THE PREVENTION OF CONSUMPTION.

LECTURE TO THE CONGRESS,

By Arthur Ransome, M.D., F.R.S.

When I was asked to deliver a lecture before the Sanitary Congress at Bolton, I felt some little hesitation in bringing before it the subject of the Prevention of Consumption.

The prevention of disease is indeed the aim of all sanitary reformers, and I had little doubt as to the acceptability of an address aiming, with any likelihood of success, at the prevention of a disease of such importance as consumption.

But this was just the point at which some misgiving would creep in, and the question would arise as to whether there was sufficient evidence of the preventability of tubercular disease, as to justify me in bringing the subject before the members of this great Institute.

I think there is, but before venturing to bring my views before this meeting, I thought it well to ask for the permission of your Council.

This permission has now been freely given to me, and I must therefore, proceed to defend my thesis as well as I am able—and lay before you the reasons for my faith, and my grounds for thinking that this fell disease, the "scourge of England" as it has been called, may reasonably be called preventable, and by what means it may be prevented or at least be limited in its range.

I need not dilate much upon the magnitude of the task before us. About 70,000 persons die every year of tubercular disease in England and Wales, and as the average duration of the disease is now about three years, this means that there are nearly 200,000 persons in the country constantly suffering from the complaint.

How fatal consumption is to the adult part of the population, may be judged from the fact that more than a quarter of the total deaths between the ages 15 and 65 are caused by it, and nearly half between 15 and 35.

> "To see it down in figures on a page,
> Plain, silent, clear, as God sees through the earth
> The sense of all the graves, that's terrible
> For one who is not God, and cannot right
> The wrong he looks on." Aurora Leigh.

It is the working years of men's lives that are chiefly affected by consumption. It is the malady of youth and middle life, and thus interferes more than any other with the economy of the State.

It carries off the most efficient of the population in the prime of manhood or of womanhood, and many of them are those who have given bright promises for the future.

Consumption often carries off the flowers of the flock—the most intelligent, the comeliest, the bravest and the best. They are cut down before they have accomplished a tithe of the great things of which their talents have given promise. Few can have failed to notice that many of those promising young people who have been thought worthy of biographical fame have finally succumbed to the onset of this fell malady.

The very magnitude of the work before us, and its extreme importance, is indeed the best excuse that I can give for bringing it before you; and if it can be proved to be within the bounds of possibility that such a disease can be prevented, the greatness of the task ought surely to be an additional incentive to attempt it, according to the Latin saying, "dignus vindice nodus."

But up to quite a recent period, not only was consumption deemed to be incurable, it was also regarded as almost inevitable. Families in which existed the taint of the disease were supposed to be doomed: a certain number of them were certain to succumb to the hereditary curse.

Insurance offices still refuse to enrol amongst their members those who have lost father and mother from the disease, and even collateral relatives who have died from it are judged to have an influence upon the life of the candidate for life assurance. It was also common amongst workpeople who worked at unhealthy trades, such as steel-grinding, glass-cutting, mining, &c., to regard the mortality from consumption amongst them as only natural and part of their fate. A fork-grinder once said to Mr. Hall, of Sheffield, "I shall be thirty-six next month, and you know that is getting an old man at our trade." And another, a young man of about twenty-six years, said he

"reckoned in about two more years at his trade he might begin to think of dropping off the perch;" adding, "You know a knife-grinder is an old cock at thirty."

Whilst these forebodings were held with regard to those who came of a consumptive stock, and those who followed certain trades, the fate of the consumptive himself was regarded as hopeless.

In my student days I have over and over again seen physicians regard the stethoscopic sounds that revealed the commencement of tubercle, as equivalent to a sentence of death, and even the late Sir Thomas Watson, in his classical work on the "Practice of Physic," says: "The tubercular disease when established is beyond our power." (Vol. II. p. 201.)

Niemeyer again remarks: "Many a patient gets well, who would formerly have been assumed to be a victim of tubercular and therefore incurable disease. I am fully convinced from my own experience of the last few years that in former times I lost many a patient from galloping consumption, only because I considered him lost from the very first." (Lecture on Consumption, p. 65.)

Even before the discovery of the bacillus of tubercle, these views of the inevitable character and the incurability of consumption were already beginning to be doubted.

It was shown by Dr. Pollock, in his work on the "Elements of Prognosis in Consumption," that: "Many cases which were given up by doctors, but outlived the prediction to arrive at old age, were undoubtedly recoveries from phthisis. Many more were instances of an early invasion of the disease with subsidence of the symptoms and long tolerance of the deposit" (p. 68). Again, he says: "I have many times witnessed all the phenomena of deposit, and all the symptoms of phthisis entirely removed" (p. 117). "The best authorities lean to the opinion that tubercle is capable of removal by absorption" (p. 119.)

Dr. T. C. Williams remarks that the animal matter of tubercle may be absorbed; and Dr. Carswell says, "the curability of this disease has in my opinion been settled by Laennec"; and my old master, Dr. Stokes of Dublin, says, "there is no doubt that modern practice has proved the curability of phthisis," adding, "it is probable that many more cases of phthisis recover than is supposed." (Lectures in 1835.)

I have myself seen many cases of what might fairly be called cure, seeing that the patients lived thirty or forty years after undoubted cavities had formed in their lungs. Still more frequently have I recorded cases in which incipient disease had been arrested, and no physical signs were to be found afterwards in the lungs. Within the last twenty years also it has become evident

that there has been a distinct diminution in the death-rate from phthisis throughout the country.

In the three years, 1858 to 1860, the annual rate of mortality from consumption per million of persons living was 2567. In 1884 it was only 1818, a diminution of 749 per million, or a total saving of about 20,000 lives every year.

Nor is this improvement confined to England. "In 1857, 39·50 deaths from consumption were returned in the State of Massachusetts for each 10,000 of the population; in 1883 only 29·90. This decrease is too large to credit to greater accuracy in diagnosis and to the transference of consumption to other States, and is mainly attributable to the prevention of phthisis by improved hygiene." (Strumpel. "Text Book of Medicine," p. 213.)

Evidence has also been forthcoming of the strongest kind, of the influence of sanitary measures, and especially of good drainage and good ventilation, as a preventive of consumption.

