, but they are usually confined to the fronts, the rooms in which the journeymen work being most disease-producing. There is one large establishment where more reasonable care is taken of those employed, and our honoured Viceroy, who has just left us under circumstances all deplore, perhaps never performed a more useful social act than that of inspecting this well-organized building, yet for so doing ridicule was cast upon him by those who are incapable of understanding the benefit of efforts to improve the condition of the working classes. The baker is even subjected to greater ills than the tailor. His place of work is on a basement story, where the heat of the oven and gas make the atmosphere unendurable, save to those whose perception of such evils is dulled by habit. The drainage is often out of order, and the air is still further irritating by the particles of dust and flour it contains. In this wretched condition he is kept from seven in the evening to four the next morning, or much longer towards the end of the week, and until the 28 chap. 1 and 2 Vic. was passed, even Sunday was no holiday to him. In London, we are told by the highest medical statist living, Dr. Guy, the result of these conditions, for 31 per cent. of the bakers are more or less consumptive. It will probably gratify you to hear that steps are at present being taken by the Corporation to compel the ventilation and cleansing of every bakehouse in the city which requires it, and to pre-

vent rooms above them from being used as sleeping places. Printers in some of the cheaper places in London are exposed to the most unhealthy conditions; for instance, the compositors on a Sunday newspaper were found to be kept continuously at work from Thursday morning to Saturday night, and at night, to prevent the blowing about of the gas, which is never protected by shades, the windows are often kept closed. The absorption of lead and antimony from the type by their moist hands often leads to slow poisoning by the metals; and among stereotype-founders the inhalation of vapours has also produced metallic poisoning. The humbler rank of clerks who sit at desks often contract the habit of leaning against it, and impeded breathing and its result, consumption, often follow. The addition of a back to the old-fashioned office stool would be a remedy, as well as the encouragement of games of athletic skill, instead of indoor pleasures, for their unoccupied time. The never-ceasing use of the pen pretty often leads to a serious deformity of the hands, known as writer's cramp. The constrained and often crooked position they often assume has led to curvature of the spine—a disease frequently produced in girls by similar causes.

Another trade in which the evil influence of a constrained position, added to the pressure of their last against the pit of the stomach is seen, is shoemaking, for very few follow this employment without becoming confirmed dyspeptics. The peculiar diseases produced by the introduction of lead, induced in painters and colour-grinders, are seen rather often in this city, where such simple preventives as absolute

cleansing of the hands before eating, and the use of sulphuric acid, which in water makes an agreeable drink, are often neglected. A similar example of neglect of easy and effectual remedies is afforded by the steel-grinder's disease. Magnetized wire gauze respirators entirely prevent the steel particles from entering the lungs, yet the Sheffield grinders are most unwilling to wear them; on the other hand, in some chemical works in this city so simple an expedient as keeping a piece of cotton cloth in the mouth has proved effectual against the inhalation of poisonous vapours. Particles of dust excite consumption most powerfully; for example, it was found that 91 per cent. of the deaths among the stone-cutters and masons of Cologne were from that malady.

There are, I believe, no match manufactories in this city, but a fearful disease attacks those who work at this employment in London and Edinburgh—namely, death of the jaw bone from the inhalation of phosphorus vapours, a severe surgical operation being necessary for its removal; but unfortunately, as in other instances I have mentioned, the workmen neglect precautions, however simple and effectual. In one factory twenty-four cases of this phosphorus disease had occurred, but not one since it was properly ventilated. The evils from want of exercise and pure air which afflict young girls employed at milinery and dressmaking come before every physician to an hospital or dispensary, they are consumption, dyspepsia, and menstrual irregularities, which are productive of the worst results, such as womb diseases, sterility, or inability to suckle children, if they bear any. Now, in France and

other Continental countries there is much greater superintendence of occupations under legal authority; but in Britain that dislike to interference which is so general has prevented many lives from being saved from the injurious effects of such causes. That it should not be left to proprietors, is shown by the fact I before mentioned in regard to copper and lead mines, which are not ventilated, as no explosive gases endanger life or property as in coal mines, and in some of them in this country, horizontal shafts of but four feet high are carried for a mile without any ventilating shaft reaching upwards to the atmosphere.

LECTURE IX.

SANITARY ARCHITECTURE AND ENGINEERING: HOSPITALS: DWELLINGS: SEWERAGE.

After Medicine, the professions most concerned in the preservation of the public health rank those of the architect and engineer, and that they have been alive to this responsibility is evident from the constant attention which the subject has received in the columns of their influential organ, the *Builder*, and its younger sister, the *Dublin Builder*. When speaking of ventilation, water supply, baths, and public parks, and the approaches to them, I had occasion incidentally to trespass upon the domains of these most useful professions in laying down the principles upon which these sources of health depend, and I shall now endeavour to apply their teachings to the case of hospitals and the dwellings of the poor, and afterwards bring before you a few facts connected with sewerage, and proposals for the utilization of refuse. Hospitals have existed for fifteen centuries, and have been always regarded as institutions where every aid which science or benevolence can command should be brought to bear on the care of the sick. It seems, therefore, almost ridiculous to insist that they shall at least do the sick no harm; but it was once necessary, for in the older civil hospitals the mortality was very much greater in them than among patients

suffering from the same diseases out of them; and as regards military hospitals, Sir John Pringle, in 1764, was stating an undeniable fact, when he asserted that "hospitals are among the chief causes of mortality in armies on account of the bad air and other inconveniences attending them." They were, again, called "dismal prisons, where the sick are shut up from the rest of mankind to perish by mutual contagion;" and Pouteau also, at about the same period, asks, "Des hôpitaux servient ils donc plus pernicieux qu' utile à l'humanité?" Of modern hospitals no such remarks can be made, and although there is ample room for improvement in their construction and regimen, they have made vast advances towards perfection in the last eight or nine years. This we owe chiefly to that female Howard and greatest of living philanthropists, Florence Nightingale. Her extraordinary labours during the Crimean campaign, when, forgetful of home, friends, or fortune, and unmindful of personal fatigue or danger, she unceasingly strove to save the health and lives of our soldiers, have been recognized by a grateful nation, but her efforts to improve hospitals at home are less known. It is sad to have to record that she has been reluctantly compelled to relinquish her most useful labours owing to her own shattered health. Mortality in different hospitals varies most widely, and there is no doubt that it is capable of being reduced in those of the highest average by well-organized hygienic improvements; for instance, in twenty-four London hospitals, which, on an average, contain 4214 patients, there occurred during the year 1861, 3828 deaths, or 90·84 per cent. per annum upon the

inmates, nearly every bed yielding a death within the year; in twenty-five provincial hospitals capable of containing 2248, 886 deaths, or 39·41 per cent., and in the Margate Sea-Bathing Infirmary, where there were 133 patients, 17 deaths, or 12·78 per cent. "Facts such as these," says Miss Nightingale, "have sometimes raised grave doubts as to the advantage to be derived from hospitals at all, and have led many a one to think that in all probability a poor sufferer would have a much better chance of recovery if treated at home."

If well-ventilated rooms, assiduous nursing, the best medicines, and the fittest food, could be secured at the patients' homes, along with that high-class skill and constant attention which even the foremost in the medical and surgical professions bestow on hospital patients, I have no doubt that such would be the result; but you will see at once these circumstances are impossible, and therefore, under existing conditions, hospitals must be relied on for the treatment of the severer cases of illness or accident, and their advantages are, at least in this city, fully appreciated by the poor, the greatest anxiety to gain admission being constantly displayed. The death-rate in the Dublin hospitals is much lower than that which Miss Nightingale gives for the twenty-four London ones, as appears from the following figures:—In the nine general hospitals in this city—namely, Adelaide, City of Dublin, Jervis-street, Mater Misericordiæ, Meath, Mercer's, Richmond, St. Vincent's, and Steevens', there were admitted from January 1 to December 31, 1863, 11,991 patients, of whom died 552, or 46 per 1000; but even this mortality is made

greater in proportion to that among cases treated at their own homes by the following circumstance: some of our dispensary medical officers are also hospital surgeons, and most of them are connected in some way or other with these institutions, and while anxious to do the best for the suffering poor, they prefer to have the more acute and serious cases in hospital under their more constant supervision, where also these examples of disease confer the important, though indirect, benefit of serving humanity, by training scientific physicians and surgeons. The difference in mortality in hospitals depends also upon selection of the cases; for instance, in those with large clinical classes, striking and severe examples of disease will be naturally sought for, and sent there by practitioners who have been educated at the institution. To render the statistics of our hospitals more readily comparable with those of London, I have computed from the Census Reports that on the 7th April, 1861, there were in the eight existing hospitals—for the Mater Misericordiæ was not opened—703 patients, and allowing the death-rate to be proportional to what I have ascertained for last year, we would have a percentage of 74 deaths instead of 90, or that of the twenty-four London hospitals. As I have said before in respect to other branches of medical statistics, the extension of registration to this country will enable fuller and more accurate numbers obtainable. In a previous lecture I have endeavoured to show that some diseases owe their origin, and many their untoward course, to want of ventilation, and I may here express my conviction that with a full regard of the necessity of fresh air in these

institutions, the most contagious cases may be mixed up with ordinary patients. The innate virulence of contagion I do think has been too much dreaded, to the neglect of simple precautionary measures, as is seen throughout all the old quarantine laws. So close was the affection of contagious matters for substances in particular conditions considered to be, that it was once laid down that feathers separated from the birds could not be admitted from a plague-stricken country without the most imminent danger. Miss Nightingale argues that fever patients should be mingled with ordinary patients, and if any others catch the infection it is a proof of so wretched a sanitary state that we may expect fevers to arise without any germ at all. I may, however, mention the fact, to be explained as it may, that there is scarcely a year that the life of some zealous student is not sacrificed, if his benevolence has led him to too close a contact with infectious cases.

Separate fever hospitals were first advocated by Dr. Haygarth of Chester, and have since met with general favour, for their advantages are patent. They remove from the filthy homes of the poor the source of disease, which will infect the rest of the family and even the neighbours, and the rich become attacked by the contagion being carried by servants who will visit their relatives when stricken down. By want of ventilation, and the lurking of the poison or continuance of its causes in their homes, the poor get relapses, whereas if removed to hospital their homes can be purified during their absence. In the three fever hospitals of this city there were admitted 3564 patients last year. Now, as one patient may be

fairly calculated to infect four others, and as 1 in 8 of those attacked die, it may be justly inferred that these admirable institutions have prevented 14,256 cases, and 1782 deaths by fever. Highly, however, as I value these benevolent and admirably conducted establishments, I must acknowledge that till every effort is made to prevent by pure air and perfect sewerage the occurrence of fever, the treating of it may be compared to the task of Sisyphus. As the fullest ventilation is required in such hospitals to burn off the peculiar poison of the disease they should be never over-crowded. I will adduce for you some instances of evils from the agglomeration of a number of sick under one roof—evils which are almost wholly avoidable, and which will never, I fervently trust, be reproduced on so great a scale. In one of the Scutari hospitals there were at one time 2500 sick and wounded, and two out of every five of them died—a proportion not, however, equalling the mortality by disease during the first seven months of the Crimean campaign, for 60 per cent. per annum of the troops died, a death-rate as high among the soldiers as that of the sick in cholera or plague times in cities. In one month there were in the Scutari hospitals eighty cases of that fearful fruit of sanitary mismanagement, "hospital gangrene." Sanitary improvements, mainly promoted by Miss Nightingale, reduced the mortality among the *sick* during the last six months of the war to nearly the rate of deaths among the *healthy* of the Guards at home. In times long gone by, the Hôtel Dieu, Paris, contained in 1200 beds as many as 7000 patients; this was accomplished by multiple beds, and by these being used in turns, "forms

being provided on which the sick whose turn it was to be out of bed could rest in the meantime." One out of every four patients used to die. Its air was such as to be called "a most foul and pestilential congregation of vapours." One-fifteenth of the women delivered within it died, and one-third of the children. Even three years ago the illustrious Malgaigne declared that as regards sanitary conditions the hospitals in Paris "were the most detestable in Europe." St. Thomas's Hospital, London, was, up to 1741, remarkable for its high death-rate (1 in 10); but after ventilation and other alterations it fell to 1 in 15·6. One lesson more, which, from having occurred at home and in the memory of us all, may make more impression. In the Irish famine-fever of 1846–7, the rate of mortality in hospitals and poorhouses was far greater than among the poor creatures who lay in the open air along the hedges exposed to the inclemency of the weather, and without sufficient food or raiment.

