HEALTH AND LIFE

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BY

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"NATIONAL HEALTH IS NATIONAL WEALTH"

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PART I.

HEALTH AND VITALITY.

I.

HEALTH AND CIVILISATION.

IF it be true that man in his past history has been ever struggling against natural obstacles towards greater advantages of health and towards the happiness which accrues from the possession of that acquirement, a notable improvement ought to be shown at the present day in the conditions of health that are manifested amongst our modern civilised communities. The results in health should compare favourably with those which existed in preceding and less-favoured civilisations, or that exist in this day in uncivilised tribes. I do not think there is any reasonable doubt that the fact is as it should be in this respect.

It may be urged that no comparison can be instituted between the current civilised states and those practically lost civilisations which marked the Babylonian, the Egyptian, the ancient Greek, and the ancient Roman empires. I have heard it expressed by more than one admiring scholar of those civilisations, that if we knew all the details of them which are now concealed we should probably see in them a standard of excellence which this age, in its most refined aspects, does not approach. I bow to this opinion with the knowledge that it is unanswerable. All I know is, that nothing comes to my hand, no book, no word, that conveys to the mind the idea of the existence of any period when the human race, existing under any form of known civilisation, was freer of great pestilences, was freer of slowly killing diseases, was freer of loathsome diseases that do not necessarily kill, than it is at this hour.

I turn to the fathers of medical science to find them rich in their knowledge of diseases, knowledge which they could never have learned unless the diseases had been before them as subjects of study. I turn to the historians to find the records of great devastations from plague, pestilence, and famine. I read the poets telling of the same, and of the vengeances of offended deities. I find an ancient ruler, no less ancient and no less cunning a ruler than Cambyses himself, teaching his son Cyrus lessons in sanitary science as lessons then much needed. With regard to health, Cyrus tells his father that "since he has heard and seen that those states which seek for good health educate physicians, and that commanders take with them physicians for the sake of the soldiers, he too, therefore, as soon as his present expedition was intrusted to him, gave his attention to this subject, and thought that he had with him very competent physicians." To which the father, Cambyses, replies, "But these physicians, my son, of whom thou speakest, are like menders of torn garments, and thus they cure those who have fallen sick. Thy chief anxiety should be to provide for health; for thou oughtest to take care to prevent the army from falling into sickness at all." And then he describes, as a modern and learned surgeon-general might describe, what is to be dreaded, what is to be avoided. He tells that the bodies and faces of men are the signs of good health and bad health; and he adds other advice and observation which shows to us that in Cambyses' day, in the midst of a very high ancient civilisation, there was no special exemption from the thousand natural ills that flesh is heir to.

I need wait no longer on this interesting topic. Happily, proof nearer at hand is before me for comparison of the modern with past life —proof which tells that with true civilisation health ever appears in friendly communion. We must not, however, rush at once to the conclusion that health and longevity are developed with every phase of what is called modern civilisation. The modern civilised man conquers, and in conquering drives the modern savage out of existence, or leaves him part of a mere fragment of a wandering tribe. But civilisation, however refined it may be, however intellectual, inventive, learned, or knowing it may be, is foolish and helpless to check disease and death unless it be wise as well as knowing, unless it be self-sacrificing, and unless the passions of men, which civilised life so variously modifies, are influenced by it in such a manner as to be held from the influence of destructive causes. When civilisation leads to excess of luxury; when it leads to excess of strain, mental or physical, after wealth and the supposed advantages that can only be purchased by wealth; when it spreads too eagerly the sails of commerce; when it grasps too fiercely after conquest and dominion; when it brings about collisions between classes of men in the same population—then it is not an agency for the steady promotion of national health and national life.

We, who would do all we can to improve the health and life of the nation, must always bear these truths in mind. Steadiness of national life requires steady national repose. The political soundness and safety of a nation are recorded in the annals of its mortality.

The best typical examples of communities living under conditions most favourable to vital integrity have been those which have been civilised in the midst of the extremest simplicity, in other words, in the midst of freedom from evils incident to civilisation. This point will well bear direct and practical illustration.

At the census of 1821 it was calculated that in the English county of Monmouth the death-rate was in the proportion of fourteen, and in 1831 of twelve, in the thousand living. But from the years 1841 to 1870, the death-rate of the same county has presented a mean of twenty-three in the thousand living, or nearly double the rate that existed from 1821 to 1831.

The mortality tables by Edmonds show that for the eighteen years from 1813 to 1830 the mortality of England and Wales was at the rate of 21·20 in the thousand living. From 1841 to 1870 the death-rate has been twenty-two in the thousand living.

These examples could be multiplied, but they are sufficient to indicate that what is commonly called advancing civilisation is not sufficient of itself, in detail, to insure a reduction of mortality in a limited series of years.

We cannot suppose that the county of Monmouth is less civilised now than it was forty-six years ago, yet its mortality has considerably increased. We cannot assume that England altogether is less civilised than she was forty-five years ago, yet her general mortality has slightly increased.

What shall we say, then? Shall we rush to the conclusion that with our vaunted civilisation we are passing into a lower phase of national life? Is our vital force on the decline? Are learned authors who have written on the decrease of disease by civilisation,—Marx and Willis, Berard, Francis d'Ivernois, Boudin,—to be considered dreamers? Is it possible that we are blindly and imperceptibly drifting into danger, wearing out, as philosophers say the sun our master is? Or is there a mistake somewhere, and are we improving, as we hope we are? Optimist or pessimist, which is the authority?

Before these questions can be answered, let us look at another series of facts. Our balance will then be more fairly poised.

II.

HEALTH AND THRIFT.

IN the year 1700 the mortality of London was computed as one in twenty-five; that is to say, as forty in the thousand. In the year 1801 it was computed as one in thirty-eight; that is to say, as twenty-six in the thousand. From 1841 to 1850 it was computed as one in forty; that is to say, twenty-five in the thousand. From 1861 to 1870 it was computed as one in forty-two; that is to say, twenty-four in the thousand. These facts show a steady and remarkable progression in favour of health, as far as such progression is indicated by reduction of mortality. Should the reduction continue, we may fairly assume that, if the improvement does not move faster even than it has moved, twenty persons out of every thousand living will die in the year 1900, instead of the forty that died two hundred years ago. One in fifty in the year 1900, instead of one in twenty-five in the year 1700, will be the mortality in the metropolis.

If we apply the same test to England altogether, we find that a century since, within two years, the deaths were computed at one in forty, or at the rate of twenty-five in the thousand living. At the present time the deaths are one in forty-five, or at the rate of twenty-two in the thousand. This, it is true, is a small improvement; yet it indicates the position that with an advance of civilised life there runs an advance of actual life. The position is strengthened by the further fact that whereas at the date of a hundred years back the whole population of England was barely eight millions and a half, in 1870 it was twenty-two millions, seven hundred and twelve thousand, two hundred and sixty-six, with one cause of mortality, the overcrowding of populations, greatly increased.

Whither, then, are we led? There seems before us a statistical paradox, and some will say, as they read, that statistics can be made to prove anything. Really, there is no paradox, and the statistics, as is commonly the case, prove, when they are honestly read, the simple and consistent truth.

To read the facts correctly it is necessary to classify them as they lie within or in the circumference of the period of time in which they have been produced, and to remember that the greater circle includes the lesser. Taken in this way, we learn that in the wider circle of time the mortality of the nation has been reduced; while in the smaller circles there have been periods in which the reduction has ceased, or has even been replaced by a slight increase.

At the same time it must be confessed that improvement so far is extremely slow, and is, indeed, so finely balanced, it is hard to predict whether it will or will not be maintained. National health is national wealth, but the reverse is not equally true. National wealth is not, of necessity, national health. I fear the contrary is nearest the truth. If we could invent a social state in which health of life and wealth of life would co-exist, we should have a state where a noble intellectual civilisation would be combined with a very frugal mode of subsistence, with moderation of pleasure, and with such restraint of passion, that violence of character would never be exhibited by those who wished to be accounted sane. With this state would be connected all the external sanitary requirements for the maintenance of health, and to these advantages would be added a due prudence in respect to marriage, so that marriages would not be contracted until the married had the means necessary for maintaining the life of the offspring that result from their union. The last-named provision is possibly the primary and essential; for death is the shadow of birth.

A valuable lesson on this subject has been written by a very able reviewer, in relation to the life value of the inhabitants of the little town of Montreux, a parish in the canton of Vaud, in Switzerland. The facts, and the argument based on the facts, run somewhat in the following order. The records of Montreux, which had been faithfully kept for several years by the good pastor, M. Bridel, showed that the population was limited to two thousand eight hundred and thirty-three souls, and told all that related to the life-history of this self-contained community. The births were at the rate of one in forty-five, the deaths one in sixty-four, annually, or 15·62 in the thousand living. The writer compared this mortality with that of a Russo-Greek population existing at the same period of time, in which population the births were one in seventeen, and the deaths one in twenty-five, *i.e.* at the rate of forty in the thousand. Mark! says he, the figures which announce the proportional mortality of these contrasted communities. In the Russian community one-twenty-fifth disappear annually; in Montreux one-sixty-fourth. The Russian generations passed away more than twice as rapidly as the population of Montreux. Who would purchase the advantage, equivocal at best, of a triple number of births, accompanied by this enormous multitude of premature deaths? In Montreux, four-fifths of those born reached the age of twenty, while in the Russian diocese of Nisni Novgorod, out of one thousand baptized, six hundred and sixty-one perished before their fifteenth year. The nuptial garments of the mothers were the destined shroud of the first-born. In the Russo-Greek community the march of life, seemingly so fruitful and rapid, if it had been calculated by the birth rate alone, was, in fact, the most murderous in Europe. In the Swiss community the march of life, so seemingly slow, if estimated by the same method, was towards health and a steady and improving vital progress.

When this writer came to inquire into the cause of these differences, he traced the rate of death to the rate of birth, under conditions favourable or unfavourable to persistence of life. He found that the advance of a population, and its condition with regard to subsistence, are universally correlative, and that a state of comfort stands in relation to the rate of increase, either as cause or effect. If the rate is rapid, the state of comfort is in the relation of cause. If the rate is slow, the state of comfort is its effect. Thus the conditions of ease, and the consequent health of the social body sustained at Montreux, were due to the comparative slowness and circumspection with which its successive races were brought upon the scene of the world.

The secret of success for securing the low mortality, and a social state in which the happy circumstances of one generation were handed down unimpaired to the next, was assigned by this excellent writer to Swiss forethought and the virtue of continence. These civilised peasants of a Swiss village conserved their health, conserved their lives, maintained a condition of ease, and thereby a condition of social health, simply by the comparative slowness and circumspection with which their successive races were brought upon the scene of the world. In Montreux the nuptial garments of the mother were *not* destined to serve as the shroud of the first-born.

It would be urged that the comparison I have borrowed between the death rate of a community of Switzers and a community of Russian Greeks is not strictly applicable to our communities of modern English type. Unfortunately the comparison admits of application. For the Russo-Greek population of a past day I may substitute an English community of the present, which cannot, in the ordinary sense of the term, be considered less civilised than Montreux was forty years ago. In Liverpool, from the year 1861 to 1870, the deaths were at the rate of thirty-nine in the thousand annually. For the little Swiss population at Montreux it would be difficult to substitute an English population of the present day in which the deaths are at the rate of less than sixteen in the thousand as a regular occurrence.

Whatever may be the favouring influences, then, of our modern civilisation,—and no one can fail to admit there are favouring influences,—they must be accepted, qualified by the knowledge that they can only prove their value when they are sustained by moral influences which lie apart from them in a sanitary point of view. The fact is obvious that some communities, by virtue of certain physical or moral laws, exhibit a high standard of health and longevity without being dependent for their health and longevity on what we sanitarians call strict formal sanitary rules. Nay, they exist sometimes in the absence of, or it may be in opposition to, certain of the sanitary rules on which an exaggerated or faithful reliance is commonly placed.

III.

JEWISH VITALITY.

THE effect of social prudence on health and life is strikingly illustrated in the history of the Jewish communities and their vitalities, in modern times.

The Jews, spread throughout the world in small clusters of population, have been unusually healthy and tenacious of life. That they should exist at all is one of the marvels of history. That they should exist as they do, and present the vitality they do, adds even marvel to marvel. Of no other people can it be so truly said that the advancing civilisation of the nations in which they have been cast has been a ban and a curse. Yet concerning them the saying is too true. From the time of their great revolt under their last great leader, Barchochebas, in the reign of the Emperor Adrian, a revolt which ended in the complete destruction of their city as a home for them, their career has been one incessant struggle with fate for very life. From the time of Justinian and Justinian law, they have had to compete not only with the difficulties caused by nature, but with the legal difficulties raised by more cruel and more specifically directed powers against them than those of nature, viz. the powers of the men who gave them permission to live and be persecuted. They have been debarred political rights and social privileges. They have been born in circumstances most unfavourable to healthy development: they have been forced to live in special and overcrowded quarters of great cities. They have been pressed to supply the wants of their oppressors, when their own wants were far greater than were the wants of those who oppressed them. They have been often deprived of the highest services which the healing science gave to their more fortunate and favoured compeers. They have been cut off from advantages of education which to others were offered in the choicest forms.

In the midst of all these adversities and deprivations the Jews have continued to live, and, what is more remarkable, have continued to live exhibiting a healthier life and a longer life than others amongst whom they have been cast. In every country to which the modern statistician has turned his attention, and has found material on which to estimate the vitality of the Jews, and to compare that vitality with the vitality of the people immediately surrounding them, the result has been as favourable to them as to the Switzers of Montreux, or the natives of Monmouthshire in the beginning of this century. Some examples of these results are deserving of our attention.

M. Mayer, in the year 1864, made a series of observations on the relative values of life of the conscript population of the town of Fürth. The physical population of Fürth was, he states, at that time poor and mean, so that the number of conscripts exempted from service on account of infirmities and defective height was greater by one-half in Fürth than it was in Munich. His calculations, therefore, were made on a population which, whether it were Jewish or Christian, was of an inferior physical character; and they are the more valuable on this account, since they present the facts derived from two populations, both of which were poor, with one, the Jewish, labouring under some disadvantages not felt by the other. Under these conditions there was observed during ten years a notable difference in favour of life among the Jews. This advantage was most distinctly evidenced during the first periods of life. Of children from one to five years of age the Jews lost 10 per cent., the Christians, or, more correctly speaking, those who did not profess the Jewish faith, 14 per cent. This tenacity of life was traced as belonging to the Jews during every other stage of life until the age of sixty. From sixty to seventy the mortality was at the rate of 12 amongst the Jews, and of 9·8 amongst the other part of the conscript class. From seventy to eighty it was 9 per cent. amongst the Jews, and 8·9 amongst the others. From eighty to ninety it was 8·1 per cent. amongst the Jews, and 2·4 amongst the Christians and others who did not profess Judaism.

The results of these calculations indicated that through every phase the vitality of the Jewish people was superior to that of the surrounding people with whom they were cast. At first sight it may seem that the Jews who had passed the age of sixty were less healthy and more disposed to die, either from premature old age or from disease, than the other conscripts. But the inference, as Mayer shows, would be wrong. The greater mortality of the Jews above sixty was due to the circumstance that a much greater number of them lived to die beyond that period of life. Even at the age of between eighty and ninety so many were left that their deaths could be counted in the proportion of 8 per cent., compared with 2·4 per cent. of their immediate neighbours.

From Fürth the inquiry was carried to Frankfort, a town in which some of the most remarkable chapters of Jewish life have been written. In this town the modern Jews have laid the beginning of that extraordinary wealth, the end and influence of which, for good or for evil, for themselves and for others, has yet to be seen; a wealth that will probably bring about the strangest revolutions that have yet been realised in their strange history; a wealth that may make them the kings of the world or destroy them altogether. In Frankfort the Jews have lived until lately in their own quarters; they have had few social advantages, as such advantages appear to the mere politician, to the man of pleasure, or even to the masses of mankind. It is no insult to them, because they have not deserved what they have suffered, to say that they have as yet barely escaped the thraldom of a people living by permission and resting upon mercy sanctioned under legal prohibition.

It would be difficult to invent, for the purposes of our present inquiry, a series of conditions more critical than have been actually presented to us in the mortality statistics afforded in Frankfort by the two communities of Jews and Gentiles. Both were living, in the general meaning of the word, under the same kinds of civilisation, but socially the Jews were hampered while their fellow-citizens were entirely free. The Jews had closer quarters, they were reputed to be less cleanly than their neighbours, and though some of them were, confessedly, very rich, the mass of them were, or were supposed to be, poorer than the majority of the citizens. They had no direct hand in making the laws, and altogether were not, at first sight, to be envied. What under these states of relative existence were the relative values of their health and life?

The answer to this curious question is given by Mayer from evidence carefully collected by Dr. Neufville in Frankfort. The average duration of life of the whole population, Jewish and Christian, was thirty-seven years and seven months. But the mortality was unequally divided. The average duration of life amongst the Jews was forty-eight years and nine months; amongst the other classes of the community it was thirty-six years and eleven months. During the first five years of life the Jewish children died at the rate of 12·9 per cent.; the children of the other classes at the rate of 24·1 per cent. Of the Jews that passed into manhood or womanhood 54 per cent. reached their fiftieth year; of the other classes that passed into manhood or womanhood 38·1 per cent. reached their fiftieth year. Amongst the Jews 24·7 per cent. attained the age of fourscore and ten; amongst the other classes 13·4 attained that nearly ripe maturity. In the total, one-fourth of the Jews lived to be twenty-eight years and three months old, while one-fourth of the rest of the community lived to reach six years and eleven months only. One-half of the Jews lived to be fifty-three years old; one-half of the other classes lived to be thirty-six only. One-fourth of the Jewish population attained the age of threescore and ten years; one-fourth of the other population barely attained the age of fifty-nine years and ten months. These general rates of mortality in Frankfort, common to the communities at large, extended, according to Neufville, into special orders. Of one hundred commercial men amongst the Jews, fifty died before reaching the age of sixty-one. Amongst a hundred of the same occupation, not Jews, fifty died before reaching the age of fifty-seven.

An eminent French statistician, who prepared for his Government, a few years ago, an elaborate paper on the vitality of the Jews,—I refer to M. Legoyt,—has reported some equally important facts relating to the Jews in Prussia between the years 1859 and 1861. He corroborates what has been stated by Mayer and Neufville as to the greater value of Jewish life in the earlier years of existence. He indicates that the number of still-born children, that is, of children who die before, during, or soon after birth, was in 1849 one still-born child in 97·75 amongst Jews, to one in 44·86 amongst other people. He shows that from 1859 to 1861, in one hundred births in Prussia, the proportion of mortality was 48·11 amongst the Jews to 66·33 amongst the other classes of the country.

From these experiences Legoyt assumes that the average life of the Israelites ought to exceed that of the general population. The fact, he adds, is so. The difference to their profit is about five years. The civil state extracts in Prussia impute to them 1·61 deaths in a hundred, while for the whole kingdom the mortality assessment is 2·62 in the hundred. The population increases 1·36 in the hundred among the Christians, and 1·73 among the Jews, annually. The effectives of the first require a period of 51 years to double themselves; those of the second a period of 41·50 years. In 1849 Prussia calculated one dead in 40·69 Jews, and in 32·26 of other classes. From a table of mortality which he constructed from data included between the years 1855-9, Legoyt drew as conclusions: firstly, that at birth the average life of the general population was higher than that of the Jewish; secondly, that at all other ages the Jews had the advantage; thirdly, that as regards the Jewish women their average duration of life did not attain that of the whole population up to the age of sixty years, but beyond that limit it became higher.

IV.

JEWISH VITALITY IN ENGLAND.

SOME other details bearing on the vitality of the Jewish people and conveying the same truths are before me. From them I submit one more series of evidences, because they are quite recent and original, and because they refer to our own country.

We have in England, as yet, no collected official documents bearing on the divisions of classes of people in respect to race or religion. We know from the admirable census returns how many persons of different trades and occupations there are amongst us. We know that in the twenty-two millions seven hundred and twelve thousand two hundred and sixty-six persons of both sexes who made up the population of England and Wales in 1871, there were six hundred and eighty-four thousand one hundred and two who were professional persons; five millions nine hundred and five thousand one hundred and seventy-one who were engaged in domestic or household affairs; eight hundred and fifteen thousand four hundred and twenty-four who were commercially occupied; one million six hundred and fifty-seven thousand one hundred and thirty-eight who were Adam's first journeymen, tillers of the soil, agricultural workers; five millions one hundred and thirty-seven thousand seven hundred and twenty-five who were toiling and spinning in the busy hives of industry, industrials; and eight millions five hundred and twelve thousand seven hundred and six who — being either boys and girls at school, or persons of rank and property, or persons doing nothing to gain a livelihood—were all classed together under the head of indefinite and non-productive persons. We know how many of all these classes were males or females, how many were married or single, with various other pieces of important information. But up to this time the facts which relate to racial peculiarities, to families, to modes of life springing from habit, education, and thought, remain unrevealed in this kingdom. The reasons that are commonly urged against the collection of official data on these points have always seemed to me to be puerile, and indeed to be the foolish results of prejudice, I had almost said of superstition.

However this may be, the fact remains that we cannot ascertain on any determinate scale what the influence of the closest inner social life of the people is on the vitality of the people. In relation to the Jews, who stand out more distinctly than any other class, we cannot estimate their numbers accurately even in London, to say nothing of the country. From two good sources of information, each of which I should have considered to be reliable, I have heard different statements,—one saying that there are twenty, the other that there are forty thousand Jews in the metropolis. Thirty thousand is probably nearest to the actual truth. Owing to these circumstances, it is impossible for me to place before my readers any such series of facts as those they have gathered from the labours of Mayer, Neufville, and Legoyt. I have nevertheless a short record to offer which bears on our subject, and which is, as far as it goes, of considerable interest.

Dr. Asher, the secretary to the Great Synagogue of Jews in London, has supplied me with the data of the number of burials of Jews in London, as they are officially known, for the three years 1873-4-5. In the tables thus supplied to me there are recorded the ages of all who were buried from the age of one month to that of ninety years. The total number of interments in the period named was two thousand five hundred and sixty-three. Of these, one thousand and eighty-four were not members of the Great Synagogue, and they are simply returned under this general head. One hundred and seventy-two were members of the families of seat-holders of the Great Synagogue. The rest were members of families belonging to the Hambro', the New, the Central, the Bayswater, the Borough, and the North London Synagogues. One thousand and twenty-six were males, one thousand one hundred and nine were females. In twenty-eight instances the deaths were premature.

Taken alone, the facts thus supplied are of little value. Fortunately, however, they admit of being compared with the tables of mortality at different ages of the whole population of London. What, then, at the same ages, are the relative proportions of deaths of Jews to the deaths of the whole population?

The answer to this question is that the vitality of the Jews in London contrasts, as elsewhere, favourably with that of the members of other classes of the community. In the earlier periods of life, viz., under five years, the favourable comparison is not so peculiarly marked as in Frankfort, but it is indicated. The rate of mortality stands in the relation of forty-four of the Jewish to forty-five of the whole population.

In the meridian of life, viz. from thirty-five to forty-five years, the contrast is better marked; for now the rate of mortality stands at the rate of five of the Jews to eight of the other classes. But it is at the more advanced ages of life that the contrast comes out with special force. At eighty-five years and upwards the number of Jews that died were 2 to 0·8 of the whole of the community; that is to say, the Jews who had passed fourscore years were nearly three to one, when compared with their neighbours of different faiths. It is worthy of notice that in the Jewish, as in other classes, the longevity of the women exceeds that of the men. Eleven Jewish women passed over ninety years of age, to five men; and fifty-three women died between eighty and ninety years of age, to twenty-two men of the same age. Between the ages of sixty and seventy years the balance was a little in favour of the men: eighty-nine men died within that period of age, to eighty-three women.

It is further worthy of remark, that in the younger ages of life the Jewish male mortality was in advance of the female. Thus of males over ten and under twenty, the deaths in the three years were as thirty-six males to twenty-four females, and from five to ten years the deaths were as fifty males to thirty-five females.

Of the Jews themselves, from whose history the returns that are before us have been obtained, nothing can be urged to show that they, more than others, derived special advantages from what is popularly called civilised progress. Those of them who lived in foreign towns were mainly of the poor of those towns; and amongst the two thousand five hundred and sixty-three who died in London, and the facts of whose deaths are given in Dr. Asher's tables, no fewer than two thousand and forty-eight, or close upon sixty per cent. of the whole, were denizens of the east, north-east, and east central districts of the great city. It cannot be presumed that any of these were under special privilege, that they should live so much longer than their fellows. Neither can their greater vitality be presumed to occur because they were Jews; for the inhabitants of Montreux were not Jews, and the people of Monmouthshire, to whom I have referred, were not Jews; yet both these presented a similar good vitality, a vitality which contrasted forcibly with that of other contemporary classes.

From all the facts above related two great inferences may be drawn. The first of these is, that civilisation, when it lifts man out of the savage state, adds to health of life and to length of days. The second is, that civilisation, when it gives to civilised man more privileges than he deserves or requires; when it ministers to his passions and perverts his freedom; when it forces him to extremes of labour; when it promotes premature marriage and excessive growth of population,—then civilisation itself lapses back into practical barbarism, and nature, maintaining her unswerving and wise course, pursues her way even with death on her wings.

V.

NATIONAL HEALTH.

WE English, as an insular people, take a just pride in that great national property called the navy. Our grandparents learned, from one of the popular school catechisms of their day, that "the founders of the English nation, having been cut off by sea from the rest of the world, became mariners, at first from necessity; but what at first appeared an inconvenience turned out in the end so much to their advantage, that they were at last acknowledged by all nations to be the undisputed lords of the ocean." One of our powerful morning papers has lately in other words repeated the same. "Were we to publish every morning the declaration that the very existence of Great Britain depends upon her fleets, it would be the iteration of a truism, but the most useful one that could be got by heart."

For my part I think, with all respect to the ancient and the modern writer, that there is another national interest which has, or ought to have, precedence even over that which attaches to the fleets. I mean the life that yields the force of the fleet. Of what use is it to give outward protection to the island, to surround every inch of it with walls of iron, unless the inner force,—the force of life which lies behind these bulwarks of the sea,—be carefully and effectively preserved? Our national strength is vital; it is in our homes before it reaches our ships; it is in ourselves, not in our cannon, which are but the thunderous mouthpieces of it. If it be not maintained, all external protection will be of little ultimate value in the face of opposing nations that shall learn to combine, with the acquirement of civilised progress, an advance in healthiness and productiveness of life in human forms. Before such developing prowess, mental and physical, all dead resistance, whatever its weight, whatever its bulk, will be of poor avail unless it be vitalised in proportion to its weight and bulk. A whale with a harpoon in its back gives up its mighty strength to half-a-dozen men in a cockle-boat, whom it could lift into the air with a frisk of its tail if its vitality were not ebbing away through the small wound.

Our present condition and position as a nation depend entirely on our national health, and on the endurance and progressive force of our national vitality. Weak communities, criminal communities, beget their like; strong communities, moral communities, beget their like; and weaker and wickeder, or stronger and better, are the steps onward, according to the direction primarily taken. Health is necessary, in short, to make health. This is the first principle in the primer of the physician.

To have health we must first make it. It comes, we say, by nature; it departs also by the same channel. It is correct to say that it comes naturally from the observance and application of certain rules which we have learned; but it also goes naturally whenever those rules are broken or disobeyed. If a man eat animal food that is free of animal parasites, it is natural that the food should build up his muscles, and help to sustain his life. If a man eat animal food infested with parasites, it is natural not only that the food should build up his muscles and sustain his life, but that the parasite he has taken into him should develop and increase within him, should live on his vital organs, and kill him outright. Ergo, he who would subsist on animal food and preserve his health must learn something beyond the experience that animal food will sustain him. He must learn, in addition, to avoid food containing parasites. He must also, by continuance of the same acquirement of precepts of health and other rules of pure art derived from human experience, learn many other truths; but the example I have given will suffice at this moment for the argument.

I employ this illustration and the argument it is intended to enforce because I want at once to impress on the mind that health, national and individual, is something to be acquired by learning, and that it does not come to man by any royal road, as a gift that asks no labour before it is bestowed. The poets have, I know, put before us their visions of Saturnian reigns; of universal health and happiness in some favoured regions; of richness, peace, and splendour now unknown. Such poetic visions I am the last to despise. They are the expressed and beautiful associations of finely attuned souls, whose wishes were fathers to their thoughts, and whose faiths in human progress were the wings of their wise and beneficent desires. But the hard facts in the history of human life on the planet, as they have been passed down to us in reliable readings, offer no evidence of the mortal elysium of the poet in any recorded history. The chapter of the life of the universal man, as it is so far written, is the picture of the man fighting with the elements, and being slain by them, yet having wisdom to conquer them when he has learned wisdom. A picture of a fight with difficulties for dear life;

of a fight to learn how to win; of a fight in which the knowledge of to-day has been torn down by the ignorance of to-morrow; of a fight followed by long waitings for new men and new lights; of a fight with ebb and flow of success from century to century.

Such has been the struggle of the world of life towards knowledge of life. Such, with diminishing tension, must the struggle still remain until all the world is vanquished by knowledge and that application of it which we call wisdom. With a few exceptions, which indeed hardly amount to exceptions, and which if they did would faithfully prove the rule, the rule has been that in the transition of man from the savage into the civilised state his health and strength and power have become developed and improved. He has gained experience and knowledge, and he has learned to apply his knowledge with advantage to the progress of his physical existence. The surest and soundest proof of this is that the civilised secondary man has everywhere conquered the savage primitive man. He has conquered because he has possessed more power, more skill, more means. In other words, because he has been physically greater, mentally greater, socially greater, all of which influences indicate that the conquering man is healthier than the conquered. The standard of comparison may be rude or refined, but it is present in some one or other degree.

Owing to the contact of knowledge and wisdom with ignorance and superstition; owing to the fact that knowledge and wisdom, commencing in small centres, have had to conquer all the world, so far as they have conquered; and lastly, owing to the fact that knowledge and wisdom have themselves been reached by devious ways—sometimes combined, and even then very feeble; often alone, and then all but extinguished—it has followed that the science of preserving health, through art, has been slowly perfected—has not, indeed, until our own time been worthy the name of a science.

VI.

MODERN PROGRESS AND HEALTH.

IN ideal moments we may be allowed to contemplate the existence of conditions in which communities shall live in perfection of sanitary splendour. It is allowable to picture to ourselves days of peace, knowledge, wisdom, and plenty, when all possible advances, as they to us appear at this time, shall be realised; when premature death shall be looked upon as an accident, death induced by ignorance or neglect as homicide, and misery arising from want as so hideous a social deformity, "that to be hated needs but to be seen."

These days are, I fear, afar off. That they are possibly near is indicated by the circumstance that some of us can in the extreme distance see them, and describe, in a feeble manner, what they are likely to be. When they come, as they will, they will not perchance be perfect, but will open the view to other vistas which new eyes will then strain to discover also afar off. For still will remain those who, repeating the words of a civilisation ages before ours, will say, "I gave my heart to seek and search out by wisdom concerning all things that are done under heaven: this sore travail hath God given to the sons of men to be exercised therewith."

While, then, we anticipate the future and hopefully set up our standards of excellence, we must not walk as in a dream, but rather work wakefully to set forth the future within the present, so that all changes leading to what may be considered Utopian results may come by such natural footsteps that to the beholders they shall steal without perception of the radical transformations they will accomplish. We must work, in fact, remembering the aids we can call into the labour of reformation; the characters of mind that have to be drawn into the labour; the demonstrations of good that have to be made clear and repeated; the prejudices that have to be removed, and the hopes that have to be engendered. He is no sanitary reformer of the true school of reform who cannot comprehend all these points of view in the great discussion on the argument *sanitas sanitatis*.

The advances which have been made in the appreciation of sanitary matters have been, in this country, of the most certain and satisfactory kind during the life of the passing generation. A little more than a quarter of a century ago I,—then one of a very small body indeed of sanitary scholars,—was struggling to establish the first *Journal of Public Health* in this country. The effort was abortive. No publisher would touch the work, and so few subscribers would assist, or promise me assistance, I shrank from the project for a time in despair, to be dismayed still more on seeing a similar attempt by an esteemed colleague and friend, the late Hector Gavin, come to grief. At last, after three years of preliminary labour, I ventured, in 1854, to bring out the first number of the *Journal of Public Health and Sanitary Review*. Backed in the enterprise by the council of the Epidemiological Society of London, who gave me their valuable Transactions for publication, and in return purchased a certain number of copies of the *Journal*, I commenced with some advantage, and I think the *Journal*, as I look at it now with a more practised eye, was fairly conceived. The motto I invented for it, "National health is national wealth"—a motto which has since passed into a proverb, and been ascribed to Benjamin Franklin and other authors, but which was original,—has been itself of some little service. The *Journal* was ably sustained by its contributors, and as on the list of contributors the name of nearly every then known sanitary reformer in England was enrolled, it may be some time of use, historically, on the record that has yet to be written of the progress of sanitary science in this country.

Since the period of which I have spoken the changes of public opinion that have taken place on matters of sanitary science are so great as to be startling when they are recalled. The tabooed subject is the subject of the day now. Every household circle is full of it; the legislative chambers are charged with it; the press finds it one of the most taking, as it is certainly the most useful, of subjects of debate; the medical profession—which, with a noble self-sacrifice, has always been foremost in the work of sanitation—is moving in its behalf with a zeal that might reanimate Hippocrates himself; and, best proof of all, poor authors and students, and shall I say enthusiasts on the subject, like myself? find they have at last a hearing and a success in their labour.

Never did Shakespeare write a thought more perfect in its truth than when he said—

> "Teach thy necessity to reason thus,
> There is no virtue like necessity."

The saying has been most faithfully exemplified in the history of sanitary science in England.