No better instance of this could be found than in the records of the mortality from this disease in the British army and navy. This evidence was collected by the commission on the sanitary state of the army, 1858, and the results are shown in the following table which has frequently been quoted before, but which can hardly be too often brought before public notice. This mortality is given at several stations for several successive periods, and I think that you will be at once struck by the enormous death rates amongst the troops in the earlier period, and at every one of the stations, and the great reduction of the rate in 1874, and at the present time it is still further reduced.*

Mortality per 1,000 *of Strength.*

	1830 to 1837.	1837 to 1847.	1863 to 1872.	1874.
Household Cavalry	14·5 ..	11·1 ..	}	
Cavalry of Line	15·3 ..	13·5 ..	} 9.17 ..	8·79
Foot Guards	21·6 ..	20·4 ..	}	
Mediterranean Stations..	21 ..	16·4 ..	11·2 ..	7·27
Canada, &c.	23 ..	17 ..	9·49 ..	6·0
Jamaica, &c.	91 ..	59 ..	17·05 ..	16·9
Madras, India	52 } ..	— ..	24·2 ..	14·22
Bengal „	44 }			
Ceylon	49 ..	— ..	21·95 ..	6·04

Rates of Mortality at the same ages prevailing in healthy country populations ..... 7·7
In England and Wales ..... 9·2
In Manchester ..... 12·4

The greater part of this excessive mortality was due to consumption.

* In 1883 it was only 6·28 per 1000, and throughout the world only 9·57.

Dr. Buchanan, now Medical Officer to the Local Government Board, has also conclusively shown that good drainage of a locality may diminish by one-half the prevalence of the disease, as in the case of the city of Salisbury.

These proofs of the preventability of consumption, were accumulated long before the discovery by Prof. Koch, that in most cases the disease originates outside the body, that it is due to the minute micro-organism named by him the bacillus of tubercle, and that its ravages are fostered by various external conditions, most of which are distinctly under the control of appropriate sanitary measures.

Since then it has become increasingly evident that Louis was right when he said, that "few persons were born necessarily to die of the disease," and it has been now abundantly proved that consumption is eminently a preventable disease.

But before proceeding at once to the inquiry how it may be prevented, let us for a few moments consider what tubercle is now ascertained to be. An amusing imaginary conversation given by Dr. McCormack, will serve to show the stride that has been recently made in our knowledge on this point.

"If you ask a pathologist what tubercle is, he will perchance reply, readily, that it is a certain deep-seated or, peradventure, superficial tumour which possibly tends to suppuration. You quietly remind him, that you do not ask where it is seated or to what it proceeds, but only what it really is. He will then, it may be, inform you that there are tubercles yellow, gray, and miliary, nay fibroid, induced by depressed vital powers, in short a defective decaying tendency in the bioplasm. You rejoin as gently as may be, that you do not care a button about their color or size, and as for depressed vital powers you consider that mere φλυαεία, since you only desire to learn what tubercles actually are."

"The pathologist now takes himself up a little, as a Frenchman might say, and briskly states that tubercle in fact is a morbid material which, being deposited on the mucous and serous surfaces and in the areolar tissues, destroys the elements which it implicates. In the excess of your courtesy you beg his pardon, and just remark that you do not want to learn where the material in question is deposited or what tissue it destroys, but only what it assuredly is. By this time our pathologist's colour becomes ever so little heightened; still he answers confidently that tubercle, as resulting from a pathological alteration, degenerates into an opaque, then a friable, lastly a purulent substance, which— But here you boldly interrupt him with the observation that not yet has he replied to your inquiry as to the real nature and essence of tubercle.

The pathologist, if he be a candid person, as pathologists commonly are, then confesses, as he might just as well have done at the outset, that he knows nothing whatever, the real nature of tubercle regarded, about the matter."

Fortunately we know something more than this now of the intimate nature of tubercle. Thanks to Prof. Koch we know that it is constantly associated with the presence of a micro-organism which, either by its own initiative power, or by means of the products of its activity, causes the formation of the bodies called tubercles within the textures of the body, that it makes its entrance from without, and that, once lodged within the frame, it travels infectively through it, chiefly along the course of the lymphatic system.

The conditions of its existence are briefly those to be found within the animal body—a certain degree of moisture, a temperature of about 37° Centigrade (from 86° to 107° F.), and a supply of nitrogenous food, such as blood serum will give.

If cultivated outside the body all these conditions must be imitated, and there is further the very important observation that it needs for its development a sojourn of at least a week, and sometimes much longer, in these conditions before it can take root, so to speak, and grow. Moreover, it is a being of very tenacious vitality, and it will preserve its virulence and capacity for development for six weeks or longer in decomposing tuberculous material, and for six months at least in a dry state. It also resists the action of many germicides.

Its close connection with tubercle has been proved, (1) by its almost constant presence in tuberculous cases; (2) by its absence in all other diseases; and (3) by pure cultivations of its colonies being injected into the body, causing tubercular disease of the parts inoculated.

Once in the body, there is unfortunately hardly a structure which tubercle does not implicate, a function which primarily or secondarily in its sequences it does not invade and derange. As Dr. McCormack forcibly says, "No tongue could narrate, no pen indeed declare its deplorably frightful ravages. The exquisitely beautiful fabric of the eye does not escape, much less with all their admirable mutual adjustments, the muscles, joints and bones. The entire living material fabric, this so magnificent handiwork of God, is in truth disintegrated, defaced, and destroyed. The interior and exterior tissues waste and wither, the fingers become misshapen, the nails curve over, the muscles both of organic life and the life of relation, no longer adequately nourished, lose their volume, the lung tissue, as Rokitansky tells us, ulcerates and disappears. The breath is as if from a vault, and in laryngeal phthisis, the poor sufferer,

spitting, choking, coughing, is perhaps carried off by suffocative spasm of the glottis at last."

Now, how may consumption be prevented? The answer to this question depends upon the reply to the further inquiry—what are the conditions that enable the tubercle bacillus to enter the body in a virulent form, and what further are those that enable it to do its deadly work there? As Cicero has aptly said, "Physicians consider that when the cause of a disease has been discovered, they have also discovered its cure." At least if this is not quite true they can often prevent disease.

Let us first dispose of a number of influences, formerly supposed to be causes of consumption that have now been proved to have only a remote or doubtful effect upon its course.