With regard to the situation of metropolitan hospitals, while I am fully impressed with the importance of obtaining healthy sites, I do not think all other considerations should be ignored, as they are very nearly by Miss Nightingale, so anxious is she to secure the most healthy positions. She seems to fear opposition from teachers of medicine, and remarks that if medical instruction be an object, it is better that students should watch rapidly recovering than lingering cases, and twice as many cases can thus be submitted to them. Even removal of the hospital to the suburbs of a town would benefit medical education, for "the quiet and studious habits of a college

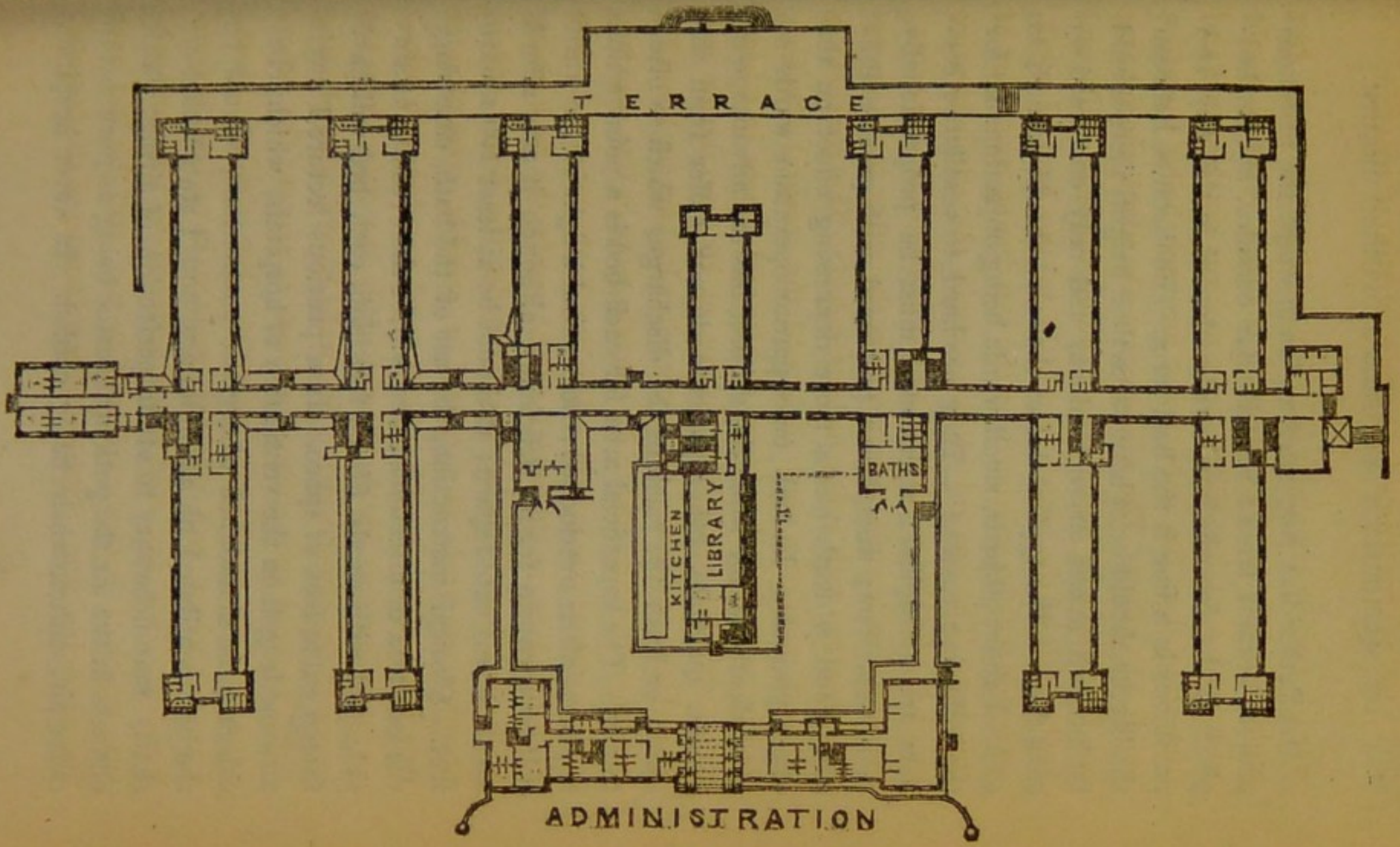
would be substituted for the desultory lecture-hunting and hospital-walking of London." After all, medical education is but a secondary object of these institutions, their primary function being the care of the sick; and when one reflects on the distance a severe accident or acute case should be carried, or the patient's friends should travel in visiting them at a suburban hospital, we must feel some satisfaction that in this city, healthy and extensive sites may be had at short distances from the centre at moderate rates.

The first principle of hospital construction, Miss Nightingale asserts, must be that it shall be built in pavillions or separate blocks, having wards, nurses' rooms, sculleries, lavatories, baths, and water-closets, unconnected with other pavillions, save by a common airy corridor; the building for the administrative part of the establishment being central.

The Herbert Hospital, near Woolwich, which I lately visited, is the most scientifically constructed hospital in Europe, and forms a noble monument to the truly great man after whom it is named. It consists of seven pavillions, the ends of which all project into free air, as will be understood by studying the plan, and which are separated from each other by twice their height in distance. Below the wards there is a basement story which accommodates the museum, library, medical officers' rooms, and stores. There are but two floors to each pavillion, and each ward has a large end window commanding beautiful prospects, in front towards the Thames, behind towards the Crystal Palace (not, however, improved by a cemetery a quarter of a mile distant). The baths and water-closets are in the free ends, and the latter are thus thoroughly aired. Each

ward is twenty-six and a half feet wide and fourteen feet high, which latter measurement is below what we would wish, and contains thirty beds, making six hundred and fifty altogether, the cubic space for each being therefore about 1300 feet. The windows are abundant, there being one for two beds, and arranged along opposite walls, and as the axis of the wards is a little to the east of north, each side will be enlivened by the sun during some part of the day. The central blocks contain the administrative quarters, kitchens, library, and convalescents' day room; one end has lunatic wards, and in the other is the operation theatre, with a few beds attached. The conveyance of food, medicine, and coals, and the removal of refuse, will be carried on by means of lifts and shoots in a basement corridor along the centre, so that no bustle will disturb the patients. Open corridors looking on beautiful gardens will be available for convalescents in fine weather, and a covered one in wet. The wards are warmed by two open fireplaces at the middle of the wards, the flues giving additional heat by being carried under the floors, which, however, are made as fireproof as possible, consisting of iron beams filled in with concrete and boarded with oak—an arrangement which likewise dulls the noise from the upper to the lower ward. The walls have a most pleasing light-coloured and polished surface to prevent the adherence of dust or organic particles. For similar objects, Parian cement and silicated surface have been recommended. Hot and cold water, softened by the lime process which I before explained to you, will be laid over the whole building. Subjoined is a drawing of the hospital.

PLAN OF HERBERT HOSPITAL.



Dr. Parkes has suggested a plan in which the pavillions project in radii from a semicircular corridor, but for hospitals of the size which is usually adopted in this city, two pavillions in a line is the best form. The distance between the blocks should be at least twice their height, there should be but two floors on each block, and only one ward on each floor. The typical size of the ward should be such as to hold about 30 beds, small wards being objectionable for the following reasons:—They are hard to ventilate; corners are multiplied; attendants must be proportionally more numerous; discipline is preserved with greater difficulty, and a death has a more depressing effect on the other patients. I look on separate operation wards as most desirable, for while the sufferer has the advantage of greater quietude, other patients do not suffer from the shock, or from the smell of the discharges which so often follow. The superficial area for each bed is a point which has been often overlooked; no vertical height of the ward will compensate for its deficiency, although it may afford an abundant cubic space; it should be at least 100 square feet. Clinical instruction, the use of the bath, cleansing, the isolation of infectious cases, will be then readily attainable, and with wards fifteen feet high, each bed will have fifteen cubic feet of space. In a previous lecture I dwelt at some length on the ventilation of hospitals, which, considering the abundance of organic emanations, should be the best ventilated of all buildings, and I stated that air shafts were necessary to attain perfection of airing, which consists in the air the patients breathe being as pure as the outer air, without their being chilled. In fever hospitals

free access of air is especially required, and no plan can be more effectual than that adopted by the Commissioners of Health during the epidemics from 1846 to 1850. It is described in the following words :—

"A sheet of zinc or tin plate is punched (not drilled) with holes one-twelfth inch diameter, and half an inch apart—thus prepared, it is inserted in place of a pane of glass in every window, or every alternate window, as required, care being taken that the side *on which the burrs project is turned to the weather so as to throw off the rain.* Neither wire-gauze nor perforated zinc of the ordinary kind will be found suitable, as both permit blasts of cold air and rain to pass through them, and the former is liable after some time to become choked with dust. Those who have had practical experience of the importance of ventilation to the sick, and of the difficulty of maintaining it, will appreciate the value of a simple plan that combines utility with cheapness, and which cannot be interfered with by the inmates of the hospital." You are, perhaps, aware that Dr. Corrigan has for many years advocated this mode of ventilation, and they have been found during an experience of twelve years in the Hardwicke and Whitworth Hospitals superior to all others. As he remarks, they are beyond the reach of the inmates, who have the strongest tendency to close up or obstruct with clothes all ventilators. I am an earnest advocate for numerous windows in hospitals on the scores of ventilation and of light, enabling the patients, if convalescent, to read in bed, or to enjoy the prospect of scenery or gardens which should always surround the building. The window space should

be half the wall space, notwithstanding the low temperature of this climate, which may be compensated for by additional production of artificial heat or clothing, or by double sashes or panes, which are very useful in preventing extremes of heat or cold. For similar reasons, the walls and ceilings should be of a light colour, and their material should not be porous, but hard and polished; pale green paper, not arsenical, varnished, has been found most suitable in this city. Whitewashing of walls, to be effective for the removal of carbonic acid, should be renewed every three or four weeks, to the intolerable disturbance and even danger of the patients; and we have already learned that that gas is by no means the most noxious constituent of foul air: ordinary plaster becomes in a few years loaded with organic matter most abundantly. The surface of the floor should be made polished and impervious to moisture, as advantageously adopted in many institutions in this country. The stairs and landings should be of stone. There are many improvements in bath-rooms and lavatories, sculleries, water-closets, and sinks, which, if carried out in hospitals, would not only expedite the recovery of its inmates, but inculcate wholesome lessons applicable to their homes when they return to them. Care should be especially taken in building latrines, which, projecting at the end of the pavillion, should have the closets along their outer wall; and for better ventilation, the partitions should not reach the ceiling, and the whole apartments should be aired by opposite windows kept open. The hospitals in this city, though small, are numerous in proportion to the population, and I think we have cause

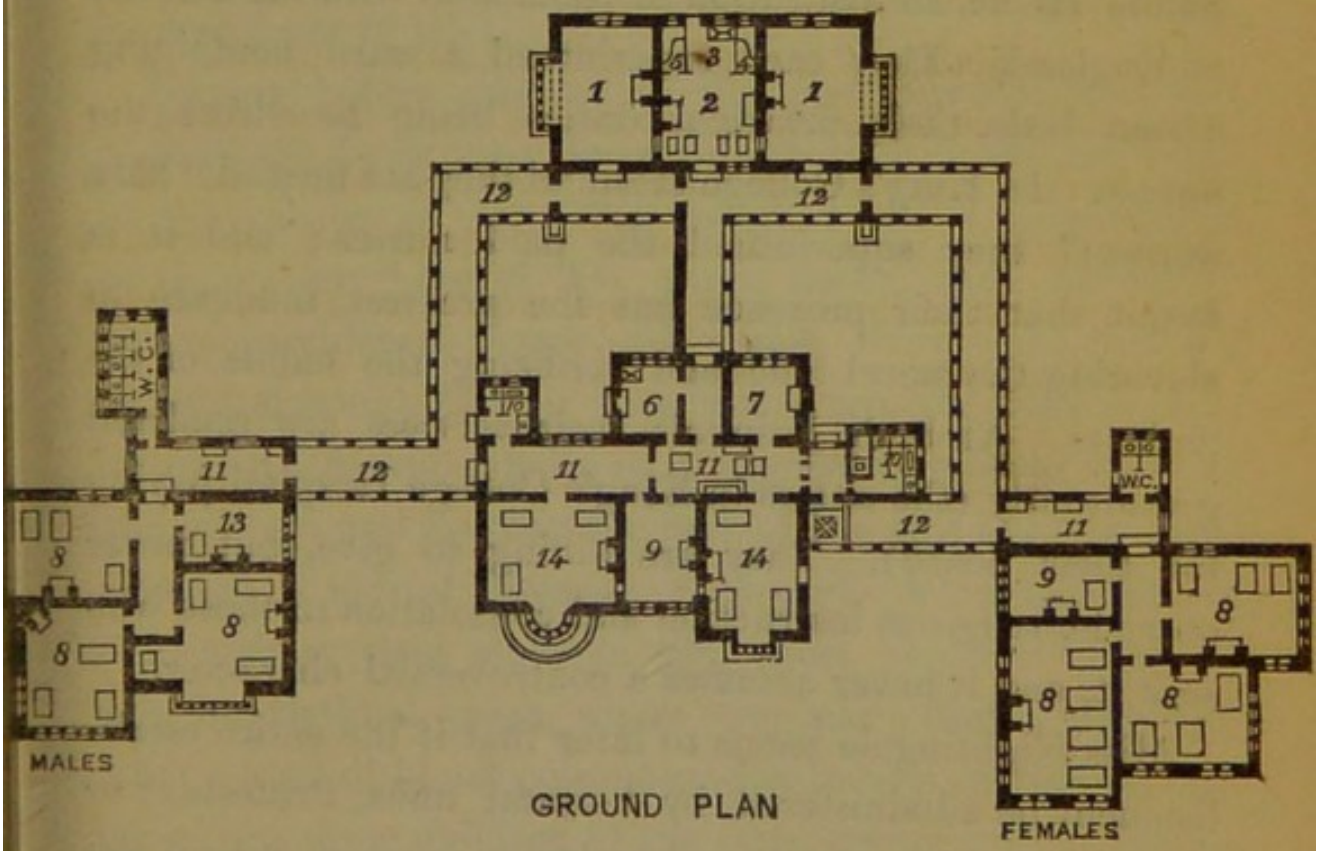
for congratulation in this circumstance, for multiplication of these institutions is more desirable than enlargement. It may be said that extensive fields for clinical study are not presented, but by a system of reciprocal admission to hospital students, as was mooted some years ago, this may be obviated. The distribution of the nine general hospitals I exhibit to you on this map.