The necessities of the Crimean campaign formed the means by which the progress of sanitary work was made sure amongst us. The principles had been taught long before. The great philosopher, Lord Chancellor Bacon, had proclaimed them in terms so remarkable, they ought never to have been forgotten; and all through the second quarter of the present century there was a struggle on the part of men of science to bring the national mind to a correct comprehension of what was needed. The Crimean disasters were, however, wanted to create the deep impression, and to quicken the national heart to steady and effective work.

At this moment we are so fully alive to the risks our forefathers have in their ignorance accepted, and are so eager to make our generation a better foundation for future generations, that the prominent danger lies in proceeding too rapidly in what is considered to be, but is not proved to be, reform of national health. All intended reforms, to be safe in their course, must be gradual in their development—must grow, as the solidest and finest trees grow, and like them must probably fall out of leaf for a while, that they may renew their life after repose from active growth. Such reforms must be founded on actual knowledge, and must be understood by the masses in the order they are set forth. This statement, which holds good in a general sense, is specially true in relation to sanitary inquiries; for so intimately is each step in the art of preserving health mixed up with social questions of various kinds, that a few false moves, or impracticable and perhaps unscientific attempts hastily made by amateur sanitarians for the purpose of doing something, may merely do harm ultimately to the cause they were intended to support.

I make these observations because it is obvious to me, and to many others who, like myself, are by education and occupation specially devoted to the pursuit of sanitary knowledge, that the efforts which at the present are being made by the Parliament and by many public bodies are undertaken without regard to system, and without any definite or comprehensive object. The elements of the sanitary question are few in number, but they lie much deeper than is generally supposed. Many recent and notable health measures are but temporary in their character, and scarcely calculated to affect the great questions at issue, either for evil or for good.

There is a strong feeling abroad at this moment that legislative enactments are capable of doing service in the preservation of health and the suppression of disease. I do not deny that a decision in a law court may occasionally check or remove some real or supposed cause of disease. But I doubt the correctness of the principles of coercion, and more than doubt the general competency of all the men upon whom may devolve the duty of inflicting fines and penalties on those adjudged guilty of breaking the law.

VII.

THE ART OF HEALING.

FROM wounds inflicted on man, in his battles with the elements and forces of nature surrounding him, and in his battles with his fellows or with the lower orders of creation, the means for the saving of life first assumed practical form. In the earliest stage of the contest the men who, in their might, fell from disease were smitten. They were felled by an unseen hand. The catastrophe was a mystery which could only be penetrated by mysterious learning. Thus arose those learned men who, entrusted with the ministrations of the art and mystery of healing, became the ministers of health. Thus appear the primitive healers who seek not to arrest the hidden hand that struck the mysterious blow, but to cure the injury the blow has inflicted. They enter into secret communion with nature, *φυσις*, for means of cure, and they invent the art, the *φυσικη*, the physic. In time they are the physicians.

For many ages the physician remains as he originated, the would-be repairer of the rents and scars caused by the accident disease. Of necessity he learns much that is useful, much that is beyond all praise; and in the inspired sentiment of ancient Greek art,—the same art virtually as that which gave us the all but speaking figures of stone and marble,—he is sublimed into immortal form, and "because he cultivates a rude and as yet vulgar science with a little more subtlety, is received into the number of the gods."

The physician in this character of the curer is indeed a useful servant of mankind. He is the learned historian of disease, and in unbroken line hands down priceless records of the course of disease. He is the expounder of the scholastic readings of his brotherhood. He observes and writes down the details of different diseases with a care that has no perfect parallel. He seeks amongst all the recesses of nature for remedies against the diseases he has witnessed. He finds a few remedies, in the finding lights upon things he was not looking for, and founds new sciences. The elements, minerals, and plants he touches have properties and qualities which perforce arrest his attention. He submits them to fire for purification; they yield him products that are entirely new. He subjects them to gentler heat for sublimation; they yield him in condensation other new products which were not before extant in nature. He is a true necromancer now, a professor of the *kimia*, or concealed art; and he gives chemistry to the sciences. Those plants in which he seeks for hidden healing virtues cannot pass long before his eyes, nor pass often through his hands, without telling him that they have relationships towards each other which look something like the relationships of families of men, or of animals. Therefore he begins to classify the plants, and the general name of the plant, βοτανη, becomes the name of a science. A bit of the substance we now call amber, picked up on the sea-shore, when it is subjected to friction, attracts light bodies, like straw, if they are brought near to it. A bit of iron ore, dug up near the town in Turkey in Asia that is now called Manisa, once the town of Magnesia, attracts iron and confers its own power to other iron. The wonderful ore, called from the place whence it was derived, Magnes, becomes in his hands a specific instrument, a *magnet*, and from the study of the magnet springs the science of magnetism. Our physician looks into these mysterious phenomena. The properties of the substance on the sea-shore, ηλεκτρον (*electron*), as it was originally called (amber, as we now call it), came under his survey, with the result of his finding that the same properties extend to glass and other bodies which, being rubbed, attract it in like manner. To all these substances he applies an original name; he calls them, after electron, *electrics;* he classifies the phenomena altogether under the term *electrical;* and, generalising upon the whole, inaugurates the science of *electricity.*

In dealing with the delicate organs of the body he has to manipulate parts which lie directly under the hand; so chirurgery—χειρ, the hand; εργον, work—surgery—is added to his labour. He invents skilful instruments for this handicraft, and refines the mechanical arts. He dissects the bodies of the dead to learn the animal organism; unclothes the body to the skeleton; separates and reconstructs the bony framework; founds anatomy; and when the time comes for finding in deep chambers of the earth the preserved skeleton remains of animals long since dead or even extinct, he has prepared the way for another study—which, indeed, he originates—the study of ancient living things, paleontology. His eyes turn to the heavenly bodies to discover, as in a book mysteriously opened to him, the destinies of men. Anon he begins to read the motions of the wandering fires, and his aid is brought to the cultivation of the astronomy of the learned world. In a later day he endeavours to comprehend the functions of living organs in men and animals, to determine the relationships of man to his lower life-mates, of man to man, of life to life, and straightway biology is raised into a special place in scientific systems of thought. Later still he strives to grasp the organic changes which the body undergoes in disease, and in this direction collects a library of facts which, yet unarranged, wait for a reading that shall yield a rich harvest of knowledge to the generations which are still to follow his and ours.

It would, indeed, be hard to magnify the skill and learning of the healer, rendered, as both have been in such great and varied ways, through the ages that have run their course. But he has been the healer purely, and not until these last days, almost our days, the preserver of health. The omission has been his misfortune rather than his fault. He has moved with the world in which he has lived, influenced by its views, guided by its discoveries, fulfilling its requirements.

Men altogether have only recently commenced to look at themselves in their national as distinct from their individual characters. Men altogether have but recently commenced to look at anything antecedent to the actual phenomena presented to their senses. So in respect to health they have thought only of their own particular sufferings, and in respect to disease they have considered merely the symptoms they have been obliged to witness. To perceive the fact that the national interests cover the individual, and that he who is striving to improve the health of all his brethren is doing the wisest thing to improve his own; to perceive the fact that whenever disease appears it has come into appearance through a well-defined series of causes, many of which are recognisable and removable; these are the modern perceptions of a few minds, which have to be communicated to the many.

The physician, whom I have traced from his origin, trying to cure diseases with one hand and inventing new sciences with the other, has had enough to do to keep on his laborious way. He might be pardoned if he had been led, rather than had been the leader, in the science of prevention of disease, and in teaching the national aspect of the question of sanitation. For professions, like persons, are greatly influenced by professed habitudes of thought. It is the business of the physician to cure the evils which the world has inherited or acquired. Why should he go into the questions of cause? The questions raised may be political. Is he to be a politician? They may be social. Is he to interfere with the daily life of his patients, turn their homes upside down, criticize their eating and drinking, find fault with their clothing, instruct them in their working, and guide them in their amusements? Far better were his hands employed in curing diseases with one hand and inventing new and different sciences with the other, as in the olden time. This is the self-interested argument, cutting like a two-edged sword, one edge for the fortune, the other for the art of the healer; a fortune that may be moderately envied, an art in the cultivation of which there is much that is fascinating to the inventive, courageous, and, above all, ambitious mind. All profit, all honour, to him who, having a disease under his care, cures or seems to cure it! No fortune, no honour, to him who waits to cure a disease which science, forestalling herself, has said shall not exist to be cured.

VIII.

THE ART OF PREVENTION.

THE physician, descending through the long line of history I have, by so light a stroke of the pen, indicated, has been true to the greater interests of the world in which he has been cast. So soon as the advancement of learning and popular prejudice gave to him liberty of action he began to study the national as well as the individual health. He began then to look at causes of disease; to balance the value of vitality against mortality; to dare to tell his fellows, "You would not want me to cure you if you would learn how, by a few rules,—simple when they are learned, and sources of unknown happiness when they are practised,—to keep yourselves well."

This is the message of the physician, as he now stands on the stage of the world, to the men and women and children before him.

It would be difficult to say who amongst the healers was first to begin to write the letters of this message. Some of the inspired amongst them of all ages have, like Virgil, sung of the grand days of universal health and happiness that were to come. Others of them have taught, by example, a perfect regimen. Of these the illustrious Galen was the great example. Galen, who in his youth was feeble, but who lived to a good old age, learned early in life so to govern himself that he allowed nothing to disturb the serenity of his mind, and never raised a hand to correct a slave. He carefully studied what aliments and exercises best suited himself, and adhered to these; he taught his followers never to degrade themselves to the level of the brute creation by eating and drinking whatever pleased them, or by indulging their sensual appetites. He tried to teach all persons he knew, whether they were wise on the subject of physic or ignorant of it, how they might, by the careful management and purity of their lives, so live that physicians and remedies would be to them alike unnecessary. In later days the Arabian schools of physic had their teachers of regimen; and since the revival of letters there have arisen at intervals such men as Arbuthnot, Hoffman, Hufeland, Haygarth of Chester, and Cheyne, who, following the thought of Plato, have entertained the belief that the very existence of physicians in a republic is a proof of the vice of the people.

One other idea has also filled the minds of all these advanced scholars and masters, an idea in which they and many others not less eminent have joined with one accord, viz. that health and happiness are synonymous terms. They have taught that he who fears to limit himself to those wants and methods which keep his body in health, lest by so limiting his desires he should lose some pleasure in which he thinks his happiness is involved, is a deluded man; that he who trusts to the health of his body, and thereby of his mind, for his serenity of life, and for the full development of the pleasures that are to be found in life, is the wisest of the wise, and the happiest of the happy.

Step by step the mind of the healer became opened to such new thoughts, and as the change occurred new views offered themselves to his comprehension, which led him into details as decidedly practical as any that related to the older subject of cure. An enlightened Italian physician (and it is wonderful how indebted the world is to the Italian schools of physic), one Ramazzini, commenced a century and a half ago—nay, nearer two centuries ago—to study the effects of the labour of artisans on the health and vital value of the labourer. He specially studied the kind of labour that is carried on in flax-working, and defined the evils of that occupation with a degree of accuracy which has not been surpassed. He was followed by many more in the same line of research, and in the present century, through the further exertions of Thackrah and other observers, we have arrived at a very clear idea of the influence of industrial labour on health and life. The knowledge that has thus been brought forth has culminated during the present year in the production of a series of statistical facts, collected under the direction of Dr. William Farr, from which the relative values of life in sixty-nine well-defined occupations have been compared by a certain standard of general life, and results have been obtained which are unexampled of their kind. I shall have occasion to draw special attention to these results in a future chapter.

From the Italian physician, Ramazzini, there dates largely another advance in the project of preventive medicine. To him we owe an early suggestion for making observations on the relation of weather and season in connection with diseases, and particularly with diseases which take the epidemic or spreading type. Before the time of Ramazzini, other men had touched on this subject. Hippocrates himself must be credited with much that is ingenious and useful, and our own English physician, Sydenham, who flourished in the time of the Commonwealth, must be remembered. But Ramazzini gave the direction to progressive thought, and even organized a society for securing the continuance of his design. In the past fifty years the Ramazzinian mode of investigation has been marvellously developed. Learned societies, such as the Epidemiological and Meteorological Societies,—both groaning under viciously hard names, by the way,—have been founded, and a varied number of useful truths have been elicited. Three examples of these are sufficiently curious and important to be noticed. It has been discovered that the body of the living man begins to lose in weight at a certain season of the year, and begins to gain in weight at another season. It has been discovered that certain diseases show a maximum or minimum of mortality at particular seasons. It has been discovered that with a given fall of temperature of the air, a proportionate number of persons die according to the period of their ages, the deaths doubling in number, under the same degree of exposure, with each addition of nine years of life amongst those who have passed thirty years of age.

The progress of the preventive system of meeting diseases has been advanced by yet another medical means. I refer to the *accidental* observation and application of observation by men of genius and courage, who have been educated in the ranks of medicine.

Among these men of genius, who have thus observed and learned, the first place must be given to Jenner. He observed that the process of vaccination prevented the communication, and therefore the spread, of small-pox. We in this day are, happily, quite unable to estimate the value of Jenner's discovery directly or indirectly. It stayed directly the ravages of the most loathsome disease that was ever known. It stayed indirectly, in proportion as it stayed the disease itself, all the many and terrible secondary consequences which follow small-pox, such as deafness, blindness, affections of the bones and joints by which the body was crippled, eruptive diseases of the skin and fearful disfigurements of feature and form, with, in some instances, development of those organic and fatal changes to which the names of struma and consumption are applied. In countries where vaccination has been thoroughly carried out the disease, small-pox, may be said to have become all but unknown; and it is to be hoped that in time the disease may be entirely abolished, and that the preventive measure which has so singularly controlled it may pass, if not out of memory, out of practice.

In the study of other great pestilences, such as typhoid fever and cholera, physicians of modern times have made many advances towards arriving at preventive means; but from none has so happy a discovery been elicited as that of vaccination for small-pox.

From another branch of study started within the ranks of physicians has been derived the statistical method of research, which of late has yielded important results. The brilliant Arbuthnot, the accomplished friend and companion of Swift, Hogarth, Pope, and other members of the galaxy of wit and wisdom of the reign of Anne, he to whom Pope wrote, "You are fitter to live or to die than any man I know"—he in the earlier part of his career wrote to the Royal Society an essay, entitled, "An Argument for Divine Providence, taken from the constant Regularity observed in the Births of both Sexes." In this paper Arbuthnot showed that there is nearly an equality in the births of the two sexes, but that as the mortality of males is greater than that of females, so in a slight degree more males than females are born into the world. To illustrate his point, this learned author included in his paper a table of the births of both sexes occurring in London from the years 1629 to 1710.

From the research thus established by Arbuthnot dates properly a method of numerical calculation, which has largely influenced the modern scholar in his studies of the values of life and of the mortalities which accrue from particular forms of disease. The science of vital statistics dates from this communication.

To the precepts of the wise professors of the healing art must, in justice, be added those of some other men, who are called, *par excellence*, the philosophers. All the philosophers are in some degree worthy of recognition as promoters of national health. Æsop's fable of the belly and the members is an admirable sanitary lesson. Plato and Seneca are rich in wisdom on the subject of health. The "Utopia" of Sir Thomas More is charged with splendid precepts for the maintenance of the universal health, and Lord Bacon is so clear in his methods of research and rules that if his designs had been carried out, the foundations of sanitary science had been safely built upon three hundred years ago.

PART II.

AIR AND LIFE.

IX.

VITALIZED AIR.

NOMADIC tribes, living mainly out of doors, or covering themselves in from the rain and wind in canvas tents, take and require but little care in regard to ventilation, since they interfere not with atmospheric laws. But when men began to erect stone walls, to hedge themselves in from the atmosphere with impermeable barriers, and to pollute their confined dwellings with their own emanations, supreme nature was defied, and the defiants paid the forfeit always visited on such delinquency. Under these circumstances the principle of ventilation, as it is called, was introduced and various ways and means were suggested, by which the atmosphere may be made subservient to the designs and life-methods of men who had learned to build. In the early days of architecture, when real stone or wood houses were first built, the necessity for any special attention to ventilation was uncalled for. In those days, when light was admitted into the building by means of large open casements, the air went in with light, and was as freely diffused. In the old Roman house, with its *compluvium* and numerous unbarricaded windows, the ventilation must have been perfect and simple. But when it became the fashion to let in the light alone, and thus to cut off the air from the same entrances, then the evil effects of confined air in houses became a necessity, in the absence of some new means for its free admission and after removal. This inconvenience was felt the more in places where great numbers of people were placed together in one limited place, as on board ship, in the wards of a hospital, the compartments of a prison, or even in the closely built streets of a city. What amount of disease, what amount of death, must have ensued for many centuries from absence of pure air, and whilst men were ignorant of the actual value of air in its relation to life and health, it is impossible to say.

For many ages after the days of the old Roman literature, little of worth is met with on the vital properties of air and the importance of a free air current. For sound instruction on these points, the world had to wait for one whose physiological labours are amongst the most remarkable records of natural science in the beginning of the last century. We may date all our knowledge of ventilation from the time of the distinguished Rector of Teddington, Stephen Hales, that is to say, from the year 1733, when Hales' treatise appeared, in which the subject of ventilation of houses was first scientifically considered. We can scarcely over-estimate the richness of the labours of this remarkable scientific scholar, or the change of sentiment, opinion, and knowledge that came from them. They lie at the foundation of much of our sanitary work, and they have led to studies which, though at the present time seemingly too remote to hold connection, are, when traced back with careful mind, markedly, and I may say sensitively, connected with his particular discoveries.

The Rector of Teddington shows forth more strikingly from the position in which he was placed in relation to the progress of chemical science in his time. The nature of gases was then not understood; for although the existence of oxygen gas had been dreamed of and suggested by Maow, under the term nitro-ærial air, and although the Honourable Robert Boyle had shown that ammonia exposed to the air gains in weight, as if it seized some other substance from the air which caused the additional weight and became a "fixed air," the nature of this so-called "fixed air" was unknown, and least of all was it suspected to be a product of the human body, a something breathed out with every human breath. The analysis of gases was unknown. Yet, by one of those simple series of observations which the fortunate and honest in science make for themselves, Hales demonstrated that the air we breathe is substantial, is a thing. He measured the air we breathe, said that the capacity of the human chest for containing it is two hundred and twenty cubic inches, measured the cubic inches inhaled at each inspiration, and discovered approximately the loss sustained in the lungs by the absorption of some part of the air, the nature and quality of which he could not determine. Further than all this, and most german to our present work, he stated the effects of the re-respiration of expired air, and indicated the dangers that follow upon the operation. "Two gallons of air," he says, "breathed to and fro for two minutes and a half become unfit for respiration. Whence no wonder that the air should be infected and apt to breed distempers in close prisons, where not only the breath but also the plentiful perspiration of many confined together stench the air, and make it apt to breed what are called gaol distempers." In another place he lets us know that he was conversant with an alkaline air in overcrowded rooms which was most deleterious.

This essay of Hales was so plain that he who ran might read. It appears incredible that after his disclosures the whole of the ruling mind of this nation was not devoted to the reformation of the unhealthy state of the nation. It is incredible, but too true, that years later the heaven-born statesman, William Pitt, blinded and choked the nation by the reimposition of the window-tax, the effect of which two-edged political folly was to put back sanitation a good fourth of the time that has passed between Hales and ourselves.

The work which Hales commenced was, however, never lost; it was held back, but it was not forgotten. The navy was the first to reap the advantage, and the ventilating bellows of this remarkable inventor, called not inaptly the ship's lungs, were extensively introduced into the naval service. Later on, Sir John Pringle introduced the system into hospitals for the sick, and long before the eighteenth century closed the idea of pure air as a part of the necessity of a healthy life was an accepted scientific fact.

Thus the value of pure air in occupied buildings became known a century ago. The knowledge acquired was weakened by war and politics, sustained by science, and favoured by the philanthropic efforts of such grand men as Howard, who, though unconnected with science, always move with her in her beneficent designs.

From the purification of the air in ships, hospitals, and gaols, and from the results obtained, men began at length to think of the purification of the same necessity of life in their own houses. The advance was crowned by two other discoveries. (*a*) By the discovery by Priestley of the true composition of the atmospheric air, and of the nature and qualities of that part of it which he called vital or dephlogisticated air, and which has since been known by the more common name of oxygen gas. (*b*) By the discovery of Black that the air of combustion, the fixed air of Boyle, the carbonic acid of a later day, is a product of animal respiration and of animal combustion, and is the fatal product which Hales had observed but had not defined.

We got into our language from these researches the word ventilation, and many plans were quickly tried to render the process of ventilation perfect. Soon another step was made, for which we have once more to thank immortal Joseph Priestley. He took a living vegetable, a sprig of mint, and placed it in carbonic acid. After a time he found the carbonic acid was removed from the bell jar in which the plant was retained, and in place of it there was another gas, the vital air, oxygen. He inferred thereupon that vegetable life is essential to animal life; that leaves of trees use up the poisonous air that we exhale, and give us back the vital air we require in which to breathe. A new sanitary work was rendered. It was made a demonstration that the presence of vegetable life is a necessity for perfect purification of the air on the breathing of which the animal life depends.

X.

USES OF AIR.

THE uses of air to man and his lower earth-mates are not easily comprehended at first sight, they are so varied and, to the uninitiated, so subtle. The effect of the ordinary atmospheric pressure on the body is a first essential to healthy life. It is by this pressure, exerted uniformly over every point of the body, that the corporeal framework is the more firmly knit together. We are, as it were, cast in moulds of air. Removed to a mountain height, where the atmosphere is lighter and the pressure diminished, the body suffers, to borrow a description from Dr. Speer, "with symptoms (varying in degree and number in different individuals) of vertigo, headache, dyspnœa, constriction of the chest, palpitation, faintness, oozing of blood from the mucous surfaces, increased rapidity of the pulse, nausea and vomiting, thirst, febrile tongue, muscular pain, sense of extreme debility in the lower limbs, and general prostration of strength"—results arising, according to the author, from a threefold source: congestions of the deeper portions of the circulatory apparatus; increased "venosity"—in plainer words, impurity of the blood; and "a loss of equilibrium between the pressure of the external air and that of the gases existing within the viscera."

The symptoms thus induced bear, in the opinion of Dr. Speer, a close analogy to those of an ephemeral fever—a remark of great importance in a physiological point of view.

The pressure exerted by the atmosphere on the body is very nicely balanced. If it be increased by artificial means as it sometimes is, as in the case of men who are working under pressure, the effect of the increased pressure is seen in symptoms of a peculiar kind. The blood in the veins becomes like arterial blood, of red colour. The number of the respiratory movements is increased, the pressure on the drum of the ears is painful to bear, the skin acts very freely, and the sense of hunger is greatly increased owing to the rapid waste of the body, while that of thirst is diminished, from the circumstance that more moisture is conveyed into the blood with the compressed air.

The pressure of the air atmosphere then, of fifteen pounds weight to the square inch, is the natural pressure limited within slight variation. It is adapted to the living condition, as it is one of its uses to be so adapted.

But there is another use to which the ordinary atmospheric pressure extends. Under its influence the lungs are kept charged with air. When the chest is expanded in the act of inspiration, the pressure of the atmosphere causes the lungs to fill with air and to follow up the expansion of the walls of the chest. During the act of expiration, on the other hand, the entrance of external air into the lungs is in a great measure prevented for the moment, and the external air itself becomes the recipient of the expired gases.

Thus the mechanical effects of atmospheric pressure on the body are most important, and the effects of extreme variations of pressure are well mapped out by certain striking symptoms. How far the effects of those lesser variations of pressure which occur at ordinary levels, and which are indicated by ordinary barometrical changes—how far these exert a physical influence on the body, is yet a question open to an extended series of observations and experiments.

A second important use of the atmospheric air relates to its influence on the animal temperature in a physical point of view. As the heat made in the body passes off from it at every point by radiation, it commingles, to use a common term, with the atmospheric medium in which the body is encased. Thus, if the external atmosphere be cooled far below the level of the body, then the radiation of the animal heat is so vigorous that an arrest of vitality, more or less marked according to the degree of cold, becomes necessarily manifest. A great variety of physiological changes in this case supervenes. Nutritive acts, which are dependent for their continuance on a full development of heat, are impeded; the great chemical changes of respiration, the absorption of oxygen, and the evolution of carbonic acid, at first increased, are afterwards reduced; internal congestions follow, and the circulation fails in power. Lastly, the soft structures, under the extreme of cold, shrink; the capillaries contract—merely, in all probability, from the loss of heat; and the whole of what in the aggregate sense may be called the vital forces are, in a greater or lesser degree, checked in their course.

When the temperature of the external air is raised towards a level or above that of the body, the due radiation of heat is checked. Then the reverse of the above conditions obtains: the nutritive and destructive changes of tissues are accelerated, the muscles are relaxed, the capillaries easily dilate, and the secretions are profuse from the skin, the lungs, and the kidneys. But this exalted condition of body can no more be tolerated than can the opposite, for any length of time. The chemical forces of life are here too actively engaged; they must be brought back to steadier play, or they will stop altogether.

The happy medium for equalising the temperature of the body is the atmosphere. We instinctively perform something for ourselves in this respect in the use of clothes, of which we put on more or less as sensation tells us. But it is our air-garment, or mould, which does most. If this naturally retains an equality of warmth —60° to 70° Fahr.—we are comfortable; if it capriciously change about from 32° or less up to 80° or more, we must put it under some certain rules: we must confine it in sections, in rooms where we live, and artificially warm it, when it is too cold; we must give it free vent, lower its temperature, and make it flow in a brisk current through our rooms when it is heated and close.

XI.

AIR AS A FOOD.

THERE is another use which the air around us plays in regard to the men and animals who live in it, as at the bottom of an immense air lake or sea. The scientific world nowadays recognises air to be a food, as much a food in its way as beef and potatoes in their way. The old saying about the chameleon—

> "Stretched at its ease the beast I viewed,
> And saw it eat the air for food"—

is thus no poet jingler's fancy, but a fact. Air is food, the first food of man and everything that lives. The chief sustaining element of the air inspired in breathing is oxygen, which forms a fifth of the whole of the atmosphere. The nitrogen, which forms the remaining part of the atmosphere, and is usually said to be the mere diluting medium of oxygen, is, however, not altogether inert, for a small portion of it taken in by each inspiration is made use of, or, at all events, does not return in expiration. In an experimental research I once made on the subject of artificial respiration, I found that the average quantity of air received into the lungs of a healthy adult man at each ordinary inspiration is fifteen cubic inches. This is but a small portion of that which he is capable of receiving, for his chest has a capacity for two hundred and twenty-five cubic inches, and he has still a reserve portion in store—a bank of air. Before the expired air leaves the lungs, the products of waste which are to be cast off from the blood are diffused into the air with which the lungs are steadily filled. This provision is admirable, in that it keeps the interchange of pure air for impure air going on in the lungs in one unbroken current, places the command of the respiratory act in a partial degree under the will of the individual, and prevents mishaps which might arise from a temporary suspension of respiration from becoming immediately fatal.

The lungs in health are thus always charged with air. This air, carried to the extreme ramifications of the air-tubes, and thence into the air-cells, of which there are in the human lungs as many as six hundred millions, is brought into indirect contact with the blood, which is circulating round the lungs from the right to the left side of the heart. I say into indirect contact, because the air-cells are lined with membrane on their part, while the blood which plays over them is itself also enclosed in plexuses of vessels, almost infinitely minute, so that there is an intervening membranous screen between the air and the blood. Here, in this fine but expansive network of air-cells and blood-tubes, do the interchanges of air and blood take place through the membranes. Here the blood returning from all the body, through the right side of the heart, gives off its gaseous products of combustion. Here the same blood is subjected to the absorption of oxygen, the small quantity of nitrogen already spoken of, and some amount of water. The oxygen, if not the nitrogen, is *food*, and thus the process of respiration is a process of alimentation. Going round with the blood to all parts of the body, this oxygen supports all the acts of nutrition, helps to build up new, assists to remove old tissues. The chemical phenomena of life are, in fact, described in the term oxygenation.

There is yet one other important fact to be considered in relation to air and man; namely, the liberation of animal heat. We have seen that the atmosphere is the grand external medium for regulating the temperature of animal bodies. It is also the grand medium for supporting the temperature of these bodies. The process of animal heat making is again a process of oxygenation, not specially carried on in the lungs, it is to be understood, but in every part of the body where oxygen enters into combination with tissue so as to give rise to a new combination.

Thus in all parts of the body where the blood brings the oxygen there is set up a slow process of combustion with generation of heat, and with sustainment thereby of the natural animal warmth. The little bodies called blood corpuscles, which float in myriads in the blood, seem to be the bearers of the oxygen. They fix it in the lungs and carry it away into the extreme parts of the circulation. There it is used up in the process of combustion, and combines with carbon to form a compound gas called carbonic acid. As this new gas is formed it is also mainly fixed, as I found by experiment, by the red corpuscles of the blood, and is carried back through the veins to the lungs to be given off into the external air, during expiration, in exchange for oxygen that is taken in by inspiration.

In the experiments which I have made on the power of the blood to take up and fix oxygen and carbonic acid, I discovered that for the blood properly to take up or absorb oxygen it is necessary for it to be first charged with carbonic acid. When it is so charged and is brought into contact with air it immediately gives up the carbonic acid and absorbs the oxygen. As the change of gases occurs there is an instant change in the colour of the blood. From being dark, almost black, in colour, it becomes of bright vermilion red; and this change is always taking place within the body so long as the body is alive and in health.

If under any adverse circumstances the changes of air and blood cannot freely take place; if the carbonic acid be retained in the body; or if, when it is exhaled by the lungs, the lungs in inspiration do not take in air properly charged with oxygen—then the whole surface of the body becomes of dark colour, the breathing is oppressed, and the muscles are convulsed; the consciousness is lost, the temperature falls, and death quickly takes place if the absorption of oxygen be not speedily resumed. Hence the immense importance of breathing at all times a pure and natural air. If even the air do not contain so much carbonic acid as to produce the serious symptoms I have above described, if it only contain from one to two parts in the hundred diffused through air, it is still hurtful: it interrupts vital action, it causes headache and nausea, impairs the appetite, and reduces the powers of both the body and the mind.

XII.

DIFFUSION IN AIR.

WE have seen that the air, by the pressure it exerts on the living body and by the mode in which it affects the animal temperature, produces the most important effects on life. We have now to consider another property of it: its power of removing the gases and vapours which exhale from the body by virtue of what is called the law of diffusion. From the lungs at each expiration, for example, fifteen cubic inches of impure air are yielded, or about as much, says Dr. Neil Arnott symbolically, as would make up the bulk of a full-sized orange. At the moment of expulsion from the chest by expiration, the expired air is heated to nearly the temperature of the body, viz. 98° Fahr., it passes into the atmosphere, floats up in it, becomes diffused, and is at last by wide-spreading brought to nought.

As, then, the heated vapour from the breath escapes, it passes away and fresh air is inspired. Why the air thus thrown off does not come back, in part at least, at next inspiration, direct into the lungs of the individual who casts it off, is due to "diffusion."

When two liquids of different densities are put together—say oil and water—they do not remain long in the happiness of a united pair. The oil, taking advantage of the density of the water, floats to the top and makes for itself a very comfortable water-bed, where it reclines uncontaminated, as all may see. But if two gases of different densities, such as carbonic acid (a heavy gas) and hydrogen (a light gas), be mixed together, they continue mixed—as free gases, be it observed, but commingled freely. Nay, if a jar of light gas be inverted over a jar of heavy gas, so that the two gases are brought simply into communication, the two at once agree to unite in the most friendly fashion. The heavy gas rises, the light gas descends, and in the end there is a complete admixture.

The discovery of this tendency on the part of one gas to diffuse into another gas was made by Dalton, who pushed his argument by demonstration so far as to lay down a scientific rule to the effect that gases of different kinds and densities offer no resistance to each other, but run into each other as they would into a vacuum. The labours of Professor Graham have since shown that the diffusion process takes place in different gases with different degrees of rapidity, and that gases are not absolutely vacuums to each other. But the final result is the same as though they were, since it has been proved that gases do, in fact, rush into a vacuum with velocities corresponding to the numbers which have been found to express their diffusion volumes, *i.e.* with velocities inversely proportional to the square root of the densities of the gases.

Of the cause of this mutual diffusion of gases we are not so clear. There is yet another great law to be discovered in this direction. But it is sufficient for our present purpose to know the fact that no gaseous matter can be set free, whether from the animal body or from aught else, without being at once freely diffused in the great ocean of the atmosphere as though practically it were being spread through a great vacuum.

It is impossible to overestimate the magnificence of meaning implied in this grand natural law. This great aerial sea, forty-five miles deep each way from any point of the earth's surface, and into which we insignificants can but raise ourselves with the help of bricks and mortar some few poor hundred feet—nay, into which our madcaps who try to pierce heaven from a gas-bag cannot penetrate more than a mile or so —this great aerial sea, how competent it is for the end had in view! how capacious a chamber it is for the distribution of coal-smoke, human breath, volcanic vapours, and gaseous poisons innumerable!

The winds must not be forgotten. The winds, great mechanical agitations of the great atmosphere in the great chamber, are always mixing up everything on a large scale, as if some enormous maelström were perpetually at work in the universe; but all in order, all according to the first law—Order. The wind movements, however, and all the effects of admixture springing out of them, must be carefully distinguished from the diffusion process; that is to say, there must be no relationship of cause and effect introduced between them—none such exists. The diffusion process is a fact of itself; it takes place in air in a state of rest, as well as when such air is in a state of motion.

XIII.

OZONIZED AIR.

SCHONBEIN, a German physicist, discovered that oxygen may assume a new form, to which he gave the name of ozone. In general terms the word refers to a gas possessing a peculiar odour. It is a negative word, conveying no accurate idea of the composition of the substance—and, perhaps, this is an advantage to science rather than the contrary, at least for the present time—the word, that is to say, is meaningless, and might, from its derivation, *οζεω*, "to smell," apply to any gas that is odorous. But because it is meaningless as a definition, it pledges itself to no theory or hypothesis as to the elementary construction of the substance it designates. When that constitution is discovered, and all chemists shake hands over it in cordial agreement, it will be good time to change the name if that be desirable, and let the designation define the substance as it really is in its essence.