1. *Climate.*—At one time it was supposed that climate was everything, both in the prevention and cure of consumption, but it has now been shown to be almost entirely without influence except so far as it permits or discourages an almost entirely open air life.

Wherever human beings are congregated together, in every part of the habitable globe, and in all climates, there is consumption to be found. It is as Dr. Lombard says "a ubiquitous malady."

It would almost be sufficient to point to the table of Army Mortality for the proof of this assertion, but I have also drawn up a table from Dr. Lombard's statistics showing its great prevalence in most of the capital cities of Europe, and in other parts of the world.

It will be seen that it is almost equally prevalent in the South as in the North, in the East as in the West.

Even in the places where there is the greatest exemption from the disease, in the desert, on high mountain ranges, and in Arctic or Sub-Arctic regions it is still to be found under certain unsanitary conditions. In Asia Minor it is often met with on the coast or in the principal towns. The Bedouins on the coast of the Red Sea, "who exchange their tents for stone built houses," suffer from it. In Syria it is met with at Aleppo, and in the Soudan at Khartoum.

In Algeria whilst the Nomad Arabs are free, "amongst the captives many die of the disease."

The same observations may be made regarding Australia and North and South America, including Canada and the Arctic regions.

Even in the high lands of Switzerland there is no complete immunity from the disease. Amongst those of the population who are attracted to in-door employments, as Dr. Emil Müller has shown ("Distribution of Consumption in Switzerland"), a

certain proportion die of the disease. Industrial in-door pursuits give rise to a rate varying from 6·5 to 10·2 per cent., and one of the highest of these rates, 9·8, is at an elevation of 3,400 to 4,400 feet. At 4,400 to 5,000 feet of altitude, in mixed labour the rate from the disease was 7·7 per cent.

Here, then, again we find the conditions of life a much more powerful influence than climate or elevation of site.

2. Take next exposure to cold, privation, and hardship of all kinds; only remotely are these causes of consumption.

It is true that there are still medical men who regard them as the chief agents in preparing the human frame for its ravages; thus Dr. Jaccoud affirms that the consumptive constitution is essentially due to "insufficient nutrition, taking this word in its widest sense," and Mon. Bouchardat, in his recent treatise on Hygiene, affirms that "the continuous loss of calorific elements, in any considerable proportion, leads to pulmonary tuberculosis," that it is due to some form of "*misère physiologique.*"

But the Army Medical Reports again afford a sufficient answer to this hypothesis. The phthisis that at one time carried off so many of the finest soldiers of the British army, was not brought on by starvation, or privation, or exposure to hardship. It occurred for the most part when they were not on active service, but in the time of peace, when they were well fed and well cared for in every material respect, far better in fact than the half-starved artisans and agricultural labourers, who only died at one-third the rate that they did.

Again, the poor fishermen of Iceland, and the hunters and trappers of North America, the nomad tribes of Asia and Africa, the wretched natives of Australia, all these people escape the disease almost entirely, whilst half the deaths of the well-protected, well-clothed, adult inhabitants of towns, are from this cause.

The Highlanders who inhabit well-built houses on the mainland of Scotland are subject to it at the same rate as the other inhabitants; whilst the ill-fed, ill-clothed fishermen of the Hebrides, who are of the same race, hardly ever contract the disease.

It is quite true that inflammations of the respiratory apparatus, especially of the tissues of the lungs and pleura, constitute a remote or predisposing cause of consumption. These diseases are apt to destroy the natural elasticity of the lungs and render them unable to dislodge or to destroy the micro-organism which may succeed in finding an entrance into them, and which thus may plant itself firmly into their substance, irritating them and ultimately leading to consolidation and subsequent softening.

If the conditions are such as to lead people easily to take cold, and if they thus produce what is called chronic catarrhal

pneumonia, they leave a condition of the lungs that both facilitates the lodgment in them of the tubercle bacillus, and also prevents its expulsion or destruction by the natural forces of the human economy. Some physicians believe that nearly all cases of phthisis commence in this way. Niemeyer says, "Tuberculosis is in most cases a secondary disease," p. 15; and Dr. Herman Weber observes, "A fruitful source of phthisis is the tendency to catarrh of the respiratory mucous membrane;" and he further points out how these catarrhs may lead to phthisis: "(1) By producing numerous mucous abrasions upon which the bacilli can settle; (2) by weakening epithelial cells and their ciliary action; (3) by rendering respirations more shallow; and (4) by weakening the nutrition and energy of the whole system."

In the light of modern research it is not difficult to understand why a loss of elasticity of the lung should lead to consumption. We have seen that the bacillus of tubercle needs for its development a sojourn of at least a week in contact with suitable nourishment, and at a temperature nearly approximating to that of the human body. It is also highly probable that in all towns and places where men most congregate some of these infective particles are present in the atmosphere, but they are for the most part quite harmless to healthy persons. One reason why they are thus harmless may well be the difficulty with which these particles could make their way along the air passages of the lungs of such people. They are constantly liable to be arrested on the moist surfaces of the mucous membrane; and, if they are once caught in this way, they will soon be passed out of the chest by the delicate "cilia" that line the tubes. Even if they should penetrate into the ultimate lung tissues also, they are likely to be destroyed by the fresh blasts of air that rush freely into every portion of a healthy lung.

These safeguards, however, are not present in lungs that have either been compressed by constrained postures, or that have lost their elasticity through inflammatory actions. The germs of the disease, therefore, if they can penetrate the inactive portions of such damaged lungs, may both find there suitable food and warmth, and may rest long enough to develope true tubercular irritation.

In complaints such as simple catarrh and bronchitis, in which there is a copious secretion of mucus, I am inclined to think that there is less reason to fear a permanent lodgment of the bacillus. This organism is, in fact, likely to be entangled in the frothy secretion, and to be expelled along with it before it can do harm.

Some years ago, in an enquiry into the nature and quantity

of the organic matter of the breath, I was much struck with the fact that in bronchitis and catarrh, and other diseases in which there was much expectoration, the proportionate amount of this substance exhaled in the aqueous vapour from the lungs was only one-half of that from healthy persons; not that there was really less organic matter thus excreted, but because it was taken up by the mucus before it could reach the mouth.