I will not enter into the vexed question of hospitals for special diseases, and with respect to the advantages of hospitals for incurables, they are indeed most truly illustrated by the admirable institution of that nature which we possess in Dublin. In London, or rather its vicinity, there are institutions which may be regarded as convalescent hospitals, but in this country we have no such institution, although its desirability, or indeed absolute necessity, has been often demonstrated. The daily papers, about two years ago, contained most convincing letters upon this subject, recommending that testimonials to departed great ones should take this form, in place of useless erections which have too often disfigured instead of beautified our city, and one of the most influential of them has recently urged that the plots of ground upon which the Martello Towers stand should be allotted for the purpose, as these buildings are now to be removed. Almost any of the twenty-seven plots round Dublin Bay would be suitable, and those at Killiney, Dalkey Island, and Howth, may be preferred on the grounds of there being no houses close to them, and there being frequent trains running near to them by which patients might be conveyed. If the good work of establishing a convalescent and consumptive hospital was com-

menced by the coöperation of the committees of various hospitals—and there is no better way of economising their funds—wards would be gradually added to bear the name, and thus perpetuate the memory of the illustrious whom it was intended to honour. A convalescent hospital should differ entirely from the character of a general hospital; and, if constructed in neat cottages capable of holding about six, will best meet the requirements of cheapness, abundant ventilation, discipline, and good example, by which the homes of the poor will afterwards profit. The annexed sketch and plan are copied from those made for the Wilts Herbert Memorial, and published in Miss Nightingale's book. In such an institution abundant employment of body and mind would be an important element of cure.

CONVALESCENT HOSPITAL.

PRINCIPAL ELEVATIONS



GROUND PLAN

1. Dining and Day Rooms.
2. Kitchen.
3. Scullery.
4. Larder.
5. Stores.
6. Dispensary.
7. Maid-servants' room.
8. Convalescents' Bedrooms.
9. Sisters.
10. Bath.
11. Corridor.
12. Covered way.
13. Gardener.
14. Sick Wards.

With respect to hospital nursing, I am glad to have this opportunity of advocating the system of "hospital sisters," which is carried out in University and King's College Hospitals, London, as I am strongly of opinion that it might be adopted in those hospitals in this city where, at present, the entire care of the sick is entrusted to paid nurses. In University College Hospital, the sisters come from respectable ranks in society, and belong to the All Saints' Home, an institution in connexion with the Church of England. They each superintend a ward containing fifteen beds, their principal duties being to direct the nurses. In King's College Hospital they are termed "lady nurses;" they superintend the paid nurses; and it is found that their presence has the greatest influence in elevating the moral tone and civilizing the habits of the patients. At both hospitals their services are rendered gratuitously (the sisters in King's College Hospital paying for their board). They are willing to give, but never obtrude, religious instruction and consolation to those who seek it, and it never assumes a controversial character.

Miss Nightingale seems to infer that if the entire establishment be administered by hospital nuns, Protestant or Roman Catholic, there will be lower average care of the sick, as "the idea of the 'religious order' is always more or less to prepare the sick for death." This opinion I cannot support, for I, in common with all other medical officers of hospitals under the care of religious orders in this city, have certainly never had to complain of want of anxiety for, or of attention to, mundane matters on the part of these sisters.

If, then, sisters in these London hospitals be so really useful, they seem required in even a greater degree for our poor, uneducated and previously uncared-for. There can be no doubt whatever, that many of our devoted fellow-countrywomen would readily apply themselves to the beneficent task; and besides the care of the sick, another field of usefulness would be opened—namely, the training of nurses for the rich and for the poor, which is now unattended to, save in the case of those who succour mothers in their hour of trial.

Having before referred to the over-crowded wretched state of the dwellings of the poor in Dublin, I will not dwell on the subject at any great length here. I endeavoured to show that "out of dirt comes death," just as surely as from accidental causes with which Providence removes us, and although bad air does not burn, suddenly poison, or drown him who inhales it, it depresses, removes appetite and energy, and keeping the flow of life at a low ebb, predisposes to mortal disease. Such evils were brought to light a short time since in that most neglected part of London, Bethnal-green, where very many deaths occurred from a kind of blood poisoning, due to over-crowding, and the effects upon children of the same crying evil is exposed under the title of "infanticide without intention" in Mr. Godwin's most able book, entitled, "Another Blow for Life," as being most rife in every part of London. As is the home, so are the people in regard to moral and social state, and although the nests of crime which infest the worst parts of London have happily no analogue here, yet there are "filthy dens in which men, women, and children

are brutalized and destroyed." In Gill's-square, Yellow-court, off Church-street, the passages off Pill-lane, Beresford-street, and Greek-street, there are human habitations so fearfully wretched, that if photographed, visited by the philanthropic, or described by so graphic a pen as Mr. Godwin's, they could not fail to excite as much popular feeling and outcry for remedy as any London dens which have been discovered. The chief cause which leads to such places being inhabited at all and their never being improved is the system of house jobbing which exists all over the poorer parts of Dublin. They are let at low rates, though indeed the highest that can be extracted from the miserable tenants, and not one penny is ever expended in trying to make them decent habitations. I believe, however, that with energetic efforts to carry out the provisions of the Common Lodging House Act, and the Towns' Amendment Act just passed, to which, I am of opinion, a system of licensing the proprietors of any house under a certain value let in tenements might be most advantageously added, and with aid of some wealthy and benevolent citizens, who will build fit dwellings for our city poor, the lamentable condition I have so inadequately sketched will be bettered. Much has been done for the rural poor in this way, by precept and example, by proprietors, especially the Duke of Leinster, and Mr. Naper of Loughcrew.

Dr. Tucker of Sligo draws the following lamentable picture concerning the hovels of the Western poor:—"The medical officer of a district has the best opportunity to illustrate this sad state of existence. Some short time

since I noticed the homely hovel of a small farmer (the tenant of a nobleman) which may be taken as the prototype of many in country districts. It was about twelve feet wide and twenty-four feet long. The domestic circle, happy family, or menagerie, that dwelt therein consisted of a sick man, his wife, four daughters, one son, three cows, one horse, two calves, two pigs, and poultry, all in one common undivided house—no partition. Generally the pigs dwelt beneath the beds, the people in them, and the poultry over head. They can enjoy the prospect of bacon and chickens which they seldom taste. An aboriginal from Maherow, named Heraghy, observed to me, in defence of this sad social state, that 'it was better have that house full than empty.'"

In many of the dilapidated parts of the Liberty, and even in close proximity to our national Cathedral, there are now open spaces which, if converted into "spirit-raising and blood-purifying gardens" for the recreation of the people, would recompense their owners, and do much to raise our poor from the social degradation under which they surely suffer. With regard to pecuniary return for capital expended on houses for the poor, the Duke of Beaufort has most clearly shown the duties of the proprietors of the land, and in many English towns four to five per cent. has been realized from newly-built humble dwellings.

The means of cleansing and sewering Dublin in the seventeenth century is said to have been so deficient, that Swift's well-known lines, describing the effects of a city shower, would seem to have been applicable to the state of his own district:—

"Now from all parts the swelling kennels flow,
And bear their trophies with them as they go;
Filth of all hues and odours seem to tell
What street they sailed from, by their sight or smell;
Sweepings from butchers' stalls, dung, guts, and blood,
Drowned puppies, stinking sprats, all drenched in mud,
Dead cats and turnip-tops come tumbling down the flood."

How imperfect was the sewerage of this city thirteen years ago will best appear from a report of a survey made in 1851 by our able Borough Engineer. He says, "The levels of the sewers I found in general very badly laid out, particularly in the streets running east and west, which cannot have rapid falls; in many cases they were almost level, in others full of hollows up and down, and frequently could act little better than cesspools, requiring to be regularly cleaned out. In some of this class of sewers we found as much as four feet of solid deposit, rendering all house drainage impossible."

The house drainage was even worse, from a mistaken idea among builders that it was necessary to have a drain twelve to eighteen inches square. The sides of these were built with bad rubble masonry, resting merely on the earth, and covered coarsely with flags, and they were brought under the basement with all kinds of angular turns and without regard to fall. They frequently became stopped, producing endless complaints from noxious smells or flooding, and from the readiness with which rats made their way into the houses. Most of these evils have been remedied by six-inch or nine-inch pipes of good vitrified stoneware. In the words of Mr. Neville, the "great essentials for effective house drainage are—that the sewer should

have a good fall, and be laid with a regular inclination from the highest to the lowest point, and, when necessary, to change the direction. It should be done by regular curves, and not sharp bends or angles. The sewer should be of such size and shape as to give the water passing through it power to scour out all deposit; and the material with which the sewer is constructed should be durable and capable of being put together so as to secure impermeability, that the fluid flowing through cannot soak into the earth and cause dampness in the floors and foul and noxious effluvia. It is also very material that the sewer should be so built as to prevent rats burrowing through, and all openings should be properly trapped to prevent the gases escaping into the houses." Since he came into office, by the removal of sewering works from the hands of the Paving Commissioners to the Corporation, twenty miles of large and small sewers have been laid down in streets which never had sewers before; also considerable lengths of old and decayed sewers have been taken up and new ones built in place of them, and where the old sewers were found sound and their levels such as to permit of their being made available, they have been repaired, underpinned, and had brick inverts placed in them and their levels corrected, thus rendering them thoroughly effective. It is intended that those works shall be continued until every street in the city has a really effective main sewer; it is also proposed to remove all the old stone gully grates and substitute metal trapped gullies, also to make side entrances into the sewers to facilitate getting into them for examination and repair, and render unnecessary the

frequent breaking up of the streets. Forty miles of old sewers have been also cleansed and repaired during the last ten years, and means of drainage have been provided to least 6000 houses. As the Corporation has now the legal power of enforcing all householders to make drains when called on, the number will be far more numerous.

I have only time to give you one instance of the influence of imperfect house drainage on the mortality of cities. Stockholm ought to be the most healthy city in Europe, for it is built on small islands which secures abundant ventilation and cleansing. Owing to a bad supply of water to houses, there is not a single house, with the exception of hotels, in which there is a water-closet. I have ascertained that it has the highest death-rate of any European city, despite the advantages which its position confers. The state of things could be improved, even without water supply, by the adoption of the *separateur* system, so common in Continental cities. A *separateur* means an iron box pierced with holes, which, receiving the night soil, allows the fluid part to escape, and the rest is deodorized by charcoal and removed in air-tight cases.

All the large sewers discharge into the Liffey, and among them is included the Poddle, which carries down the refuse of about 450 acres of the foulest part of the city. This sewer is often dignified by the term "river," but it seems to me more to merit the description applied by Pope to the "Fleet Ditch :"

> "The king of dykes, than whom no sluice of mud
> With deeper sable blots the silver flood."

I trust, however, we shall all live to see the Liffey "a

silver flood," and not, as it is now, "an absolute pestilence in consequence of its being made the channel for the whole sewage of the city," which are the words by which Lord St. Leonards described it in the House of Lords.

Various remedies have been proposed from time to time by engineers, such as covering over the whole river, and constructing a magnificent Boulevard; running a railroad down the centre between solid walls, and dividing the stream into two portions, thereby increasing the scour; erecting flood-gates at Carlisle Bridge to be flushed at low tide. The stagnation of the water in the latter plan would be most objectionable; and the only efficient remedy lies in the construction of intercepting sewers similar to those devised by Bazalgette in London, and to which I referred in a previous lecture.

A most able writer in a recent article in the MEDICAL PRESS has advised, that "barges should be placed under each outlet of a sewer, and provided with a filtering apparatus containing disinfecting materials, through which the sewage should be allowed to flow, the apparatus being so contrived as to retain the more solid part and the sediment of the sewage. Where the sewers are of a size permitting it, men could push accumulations through the sewers into the barges; in smaller sewers flushing by such means as that invented by Sir John Gray some years ago could be adopted with much benefit."

There is no doubt that the time is approaching, when, by a process of deodorization, the sewage will be rendered innocuous, and will be applied to fertilize the land. The attention of the most able chemists and sanitary engineers

is now fixed on the subject, as the pages of the *Journal of the Society of Arts* will testify. Lime and carbon, such as our peat, are efficient and not hurtful to plant-life, and the latter has been used for the destruction of the foul air of the sewers, which too often are distilled into the houses.