The circumstances under which ozone may be presented are to a considerable extent known. When an electrical machine—a common frictional machine—is set in motion, and sparks or flashes are taken from the positive conductor, ozone is developed, and its characteristic odour is readily detected. When water is decomposed by electricity, ozone appears, with oxygen, at the positive pole; in fact, according to one view, the oxygen is simply in an active state, ozonized. If oxygen, nitrous oxide gas, or carbonic acid gas be placed in a glass jar, and electrical sparks be passed through the gas, ozone is developed. Ozone may also be obtained by gently heating the end of a glass rod, and then immersing the said end in a jar through which rectified ether is diffused in vapour.

A ready way of making ozone is to take sticks of common phosphorus, scrape them until they have a metallic lustre, place them in this condition in a large bell jar, and half cover them with water. The air in the bell jar is soon charged with ozone, and a large room can be readily supplied with air in the ozonized state by this process, if the air in the jar be made to pass into the room in current. In this way ozone is sometimes diffused into the sick room.

To make ozone on a large scale, an apparatus invented by Siemens is the best. A cylinder of glass is covered neatly on its surface with tinfoil, in the same manner as a Leyden jar. Then within this cylinder a smaller cylinder, also coated with tinfoil, is introduced and fixed with cork. The two free ends of the large cylinder are closed with corks well coated with sealing-wax varnish, and each cork is perforated so that a small wooden or glass tube may be inserted. There is thus formed a chamber of glass lined with tinfoil, and if a bellows be attached to one of the small tubes, and air be driven from the bellows, it passes through this chamber and can be collected as it escapes at the opposite end. To ozonize the air that may be sent through this chamber, it is now only necessary to discharge electrical sparks through the chamber while the current of air is making its way. To effect this, the coating of tinfoil on the inner and the coating of tinfoil on the outer cylinder are each armed with a fine platinum wire. These wires are connected by their free ends with the poles, one wire to one pole, the other to the opposite pole, of a large induction coil. The coil being set in action by the power derived from a Grove's battery, electrical discharges are made in the chamber of the cylinder, and the air is richly ozonized. The silent discharge of the coil is better than the spark discharge.

Such are some of the methods by which ozone is artificially produced; and however produced it, appears to have the same properties. It is therefore assumed to be the same substance as derived from all these sources, and it is now believed to be condensed oxygen.

On dead matter that has become putrid, ozone acts with great vehemence as a deodoriser or purifier. This it effects by decomposing the products which emanate from the putrefying body, and the effects are the same in the most offensive compounds.

The first important fact I would like to impress, is that the substance called ozone energetically destroys the putrid emanations of decomposing animal substances, and, even after they are long dead, restores to the dead matter certain of its properties which, though in truth they are always physical, are vulgarly called vital. We might turn this fact to some great account in the matter of decomposing animal food. If the butcher were a scientific man, he could at little expense restore to wholesome freshness and purity a portion of the changing flesh which now, at bad seasons of the year for preservation, he is obliged to cast away.

By some grand process ozone is produced in the atmospheric sea which surrounds our planet. It is estimated to exist naturally in the proportion of one part of ozone to ten thousand parts of air. I cannot vouch for the entire accuracy of this computation, because the amount, according to our present mode of estimating it, seems to fluctuate, and no sufficient number of experiments have been made in different portions of the world to allow of a correct average being determined. We must take one part in ten thousand as an approximate, not an actual value.

The natural process leading to the production of ozone in the atmospheric sea is not as yet understood. At first electrical storms were conceived to be the means of production. Then Professor Dove advanced the idea that the ozone is generated in the upper equatorial currents of air, and is by these diffused over the planetary surface with the north and south winds. And again Dr. Moffatt, whose labours in this department of science cannot be overestimated, considers that ozone is connected with the phenomenon of phosphorescence, and that, in short, it is produced in nature at large as we have seen it produced in the laboratory as a result of phosphorous oxidation. Of all these theories, that of Dr. Moffatt is the most simple, and is perhaps best supported by observation.

When we know the two facts that ozone purifies decomposing organic substances by breaking up the offensive deleterious products of decomposition, and that it exists naturally in the air we breathe, we might infer that it fulfils some useful purpose in the universe without speculating rashly. But we have no occasion to speculate at all, for we find as a positive fact, sustained by the most perfect evidence, that ozone *is* usefully employed, and that in truth it is a great purifier of the impure air of city and town. It is now proved that the ozone in air, after it is diffused through town and city, is no longer to be detected there by the most delicate tests for its presence. Hence it is said to be lost in towns. In other words, it is used up in the process of destroying those exhaled substances which pass from the bodies of men and animals, and which escape from the organic débris that necessarily accumulate in and about every human habitation.

XIV.

USES OF OZONE.

THE condensed oxygen, called ozone, as it is the great purifier of the dead earth, so perchance it is the physical purificator of the living animal. The light shines doubtfully here, but the direction of it is to show that when oxygen gas is brought into contact with the blood in the living lungs, it is in part transformed into ozone, and that the subtle active agent is doing its work more secretly, but as certainly, within the tissues of the organism as in the world without.

The physiological effects of ozone are destroyed by heat, and are obscured or prevented by extreme cold. In experiments to show the effects of ozone on animal respiration, I found that a temperature not lower than 65° Fahr., and not higher than 75°, should be sustained.

There is a condition of atmospheric oxygen in which that gas exhibits an opposite condition to its ozonized condition. There are different methods of proving this, which I have not space to describe, but I may state that in some experiments on the reinhalation of air many times over I was able to reduce oxygen to such a negative state that it failed to support life. The act of purifying such oxygen from carbonic acid and other tangible impurities had no effect in rendering it better fitted for the support of healthy life, but ozone at once restored to it active power.

In this negative oxygen animals die as if under the influence of a narcotic. In it the destruction of the products of organic decomposition is greatly impeded, and the presence of such products speedily renders it intolerably offensive; dead animal tissue rapidly putrefies in it, and wounds in the bodies of living animals become sanious, dark, and unwholesome.

We may gather from what has gone before a few facts bearing on hygienic measures, general and special. We may learn that as ozone is used up in crowded localities, and as its presence is essential for the removal of the products arising from decomposing organic remains, no mere attention to ventilation, however important that may be, can suffice to make the air efficient for supporting healthy life unless the air be rendered active by the presence of ozone. Hence it is an absurdity of the worst description to build hospitals for the sick in the midst of the crowded localities of the poor, and to ventilate them with air that has swept its way over a sea of ammoniacal compounds derived from the living and the dead, unless pains be taken to charge them with ozonized air. Human dwellings built on the borders of lakes or pools charged with organic débris, or built near manure-heaps or over sewers, or on ground saturated with putrefying substances, become necessarily the centres of the fever type of disease; not by necessity, as is vulgarly supposed, because the inhabitants are conscious of a "smell," but because the air they breathe is reduced in active power, and poisons are being generated around them to which they are constantly exposed, and before which they fall a prey.

In time we shall take care to conserve ozone where it should be conserved, to supply it like light in places where it cannot be always secured naturally, or to neutralise it if, like the Roman centurion's soldiers, it comes when we do not want it.

In ozone another generation may actually see an article of commerce, and even now an "ozone company" might prove itself not merely a useful, but, as a sequence, a paying concern. Such a company could deodorise, disinfect, and give sea air to every household that required it. The "supply" could be as manageable as coal gas and as cheap as water. With due precaution, the lieges might make use of the agent as safely in their households as men of science make use of it in the laboratory.

XV.

OZONE AND DISEASE.

WHEN air containing an excess of ozone is breathed for some minutes it produces, first, a sense of irritation of the nose and throat, with sneezing, and soon a dull heavy pain in the head, and headache more or less severe. After a time there is a watery discharge from the nostrils and a free secretion from the back of the throat. When the inhalation is over the symptoms gradually subside, and I have never known any bad effects follow, although the headache will remain for five or six hours. These symptoms are very decided, and have been experienced by Schönbein, Scoutetten, Wood, myself, and many other observers. As a class of symptoms they are, without doubt, identical with those which characterize nasal catarrh, or common cold. I do not believe that any of my learned brethren in physic would hesitate for a moment in pronouncing a person who was suffering from ozone cold as being affected with common cold, premising that the cause was withheld from his knowledge.

The inference, therefore, has been drawn that when common cold is the prevailing disease there is an excess of ozone in the air, and that the symptoms are due to such excess of ozone.

On this particular point the light we have shines doubtfully; the inference is fair and reasonable, but the actual proofs are not as yet afforded. The position is as follows.

A disease identical with catarrh can be excited by the inhalation of an air containing an excess of ozone. It has been shown, especially by Dr. Moffatt, that catarrh is common during what are called ozone periods, that is to say, when ozone is freely present in the air. But catarrh is sometimes present in a general form when, by the ordinary tests, ozone cannot be shown to be present in excess.

The theory, therefore, is not perfect in all its parts. It may be imperfect because our present tests for ozone are not sufficiently accurate; it may be that the test we employ is sometimes interfered with in its action by the presence of other bodies foreign to the atmospheric air. The test itself consists of a paper saturated with solution of iodide of potassium and starch. When this paper is exposed to ordinary air it undergoes no change; when it is exposed to ozonized air the potassium is oxidized, and the iodine being set free combines with the starch, forming iodide of starch. The iodide of starch strikes a dark blue colour, and the depth of the colour struck on the paper gives the theoretical degree of ozone present in the air. Schönbein and Moffatt each prepared test-papers, with scales, for comparing degrees of intensity.

The test being made more accurate, it is possible, and indeed probable, that in time ozone will be proved to stand to catarrh in the position of cause to effect. Nay, I have thought that local currents of ozone may probably be generated from the friction of air in its passage with violence through narrow channels, as when there is produced what is commonly called draught; and certainly an ozone paper colours more quickly in a draught than it does in a calm air. But, after all, these facts bearing on the connection of ozone with catarrh may be singular coincidences only. It is hard to think so lightly of them, but it would be unsafe to think more.

Speculation as to the influence of ozone in the production of disease has been carried much further by some authors. It has been argued that croup, diphtheria, quinsy, bronchitis, inflammation of the lungs, and pneumonia stand to ozone in the position of effect to cause. Presuming that common cold is really a product of excess of ozone in the air, there can be nothing more reasonable, or more fairly inferential, than that these other allied disorders follow upon the same cause. And, again, there can be no doubt that the disorders are most common and most fatal during the ozone periods, periods when ozone is most active; but, for the same reasons as were given in regard to common cold, the evidence is not decisive. The evidence that has been accumulated ought never to be forgotten by the man of science, and no opportunity for extending it and improving it ought to be let slip; but it cannot be accepted in any positive sense at this moment.

In a paper by Dr. Moffatt, read by him at the British Association for the Advancement of Science in 1865, he did indeed somewhat more than anticipate these successes. The paper is entitled, "Phosphorescence in connection with Storms and Disease," and in it he exhibited tables to show that the atmospheric conditions under which the luminosity of phosphorus takes place are those of the south or equatorial current of air, with a minimum of atmospheric pressure and a maximum of temperature and humidity; while those conditions under which non-luminosity takes place are the conditions of the north or polar current, namely, a maximum of pressure and a minimum of temperature and humidity. The atmospheric conditions of ozone and non-ozone periods are, he insists, the same as those of luminosity and non-luminosity of phosphorus. Phosphorus becomes luminous and ozone periods commence on the approach of storms, and if a storm sets in during a luminous or ozone period, the luminosity increases in brilliancy and the ozone in quantity.

Moffat also showed tables which he had prepared from observations on the luminosity of phosphorus, on ozone, and on the prevalence of diseases in connection with the system of meteorological telegraphy instituted by the late Admiral Fitzroy. From these it appeared that all the periods of luminosity commenced with the setting in of the atmospheric conditions, of the approach of which cautionary telegrams gave warning. Of diseases, 80 per cent. of apoplexy, epilepsy, and sudden death occurred on the days on which phosphorus became luminous.

The atmospheric conditions which lead to those storms are, he says, invariably accompanied by diseases of the nervous, vascular, and muscular systems. During the two years, one hundred and forty-three cases of those diseases came under his notice, of which 54·5 per cent. took place on telegram days, and 45·5 per cent. on other days similar in a meteorological sense to those on which the telegrams were issued, differing only in degree.

Although storms are accompanied by diseases of some kinds, they are, nevertheless, he maintains, of great benefit in a sanitary sense. They carry with them a supply of nature's deodorising and disinfecting agent—ozone. As far as he had opportunities of observing, he had come to the conclusion that cholera disappears with the setting in of the equatorial or ozoniferous current, as was the case at Newcastle in 1853, and in the London epidemic. During a cholera epidemic the barometric readings are high, a calm prevails, and there is no ozone.

In conclusion, Dr. Moffatt asks whether—seeing the intimate connection there is between periods of the luminosity of phosphorus and ozone periods, and of non-luminosity and non-ozone periods, and knowing that ozone is formed by the action of phosphorus on moist air—we may not reasonably look to phosphorescence as the chief source of atmospheric ozone?

XVI.

DEVITALISED AIR.

WE have seen that the air we breathe may be rendered impure by the presence in it of the products of breathing. We have seen that the air may be changed in quality by the influence of electrical discharge, and may possibly become injurious to health. There is yet another class of facts about the air which are newest of all, and which deserve to be mentioned on that account if on none other. To explain this set of facts I must trace the progress of research that led to them.

Many years ago the late Sir Benjamin Brodie and Mr. Broughton conducted a remarkable series of experiments on the effect of inhalation of oxygen gas in its pure form. The experimentalists named wished to determine what would be the effect of oxygen gas on animal bodies if the gas were breathed undiluted. Would the animal life be sustained for a longer or a shorter time in the pure oxygen? Would the combustion of the body be quickened in it? To arrive at a correct conclusion they placed living warm-blooded animals in chambers charged with simple oxygen, and beneath the chambers they placed, under a false perforated bottom, an alkaline solution, in order to absorb the carbonic acid which the animals produced in breathing. To the great wonder of the observers, they witnessed the fact that after a time the animals, inhaling what Priestley, the discoverer of oxygen, very properly called it, "vital air"—that the animals inhaling this vital air, instead of living more actively than they would live in an equal proportion of oxygen diluted as it is in the atmosphere, became languid and drowsy, and finally died in a state of sleep. When the observers removed the oxygen from the jar in which the animals had died, they found that the gas would support the combustion of a taper precisely as when it was freshly made, and they also found that it showed no evidence of the presence of carbonic acid gas. From these experiments, therefore, it was accorded that oxygen gas in a pure and simple state is a narcotic poison, and as such it was set down in every text-book that treated on the subject, for many years.

In the early part of my career I was led from the study of anæsthetic vapours to go over this ground, which had been so singularly opened. I thought it possible that oxygen might be used so as to make it actually a sleep producer, but I started also with the idea in my mind that probably there was some error in the original experiments, that the whole of the carbonic acid produced by the animals in the oxygen had possibly not been removed by the experimentalists, and that a small remaining quantity of the known narcotic (carbonic acid) was after all the cause of the phenomena that had been observed. I therefore commenced to experiment in a different manner.

Instead of constructing a chamber with a false bottom, and with absorbing fluid underneath, I so constructed the apparatus that from a very large store of pure oxygen a current of the gas should steadily and continuously pass. In plain words, I ventilated a room perfectly with pure oxygen instead of common air. In such a room I found that for weeks life could be sustained, and that no narcotic symptoms were developed. I also found that if the temperature of the oxygen were maintained at summer heat, the combustion of an animal body in the gas was increased—that the appetite was made voracious, and yet that the excess of food did not prevent wasting.

Clearly, then, it occurred to me that the first experimenters were wrong, as I had suspected, and that carbonic acid gas was in their case the cause of the sleep.

But now a new light came on the subject which changed the view and gave a much more important reading, a reading that bears manifoldly on our present study, and others allied to it. I was not a rich experimentalist, and I found that to ventilate a good-sized experimental chamber for several weeks with oxygen was a process too costly for my means. So I devised this expedient. I made a large store, eighty gallons, of oxygen in one reservoir, A, and by water suction I drew the gas gradually through the chamber into another reservoir of the same size, B, letting the place of the gas from reservoir A be taken by water let in from a tap. As the oxygen entered the chamber from A it was pure; as it passed out on its way to B it carried with it the carbonic acid that had been produced by the animals living in the chamber. In its exit from the chamber, in its course to B, the gas was stopped and purified: it was passed through sulphuric acid to remove ammonia, it was passed through potassa to remove carbonic acid, and then it was passed through lime-water; and until it passed through lime-water so clearly as to leave no trace of evidence of carbonic acid it was not admitted into the reservoir B. It was also tested in various ways in order to see if its physical qualities were those of pure oxygen.

When this purification was quite perfect the oxygen from B was repassed through the chamber into A with the same precautions as before, and I expected the same results as followed the process of ventilating with freshly-made oxygen. The expectation was not fulfilled. To my surprise, after a few passages of the oxygen gas from the reservoirs through the chamber it ceased to support the active life of all warm-blooded animals. Frogs continued to live in it unaffected, but other animals passed into the same torpid, narcotized state as Sir Benjamin Brodie had discovered in his research.

A further and very prolonged inquiry on this new basis of observation showed me that oxygen gas in contact with oxygen that has been breathed loses some quality which destroys its power of sustaining natural life. It may be made to resume its activity by treating it with electric discharges; it may be raised to activity by increase of temperature; but without such treatment it is practically inert for vital processes, though a taper will burn in it with the usual brilliancy.

In this deteriorated oxygen I found also that dead organic substances underwent more rapid decomposition.

Still further, I learned that the presence in oxygen gas of various vapours and products of decomposition interfered with the vital action of oxygen in the same way. I have no doubt that every one of those useful narcotic vapours which we employ in order to suspend sensation while painful operations are being performed effects the same change—that, namely, of arresting the vital action of oxygen gas.

Whenever we bring into the air we breathe any agent which reduces the activity of the oxygen, we subject ourselves, though we may not by any sensual perception be conscious of the fact, to an influence which depresses our vitality. By the old this depression seems to be felt less severely than might be expected. By the young it is intensely felt, and much of the feebleness of the young in crowded localities is, I believe, due to this special cause of deterioration of air.

XVII.

DAMP, DARKNESS, AND COLD.

WE have learned by careful research in modern times that the air may be deteriorated and made imperfect for the due sustainment of life by other causes than those already described. The presence of excess of moisture in the air is one of these causes. We recognise this cause under the term of damp, and when we say that the air of a house or of a place is damp, we at once express our knowledge of its unhealthiness. This is an old fact, but it has lately been much elucidated. We know now that damp air causes rheumatism, neuralgia, and pulmonary consumption.

We have made out more definitely of late the power of the sun to purify the air by various direct and indirect ways. We have learned the part which light plays in vegetation—how, acting upon the vegetable life, the chemical rays play the part of perpetual chemists to the world, decompose the carbonic acid in the leaf of the plant, fix the carbon for the plant, give up the oxygen for the uses again of man. But it is not, I think, generally understood how refined this process is, and how it is contravened sometimes by ignorant human ingenuity, or how potent it is for good when it is not crossed in its working. Let me give two illustrations of these truths.

I have recently been studying the effects on vegetation of those noxious vapours which are given off in the air from some chemical manufactories. I refer specially to those vapours and gases which escape from alkali works, and which so effectually destroy vegetation, viz. chlorine, hydrochloric acid, and sulphurous acid. In experimenting on the action of these gases on plants, I noticed amongst other effects that in their presence the chemical changes of the plant under the influence of light were reduced in activity. In explaining this fact to Mr. Norman Lockyer, he suggested as the reason that the presence of the gases named probably cut off the part of the sunbeam, the chemical rays, which cause the decomposition in the leaf. On testing this theory by experiment, the result came out as predicted. Mr. Lockyer was good enough to make a series of experiments for me to witness with him, in which it came out clearly that on passing the electric beam through atmospheres containing the gases named, the chemical rays were intercepted or cut off with more or less of decision, according to the admission of the gases into the air-tube through which the light passed.

Let me by a second illustration show the effect of light in purifying. A distinguished native physician of our Indian empire, Dr. Gopaul Chunder Roy, sent me for experiment some cobra poison. As it came fresh to hand it was found to be exceedingly fatal to animal life. Soon a portion of it which had been left on ivory points in a bottle was observed to have lost its poisonous power, while other points in a bottle wrapped in paper in a drawer remained active. This led me to test directly the action of light on this poison, and to find that sunlight so changed it, even in a few days, when the light was intense, as to destroy its poisonous properties altogether.

Such facts as these serve to impress on the mind, in thinking of improvements in houses and towns, what a necessary process is the purification from day darkness, and how important it is to let in the sun, the whole sun, and nothing but the sun. They also show, on the one hand, how easy a thing it is to destroy, or rather to cut off, a part of the sunbeam, and how bad a thing it is to cut off such a potent agency as that which will destroy an organic poison like cobra poison, and by analogy such poisons as smallpox, scarlet fever, and typhus.

One further truth has come out of late research. I refer to the influence of an equable temperature of the air on health and life. The wave of cold that passes from time to time over our houses is so decisively and sharply destructive to life in certain ages as to kill by a kind of geometrical progression. If on persons thirty years of age it produces an increase of mortality, the fatal effect doubles with every nine years of life. If it kill one person who has reached thirty, it kills two of thirty-nine, four of forty-eight, eight of fifty-seven, sixteen of sixty-six, thirty-two of seventy-five, and sixty-four of those who have attained to eighty-four.

Here, then, are some modern data for sanitary improvements and their relationships to life. These are the facts which sanitary science has gathered within this last hundred and fifty years, and mostly within the last twenty-five years.

Pure air, pure water, purity from damp, pure light, equable temperature. These are the five fingers of the right hand of health. Every builder ought to know them, every parent ought to know them, every child ought to be told of them, and the reasons on which they are based.

They are little known, and yet it is true that in questions relating to health, knowledge has immeasurably exceeded practice. If for the next twenty years not another new fact were added to our present knowledge, if during the whole of that time our energies were devoted to the direct application of the knowledge that has been obtained respecting the air and its uses, I doubt whether the capital of present information would be fully utilised.

PART III.

ALIMENTATION.

XVIII.

HEALTH AND ALIMENTATION.

HEALTH and Alimentation go so closely hand in hand, we may recognise in some characteristic series of healthy conditions the qualities of food on which they are sustained. We may recognise equally well from the evidences of certain forms of disease that either deficiencies of foods or unnatural kinds of foods are present in the diets of the diseased.

Buckle, in his desire to prove that all natural characteristics are due to a few simple physical laws, has dwelt unjustly on the influences of foods as determinators of such characteristics. He held it possible, "by the application of a few physical laws, to anticipate what the food of a country will be, and therefore to anticipate a long train of ulterior consequences." Hence he assumed that a particular food was natural to a particular community placed on special parts of the earth, rice to the natives of India, bread to men of these northern climes. In the view that the qualities of a people are determined largely by the qualities of the foods on which they subsist, the distinguished author of the "History of Civilisation" was right. In the view that each part of the earth specially provides the best foods for the inhabitants of that part, he was generalising too far. To a considerable extent it is true that in each portion of the world the people living on that portion find in the products of it all that they require, but not according to any particular design bearing upon that particular people; because, when all the facts are examined, it is found that such food as is really the best for one people or one race is the best for all people and all races. A community that is confined too severely to any one food is never a healthy community in the strict sense of the term, and a community that is truly healthy may safely be accredited with the possession of such a variety of alimentary substances as would sustain all the rest of the world with equal completeness.

The errors that have crept into the arguments on these subjects are due to other errors of a physiological and local character, from which such great observers as Buckle himself are not altogether and at all times free. For example, Buckle, from the premise that in India rice takes the place which in England is held by bread, and is the essential article of diet to the millions of India, has argued that rice therefore is the natural food of those millions, and has founded upon this assumption the generalisation I have quoted. But the premise was incorrect, and therefore the conclusion; for it is physiologically impossible for any human being to exist on rice, seeing that rice cannot yield muscular substance, and, as Mr. Cornish has most ably demonstrated, it is not true that rice is the essential article of diet to the millions of people who form the bulk of the Indian population.

The true scientific position of the question is that to form the healthy man anywhere and everywhere, the same qualities of food are required for him anywhere and everywhere; and when differences arise from differences of quality, they are not to be accepted as special results of natural selection for the particular welfare and health of a people, but as physiological variations resulting from varieties of food which may be very good or very bad, or indifferently good or bad, according to circumstances, and certainly without reference to such physical provision as Buckle has assumed. An East Indian may exist largely on rice because he cannot get other food; a Russian, for the same reason, may exist on rye bread; a Norfolk labourer on Norfolk dumpling; a Scotsman on oatmeal cakes. But because these foods are or may be to those who eat them the foods natural to their countries, it is not to be assumed that they are all-sufficient, or that they supply what is sufficient to maintain the most perfect standards of health.

I introduce the subject of alimentation in its relation to the national health with the above remarks, for the purpose of enforcing the principle that food has now to be considered in the first instance from a physiological point of view. The best method for feeding the people has always been a great political question. Plague, pestilence and famine, battle and murder, have in the most solemn manner been classed together, and of all these calamities famine perchance has most terrified the rulers of mankind. The time has come when the question of food supply must pass through the hands of the teachers of science before ever it reaches the hands of the politicians. It is the duty of men of science to show what is food in the most simple and necessary sense of the word. It is their duty to study what is sufficient quality of food and what is sufficient quantity. It is their duty to study, further, what is over-sufficient, what is under-sufficient, and what are the evils of over-sufficiency and of under-sufficiency.

In a reformed world the understanding of the food question will be simple enough. In the course of the present century science in the most wonderful manner of exactitude has discovered the elementary organic parts of the animal body, and has so analyzed the outside sources of those parts, from which the wasting body is supplied, as to know the precise value of all foods which are in common use.

By the first of these studies it has been found that the constitutional structure of the body is made out of a very few principles. Of water, which forms seventy-nine per cent. of the blood, eighty per cent. of brain, eighty per cent. of muscle, ten per cent. even of bone, and which is the fluid menstruum and only natural fluid menstruum of all the substances that are in solution. Of albumen. Of fibrine, which forms the solid part of the muscles. Of gelatine, which is found in bone, tendon, and cellular tissue. Of fat. Of phosphate of lime, which forms the earthy and resistant base of bony substance. Of chloride of sodium (common salt), and other saline substances which, existing in the blood, add to the specific weight of that fluid, and perform some secondary offices in the secretions. And, not to enter too far into detail, of the metal iron, which in the corpuscles of the blood makes them, as it were, into a metallic chain running through the whole circuit of the blood in all the minute ramifications.

By the second of these studies it has been found that all the constructive materials of a living body are made ready for the body outside itself, and that, with the exception of a portion of the water and of some saline substances, the materials for the body are made in the vegetable kingdom. The vegetable world is discovered to be the grand laboratory of nature in which, in line of continued experiment, with the sun as the furnace and source of energy, the products necessary for the animal life are elaborated and are so prepared that they are all but ready for use. One food which the animal itself more perfectly elaborates out of what it receives from the vegetable supplies,—I mean the secretion on which the mother feeds her young, and which may be accepted as the typical and, when it is taken from a healthy source, the perfected food, *milk*,—is the only exception to this rule.

Scientific inquiry has made these simple truths as clear as clearness can be, and, extending the observations from the particular to the general, has further shown that in all climes and under all conditions the elementary facts of construction are the same. Each living animal of the same construction requires the same materials for constructive purposes. The quantities of materials respectively may vary according to climatic necessities, more oleaginous food being required in one locality, more muscle-forming substance in another; but the qualities remain in all cases fixed by an arbitrary rule of nature, from which there cannot be divergency of action with persistency of health.

XIX.

ESSENTIALS OF FOODS.

THE course of investigation has led to the demonstration that the ultimate resolution of food within the body, during which and by which resolution the body is animated and sustained with animation, is traceable through what are termed technically the animal excretions, the excretions of the lungs, the skin, the kidneys, the bowels. Those products which the vegetable world elaborates by its chemistry resolve accurately, within the animal, into new products which approach at last to the earthy substances that in turn give food to the plants. Only the water remains unaltered: that coming to plant and animals alike from its primitive sources, continues as water and unchanged in chemical quality, though the medium in which all the changes of other substances take place, so accommodates itself to form of structure that it becomes, by combination, solidified in muscle, brain, bone, and sinew, fluid in the blood and secretions, vaporous in the breath.

Given, therefore, a fixed diet, the ultimate products of the animal sustenance will be formed upon it. The products due to the resolution of the fat-making materials will be evolved from the lungs as carbonic acid. The products due to the resolution of the muscle-making materials will be evolved by the kidney in the form of a salt known as urea. The products also will be eliminated according to the supply of the material from which they are formed. An excess of animal food will, for example, lead to an excess of urea in the renal secretion, and if the body be kept at rest the amount of urea secreted will hold a definite relation to the amount of animal muscle-forming matter that is consumed in the food.

Still more, we now read by the light of science that during the process of improper feeding certain internal changes of the body take place, which, though unseen while the body lives, are as definite as any of the changes of an external character that are visible in shape and form. From excess in the use of some foods extreme changes occur in the blood-vessels, by which the vessels are charged with fatty substance, and are thereby weakened or obstructed. By excess in other foods the minute muscular fibres are made to undergo degeneration, and the central muscle of the circulation, the heart, is reduced in its power and impeded in its functions. By other excessive uses of foods, visible or objective changes of the body are induced, such as obesity, eruptive conditions of the skin, and diseases as distinctive as that once terrible chronic plague of our naval forces, sea scurvy.

The diminution of food, the limitation of qualities of foods apart from quantities, leads, in its way, to special deflections from the standard of health of the most striking character. The extreme reduction of foods, and especially of muscle-forming foods, leads to the development of the contagious malady or plague called famine fever. The reduction of the inorganic bone-forming structure, phosphate of lime, leads to the development of a disease of the bones in which they, from suppleness, bend and give a misshapen skeleton.

Thus, without the introduction of any injurious foreign substances into foods and drinks,—and under the head of foods I include all that is capable of sustaining the body, be it in the shape either of food or drink,—there may be induced by feeding certain definite changes in the animal body, which changes invariably follow the error that is committed according to fixed rule, and which afflict alike, when they are in operation, men of every race, of every clime, and of every age.

In studying the effects of alimentary substances on the national health it is necessary, therefore, to consider in the first place the essentials of foods, what are wanted and what are not wanted. If we extract from them any part of what is wanted, the health is not maintained; if we put into them anything that is not wanted, the health is not maintained; if we give the right things in excessive quantities, the health is not maintained; if we give the right things in insufficient quantities, the health is not maintained.

Suppose we divide these essentials of food into their respective parts; they then present themselves before us in five groups. There is first and foremost the *water*, which we have seen makes up so large a part of the body as water simply and in its purest form. Secondly, there is the muscle-forming food, called sometimes, because the element nitrogen enters into it, *nitrogenous food*, or, because it assumes in the organism the colloidal or jelly-like state of matter, *colloidal food*, or, because it has been assumed to be derived from albumen, *albuminous food*. Thirdly, there is the saline, or, as it is sometimes designated, *mineral food*, of which the lime salt in bone is the most striking example. Fourthly, there is the *metallic constituent*, of which the *iron* present in the blood is the marked element. Lastly, there is the *hydro-carbon class of foods*—the foods which, burning within the body, sustain the necessary animal temperatures, and which have their best representatives in rice, potatoes, and arrowroot, and other starchy substances, sugars, fats, and oils.

XX.

PREPARATION OF FOODS.

BY a process of learning, by an experience in some sense scientific, yet standing apart from professed science as we moderns know it, man in the course of civilisation has arrived at the art of preparing foods so as to retain all their bases and basic properties. But though he has thus learned an art, and discovered various methods by which to divert and delight the palates of those who depend upon it, his labour has been too sensual to be wise and too crude to be economical. The refinement of culinary art, so far, has consisted in getting together more than sufficient of all the bases, in making the mess delightful to the sense of taste, and in leaving the system of the man who feeds on it to work out the problems of application and elimination. By this ignorance in art, or want of scientific direction, the health of the most civilised communities has been injured, sometimes fatally injured, by plenty. By the same ignorance the health has been injured, sometimes fatally injured, by famine in the very midst of plenty, if the plenteousness could but have been seen and judiciously applied.

At the present hour throughout the whole of our communities these great errors of art in relation to food are in active existence. The sensual appetite rules the roast, and proclaims its determination to be gratified at all costs. The rich man feasts on his mixed incongruous foods and drinks, as if his body were made solely to be the servant of his luxurious desires. The poor man takes his common fare half cooked, as if it required no preparation, and no consideration except its plentifulness and the convenience with which it can be obtained. The poor, like the rich man, goes in for quantity, and, when his means allow him, for luxury too. In some mining districts, when times are good and wages are high, the working miner looks on his luxuries for the stomach as the great objects of existence. He must have everything in season, and, not content with that supposed advantage, must force the natural gifts out of their season, and on the earliest of the forced viands, from the fields, from the gardens, from the herds, must indulge his trained appetite to the full bent of its depraved capacity.

It is a peculiarity of natural ordinance that the provisions of nature seem to be in excess of every necessity. I say seem to be, because the excess cannot really be greater than is necessary, though to our limited appreciation of the universal system it appears so to be. Thus the multiplication of life on the planet is so rapid in all forms of life, that were it not for the balance of death in thousands of premature ways our small globe would soon be overstocked, and would cease to find sufficient sustenance for its inhabitants. In like mode man seems in many things to imitate the instinct of nature, and to provide himself always, if he can, with more than he requires. The fact is most strikingly evidenced in the case of feeding. There is scarcely a man or woman to be found who does not, when the opportunities are present, consume more food than is possibly requisite for the healthy sustainment of life and activity. The fable of the belly and the members is the truest of histories. To the wants of the digestive organs all other organs must contribute; hands and feet, eyes and ears, brain and nerves must labour, primarily, for the insatiable stomach, that first master which, in turn, proves the first minister to their necessities.