Professor Tyndall has also shown, by means of his illuminated tube, "the filtering action" of the lungs—all dust inhaled being caught up by the bronchial secretion and prevented from appearing in the expired air. It would equally be prevented from travelling into the air cells. Something of this kind must always go on in such diseases as those in question.

But even in chronic bronchitis, after a time, the expulsive machinery may become defective, the waving cilia may become less active, the muscular apparatus of the tubes may be weakened, and dilatation and plugging of the air passages may occur; thus the bacillus may find a lodgment within the lungs, and true tubercular disease may be set up. This specific infection is again still more likely to take place if from any cause the ultimate tissues become inflamed, as in the various forms of catarrhal-pneumonia or broncho-pneumonia. In this case, even more than in simple catarrh, the lung loses its elasticity, its tissues are more open to infection, the residual air becomes stagnant, and its impurities, including foreign germs, are liable to be imprisoned for an indefinite time. In such a sense as this then, the causes of inflammatory diseases of the chest are also the causes of consumption.

But is exposure to the elements as fruitful a cause of cold-catching as is commonly supposed? Do we find that men who are much in the open air are more likely to take cold than the inmates of well warmed and well closed apartments? Quite the contrary. Soldiers on campaign, sailors, fishermen, hunters, gipsies, engine-drivers, coachmen, gardeners, agricultural labourers, none of these people suffer much from catarrhal affections, unless they are intemperate. To quote again from Dr. McCormack (p. 40), "Arctic explorers, supplied indeed with food and clothes, confront with perfect equanimity the chilliest air that ever flowed. Whymper safely slept, he tells us, *sub dio*, in chill Alaska, with only a screen to windward, when the mercury in his barometer was frozen hard. Von Wrangel relates quite a similar experience in respect of the dwellers by the shores of the Arctic ocean."

It is interesting to notice also the immunity from cold exhibited by our volunteers when they camp out for a week or a fortnight, and the instance has the more value because most of

these men are unaccustomed to an open air life, and have for the most part of their days been the occupants of close offices or stuffy warehouses.

I have known men to be thus exposed for a great part of their time not only to cold, but to drenching rain, with pools forming under their beds in the tents, and yet not a single man in a battalion has been invalided from the effects of cold.

On the other hand we know that the inhabitants of towns not only contract diseases of the lungs, but die of their consequences in excessive numbers. It has been calculated that in Manchester people die of these complaints at more than three times the rate that they do in breezy Westmoreland. Mere exposure to cold, and hardship, and privation, are not therefore to be reckoned as causes of consumption.

3. The next supposed cause of consumption to which I shall allude is the inhalation of irritating substances, or dusts arising from works of various kinds, such as steel grinding, glass cutting, brush making, &c.

In the year 1858, Dr. Headlam Greenhow presented to the Privy Council a report in which he pointed out the influence of occupation as a cause of pulmonary diseases. In 1860 and 1861, he returned again to the subject and dwelt especially upon the large mortality from these complaints, amongst those who worked in an atmosphere impregnated with dust consisting of fine particles of metal or of sandstone, &c.

His statistics, although very valuable in many ways, are nevertheless open to criticism in reference to the causation of consumption. He groups together many very different forms of lung affection—many that are not tuberculosis at all—and he was not able in many cases to discriminate between the effects of the occupation itself, and those of the conditions under which it was carried on.

No one, indeed, who has studied the vital statistics of these occupations, or who has medically attended the workpeople, can doubt the power of irritating dusts in inducing a state of the lungs that is favourable to the reception of the specific organism.

Just as in the case of lungs otherwise injured, tubercle may readily be engrafted upon a miner's or a needlemaker's lung; but the disease that is first caused by the particles these men inhale is not tuberculous at all. It is simply a chronic inflammation, affecting chiefly the connective tissue and the formation of a fibroid tissue in the alveolar wells. It leads ultimately to a contraction and, so to speak, to a strangling of certain portions of the lung tissue. But no bacilli are found in either the tissues or in the expectoration of such patients, as I can testify from frequent stainings.

I have myself watched many of these cases affecting persons who have lived under otherwise healthy conditions, and although they have ultimately succumbed to the exhausting effects of the disease, yet from first to last they have kept free from the infection of tubercle. The cirrhosis, or fibroid disease, as it has been called, has never degenerated into true consumption.

Dusts, therefore, although they are a serious danger, and they ought on this account to be kept away from workpeople as a preventive measure against consumption, yet are only remotely a cause of the disease. Much the same must be said of stooping postures during work.

4. I would say a few more words on the subject of hereditary predisposition to the disease.

That this is a real source of danger no medical man would deny. Thus we have seen instances of families in which almost every member has died of the disease, and others in which members of the same family living in different and far distant places, have yet one and all ultimately succumbed to it. In every such instance however, so far as I am aware, something has been added to the mere vulnerability of the persons attacked, either residence in confined air, repeated attacks of cold or some other assisting cause. And such a tendency to contract the disease can only be regarded as a remote and not as an essential cause of consumption. There is no need to assume the existence of a tubercular constitution any more than there is to affirm that there is a diphtheritic or typhoid constitution when a family is unusually predisposed to these disorders.

I know, for instance, of one family in which six out of eleven children have died of diphtheria, and other members have suffered from the complaint. They were not all struck down at the same time or by the same epidemic, but three children died in one place, one at another, and two in the village where the family is now residing. Such a fatality as this from a particular disease means nothing more than a tendency to contract it, and a readiness to give way before its attacks.

It is, moreover, highly probable that heredity has much less to do with consumption than is commonly supposed. A very large proportion of cases arise without any phthisical family history in the past. Many healthy families leaving the country and coming to reside in crowded towns lose some members subsequently from consumption. In the army more than 60 per cent. of cases are non-hereditary. Even when we take the difficult test of statistics we find they are apt to be deceptive. Thus Briquet found that one-third of the consumptive patients at a hospital were born of consumptive parents on one side or the other; Dr. Quain 25 per cent; Dr. T. C. Williams 12 per

cent. of direct influence, and 48 per cent. of family predisposition. But in these figures no account is taken of the influence of external circumstances, circumstances that are common to all the members of the family.

Again, there are so many deaths from phthisis in the country (as I said before, about half of all the deaths between the ages of 15 and 35 are due to this cause), that, without any such thing as hereditary taint, there would be nothing surprising in the fact that half of the consumptive patients have had consumptive relatives.