In one year 144,414 tons of ash-pit stuff were sold in Birmingham to the neighbouring farmers; but taking into account all expenses, it must be acknowledged there was a loss of £6000 to the borough. In the Liberty and other poorer parts of this city, such matters have been up to this stored up in nightmen's yards to the great detriment of the inhabitants. The water of sewage has been the great difficulty, its weight and bulk making the cost of its carriage exceed its worth, and it has even been proposed to substitute a complete system of scavenging and immediate deodorization for sewerage, as such matters only become hurtful when putrefactive change begins. By some it has been deemed more advisable to use the fluid refuse, to irrigate fields in the neighbourhood of large towns, and this plan has been carried out successfully by the Earl of Essex at Watford, at Croydon, Rugby, and for some years on a vast scale at Edinburgh. At the first-mentioned place the following experiment was made: two acres were irrigated by 60,000 gallons of refuse, which cost about 14*s*., and two were left unirrigated. Both were sown with wheat and treated in every way identically, and there was a clear profit of £4 15*s*., more from the irrigated than the unirrigated acres. At Carlisle Mr. McDougal has leased the sewage which he deodorizes with his crude carbolic acid. At Hyde, in Cheshire, 180

cottages are placed under a dry method by the "Eureka Sanitary and Manure Company," and the Inspectors of Nuisances have reported most favourably of it.

Many parts of England are becoming so exhausted of plant-feeding constituents in the soil that the question of utilization of sewage is becoming one of national importance; for the vast capital which leaves the country to pay for corn and other foods and manure should be kept at home for other purposes. As Baron Liebig has shown, "the employment of sewage in agriculture could make it possible to bring large tracts of land into cultivation which hitherto, owing to expense of tillage, had been laid waste and neglected. It is neither fantastic nor ridiculous to believe that without purchasing foreign manure, and by a judicious utilization of the sewage of towns and villages, England would be able to dispense with the importation of food from abroad." The whole subject is exciting just now the greatest interest. Baron Liebig having stated that the manufacturers of artificial manures are "inimical to the utilization of sewage," a wordy warfare has arisen; and as the subject is to be one of three selected for discussion by the Public Health section of the Social Science Association at its congress at York on 22nd of September next, the meeting of that body will be more than ordinarily lively.

LECTURE X.

INFLUENCES OF SOIL AND CLIMATE ON DISEASE: CLIMATOLOGY OF IRELAND.

THE plants which man consumes as food, and those which feed the animals he makes subservient to his uses, derive their sustenance from the soil or surface-crust of the earth; the atmosphere and waters which surround him also are influenced most powerfully by this crust, so that it becomes nearly as important a factor in determining questions of public health as the air we breathe or the water we drink. All soils consist of crumbled rocks broken down by the action of air and water, and mingled with vegetal and animal matters, but they may be arranged in three classes according to the preponderance of each constituent; thus, calcareous soils contain carbonate of lime plentifully, the sandy possess much silica, and the clayey consist almost entirely of alumina. The farmer delights in a mixture of these, which, under the name of loam, has been always regarded as most fertile.

Besides the vaster metamorphoses which heat in past epochs has wrought in the geological features of a country, changes are constantly occurring in the nature of soils; for instance, the clay or lime will be washed from the higher to the lower levels, leaving but the barren quartz

behind, and in drier countries winds will act similarly, and will carry off the richer soil as dust to other districts, or if blowing from the sea they may render sterile cultivated fields by covering them with sand. By the wind also are carried those innumerable germs of plants which clothe with vegetation coral islands shortly after they are projected from the bosom of the ocean. Water along the banks of rivers sorts various soils, and give rise to what are termed alluvial deposits; and lastly, dying trees or smaller plants accumulate and blacken into humus or peat in situations where shallow water rests on an impermeable bottom, such as covers so large a portion of the west and centre of this island. Vegetal matter acted on by fire in past ages has given us coal, and from the excretions of animals such rich mines of agricultural wealth as the guano of Peru or the coprolites of England have resulted.

The degree to which each variety of soil retains heat is the first hygienic circumstance I shall notice. Sand excels all others in this respect, and if its capacity be represented by 100, that of light clay will be 76, pure clay 66, calcareous matter, finely powdered, 61, and humus or peat 49. The suitableness of a sandy soil for bivouacking in the colonies depends on its great retaining power for heat. The capacities of these soils in absorbing and holding moisture is in reverse order, and with regard to humus, so great is its thirst for water, that it will attract fifty times as much in a given time as a sandy soil. Even the colour of a soil is an item in its climatic features; the dark-coloured absorbing and radiating heat, the light-coloured reflecting it. Humus and clay have, moreover,

the property of retaining organic matter, some of which must, however, undergo destruction by oxidation, or else the accumulation of vegetal *débris* in forests, or of animal refuse near cities, would render whole districts uninhabitable.

The affinities of different soils for heat, moisture, and organic matter, have an important bearing on the question of what are the proper sites for camps or hospitals—a subject on which Miss Nightingale has the following apposite remarks:—

"As the object to be attained in hospital construction is to have pure dry air for the sick, it will be evident that this condition cannot be fulfilled if a damp climate be selected. It is a well-known fact—*e.g.*, that in the more damp localities of the south of England, certain classes of sick and of invalids linger, and do not recover their health. Again, retentive clay subsoils keep the air over entire districts of the country always more or less damp, and soils of this character should not be selected as sites for hospitals. Self-draining, gravelly, or sandy subsoils are best. River banks, estuary shores, valleys, marshy or muddy ground, ought to be avoided. It may seem superfluous to state that an hospital should not be built over an old graveyard, or on other ground charged with organic matter, and yet this has been recently done. Although hospitals are intended for the recovery of health, people are very apt to forget this, and to be guided in the selection of sites by other considerations—such as cheapness, convenience, and the like; whereas, the professed object in view being to secure the recovery of the sick in the

shortest time, and to obtain the smallest mortality, that object should be distinctly kept in view as one which must take precedence of all others."

Such principles also should guide the immigrant in choosing his settlement in our remoter colonies. The configuration of the ground is also important, for a flat or concave surface will allow the accumulation of water, which can scarcely be drained off, but must escape by evaporation, and promote malarious and other diseases, as I have already ascertained to be the case with some of the most populous districts in our city. Cultivation has usually rendered unhealthy places much more salubrious, although when first commenced in countries where the soil abounds in decomposing organic matter, ague and similar maladies have quickly followed when the earth was first turned. Cultivation will be, however, always the great spoliator of land, if means be not taken to restore to it the constituents which are abstracted from it by plants, and the evils of this error are very apparent in some colonies, especially in those regions of North America which have been cultivated for the first time; for instance, a settler establishes himself upon a fertile spot, and in a few years so exhausts it of materials which he takes no care to replenish, that it becomes barren, and he is forced to desert it to inflict the same injury on another district. Such results could not occur if the land had had restored to it by manuring the elements of which it had been deprived. From like causes the Campagna, which once supported thirty flourishing cities, is now a desert. The physical or geographical circumstance which most closely

influences the salubrity of a district is its elevation, which, if moderate, affords most favourable conditions, and the natives of elevated districts are always hardier and more enterprising than those who dwell on plains. In ancient history, mountaineers were nearly always conquerors, lowlanders the conquered. The atmosphere of elevated localities is usually cold, dry, and free from such organic or artificial gaseous impurities as I have spoken of in previous lectures, and as refuse rapidly drains off, the water is usually pure. You will remember the facts I submitted to you, showing the connexion between altitude and cholera and typhoid fever; but the latter disease, while generally traceable to imperfect sewerage, has been observed among the hunters on the Rocky Mountains by Dr. Hammond. The salts of mountain springs and streams varies with the geological substrata, which, however, being often calcareous or magnesian, accounts for the proclivity of the inhabitants of hills or the valleys between them to goitre or cretinism.

Sunlight does not act on such places so freely as on the plains, and this want of insolation, in conjunction with the low temperature, produces that stunted and blanched or etiolated character occasionally seen. The obstruction to light which the smoke of cities, where manufactures are carelessly conducted, is highly promotive of consumption and general enfeeblement. Even in the hottest climes—India, for example—elevated spots with moderate temperature occur, and are taken advantage of in that country for the erection of sanitaria for our troops. The bracing air and exhilarating scenery which may be enjoyed

upon mountains are remarkably efficacious in promoting recovery from debilitating diseases, and I regard the Dublin mountains as perfect sanitaria from some experience of their powers. The breathing capacity of those dwelling at great altitudes, for instance, the Inca Indians, is most enormous, and this may account for the preventive power of such residence over consumption, for greater efforts are required to inhale enough oxygen in such a rare atmosphere, and the chest becomes enlarged and the lungs expanded, the upper parts of them, which are especially prone to disease from being disused, now dilating. Circulation, and all the nutritive functions to which it ministers, become more active.

Plains differ very widely in a sanitary point of view, as they are high tablelands, or are sunken between elevated lands; the former are most healthful, as exemplified in the interior of Spain, which presents the strongest contrast in salubrity with the coast; the latter frequently have an alluvial soil, and are highly promotive of malarious disease. The sea shore is healthful because of the purity of the air, its abundance of ozone, and the delightful freshness and stimulating influence of the scenery, more especially the exquisite alternations of light and shade which the ocean presents. The humidity of the air and the cold winds which often prevail, make it, however, an undesirable resort for many pulmonary and rheumatic invalids. Places at the mouths of rivers are much less healthy, as organic matter in abundance collects about them if the river has been the main sewer of the town. The prevalence of ague, fever, and other zymotic diseases in Cork, and its high death-rate, as

well as that of Limerick, seem to be partly explicable in this way.

Latitude or distance from the equator is an important factor in determining the complex question of climate; but disturbing influences, some of which I have already set before you, render the subject one of peculiar difficulty, which even the profound Humboldt acknowledges, when he says :—

"If the surface of the earth consisted of one and the same homogeneous fluid mass, or of strata of rock having the same colour, density, smoothness, and power of absorbing heat from the solar rays, and of radiating it in a similar manner through the atmosphere, the iso-thermal, iso-theral, and iso-chimeral lines would all be parallel to the equator. In this hypothetical condition of the earth's surface, the power of absorbing and emitting heat would everywhere be the same under the same latitude."

As an instance of these disturbing circumstances, I may mention insular position, for temperature and other climatic features are more equable in islands than on continents, owing to the power which the ocean has to distribute heat and moisture; seasonal changes are, therefore, less sudden, and periods of rain or drought less prolonged. Our own island, warmed as it is in addition by the Gulf Stream issuing from the Gulf of Mexico, illustrates these natural advantages, as also does that not sufficiently valued bathing place, the Isle of Man, which, in coolness of summer and mildness of winter, is unequalled by any part of the mainland of the British Isles.

I have, perhaps, dwelt at sufficient length on previous

occasions on the circumstances which depress the salubrity of cities, when talking of the impurities which pollute their atmospheres, and the difficulties which attend their purification by natural means, because of the scantiness of vegetation and the close and irregular way in which their streets are too often built ; I shall, therefore, now merely mention the fact, that the temperature of towns is kept higher than in the surrounding country by the numerous fires, by over-crowding, and by the absorption of heat by stone and brick. The mortality of cities is then greater than rural districts, other things being equal, but they are free from diseases of malarious origin.

The first climatic condition of which I shall note the effects on the health of man is temperature, and in estimating this item the annual and monthly mean must not be the only information recorded, for the maximum and minimum, as well as the rapidity with which they fluctuate, are really more important, especially in their influence on the breathing organs, including the skin. Two places may have mean temperature of 65°, yet in one the fluctuations may be between 30° and 100°, while in the other the climate may be so equable as to range but from 60° to 70°. The variations in the former case are especially pernicious if they occur with suddenness, as is painfully illustrated in that grave of our countrymen, New York. The poor emigrants who arrive there with but a single suit of clothes are prostrated in hundreds by pulmonary complaints. I may mention that the mean daily temperature can be readily determined in any place by observing the degree exactly at sunset as Humboldt discovered. The method

which the same philosopher recommends for ascertaining the mean annual temperature—namely, examining water just as it issues from a spring—is not reliable, for depth and other circumstances produce variations in springs from those that are near the freezing point to those that are thermal almost to ebullition.

What I told you of the effects of the hot dry air of a bath upon the human skin is true of the influence of a hot dry climate, for both promote extremely cutaneous action, which, by the evaporation of the perspiration, obviates to a great extent their great heat. No very high temperature is endurable in moist air, for perspiration cannot be then so free, and diseases of internal organs ensue from the excessive rush of blood to them. In hot climates—India for example—the skin acts so freely that little water is left to carry off the waste matter from the kidneys ; the lethargy which prevents exercise produces torpid livers, and these are the types of disease which prevail. In Africa, on the other hand, it is not the tropical heat which is so baneful, but the great humidity and the rank vegetation which covers the uncultivated parts of the country. This last-named condition has been partially removed, and the awful mortality of British troops on its western stations much diminished. Of 1658 soldiers sent there in eight years, ending 1830, 1298 died, and only 33 remained fit for service. The dampness of the air is so great that all steel instruments, even the ladies' needles, have to be kept immersed in oil. As in other humid regions of the torrid zone, the diseases are malarious, such as yellow fever and ague, or are such as are rendered more frequent and fatal

by its influence—diarrhœal and dysenteric complaints, for example. These latter diseases produce in India also the greatest numbers of deaths.

The effects of dry and moist years upon disease are quite evident in our own country; about one in every five is extremely dry, and then fevers and cholera prevail, because of the difficulty with which excreta are washed away, and one in ten is excessively wet, when influenza is the zymotic we hear most of. Observations made at Greenwich indicated that positive electricity was very scanty in the atmosphere during cholera epidemics. The physiological effects, however, of electricity is a subject on which but little has been as yet satisfactorily determined.