It is not to be presumed that anything will, in essence, modify this natural primary craving. It is not to be wondered at that every measure which tends to satisfy this craving should be considered amongst the most beneficent and remarkable, and that the politician who gives the cheap breakfast and takes the tax off the loaf, or the agriculturist who makes two blades of corn grow where one has grown before, should be the most popular and the most honoured of men. It would be as foolish to unite against these instinctive habits and desires after food as to unite against life itself and its continuance. At the same time, as we are all endowed with reason as well as instinct, as we have an outside not less than an inside nature, which outside nature, like the clothes we wear, or the manner we assume, or the thoughts we speak, show the wisdom with which our existence is tinctured, it cannot be useless to train the instinctive desires into something that is within control—it must be useful to learn to what extent we may exceed necessity and bring upon ourselves and ours the injury that ever follows upon extravagance.

XXI.

MODERN COOKERY.

IN no department of life, as it at present exists, is the correction of instinct by reason more urgently required than in the matter of alimentation. At no period in the history of this nation have happiness and comfort so prevailed as in the present age. In no age have the people been so well provided with food, so well clothed, so well housed, so well educated. And yet it is true that, in the matter of feeding, nothing could be systematically worse than the systems which still prevail: the errors lie on every side.

Altogether there is an exaggerated importance attached both to eating and drinking. Everybody seems as if he carried about with him a spoon with something in it to put into somebody else's mouth. "Won't you take something?" is the first expected word of common hospitality and good-nature. If a great event of any kind has to be signalised, it must be distinguished by what is characteristically called a feast, which means the supply of certain articles of food and drink beyond what is taken in the ordinary rule of life, and beyond what is in any rational point of view commendable. If a friend be invited to dinner, the immediate object is not to give that friend what will be good for him and for his health, but what may be doubtful for him and extravagant for the giver. In the exuberance of generosity he is asked to eat what is no longer food, but so much money which he cannot digest, and which would not help him if he could. If a man praises his cook, and asks a friend to come to his table because he has at command the best *chef* in the world, he does not speak of that *chef* as of a man who understands the relation of food to the wants of the body, and who can make the simplest supplies of nature applicable to the readiest and easiest building up of the bones, the muscles, the brain, the senses. He speaks of an artist who can spend the largest amount of wealth in ministering, in the greatest number and varieties of modes, to the sense of taste—an artist who can induce the visitor to wreak the worst vengeance on his stomach and other oppressed organs, which, being overtaxed, make all the body feel with them the weight of the taxation.

From this point of view of alimentation, the art of cooking has but one object, that of making a huge excess of food find agreeable entrance into the body.

There is another mode in which the art of cooking food is degraded. Amongst the working masses, in their everyday life, the food that is eaten loses more than half its value by the faults peculiar to its preparation. You see the working or labouring man going to laborious duties, which call for the best and most perfect adaptation of food,—so that the force that the food can supply may be all converted into working force,—and there is the precious food, the compressed energy of the man for his labouring hours, tied up in a handkerchief, with little regard to its cleanliness or to the place where it is to be stored until it is required. If you look at the mode in which that food has been cooked, it will strike you, in nine cases out of ten, that the ready digestion of it is beyond any human possibility. The bread will be dry, hard, and probably coarse; the animal food either partly cooked or cooked to dryness; the pastry thick, heavy, cold; the cheese, if as a supposed luxury cheese be provided, dense, or soft, or acid, or of strongest flavour. To the whole will probably be added one or two cold potatoes, which at their best were hardly boiled—that is to say, were boiled hard that they might hold together.

Physiologically speaking, a meal of this kind, prepared as I have stated, and prepared in a manner I have copied from direct observation, loses more than half its value. If it contain all the elements necessary for nutrition, it is digested with difficulty and labour, and the force expended on it by the stomach, and which ought to be expended in muscular labour of the limbs, is so much labour utterly thrown away. Neither is the mischief finished here. The laboured digestion brings on what is commonly called indigestion; the stomach and intestines are distended with flatus; the nervous surface of the alimentary canal is rendered irritable, and the mind thereupon is disturbed; hard work becomes annoying work, and after a time the body generally suffers in its nutrition, owing to the persistent nervous irritation to which it has been subjected.

Thus in the richer and in the poorer classes of our society the errors in the preparation of food are all-pervading. In the one class the alimentary organs are injured by satiety and luxurious excess; in the other the alimentary organs are injured by the extra labour and irritation to which they are daily exposed.

The same mistakes extend through the middle classes of society, though not to so extreme a degree; for here is found occasionally the housewife who can cook decently, and who, from the necessity for economy, learns in a practical rule-of-thumb way the kind and character of food that best suits those under her charge, and the cheapest and most efficient modes of preparation.

If in the above observations I have seemed to speak too extremely on the follies that are extant in the methods of administering to the sense of taste, it certainly has not been with the intention of decrying that artistic preparation of foods which tends to make them agreeable to the sense. The first requirement in the preparing of alimentary substances for the table is so to prepare them that they shall be presented in a form best fitted to be assimilated, and in a form best fitted to sustain the wants of the body, without excess on the one hand or deficiency on the other. Such a process represents the *science* of preparing food for the table, but it does not interfere with the *art* that would, in a moderate and simple manner, please the sense or senses. To set forth foods in a mode that is pleasant to the eye is harmonious and healthful, and to make them so that they shall be pleasant to the palate is still more healthful. The science and the art, in fact, go well together. The evil begins when the art is allowed to override the science, and when the senses are gratified at the expense of the whole body. Against that system I protest, and that alone.

XXII.

QUALITIES OF DRINKS AND FOODS.

IF faults of the gravest kind are to be found in the systems of preparing substances for alimentation, faults equally serious are to be detected in the qualities of substances that are prepared for and are used by the community as foods and drinks.

The fact has already been noticed, that within the body the fluid which makes up the mass of the soft tissues, holds the soluble saline matters in solution, and acts as the menstruum of the colloidal substances, is simple pure water. The entirety of all the mechanism of the organic parts in their individual and in their united capacities rests on this arrangement. The specific weight of the blood, the specific weight of the fluid secretions, and the important relative balance of weight between the blood and the secretions, rests on this arrangement. The proper suspension of the colloidal albumen and fibrine in the blood in conditions ready for their application for filling up the waste of the solid tissues, rests on this arrangement. Any process that interferes with the proper relationships of the water of the blood to the tissues interferes with the natural uses of the water, and leads inevitably to a perversion of function which proclaims itself, with more or less of intensity, as a disease.

The supply of water for maintaining the vital purposes is derived from what we drink as fluid directly, or from what we take in combination with solid foods, all of which hold in them a quantity of water. Some animals, those which subsist on moist vegetable food, find in such food itself sufficient water for their wants; but man requires a certain small measure of water over and above that which is conveyed by foods. In a natural state of living the quantity for a full-grown man need rarely exceed twenty-four fluid ounces in the twenty-four hours, and I know one individual who, though he leads a moderately active life, confines himself to twenty ounces of fluid in the period named. The quantity is of importance, but it is of greater moment still that the quantity shall be unalloyed, that the design of nature shall be carried out in all its perfection, and that the blood shall carry no other fluid mixed with its structure into the membranes and tissues, than the one fluid water.

Let the water be overcharged with saline matters, such as common salt (chloride of sodium), or with soluble organic substance, and speedily the injurious effects of the admixture are developed. Unfortunately in many, I might indeed say in most, of our water supplies some or other of these foreign agents are present, and a considerable amount of disease is produced by them. But their effects are small compared with the admixture of another foreign and injurious thing which enters into the drinking water of the large majority of our community, which, under an utterly erroneous impression respecting it and its uses, is considered too often to be a necessary addition, but which is, in truth, an unnecessary pollution. The foreign agent I now refer to is the liquid called alcohol.

The errors in qualities of solid food are of less moment than the formal and singular error in relation to drinks, to which special reference has just been made, and yet they are sufficiently numerous. They spring in some instances from subservience to mere taste. In other instances they are due to ignorance. In a certain large number of instances they are the effect of necessity. The result as a whole is, that in the midst of the wildest and most useless extravagance there occurs, what must needs be the consequence of extravagant indulgence, a large amount of disease and of premature death from excess; a large amount of disease and discomfort from misappropriation of food that ought to be better applied; a large amount of miserable health, deformity of person, crime, and occasionally death itself, from direct privation of the aliments that are necessary for the maintenance of life.

From a view of all classes of society it is seen to be impossible that any of them can be at this stage of our national existence properly sustained by food. Those of us who, as physicians, have under our observation the more affluent classes, are drawn to the conclusion that amongst those classes a much larger quantity of alimentary substance is consumed than can possibly be of service, and which being of no service is a cause of injury to the digestive organs, and equally to the muscular organs, which by interposition of fatty matter are impeded in their motion. The discomfort, the languor, the debility which occur from one of these induced evils alone—I mean the deposit of fat around the heart—are of a kind which none but the physician can properly compute.

For these and other reasons there is springing up amongst the members of the medical profession a truly wise system of prescribing not only abstinence in regard to alcoholic drinks, but abstinence also in diet: reduction of quantity, and more accurate selection of those articles of diet which are absolutely requisite.

In the affluent classes we see the errors of excess: the too corpulent body; the distended stomach; the slow and uncertain muscular movement; the easily wearied breathing; the feeble and readily fainting heart; the sleepy brain. By a ridiculous use of words the physician, when he directs these sufferers to let themselves down to a natural proportion of food and drink, is accused of prescribing a starvation treatment—which, indeed, is the only remedy, and which is, as a rule, a success beyond expectation when it is faithfully followed.

Amongst the less affluent classes, but amongst those who know nothing of what is actual want, we begin to notice errors in the matter of selection of food. The affluent have at command so much of everything, they feel no necessity to make selections. The needier man needs to select, but not appreciating the need looks commonly on quantity as the thing to be obtained, and buys what is cheapest and most abundant. He exhibits the same prevailing fault, desire for excess, which desire is greatly increased in communities where large masses are congregated together in densely populated cities and towns. So marked is this fault in relation to the use of animal food, that during the cotton famine I computed, that if throughout the whole population of England the average quantity of fresh animal food used by each person was seven and a half ounces per day, the average proportion to each inhabitant of London was twenty-two ounces.

It may fairly be concluded that much of the excessive amount, in the large and wealthy centres, is not actually eaten, but is practically thrown away or misapplied. That a gross excess is consumed there can be no reasonable doubt, and I fear that since the period of the cotton famine, our increase of wealth has added to rather than reduced the evil.

In the midst, however, of increasing luxury amongst the upper and middle classes of society, one disease is, I am bound to say, markedly decreased. I refer to the disease known as gout. Every practising physician who can carry back the recollections of disease for thirty years, as I can, must be struck by the remarkable limitation of this malady, this special malady of luxurious living. A right-down case of acute genuine gout, such as I remember to have seen as a very ordinary phenomenon indeed in the early days of my career, is an exceptional phenomenon now. This decline of one of the most common and most painful of human evils can, I think, be traceable only to one circumstance, the departure from the custom of indulging in deep potations of port and other rich, strong, sweet wines. Considering that gout is a disease which once induced by indulgence becomes hereditary, it is remarkable, and hopeful as remarkable, to witness that such a brief abstinence from one national custom should have been followed by such signal and good results. I think there is no reason to doubt that if total abstinence from all spirituous drinks were to become as universal as total abstinence from those drinks of the vinous class which specifically induce gout, not only that disease, but many others which have their origin in the use of alcohol, and which descend in line, would be equally reduced, and in two or three generations effectually wiped out.

Amongst the lower classes of our communities the question of health and alimentation is presented to us in a somewhat different light. We see in the deformed weakly children of the very poor evidences of deficiency of the foods out of which the skeleton is built, and from which also the brain substance and nervous material should be supplied. We see in these examples the effects of food too watery and too exclusively formed of the bread-and-water type. We see in the women of these classes nervous enfeeblement from excess of tea and from subsisting on bread, or bread and butter, unmixed with better and varied sustaining foods. We see, again, too commonly in the men, the bloated enfeebled condition induced by excessive indulgence in beer, coupled with the persistent indigestion incident to the consumption of badly selected, badly prepared foods, of the animal and vegetable series.

Fortunately we know that these conditions are not a necessity, are not truly due to the want of food, but to the want of knowledge. There are few men now out of the workhouses so poor but that they can get as much food, and as good food, as the persons who are incarcerated in our prisons. And certain it is that prison fare, though it may not be so palatable as the free man at little extra cost could easily make it, is, for all essential purposes, a good alimentary sustainment, and one towards which every member of the community might incline with benefit to his health and with certain addition to his wealth.

The best rules to remember in respect to qualities of foods and drinks are, briefly, as follow. (*a*) That pure water is the only natural beverage, and that under ordinary circumstances the adult man or woman does not require more than twenty-four ounces of it as a minimum and forty as a maximum in twenty-four hours. (*b*) That of solid food, animal and vegetable combined, the same number of ounces, minimum and maximum, is also sufficient. (*c*) That of solid food not more than one-third need to be of the animal muscle-feeding class, leaving the vegetable starchy and oily or heat-supplying substances to make up the remaining two-thirds. (*d*) That the foods should be cooked so as to be freed of their rawness, without being reduced to tenderness or shreds or hardness by over-cooking. (*e*) That the foods should be themselves pure and of healthy origin. (*f*) That the division of food by meals should be into three periods, in times of equal length and of about five hours' duration. (*g*) That the gratification of the gustatory sense should be made secondary to the actual requirements of the body for its aliment,—should, in fine, be kept as neutral as the taste of the young child who feeds on the most natural and at the same time the most neutral of all foods, milk.

If these rules were remembered and acted upon, without divergence into feasts for indulgence or fasts for repentance, the national health would make an advance towards the development of a race constructed for an enjoyment of happiness which the imagination of the poet has as yet alone conceived.

XXIII.

ABSTINENCE FROM ALCOHOL.

I ADVOCATE that every person should abstain from alcoholic drinks. On four points relating to this advocacy I am more frequently questioned than on any other. The points refer to digestion with and without alcohol; feebleness of the circulation; feebleness of the body; and, the trial of total abstinence. A short reading or two on these subjects is in place here, and though expressing views which are not commonly held, they may, I hope, be useful.

The common idea that alcohol acts as an aid to digestion is without foundation. Experiments on the artificial digestion of food, in which the natural process is very closely imitated, show that the presence of alcohol in the solvents employed interferes with and weakens the efficacy of the solvents. It is also one of the most definite of facts that persons who indulge even in what is called the moderate use of alcohol, suffer often from dyspepsia from this cause alone. They acquire the morbid feeling that they cannot take food in the absence of stimulants. In some instances they are led to take more fluid and less solid food than is natural, and in other instances they take more of both kinds than can be healthily assimilated and applied. Thus the use of the stimulant leads to flatulency after meals, to tendency to sleep, to indolence of mind and body, and to disturbed rest. In fact, it leads to the symptoms which, under the varied names of biliousness, nervousness, lassitude, and indigestion, are so well and extensively known.

From the paralysis of the minute blood-vessels which is induced by alcohol, there occurs, when alcohol is introduced into the stomach, injection of the vessels and redness of the mucous lining of the stomach. This is attended by the subjective feeling of a warmth or glow within the body, and is followed by an increased secretion of the gastric fluids. It is urged by advocates of the use of alcohol that this action of it on the stomach is a reason for its employment as an aid to digestion, especially when the digestive powers are feeble. At best, the argument suggests only an artificial aid, which it cannot be sound practice to put permanently in place of the natural process of digestion. In truth, the artificial stimulation, if it be resorted to even moderately, is in time deleterious. It excites a morbid habitual craving for a stimulant, and it excites over-secretion of stomach and acidity. In the end, it leads to weakened contractile power of the vessels of the stomach; to consequent deficiency of control of those vessels over the current of blood; to organic impairment of function; and, to confirmed indigestion.

On these grounds alone I infer that alcohol is no proper aid to digestion. I know from daily observation that when it is felt to be a necessary aid it is doing actual mischief, the very feeling of the necessity being the best proof of the injury that is being inflicted. Lastly, on this head, it is matter of experience with me that, in nine cases out of ten, the sense of the necessity, on which so much is urged, is removed in the readiest manner by the simple plan of total abstinence, without any other remedy or method. When, in exceptional cases, total abstinence fails, other remedies, as a rule, also fail, and the indication is supplied that the natural functional activity of the digestive organs is irrevocably destroyed.

The effect of alcohol on the circulation of the blood is to quicken the circulation. The heart beats more quickly after alcohol is imbibed; the vessels of the minute circulation are dilated, and at the same time are reduced in their contractile power. A moderate degree of cold applied to the vessels of the body produces the same effects, and hence cold and alcohol go hand-in-hand together in inducing torpidity and general failure of vital activity. During the time when the heart is beating more quickly, and the blood is coursing more rapidly through the weakened vessels of the vital organs, a flush or glow is experienced which, in time, becomes a sensation, if not of pleasure, at least of excitement. By continued use of alcohol, the vessels lose their control, and the heart fails in its power unless the stimulation be renewed. At last the sense of want of power and of languor, when the stimulant is withheld, is transformed into what is conceived to be a natural necessity. The weakened stomach yearns first for what is called its stimulant, and then the languid body craves, in response, for the same. But the rapid course of the circulation leading to the increased action of the vital organs is, after all, the rapid running out of the force of the body. It is like the rapid running down of the timepiece when the pendulum is lifted. The running down demands, in turn, the more frequent winding up; and, the result is premature wearing out and disorganization of those organic structures on the integrity of which the steady maintenance of life depends.

During these unnatural courses of the circulation under alcohol, the degrees of structural change which occur are most serious. The minute blood-vessels are rendered feeble, irregular in action, untrue to their duty. The membranes of the body become changed in structure. The organs that are most necessary for life, such as the brain, the lungs, the liver, the kidneys,—organs which are failures unless their membranes and their vascular parts be kept intact,—lose their powers for work, and from their defects disease in tangible form is organically developed.

Another cause of feebleness from alcohol, indirectly connected with the circulation, is the change to obesity which alcohol produces. It is one of the effects of alcohol to check the natural process of oxidation in the body, and for this reason, as I have experimentally proved, it reduces the animal warmth. The influence of this repression does not end here. Under it there is an impaired nutrition, and in many instances a great and unnatural increase of fat in the body, what physicians call fatty change or fatty degeneration. In the beginning of this change it is usual that the fatty substance is laid up outside and around the vital organs, or beneath the skin, where it is stored away in great abundance. In later stages, and occasionally from the first, the fatty particles are deposited within the minute structures of organs, in the muscular structure of the heart, or in the substance of the brain or kidney. The fatty degeneration, in this manner induced, is, of necessity, a permanent cause of feebleness, of premature decay, and, not unfrequently, of sudden death.

The view that alcohol is demanded in order to keep up a feeble circulation is opposed to reason and to practical knowledge. It is a view that rests altogether on the feeling or appetite of the person who, on his or her own experience, defends it. The very fact that such personal experience is felt is an indication that the alcohol is inflicting injury, and that abstinence from it is absolutely demanded.

XXIV.

DEBILITY FROM ALCOHOL.

THE same argument that applies to feebleness of the digestive process and to feebleness of the circulation, in relation to the use of alcohol, applies also to that general feebleness of the body which is commonly referred to when persons say they are not strong enough to do without alcohol. I have found by direct experiment that the effect of alcohol is to reduce the muscular power, and that even during the excitement which alcohol produces, in the stage of excitement there is no actual increase of power, although there may be great muscular disturbance and apparent excess of motion. The strongest men and women living are those who do not take alcohol in any form; and the experience of persons who fairly try abstinence is, that more work and better work,—whether the work be mental or physical,—is performed without alcohol than with it.

The general evidence on this point is most conclusive, and, if I might venture to state my own individual experience, I would say that the evidence is as surprising as it is satisfactory. I have worked actively while indulging in a moderate measure of alcohol daily. I have worked actively while abstaining altogether. In a word, I have made direct personal experiment on the subject; and I am bound to state that the work that can be done during entire abstinence is superior in every respect,—in respect to amount, in respect to readiness of effort, in respect to quality, in respect to endurance, and in respect to mental ease and happiness,—to that which can be done during times of moderate indulgence in alcohol.

Alcohol does not give strength, does not maintain strength, and its use cannot truthfully be defended on the ground that the body is not strong enough to do without it. When any one feels that he or she requires alcohol to maintain strength, the evidence favours the suspicion that that person is in danger of collapse from the action of the very agent on which reliance is falsely placed.

I have only one more observation to make on this head, an observation I have once before made, but which I venture to repeat. It is that the strongest of our domestic animals, and the most useful of them, work from morning to night, and do all the work that can fairly be expected from flesh and blood, yet require no alcohol, and if they are trained to the use of it they simply fall into feebleness and uselessness. If we could by a grand destructive experiment treat our domestic animals with alcohol as human beings are treated with it, the value of the lower animals would at once decline, and in time we should have none that were edible, none that were workable, none that were tameable.

The long-continued habit of taking alcohol engenders an appetite for it which, it must be confessed, is a very powerful influence in its support. To forget and to overcome this appetite faculties are required of which many persons are deficient, viz. strength of will and determination. In some instances even courage is demanded as well as strength of will, in order to vanquish the desire engendered by the habit. But when the will is strong enough for the effort, the success of total abstinence is certain. It is probable that so long as any alcohol remains in the body, the desire, —I may say the urgent desire,—for more of it is severely felt. After a sufficient time for its complete elimination from the tissues the appetite grows feebler, and at last it ceases altogether. The habit is buried and forgotten, and, this result reached, the new life that is realised is unencumbered by a desire that is as useless as it is masterful when it is allowed to have its sway. Then the idea that the abstinence produces illness and enforces a return to the stimulant entirely passes away.

An error often committed by temporary abstainers from alcohol is, that ailments to which they become subject after they commenced to abstain, and which might have occurred with equal certainty if alcohol had been persisted in, are caused by the abstinence. It is especially necessary to warn those who are beginning to abstain from this error. There is no evidence whatever that I can discover in favour of the supposition that any disease occurs from or is dependent on total abstinence. I have myself never seen disease induced in such manner, and whenever I have entered carefully into the study of symptoms that have been assigned to the cause named, they have afforded no proof of actual disease. They have been purely subjective symptoms, and have indicated nothing more than the will, or the idea, or the inclination of the person who has complained of them. The best evidence on the point now under consideration is, however, afforded in the effects of enforced abstinence on those alcoholics who, under hospital, workhouse, or prison discipline, are rigidly and peremptorily debarred from alcohol. I have failed, so far, to obtain a single instance of the origin of any known and definable disease from the process of enforced abstinence. No one, I believe, has ever pretended to write out the history of a disease induced by that process. On the contrary, the generally expressed opinion is that enforced abstinence promotes health, and that it tends, when the appetite for the stimulant is subdued, to promote the after-sobriety of professed inebriates more effectively than any other measure that has been tried for the prevention of intoxication.

PART IV.

HABITATIONS.

XXV.

PRIMITIVE HABITATIONS: CAVE, CASTLE, AND CLOISTER.

THE construction of human habitations has progressed towards its present and still imperfect state under the pressure of various necessities, of which health has not been one of the foremost. It is true that the rudest savage who builds a hut to protect himself from the cold, or who puts up a tent of leaves to keep out the wet and obstruct the heat of the sun, is in some sense consulting his health as well as his comfort; but this cannot be considered as his object in construction, or at best it must be accepted as an object of a secondary character.

As we ascend in civilisation we find the ideal of construction improving for set purposes, and in a truly scientific and artistic manner, when the ends had in view are remembered. But, again, the science and the art were not introduced because the possession of health was in the scale, but rather because the possession of power was the prime consideration. In European development of civilisation political advancement held the first place with nations and families, and their residences had consequently to be formed by the circumstances of their existence.

It is only when a nation is settled in power, safe from external resistance to hostile forces, perfectly free within itself, obedient without demur to its own self-imposed and wise laws, and so far enlightened that it can begin to look critically on itself and its history,—it is only under such fortunate circumstances that new and important practical improvements can be carried out.

We at the present period of English, or I had better say British, life are so favourably circumstanced; but it is really the first time in our history, and it is therefore no cause either for wonder or for fault-finding that we are as we are—that we retain amongst us the elements of barbaric ages, and that by association we cling to them.

In the primitive times all was rude, offensive, defensive, mystical. The first men had to protect themselves from the inclemencies of the weather, or the still worse dangers arising from inveterate and powerful human foes. They concealed themselves thereupon in natural hiding-places—in caves and recesses of the earth.

After a time they ventured forth, and built well-guarded and fortified places above ground. Anon they built places for worship of the great Powers from which they sprang, and to whom they felt their homage and adoration a reasonable service.

These influences extend even to this day. Our modern buildings spring from the three sources, the Cave, the Castle, and the Cloister, and all progress is traceable through them.

In Nottingham we find a series of caves like to underground vaults and cellars, in which the primitive inhabitants found protection and secrecy from the external killing forces of nature, as well as from human foes. Snottingha, a cave, as the Saxons defined it, was the home probably of some feeble race which they overthrew, and which was strongly centred in what we now call Nottingham and in many other localities. These timid cave-holders vanquished, their great conqueror must have his place above ground as well as below. He may have his caves and dungeons still out of sight, his secret passages and ditches of water, but he must build above ground for protection from enemies without rather than from enemies within. Therefore he ignores all laws that tend to internal health, knowing none. In time, as his people increase, they must be hutted out of the walls of the fortress, and live about in a walled city. The walls and gates enclosing the narrow streets and huts are again for protection; the cellars and underground communications are for retreat or protection.

And still another element enters into this more ambitious building project—the idea of strength and durability. The place must not only resist, it must by its massiveness remain a monument for ages of the name and greatness of the founder.

Gradually the cave-dwelling ceased as such, but the construction of all our important central towns was, and in many instances is still, based on the walled or protected principle, a principle utterly unscientific in a sanitary point of view, but scientific enough for the purposes for which the design was laid out in the first instance. With the stirring events of the great revolution in this country the original intention of the fortified castle ceased to exist: the thunder of Cromwell laid these centres of disease in the dust, and the idea of construction of buildings, both in masses of towns and isolated houses, underwent a certain modification. The modification was imperfect, and to this day it clings to the mind of the builder. Protection, darkness, underground passages and vaults, strength and durability for ages,—these are ideals which still stop the way.

The cave and the castle thus played their important parts in sanitary, or I had better say, in insanitary, history. In time the cloister followed. The objects of the builders in this case were threefold, mercy, luxury, and artistic beauty; objects which, grandly carried out, were a fine political set-off to the hard and stern lessons taught by the lord of the stronghold.

When the great king or earlder-man built his castle, he built for protection from enemies of human kind rather than for protection against those hidden enemies, mysterious pestilences and hereditary diseases. He had to herd up his armed retainers within his thick walls in large numbers. He had to let his slaves live out in such surrounding huts as they by rude instinct could rudely build.

The sons of the Church who erected the magnificent churches and cathedrals and abbeys built in perfection of taste of construction, but with little care in respect to health. The spots selected for their residences were spots well selected for protection from bleak winds, for shelter of woods, for choice of springs of water, for running streams, for forest glades, and for easy foundations of highway and road. But here the conditions for health ceased. There were no provisions against dampness of air, closeness of air, impurity of air, impurity of water. Half the conditions of health were reached; the rest were left untouched.

It would be unfair, in reviewing the work of the first builders of human habitations, to criticize them too keenly by the light of modern science. They built from necessity, and it were hard to scold them if they did not discover what we have but just learned, viz., that in a town or in a house there are certain internal necessities for health which are as important as external situation, and which cannot be neglected without incurring the certain penalties of disease and excessive mortality. The first builders raised their various shelters and houses to meet the variations of seasons, to keep out wind and rain, to give protection from the heat of the sun, or to fulfil some such other general service. To learn how to ventilate, how to warm, how to light, how to drain, how to secure a pure water supply, was a process or series of processes which could not be made matter of practice in scientific form until science had shown the object and value and plan of those arts.

With all their necessary shortcomings in respect to sanitary requirements, the ancient architects were far less culpable than their masters, the politicians, who determined to a large extent both principles and practice. The original necessity for erecting fortified cities, with their high walls, surrounding moats, narrow streets, closed gates, and central castle, created a stern defiance to all the natural and domestic requirements for health. The necessity, however, created a method which became an example, so that when more peaceful times were reached the plans of the city were laid out after the old system, and included many of its vices. These bad plans remain to the present hour in many instances, and much of the labour of the sanitarian has to be expended in correcting them.

It is impossible to overestimate the dangers and miseries which have followed and have been dependent on the fundamental errors of the walled town and city. In such centres the great plagues of the world have found their grand resting-places. In the streets of these places the poor miserable rickety, scrofulous, consumptive pale children of the earth have been reared. In the streets of these places the crimes of the massed communities have been engendered together with the diseased perpetrators of them. Disease and crime have nourished each other.

XXVI.

SANITARY RECONSTRUCTION.

TO the castle and the cave may be traced many of the errors in the construction of houses in great cities and towns, I mean errors in respect to the sanitary value of these houses as human habitations. To the cloister must be traced most of the errors pertaining to many private mansions in retired country places. To the castle and to the cloister may also be traced the plans, and until quite recently the errors, of most of the great public buildings intended to act as corrective or as benevolent institutions.

In imitation of the castle, public buildings such as gaols have taken the character of the castle, with the result that when great plagues affected and infected great communities, they found in these public places their centres. Out of the gaol stepped the black assize. The prisoners poisoned in their cells poisoned in turn the officers of the courts of justice, and innocent and guilty alike were swept away.

To what extent ignorance on these subjects prevailed a few centuries ago is shown by a practice which is hardly yet extinguished. It was believed during those darker times that the odour which rises from the plant known as rue is a preventive of contagion, and so before my lord judge there was laid a bunch of that innocent plant, on which his lordship might regale, through his sense of smell, whenever he desired. The rue, it was assumed, stood between the fever-stricken wretch in the dock and his lordship on the bench. Within present memory the custom has remained of placing the rue on the bench for his lordship; but the charm is dispelled.

The castle, as we have seen, was not the only building from which the habitations of mankind took their origin by the process of imitation. The cloister was to some extent also in fault. The cloister became the model of the asylum for the insane, and the asylum for the insane became in turn the model of the hospital for the infirm; of many of the almshouses for the poor left by the benevolence of the rich; of many of the workhouses built, after the passing of the Act of Elizabeth, for the maintenance of the poor; of many public buildings used as manufactories; and in most cases of hospitals for sickness and pest-houses.

The faults of sanitary construction on the cloister system were fewer than were those of the castle and its miniature successor the gaol; but they were nevertheless manifold. They led to the introduction of small windows, of close corridors, of damp underground passages, of one-sided window ventilation, of narrow fireplaces, of low ceilings with heavy beams in the crevices of which the dust of ages could accumulate, of thick walls, and of bad roofings.

With these forms of construction there was, it must be admitted, a certain picturesqueness of effect and a quaint homeliness that is not without its charm, and it is only candid to say, indeed, that to many the picturesqueness and the homeliness have a very distinct charm. The feeling, from associations of an historical kind, and due probably to some distant hereditary liking, extends to almost all if not to all English people.

It is unfortunate that feeling and health do not go hand in hand in this matter, and that the cloister system was not a sanitary system. It did not provide for sufficient air, for proper admission of air, for circulation of air. It did not provide for proper warming, nor for the exclusion of damp. It did not provide for the due admission of light. The deficiencies in these respects alone were fatal to healthy construction. These were deficiencies of internal construction. To them were added others which were external. The cesspool for the reception of the sewage was placed too near the source of the running stream, or well, or lake from which the institution received its water supply. The walls of the cesspool were made of porous material, or in some cases were made merely of the earth in which the pool had been sunk. The water supply was little cared for; if the water were sparkling and cold it was considered perfect, and the idea of organic impurity was never dreamed of. That source of disease, organic impurity of water, remained to be discovered by a philosopher of our own age, a Yorkshireman who practised in London, whose name was John Snow, who was once my own familiar friend, and whose life I have written, but whose great and useful work will probably not be duly recognised for many a later day.

Wherever we travel in England even in this time we read, if we look at the public and private buildings, the history of the pre-scientific age, or I had better say of the pre-sanitary age. The occasion has come when with the breaking up of much that has been cherished in other departments of social life, we must break up also the old and long-cherished plans which the ancient masons,—noble representatives of a noble craft as they were,—planned and established to last a long time, but not as they thought for ever.

In the present day the grand problem before the nation is the reconstruction of the habitations of the people in cities, towns, and villages. There is at present a fair knowledge that construction as it progresses is imperfect, and that the results of new construction are, as a rule, bad. No man is quite satisfied with his domicile. This house is too dark; that is sufficiently lighted in so far as windows go, but is badly arranged in regard to its windows as ventilators. This house is too close, that is too draughty. This is damp, that is dry but intensely cold. This has an abundant water supply but no bathroom; that has a bathroom but a deficient supply of water. This has good drainage but no effective traps; that has bad drainage, trap it as you will. This has no soft-water cistern; that has one, but the water in it soon decomposes, is always of greenish colour, and is of little use. This has no hot-water supply; that has, but the supply is constantly out of order.

These are the complaints which the physician daily hears, and for which up to the present time he has been able, in the general confusion which prevails, to provide few remedies. It is as though all people were becoming alive to the necessities and the requirements of a healthy habitation, but that the knowledge was creeping in by instalments and at irregular intervals, so that no perfect system of a uniform kind can be obtained.

For my part I have never yet seen a single model private habitation, nor an approach to a series of such habitations. Real advancements lie entirely in the future. First we shall have model houses and a small model town; then, as the general intelligence advances, there will be radical imitative reforms, which will progress with unusual rapidity.