Dr. Walshe, the chief authority on chest diseases in this country, obtained from his hospital patients the result that about 26 per cent. came of a father or mother, or of both parents similarly diseased; but in discussing the significance of these figures, he asks whether they prove the reality of hereditary influence, and decides that they do not. "This ratio," he says, "of 26 per cent. might be, and probably is, no higher than that of the tuberculized portion of the population generally," and he concludes that "much phthisis is, in each generation, non-hereditary."

In any case it is highly probable that this influence has been greatly overrated. If the true causes of consumption are avoided, even those who come of a consumptive stock will escape the hereditary curse. As Louis says ("Recherches sur la Phthisie," p. 532): "Nous n'avons recuelli aucun fait en faveur de l' hérédité de la phthisie."

We are now prepared to consider certain conditions that seem to be more essential to the virulent activity of the micro-organism, and

(1) I would mention bad drainage of soils upon which houses are built.

The Commission on the sanitary state of the army in 1858, whose report I have already quoted, combined as chief agents two causes, and affirmed plainly that "the ravages committed in the ranks of the army by pulmonary disease are to be traced in a great degree to the vitiated atmosphere generated by overcrowding and deficient ventilation, and *the absence of proper sewerage of barracks.* In 1864 Mr. A. B. Middleton also called attention to these two sources of danger in a paper read before the British Association at Bath, but in an independent enquiry conducted in 1862 in Massachusetts by Dr. Bowditch, the extreme importance of dampness of soil as a cause of consumption was insisted upon.

He came to the conclusion that—(1) "A residence on or near a damp soil, whether that dampness is inherent in the soil itself or caused by percolation from adjacent ponds, from

marshes, or springy soils, is one of the primal causes of consumption in Massachusetts, probably in New England, and possibly in other portions of the globe. (2.) Consumption can be checked in its career, and possibly, nay probably, prevented by attention to this law."

Shortly afterwards, and without any knowledge of Dr. Bowditch's conclusions, Dr. Buchanan, who is now the chief Medical Officer to the Local Government Board, came to much the same conclusions as the result of an elaborate research into the distribution of consumption in the three south-eastern counties of England beyond the limits of the Metropolis.

His conclusions are well worthy of being quoted *in extenso*—they are as follow:—

(1.) Within the counties of Surrey, Kent, and Sussex, there is, broadly speaking, less phthisis (*i.e.*, consumption) among populations living on pervious soils than among populations living on impervious soils.

(2.) Within the same counties there is less phthisis among populations living on high-lying pervious soils than among populations living on low-lying pervious soils.

(3.) Within the same counties there is less phthisis among populations living on sloping impervious soils than among populations living on flat impervious soils.

(4.) The connection between soil and phthisis has been established in this enquiry—(*a*) by the existence of general agreement in phthisis mortality between districts that have common geological and topographical features of a nature to effect the water-holding quality of the soil; (*b*) by the existence of general disagreement between districts that are differently circumstanced in regard to such features; and (*c*) by the discovery of pretty regular concomitancy in the fluctuation of the two conditions, from much phthisis with much wetness of soil, to little phthisis with little wetness of soil. But the connection between wet soil and phthisis came out last year in another way, which must here be recalled—(*d*) by the observation that phthisis had been greatly reduced in towns where the water of the soil had been artificially removed, and that it had not been reduced in other towns where the soil had not been dried.

(5.) The whole of the foregoing conclusions combine into one—which may now be affirmed generally, and not only of particular districts—that "wetness of soil is a cause of phthisis to the population living upon it."

(6.) No other circumstance can be detected, after careful consideration of the materials accumulated during this year, that coincides on any large scale with the greater or less prevalence of phthisis, except the one condition of soil.

These results have since been confirmed by Dr. Haviland, and by the Registrar-General of Scotland. In the conclusions drawn from his map of the distribution of phthisis in England and Wales, Dr. Haviland says: "Damp, clayey soil, whether belonging to the wealden, oolitic, or cretaceous formation, is coincident with a high mortality;" and the Registrar-General, in his seventh report, remarks that "the towns, villages, hamlets, or houses which were situated at or near undrained localities, or were on heavy, impermeable soils, or on low-lying ground, and whose sites were consequently kept damp, had a very much larger number and proportion of cases of consumption than towns, villages, hamlets, or houses which were situated on dry or rocky ground, or on light porous soils, where the redundant moisture easily escaped."

The vapours that arise from damp ground, and which make their way into houses, are often very impure, and charged with organic matter that may be a suitable food for the tubercle bacillus.

In an address to this Congress, held at Leicester, the year before last, I gave the details of an inquiry into this subject that goes even further than those already cited—a contrast between two populations, one being on clay lands, the other on a hill of sand. The result was derived from a ten years mortality table, and was that whereas in this period there had originated forty-four cases per 1,000 inhabitants on the clay lands, on the sand only one per 1,000 had thus suffered, and that not one of the children or females of the population who were constantly resident there had contracted the disease. In this instance, however, we had only the influence of a dry soil to deal with; the houses were those of well-to-do people, and were fairly well ventilated. Whether there would have been the same immunity under other conditions is very doubtful.

Still it is evident from the facts before us that there is a close relationship between the condition of the soil and consumption—a relationship so close that, as we have seen, a residence on a porous soil, under otherwise favourable hygienic conditions, will apparently preserve the whole community from the disease.

It is further noticeable that in these cases hereditary predisposition made no difference in the result. There were present in these populations many whose parents or near relatives had died of the disease, and yet they did not contract it so long as they lived in the place. I think it may therefore be fairly assumed that in a well drained, uncontaminated soil, we have one of the means by which consumption may be prevented.

2. But we still have to consider the most prolific source from which the bacillus of tubercle derives its virulence—a cause

without which neither starvation, nor exposure, nor hard work, not even probably hereditary predisposition will bring on consumption. It is a cause that is common to rich and poor, that is to be found in all climates, in all collections of human beings, and that is only absent in the places where consumption is not to be found. In two words, it is *foul air*, and for the most part it is air that has been rendered foul by previous respiration.

It is to Dr. McCormack that we owe the most definite statement of this now well-recognized influence, and as he says, "wherever there is foul air * * * * there we meet consumption, there we meet scrofula, and an untimely death."