Cold is our most powerful depressing agent, and, if intense and prolonged, it extinguishes life by injury to the nervous system, as has been generally known since Captain Cook's graphic account of its effects on the surgeon of his expedition. Dr. Solander was returning with Sir Joseph Banks and nine others from a botanical excursion in Terra del Fuego to the ship, during extreme cold, and finding that some of the party were showing drowsiness, he warned them most forcibly of the danger of sleep, "whoever sits down will sleep, and whoever sleeps will wake no more." He was, however, himself the first to lie down, begging to be allowed to die in peace. His companions, however, roused him, and he afterwards saved the lives of others who would have succumbed to fatal sleep. The influence of cold weather on mortality is manifested by the larger returns of the Registrar-General when it occurs, especially if combined with wind, which, by con-

stantly removing the stratum of air which the human body has heated, increases its depressing effects. When the temperature in London falls from 45° to 27° it is calculated that about 400 persons perish. Bronchitis is the cause of death so excited, and during this week, so remarkable for heat, but four deaths have occurred in this city from that disease, being the smallest number since registration was instituted. It is upon the very young and very old that cold exerts its most fatal power, as the heat-producing function is less active, and to them especially should such seasonable charity as blankets, clothes, or food be supplied. The greatest natural cold—namely, 91° below Zero, was observed in 55° N. Lat., and India is said to present the extreme of heat—namely, 120°, so that man is capable of living within a range of 200°, which is a faculty possessed by no other animal.

The cold climates are such as lie between 55° of north and south latitude and the poles, and the place which has the lowest annual mean—namely, 1·66°, is Melville Island. The range I have mentioned includes most of the north of Ireland and Scotland; but a bounteous Providence has sent us the Gulf Stream, which mitigates the rigorous climate which would be ours from the position of the island. The diseases said to be due to intense cold are often more justly attributable to a combination of this condition with humidity; they are of the rheumatic, scrofulous, pulmonary, and diarrhœal types. In arctic regions, too, low temperature, combined with such degenerating influences as deficient light and scanty food, has stunted the races which inhabit them, but they are free from the ills (con-

sumption included) which a faulty civilization has inflicted upon other races. As was quaintly said by a Danish writer more than a century ago of Greenland: "The temperature of the air is not unhealthful, for, if you except the scurvy and distempers of the breast, they know nothing here of the many other diseases with which other countries are plagued, and these pectoral infirmities are not so much the effect of the excessive cold as of that nasty foggish weather which this country is very subject to."

The term "temperate climate" is usually bestowed on all those between 30° and 55° of northern and southern latitudes, and in them a wider range of temperature has been observed than in the arctic or torrid zone; for instance, the Surgeon-General of the United States tells us that at Fort Kent a range of 129°, or from 39° to 190°, occurred in the year 1845. As an example of one of the most favoured climes in this zone, I will confine your attention to our own island.

Descriptions of the climate of Ireland are contained in the writings of the Four Masters, and, concerning later periods, in those of Boate, Molyneux, and Rutty, and all seem to indicate that it has undergone no remarkable change within a period extending over many centuries. Now, as then, its principal features are the general prevalence of westerly winds, of severe easterly gales in spring, which have been complained of by almost every ancient writer, the comparative mildness of winter and the coldness of summer, dampness at all seasons, and a generally equable temperature. The last-named condition, as I have observed, is due to its being surrounded by sea, and to the

influence of the Gulf Stream, for while parts of the Continent—Prussia, for example—are annually covered with snow, and the Elbe is not unfrequently frozen, our northern lakes are scarcely ever frozen, and the myrtle blooms in the open air at Glenarm in the same latitude—namely, 55° N. Few parts of this country are more than 300 feet above sea level, so that but about one degree of temperature is thus lost by elevation.

The superficial features of Ireland account to a great degree for the mildness and dampness of its climate, and foremost among such features must be noted the abundance of lakes, rivers, and bogs, which so plentifully yield water to the clouds by their evaporation. The vastness of the Shannon, "spreading like a sea," as the poet Spencer has it, would, in so small an island, alone account for its humidity, which, however, is not so excessive as to deserve Lord Macaulay's description—"Ireland is a marsh, saturated with the vapours of the Atlantic." The geological substrata are mainly limestone, granite, quartz, and sandstone, and they are clothed with soils of more than average fertility, except where bog, or vegetal matter carbonized by moisture, not by heat, as coal is, prevails.

The mean annual temperature may be set down at 50°, the winter average at Dublin being 41°, and the summer 61°. In Belfast I find the summer average is 64°, the winter 40°, or the annual mean 52°. The severity of our winter rarely sets in till after Christmas, and the amount of frost is below that of England. If our climate depended only on its latitude, and was not warmed by the Gulf Stream, the winter mean would fall to 10°.

The mean annual height of the barometer, the instrument which measures the pressure of the air, was for six consecutive years 30·55, 29·31, 30·13, 30·58, 30·64, 29·27, and one of the highest degrees it has attained is 31·5, and the lowest 27·5

The amount of rain varies in different parts of the island, being greatest along the Atlantic shores, owing to the influence of the ocean and to the mountainous ranges which run close to the sea; there was, for instance, at Collooney, near Sligo, 42 inches of rainfall, while it was but 21 in the central district, Armagh. At Belfast the annual average is about 35 inches, at Dublin 30, greatest in October, least in February, acccording to that learned meteorologist, the Vice-Provost of Trinity College. The number of wet days is much greater in this country than in England, as is also the rainfall, which at London averages but 21 inches, and these circumstances have originated the prevailing, though to a certain extent exaggerated, impression of the hnmidity of our atmosphere. That it does not shorten life appears from the fact that the number of persons over 100 years of age is, in proportion to the populations, five times as great in Ireland as England, and the greatest longevity has been observed in Connaught, the wettest of the provinces. If 100 be allowed to represent the utmost saturation of the air, 86 is the average for Ireland, and on the 14th and 16th of last January it attained the enormous percentage of 94°.

Of all regions of the earth the inter-tropical are the most humid; but as we go towards the poles the number of wet days increases, although the actual amount of rainfall

decreases. Perhaps the extremes in this respect over the world are presented by Sierra Leone, where the mean fall is 189 inches, and the edge of Peru, sloping to the Pacific, where rain was never known to fall. With us the south-west is well known to be most pluvious, and in one year the rainfall at Cahirciveen was 59 inches, while it was but 21 in Portarlington. In estimating the fitness of any place as a residence, especially for invalids, the number of rainy days is a more important factor; for instance, as Dr. Madden, in his recent able book on "Continental Climates," tells us, the rainfall at Cannes, in the south of France, is five inches higher than at London, yet the rainy days average 178 in the latter, and but 52 in the delightful watering place I have mentioned.

Dew is a deposit of atmospheric vapour, the effects of which are popularly and with justice dreaded. It falls when the capacity of the air to contain moisture is lessened by its temperature being lowered at the departure of the sun, and it therefore increases from shortly after sunset to midnight. In seaside and lake districts it is greatest, and on the contrary, the phenomena is never observed in such arid deserts as Sahara.

Winds or currents of air produced by changes of temperature are either variable or constant, of which the trade wind, which carries a cold current from the poles towards the equator, is an example. Some winds—the monsoon, for instance—are periodical. The winds which we term easterly do not blow from any considerable distance due east, but are rather streams of polar wind which, according to Admiral Fitzroy, are deflected by the Danish, Dutch,

and French shores, and thereby are rendered easterly to our coast. But inasmuch as these shores are very flat, I venture to suggest that the rotation of the earth is a more obvious cause to assign for the deflection. Be this as it may, however, there are few of us who have not experienced the disagreeable effects of these gales upon body and mind.

The malady which, from its frequency, will best illustrate the effects of moderate climates, is consumption. Prof. Henessey has shown that in districts with an average temperature of 49°, deaths by consumption are two and a half times as frequent as in counties, such as Kerry and west Cork, where the annual mean is about 51·5°. It is worthy of note that this latter region is that which the late Professor Edward Forbes proved to possess a mountain flora of the same kind as exists on the hills of Spain and Portugal. The mean annual temperature is three and a half degrees higher in the south than the north, and two higher along the western than the eastern coast. The cause of this difference is the Gulf Stream, which begins to exert its genial influence about September. For this reason I have found that pleasant watering place, Salthill, Galway, most agreeable late in the season, when all the east coast places had been deserted.

That profound philosopher, Sir Humphry Davy, attributes many of the characteristics of the British nation to its climate. "Of all the climates of Europe, England seems to me to be the most fitted for activity of mind and the least suited to repose. The alternations of a climate so various and rapid, constantly awaken new sensations, and the changes of the sky from dryness to moisture, from the

blue ethereal to cloudiness and fogs, seem to keep the nervous system in a constant state of excitement. In the changeful and tumultuous atmosphere of England to be tranquil is a labour, and employment is necessary to ward off the attacks of *ennui*. The English nation is pre-eminently active, and the natives of no other country follow their object with so much force, fire, and constancy." The same may be said of this climate, for the difference between the winter and summer means is but 20°, whereas in other countries—Russia, for instance—it is 80°.

I have not time to discuss the climates of special parts of Ireland, nor the suitableness of many of our watering-places as residences for invalids; but I am afraid that the reason which Dr. Rutty assigned one hundred years ago for their neglect may still have force. He longed "that our patients could be persuaded to lay aside their unrighteous prejudices against the productions of their own country." This day a patient of mine returned from the spas of Lisdoonvarna full of enthusiasm upon the efficacy and comforts of a sojourn there. Our great chemist, Dr. Apjohn, has shown that iron and sulphur exist in each of the springs in most suitable proportions. During a prolonged tour last year through the Continental watering-places, I saw nothing with which we could not compete at home as regards scenic effect, and I am a firm believer in the feasibility of forming by chemical skill factitious waters, identical in composition and quite as useful as those which issue from the earth. Waters identical with the natural ones have been made by digesting some of the soils of the Bohemian springs in distilled water. The adjuncts of baths,

drinking fountains, musical bands, promenades, and assembly and reading-rooms, could be easily accomplished, and if the scheme was connected with some large hotel conducted by a company, would be, I feel sure, pecuniarily successful. Those whose means or leisure would not allow of a Continental sojourn could then attain perhaps all its advantages near home. For somewhat similar objects the Crystal Sanatarium Company just formed in London proposes to cover in with glass a large area of ground (140 acres), and to preserve therein an equable temperature, similar to Madeira; to build residences having communication with the grounds so enclosed, and to lay out the interior in the most attractive form of landscape gardening, with the fruits and foliage suitable to a climate like Madeira, and the project has met support from fifty-seven of the most eminent physicians and surgeons of London, who declare, "we should feel it our duty to recommend many of our patients to be domiciled under its roof, during our attendance upon such cases as affections of the heart and lungs, consumption, asthma, and bronchitis, and generally in cases of invalids and convalescents, where air and exercise are necessary, with an uniform degree of temperature, independent of weather or season." Forgetfulness of his bodily, and perhaps mental, ills, is the strongest inducement held out to the patient cogitating a foreign tour by Dr. Madden, who quotes Cowper's apt lines depicting the anxious thoughts which afflict valetudinarians:

"We next inquire, but softly and by stealth,
Like conservators of the public health,
Of epidemic throats, if such there are,
And coughs and rheums and phthisic and catarrh."

But such anxieties and depressing feelings are, I think, nearly always individual peculiarities. In nearly every ancient and modern city of Europe the western extremity has been selected by the opulent classes for its salubrity, which is owing to the following fact: westerly winds prevail, and the pure air of the surrounding country is thus blown over the neighbourhood, instead of the air charged with city emanations, which are so injurious.

Dublin is an exception to this rule, because from proximity to the sea, and the ascending currents which sea breezes give rise to, carrying off smoke and impurities, the southern and south-eastern parts are more desirable residences. The substratum consists of gravel and strong yellow clay. Until, however, the registration and sanitary inspection of the city will be perfected, we shall be scarcely able to determine the relative salubrity of various parts of the city, to map out their prevailing diseases, and thus bring our hygienic agencies to bear on them for the purpose of reducing the causes which render a disease more frequent or fatal in one place than another.

I will now mention very briefly the diseases which prevail in each of the four seasons. Inflammations of the breathing organs, rheumatism, dysentery, and scarlet fever, occur in greatest frequency during the winter three months, and they render the death-rate greater in this than in any other quarter, especially among very young or very old people. During spring much the same diseases prevail, with the addition of croup and hooping-cough, and it is the most fatal period for consumptive patients, the east wind frequently ending the work of destruction which

winter began. In summer, bowel diseases, typhus fever, and small-pox swell the bills of mortality; and lastly, autumn has always been regarded the most fatal of all the seasons ever since the time of Tertullian, who calls it "tentator valetudinum." The reason of this is chiefly that the climatic conditions are variable, suddenly changing from a summer to a wintry character, and the diseases most formidable in each may combine in autumn to render it insalubrious. The deaths by consumption and some other lung diseases are least in this quarter.