With the full impulse that will come from a more perfect appreciation of sanitary requirements, most of our English villages will have to be reconstructed altogether; pulled down, stick and stone,—except the church and such antiquities as deserve to be specially retained,—replanned into streets and gardens; redrained and rebuilt in accordance with a perfect system of construction. By these means much ground, now useless, will be saved; much money foolishly expended in maintaining badly planned highways will be saved; many plans for giving happiness and recreation to the people will be secured; and health will be improved up to its natural standard.

These advantages will show such a singular economy, resulting from the wholesale system of improvement, that the economical argument alone on behalf of the system will carry the day. Even that persistent village nuisance and source of fever, the farmyard, will undergo the necessary radical changes, to the pecuniary advantage of the farmer, as well as to the advantage of the health of his neighbours.

There are three directions in which to begin to move in the work of reformation in the habitations of the people. The first of these consists in the erection of model houses and towns *de novo*. The second consists in adopting a thorough system of remodelling what now exists and, for various reasons, must exist. The third consists in adding to the houses of the working classes accessory buildings in which the labour of the day may be carried on away from the rooms where their meals are taken and their hours of sleep are passed.

XXVII.

A SANITARY MODEL: THE MODERN GAOL.

THE builder of model habitations, knowing and skilful though he may be, can never by his subtlety and skill meet those causes of disease and death which spring from atmospheric variations and from those social and self-imposed influences to which reference has already been made. His work, notwithstanding, will be of greatest value if it but fulfil its legitimate object, viz. that of removing the causes which admit of being mechanically separated from the whole existing series of causes. He will in this way, with comparative ease, reduce mortality to a certain rate lower than exists now, although he will still have to meet not only the uncontrollable nature, but that equally difficult obstacle, human free-will, which, when it is opposed to progress, and even to the welfare of him who wills, is an opposing force as uncontrollable as any one of those which nature directly imposes, in voice of storm, or wind, or drought, or deluge. Of the four hundred and twenty thousand persons who die in England and Wales in a year, two hundred and ten thousand die from causes humanly preventible, and preventible in greater part by the mechanical means of prevention which are now under our contemplation.

What can be effected by vigorous sanitary measures, carried out in all their entirety, is best indicated in the results of modern prison life. In past days the gaol or prison was the focus of disease. I have seen a history of gaols the pages of which hardly admit of being read, so terrible are the records of fostered disease. Diseases were generated in the gaols as if for experiment, and were propagated from them as if for the same purpose. Now all these conditions are changed.

The modern gaol is a place of spotless purity in a sanitary point of view. The large corridors are charged with the purest air. The temperature of the air is rendered equable beyond anything that is found in the private dwelling. The atmosphere is not only pure and equal, but free of damp. The water supply is plentiful and wholesome. The walls of the buildings are kept cleared of dust, and the floors so pure that literally one might eat from them as from a clean dish. The drainage is, in most instances, so good that all excreted and refuse matter is carried off in detail, and accumulation of it in part or in whole is impossible. Thus, we may say, the sanitary work of the architect is complete. In the sick hospital such work is often abominable; in the workhouse it is very imperfect; in the model prison it is perfect.

The sanitary metamorphosis of the gaol is decisive. Into common habitations there could be easily extended, with every additional artistic refinement, the architectural sanitary reforms that now exist in prisons; but the process of sanitary reform would be liable to interruption from the disturbing influence of freewill, and the strict analogy from results would not be manifested.

In the prison we see also what is the effect of enforced individual discipline combined with the external sanitary safeguards. The prisoner is obliged to make the sun his fellow-workman. He is compelled to take long hours of rest if not of sleep, and very soon he finds all the hours pass fairly in sleep. He is deprived of those so-called luxuries, alcohol and tobacco. He is made to take regular muscular exercise. He is fed on the simplest yet on sufficient fare. He is protected from inclemency of season. And, finally, he is under constant medical supervision, so that, if he be seized with any serious illness, he is treated immediately with the proper remedies.

Taking him all in all, the modern prisoner in one of our model prisons is a wonderful subject of observation for physiological and sanitary purposes. So uniform is his physical wear and repair, that in an immense establishment like that at Wakefield he and all his colleagues obey the vicissitudes of season with such exactitude, that they begin to lose flesh in September, and begin to gain flesh in April, with a precision of movement as regular as the movements of the seasons themselves.

The results on the disease and mortality of the gaol population are as remarkable as the results of a chemical demonstration. The great epidemics of gaol fever are exorcized. The presence of an epidemic disease is so rare that it ranks after the style of an accident, such as a fire or the bursting of a cistern. As a result the mortality is so reduced that in our military prisons it has positively fallen, as Mr. Chadwick has shown, to below five in the thousand annually. In a word, in respect to health of habitations, the models of them are now found in the cells of the imprisoned criminal classes. The criminal taken from his home in one of the crowded passages of Liverpool or Glasgow is placed, after he is cast into prison to work out his sentence, in a position where the chances of living are as seven to one better than they were in his old and fatal haunt.

We cannot expect to secure out of the prison all the advantages for health that exist in the prison. We must not expect them for many a long day. When freewill is educated to be guided by knowledge and reason, and when it becomes resolute in the masses to do of itself what is found to be best, the rule of self-obedience to the right will briug all things into order, and will discover the ease with which liberty wears the yoke of discipline. Then, as every person will systematically take part in suppressing the conditions which favour disease, the suppression will be a light task. Now the conditions leading to disease are like those which lead to a fire in cities built of wood, in which people live who, ignorant of combustible substances, distribute them carelessly, and wonder at the conflagrations they chance to excite.

The great sanitary work of the day in this country, and in all civilised countries, is to find the best mode of placing the people of large communities in habitations which shall be as healthy as the prisons, and which shall at the same time supply what the prisons necessarily fail to supply, those objects of beauty in nature and art which tend to make the home a garden of delight and the town a centre of intelligence, social happiness, and educational progress. It is a gigantic task to contemplate. Whoever passes over the railway highways of London and other large towns, and sees in the houses beneath how the denizens of the place are packed in their close rooms, so that the caged birds in their cages hanging at the windows seem happier and freer than their masters, reads the task. Whoever rides through our rural districts and sees the thatched hovels and huts in which the agricultural populations are housed, the thatch a nest of the seeds of pestilences as it is of the eggs of the sparrows, reads the task. Whoever thus passes and observes and thinks must needs appreciate the greatness of the required labour that shall reform such a system as exists, and by the process physically regenerate those who, born to suffer the life that is granted them, find in premature death their kindest fate.

XXVIII.

IDEAL OF A MODEL CITY.

I DO not urge, as some have supposed, that the perfection of sanitary science in construction of dwelling-houses will bring forth all the ends to be accomplished by sanitary science. This would indeed be Utopian in the wildest sense of that term. If, by the perfection of building, we could exclude the poisons which cause the contagious diseases, and damp, and darkness, and confined air, and the fine particles of dust in the air which enter the lungs to keep up constant irritation, and water that contains injurious products—if we could carry out these exclusions, we should indeed soon make marked advances in health.

If at the same time we could introduce all the best methods for insuring cleanliness of person and raiment, could give the best opportunities for outdoor and indoor recreative activity, and could establish the best places for preparing healthy and nutritious foods and drinks; then the duty of the builder might be considered as completed, and the duties of the physician and legislator might be considered as about to recommence on a sound foundation.

Were, however, these reforms each and all carried out, there would still remain those causes of disease and mortality which spring from social influences, from worry, grief, anxiety, irritation, and the reel of the passions. There would still remain those great external atmospheric variations which from the first of man's existence on the planet, and all through his career, have influenced him in his course. There would still remain the last grand cause of death, the wearing out of that physical organism by which, through a limited series of years, the man has been identified on the earth as an independent living responsible being.

In the ideal of a model City of Health,—Hygeia,—I have pointed out the details that are necessary for every model building or series of buildings in which human beings are to live in due enjoyment of health. In that imaginary city I have sketched forth the improvements which have to be carried out *de novo*. These include chiefly the following details:—

The living space is assumed to be so arranged that not more than twenty-five persons are lodged on an acre of ground. That is calculated as the densest population that could be safely housed. The houses in which the population reside are so planned that each acre of land can receive five houses, and each house can receive a family of five persons. The houses are built three, or at most four, stories high, and each story is confined to fifteen feet in height, by which means the great evil of tall, overshadowing, densely packed human warehouses is prevented. The houses are built on solid arches of brick-work, so that where in other towns there are areas and kitchens, there are here subways through which the air flows freely, and down the inclines of which all currents of water are carried away.

The streets of the city, wide and, owing to the lowness of the houses, well lighted and thoroughly ventilated, are laid also on arch-ways, and beneath each of the main streets is a railway by which all the heavy traffic of the place is carried on. The streets are planted on each side with trees, and in many places with shrubs and evergreens. They are paved with wood set in asphalte; and the side pavements, which are everywhere ten feet wide, are of light grey stone. The pavements have a slight in-cline towards the streets, and the streets have an incline from their centres towards the margins of the pavements. The streets are washed every day, through side openings, into the subways, the washings being conveyed with the sewage to a destination apart from the city. Thus the streets everywhere are dry and clean, free alike of pools and open drains.

The spaces at the backs of the houses are gardens, which gardens are common to all the houses, so that children have good playgrounds at home. The gardens are planted with trees and evergreens, but nothing is wanting to give facilities to the children for healthful exercise and play. Practically the houses stand in gardens; for the streets, with their evergreen foliage and cleanly kept dry walks, are also like a garden with walking-paths and a central thoroughfare.

The introduction of subways beneath the houses does away altogether with those underground caves called areas, kitchens, and cellars, in which, in bad imitation of the primitive cave-dwelling savage men, so many thousands of our industrious people now vegetate. The subways, at the same time, perform an important service. All pipes are conveyed along the subways, and enter each house from beneath. The mains of the water-pipe are carried along the subway. The gas main is carried along the subway. The supplies of gas and water enter from the basement of each house, and are at every moment within the immediate control of the householder. The supplies of water and of gas are constant; and if there be an escape of either within the house, the owner can separate them at the main from the floor of the entrance-hall, or from a side opening of the wall in that part of the house. Beneath the floor of the subway lies the sewer of the house. The sewers are built of brick, and are trapped from each house. Into each sewer, which is well flushed and ventilated, there are convenient entrances by which they can be inspected, and through which the workmen can pass to make repairs or remove obstructions. The subway thus becomes a very important part of the construction of the house. It not only prevents the house from being charged with damp from beneath, but it leaves a convenient space in which all repairs connected with water supply, gas supply, and sewerage can be carried out.

The living part of every house begins on the level of the street, and the walls of the houses are built of a brick which is not porous, and which therefore cannot be saturated with water. Some kinds of common brick will take up, as Mr. Chadwick has found, a pound weight of water. A roughly built exposed cottage, during a short season of heavy wet, may take up many tons of water, which water, when the dry weather returns, is carried in vapour into the warm rooms, creating a damp as persistent as in wet weather, and leading to those physical evils from damp of which consumption of the lungs is the most prominent form. To avoid the dangers from this cause, the bricks used are made of glazed substance, and are quite impermeable to water. The bricks are perforated; at the end of each is a wedge-like opening, and all the openings communicate. The walls, therefore, are honey-combed, and into them a body of air constantly circulates, which air can be warmed from the firegrates of the house. The walls of the living-rooms are lined with glazed tile, and can be washed down as an earthenware vessel is washed. The colour of the walls is grey, as a rule. The mortar and cement in which the bricks are laid, and all the timbers employed in the buildings, are rendered free of moisture. Sea salt, so common an ingredient of mortar made from sea sand, and so often present in wood that has crossed the sea, and so efficient an absorbent of water, is carefully excluded.

The most radical improvements in our system of model habitations lie in the arrangements of the roofs and the kitchens. In the houses of the present day the kitchen is at the basement, while the upper part of the house is carefully sealed down by the roof. The result is that all the close and disagreeable, and it may be foul and dangerous, vapours from the kitchen and lower offices ascend to the upper rooms and passages of the house, just as gases introduced into an inverted bell-jar filled with water ascend to the upper part of the jar, displacing the water. In our model houses the risks from this cause are avoided by placing the kitchen at the top of the house, immediately beneath the roof. The kitchen acts as a ventilating chamber, into which all the air from the lower part of the house is drawn, and through the chimney and ventilator of which the air finds ready exit. Thus the house is kept free of the odours of the lower regions, and is ventilated at all times with fresh air derived from without, and warmed by its passage through the honeycombed heated walls.

The position of the kitchen at the upper part of the house is attended with other advantages than those just stated. From the kitchen there is distributed throughout the house a constant supply of warm as well as of cold water. The weighted dishes have to be carried down instead of up-stairs; the light dishes only have to be carried up-stairs. The kitchen is perfectly lighted, so that the least uncleanliness is readily detected. The scullery, which lies off the kitchen, communicates with the dust-bin shaft; and from every floor of the house a distinct communication, by a sliding door, is made with the same shaft. A sink also exists on every floor for receiving waste water, so that the plan of carrying the heavy slop-pail from floor to floor is dispensed with altogether.

Above the kitchen is the arched roof of the house. The roof, which is flat, or nearly so, on the exterior surface, is coated with asphalte, and, being barricaded with a light iron palisading, makes an airing-ground or a drying-ground, or even a garden, according to the tastes or the requirements of the owner. The smoke from the chimneys is collected and drawn away to a central shaft, so that the air is kept clear of soot-dust, and a pure blue sky overhead is obscured only by the curtain of cloud which nature, in her grand designing, sees it wise sometimes to impose.

XXIX.

IDEAL OF A MODEL HOUSE.

THE plan of a model city was confessedly ideal in relation to our present actual position in practical science and art, I mean in relation to the actual present possibility of carrying out the idea. At the same time I studiously avoided, in laying out the plan, all that was, even at present, impossible. I asked, as each step of the city was figuratively drawn, could an architect do this for me if I gave him the order? Could a builder find the materials if I gave him the order? Could workmen be found to carry out the details in every particular? Moreover, I fixed my mind on the ordinary class of architects, builders, and workmen, and if the answer to the questions I have named above were negative, I threw that part of my ideal design aside as something to be waited for.

In this way I extracted at last an ideal city which in every detail was strictly possible.

The result is that experienced builders say there is no difficulty whatever, save the novelty and the fear of expense, in turning the ideal into the practical, and in producing truly a model-city health — a city in which the mortality will be reduced to the lowest possible standard which can be secured by the improvement of human habitations. At the same time, seeing the difficulty of carrying out the scheme in perfection of detail, and in combination of the perfected details, I clothed the plan in the garment of an allegory, so that it might exist in the minds of men before it actually existed upon the earth. I expected, and I have no reason to doubt the correctness of the anticipation, that the allegory will remain impressed, as such, on the mind, and I hope it may live until the reality it would foreshadow is an accomplished fact. Then, when there is nothing new in it, it may die, and I am more than content that it should have that distinctive and, I may say, intended destination.

But while the combination remains unformed, waiting for gradual development out of the details, there is no reason why the details should not be at once considered, with a view to their practical application. I shall therefore proceed to bring forward certain of these, beginning with the dwelling-house.

It will answer my purpose best to take as a dwelling-house one of the better middle class. The large mansions of the superfluous rich will continue, I suppose, much as they are, whatever the improvements of the sanitarian may be. The rooms and halls there which are only meant for state and display are not under the necessary influence of sanitary regulation, and the parts which are intended as residences for the family will adapt to the middle-class level. I may, therefore, leave the half-tenanted mansions to their luxurious fate. I may also, to a large extent, leave out of the plan the dwellings of the poor, not because these ought to be neglected, but because it is of very little use making radical changes in those dwellings until the dwellings of persons who are above poverty are set up as examples of principles and of practice. A few examples of improvement would do more to advance general improvement than all the statistics that have ever been collected to prove the unhealthiness of existing systems.

I will suppose a very simple model house; such a house as I would, if I could, build for myself as a residential house in this metropolis. As I proceed to construct I will point out the faults of those parts of our modern houses which I would remove or remedy. As I add new arrangements I will state not only the designs, but the objects of them.

In the building of a model house I should commence the reformation from the basement. The basement saps the health of the occupant of the house more than any other deteriorating influence. The basement walls and rooms are the condensing chambers of water, and, be they kept ever so clean, they are ever at fault on the score of dampness. How can it be otherwise? They are surrounded by the damp earth, the well in which they are planted. Into them all the rain that falls near the house splutters down. The pipes from the house, which convey away water from roofs and closets, find at the low level of the basement their easiest points of leakage. Into this basement the boiler of the kitchen and every boiling pot and kettle discharges its volume of steam. Here vessels containing fluids are set to cool and to let the fluids they hold evaporate while cooling. Here various articles of clothing and linen are put to the fire the live-long day—tea-cloths, damp dusters, house-flannels, drying-towels, damp clothes, dripping umbrellas, and wet boots and shoes. Here all the crockery of the house and nearly all utensils are washed, and, partly dried, are set up to dry on the shelf. Here the sinks are deluged and scrubbed, the ablution finishing with a final douse of water, which runs off in great part, but which also in part remains in the stone to pass away by evaporation. In a word, in this basement, where, of all places in the house, and I might almost add in the world, the process of drying must of necessity be most imperfect, all the wetness of the house is concentrated, and the attempt is made, at the expense of heat, to dry everything by sending up the water at great and unnecessary cost into the rooms of the house that are above. All day this process goes on vigorously. At night, when the basement cools, as it does with much rapidity, the condensation of water from every available source recommences. In the early morning the cold chilly rooms with their dripping walls are re-heated, and the water is raised into vapour.

XXX.

A MODEL HOUSE: THE BASEMENT STORY.

I WAS recently attending a lady who resides in one of the most open parts of the West-end of London. She was suffering from constant neuralgia and rheumatic pain. As I descended the staircase after my visit I put my hand on the mahogany rails of the banister, and found my glove saturated with water. From the top to the bottom that piece of woodwork was in the same state. The walls were equally damp, and from the basement there was ascending a persistent stream of water vapour. I ventured here to suggest that the builder was required as urgently as the physician.

I give this one out of any number of experiences which thoughtful practitioners of medicine daily recognise, yet feel they cannot remedy. A large percentage of preventible disease is due to the one grand cause,—damp. Dr. George Buchanan's researches have proved this fact beyond dispute in respect to the disease consumption, and I begin to think that the theory of a very eminent physician, who some years ago contended that mere dampness was an all-sufficient cause of ague and malarial fever, was pretty near to the truth.

These great observations are sustained by the smaller which we witness in daily life. The frequent colds, the chilliness, the sense of exhaustion, the pallid feebleness of tenderly home-bred children, the recurring attacks of toothache, rheumatism, neuralgia, cough, which attend damp seasons, I believe are all induced, or when not actively induced are aggravated, beyond any computation we have yet made, in the houses of great towns, by this process of living over water-diffusing passages and chambers, with an exit shaft into the upper rooms for vapour drawn up from below by the fires above. People who live on piles raised some feet above running water are even better protected.

The dangers of the basement do not end at this point. The basement is dark, hence it becomes the nest of unperceived abominations. It is the receptacle of the dead organic refuse, and the place where unstopped drains open into the house. The dust of the rooms above gravitates into it during the stillness of night, to settle on the foods and drinks that in semi-darkness are carefully stowed away. The food itself undergoes more rapid changes towards decomposition than in the dry and open air. And, owing to the readiness with which all organic decomposing particles are borne in air saturated with water, the dissemination of these particles throughout the house is made a ready way to the conveyance of the poisons of disease.

I am sorry to say I have not yet done with the basement. To the many other previous faults connected with it, is the most serious, that it is frequently made the sleeping tomb of living men and women. I could take you, my reader, to basements of good houses in this so-called civilised metropolis, where every dark nook and cupboard in the basement, that is available for such a purpose, is the receptacle for a shut-up servant's bed. I could show you where philanthropists and philanthropesses rest every night over these catacombs of sleeping slaves. I have known it offered as a recommendation to an empty house standing to be let that any number of servants could be lodged in the basement. I have seen a house in which sixteen servants sleep in these underground beds, not one of whom can at any season of the blessed year see properly to dress without the aid of artificial light.

Take in the picture of an unfortunate servant emerging from such dank darkness, in gorgeous array of heavy livery, to attend on the celestials who are encamped in the galleries over his head: barbaric splendour—splendour differing in what respect from the picture of the lord of the castle summoning his retainers from their caves of earth to carry his badge of greatness? In this respect, that the great lord who confined offenders in the caves beneath him took good care to cut them off from direct communication with himself and his family.

The first great improvement I should introduce into the house is so to remodel it as to stop the basement of the house from becoming a living place, cookery, laundry, bottle-vault, refuse store, larder, servants' bedroom, drain-trap and lavatory. I should turn it to its proper and legitimate use,—a real basement, an arched subway through which the air can constantly pass and repass, and on which the house can stand firm and dry without any in-door connection whatever with it.

The area as it now exists is no objection; on the contrary, it is an advantage. A house standing on a simple basement with an open space before and behind is well placed. The basement itself I should use at the same time for many useful and necessary purposes. It would contain three arches, each of which through free openings would communicate with the open air, so that a current of air might at all times pass through and through. One of the arches would lead to the staircase at the back of the house to form the servants' entrance. In the basement would be placed the closed bin for receiving by an outer shaft all the refuse of the house. In the basement would be a closed tumbling-bay in which the soil pipe of the house, separated by an open air space from the sewer, would discharge itself. Through the basement the water-pipe for supply of the house and the gas-pipes would enter, while two, at least, of the arches might be fitted up with good furnaces or stoves, into which air derived from the upper part of the arch could be drawn and heated and purified, and passed into the upper part of the house.

Nicely fitted, the basement rooms might be turned into hot-air rooms like the Roman baths, or to other useful purposes. But about the basement part there would always be this provision, that it could never be entered by a direct shaft communicating and forming a distinct connection with the rooms of the house above it.

XXXI.

A MODEL HOUSE: THE UPPER FLOORS.

FROM the modifications required in the basement of the house the next change I should introduce would be in the staircase. This change, unfortunately, in all houses, as at present constructed, would be carried out with great difficulty. But in the building of new houses it would be easy, and it should never be omitted.

In the present construction the staircase of the house is the shaft of the dwelling through which all the products of respiration, combustion, and other forms of volatile impurity, rise from the lower to the upper floors. It holds an open communication with all parts, and while it allows for the diffusion of every volatile impurity and damp, it prevents the possibility of maintaining through the house an equable and agreeable temperature. It is the great source of draughts, and it lessens beyond measure the size, comfort, and arrangement of every floor. Worse still, it enforces that all the water-closets shall be included actually in the living part of the dwelling, one of the most unwholesome and objectionable of all domestic arrangements.

I should therefore place the staircase in the rear of the house, in a distinct shaft or tower of its own leading straight from the ground floor to the upper part above the level of the house, where it should terminate in a well-lighted turret. I should let it extend downwards by a descending continuous but-open air flight of stairs into the basement. At each floor of the house I should make a communication with the staircase by a door, so that in fact each floor would be distinct in itself,—a flat, if you would like to call it so,—that can be independently lighted, warmed, and ventilated.

The staircase shaft communicating with all the house, but standing as distinctly by itself as a street, would turn to most useful purposes. Through it all the ventilating pipes of the house would be regulated. Connected with it would be a smaller shaft for a lift to carry goods from the basement to every floor. From it at the back part, and projecting out into the open air, would be built the water-closets on certain of the floors, and small spare rooms, such as bath-rooms or lavatories, on other floors. The entrance to the staircase would be at the extremity of the entrance-hall, from which it would be shut off by a door.

On the special arrangements of the floors of such a model house as I am describing I do not enter at this moment, the general principle of the house for its sanitary purposes being all that concerns me now. I may pass through the ground floor, ascend the staircase to the first floor, pass the door of that, ascend again to the second floor, pass the door of that, ascend once more to the third floor, and there stop.

In this third floor I make a very decisive change from what is common. Here I would place the kitchen and the servants' offices in the front, and the servants' dormitories in the back. The whole of this floor should serve, as the basement serves at present, for the domestic work of the household. Light, good ventilation, easy exit for all the vapours and gases and odours of cooking, would be readily obtainable. Every part of the process of preparing food would be possible, with as much of absolute purity as is attainable in the most refined chemical laboratory, where perfect purity is the only means for truly successful work.

By the shaft and lift the kitchen floor would be in instant and easy communication with all the other floors. The trouble of carrying heavy weights up and down stairs would be saved.

From a spare boiler in the kitchen hot water, and from the cold water tank cold water, would traverse to every floor. Each floor would be made by this means independent ; it would have its own sink and opening into the dust-shaft, and all the inconvenient marches up and down stairs with pails and dust-boxes would be entirely saved.

I have yet another story into which to invite the reader in this model or remodelled sanitary house for a town or city. I want to show the transformation of that part of the house which is still called the cock-loft ; so called, not as many suppose, because it was the place where that early bird in more primitive times saluted the morn, but because it is the crown or cap of the house.

This part of the house, I take it, is in large cities the part most misapplied after the basement, and some day we shall be considered Goths for the modern manner of constructing. Here it is a pointed roof, to sleep beneath which is to be roasted in summer and frozen,—I am speaking from an actual experience when I say frozen,—in winter. There it is a long half-flat roof with numerous angles through which, do what you may, water will pour. In short, it is every kind of absurdity which fanciful uselessness can devise.

In the house I propose I should utilise this space to the best and most healthy and most charming of purposes. Upon a firm, almost level asphalted roof, the excellence of which I have tested in one of my own houses for twenty-three years, I should raise, in iron and glass, a covered garden equal in extent to the whole area of the house. The house would thus be double-roofed, and from this circumstance alone would be specially warm and dry. In a house thirty feet wide and fifty deep this garden would be of a size actually handsome. Into the garden the stair shaft would finally enter, and here, if from the lower part of the house any emanations passed, they would not be sealed up for the sleepers underneath to feed upon deleteriously, but would be eaten up wholesomely by the living vegetation.

Heated readily from the kitchen beneath, this covered garden might have at all times a summer temperature. In it the children could engage in luxurious and healthful play. In it the ladies of the household could find occupation in cultivating those natural beauties of flowers and evergreens, which so cheer the heart through the sense of sight. In it the sterner sex might spend hours of change now unspeakably dull from the monotony of one or two rooms of more limited size. In it, in fine, the most agreeable recreative pleasures would be possible, while with them would go the fact that, with the pleasant and the natural and the beautiful, health was also trained, and happiness, her dependent sister, nourished.

PART V.

WORK AND PLAY

XXXII.

HEALTH AND LABOUR.

THAT man was born to live by the sweat of his brow is a figure of speech the truthfulness of which remains as perfect now as on the day when it was first spoken. Who tries to break that law wrestles with all the forces of nature and is brought foolishly prostrate. "I will lay up," says the foolish man, "so much wealth out of the present that my children and children's children shall never require to work. They, at all events, shall not be sons and daughters of toil." Under the influence of this sentiment some men work in such disobedience to natural rule, that they themselves die in the middle stages of their life. They would wonder if they could see the folly of the sacrifice.

To work for his own health and means of subsistence; to work from the first working times until the close of life; to work for those who are young and dependent upon him until they too can work as he has done for health and life; to work a little in advance for those of his own who may continue to demand from their own weakness more care and aid;—these are true duties belonging to every man. Pressed far beyond this bound, the effort becomes unjust, and injustice in natural things has its certain rectification. The law is absolute. Man shall live by the sweat of his brow, and no man shall work for another who can work. The surplus of work which a man can expend for more than his own wants is but sufficient for the helpless who rest on him. That is the natural law.

To the children of the earth, the earth is presented as a garden, and the primitive ideal of the life that is, as a life planted in a garden, is the simplest and truest. "Here," nature tells her children, "here is the great sphere for your labour. It is your property to discover and to conquer, to its utmost bounds of sea and land. Make it, if you will, a garden of richness, and pleasure, and delight, for it is yours also to enjoy. Some of you in this sphere must overlook and govern. Some must teach the ignorant. Some must tend the feeble and sick. Some must make and invent new instruments for the handicrafts, and find new modes of transit from place to place. Some must till. Some must hew the way into the earth, and find new treasures. Some must recreate the created, and bring forth forms of natural beauty on stone or canvas that shall delight the eye and cheer the heart. Some must be the treasurers and scientific re-distributors of the wealth which the toilers have extracted from the earth. Some must be scribes who watch and score the work that is done for other ages to read. Some must sing songs, or tell tales, or bring up to sight the life of the past, for the rest and delectation of the workers of every class. Some must survey the whole field of labour, and teach from the observation those lessons of morality, of health, of goodness which observation makes known as the best lessons for rules of life, of the life of all. But all must work. The whole generation of labourers, be it ever so great, cannot work so as to lessen the labour of its successor. New knowledge, new labour, new responsibility."

Still, age on age, there is the garden that must be supervised, weeded, embellished. It dies with its children, it rises again with them.

An age may be strained in work to the utmost, and die at its work, and still the next age must strain and die. The garden itself never rests. In steady revolution, in time and space it knows no rest, and allows none.

That cunning old knave of a gardener there, coming out of the dark grotto, has pillaged the earth unjustly, or has pillaged the wallets of his fellows with such infinite skill that he cannot, he thinks, be punished. He has a store securely hidden, so he fancies, which none but those who are privileged to be directed by the insane scroll which he calls his last will and testament can find and use. These happy-born will not, like him, have to work in the garden, but will walk about in it buying its pleasures, its health, its slaves. Fool! if they be ever so cautious, they cannot battle long against that perpetual motion. If they do, they will clash and be annihilated, or from sense of self-preservation they will fall at last into a gang, and work with the rest. Nay, cunning old man, if you use your hoard to perpetuate yourself in what you consider immutable materials—in marble, in stone—you will fail. For they will change also, or be changed. They, too, must be reformed for new work.

In the garden of life there must be universal work from universal man. Here we start on firm ground. Without work universal there can be no health universal. Here, again, we start on firm ground, and this is the basis of our argument. We say soundly enough occupation, or work, is necessary for health. The question to be studied is how near in the present stage of the cultivation of the garden of life have we approached to those measurements of labour, and to those natural and necessary industries which are in accord with a life that is healthy and therewith happy.

As in this spirit of inquiry we look at the work that is in progress in the garden, we cannot, I regret to say, be satisfied with the prospect. There are a great many idle clashers there in all ranks, who ought to be at work, but who are making collisions simply with those who are in train. There are a great many who are doomed to work who ought not to be in train, owing to their physical weakness. There are a great many who are in train at work that is too heavy, too long, too laborious. There are a great many who are in train at work which is positively injurious to themselves and others, planting poisonous seeds where only wholesome fruits or flowers should grow. In some sections of the garden of life there are many who stand ready to slay, who are trained to fight to the death the owners of other sections if a mere quarrel should arise. In other sections there are great hives of workers fabricating the instruments of death for the slayers.

Truly the primitive garden, the Paradise, is not yet regained.

XXXIII.

MORTALITIES AND OCCUPATIONS.

WHEN we come to the scientific consideration of the relation of work to health, we are led, in the first place, to study the relation of work to life. Health is a detail, life a principal. If we can determine, as a preliminary fact, how the years of life of men following different pursuits in some important sections of labour are modified by the labour, and if we find there are great variations in this respect, then we are enabled to seize from the relative mortalities some leading truths, and by a comparison of value of life to judge of the value of health in different grades of workers. Afterwards we can enter into detail on the classes, and inquire what in particular classes are the particular variations of health, and how far these variations depend on the labour of the class.

Up to the present time the information that has bee obtained on this subject has been extremely small. I mean that information, based on so many carefully recorded observations that the inferences to be drawn from them may be safely accepted, has been small. At last, in this country, under the able designing hand of Dr. William Farr,—whose labours will be better known as time reveals them, because they are so great, that time is necessary to unroll them,—at last, under his hand, we have obtained so much information respecting life and occupation in the part of the garden of the world called England, that a good solid basis is laid for the support of the most valuable records of general structure and of detail.

We know now, in respect to seventy well-defined sets of workers in England, what is the value of life under each class. We can set class against class, and without any danger, in this instance, of exciting collision or ill-feeling, can compare one class with another.

I propose to take the facts respecting occupation and mortality, as they have been drawn up for our study. They lie before me in an original table which, for a course of lectures recently delivered at the Society of Arts, I was permitted to receive from the Registrar-General's office, and the lessons they teach will, I hope, be easily learned from the history I am about to write.

Our authority sets forth by extracting from his returns of mortality, which now are sufficiently perfect for the purpose, the annual death-rate in England and Wales of males aged fifteen years and upwards, who were engaged in seventy occupations during the three years 1861, 1862, and 1871. He shows—(*a*) The years of life belonging to these different occupations in 1861, 1862, 1871. (*b*) The deaths in each class that were actually recorded in the said three years. (*c*) The deaths that would have occurred according to a standard rate of deaths derived from the mean rate of all the deaths. (*d*) The names of each of the seventy occupations. (*e*) The deaths of the males aged fifteen and upwards engaged in each of the seventy defined occupations, in comparison with the mean deaths per cent. of representatives of all the occupations. (*f*) Lastly, he gives the annual death rate of the males of the seventy occupations per thousand, living at eight groups of ages, from the age of fifteen years to that of seventy-five and upwards.

It will be seen by this outline how comprehensively the information supplied is laid out. In course of time the information will be enlarged upon, and in some details, perhaps, modified. Indeed, it is now put forward with these explanations on the face of it. But, approximately, it is so near to the truth, we need not cavil at details. It is the best knowledge yet acquired on the subject upon which it treats, it has been collected with infinite labour, and it calls for grateful acknowledgment.