His further theory that tubercle is due to "carbon and other impurities inadequately discharged during the process of respiration" is now not tenable, but his demonstration of the danger of breathing air that has been breathed before is of none the less value.

Let me very briefly bring before you the grounds for this opinion.

1. We have the fact that increased density of a population means also increased general mortality, and especially increased mortality from lung disease. The late Dr. Farr was the first to establish this fact, and to reduce it almost to a mathematical demonstration.

In proportion as larger and larger numbers of persons are attracted to a certain limited area of ground, in that proportion, *cæteris paribus*, does the mortality from consumption increase.

It is true that we have along with this condition a combination of most, if not of all, the other circumstances unfavourable to health—poverty, insufficient food, low site and often damp ill-constructed dwellings; and we might with equal right select any one of these things as the true cause of the disease, but for the strong fact that all these things exist, in still greater intensity, in some country districts of England, or in the poorer villages of Scotland, along with a very low rate of mortality from consumption.

2. We have the evidence, that is now most ample, that in proportion as people are attracted to indoor occupation, and in proportion to the degree of closeness and bad ventilation of the places in which they work, in that ratio is the rate of mortality from consumption increased. This fact was first demonstrated by Dr. Greenhow in his statistical inquiry, but it has since been fully confirmed by other observers.

Any one who looks at the map of the distribution of consumption in England prepared by Mr. Alfred Haviland, must be at once struck with the deepening of colour that shows intensity of disease in the great industrial centres of the country. The

influence of this cause is also shown by the contrast between the male and female rates of mortality in town and country districts.

In some parts of England the men are the chief workers at indoor employments—as in Sheffield and Birmingham; there you find the male rate the highest; in others, as at Nottingham, Huddersfield, and Macclesfield, the women are most employed, and consequently they die most numerously of consumption; and in places like Liverpool and Manchester, and Stockport, where there is little difference in the employment of men and women, there is also little difference in the rates of mortality from consumption; both are high.

But the most striking testimony is from the relative death-rates in the two sexes in country places, such as Market Drayton, Bakewell, Nuneaton, Camelford, and Pickering. Here, where the men are constantly out of doors, their consumption rate is uniformly low, while the women, who keep the house, die at a constantly higher rate of this disease.

3. We have the experience given to us by the records of the mortality from consumption in the British Army and Navy, and a similar history could be told of the European forces.

In the exhaustive report of the Commissions upon the Sanitary State of the Army, it appeared that lung disease was more than twice as fatal amongst the picked men who formed the army as it was amongst the ordinary civil population of the country (12·5 of the former to 5·8 of the latter).

They pointed out that in civil life, insufficient clothing, insufficient and unwholesome food, sedentary and unwholesome occupations, and the vitiated atmosphere of unhealthy dwellings, all contribute to the propagation of this class of diseases. But in the army it cannot be alleged that the clothing, the food, or the nature of the occupation in itself, are of a character which would justify the imputation that they are among the predisposing causes of the excessive mortality of the soldier by pulmonary disease. (Report of Commissioners on the Sanitary State of Army, 1858.)

I have already given their opinion as to the true causes of this contrast.

4. I have lately had occasion to examine into the distribution of phthisis in certain districts of Manchester and Salford, and have ascertained that in every case the parts of these districts most affected by the disease are the close courts and alleys, the shut-in streets, and especially the back-to-back houses.

5th and lastly. We may take an entirely different method of proof and we can show that wherever, in different parts of the world, there is an abundance of fresh air in the dwellings of the people, there is to be found a comparative immunity

from the disease, even though most of the other surroundings are, in a sanitary point of view, almost as bad as they can be.

On the whole I think it may be regarded as fully proved that the breathing of air rendered foul by previous respiration is one of the conditions required to enable the bacillus of tubercle to take root and to grow in the lungs of human beings. Similar evidence is also forthcoming as to its influence upon animals—horses, cows, monkeys, &c.

It is important then to inquire what are the ingredients in respired air that are thus so potent for evil.

We can of course easily answer for one of them, and it might be supposed sufficient to account for all the facts that have now been brought forward. I mean the presence of the tubercle bacillus itself. This must needs be present in such air, or the disease would not arise. It must come originally from the body of some tuberculous patient. It may have come directly from the breath, as it has been found in the watery vapour exhaled from the lungs of such persons; but it is more probably mixed up with the dust in the air, forming one of the innocent looking motes that dance in a sunbeam. It may have been at some time or other derived from the dried up excretions of some poor consumptive, by its inherent vitality outliving its victim; but the strange part of the story is that the micro-organism cannot do its work unless it is assisted by the presence of other impurities. We cannot doubt that the creature is given out into well-ventilated, as well as into badly aerated spaces, and yet so far as we know it never communicates the disease in the former case.

How is it that in the wards of a consumption hospital, or in the sick rooms of well-ventilated houses, it never attacks the attendants? Even in the confined dwellings of the poor direct contagion, in this country at any rate, is a very rare event, and where drainage and ventilation are good I have never heard of or seen any case of direct transmission, even where there has been ample opportunity for breath to infect breath, as in the case of husband and wife or sisters sleeping together.

So far as we know the only other components of expired air that could have any effect in enhancing the virulence of the bacillus are the carbonic acid, the aqueous vapour and the organic matter that it contains in excess. But all these substances must be present under the circumstances already spoken of, in which there is yet no direct transference of the disease. How, then, can these facts be reconciled with the overwhelming evidence that air rendered foul by respiration is one of the most powerful agents in producing consumption.

The explanation given by Dr. Koch is (1) the need for some

preliminary injury to the lungs in persons who are about to act the part of hosts to these parasitic organisms, some denudation of the mucous membrane of the lungs, or some injury to the elasticity of these organs; and (2) the need of a plentiful supply of the infecting material.

The number of these microbes contained in the breath, even in advanced cases of phthisis is, as I can testify from repeated examinations, exceedingly small; but, on the other hand, the dried sputum from such patients contains them in enormous quantities. "This sputum is not only ejected directly on to the floor, there to be dried up, to be pulverised, and to rise again in the form of dust, but a good deal of it dries on bed linen, articles of clothing, and especially pocket-handkerchiefs, which even the cleanliest of patients cannot help soiling with the dangerous infective material when wiping the mouth after expectoration; and this also is subsequently scattered as dust."