A few remarks on acclimation, or the process man undergoes in becoming naturalized to any new clime, may not be inappropriate. It has been most erroneously asserted that a race in colonizing a new country must necessarily undergo degeneration, but such a statement is disproved by numerous facts in the world's history; for instance, the inhabitants of the British Isles are not aboriginal. The secret of successful colonization is that such changes shall be made as will make the mode of life closely conform with that of the original inhabitants; but under the heads of food, exercise, and clothing, I have brought before you most of the principles which should guide those who, in following the tide of emigration, exchange a cold or temperate clime for a hot one, or, as is more rarely the case, a hot one for a cold. There is a limit to acclimation, and indeed our best Indian hygienists tell us that our troops in that empire never become acclimated, so that the polity of leaving regiments but three or four years on that service cannot be doubted.

I have left myself but a few moments for the discussion

of the influence of our climate upon the prevalence of disease, so that I shall be compelled to postpone many remarks which crowd upon me to the next occasion when I shall have the pleasure of meeting you. The materials for a medical history of Ireland in ancient times are scanty. In speaking of the diseases of his times, Cambrensis makes use of a very dubious expression: *morbidos enim homines præter moribundos paucos invenies*, from which some might draw the inference, I feel sure unjust, that the doctors of that day made short work of their patients. Campion, in his History of Ireland, tell us: "Inhabitants, especially newly come, are subject to distillations, rheums, and fluxes, for remedy whereof they use an ordinary drink of aqua vitæ, so qualified in the making, that it drieth more and inflameth less than other hot confections. The air is wholesome—not altogether so clear and subtile as ours of England." With so much moisture and abundant vegetal remains, it has always been a matter of surprise that malarious or aguish diseases did not infest Ireland; but the mildness of the climate seems to account for the exemption, as a high temperature is needed for the development of these poisons. The numerous mosses and other small plants may also decompose the vapours from the bogs. I may mention that human bodies are sometimes found preserved in peat by a kind of tanning, and the astringency of the bog-water may also go some way in accounting for the remarkable absence of reptiles.

When speaking of the food of our peasantry, I had occasion to express an opinion that the great frequency of dyspeptic ailments could be partly attributed to its un-

varied innutritious and bulky nature, but at the same time I think that the dampness of the climate also predisposes powerfully by promoting internal congestions. A similar remark has been made of the inhabitants of the United States, where, however, the unwholesome modes of eating have much to do with the causation of such complaints. I must, however, defer some further remarks on this subject till Thursday.

LECTURE XI.

THE PREVENTION OF ZYMOTIC AND CONSTITUTIONAL DISEASES: FEVERS: CHOLERA: CONSUMPTION, &c.

HAVING now discussed the principal physical agents which influence the health of communities, in doing which I have had occasion incidentally to mention some measures which have been found effectual in lessening the ravages of many diseases, I thought it well to offer you a few observations upon the nature and prevention of those over which we have most control. As my object is to spread such information amongst the general public as may be practically useful, I shall at once tell those professional students who are among my hearers, that I shall not attempt to lecture them on the diagnosis and treatment of disease, for which they must depend upon my own venerated former teachers, the Professors of Medicine and Surgery in this College.

The diseases which are most clearly preventible are those which are usually grouped under the title of "Zymotic"—a term which I shall endeavour to explain to you, for no more popular word conveys the same meaning, and I hope you will allow that throughout these lectures I have eschewed technical expressions, except when there was no more intelligible word, or where their mean-

ing was explained by the context. It was Liebig who first expounded the resemblance of contagious diseases to the process of fermentation. In both, an infinitely small germ gives rise to successive changes which propagate surprisingly the material introduced—a circumstance which makes their virulence greater than that of mineral poisons. Thus, different from poisons of the extraneous kind, the dose seems immaterial, but the zymotic agents agree with these in selecting some special organ on which their effects are produced; thus, as arsenic and foxglove, no matter by what channel introduced, act respectively on the stomach and heart, small-pox acts on the skin, and typhoid on the intestinal glands. It is worthy of note that the fulness of the veins has a most remarkable effect on the taking up of the ordinary poison; thus, a dose which will kill a dog in two minutes, will be fatal in one-fourth the time if the animal be bled just previously, and the full state of the vessels after food is the best armour against the introduction of contagious poisons; for such reasons I have always warned our students that breakfast should be always partaken of before the hospital visit. The *torula* or yeast germ can be removed from air by filtration, and such air is then incapable of promoting fermentation—a fact which suggests that air can be filtered of, or purified from, the seeds of contagion. While, however, we exert ourselves to free the air from the contagious emanations of a patient, we should remember that the causes which originally acted is more potent; for instance, there is more danger of typhoid from residence near a neglected sewer than even a prolonged sojourn in the sick chamber. Perhaps the most

remarkable feature about these contagious diseases is that they attack us but once, and the circumstance is unexplained, unless it is that each zymotic exhausts the peculiar pabulum in the blood on which it feeds. Neither can we explain their occasional epidemic progress or increased virulence by meteorological conditions, although similar influences affect the diseases of the lower animals concurrently, as has been shown by Sir Wm. Wilde in his histories of the Irish epidemics. One more fact to convince you of the importance of the topic. One-fourth of all the deaths which occur in these kingdoms are due to zymotic diseases, which, moreover, tell chiefly upon the youth and flower of the population.

Small-pox is the typical zymotic disease, and the circumstances which increase liability to its contagion are—1, early age, as it has not been endured before; 2, want of the protective measures to which I will just now refer; 3, peculiarity of race—thus, the negro and other dark races are most susceptible of the poison in its worst form; 4, fear, and other depressing causes; and 5, epidemic influence. This disease was lately three times as frequent in Ireland as in England, and twenty times as in Continental countries where vaccination has been for years compulsory. In 1863, the dispensary medical officers of Ireland attended 1486 cases of small-pox, yet out of the 128,850 children who were born but 106,510 were vaccinated; but on the first day of this year there came into force the Act which obliges every child to be protected under penalty. The £5 penalty for practising inoculation by small-pox matter does not seem to be a punishment severe enough, for at

the late assizes there were in one county alone (Donegal) four cases of homicide from this fatal practice. The best instance of the efficacy of this protective measure I can give you is the fact that for twenty-eight years in the London Small-pox Hospital not a nurse or servant has caught the disease, for every one of them has been vaccinated or re-vaccinated on their appointment.

You are, perhaps, aware that the small-pox poison is transmissible to lower animals; for example, the well-known case where a cow took the vaccine disease from having lain upon some flock from the bed of a small-pox patient. Ovination, a similar operation to vaccination, was practised extensively in England last year by the veterinary surgeons as a preventive to small-pox in sheep. Some indirect benefits are likely to accrue from vaccination, for it has been shown in Sweden that scrofulous complaints are much less frequent since the protection has been made compulsory. In this and other practical benefits, the immortal Jenner's prophesy is being realized: "the best and keenest of all arguments for vaccination will be those that are engraven with the point of the lancet."

The poison of scarlatina seems the most contagious of all its class, having the greatest infecting distance, and fixing with the greatest tenacity in dwellings, furniture, or clothes—fomites they are technically called. For this reason when the disease breaks out in schools, it is generally politic to close them up entirely for some time. The heat of boiling water destroys the poison, and rooms or clothes in which the poison may be lurking should be thoroughly steamed or fumigated with sulphurous acid

emitted from burning sulphur. The disease is inoculable, but the malady so produced being as severe as the ordinary kind, such an operation is not advisable. The most malignant epidemics of this disease from which Ireland has suffered were in 1801–2–3, and 1834.

Measles poison would seem to be nearly as contagious, for instances have occurred of the disease being carried by children's clothes packed in a box and sent from schools where the epidemic had broken out. In America this disease has assumed a serious aspect, for 22,000 soldiers were prostrated by it during the first year's campaign. I may mention that Dr. Salisbury of Ohio has endeavoured to prove that the measles poison owes its origin to a fungus which grows upon rotten straw. He inoculated himself, his wife, and twenty-seven other persons with this fungus, and in all an eruption similar to measles followed, and none of these individuals so protected caught the natural measles, which just at the time was strongly epidemic.

In connexion with this subject, I may remark that Dr. H. Kennedy has published an interesting case where a measles-like eruption followed the application of some mouldy flaxseed meal. Several hundred children in France are said to have been inoculated with the disease by inserting a tear from a patient into a puncture.

In my Introductory Lecture, I endeavoured to impress on you that typhoid fever was about the most preventible of diseases, yet 140,000 cases occur, and 20,000 at least die of it every year in England, and as the average age of its victims is 21, and all ranks are obnoxious to it, the very flower of the people is included. I will not dwell on

the subject further here, save to remark, that in having pustules on the intestinal mucous surface, it resembles the diseases—small-pox, for example—which are characterized by peculiar eruptions on the skin. It is supposed that the seeds of this disease may dry up, and yet, like those of many plants, may germinate when submitted to favourable conditions. There is much greater risk of contagion from the decomposition of the poison in faulty sewers than from the atmosphere about the patients, and its progress is much more virulent when introduced by water drank than by air inspired.

I enumerated many chemical destroyers or disinfectants of acknowledged efficacy, but I wish now to add to the list McDougal's fluid (crude carbolic acid), and McDougal's powder (carbolate of lime), which are cheap, convenient, and thoroughly reliable in eradicating this pest "born of putrescence."

Typhus has always been Ireland's epidemic enemy, and is still five times as frequent in Dublin as London in proportion to the population. You all must have read of the lamentable way in which this fever decimated the army in past centuries, and the contagion was usually introduced in the following way: Commissions were formerly given to those who collected a certain number of recruits, and a promiscuous rabble, reeking with the seeds of typhus, was often obtained by ransacking the lowest haunts, and even the jails. In these latter places so virulent was the poison, that the judges, witnesses, and others, who were engaged in court rarely escaped, as I could relate to you if time permitted, from the writings of Lord Bacon. The inten-

sity of the disease would seem now to be much less, for persons in the house with a typhus patient suffer little risk, and those in neighbouring houses none. I have investigated some cases in which the inhabitants of a house were reputed to have caught typhus from patients in a neighbouring one; but I have always found that the attack was due to an original focus usually promoted by similar unsanitary conditions. If there be suitable arrangements for the exit of the infected air and the entrance of the fresh, I have never thought it necessary to banish relatives from the patient's house, for their affectionate solicitude is often more valuable than any hired services. I will now recapitulate the circumstances which recent pathologists assert to be promotive, if not productive, of typhus, and you will acknowledge they are all preventible. 1, over-crowding and defective ventilation; 2, personal squalor, especially the wearing of clothes soaked in cutaneous exhalations, and dark-coloured woollen stuffs have by far the greatest power of absorbing the poison; 3, a low state of the system due to scanty or bad food; 4, a medium temperature.

As regards the most plainly malarious of diseases—ague—it used to prevail in Dublin and its vicinity; but owing to improved surface-drainage it has almost wholly disappeared.

The next group of the zymotic diseases is that of which the breathing organs are the seats, and among them influenza is the most clearly epidemic, the most rapidly diffusible, and most largely fatal, at least 4000 persons in Dublin having succumbed to it in four months of

the year 1837. Few old people escape if they are attacked; but Dr. Graves mentions a notable exception. He attended Judge Day, the contemporary of Goldsmith, at the age of 93, and he recovered perfectly. There are reasons for supposing that influenza is due to some specific poison floating in the air, and acting like the emanations from the sweet-smelling vernal grass which gives rise to that remarkable disease, "hay-fever."

Whooping-cough, another zymotic, seems to be excited by some poison which acts exclusively on the branches of that widely-distributed nerve, the pneumogastric. That the poison is not solely aërial would appear from a child just born having had the disease, which must have been carried to it in the mother's womb. Quinsy, croup, and diphtheria, are other examples of this group of diseases, and in the prevention of all of them, ventilation, drainage of excreta, and removal of dampness, are hygienic measures of tried and positive efficacy.

Cholera, the most dreaded of the zymotic diseases, which choose as their seat the digestive canal, is, as I endeavoured to explain on two previous occasions, communicated by a specific poison emitted from a patient already attacked, and carried to others through the water or air. It, therefore, follows the lines of human intercourse for the most part, but outbreaks do undoubtedly occur which allow of no such explanation. It first appeared in Dublin on 22nd March, 1832, and arose in Cork on 12th April, probably from some new source of contagion (perhaps by the steamer which then plied between these cities), for Naas, which lies along the direct road, was not attacked till April 13th.

That learned physician, Prof. Aitken, to whose comprehensive treatise I am indebted for many facts, relates the following exceptional case:—"In one of the Western Islands, the most remote from the mainland, the disease suddenly appeared, where so little intercourse existed with the place that the clergyman of the island continued regularly every Sunday for eighteen months to pray for King William the Fourth, as if he had been alive, after our gracious Queen Victoria had ascended the throne."

The cholera, which is endemic in these countries, prevails, for reasons I explained before, during hot dry weather, and is in London contemporaneous with the putrefaction and stench of the contents of the Thames, and a death in this city from the same disease has just been registered by one of our dispensary medical officers. When our water supply will be available and our sewerage efficient, we may set at defiance even its awfully aggravated and epidemic form.

I will conclude what I have to say upon those zymotic diseases depending upon the introduction of a specific poison into the blood by mentioning that Prof. Polli of Milan has energetically advocated the use of chemical antidotes to them—such as the sulphites—which are known to possess the power of checking catalytic action. If their curative efficacy be proved, they will become still more reliable in preventing the specific zymotic process consequent on the introduction of the poison.