As the facts which have accumulated in the manner above described are surveyed, the most striking of all is the disparity in value of life between the representatives of different occupations. Taking one hundred as the standard of deaths of all who are employed in all the occupations named, that is to say the mean of the whole number of deaths equally divided, we discover that some of the classes of the seventy English workers die at the rate of sixty-three as compared with the standard; while others die at the rate of one hundred and forty-three. These are the extremes of the scale, the top and bottom, taking the class that presents the highest vitality at the top, and the class that presents the lowest vitality at the bottom. Between these come varied degrees of vitality amongst the different classes, from the highest to the lowest degree, in forty-five gradations.

XXXIV.

WORK AND LONG LIFE.

THE workers who stand at the head of vitality are the barristers. The deaths recorded in their class, in the three years from which the observations are derived, were one hundred and thirty-five. The deaths that would have occurred amongst them in the same period, if they had shared the common rate of deaths with all the others—would have been two hundred and fifteen. The rate of their deaths was sixty-three, compared by the standard of a hundred as the mean mortality.

The next in order on the list of those who present a high vitality is the class composed of the clergy of the Established Church of England. The deaths in this class were actually one thousand one hundred and five in the three years. The deaths that would have occurred amongst them, according to the standard rate, would have been one thousand five hundred and forty-seven. The rate of their deaths, compared with the total of all the deaths of all the classes, was seventy-one to the hundred. The good health and longevity of the clergy has long been observed, both in England and in Switzerland, but that it was so superior in its totality had certainly not before been surmised.

Under the head of Protestant ministers are placed all the other ministers of England and Wales who, preaching Protestant principles, are not included under the title of ministers of the Established Church. These are a very slight degree lower in the vital scale. They rank as seventy-five to the hundred.

Next in order to the ministers come the class of men in trade known as grocers. These yielded an actual mortality, in the three years, of three thousand one hundred and sixty. By the mean standard they would have yielded four thousand one hundred and seventy-three. The rate of their mortality, compared with the standard of the hundred, was seventy-six.

In another very large group of traders who combine grocers' business with other forms of shopkeeping the same favourable condition did not precisely obtain, but still it was not greatly altered. The deaths were at the rate of seventy-seven.

After the grocers come a small class of a very different order, a class not destined probably to remain always on the books of the statistician. This class is made up of gamekeepers. The rate of their mortality was eighty.

The large class of superintendent tillers of the soil known as farmers and graziers are the next favoured. Their mortality is eighty-five, as compared with the standard of a hundred. They are followed by the civil engineers, eighty-six; booksellers and publishers, eighty-seven; and wheelwrights, eighty-eight. Next to the wheelwrights are the silk manufacturers, who rate at eighty-nine, and who are specially worthy of notice because they contrast most favourably, as we shall see in due time, by the side of some other workers in textile manufactures.

Labourers, including the whole class of agricultural workers, and carpenters and joiners, succeed in order. They each present a mortality of ninety-one, and compare a degree favourably with the little class of men who are known as bankers, and whose rate of death is ninety-two. Next to them are the whole class of male domestic servants, who yield a rate of ninety-three deaths in proportion to the hundred.

Sawyers, a rather large class of working men, present a little higher mortality, ninety-five. Brass manufacturers and braziers present ninety-six as their rate, and paper manufacturers and musical instrument makers present the same, viz. ninety-six. Gunsmiths and blacksmiths rise to ninety-seven. Shoemakers, iron and steel manufacturers, and tanners and curriers, rise to ninety-eight. Bakers complete the list of those who stand on the favourable side of the standard in the scale. They exhibit a mortality of ninety-nine, compared with the standard of one hundred as the mean.

We have now descended step by step along the scale until we have arrived at the classes of men who, out of the seventy occupations under our cognizance, yield the standard mortality of a hundred. These are two in number. They are engine and machine makers, and wool and worsted manufacturers.

To place the computations in perfect simplicity of statement, we may rest here, and, in a line, run back the order from the standard to the lowest degree of mortality. It will run then in this way: to the hundred that would have died by an equality of deaths throughout the whole of the seventy classes of workers, there died ninety-nine bakers; ninety-eight tanners and curriers, iron and steel manufacturers, and shoemakers; ninety-seven blacksmiths and gunsmiths; ninety-six musical instrument makers, paper manufacturers, brass manufacturers, and braziers; ninety-five sawyers; ninety-three domestic servants;

ninety-two bankers; ninety-one carpenters, joiners, and labourers; eighty-nine silk manufacturers; eighty-eight wheelwrights; eighty-seven booksellers and publishers; eighty-six civil engineers; eighty-five farmers and graziers; eighty gamekeepers; seventy-seven grocers and shopkeepers; seventy-six grocers; seventy-five Protestant ministers; seventy-one clergymen of the Established Church; and sixty-three gentlemen of the long robe,—barristers.

XXXV.

WORK AND SHORT LIFE.

AS we resume our narrative and proceed on our way the picture becomes sadder. We leave the standard of a hundred, in which engine and machine makers and wool and worsted makers were enrolled, to see before us a long list of forty-three classes, in which the rate of vitality is lower and the rate of mortality higher than the standard. At the first the difference is very small, but it falls to a figure a little more important than the figure on the other or favourable side.

The classes which depart first from the standard in the downward direction are iron, copper, tin, and lead manufacturers. They rank as a hundred and one, and in this respect stand side by side with bakers and confectioners. The schoolmasters and solicitors come next at one hundred and two. After them follow the millers, and, side by side with the millers, in respect to rate of mortality, the Roman

Catholic priests. These both have a mortality of one hundred and three, compared by the standard. The comparison is very strange in regard to the priest of the Roman Catholic Church, when it is made with that of the ministers of the Church of England, or with Protestant ministers.

Watchmakers come in order after the priest and miller; they rank as one hundred and four; and one step below them are the tobacco manufacturers, who rate at one hundred and five.

We reach at this point another representative class of the strictly professional order, in the men belonging to the science and art of physic. They, one would think, living only to learn the laws of health and of life, might surely be on a level with the other professions, and might rank above such hardly conducted lives as those of the baker, blacksmith, sawyer, domestic servant, or farm labourer. It is not so. These men who labour to save life stand six degrees down in the scale below the standard; thirty-five degrees below the most favoured class of all (the barristers); thirty-four below the clergy of the Established Church; and three below the priests of the Roman Catholic Church. They rate as one hundred and six, and by their side are the shipbuilders, who yield the same figure.

Messengers and porters, coachmakers, and ropemakers are three classes which lie together next in order: they rank as one hundred and seven.

The class of shopkeepers known as drapers are immediately lower on the list; they rank as one hundred and eight. It is of importance, for reasons I shall ultimately have to offer, to compare these shopkeepers with the grocers, between whom and themselves there is so wide a difference in the matter of mortality.

Next to the drapers come the tailors, who stand at one hundred and nine on the list, and with them the workers in wool, cotton, flax, and silk manufacture, who also stand at one hundred and nine. Respecting this last-named group, an error of classification has crept into the account, which it will be well to avoid in future tables. The wool and worsted manufacturers have already been estimated in previous and distinct classes, and have been found to be favourably placed. Some of them are here mixed with the cotton and flax workers, probably because in the cotton and flax manufacturers, from which the returns are obtained, there are wool and silk workers also; but these, by being blended with the others, vitiate the calculation because they lighten the mortality. However, they are so grouped, and we must take them, with this correction, in the order in which they are placed.

The two groups which succeed are one degree lower in the scale, viz. one hundred and ten; they are chemists and druggists and commercial travellers. Following them, a degree lower still, viz. one hundred and eleven, are the insurance service clerks, commercial clerks, and butchers. Carvers and gilders rank at a hundred and twelve; farriers at a hundred and thirteen; miners, cotton and flax manufacturers (taken together), and printers, at a hundred and fifteen. Bookbinders rate at a hundred and sixteen, glass manufacturers and fishmongers at a hundred and nineteen, and plumbers and painters at a hundred and twenty.

Fourteen occupations remain on the list, which are remarkable in that they present the highest mortalities. They begin with railway engine-drivers, officers, and servants; tool, file, and saw makers; and harbour and dock labourers; all of which classes have a mortality of one hundred and twenty-one. Hatters, coppersmiths, and needle manufacturers are still more unfavourably placed, viz. at a hundred and twenty-three. Manufacturing chemists and dye and colour manufacturers run down a degree further, viz. to a hundred and twenty-four. Hairdressers sink to a hundred and twenty-seven; bargemen to a hundred and twenty-nine, and carmen, carriers, and draymen, together with horsekeepers and grooms, to a hundred and thirty-one.

The last three classes on the list are of all the most exceptional. They are—(*a*) Inn and hotel keepers, licensed victuallers, or publicans. (*b*) Earthenware manufacturers. (*c*) Coachmen (not domestic) and cabmen. In the first two of these classes, the rate of mortality, computed by the standard of one hundred as the mean, is one hundred and thirty-eight. In the last-named class the rate is one hundred and forty-three. In other words, for every hundred deaths of the representatives of the seventy occupations collectively, there are one hundred and thirty-eight deaths of innkeepers and earthenware workers, and one hundred and forty-three of cabmen and non-domestic coachmen. The last class die as two to one compared with the clergy of the Established Church.

The three groups of occupations thus signalised stand out in a peculiar light, and offer a strangely striking example of the influence of occupation on health and life. Of the groups themselves, the earthenware manufacturers are a very small group, the total of the deaths recorded against them in the three years being only one thousand three hundred and twenty. The coachmen and cabmen, though larger in number,—the deaths recorded against them being, in the three years, two thousand two hundred and thirteen,—constitute also a comparatively small group.

The innkeepers, on the other hand, are a large class, the number of deaths recorded against them for the three years being seven thousand one hundred and twenty-seven, instead of five thousand one hundred and sixty-seven, that have occurred amongst them according to the standard rule. We are obliged, therefore, to place this class of workers in the lowest part of the scale of vitality of all the great classes of workers in England and Wales. If we were to depart from our table and make search among all the minor occupations not included in the seventy that have come under notice, none other could be found that is so disadvantageously placed in relation to value of life.

XXXVI.

CONDITIONS AND MORTALITIES.

AS we glance with scientific appreciation over the facts revealed by the history that has been collected, and which is now in our possession, several points stand prominently forward. It will not be lost time to look at one or two of these.

In the first place, we are led to see that the degree of mortality, and therefore, as may be fairly inferred, the degree of ill-health incident to an occupation, is not of necessity connected with the occupation, but is due to some error, which may perhaps be very slight, but which, continuously persisted in, is extremely fatal. Let us glance, for example, at the facts relating to two trades, that of the grocer and that of the draper.

In the labour carried out by the workers in those businesses there cannot be any great difference in the amount of work done nor in the hours of work. Neither can there be any marked or sufficient difference in respect to social advantages. The draper lives as well, is sheltered as well, is or may be as well provided with recreative pleasures, as the grocer. They both live in the same communities, exposed to common general influences and to similar anxieties in reference to business affairs. It is not probable, and indeed there is not the slightest reason to assume, that the grocer leads, as a rule, a more temperate or more perfect moral life than the draper. Yet there is this extraordinary difference between them, that by a mean of a hundred as a standard for men belonging to seventy occupations, only seventy-six grocers die to one hundred and eight drapers, and this in males varying in age from fifteen to seventy-five years.

When we analyze the phenomena we find that this great difference is produced at definite periods of life, and that from fifteen years up to fifty-five the mortality at every period is in excess amongst the drapers. From these facts we are driven to infer that the evil which is at work amongst the drapers is of an acute kind, influencing life in its earlier stages. If we inquire one step further we discover that the evil lies in diseases affecting the organs of respiration, such as consumption and bronchial phthisis. The explanation of the difference of mortality between grocers and drapers is now at hand, without mystery.

The grocer lives in an open shop with doors rarely closed from morning to night. He deals in goods which give off little dust. He is rapid in his movements, and keeps himself warm by exercise, without the aid of hot stoves and thick raiment. The draper, on the other hand, works in a close atmosphere. His shop-door is on swing hinges, and is commonly blocked up with rolls of woollen or cotton material. His shop is literally stuffed with goods. He is engaged handling goods which fill the air with fluff and dust. He warms up his place with stoves, and from morning to night he keeps up his temperature by artificial means. Under these conditions he becomes first dyspeptic, thin, pale, and anæmic; then consumptive or bronchial; and so he succumbs. The source of evil here is easily traced, and is as easily removable. It belongs to the occupation as a matter of ignorance, not of necessity. It is a type of many similar errors connected with those occupations which yield the highest mortalities.

In other examples the degree of danger accompanying the occupation is so closely connected with it that it is inseparable, although at first sight the connection may not seem necessary.

One who casually compares the life of the members of the profession of the Church with the life of the members of the profession of Medicine might think that between the two professions there was little reason for difference of value of life. Yet by the standard we have obtained it follows that for every seventy-one clergymen who die, one hundred and six doctors die. When we come to the cause of this difference, we find that up to thirty-five years of age the deaths are in the proportion of two of the doctors to one of the clergy, and that from this period of life through every decade the excess of mortality, in a lesser ratio, continues amongst the Æsculapian fraternity.

The cause of this difference lies in the difference of occupation purely. The extreme labour of learning, and the danger of the learning through which the man of physic has to pass before he attains his qualification, are the great causes of his mortality in early life. Later, the struggle to live, coupled with the day and night watching; and later still, the increasing watchfulness and anxiety which come with success,—these causes all add to the failure of physical health and to the loss of life which is inflicted on this class of workers. In short, whoever enters the profession of medicine must enter it knowing that, compared with the clerical and other professions, he must accept a shorter lease of life than theirs, in compensation for the longer leases of life it is his high privilege to confer on his fellow-men.

There are classes of labourers who, engaged at very laborious work, die in very different proportions because their work is carried on under different conditions. The dock-labourer's work is not actually harder than the farm-labourer's; yet the dock-labourer dies at the rate of a hundred and twenty-one, the farm-labourer at the rate of ninety-one. In this case the greater exposure of the dock-worker to physical accident, and to extremes of cold and wet, are the determining causes of his greater mortality. The same may be said in respect to the differences between the bargemen and the blacksmiths.

There are classes of labourers in which the great mortality that prevails amongst them is due to the want of scientific care in carrying away the products of labour which are given off as volatile refuse. These products are dusts, or gases, or vapours which the worker breathes or receives into his lungs, and the presence of which in the air is sufficient to convert a light and easy occupation into a seriously fatal pursuit. The work of the hairdresser cannot possibly be esteemed a more laborious art than that of the wheelwright. But the hairdressers, who are all day inhaling a close atmosphere charged with fine particles of hair-dust, die at the rate of one hundred and twenty-seven, while the wheelwrights, who are toiling in all weathers in the open shed, die at the rate of eighty-eight. It is quite unnecessary that any such differences as these should exist. The fatality from impure air charged with dusts is so much ignorant destruction of life.

There are classes of workers who present high mortalities, from the circumstances that they are exposed directly to poisonous compounds which, absorbed by their body, produce fatal disease. The workers in lead,—plumbers, painters, and potters,—and the workers in some chemical factories, and at some chemical pursuits, such as photography, afford illustrations of this nature. The labour of plumbers and painters is not more severe than that of carpenters and joiners, but the death-rate of the former is as a hundred and twenty to ninety-one of the latter. The cause of the difference in this instance is the exposure to lead, chiefly, and some other similar cause is at work in the other examples of high mortality referred to under this head. In many of these examples all the danger is induced by deficient cleanliness on the part of the worker. By the combined efforts of workmen and of science these evils may in time be removed.

The most startling fact of all in reference to occupation and health is that which is told of the innkeepers and publicans. This class of the community is really at the lowest of the vital scale. The cause, unhappily, is not difficult to discover. There is nothing in the occupation of an innkeeper, as an occupation, which can account for its unhealthiness on ordinary grounds of labour. It is not an occupation which exposes those who fill it to physical danger, as the work of the miner or the engine-driver does. It is not an occupation which makes great demands on the physical organism, like that of the blacksmith or ropemaker. It is not an occupation which leads men into solemn charges and responsibilities, like those of the physician, solicitor, or clergyman. It is not an occupation which brings those who follow it to the miseries of want and starvation. Why, then, is it the occupation most nearly allied to death? The answer is simply told. The occupation is the one that is most nearly allied to alcohol. This agent of death, which diffuses danger more or less amongst all classes of workers, tempts most rapidly into destruction those who are the dispensers of it.

The influence of this one agent vitiates to some extent every calculation on the vitality of classes of men. Here it stands out on its own ground, telling its effects on its chosen servants, and teaching a lesson by the fruits it yields in them, which, if the lesson stood alone, were a sufficient recompense for all the labour through which the facts that have now passed before us have been collected.

Of the members of the seventy occupations we have specially studied, few do too little work, many do a great deal too much, and probably so long as there is human competition excess of labour will prevail, and will be a certain cause of an excess of mortality above the natural standard. But the real dangers, the series of causes, which lead to the great excesses of mortality are to be found outside the occupations as mere departments of human industry and skill. They lie in the conditions under which the skill and the industry are developed and pursued; conditions nearly every one of which are removable without a breath of injury to the art or business itself, whatever it may be.

In the history given in the above passages I have recorded the leading facts bearing on life and occupation in this country in so far as they are officially authenticated. They may be accepted as fair representations of the facts of other countries similarly civilised. In respect to health they show at once that the conditions conducive to good health must indeed be little cared for in a community some classes of which die at the rate of two to one over other classes, and in which those who are now most favourably circumstanced are actually not fully up to the natural standards of health and longevity.

XXXVII.

IDLENESS AS A DISEASE.

THE old proverb that eight hours of the twenty-four of each day should be passed in work, eight in sleep, and eight in play or recreation, is one of those true sayings which science willingly accepts and confirms. In our modern days, however, no rule of life is more deliberately broken. The age is so decidedly and decisively competitive, that the race daily run for wealth, reputation, fame, name, and honour, is spent in trying who shall do most work with least sleep and least recreation. In fact, sleep and recreation have ceased to be considered as useful parts of existence, and are looked upon as so much loss of time.

The ungallant Caliph Omar is reported to have said of women that they were great evils, but that the greatest evil of all was that they were necessary. Our busy man of the present day says, practically, the same thing respecting sleep and recreation: They are great evils, but the greatest evil of all is that they are necessary.

In the race that is being run for wealth, reputation, fame, name, and honour, success, no doubt, does now turn on the time that can be devoted to work. The law of the survival of the fittest was never so actively carried out as it is at the present hour. They who make solid and rapid progress are the strong workers, the men who can endure most fatigue and perform the largest amount of mental or physical strain, or combined mental and physical strain, in the shortest intervals. The weak go to the wall in one way or other. Some of the weak, the majority of them, serve the stronger. Others of them, thinking they can make up in cunning what they want in power, try intrigue, practise criminal acts, as a means to reach the forward ranks, and, failing, find a home in the gaol instead of the mansion. A third set of them sink into the workhouse or charitable asylum, and live on the alms of those who are above them.

Through the whole of the classes that really work, the tendency to excess of work is relatively developed. The strongest drag the weakest in their train, and make the work and hours of work for all, according to their pleasure. Thus the hours of recreation, whatever may be said of them, are ordained by fashion, and no man, unless he be quite independent (when he, generally, by a reaction against work altogether, has none other but hours of idleness), can be so placed as to have a choice or voice in regular and systematic recreative delights.

When, some time ago, I published a series of remarks similar to those written above, it was answered by one of my learned brethren, for whose opinion the utmost possible respect is due, that there was a considerable amount of disease induced by idleness, and that the idea of production of disease by overwork was problematical. The observation led me carefully to reconsider the facts involved in this question, but without finding any reason for modifying my former views. I do not for a moment deny that many people suffer from idleness. I fully admit, and have already written, that idleness, which I am bound to look on as a physical infirmity, is destructive, in a certain sense, to those who indulge in it. But when I come to consider the number of persons who suffer from idleness and compare them with the number who suffer from sheer overwork, the comparison is absurdly small of those in whom idleness has taken baneful root, by the side of those who from toil swell the ranks of the diseased.

Idleness is an infirmity. In its completest development it ignores recreation as much as it ignores labour. It is a paralysis of the will, and in certain cases may be looked on as in itself a distinct and fairly defined disease, which nothing can immediately cure. I have observed also that this disease, idleness, may be born from two sources.

There are families in which idleness is an hereditary curse. You may blame these families as much as you like, you may punish them, but you cannot directly change them. It is only by the admixture of the elements of them with the elements of other families, only by breeding industry into them, that a change of a permanent kind can be specifically perfected. There are families in which specific diseases or taints, passing in hereditary line, are the causes of that physical and mental inactivity which nothing can animate, and to which we give the name of idleness. Such causes must remain until they are gradually removed by the introduction of an improved sanitary system permeating all classes of society, and rectifying the social errors that everywhere prevail.

These hereditary influences are often of ancient date. They come down from the times when men in masses were begotten to bondage; when the masses were indeed herds, herding together as best they could, less cared for than the cattle and swine they tended; less free and worse provisioned. They come down from the times when the food that was eaten was collected without the slightest knowledge of its properties beyond those that satisfied the rude appetite or gratified the taste; when the food, even if it were good and nourishing, was cooked so badly that all the force of a stomach taxed to its utmost was unable to complete the resolution of the substance into new body and blood; when the dress was insufficient to protect the body from the vicissitudes of weather; and when infectious diseases, springing from personal uncleanliness and vice, or from overcrowding under cheerless, cold, unclean, and dark shelters, spread like wildfire through the ranks, and left many whom they did not slay hereditarily wounded.

In our present day the worst of the evils springing from such sources are greatly modified, because, bad as things are, they are better than they were to an extent it were difficult to depict by any art of history less facile to read than that which the painter by his magic force could place upon the canvas. But the modification is partial after all, and even now there are in various new phases origins of the disease of inaptitude, idleness.

Amongst these causes not one is more potent than the strain of labour after success to which I referred above. That parents who are worn-out by the struggle of life produce enfeebled offspring, whose powers of work, whose facilities for work, and whose proclivities for work are impaired, is one of the most striking physiological facts of the present day. It is as though men, and women too, were laying before the eyes of the physiologist a great physiological experiment on the influence of labour on life in which they and their children are the subjects of experiment.

The experiment is not vain. It shows that Nature puts fetters even on industry; wills that the work of the world shall be distributed through the various generations of men; that each generation shall take its equal share of labour, and no more; and that if any generation insists on more, there shall follow, in compensation, a new generation or new generations which shall not be able to imitate their fathers, but shall rest in order to redeem what their fathers have prodigally misspent.

XXXVIII.

COMPETITION VERSUS HEALTH.

IN the course of my observations so far, I have made reference mainly to persons who have passed childhood and the heyday of life. Whatever errors in respect to work and recreation are committed amongst them, are committed and intensified amongst the younger classes. It matters little into what class of English society we enter,—into the homes of the manufacturers of earthenware in the pottery districts, into the manufactories of large towns, into the agricultural districts, into the homes of the middle and upper classes,—there is the same unnatural system in progress, the forcing of the young into the active duties of life, and the resort to recreations and exercises which really are not recreative pleasures, but are too often recreative tasks that belong to the schoolroom rather than to the playground.

The children of the industrial classes are becoming more favourably circumstanced than they were a short time ago. The introduction of the half-time system into manufactories; the introduction of the system by which children under ten years of age are forbidden to work; the introduction of board schools; and the educational system, half instructive and half recreative, which is aimed at in the schools;—these are all good omens for the future of the children of those five million industrials who constitute the backbone of the country.

Amongst the children of the wealthier classes the errors are as they have long been, while in some directions they are undergoing multiplication and intensification. Our youths of both sexes, under the pressure of the competitive system of learning which prevails at this time, are practically forbidden recreation.

I have recently been watching a young man who has been preparing for graduation in honours for one of our universities. I have recently been watching a young lady who has been competing for a first place in the high-class university examinations. I have looked at the lessons these pupils have been forced to learn, at the charges of knowledge they have been obliged, in a given time of short duration, to stow away in their brain, and which charges, when the examiner pulls the trigger, must be exploded on the examination paper. I have looked at one particular subject of examination with which I am best acquainted, and I have asked myself, "How long would it take me, who am a fair hand at learning anything I may apply myself to, to get up sufficient information to answer all the questions that are set for these young minds to answer?" The conclusion I have been forced to arrive at is that the task on the one subject on which I am best able to form a judgment, because it has been a pursuit of my life, would be more than sufficient to fill properly all the time that is given to learn the whole programme. I see, indeed, a trained specialist in one department of learning putting forth his trained strength to wrestle, on his own ground and on his own conditions, with a youth who has been straining to get up a similar contest with a number of other trained specialists, not one of whom could wrestle with his colleagues off his own ground.

The process amounts to an inquisition, and it were better for the upper and middle classes if there were no universities at all, than that such a pressure should be inflicted on their children. To have sent a Faraday, a George Stephenson, a Fergusson, a John Hunter, a Newton, a Shakespeare, a Bacon, through any such an ordeal, would have been either to have whipped him into silence on the stage of the world, or to have made him the merest of pedants.

In time, as Nature with her clear voice declares herself, the blunder will stand out too distinctly to be unrecognised. When it is seen, as it will be seen in another generation of manhood, that the humble board schools, teaching the "three R's," are the training schools for all the genius and mental greatness of the country, and that the men and women who have been pressed into the university service are beaten into fits by their lower and freer neighbours,—are, in fact, nurtured imbeciles compared with their lower and freer neighbours, —then the follies of the existing plans will be discovered, and the rectification of them will be the earnest question of the day.

At present it would seem that matters must stand as they are. The university scholars have it all their own way; they have no competitors as yet in the race, and no comparisons can be made of a practical kind until the competitors from the board schools are on the field. We can therefore only look in advance to see what will happen, and predict the future from the psychological and physiological lights which lie before us for our guidance. These, fortunately, are decisive enough, and they are helped by the facts which the history of man has given for our edification.

The lights show us that young brain unduly exercised becomes old altogether while it is yet young, and that old brain moderately exercised remains young in parts when, as a whole, it is old. They show us that the mind which will throw off the most brilliant work, the mind that will master the most difficult inquiry, the mind that will lend itself most readily and earnestly to the hardest tasks, is the mind which has simply been put in the way of doing work, and which, possessing the elements of method,—reading, writing, calculating,—has been left to its unfettered freedom.

The modern student of the middle and upper classes of society, during the period he or she is preparing for examinations, which means the most critical period of his or her life in respect to health, finds no time whatever for healthy recreative pleasures. There is no possibility of such a thing; the exigencies are too pressing. The dread that failure on a single subject may cause "plucking" is so incessant, the mind has really no peace except when the eyes are bending over the book, and are straining to take in still more and more of the hard lesson.

The anxiety brings sleeplessness; the sleeplessness increases the anxiety; the body becomes feverish; and at last, when the great effort has been made, the result, whichever way it turns, is in the end bad. To win is to secure a passing advantage bought at the cost of some years of life, and with the mental faculty forced into grooves out of which it never quite frees itself. To lose is to be subjected to a chagrin and annoyance which in sensitive natures runs actually into remorse, shame, or a dazed imbecile carelessness which, in a person past maturity, would lead to dementia, and which at no age is fairly recovered from or fully forgotten.

I am perfectly alive to the fact that, in writing what I have written above, I am stating some very hard and unpleasant truths. But "if an offence come out of truth, better is it the offence come than the truth be concealed." I am but telling as a true physician what experience teaches me of the physical conditions induced by the excessive and useless exercises of labour to which the younger and as yet better brains of our community are subjected. I am but telling the experience of other members of my profession who feel as I do, if they do not express themselves so freely.

After a lecture I had to deliver in one of our large provincial towns during the past session, and in which I stated what I have here committed to paper, one of the eminent physicians of the place came forward to me to thank me for the statement, and to give me the following personal experience. "My own son," he said, "a youth of good intellectual parts, made up his mind to go in for his degree at a university"—naming the university in which, in this kingdom, the process of intellectual destruction is most scientifically and systematically carried out—"and determined also, if it were possible, to win a good place in the lists of honour. He worked through all the preliminary grades with untiring industry, taking no rest, and unable to find time for any. He went in for his great effort, lost, and now is wandering on the Continent utterly broken down, mentally and physically—more like an idiot, for the time, than a youth of good intellectual capacity originally, on whom every expense had been bestowed to ensure for him a good education."

These results of their system they who plan and carry out the examinations do not see. They who manage the university are intent only on the sustainment of what they, most honestly I know, consider to be the credit of the university, the maintenance of its high character, and the assurance that none but brightest scholars should appear on the rolls of its graduates.

The examiners look purely for the direct efficiency of those who come before them for examination. Neither manager nor examiner can ask after the antecedents of those whom they take in charge. They do not know that the student may be the subject of tubercular diathesis, of heart disease, or brain affection ; and that out of every three students one at least will be under some such disqualifying hereditary influence. They proceed, adding difficulties upon difficulties, as if every student had the same stamina and the same capacities. Without the least intention, and without the least suspicion of what they are doing, they often test, by their crucial severity, the physical instead of the mental powers of their candidates, and, as ruthlessly as ignorantly, pluck the best brains by overtaxing the feeblest hearts.

XXXIX.

SPECIALITY IN WORK AND PLAY.

IT has been constantly repeated by the philosophical historians that different ages present different and, as it were, alternate pictures of mental and physical power. This age was one of genius, that of mediocrity; this of war, that of peace; this of quiet inventive thought, that of quick, sure, successful inventive application and manufacture; this of pleasure, that of laborious anxiety. To the physiologist these phases are all natural phenomena following from simple causes, as day follows night and night day. The age of genius wore itself out by its own efforts. The ages of war, of active mechanical labour, of travel, did the same. Then followed the ages of quietude and rest, in which the exhausted energies were recruited; in which the potentiality of living action was stored up; in which the man universal practically slept and dreamt to rise again in new form, charged with new energy for new efforts like a man who has risen from a night of sound repose. We are passing through one of these phases, one in which the whole soul of the man universal is quickened to mechanical work, to liberation of all his potentiality in regular and systematic order, through work given out and expended by the hands. Every man's hand is becoming mechanical, and there is as much active brain now in some men's hands as there was in the whole organization of the majority of men who lived a century ago. Such, too, is the force of moral contagion, that for the first time in the history of the world women are entering the lists with men, and no longer content

"To guide the spindle and direct the loom,"

are determined, at least for a time, to share the field of active combat with their sterner partners, and to join with them in the common handicraft struggle for wealth, reputation, fame, name, and honour.

With this mechanical tendency, this desire to cultivate every branch of knowledge on the mechanical principle, so that even mental operations are expected to move with the precision of a steam-engine, there is developed another tendency, that of working in grooves, and attaining what is called perfection in special departments of art, science, and literature. To some extent this division is, perhaps, a necessity, but carried into such minuteness as at present exists, it is hurtful beyond expression. The ideal of individual perfection in the performance of the one particular art or craft, without diversity of occupation,—that is to say, the devotion of a life to a single intent or purpose,—is of all exercises the most ruinous to the vital nervous power. It brings the whole nervous energy into concentration upon special sets of the motor instruments of the body. Before maturity is attained the living man is transformed into an automatic mechanism which becomes so distinctive that no other motion except that which the habit directs is tolerable. Limitation of view, limitation of knowledge, of thought, of sympathy, of muscular movement, becomes a second nature, and leads to dependence of one man on the other and others, until the perfect master in his own department is a helpless child so soon as he is out of his own narrow sphere. Dependency breeds dependency, while the splitting up of departments into departments continues without end.

The special desire for attainment of special excellence extends itself from work to play, and men tie themselves to a particular recreation as they do to the work by which they live. The wealthy men who can afford to play at politics in the Houses of Parliament find it necessary to specialise there,—to take up some subject, and to talk, and write, and argue on it, until by iteration and reiteration they become publicly ticketed with their speciality. The men who can afford to amuse themselves in other ways in their own homes or clubs, work up some particular game—whist, chess, billiards—until they have gained the reputation of being the best in that art. In their own circle as masters of the art, they are so exclusively devoted to it that they think of no other pastime.

Into this acquirement of a second nature in what is considered to be recreation, the mechanical taste of the age again shows itself. The man is known by his play. He has a system which he invariably follows, and out of which he is never at home. Sometimes he imparts his system to others, and becomes a teacher of it; sometimes, most commonly, he keeps his system to himself, as a system too precious to be made a common property with the rest of the world. The effect of all this is that an accomplished man, in the complete sense of that term, is not now to be met with, and if he were met with would be looked upon as superficial, or as knowing too much to know anything well. Now and then an accomplished woman is met with, and is tolerated, but even she is *rara avis in terris*.

The effect of this intensity for one exercise is to turn that which is called recreation into work, and often into work of the hardest kind. The City man, or the hard-worked professional man, or the mechanic engaged all day in the workshop, is tempted in the evening to take a few hours' drill in a volunteer corps, or to encounter a long march, or to have a turn at the butts and strain every muscle and nerve in competitive desire to be the best marksman. If volunteering be not the recreation, then cricket, or bowls, or rowing, or gymnastics, or bicycling take the place, and the struggle in these recreations is, again, to arrive at such excellence that the amateurs shall compete successfully with the professionals who make the pastime an art by which to live.

The same strain is followed in indoor games and exercises. If the dance is the amusement, it must needs begin at the natural hour of going to rest, and must be continued until the time when the natural hours of work ought to begin. If music be the evening's pleasure, it must be carried on as if the performers were on the orchestra platform of the Philharmonic, and were forced to get their bread by the skill of their performance.

If four old fellows, or young fellows, or middle-aged fellows, sit to a rubber of whist, they must lay down their stakes and play as if dear life depended on the measure of the die. They must tax their memories to remember what cards are in or what cards are out, until they are dizzy with the effort. They must learn Blue Peter and all the newest arts of play. They must call up old experiences in order to remember good finesses and leads. They must carry in their minds a whole book of rules. And if they would keep their reputation as first-rate players, they must be ready at any moment to dispute every point of play; to argue out how this would have happened if that had been done; to bet on results, and stand by loss or gain with equal composure; to bear the anger of a partner who loses, and to protest to the last, if a stake has seemed to be lost by some misadventure or loose play, that the principle was correct and the result the same as if any other play had been carried out.