I am doubtful myself how far this explanation would account for the exemption of the attendants of consumption hospitals from disease, and still more for the immunity conferred by residence upon well-drained porous soils.

It affords no reason for the diminution in the phthisis rate of Salisbury, for instance, by one-half, after the introduction of proper drainage, and I am therefore inclined to believe that we have still not attained to a complete knowledge of the natural history of the microbe, and to venture the hypothesis that it may gain in virulence by a short sojourn outside the body, in the presence of organic compounds favourable to its existence, and contained either in impure ground air or else in air rendered foul by respiration; experiments need to be made on this point.

In this case the bacillus of tubercle would fall into the same category as the microbe of enteric fever and cholera, and whilst scarcely at all infective from person to person, it would gain the power of reproducing the disease by a sojourn for a shorter or longer time in some medium favourable to its development. If high temperatures are absolutely needed for its existence I am inclined to think that it would find them in some nook or corner in the common kitchens and living rooms inhabited by many of the poor inhabitants of our towns.

It is possible that all the components of expired air except the oxygen may take part in sustaining the existence of the microbe. I do not know whether the action upon it of carbonic acid has yet been ascertained, but it seems probable, from its continued existence in decomposing fluids, that it is one of those bacilli whose life is fostered by this vapour. We can see at once also that aqueous vapours charged with organic matter would be eminently fitted to sustain its existence. The nature

of the organic matter contained in the breath is not yet fully ascertained; it is probably partly gaseous and partly solid. I have myself examined it microscopically in a good many cases, both in health and disease, and have ascertained the quantity exhaled under various conditions. It certainly contains numerous solid particles; some of it simply disintegrated organised material, some dried up epithelial scales, and in some diseases, as in measles and whooping cough and phthisis, the specific organisms of the disease.

Its quantity is indeed very small, I found that only about 0·2 of a gramme is excreted per diem by healthy adults, or 0·4 gramme per metre of expired air, but this is 500 times as much as Dr. de Chaumont found in the outer air, and when condensed upon solid bodies it often forms a perceptible foully smelling film, and we know further from Dr. Hammond's experiments that it is virulently poisonous, and it would probably sustain the life of the bacillus, though I am not aware of any direct experiments on this point.

We are now in a position to state the measures that are needed for the prevention of this terrible scourge of our population, and they may be thus briefly enumerated.

1. As far as possible the disinfection or destruction of the phthisical expectoration.

2. The discouragement of marriage between phthisical individuals.

3. The prevention of irritating dusts in workshops, or at any rate the adoption of means for sweeping them away from the mouths of workpeople, as is now almost universally done in the workshops of Sheffield.

4. The discouragement of stooping or confined postures during labour.

5. The better drainage of impervious soils, and the cleansing away of all kinds of filth.

6. The provision of thorough ventilation by night and day, not only in workshops, offices, warehouses, and factories, but also in the dwellings of both rich and poor, and in the streets and crowded alleys in which they live.

By the adoption of some such means as these I firmly believe that, in the course of time, we should see the present frightful mortality from consumption greatly diminished, and although they could probably be only partially carried out, every effort in the right direction would be rewarded by some improvement in the death-rate, not only from consumption, but also from other diseases, and especially diseases of the lungs.

CLEANLINESS.

AN ADDRESS TO THE WORKING CLASSES.

By Major Lamorock Flower,

Sanitary Engineer to the Lee Conservancy Board, &c.

"If I wash thee not thou hast no part with me"—so spake the greatest of all teachers, and with humble reverence will I endeavour to draw from *His* teachings the lesson which I trust the working classes of this important and prosperous town may learn from the Congress of the Sanitary Institute.

Cleanliness is a subject which opens up ideas of almost illimitable magnitude. It is practically the very mainspring of our existence. It is spoken of as being "next to goodliness," or as some put it, "next to godliness"—cleanliness both without and within; and how many are the graces which surround the cleanly being? How great a moral did Sir Charles Napier point when in consultation as to the "articles" necessary to be taken by the men of his army on a campaign, he said, all that a man wanted in that way was "a bit of soap and a tooth brush?" He implied cleanliness of person to be the order of those under his command, and perhaps it may not be too great a straining of an inference to imply by the tooth-brush that those foul utterances which too often come from the mouth of man should not be.

The Great Duke of Wellington was a cleanly man. He is reported to have said his best officers were his greatest dandies, and he was wont to give a little lecture occasionally on a dirty button. Selecting some soldier from the ranks, who had probably "skipped" a button from his polishing performance, he would say, "The second (or otherwise) button on your coat, my man, is dirty; and what is the consequence? You are a dirty

man; the company to which you belong is dirty; the battalion is dirty; the brigade is dirty; the division in which you are is dirty. Egad! the whole British Army is dirty on account of that dirty button."

Now what did all this imply but cleanliness necessary to well-being; and attention to even the smallest detail was not beneath the touch of his master mind. Who can fully realise the value of attention to little things? A little thought will, however, make us fully appreciate its importance. Sands make the mountain, moments make the year; nothing is too small or too insignificant to be overlooked. We all have our little corners to fill in the great scheme of life. A great painter, eminent for attention to small matters, said that looking to trifles made perfection, and that perfection was no trifle; and He of whom I spoke in commencing this address, said "even the very hairs of your head are all numbered." Cleanliness in dress—dress suitable to station—is again an important point. Shakespeare said, "The apparel oft proclaims the man," and how true is this. What a sad sight it is to see a good British workman about in rags and tatters, slouching along—it may be as the Scotchmen say, "a bit fou" into the bargain. Such a sight always seems to point to that curse, a want of order. Order is Heaven's first law. The cleanly person is a creature of order; we never find a disorderly person smart and cleanly, nor do we ever see a slovenly uncleanly person orderly. How invaluable is that man or woman to those who employ them who bring order and cleanliness into their daily duty; method is at the root of all their actions, and out of method comes punctuality, for "Method is the very hinge of business, and there is no method without punctuality."