On another occasion I dwelt at perhaps sufficient length upon the influence of want of pure air in the production of consumption, which is so potent that the deaths among

in-door artisans, such as tailors, shoemakers, weavers, and printers, from this disease are at least twice as frequent as among those who labour in the open air. Much may be done in the way of prevention, both by public and private hygienic measures. Under the former head I include the opening of public parks and grounds, a close supervision of the establishments where people work in numbers, and the application of the most scientific preventives to the special injuries which many noxious trades inflict, and in such arrangements our French neighbours far excel us. Among means which lie in each individual's power are the fit ventilation of bed-rooms, to which sunlight should have free access by a proper aspect being chosen, and free exercise in the open air with the habit of filling the lungs occasionally to the utmost, for by ordinary breathing their upper parts are not inflated, and remember a disused organ always suffers.

I must mention to you some remarkable facts with regard to the habits of many of those who have afterwards become consumptive—namely, that they have suffered from that kind of dyspepsia in which acid is too freely produced in the stomach, and that they have exhibited a constant dislike for fatty foods. The peculiarity of their digestion would then be that while albuminous food would be assimilated, the alkalinity of the saliva and pancreatic juice would be neutralized, and their respective functions—namely, the conversion of starch into sugar and the taking up of fat interfered with. The remedial powers of cod-liver oil, which insinuates itself so readily into the absorbents, may depend upon their supplying this want. The

preventives of consumption are urged so enthusiastically by Dr. McCormac that I shall sum up by giving you his list—the respiration of a pure untainted atmosphere by day and night—improvement of the artisan's *locale* and habits, including his bent and sedentary posture—the substitution of steam machinery for dry-grinding and stone-chiselling—attention to the digestive and cutaneous functions—improvements in the aspects of houses and sleeping-rooms—increase of out-door pursuits—and lastly, full and free respirations in the open air. Dr. Aitken, Professor of Pathology in the Army Medical School, most justly remarks:—

"Experience has now adequately demonstrated, that the tuberculous cachexia springs from causes over which the public, rather than the medical profession, have control. The physician must be at once impressed with the belief, and encouraged with the hope, that when he acquires the confidence of the public in the practice of his profession, he may exercise a powerful influence for good in teaching how much they may themselves control the ravages of consumption by prudent marriages and sanitary attention to offspring. There are several circumstances which show the great influence of public sanitary measures in controlling the ravages of consumption when these measures are scientifically directed to the preservation of the general health, and especially when men are associated together in great communities—an influence much greater than the best directed efforts of the medical profession can establish through their *materia medica*. It is by the mode of life as citizens of the world, in the social relations of

husbands and wives, parents and children, and in the public relation of masters and workmen, that the extent and ravages of consumption are to be controlled. It is by a strict attention to the rearing of offspring, and in the subsequent regulation of food, clothing, cleanliness, occupation, the choice of a profession, and by many other circumstances which have an obvious influence (perhaps at first sight inappreciable) on the maintenance of the general health, that our hopes of success as practitioners of medicine must rest in the prevention of that bad habit of body which develops and propagates the tubercular diseases in civilized society."

Upon dietic diseases I made a few remarks on a former occasion, and now, concerning one of them—namely, gout—I can tell you in a very few words all the measures which are preventive by quoting Abernethy's reply when asked, What was a cure for the gout? "Live on sixpence a-day and earn it," for temperance, exercise, and a freely acting skin, are among the hygienic requisites comprised in the aphorism.

As I have endeavoured to elucidate, our tissues do not remain permanently ours, but are being in health constantly removed and renewed. Now, when renewal fails and substances lower in the scale of human chemistry become deposited instead, we give the name of "degeneration" to the condition. The fatty form in which a tissue—the muscular, for example—is either chemically converted into fat, or is removed to give place to that substance, is the most frequent, and chooses such vital organs as the heart, brain (yellow softening), and the kidney (chronic

Bright's disease.) We are warned that sedentary habits are strongly promotive of this affection, for it was fatal to such prolific writers as Abercrombie, Pereira, and Thackeray, and such industrious lawyers as Cresswell and Slade. The influence of the ingestion of too much heat-producing food to the exclusion of tissue-material we have already discussed; but it remains for me to explain the physiological effect of alcohol, which we will find tend powerfully to the production of fatty degeneration. It checks the changes which our tissues are undergoing, interferes with the due oxidation of the blood, or the combustion of its waste material, and, according to many authorities, supplies material itself for the formation of fat, as more certainly does the sugar, which most of its preparations plentifully contain. Distilled spirits are for this last reason less promotive of fatty degeneration than other alcoholic liquors. I shall not now dwell on other evils of intoxication, lamentable though they are, save to say that it is not on the individual alone they work destructive changes, for his offspring, in addition to moral injury, undergo most manifest physical deterioration. In this way alcohol is one of the most powerful causes of that remarkable character of disease in the nineteenth century—namely, that while the mean lifetime of adults is becoming prolonged, that of children is being most perceptibly shortened.

LECTURE XII.

VITAL STATISTICS OF IRELAND: SYSTEMS OF REGISTRATION: SANITARY ORGANIZATION: CONCLUSION.

It seemed to me that the course of lectures which it has been my pleasure to deliver to you would be incomplete if I did not endeavour to give you some succinct view of the present status of disease in Dublin and Ireland generally. This I am enabled to do by those admirable statistical reports which, for the last three decades, the Registrar-General and Sir Wm. Wilde have prepared from the Census returns, and by the registers of deaths, which are now systematized so ably with the coöperation of the Medical Registrar. The very great readiness with which the general public have given the data for preparing these returns seems to be reflected in these distinguished public servants, for whenever they believe that benefit can arise they most willingly allow their information to be utilized for the public good. The diseases or infirmities under which the people of this country laboured when the Census was taken in 1841, 1851, and 1861, were wisely divided into—1, those of a permanent nature, as deafness, muteism, blindness, lunacy, idiocy, paralysis, epilepsy, lameness, and

decrepitude; and, 2, the temporary, which included all the ordinary, acute, and chronic complaints. Much accessory information has been given by the Commissioners.

"Viewing a Census in the light of a social survey, in which the condition as well as the enumeration of all classes of the people should be considered; and believing that a knowledge of the nature, causes, and extent, as also the distribution and results of the epidemic diseases of this country may tend to assist the legislature in future sanitary investigations and improvements, not only in the necessary provision for the destitute, but also in supplying suitable relief to the suffering."

With regard to the first disability, inquiries were made "whether the person was born deaf and dumb, or became so afterwards; to what cause the malady was attributed; whether the persons so returned were paralytic, idiotic, or in any other way, mentally or physically, affected; whether other members of the family, either of the present or previous generation, had been mute; and also as to the education, social condition, and other circumstances, of all the persons so returned." The proportion of those born deaf and dumb to the population of Ireland was, in 1851, 1 in 1573, in 1861, 1 in 1370.

The increase in the last year appears to be due to the emigration, which drained off the healthy, leaving these afflicted persons at home or in public asylums. Many noteworthy results were afforded by this searching investigation into the circumstances of the deaf and dumb, aud

they prove, contrary to the opinion now pretty general in France, that marriages of consanguinity are productive of deaf and dumb offspring. Six mutes in a family occurred five times, and seven in one case, in which "there was neither hereditary predisposition nor any other probable physiological or pathological reason assigned to account for this very remarkable peculiarity." The *Status of Disease* for 1851 records a remarkable case in which the parents were third cousins, and had seven mute children, all females, six of whom were twins. A more recent inquiry ascertained that only one of these now survives, and that this family had eight deaf and dumb children born in it. In families having a single mute it was most generally a first child, and mutes were most frequent in families of six or seven.

In 1851, there was 1 blind person to every 864 of the population—a proportion which is larger than most other countries, and due to the ophthalmia which had prevailed epidemically during the years succeeding the famine, for want of food is especially apt to give rise to destructive disease of the eye. I may mention that in Norway, where the food is very poor in nitrogen, the proportion is 1 in 540, and in the United States, where it is the contrary, but 1 in 2489. The last Census gave a higher proportion—namely, 1 in 843, in this country than in 1851; but, like deaf-muteism, it depended on the blind not having emigrated in ratio to the healthy population. The proportion of lunatics to the whole population is 1 in 821, while in 1851 it was reported at 1 in 1291. Compared with other countries, Ireland occupies, together with Nova Scotia,

Sweden, and Bavaria, a medium position between the high rate of lunacy in Prince Edward Island, Oldenburg, and Denmark, the average of which countries is 1 in 477 of the population, and the minimum proportion, which is in Piedmont, Savoy, Holland, and Saxony, where the average ratio is but 1 in 1931. That there are 1991 more persons now in Ireland afflicted with lunacy than in 1851 is a fact of the gravest import, although the imperfection of the method of acquiring information in the former Census in this particular may have been defective, and the peculiarity of the Irish exodus, to which I have before alluded, may have falsified the returns as comparative surveys. With regard, then, to permanent infirmities, the following summary gives the comparative results of the two Censuses :—

1851.		1861.	
	1 person in every		1 person in every
Deaf and Dumb .	1265	Deaf and Dumb .	1026
Blind . .	864	Blind . .	843
Insane . .	1291	Insane . .	821
Idiotic . .	1336	Idiotic . .	825
Lame or Decrepit	1498	Lame or Decrepit	1408

The statistics of the various prisons are given very fully in the Census Report, and the very learned physician who reviewed it in the *Dublin Quarterly Journal of Medical Science*, makes the following judicious remarks :—"It were well if some inquiry were made as to the vital statistics of the sanitary and mental condition of convicts, as resulting from their very hopeful position. By this we mean any

record of how much bread, meat, porter, pudding, and other good things they get; how many hours they labour during the day, and the amount of work done, as compared with the working hours and work done by honest *adscripti glebæ;* how much clothing, good housing, cleanliness, and amusement is inflicted on these wayward children by a paternal government; in fact, how much inducement is held out to the honest man to become a rogue."

Despite all these advantages, we find that disease was most prevalent—1 in 10 of the prisoners having been under treatment; and the same writer exclaims:—"If all these gentry had been formed into a rogue's brigade, and sent into the trenches before Düppel, or subjected to Prussian tender mercies elsewhere, we might not wonder at the sick in hospital being reported as 1 in 10; but so large a proportion of sick in our quiet prisons at home, with protection from wind and weather, warm clothing, wholesome food, plenty of cleanliness and idleness, a little moderate exercise, and good medical attendance, forcibly suggests some queries to the medical reader. Are the prisons unfit for habitation, as in the days of Howard? Are the clothing and food insufficient or of bad quality, as at the Crimea? How much or how little illness secures a remission of that terrible judicial sentence, "hard labour?" To what extent does malingering prevail in our prisons? and what sort of pigmies are the natives of the various localities robbed, burned, or otherwise injured by this decrepit set of prisoners?"

You will readily understand the difficulties which sur-

rounded the collection of trustworthy returns of those sick of various temporary diseases on the night the Census was taken, but they are, I am sure, sufficiently accurate to allow us to derive conclusions as to the increase or decrease in various diseases in 1861, as compared with 1851. This I have done in the following epitome of the number of cases of the most important diseases of the zymotic and constitutional classes which mainly have concerned us in discussing Preventive Medicine :—

I. ZYMOTIC.	1851.	1861.
Ord. 1.—Miasmatic.		
Small-pox	888	116
Measles	1035	1308
Scarlatina	324	266
Quinsy	80	176
Whooping-cough	359	153
Fevers	13777	2350
Erysipelas	256	228
Ophthalmia	3883	1307
Influenza	—	2330
Dysentery and Diarrhœa	9729	1139
Ague	201	81
Rheumatism	3953	4103
Ord. 2.—Enthetic.		
Syphilis	824	370
Ord. 3.—Dietic.		
Privation	191	6
Purpura and Scurvy	149	101
Dyspepsia	345	526
Ord. 4.—Parasitic.		
Itch	1193	397
Scald Head	2042	276
Worms	283	259
II. CONSTITUTIONAL.		
Ord. 1.—Diathetic.		
Dropsy	1464	952
Ord. 2.—Tubercular.		
Scrofula	2654	1615
Tabes	747	275
Consumption	4182	2650

I will now give you a very brief sketch of the two schemes of nosology, or the arrangement and classification of disease which are used by the English and Irish and by the Scotch Registrars, both of which differ very considerably from that adopted in the Census reports we have just analyzed. The inconvenience of this is obvious, and it would be most desirable that before the next Census at least they should be similarized. The classification originally proposed by Dr. Wm. Farr twenty years ago, seems to me as nearly perfect as the state of medical science then permitted; but it now requires readjustment, and I understand such is contemplated by the coöperation of such authorities as the Medical Registrars of the three kingdoms, and the Medical Officer of the Privy Council, Mr. Simon. I am sure that no classification which will require essential changes with the progress which we may confidently trust medicine will yearly make will be adopted by this congress of the medical statists, for otherwise much confusion would result, and useful and accurate comparisons of the status of disease could not be conveniently made with previous years. Meanwhile, the issue of the "Statistical Nosology" by the Registrar-General for Ireland was necessary in order to get returns at all intelligible or classifiable. I may here mention that I think the willingness with which returns have been made has been due to the very great respect in which that gentleman is held, for the extraordinary zeal with which he has devoted himself to arranging the statistics of this country entitle him to national gratitude. Most of the medical institutions have lent him their aid; for instance, the great body to which

it is my pride to belong, at a meeting of the Council, held on the 3rd of March, 1864, resolved:—"That we, the President, Vice-President, and Council of the Royal College of Surgeons in Ireland, deeply impressed with the importance and value of the lately enacted measure for the Registration of Births and Deaths in this part of the United Kingdom, and anxious to have its provisions fully and accurately carried out, do resolve to promote, as far as possible, the objects of the legislature, and earnestly recommend the Fellows and Licentiates of the College to assist the authorities in procuring the statistical information required under the Act."