To crown the whole of this recreative business, time is obliged to be considered no object. "Time was made for slaves," and the slaves acknowledging the argument keep up the effort until sheer weariness and irritation at loss, or exultation at success, drives them to their broken rest. They tell you that at the end of a year they are as well off as they were at the beginning, however great the stakes may be for which they have played, so thoroughly does constant play over a long period of time equalise the risks. This refers to the money lost and won; not a word is said, not a word is thought, of the health that is lost, of that worthiest of possessions and choicest of gifts, which is never equalised by any length of time occupied in the play, and the loss of which once entered is always down on the debit side of the account to the end of life.

In the more widely scientific game of chess the method of play is little different now from that of cards. It is true that high stakes are not commonly played for at every table when men or women sit down to play, and that the honour of winning at chess is considered as a *quid pro quo* for a money prize. In this sense chess takes a much worthier place than cards. But the mental labour that is expended on the game by those who become infatuated by it; the strain of calculation to which it subjects its votaries; the inventive and speculative thought it enforces, even at times when the game is not in progress, is exhaustive to a degree that is little understood by any, and least by those who are under the spell of the fascination. The chess-player who has once got the game so in his mind that one of the great objects of his ambition is to master it and be a distinguished player, carries, virtually, a chess-board and all the pieces in his brain, where, like automata, the pieces move about by day and by night, to the infinite cost of the owner's rest and the ruin of his life.

In making these criticisms, I am not urging a line against the recreations themselves to which I have invited attention, or to any other recreations. All good and wholesome recreations are useful diversions from the daily life, as pure pleasures. I would not take one away, I would thank all who would invent more, and I think that the man who invented the game of croquet has not received a tithe of the thanks which he really deserves.

Against games there can be no objection. The mischief commences when the games, ceasing to be recreations, become muscular and mental labours. When they are carried to such extent that they who follow them on would feel them burdens too heavy to be borne if they were enforced by tyrant masters, then the games, instead of being reliefs from the cares and necessary labours of life, are added cares, added and unnecessary labours, by which so much strength that ought to be conserved is cruelly thrown away. Day by day adds to my experience of the evils here described, and my duty were not performed if, in deference to popular taste, I hesitated to expose them.

XL.

RECREATIONS, GOOD AND BAD.

IT adds to the evils pertaining to the mental training of youths who are passing through our university mills, that such recreations as they venture on are, in accordance with the spirit of the time, of an exhausting or debilitating character. Running and rowing; indulging in furious gymnastic exercises; billiards; long and wearying walks, with rest in lying by and smoking—these are the kind of reducing pastimes which the hard-worked student selects as a relief from his mental strain.

The youths of other sections, who, having no university or professional scholastic career before them, are engaged in commercial or mechanical callings, or who are acting as clerks, copyists, or artists, though they are more favourably circumstanced in regard to mental exercises of a severe kind, are equally indifferently circumstanced in respect to recreative enjoyments of a natural and healthy character. The long hours of business to which they are subjected, the closeness of the air in which they labour, the cramped position of the body under which they work, demand that the recreations they indulge in should be in pure air, should include simple but not fatiguing exercise of the body, and should secure what are the real and instinctive pleasures of the mind. "The love of simple pleasures"—says Mr. Hunt, a writer who has written so admirably, it is a thousand pities he has written so little—"which find their home among flowers and forests, mountains and rivers, and the wide sea, is far more strong, not only in childhood, but at all ages, in uncontaminated minds, than the love of pleasures and amusements artificially invented."

The proofs of this true and wise expression are fully seen in natural desires. The pleasures named are those for which the hearts of our youths yearn, but which they rarely obtain. The artificial pleasures they can obtain are not real and abiding joys, but are too often mere transferences of labour from one kind of employment to another. And though, because they are such transferences, they are better than the continual grind at one occupation, they are poor representatives of those true recreations on which the health of mind and body so largely depends, and become injurious recreations when they are carried on, as they often are, in the close heated air—charged with tobacco-smoke and vapour from gas—of the billiard-room, card-room, debating arena, or music saloon.

The amusements and recreations of children are, in all classes of society, somewhat better than they were a few years ago. The earlier times for holding children's parties which have been adopted in London during the past two seasons, and which allow the children, after five or six hours' play, to get home to bed by nine at night, are much more reasonably and naturally selected than formerly obtained. The introduction of croquet and of other outdoor games in which girls as well as boys take part, and which give good exercise without violence or exertion, is a great advancement. The reintroduction of the good old-fashioned dances for children, in which there is freedom of movement of the body without the stiff formalities of set dances of the Parisian school, is another good revival calculated to prove both interesting and healthful. While the custom, becoming so general, of taking children for a month every year to the seaside, and of allowing them perfect freedom of action to wander by the shore, and paddle, and dig up sand-forts, and bathe, and learn to swim, is one of the greatest improvements of modern life, one of the surest means of bringing up a healthy race of men and women to fill the places which the present men and women occupy, and to perform in a more advanced manner future duties.

These improvements in the recreations of the child-life are not to be over-estimated. They are, nevertheless, very much marred by other combinations of work and so-called play connected with the different systems of education. School-hours for young children are two-thirds longer, at least, than they should be. The device of making children take long and solemn walks in rows of two and two, as if they were taking part in a daily funeral, and the restriction of the exercises, of girls especially, to mere formalities of muscular movement, are ruinous formulas. Worst of all, in relation to both sexes, is the introduction of that competitive prize system, by which mere babblers are trained to speak and argue and deliver facts and opinions with the assumed authority of matured minds, and are inducted into this precocity by a method of forced training that destroys future power, and counterbalances the good that in other directions is springing up to improve the mental and physical tone of the rising generation.

I believe that, here again, the board-school system will have a great influence on the systems that lie above it; and that parents,—for it is the pride or ignorance of parents far more than the faults of teachers and masters which encourages existing evils,—will learn from the humbler system that the simplicity of childhood demands simplicity of education.

In all phases of life recreation is a necessary part of the daily existence. It must change in character with every age, but it belongs to every age of life. The proper application of it lies in the pure and simple method of making it innocent, varied, and simple. For persons advanced to or beyond maturity, in whom the physical growth and development is completed, all extreme physical exercises can have but one effect, that of reducing more rapidly an already wavering or declining power. Severe exercise is to them a process of running down the hill of life when it should be leisurely walked down. In like manner, for these matured organisations all vehement competitive mental games, billiards, whist, chess, are equally injurious when they are carried into excitement, anxiety, fatigue. For the body runs out by the nervous as readily as by the muscular centres, and the mental fatigues named, with others similar, are rapidest of destroyers. Through them the descent down the hill of life gains a momentum which is even less easily checked than the speed incident to over physical exertion.

For the matured man, exercise within fatigue in the daily work is the desideratum. Work then becomes a means of prolonging and improving life. Work that may be made of the most enduring character is then carried on. But in this period of life recreation must be recreation. It must be something that the eye or the ear can take in without labour, without effort. Beautiful scenes and works of nature that unfold themselves so as to be comprehended at a glance. Beautiful works of art, dramatic, pictorial, that in the best of human representations imitate nature. Clear and eloquently simple discourse, that teaches and explains, without tedious argument, what is newest and oldest and truest. Readings of a like character. Mental games, which bring into play old and acquired knowledge, or which, if they call for new knowledge in their exercise, are moderate in their demands. Physical exercise that can amuse without creating weariness or subjecting the body to shocks and sudden cessations from rapid motion and falls. These are the only recreations fitted for men who, having passed the meridian of life, have arrived at the stage when the elasticity of the tissues is impaired; or the reserved stock of life, the *vis vitæ* that impelled youth, is failing, never to be regained, but most easily to be exhausted.

The exercises of recreation for youths and for men who have not reached the meridian of life may be as active as the players will. But the players must not exceed the bounds of nature. They must not carry wearied limbs and minds into recreative sports, which are but hard labour under another name, and which, being made the end of each day's toil, are carried into the night, to the forfeiture of a portion of the eight hours' term of sleep that is essential for the perfect renewal of the vital motion. They must not let recreation unduly precede the day of hard work; nor follow it, whether it be of mind or body, in impure air; nor sustain it by unwholesome foods and stimulating drinks.

Amongst the female population there is great improvement of late in relation to recreative outdoor amusements. The croquet-lawn has to be accredited with much of this good and wholesome change, and the more we see it developed, in every reasonable way, the better will it be for the future mothers and children of our country. It cannot be too strongly urged that all recreations which bring the young of both sexes together are doubly useful. Such combinations in recreation impart courage and strength to women, gentleness and strength to men.

In childhood all recreative exercise should be free as the air. Even in close towns, those children who roam the streets and alleys and very slums are better off for health than they are who are kept in the close nursery or parlour. If we compare, in such a place as London, the street children with the children of the richer classes, we see a comparison which is favourable to the poorer. But if we compare both these classes with those children of the shopkeepers who are too respectable to be let free of the streets, and too poor to find a playground in the squares, we see how striking is the comparison; how strong and well the outdoor urchins are, rich and poor, by the side of the unfortunates who pine indoors, or find their longest stroll from home to school, and school to home. Through all the classes, however, reform is demanded. Less of forced work, mental or physical; more of recreative freedom; less life indoors; more life in the gardens, on the hills, by the sea. Learning is cheap now, and whoever can read and write can become a scholar, if he can become a healthy being. The dearest thing in the market is health, without which learning, be it ever so cheap, is bought for a sacrifice, and is burnt on its own altar.

XLI.

GETTING UP.

THE universal experience of the wisest men of all ages is in favour of the habit of getting up early in the morning. The practice is closely connected with goodness of work and length of life. It is also closely connected with happiness and activity of life. The physiological facts on this subject are striking. Those who rise early in the morning are, without any doubt, able to work during the succeeding hours for a longer time than those who habitually rise late. So it comes to pass that confirmed early risers usually wake at their ordinary time, even when they have been late in going to bed, and during the day feel less fatigue than do persons who from habit linger long in bed. There is something in the act of breathing the early morning air which invigorates for the whole day, which seems to remove oppressive vapours from the body, and which renders all the active organs of the body, the brain, the nerves, the organs of the senses, the muscles, the lungs, and the heart, freer to act and to perform their varied functions.

In this English climate it is always proper to take at least eight hours of sleep. A strong man in the meridian of life,—I mean a man of thirty and from that to forty years of age,—should not take less than eight hours. A woman of the same age may take nine hours and be all the better for it. Children under twelve years of age should have twelve hours' sleep, and youths of both sexes between the ages of twelve and twenty-one should have ten hours. Persons who have advanced beyond forty-five years should begin to take a little more than the eight or nine hours. They may, with advantage, add half an hour on for every additional five years of life. In this way the strength and happiness of old age is greatly conserved and favoured.

Through all these changes the habit of early rising should be maintained, and the time of sleep should be reckoned back from the hour of rising in order to set the hour for going to bed. Taking it all round, six o'clock in the morning is a good practical hour for getting up in this climate. This means that the full-grown man should go to bed at ten o'clock at night, the youth at eight, the child at six. Some allowance may be made, however, for season. In the period of the year when there is a long stretch of sunlight the hours required for sleep are reduced for all classes of ages. At midsummer one hour less of sleep will suffice compared with what is required at midwinter. At midsummer a man in the prime of life may therefore go to bed, if he likes, at eleven, a youth at nine, and a child that can run at eight. These are simple rules to be remembered, and if they were generally acted upon they would tend very much to improve the health of all classes. They would enable all classes who work, from schoolboy time through all the time of manhood, to perform more work and better work than if the hours of sleep were taken in such a manner as to begin later in the night and end later in the morning.

The reason why the morning air is so conducive to health, the reason why it supports all the actions of life during the day with so much power and cheerfulness, is that the air is very pure and active if it be free. All through the night the outer air has been undergoing rapid changes. There has been time for the diffusion through it of various products of decomposition. Then with the return of light there is a chemical change between the carbonic acid gas in the air and the vegetation on which the light falls. The green leaves of the plants or the green leaves of grass begin to fix the carbon of the carbonic acid that is in the atmosphere, while the oxygen of the carbonic acid is given back in the new and nascent state to the air. The freshness of the morning air in spring, summer, and early autumn is due to this cause, and all living things are benefited by it.

In addition to these advantages to the physical health from early rising, the mental health is also invigorated and refreshed. In the country no part of the day is so beautiful as the early morning, and in large towns even the same is true. No one has ever seen London so well as he who has traversed the great city in the first hours of the day. Then its air is clear, its streets are free, all its vastness as a city is comprehended, and its architectural beauties and faults are correctly appreciated.

There is one more advantage connected with the practice of rising early at a stated hour. The practice begets the habit of regularity and punctuality. I have never known a man who rose late and at irregular times who was punctual and regular in the after-course of the day. The fixed habit of rising at a given time becomes in a few years so defined and, as physiologists say, so automatic, that it is even a pain to break away from the custom. It occurs, indeed, that the sleeper wakes up whether he will or no. In this manner he attains one fixed and habitual method, and that prompts him to learn and acquire the same method in other acts. He has full confidence he can do one act of the day with precision, and thereby the certainty is impressed on him that he can do more with like regularity. He can rely on himself, and very soon those who know him feel that they also can rely on him. Such a man is a strong man, and is sure to get on in the world.

I have only one word more to say on this head. It is that when once awake it is good practice to turn out straightway. The mind is then bright for the day. Second naps in the morning breed heavy, leaden days, in which the head feels bound as with a cord, and as if another necessary nap were always coming on. To read in bed in the morning is very bad. To get up briskly is to be sharp and sure till it is time to turn in for another night.

XLII.

GOING TO SLEEP.

THE poet Wordsworth defined sleep as the "twinkling of oblivion," a beautiful expression, but one which does not describe the intention of the natural process. Shakespeare is much more perfect in definition, and indeed is all but perfect when he says—

> "Sleep, that knits up the ravelled sleeve of care,
> The death of each day's life, sore labour's bath;
> Balm of hurt minds, great nature's second self,
> Chief nourisher in life's feast."

Some other illustrious writers and poets have been almost equally felicitous in their definitions. Philip Sidney speaks of sleep as:—

> "The poor man's wealth, the prisoner's release;"

and Dryden declares it—

> "Of all the powers the best.
> O peace of mind, repairer of decay!
> Whose balms renew the limbs to labours of the day."

Similar descriptions have been rendered in other but more prosaic terms by the physicians and philosophers. Hippocrates, whom we recognise as the Father of Medicine, and in whose works all that remains of the science and art of healing up to his time is recorded, treats specially on the importance of sleep as a means of health. While Menander, immortal writer of Greek play, and who must have been a scholar also in physic, maintains that sleep is possessed of such healing virtues that it might be considered a natural cure for all diseases.

The phenomenon of sleep is very singular and interesting. It occurs in the natural state with the regularity almost of night, and it ceases with the regularity of the dawn. It goes with the sun, said one of our old physicians, and he was nearly correct. Sleep, however, is to a certain extent under the control of the will of the sleeper, who during the earlier part of his life can limit it in its duration to five and even to four hours in the course of the twenty-four. He can also so modify the periods of its recurrence that he can, if he will, turn day into night, as the time of his rest by sleep.

All these departures from nature are injurious. They become, after a while, automatic in their course, that is to say, by habit the body feels an inclination to sleep and to wake from sleep with a regularity that is like the mechanical movements of a timepiece, and for a long season of life the artificial habit seems to take the place of the natural. But nature will not be tampered with for ever, and so they who take too little sleep, and especially they who take too little sleep and that little in the wrong hours, invariably suffer at last for the mistake, whatever it may be that has led them to cross the boundary-line of natural law. There comes to these persons a period of prolonged weakness and weariness when sleep will steal over them whether it be wished or not, and then, encroaching and encroaching on the waking hours, it hangs at last like a permanent shroud over the whole life, until the sleeper sleeps into actual death. Or,—and this is the most painful ending,—the prolonged sleeplessness extends itself, and the man cannot get natural wholesome sleep at all. We physicians say of such persons that they are suffering from "insomnia." They do indeed suffer. They fly to opium and other agents that produce sleep, to obtain no more than a temporary relief, and at last they sink into helplessness and into death, remaining to the end sleepless except when they are under the influence of those artificial remedies which act on the brain to produce an unconscious state something akin to sleep, but not the same either in character or in usefulness.

The most perfect natural sleep is that which is experienced in childhood. Then after a day in which the limbs have been exercised by running about, and the mind has been kept active by pleasing scenes, the whole body sinks suddenly into sleep and remains asleep for ten or twelve hours without a movement except the continued motion of the heart and of the breathing. The little sleeper so happily circumstanced tells you when he wakes that he thinks he has only closed and opened his eyelids. He has no idea whatever that several hours have passed away. He has had no disturbing dream, he has heard no sound, he has felt no variation of heat or cold, he has felt in fact nothing, tasted nothing, smelt nothing, seen nothing, heard nothing. He might have been, for the matter of his life, like the old man of the seven ages:—

> "Sans teeth, sans eyes, sans sense, sans everything."

But when he wakes as does the day he finds all his senses active, all his wits about him, and all his strength repaired. His life is renewed.

The youth who takes great care to lead a very simple and innocent life, and who cultivates sleep so that at the right times it comes over him in an automatic manner, retains throughout his life the almost perfect sleep of childhood. He grows a happy man, and I believe I may say is always healthy. Certainly he lives longer than the rest of the world, and recovers more quickly than others from the illnesses he may contract through those external influences by which the different diseases that affect mankind are called forth. Menander was right; sleep is a natural cure.

Thus it becomes a duty of every one to cultivate natural sleep at the natural hours, and to let nothing interfere with the process either at its beginning or at its ending each day. Sleep is a period of internal quiet when the body is least able to receive outward vibrations and impressions; therefore sleep should be courted and carried out when the motions and vibrations of the outer universe are most effectively lulled. When all is darkest and most silent, in a word, when all is night and when the day sleeps, then is the time for human sleep, and none other. To deceive ourselves on this point, to say, "Let us sleep at any time, for it is all the same so long as sleep is secured," is to resist one of the wisest canons of common experience, and of science too, with equal pertinacity.

PART VI.

HALLUCINATIONS.

XLIII.

SHADOWS OF THE MIND.

A WHOLE series of mysterious manifestations, and these of the simplest kind, are connected purely with the physical conditions which modify the natural mode of conveyance of an object or act to the senses. The mirage, the double sun, the monster in the fog, the reflected sound or echo, even the reflected image in the clear stream, these, the mysterious manifestations of the earliest history of man, when the fixed principle of his thought had no rival, are now acknowledged, all but universally, to admit of a physical exposition that strips them of their mystery. Such obscure manifestations as remain, and are not traceable to external influences, are discoverable in the processes for observation within the observer; in his senses and the parts to which they minister.

For the full action of every part accomplished by and through the senses there are many factors

There is a collective organ for condensing each external fact that is brought to the man; a seeing organ; a hearing organ; a touch, taste, and smelling organ. There is in each organ also a receiving nervous surface. There is from this surface, leading into the man, a communicating nervous cord. And at last, at the end of the communicating cord is a nervous centre, in ready communication with a congeries of nervous centres for taking up the impression conveyed, for fixing it, and for bringing it into union with other impressions that have already been received, fixed, associated.

Suppose all these parts at all times natural, at all times in harmony, then everything that seems unnatural might be fairly ascribed to the reception of actual outward manifestations that are out of the common denomination of nature. Suppose, on the other hand, that these parts are not always in harmonious working order; then the design unfolds itself that there may be impressions, made by or within the man, that are mysterious or unreal, in so far as the true reading of the outer universe is concerned, and, in a word, hallucinatory.

And this is what physical science teaches, that each of the parts named as factors are, at times, disturbed or deranged in function. The collecting organ may be at fault, the receiving nervous surface may be at fault, the communicating cord may be at fault, the receiving centre may be at fault; and, in accordance with error of function in one or more of the parts, there may be aberration varying from that which is merely physical to that which is psychological in the most refined degree.

The simplest illustration of derangements of function is met with when there is perversion of action in the collecting organ, as in the eye in instances of colour-blindness or of *muscæ volitantes*,—floating specks appearing in the field of vision. More complex is a condition in which the reception of an impression on the receiving nervous surface of an organ of sense is too long retained, so that the impression remains when the first cause of it is gone.

Sir Isaac Newton, looking too intently at the sun, had left upon his sense a vivid picture of the sun, a phantom to some men, to him a phenomenon, painfully persistent, but understood by him as a pure physical fact. I knew once a gentleman who had a peculiar impression of an odour left on his olfactory surface, and for months it remained a source of constant discomfort, anxiety, and even timidity. In vision an aberration of function in the receiving surface may occur from mere strain to see in obscurity. Thus in looking at an object in partial darkness, as at night, when the stars are beclouded, an object steadily and strainingly gazed at seems to come and go, or, as is commonly said, to vanish and reappear.

There are various states of the nervous organisation in which the conduction of external impressions from the organs of sense to the sensorium is so perverted that modifications of external impressions are both induced and sustained. The delicate muscular mechanism by which the two great organs of the senses, the eye and the ear, have their various parts correctly adapted, are under refined nervous control, and easily lose their adaptations when the nervous control is either defective or changed from its natural use. The nervous atmosphere through which impressions vibrate from the receiving surface to the receiving centres, is susceptible of change, and thus under various circumstances there is an easy step to perverted appreciation of external things.

We have many known agents which exert their power by thus interfering with the healthy relations that should subsist between the organs of sense, the conducting way, and the mental centres to which all impressions are finally delivered. Alcohol taken in excess leads to such disturbance of balance of action, and therewith to false impressions of external objects, phantoms not made by the imagination, but constructed out of perverted sensual action. Opium, haschish, and some vapours and gases made to enter the body induce the same perversions, so that objects that are really before the observer appear to the perverted sight far distant, or larger or smaller than they are. Slight sounds are exaggerated into tempestuous noises, and sensations of smell, taste, and touch are either exalted into undue activity or lost altogether.

In connection with this subject I may observe that some of my physiological researches have led me to the view, that in certain conditions of the body there are produced, within the body itself, organic products which in the most potent manner affect the organs of the senses and interfere with their function. In a laborious investigation on the action of organic compounds of the sulphur series, I found that the most marked changes in the reception of impressions could be induced by certain of these organic substances, together with symptoms of hysteria and of muscular debility singularly analogous to those states of the body in which debility of the motor organs is attended with what is called excessive nervous susceptibility and excitability. In diseased states these same organic products exhale from the body, or pass off by the secretions, as products derived from organic chemical changes progressing within the organism.

XLIV.

DECEPTIONS OF THE SENSES.

A MAN, under any of the deceptions above cited, is never supposed to be anything less than deceived. The man who sees little specks, called *muscæ volitantes*, floating in the air may explain the form of the shadowy things seen with the utmost exactitude. He may,—I have known such a case,—give to the appearances fanciful names from their forms; yet it is not at any time supposed that the seeings are realities. The man who tells you a red object is colourless, or is of different colour to what all other men call red, is considered, however persistent he may be in his opinion, peculiar only and deluded. The man who explains that he sees but the half of an object, or that he sees two objects when there is but one before him, is at once accepted as incorrect in his observation. The man who, under opium or haschish, receives the impression of being in rooms of infinite space, of grasping in one sweep of apprehension incalculable intervals of history, is held to be for the time of disordered mind. And the man who, under the poison of alcohol, turns the simplest of objects into the likeness of the fiend, is credited with obvious derangement so long as he thus misinterprets what exists before him.

Yet there are many persons who, recognising such every-day truths to the full, accept other hallucinatory phenomena, of a similar origin, as actual external realities, and who, once believing, adhere to the opinion they have formed more determinately than to any ordinary fact or business with which they are hourly concerned.

The illusions depending upon changes of functions in the receiving surface of an organ of sense, or in the conducting cord, are comparatively simple. It is when we come to consider the reception and the fixing of impressions in the brain that the profoundest difficulties arise. Here we pass, with ease, out of the domain of current physical science into what is but useless speculation, unless we are ever on our guard in thought. I shall touch, consequently, on but few parts of this subject—on such as are nearest to the physical basis of research.

The brain receives and retains external impressions brought to it through the senses. In the exercise of this function it may become unduly impressionable, and may be the seat of illusion. Under these circumstances, one particular impression may so overrule every other impression that it shall persistently present itself. Sometimes a sudden impression is made upon the brain so potently that it is stamped, as it were, in persistent relief, coming forward at any time, but specially when the mind is unoccupied or is weakened, with all the force of a new reality.

The distinguished French physician, Andral, one of the most accurate of observers and least superstitious of men, affords an illustration of this illusion. When he was a pupil commencing his medical studies, he was terribly impressed at seeing, for the first time, a dead body on the lecture-table. Many years afterwards, during an attack of illness, he saw in his room a dead body stretched out before him, and it was not until some minutes had elapsed that he recalled the connection between this outward vision and the early impression that had been made upon his brain.

I know myself another instance, differing in detail, but belonging to the same order of phenomena. A youth, who had all his life been easily moved by any painful sight, entered the profession of medicine, and saw, as a first experience, an eminent surgeon perform the operation of amputation at the shoulder-joint. This was before the introduction of means for the abolition of pain, and the effect on the mind of this observer was terrible. He did not faint, as some of his neophyte comrades did, but stood resolutely transfixed in wonder and fear. In time he got over the dread, from that moment lost all dread at seeing operations, and, in fact, has himself many hundred times since taken part in surgical art. But this remains, that whenever he is present at any operation, the first operation that so impressed him is always present to him in its minutest details, as if it also were veritably in progress.

Connected with this form of hallucination is that of hearing sounds with which the ear has been at one time very familiar, without external obvious cause. Dr. Samuel Johnson, in this manner, heard, as he believed, the sound of his mother's voice calling his name, "Sam!" when she was separated from him by the distance between Lichfield and Oxford.

In studying this class of illusion, it is necessary to observe that the illusion is not an act or effort of memory, *i.e.* it is not an effort called forth by any act of volition. It is akin to that singular sensation which they who have lost a limb occasionally experience spontaneously—an experience as if the limb were still in its place, and were endowed with the sensibilities it once had, but which practically are forgotten. It is the same as that illusion of "pre-existence" which many have experienced, when a recognition seems to be felt of something already known, and which the memory is unable, however severely it is taxed, to recall. In a word, it is illusion *sans* volition.

XLV.

APPLIED HALLUCINATION.

A NUMBER of mysterious manifestations are traceable to the simple fact of recurrence of impressions altogether independently of the will. There are others which are purely volitional, and these constitute a distinct class of hallucinatory phenomena. They are illusions produced by what I should call the faculty of projection of objects that have been received from without by the brain, and fixed in it. We exercise this faculty naturally when at will we repicture to ourselves, or project what we have seen, heard, felt, or otherwise received by the senses, but what is not at the moment before us. We recall a landscape we have surveyed, a tune we have heard, and the like; and if the impression be correctly fixed in us, and we will it to return, it comes back directly. In the act we project from us that which we recall, and look at it, or listen to it, as if it were again external to us. This faculty, exalted to unnatural degree, is a fruitful source of illusion.

Wigan supplies a striking illustration of this kind in the case of an eminent portrait-painter who followed Sir Joshua Reynolds. The painter in question once produced three hundred portraits from his own hand in one year. When asked on what this peculiar power of rapid work depended, he answered that when a sitter came to him he looked at him attentively for half an hour, sketching from time to time on the canvas; then he put away the canvas and took another sitter. When he wished to resume the first portrait, he said, "I took the man and put him in the chair, where I saw him as distinctly as if he had been before me in his own proper person. When I looked at the chair I saw the man." After a while the painter began to fail to discover the difference between the real and the imaginary sitters, so that he became actually insane, and remained in an asylum for thirty years. Then his mind was restored to him, and he resumed the use of the pencil; but the old evil threatened to return, and he once more forsook his art, soon afterwards to die.

Talma, the actor, had a faculty of mental projection equally singular with that possessed by the artist whose history Wigan has related.

Talma could project before himself the form of a human skeleton with such perfection of detail that to him the form was a reality. When he stood before the footlights he had in his presence, in the theatre, an audience of skeletons. Goethe, who conceived himself to be the greatest of men after Shakespeare, once projected his own figure and viewed it as if it had been that of another person.

I might prolong the record of these hallucinations; but to prove that they exist is all-sufficient for the purpose I have in view. They are, the reader will see, nothing more than the results of an exaggeration of a natural faculty, which faculty, well possessed, is a marvellous accomplishment, but over-possessed is a disaster to the possessor.

There is another form of hallucination, having its seat in the brain, and which springs from what has been called the effect of the imagination. Imagination, brought to its true meaning, is the art of the will to combine into various groups the pictures or impressions that have been condensed in the brain through the senses. We are accustomed to speak of men of imaginative turn as original men. In a sense, this is false and true. It is false if we mean by the expression that a man can originate absolutely. It is true if we mean that a man can originate combinations of impressions he has received from the outer world.

The power or faculty of forming by the will original combinations of things, events, facts, received and stored up in the brain, is as varied as is the faculty of forming combinations or arrangements of things and facts that lie before the observer for his use or application. One man makes out of his inner hidden properties the most perfect of forms or stories, and puts them forward in language or in writing to charm and captivate his kindred. Another puts forward mean and commonplace forms of combination. These men are understood, and no one supposes them subject to hallucination.

But there is a third class of man who holds a distinct position as an imaginator. He puts out his treasures in such rank confusion that we are unable to recognise the pictures he directs us to see. Him we conceive to be estranged, for he produces, according to the general judgment, impossible combinations, his crowded or squalid fantastic imageries appealing to no recognisable realities. Such men, in the wildness of their combinations, give to us pictures of new heavens, new earths, new shades, which they have mentally surveyed until the impression, in all its wantonness, is to them an absolute truth, a truth it is a duty straightway to communicate to mankind. To name only one, from what might be a volume of illustrations of this type of imaginators, there is Benvenuto Cellini, who, visited by an invisible spirit, was carried even into the effulgence of the sun itself, discovering the luminary, when divested of its rays, to be a ball of molten gold, and seeing emanate from it divine forms of infinite splendour, which he could afterwards describe as faithfully as he could the prison in which he was incarcerated or the couch on which he slept.

Uneducated sceptics, hearing what they call these stories of the marvellous, are wont to say that all narratives of the kind are the results of disordered imagination. In this they are often greatly wrong. The power of combining received impressions is, I admit, easily and frequently exaggerated into the production of hallucinations which, recited as realities, constitute a very large class of hallucinatory phenomena, and indicate truly a disordered imagination. But some men who possess this power of strange combination in the most marked degree are able to control it and to produce from it fictitious history, or applied hallucination, which is the consummation of idealistic art.

XLVI.

PROJECTED VISIONS.

THERE are changes of function due to what may be called disturbance of the vascular tension of the brain. In order to receive external impressions in a perfect and natural state, it is necessary that the nervous organization, like a musical stringed instrument, should be accurately attuned, its various minute parts, its fibres, set, yet not unduly strained. The tension is maintained by the pressure of the blood—the silent blood stream, that is ever, during life in circuit, filling up vacuities, supplying new portions of matter, supplying fluids to be diffused through different receiving organs and regulating pressures. To the brain this blood may come in equal current, or it may ebb, or it may enter like a tide; so that the tension may vary from low to high, with varying phases of mental change following upon varieties of tension.

When, under any circumstances, the blood current ebbs, so that the brain is indifferently supplied with blood, external impressions rush in through the senses in such disturbed profusion, that a new existence may seem to have opened itself to the mind, with flashing, flickering manifestations of the past, and with the will losing its steady command. The light of day is insupportable in its brilliancy. Sounds the faintest are exaggerated into torrents, or peals, or blasts. Faint odours are overpowering, and other physical impressions, not appreciated by the healthy bystander, are recognised by the prostrated organism.

A woman who was saved from drowning, and who was restored from what seemed the unconsciousness of death to life, once related to me her experiences of the phenomena I have named with wonderful and simple fidelity. As she sank the noises of the water, though it was still water, and the voices of persons who were calling for her rescue, were appalling from their intensity — "they were like thunder." The touch of the water seemed as if it were creating the dissolution of her body. At last, as if being distributed into some immeasurable expanse, she was lost, knowing no more until she found herself, hours afterwards, in a warm bed, with friendly hands supporting her, and friendly voices pressing her to try to swallow nourishment. The ecstasies of the starving or frenzied person, often so poetically described, are of this order of phenomena, but in minor degree.

There is an opposite condition of the brain to the above, in which the tension is unduly increased by pressure of blood. Under this condition the tendency is not for the nervous organization to receive the impressions of the outer world in overwhelming confusion, but to project certain of the impressions it has received into the external world to re-view them. A perfect illustration of this perversion is supplied in the narrative of Nicolai, a bookseller of Berlin, who himself describes what he experienced. Nicolai had been accustomed to be bled twice in the year, as was the fashion in his day; but at the close of the year 1790 the process was omitted. In the beginning of the year 1791 he was affected in his mind by several incidents of a disagreeable character, and on the 24th of February of that year he observed, at the distance of ten paces from him, the figure of a person he had known in life but who was deceased. The figure remained before him for seven or eight minutes; then, as he became exhausted, he fell into a troubled slumber and slept the ghost away.

Later in the day the same figure and other figures returned to the astonished Nicolai, and until April continued to return, so that he became accustomed to them; and, learning to distinguish phantoms from phenomena, he observed the phantoms, correctly knowing them to be projections from his own brain. The forms, he said, were for the most part human figures of both sexes, some of persons dead or distant, whom he knew, others of persons he did not know. They came without his will, and went without his order. Occasionally the figures were mounted on horseback or were accompanied by animals of natural size and colour, but all, perhaps, were a little *paler* than natural. To Nicolai the figures, when he became familiarised with the phenomena of their appearances, spoke, their speeches being short and not disagreeable.