In the Registrar's Nosology the diseases which produce death are divided into five classes, which are each subdivided into orders, of each of which I have given but one example to save space. If I have set down a second disease under some of the orders, it is because I have a remark to make upon it.

I. ZYMOTIC DISEASES.

	EXAMPLE.
1. Miasmatic Diseases .	*Small-pox, Fever.*
2. Enthetic „ .	*Syphilis.*
3. Dietic „ .	*Scurvy.*
4. Parasitic „ .	*Worms.*

II. CONSTITUTIONAL.

1. Diathetic Diseases .	*Cancer, Gout, Dropsy.*
2. Tubercular „ .	*Consumption, Goitre.*

III. LOCAL.

1. Diseases of Nervous System,	*Apoplexy, Convulsions.*
2. „ Organs of Circulation .	*Aneurism.*
3. „ Respiratory Organs .	*Bronchitis.*
4. „ Digestive Organs,	*Inflammation of Stomach, Painter's Colic.*
5. „ Urinary Organs,	*Bright's Disease.*
6. „ Organs of Generation .	*Ovarian Dropsy.*
7. „ Organs of Locomotion .	*Inflammation of Joints.*
8. „ Integumentary System .	*Ulcer.*

IV. DEVELOPMENTAL.

1. Diseases of Children .	*Teething.*
2. „ Adults .	*Childbirth.*
3. „ Old People,	*Old Age.*
4. „ Nutrition .	*Debility.*

V. VIOLENT DEATHS.

1. Accident or Negligence,	*Burn.*
2. Battle . . .	*Wound.*
3. Homicide . . .	*Poisoning.*
4. Suicide . . .	*Drowning.*
5. Execution . . .	*Hanging.*
Other Violent Deaths not classed . . .	
Sudden Deaths, cause unascertained . .	
Causes not specified or ill-defined . . .	

To the classes I do not think any objection could be made, and it is of the utmost importance that preventible maladies, although of different seats, should be grouped under one head, such as "zymotic." The subdivision into orders is likewise very scientific, and it is only with regard to the places which a few diseases occupy that I would venture suggestions. I think, for instance, that it is high time we should have deaths from typhus and typhoid fevers recorded separately. From the diathetic order of constitutional diseases I would remove gout to the dietic order of the zymotic, for it is evidently due to circumstances of food or drink. Dropsy is a most inaccurate term, under which deaths from diseases of the heart, liver, kidney, &c., are confounded. As convulsions, that destroyer of infants, is usually due to reflex disease excited by bad air or improper food, I would be glad to see it under the zymotic head. Goitre is surely misplaced in the tubercular order, and for reasons I have so often mentioned, appears clearly dietic; and, lastly, I think it would be advantageous to group painter's colic, which is now registered among the local diseases, with other very preventible ills which arise from special occupations, under some such title as "Industrial." As the public should share in the information collected by registration, I am in favour of using popular terms, if as accurate as technical ones; for instance, consumption and water on the brain are surely as suitable as phthisis and hydrocephalus, though less pedantic.

The Scottish system, proposed by Dr. Stark, the Medical Registrar, tabulates every disease under the "organ

of the body which was primarily and chiefly affected," and an example or two from the remarks with which that physician elucidates his plan will make its principles more clear :—

"According to the rule laid down, therefore, diphtheria must either be classified under diseases of the organs of digestion, or, where I have provisionally put it, under fevers. It seems to me to be so closely allied to cynanche maligna and cynanche tonsillaris, both of which are undoubted forms of scarlatina, that it seems to me we have no choice left us but to place it after scarlatina. For statistical purposes there can be no such class allowed as the tubercular; it would violate all our rules. Every disease now put under that class must be referred to the organ of the body chiefly affected; so phthisis must be referred to diseases of the respiratory organs; hydrocephalus to diseases of the brain; tabes mesenterica to diseases of the organs of digestion. Whooping-cough and croup are so purely diseases of the respiratory organs, the wonder is they were ever put elsewhere. Diarrhœa, dysentery, and cholera, may be called the leading diseases of the organs of digestion, and that is their undoubted proper place."

I have not time to discuss the merits or demerits of this plan at large; but I must say that while the advantages of classifying diseases according to their precise seat, if always ascertainable, are not very evident, the disadvantages of separating those which owe their origin to similar

morbific agencies and are preventible by similar measures far outweigh them.

A few words about a uniform plan of hospital statistics, the advantages of which would be as follows: we could ascertain the mortality of different hospitals in various diseases or accidents, and as some cases might be more advantageously managed in one hospital than in another, owing to climatic or hygienic conditions, great benefits and economy of the funds should result. The laws which govern disease and the influence of particular remedies could be studied from accurate and copious data, and also the utility of various operations, many of which from the limited experience of one man may now be brought into undue prominence. No form could be better for the purpose than that which Miss Nightingale has drawn up, and which has been adopted by the International Statistical Congress, St. Bartholomew's, and London Hospitals, and similar institutions.

Sir Wm. Wilde's investigations brought to light in 1841 the suggestive facts that there was in Dublin the most astounding difference in the death-rates of the first-class squares and streets, where it was but 1 death in 122, and such poorer districts as St. Paul's, Linen Hall, and St. Catherine's, where it was 1 death in 37, 42, and 43 of their denizens respectively. It is much to be feared that these proportions have not been much equalized as yet, but the accurate mortality returns we will have from this year will guide our efforts in these directions. It has been asserted also that Irish poor carry with them the disease generating tendency with which they are afflicted at home

into those English and Scotch, and perhaps American, towns into which they emigrate, or at any rate that the mortality of many of them is in proportion to the percentage of our countrymen. In Liverpool, 18 per cent. of the population is Irish, the death-rate is 30 per 1000. London has a much smaller proportion of our poor countrymen, its general death-rate is 23; and Greenock, with 12 per cent. Irish, loses 35 per 1000 of her inhabitants annually, while Aberdeen, with 2 per cent. Irish, loses but 21.

The Act for the Registration of Births and Deaths in Ireland, 26 Vic., chap. 11, came into operation on the 1st of January last, rendering it a legal offence not to give notice of a birth within three months, or of a death within fourteen days. There are reasons for believing that it is now working with great accuracy. For the three months, January, February, and March, there were registered within the municipal boundary of Dublin 1940 deaths, or a weekly average of 149. There were but 3 deaths by small-pox (against 10 in the next quarter), and all in persons unprotected—that is, not vaccinated. The average weekly deaths for the second quarter was but 113, and the total 1474 against 1940. For the half year ending July 2, there were 3414 deaths recorded, the ratio of males to females being as 95·4 to 100. This number gives upon the population of Dublin (254,808 in 1861) a death-rate of 1 in 37·3, or 27 per 1000, and, strange to say, it is identical for both north and south districts. For comparison sake, it may interest you to know the death-rate of other European countries—it was 1 in 27 in Lower

Austria, and but 1 in 48 in Scotland. There was no epidemic during the six months, but the following deaths took place by zymotic and constitutional diseases, which, I trust, I have convinced you are wholly, or in a great degree, preventible:—

Fevers	159
Scarlatina	59
Whooping-cough	44
Diarrhœa	36
Small-pox	13
Diphtheria	9
Measles	5
And amongst the constitutional, phthisis	448

As you are aware, the returns are published on Wednesdays, and I have, as Medical Officer of Health for the City, the advantage of receiving them the previous day; and through the kindness of the authorities I hope to get the address of every death by preventible disease on Monday, in order that the sanitary inspectors may discover and remove the causes which led to its occurrence. I do trust somewhat confidently that good will result from the harmonious working of the registration and sanitary systems, and I, for my part, will look on the weekly return as my pressure gauge, for it will stimulate our efforts to diminish the removable causes of disease, if it tells of increasing deaths by preventible maladies, or if they be decreasing, we will en-

deavour to ascertain the circumstances which have led to so favourable a result.

I will next detail very briefly the means which the city now possesses for preventing the occurrence of disease. A complaint book lies at the City Hall, and in it can be entered notices of any nuisance which has been observed within the city boundary. The inspector of nuisances then visits the locality, gives instructions for its removal, and enters a description of it on the opposite page of the complaint book. The more remarkable, or those in which a professional opinion seems needed, are specially reported to me, and I give instructions as to the proper means for removing them or abating their injurious effects. Lists are received daily from the registrars of the fever hospitals of the residences from which patients are taken, and all such houses are visited by the inspector or his assistants, and ventilation, lime-whiting, and cleansing of them is insisted on. The six sanitary constables of the metropolitan police report weekly to the Sanitary Committee of the Corporation all nuisances they have discovered and the means taken for their suppression. All sewer-traps and gullies are kept constantly under inspection, and repaired when necessary, and cess-pools are suppressed when possible. Means are being taken to compel the proprietors of over one hundred factories to consume the smoke of their chimneys, which is productive of much nuisance and inconvenience to those living near them. There will be endeavours made to remove all lime-kilns from the city, and in the country they should be suitably protected, for over thirty lives are lost by poor wretches

sleeping by them, being burned or poisoned by carbonic acid. Lists of all cases of zymotic disease will be received from the dispensary stations in the city; and the able physicians of these institutions, by forms which have been supplied them, will be able to bring under the sanitary department all causes which, if unchecked, might propagate disease. I will report every second Friday to the Sanitary Committee all deaths by preventible diseases which have occurred for the preceding fortnight, with remarks on the sanitary state of the city, and the means adopted for improving it, and the committee will probably make these statements public, if they see that benefit can arise.

Among our occasional duties will be endeavours to suppress any epidemics which may invade the city; and I am convinced that this sanitary organization, by urging vaccination, examining water supply and drainage, and removal of the poor to hospital—if small-pox, cholera, or typhus should prevail epidemically—will save many lives. From the public we can get most efficient aid, and if the benevolent, whose mission of charity or religion brings them to the dwellings of the poor, will inform the sanitary officers at the City Hall of any comfort and health-destroying nuisances they may observe, they will render their house-to-house visitation still more valuable. By an Act just passed, all humble houses set in tenements may be inspected and the owners of them compelled to keep them in a habitable and wholesome state, according to bye-laws which are being framed by the Committee, with which it is my privilege to be connected.

I trust I have shown you in preceding lectures that medicine, directed by modern sanitary science, has become a productive art, for it has extended the average duration of life to nearer what was ordained for man by removing many causes of disease. Nevertheless, the physician, as has been fitly remarked by Professor Aitken, must, above all, "remember that the sphere of his professional exertion is limited and surrounded by insurmountable barriers, and that death will eventually come alike to all, reminding him that he himself must become a victim to the incompetency of his art."

I cannot bring this course of lectures to a close without expressing my acknowledgment for the favourable reception my efforts have met with, both from my own profession and from the highly respectable lay audiences which have honoured me by their presence here. I am well aware that this favourable reception is not due to my own merits as a lecturer, but to the practical importance of the topics with which I have had to deal. A large and influential portion of the Irish community have come to recognize the necessity of sanitary reform, and are resolved that so far as in them lies Ireland shall not lag behind other civilized nations in cleanliness, temperance, or in physical or moral well-being. With such a conviction abroad, and such a resolution generally diffused among the natural leaders of public opinion, the work of the conscientious lecturer, however moderate be his talents, becomes prolific of good; at all events, animated with this hope, I shall labour zealously to render my next course of lectures less unworthy of your approbation.

I shall avail myself of the powers which the favour of the Town Council has conferred on me to make myself minutely acquainted with the causes which operate on the health of this city, with the condition and habits of the labouring population, and with the remedies and appliances which have been devised elsewhere, or which may be suggested here to bring about a better state of things. However inadequate may be my powers, or indeed the powers of any single person, to cope with the multifarious topics included under the term of "Public Health," I trust that I shall keep steadily before me an adequate ideal of what that term really denotes. As the health of the individual means more than the mere absence of specific disease, as it means the pleasurable and vigorous performance of every physical and intellectual function, the health of a community means not merely that it is not decimated with zymotic diseases, wasted with famine, or poisoned with miasms, but that it enjoys a high degree of vitality, that it is susceptible of, and has opportunities for, all manly exercises and all innocent and beneficial pleasures.

The physical type of the Irishman, as has been proved on every battle field in Europe, on the prairies of the West, and in the wild Australian bush, is inferior to that of no other variety of our species. We are blessed with a fertile soil and a genial climate; our coasts swarm with food, a rich harvest for Cornish, Manx, or Scottish industry, and although no great arsenal or dockyard gives employment to our people, our harbours and estuaries are not surpassed by any in the sister kingdom. There is no reason why our

people should not be industrious, cleanly, respectable, and prosperous, if only we resolve they shall be so, and that we endeavour to undo, by every legitimate effort, the evils which have gathered upon us through indifference or neglect.

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