In the whole history of spiritual manifestations, so called, there is nothing that equals in marvel this experience of Nicolai. How his spiritual history would have ended had it progressed to his death, and what beliefs would have been founded upon it had it received no correction, it were indeed hard to say. Fortunately, as I think, in the month of April, 1791, a cold-blooded Sangrado of a surgeon formed a conclusion that the loss of a little blood by means of leeches might clear the vision of the haunted bookseller. On the 20th of that month the surgeon carried out his design at eleven o'clock of the forenoon. During the operation, says Nicolai, the room swarmed with human forms, and continued full till four o'clock, "when the digestion commences." Then the figures began to move more slowly, afterwards they became paler; at half-past six they were all entirely white, and moved very little, though they were distinct in form. The figures did not glide away, neither did they vanish, but in this instance they dissolved immediately into air, some of them remaining, in pieces, for an interval. By degrees they were all lost, and at eight o'clock there did not remain a vestige of them; neither did they return. Nicolai was cured by his Sangrado.

PART VII.

POLITICAL SANITATION.

XLVII.

STATISTS AND HEALTH.

SOME circumstances of a purely political character have helped on the study of the subject of national health. Previous to the great revolution, which dethroned James II. and put William and Mary on the throne, there existed a tax called the hearth-tax. Every hearth in the kingdom had to be paid for. Severe as this impost seemed to be, it had one good effect indirectly; it led to the collection of correct information as to the housing and numbering of the people. Two shillings had to be paid on every hearth. How many hearths were there, and how many houses? The "hearth books" became important documents. In 1685 Dr. Davenant computed from these books that at Michaelmas of that year the number of houses in all England and Wales was one million three hundred thousand, of which five hundred and fifty-four thousand six hundred and thirty-one were houses of one hearth and chimney. The average of persons to each house was computed at five persons, and an estimate was thus made of the number of the people. The population of England and Wales then was not quite double the population of present London. The enumeration was crude, and the object of it at the time irrelevant to the subject of health; but it had this value, that it set afoot the system of national stock-taking, which has eventuated in those wonderful returns of population, house accommodation, births, marriages, deaths, and occupations, which to the modern student of health are so invaluable as bases for all the work on which he is engaged.

In late times the unnecessary risks and losses to which our men of arms have been exposed during active service have forced on the attention of statesmen the necessity of considering the best means of preserving the health of the soldier. The experiences of the Crimean campaign; the experiences of the destruction of troops from residence in India, irrespective altogether of the vicissitudes of war; the disclosures of the great fatality from the disease pulmonary consumption in men pent up in close barracks at home; these and many similar lessons have led to increased attention, on the part of politicians, to the health of the communities which make up our fighting populations in times both of war and peace.

The outbreak of devastating epidemics and the occurrences of such catastrophes as gaol fever, Irish famine fever, and cholera, have demanded and at last obtained a degree of political attention which has been without parallel. Cholera, it is true, is not rendered impossible in this nation, but famine fever can hardly occur any more in the United Kingdom; while our gaols, which in the days of Howard were the foci of fever and pestilence, are now, by a strange change in events, the health spots of the land. Could any one have told Howard that within ninety years of his death the gaols, in which he saw sacrifice of life to ignorance in the highest development that was possible to his observation, would be the places where the tests of lowest mortality were being proved, what would have been his wonder or his satisfaction?

Yet it is a fact, as demonstrable as any fact that was ever written, that if we could bring the mortality of the whole community to the degree of mortality that now exists in English gaols, we should reduce the death-rate almost to a natural standard, and make the common term of life a hundred years.

In yet one other direction political necessity has led to improvement in the national health. At the latter part of last century our factory system, which by that time had become of primary importance to us as a commercial country, was in as bad a sanitary form as bad could be. Men, women, and children were sacrificed ruthlessly to the greed of the trader, who spun his wares from their lives. In 1802, therefore, an Act was passed for the better regulation of factories, a first Factory Act, which called in the aid of medical men, and which was intended to produce, and did produce, an improvement in the health of operatives of both sexes, old and young.

Since the passing of the first Factory Act many more have followed, and although up to the present time much that requires to be done is left undone, we, as a nation, have the credit of being earliest in the field in endeavouring to relieve factory labour of its sickly burdens. "England," says a recent Belgian writer, "taking precedence of all other peoples on the road to industrial progress, was the first to know the evils of it, and consequently to endeavour to do away with them." From an initiative commenced three parts of a century ago other nations have followed in train, and a good example in political, like a good example in private life, has spread beyond its home to carry with it humane and profitable service.

With the political aid that has been rendered to the study of the national health, there must also be taken into account economical science in its public applications to the value of money, of property, and of life. The learned Dr. Price, who a hundred years back may be said to have laid the foundation of method for computing the values of lives, and to have invented political arithmetic, traces very clearly this economical arithmetical science and its results to the origin of the national debt. The statement may strike many minds as peculiar, but it is nevertheless true. The national debt was the fruit of the last great revolution. It began with a debt of a few millions. In 1700, Price says, it was only sixteen millions. In 1715 it was fifty-five millions. From 1715 to 1740 it sank to forty-six millions. It then rose to seventy-eight millions, sank to seventy-five, and rose again, in 1775, to one hundred and forty-six. It was afterwards reduced to one hundred and thirty-six millions; and, rising once more, had, in 1783, exceeded two hundred millions, "with an example of expense," adds Price, "now going on which will probably make this kingdom the wonder and terror of future ages."

I may leave the modern scholar, who knows as much about the national debt as I do, to reflect on Dr. Price's prophecy. I only refer to the matter to point out that from the calculations made upon the values of the lives of those who first invested in the national funds, there sprang into fuller activity than had ever before existed, the method of estimating life by its value in the money market. The "London Annuity Society," the "Laudable Society for the Benefit of Widows," the "Society for Equitable Assurances on Lives and Survivorships"—these and other societies became great undertakings, for the conduct of which various new calculations on vitality were required, calculations that were accurate and even refined in their accuracy.

The demand for information was thus supplied, and with the supply there was found to be much useful matter relating to the national health, the conditions under which health is conserved, and the conditions under which it is impaired. In a letter to the illustrious Benjamin Franklin, whose own writings and proverbs teem with sound maxims on health, the author I have named above,—Richard Price, D.D., F.R.S.,—dwelt on expectations of lives, the increase of mankind, the number of inhabitants in London, and the influence of great towns on health and population. In a masterly way he laid many bases of fact and suggestion. From his labours we may date the origin of the methods by which in this day, with vastly improved resources and learning, we calculate births against deaths, averages of mortalities in different localities, and averages of mortalities at different periods of human life.

XLVIII.

LEGISLATION AND HEALTH.

THE labours of the legislative sanitary reformer lie in four directions.

1. In an endeavour to understand simply the nature of diseases, their alliances, their true distinctive characters, the modifications to which the body is subjected under the influence of diseased action, and the chemical or physical measures best adapted for removal and prevention of disease. Labours of this kind require the highest order of medical intellect; they are altogether removed from the business of the mere politician, and they imply in him who prosecutes them a mind fully charged with all the modern doctrines of chemistry, physics, and the laws of life. These labours tend to lead the mind from effects back to causes.

2. In an endeavour to seek out primarily the causes of diseases, irrespective of the symptoms and the other details involved in the considera-

tion of the diseases themselves. Efforts in this line of research should embrace observations conducted on a large scale, bearing on the effects of locality, climate, season, meteorology, contagion, habit, diet, and occupation, in giving rise to distinctive types of disease.

3. In striving to make the vast stores of information already acquired in regard to the two forms of inquiry above noted accessible to all classes of society, by having them scientifically popularised and diligently taught.

4. In giving free scope and encouragement to those mechanical arts which tend to improve the beauty and convenience of towns and cities, to lessen muscular labour, to increase the comforts of the poor man's home, and to introduce such an elevated class of amusements and occupations for leisure moments as shall make the hearts of men happier, their minds less animal.

In these offerings to reason and knowledge lies the true reform—the *elixir vitæ*, which carries all the charms the quacksalver's bill claims for the quacksalver's pill.

In the prosecution of the few and simple principles thus sketched out is embodied, I believe, the beginning and the end of sanitary science. These ignored, all else is mere practical dilettanteism, mere playing with the details of principles, while the principles themselves are undeveloped. Right honourable and honourable gentlemen may discourse in the senate house, and sit on committees of inquiry, and publish tons' weight of blue-books, and preside over boards of health, and invest magistrates with new powers; but, the mortality tables of the Registrar-General will still tell how little can be done until a new impulse is supplied leading to improvements in the application of the knowledge that has been so laboriously acquired.

There are some diseases which seem to stand forth independently altogether of what are usually understood as pernicious influences, diseases which have a specific cause of which we know nothing at present, and cannot form a reasonable idea. There are other diseases, the propagation of which are almost as traceable as is the generation of the living world. If legislation must do something, as it ought, why should it not direct inquiry in reference to this distinction? And when it has made out a few facts regarding those diseases, the propagation of which is understood, why should it not make a trial to lessen or extinguish them? There is a disease of diseases which a mock morality makes it a very crime to name, but which leaves its base imprint more or less marked on every hundredth babe at least born in this kingdom, and which engrafts a host of maladies on half our Saxon race. This of all diseases is most preventible by coercive legislation, if such legislation can do anything whatever. It cannot. It cannot stop small-pox, though it has Jenner's discovery in its right hand. In short, in relation to sanitary science, the legislature can do but one basic thing, namely, promote scientific education. But if it would do this, it would speedily do all.

The two instances of imperfect legislation to which I have referred above are excellent examples of the difficulties that lie in the way of enforcing legislation on a people that revels in freedom, even when the legislative action is necessary for the actual protection of life as well as health. There can be no doubt that the Contagious Diseases Acts and the Vaccination Acts have exerted controlling influence over two of the most fearful of the diseases afflicting the human family. Yet the difficulties of maintaining these Acts in operation are so persistent and so great, it is doubtful whether both may not for a time be repealed under the pressure of the stern opposition that is made to them.

How unreasonable the opposition to vaccination is, how thoroughly that opposition is maintained by simple want of knowledge, is proved by this one circumstance, that the members of the medical body, who are by necessity most familiar with all the dangers and all the advantages attending the process of vaccination, are so satisfied as to the infinitesimal character of its danger, and so assured of the infinite quality of its advantages, they are, of all sections of the community, most anxious to secure for themselves and their children the protection it affords. On the occasion of the prevalence of small-pox in 1870-1, a public vaccinator to whom I applied for the vaccination of my own family informed me that the doctors alone gave him sufficient employment for another pair of hands, that they were always the first to apply to him, were most importunate of all to take advantage of the prophylactic, and were, he believed, all but universally protected by it. The fact sufficiently accounts for the immunity from small-pox which the doctors, who are most of all exposed to the poison of the disease, exhibit during an epidemic. It suggests at the same time singular contrasts in action and in result as between them and those who really, on no knowledge at all, object to the process.

The practical lesson that is to be gathered from these strange and anomalous experiences is, that legislative action which is opposed to free-will must always be the most perplexing to the legislator, and, except in instances of absolute necessity, should never be attempted. Free-will combined with ignorance is resolute, and usually wrong. Free-will combined with knowledge is so right it needs no law. When he meets the first combination, the legislator must be in perpetual contest, and must make his way purely by the strength of his position, for the time. When he meets the second, he has nothing to do but lay aside his power, and let the freedom and the knowledge take their own course without his interference as a legislator.

To me it would be the most enjoyable duty to be able to state that free-will and knowledge travel now hand in hand in relation to questions that affect the health of the people. The most earnest opponent of the Vaccination and Contagious Diseases Acts is not more opposed than I am to such compulsory measures for the public safety. *Salus populi suprema lex* is the only defence I can offer for what are arbitrary and I hope but tentative measures, destined in days of wiser and wider understanding to be cancelled and forgotten.

XLIX.

REGISTRATION OF DISEASE.

MUST it be said that the Government has no responsibilities and no duties in respect to the maintenance of the national health? Can local administration, or private enterprise, or individual effort, alone or in combination, be left to their own discretions and devices? By no means. There is full scope for the action of Government, independently of its doubtfully useful coercive functions. There is before it certain grand supervising and directing functions which, up to this time neglected, should at once be brought into consideration.

I cannot do better than invite public attention to some of the more important of these functions of Government. They are vital in respect to the interests of the community, but, vital as they are, they are certain to receive no application through the legislature until an enlightened public opinion forces upon the legislature the fact that it demands their institution.

The first grand sanitary work demanded from the Government is the institution of a department for the registration of disease throughout the whole of the United Kingdom. It is as vain for the State to apply legislative action for the prevention of disease generally, while it is ignorant of all the phenomena of disease that are present, as it would be vain for the individual to write a prescription for a particular form of disease while he is ignorant of the symptoms of the malady and the circumstances under which it was developed. I have been hammering at this subject now for twenty-three years, and, at the risk of hammering again, I repeat that it is the first essential for the good of the nation that the registration of disease should be made as much a part of the business of the State as the registration of births, deaths, and marriages. The registration of births, deaths, and marriages shows admirably the balance that is paid over by disease to death. We want now to know the balance that is paid over by health to disease, and the reasons of the debt.

The registration of disease is one of the simplest duties that could fall to the action of the State. It has only to be done, and might within any one year be in as perfect working order as the registration of births, marriages, and deaths.

I do not say this from theory, but from direct experience. In the year 1855 I commenced an effort to test the practicability of this scheme, and was soon assisted by a large body of competent observers. At one time fifty observers were lending me their services, from forty-four points of observation extending from the Scilly Islands to the Hebrides. The facts were published quarterly. The diseases affecting the human subject, the diseases affecting the lower animals, and the diseases affecting plants, were recorded with more or less of detail; and in some instances the observers added an excellent account of the meteorological conditions that had prevailed in their districts during the periods of observation. These returns were commenced in the March quarter of the year 1855, and were continued regularly for four years. They were published in the *Journal of Public Health.*

These records of disease, obtained as described, may still be read with profit. In one of them, reported from the notes of eight observers, by Mr. Haffenden, of Canterbury, there was given, in the spring quarter of the year 1857, the first distinct account of the outbreak of diphtheria in England, from a series of cases observed at the village of Ash, by Mr. Reid, of Canterbury. If such a prompt report of every disease new to the country were conveyed to the Government immediately on its outbreak, I need not tell how important might be the action of the Government in stamping out the plague at its primary source.

The success of this experiment for the registration of diseases was the actual cause of its failure. It was impossible for any one individual to bear the labour and the expense of collecting and publishing regularly the returns of disease from fifty observers, though their valued labours were freely given. When, therefore, the experiment had been fairly tried and shown to be practicable, I laid the results before Sir Benjamin Hall, afterwards Lord Llanover, who was once President of the old Board of Health, and suggested to him that the weekly records of the union medical officers of the kingdom should, by a very simple modification, be utilised for registration of disease, after they had served the purely local purpose for which they were intended. Sir Benjamin Hall received the scheme with much favour, and promised to take the opinion of the Registrar-General upon it: but after a little time he informed me that the carrying out of the design would involve an expense which the public, he believed, would hesitate to meet, and so the attempt was not made.

In scientific research it is so common for the most laborious series of researches to fail in their direct object, that men of science become inured to failure, and soon cease to lament over it. I confess, however, I have never ceased to lament the failure of my original proposition for obtaining a complete registration of disease in this country. I regret most deeply the time that has been unnecessarily lost. If I could have continued to have received reports four times a year from but fifty observers during the twenty-three years that have now passed, I should by this time have collected over four thousand sets of facts relating to disease, from which something useful must have been derivable. If the larger scheme I proposed had been carried out—if the weekly returns of the three thousand poor-law medical officers had been utilised for the same period, instead of being allowed to go to destruction when their first use was over—some three million and a quarter of facts, relating to diseases and their causes in England and Wales, would by this time have been collected. It is impossible to estimate this deplorable loss of knowledge, and still the loss goes on. I name the subject in order to urge forward an endeavour to prevent the further and continuous waste of knowledge.

To know the diseases of a country in their entirety; to know the relation of the diseases in men to the diseases of inferior animals and of plants; to be able to fix the special localities of special diseases ; to be able to trace the diseases back to occupations, modes of life, and all the external exciting causes from which they spring —is knowledge which every statesman, surely, should long to acquire. Such knowledge is the best history, the best book of reference that could be obtained, from which to read the health, and thereby the wealth, of our people. Domesday-book were a poor contribution by the side of that book of vital possessions to which I once again venture to direct public attention, with a view to its commencement as a public work.

L.

DISPOSAL OF THE DEAD.

IT accorded with the disposition of the ancient Greek to burn his dead. For the Greek was the father of mirth, and it was never in his happy mind to retain long near to him that which would hold him in gloom. So to the eternal fire must go his nearest and his dearest when the spirit that animated the body was resolved away. Burial of the dead was to his mind a slow and even wearisome process, to be followed out only in emergency. The traveller who should find a dead body was asked to bury it, or at least three times to cast dust upon it—

> "Quanquam festinas, non est mora longa, licebit
> Injecto ter pulvere, curras."

And the sailor who floated ashore from the sea bore on his body the most costly gift he possessed for him who should give its lifeless bearer the rite of burial. But these acts were exceptional, the necessities inflicted upon those who could not be submitted to the pyre.

Beyond this reason, moreover, the Greek found and felt another motive for that system of cremation he all but universally practised. Strange as it might seem to men of other races, the very process of submitting the body to be burned was to him the sign of the life that is immortal. The body he with so much ceremonial committed to the fire was not, in his ideal, destroyed. Great men, according to that ideal, were raised to the world of the higher intelligences; and Pluto himself, because he taught the art of disposal of the dead, was for his art believed to have been received into the number of the gods. The thought that animated the Greek was indeed the reverse of the material conception of organic structure, living or dead. The men who transformed their heroes into divinities, and who carried out their young dead to the funeral pile before the dawn, that the sun might not be the witness of so terrible a calamity as the cessation of life while yet it had not approached its perfected glory, were hardly the men to be tainted with the belief in the cessation of individual phenomena with the cessation of that visible motion from which we infer that the body that once was living has ceased to live.

With the Greek, the burning to which he subjected the dead body was a process for the purification of the soul. The soul, left unclean in its earthly state, required to be rendered free and perfect by the absolute destruction of the casement in which it had been enshrined during its mortal course, and to which it might still cling. So they submitted the casement to the *pur*, the great and absolute purifier, the fire. Further, they conceived that in this purification they set free the indestructible principle of life, that it might enter the more speedily into the domains of the blessed. This was the Greek ideal of what we call cremation. Symbolized, somewhat differently, it remains to this day connected with a faith to which millions pay allegiance.

It accorded with the disposition of the ancient Egyptian to retain his dead as perfectly as art could enable him. The body, the receptacle of the soul, was too precious to be cast away to the earth to rot there, or to the sea to be devoured of animals, or to the fire to be resolved into thin air. It was to be held so that the spirit which once animated it might at some strange and eventful moment re-enter its tabernacle and reign in it again, incorruptible. In this ideal we have the origin of a belief which is still most prominent in the thoughts of mankind, the root of a faith symbolized specially, and accepted also by millions of mankind. In our care of burial of the dead, in our sepulchres and stately tombs, we strive to express what the heart prompts from this source.

This ideal received its fullest recognition in the process of disposal of the dead by embalming. The poorest and the richest Egyptian preserved his dead, with all the perfection his means could devise. The rich man with his costly gifts left his lifeless friend in the hands of the embalmer for seventy days, and received back the body swathed in cloth and gum, so perfectly prepared, that set up amongst the living or laid in the sarcophagus of all but solid stone, it could be left safe there for all the ages that were to come. Left, not dead, but waiting in solemn silence for the renewal of life that would one day as surely revive it as the sun revives the silent earth into the living day.

When father Abraham, refusing it as a gift, bought of Ephron the Hittite the field before Mamre for four hundred shekels of silver, that he might bury his dead out of his sight in the cave of Machpelah, he followed another disposal of the dead which, through all the variations of the marvellous race he founded, has held its course. To the Greek this mere burial would be barbarous. To the Egyptian it would be a poor imitation of that perpetuation of mortality by which the mortal would be made to rejoin the immortal part. It symbolized, in another and natural ideal, the ideal of a seed seemingly dead but susceptible of reanimation. The seed sown in the ground is buried, but does it not spring up again? That which is sown is not quickened unless it die. And so with the body: it is sown in corruption, it is raised in incorruption; it is sown a natural, it is raised a spiritual, body. How fixedly this principle of burying in the earth, of replacing in the earth that which came from it, has remained rooted in the minds of men, through Jewish interpretation, let any thinking person consider. The masses cling to it despite pictures of disgust, however realistic; and even the choicest of our philosophers have held by it to their final sleep, and, like Franklin, have written it for their own epitaph.

THE BODY
OF
BENJAMIN FRANKLIN
PRINTER
(LIKE THE COVER OF AN OLD BOOK,
ITS CONTENTS TORN OUT,
AND STRIPT OF ITS LETTERING AND GILDING)
LIES HERE FOOD FOR WORMS;
YET THE WORK ITSELF SHALL NOT BE LOST,
FOR IT WILL (AS HE BELIEVED) APPEAR ONCE MORE
IN A NEW
AND MORE BEAUTIFUL EDITION
CORRECTED AND AMENDED
BY
THE AUTHOR.

Amongst us the mode of disposal of the dead by burial has become so universal it were vain to endeavour to change it. We may, however, with advantage study how to improve the system, towards which object I would offer the following suggestions.

The construction of the soil of the burial-ground is of first moment, and might readily be made matter of legislation. The soil that is most fitting for this purpose is a fine carboniferous mould, or a mixture of such mould with lime and sand. In such a soil the complete removal of the body might, under proper conditions of burial, be secured within a period of ten years, and in such a soil renewal of burial might be safely carried out after every such interval. In Naples it has been customary to bury in pits of earth with which lime has been mixed; to bury so many bodies in one section on a given day; to allow that section to rest for a year, then to remove the whole of the earth of the section with its organic remains, refill with new earth, and bury again for the next year in the new earth. In this country such a prompt system would not be tolerated, but the method of burial in a destructive, but more slowly destructive, earth would probably meet every necessity, without creating undue prejudice at the commencement of the reformation.

In some localities a natural soil would yield all that is wanted for perfect burial in earth. In other localities the earth would have to be specially constructed, and a series of carefully conducted experiments on the destructive powers of various earths would be required before a perfect system could be obtained. It will probably be found, I repeat, that an earth composed of equal parts of fine carbon or virgin soil, sand, and lime, would be the most rapid of all combinations for the destruction of the animal matter, and the absorption of the products of decomposition. In a cemetery correctly constructed, with twelve feet of prepared earth as its basis, such a soil might remain undisturbed, except for purposes of burial, for many years; long enough, certainly, for the burial-place of the majority of the dead to be forgotten and for the dead body to pass into entire reunion with the earth from whence it sprang. After a given and due time, without any injury to sentiment, the soil could be removed in sections and be resupplied with new material for new burials.

I have described the artificial soil which would prove the most effective for the purposes of burial from the facts I have gleaned during direct observation of the action of different substances on dead organic matter. Specimens of such matter buried in pure carbon, in virgin carboniferous earth, in a mixture of carboniferous earth and sand, and in this latter mixture to which lime had been added, were found to undergo resolution, in the last most, in the first least effectively. A fresh carboniferous earth answers exceedingly well, better than pure vegetable carbon. The rapidity with which it deodorizes even decomposing animal matter is most remarkable. It may be said to act in a matter of minutes. The rapidity with which it produces destruction of the organic substance, especially if it be kept dry, is equally surprising. The complete decomposition may be included in from twenty to thirty weeks.

It is worthy of remark, however, that all the parts of an animal body are not equally destroyea in the same time. The integumentary parts and the membranes are much more slowly destroyed than the muscular, and the muscular are more slowly destroyed than the nervous. The bony parts are more resistant to destruction than the integuments, and the pigments are more resistant than the bone.

With these modifications of the earth in which the dead should be laid must come an entirely new system of burial. It would be in vain to construct the best burial-ground if the present system of enclosing the dead in coffins of wood or iron or lead were to continue. The coffin should be nothing more than an easily destructible shroud, in which the mortal remains may be concealed from view until they are deposited in the earth.

The present coffin is after the mode of an Egyptian sarcophagus, and is probably an imitation of that receptacle. In the form of this receptacle there is nothing objectionable, and if the popular taste wills that it shall be maintained, so be it. But the structure must be so modified that the instant the body is placed in the earth it shall either be in direct contact with the surrounding earthy matter or shall be separated from it by some simple organic material that is easily and rapidly destroyed. The newly proposed wicker coffins would probably answer the purpose intended, but they have the fault of not being sufficiently destructible. A return to the ancient bier and to the primitive mode of simply enveloping the body in cloth would be the most rational improvement.

LI.

LEGISLATION AND GOOD WATER.

THERE are certain common necessities of life which, supplied from impure sources, are the causes of many diseases, but which, supplied from pure sources, are the great maintainers of health. The grandest representative of these common necessities is water, for the animal body is made up of water more than of any other compound that enters into its organic construction.

For this important, all-essential constituent, water, we have had to depend hitherto on various supplies; on the rain that falls into the cistern; on the river that flows near our houses; on the wells that are sunken into the earth; on the rivulets that flow out of rocks, or out of the earth—natural springs. Precisely as these sources have been found for the convenience of the inhabitants, they have been resorted to without any reference whatever to the healthiness of the supply.

Not until these late years—not, indeed, until

Dr. Snow twenty-five years ago began to direct the attention of the world to this all-important subject, and to demonstrate by his wonderful researches the fact of its importance—did the wisest of men look with any anxiety on water as a source of disease. Afterwards, when Snow had made it appear most clear that cholera is mainly dependent on an impure water supply, the wider question of the whole influence of water in the production of disease came forward for discussion; old and half-forgotten truths began to be revived and put into their proper place, and new truths soon burst into light. The result has been to show that a large number of diseases, which were originally supposed to be due to some occult and unremovable cause, are due to the consumption of impure water. Typhoid fever has been traced to water charged with decomposing excreta, and, perhaps, other organic decomposing substances, in the same way as cholera has been traced to the consumption of water holding in it the poison of cholera. Goitre has been traced to the consumption of water containing an excess of saline constituents. Ague has been traced to the drinking of marshy water as its cause. Paralysis has been found to occur from the dietetic use of a water charged with lead derived from leaden pipes. Diarrhœa and continued fever have been constantly discovered to arise from the swallowing of water derived from wells contaminated with sewage or the fluids from filthy drains and stagnant pools.

In these and some other directions, the connection of acute and chronic diseases with the water supply has been satisfactorily determined; and now it is frequently asked, as it ought to be, by the community generally, when the healthiness of a place is under consideration, what is its water supply. Every one, in fact, who knows anything at all, is alive to the necessity for a proper supply of the natural fluid aliment of man and beast; while the learned have so far advanced in their knowledge as to be able to compute the rate of healthiness of a place and the character of some of its prevailing diseases by the examination of the water with which the people of the place are regularly fed. With all this knowledge, general and special, it still remains too true that the supplies of water throughout the country are so uncertain and so often bad, that they are a persistent cause of the most serious disease. The health resorts of England, as they are called, and as they would be truly called if they were properly fed with water, are amongst the worst of the water-contaminated centres.

To meet the dangers arising from supply of impure water we have so far had to depend, mainly, on the exertions of private companies, or, in rare instances, on the public enterprise of municipal bodies. Some advance has been made from these efforts, and sufficient has certainly been effected to prove that in water supply, as in everything else, "where there's a will there's a way," that no barriers lie between healthy men and healthy water which modern science cannot overcome, and that the purest water is a commodity to be ensured at a fair cost of money, and the labour and skill which money purchases.

It seems to me that at this crisis the legitimate duty of the Government is to legislate on the question of water supply. The Government now knows, and the people know, what precisely is wanted in respect to the maintenance of health by water food. Both know the dangers that belong to neglect on this great subject. Both know equally well that supply of water to the whole kingdom, to every city, town, village, hamlet, separate mansion, lodge, is out of the range of pure private enterprise, and cannot be safely entrusted to an unlimited number of independent companies, each liable to differ on matters of science, economy, and method. Both, therefore, should be of one mind to place the government of the supply under strict legislative enactment, so that every living centre should be made certain of receiving this abundant gift of man in the condition fitted for the necessities of all who live.

There are two processes by which the legislature may proceed to act on the matter of water supply. It may declare what is a standard of a pure water, and enforce, as is proposed, all municipal and local boards to supply such water to those whom they locally govern. It may take the whole business in its own hands, as it has the postal supply, and be itself responsible for waterworks everywhere. I do not discuss the merits of these respective systems. It is sufficient to indicate that on this subject of health it is time for the legislature to take up the cue and make a good appearance.

LII.

LEGISLATION AND STRONG DRINK.

TO see that the nation has a pure supply of water is not more important than to ensure that supplies of fatal drinks shall be at once reduced and in the end abolished. For more than a hundred and fifty years this question has been before the legislature, and still the Lords of the Privy Council might write by her Majesty's command to the Custodes Rotulorum of the several counties, precisely as the Lords of the Privy Council wrote by his Majesty's command on March 31st, 1743—"That the excessive drinking of spirituous liquors has not been prevented by former Acts of Parliament, but still continues the same; and it is complained of as a custom destructive of the health, morals, and industry of his Majesty's subjects, and to the peace of his kingdom."

There are few now who do not admit the evil that has to be legislated for, and the necessity of immediate legislation—none, except those who are directly or indirectly profiting, or thinking that they profit, by the sale of strong drink. Every legislator who speaks deplores the evil, and would, he says, fain crush it. Every candid legislator knows that the nation is ready for the gradual abolition of the trade in strong drink; yet not more than one in seven dares to insist on legislative action, and no Government dares to touch the question with a view to restrict the sale of the most useless article at its best, and the most fatal article at its worst, of all the things on earth human beings buy and sell.

The future historian, watching the curious contest that is now in progress, and seeing its bearings with a distinctiveness we cannot realise, will have many speculations on the reason why such a contest was so long on hand, and why the greatest enemy of civilised man was allowed so long a reign. He will probably come to the conclusion that the chief reason was of a physiological character. He will say the generation did not see the evil because they were born to it, begotten in it, begotten upon it. The degeneracy of liking the enemy had to be bred out before a majority could exorcize it by the action of their free-will. The time, I think, approaches when the generation is sufficiently changed to begin the process of exorcism. It can only begin practically by legal enactment. I know it will be said that such moral extension of temperance as will give direction and power to political movement might be expected to move everything in due order and with due effect, without the introduction of any one addition to the statute book. I venture to think not. I would be second to none in supporting moral over coercive human law, in cultivating virtue, if I may so say, by fashion rather than by penalties and punishment. But in this drink question the law, as it is, is hopelessly involved. The law which should protect the nation from the folly and crime of drink, if it did anything at all in the matter, does actually legalise, and I am not saying a word too much when I say patronises and sustains, the evil. It exacts dues out of the iniquity, and doubles the injury which the enemy himself inflicts. It allows every temptation to drink to stand forth in the public thoroughfares to catch the ignorant and unwary. It trains the ignorant, by these means, into drunkenness, robs the man it trains of money for what are called State purposes, punishes him if in his trained, legally trained, madness he commits some offence against society, and finally leaves him unprotected from his own acts when his madness is fully confirmed. Can any system be worse than this? Can any system more urgently require reformation?

It is not necessary to ask the legislature to adopt any process for reducing the power and efficiency of rational free-will, in asking it to do something to help those who are struggling to put down the great crime of our age, and who only fail to triumph because the legislative machinery stands in the way. It is but necessary to pray the legislature to remove its own acts, by which it gives licenses to a large class of men to traffic in alcohol, to the injury of the national health, if they will but pay for the licenses. The State surely can say we will not take part in the wholesale disposal of an article that is to be retailed for the life service of none who buy it, but for the fatal service of the many who buy. In this case, in fact, the State has only to withdraw its protection to place the drug alcohol in the same position as other chemical bodies of the same class, to recognise that death produced by alcohol is the same as death produced by any other poisonous agent, and to leave the use of this agent in the hands of those who are learned enough to know how to use it, if it be at any time a warranted necessity.

Presuming the State has not power to act altogether in this concern, it should at least give fair play to those advanced communities which in their own spheres are anxious to legislate for themselves, which beg for no more than that they, by their free-will, may exclude an evil they abhor, and which hope, by the example they would set, to extend their movement until the supreme will of the people shall emancipate the legislator from all the peril and responsibility of making the local the imperial policy of the commonwealth.

For the due consideration of these contemplated measures, and for the due working of the sanitary laws and regulations which already exist, one great reform is required within the Government itself. It is essential that there should be a recognised minister of health, having a department under him that shall be completely organized for dealing with every matter pertaining to the public health and life. At present sanitary work is so chaotic the nation generally neither appreciates the quantity nor the quality of the work that is actually performed for it. The Registrar-General is an important State sanitary officer. The President of the Local Government Board is an important State sanitary officer. The President of the Board of Works is in some sense an important State sanitary officer. The Secretary of State for the Home Department is vested with duties which can only be interpreted as sanitary. In this confusion sanitation stands connected with legislation by many loose ties, and is, according to the popular mind, disconnected and inoperative. It has no fixed place in the system of government, and is treated consequently as if it had no fixed or enduring importance. The consolidation of all that now exists of official sanitary work into one department, under the direction of a responsible minister fitted by education for the ministerial duties, would do more to bring the people to the idea of sanitary science, as a distinctive part of political science, than any step that has been taken in the whole history of the country in relation to its health.

We must probably wait long for sound legislation on matters of health, for there is always more tempting metal than health before the politician. But we must not therefore weary in sanitary work. Each man and each woman is a politician in the circle at home, and if each will work intelligently in the million little centres which under the name of home make up the nation, the Minister of Health, who must one day appear, will find his labours so much the easier and his success so much the more certain and honoured.

THE END.

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