Cleanliness in the home. "Home! there's a magic in the word;" and how do not we working men—for I claim to be a working man as much as any of you—how do not we rejoice in a cleanly home, a refuge after the toils of the day, the remembrance of which lightens our daily task and makes the work go all the easier? and what joyous homes may we not have where cleanliness "rules the roost?" How much lies in the brightly polished metal, the bright blackened stove, the clean swept hearth, the bright, clean window-pane; the window-sill, it may be, decked with a few flowers, fit emblems of a bright place within? And how easy is all this of attainment. The late Sir Joseph Paxton, the great gardener, thus wrote on window gardening:—"The cultivation of flowers is of all amusements of mankind the one to be selected and approved as the most innocent in itself and most perfectly devoid of injury or annoyance to others. The employment is not only conducive

to health and peace of mind, but probably more good-will has arisen and friendships been founded by the intercourse and communication connected with this pursuit than any other. The pleasures arising from the culture of flowers are harmless and pure; a streak, a tint, a shade, becomes a triumph which, though often obtained by a chance, is secured alone by morning care, by evening caution, and the vigilance of days. It is an employ which, in its various grades, excludes neither the opulent nor the indigent, teems with boundless variety, and affords an unceasing excitement to emulation without contention or ill will. There is no other pursuit alike calculated for peer and peasant in which the distinctions are so trivial; for the cottager may possess and enjoy the same beauteous rose or fragrant mignonette in his little plot or his window that occupies a place in the garden of the richest. There are few surer tests of a happy home within than the flower-decorated window and neat kept garden; and there is no occupation for the leisure hours more calculated to keep it so, or to soothe the mind. It yields pleasure without surfeit; the more we advance the more eager we become." A pleasant picture truly, and one which, methinks, is already realised in some homes in Bolton. The Great Teacher often drew his pictures from flowers, and the higher we grow in appreciation of order and cleanliness the more we shall love them. Lady Blessington beautifully writes:—

"Flowers are the bright remembrancers of youth:
They waft us back, with their bland, odorous breath,
The joyous hours that only young life knows."

Let me, then, recommend to you window gardening as one of the evidences of cleanliness. Perhaps it may not be out of place here to note that, to quote Lord Albemarle, some years since he was attracted by a bright, pretty little girl, who seemed to take much pleasure in caring for and watering the flowers which grew under a certain window where he sat; it seemed to give that simple and becomingly dressed little lady infinite pleasure. Who was she? The Princess Victoria, now and for over fifty years our Queen.

I spoke just now of perfection; that should be the aim of all of us working men. What are the essentials of a good working man? A healthy body, born of cleanliness; a healthy mind, naturally following cleanly and orderly habits; a clear brain, following both. Aim at perfection, let this be your resolve:—

"If I were a cobbler, it would be my pride
The best of all cobblers to be;
If I were a tinker, no tinker beside
Should mend an old kettle like me."

I think, perhaps, I have said enough generally as to cleanliness, and in order to have that pleasant home we must have a healthy house. There are certain essentials to this condition. The house should not be damp, and to ensure this it must be built on a healthy site; proper provision must be made to prevent the damp rising up the walls, and the dampness of the earth rising through the floors; if the soil be damp a sufficient layer of concrete should cover the whole site. I do not intend to weary you by going through all the details of house building, and I will only speak generally. Another important point about a healthy home is that no impure matter should be allowed to accumulate in and about the building; there should not be any blind corners with the dust swept up into them to fester and decay; the ash pit or receptacle should be frequently emptied, daily if possible. How often do we hear of "death in the dust-bin?" The floors of rooms should be scrubbed at least once a week; in one word, freedom from every kind of impurity is an absolute necessity. Then there should be abundance of light in a healthy house; no dark corners, giving a chance for filth to accumulate unseen; besides, plenty of light makes a house more cheerful. There should also be a plentiful supply of wholesome water; care should be observed that the cistern which supplies the drinking water does not also directly supply the water-closet, if such a thing exists. We require water from the first moment of our existence, and it enters largely into all the compounds of our daily wants. It should be jealously cared for, and the cisterns or other places for its reception should be frequently thoroughly cleaned out. A very large number of "the ills our flesh is heir to" are due to the use of impure and improper water. Water, to be really wholesome, should be first boiled, then filtered through some one or other of the many media which are provided for this purpose. Plenty of soap and water and an efficient application of that useful commodity known as elbow grease will much tend to keeping up a healthy home. If it be possible, too, the water supplied to a house should be soft, not hard; cleanliness may then be more readily attained.

Again, plenty of fresh air should be supplied to a house. Ventilation is nothing more than air being constantly changed. Draughts are inexcusable, and by a proper arrangement of opening windows, air may be kept in motion without the inconvenience, annoyances, and danger of draughts. Care should be taken that the chimney flues are always open to assist in the circulation of air, and the pernicious practice, too commonly observed, of shutting down the flap of a register stove should be abolished. In the morning, on rising from bed, open all the

windows, turn down the beds, and leave them open to "the fresh air of incense-breathing morn," and not, as is too commonly the practice, keep the windows shut and make the beds as soon as the occupants have left the chamber. There ought not to be any "dead ends" to passages. Few can overestimate the value of fresh air.

It is not always possible to have a bath room, but conveniences for personal cleanliness should be present; and anyone who is accustomed to the comfort of a good sound daily ablution of the whole of his body will never be without it.

Cleanliness in cooking is again a most important point. A good housewife will see that all her cooking appliances are kept in perfect order. There should be ample convenience for "washing up;" and here let me note one fruitful cause of disease—the discharge of sink washings direct to the cesspool drain, or sewer, without the intervention of a proper trap. All wastes from sinks, baths, and wash-up places should discharge into the open air over a properly trapped gully, and not, as is commonly, too commonly, the case, direct to the drain; the bell trap of the sink being taken up and put on one side thereof "to let the stuff away"—a favourite form of excuse.

I will not here go into the question of proper ventilation of sewers, or the efficient flushing thereof; but these are again important points in securing cleanliness. The recent almost tropical weather has shown us that sewer air escaping through the street ventilators is by no means pleasant, and many a person has been struck down by sickness from casually inhaling the foul air. It is quite possible to ameliorate this: I will not, however, on this occasion go into the question.

Sir John Simon says, "It is to cleanliness, ventilation and drainage, and the use of perfectly pure drinking water, that the population ought mainly to look for safety against nuisance and infection."

Some five-and-twenty years since, when Lord Palmerston was Prime Minister, we suffered from a fearful visitation of Asiatic cholera. It was called, and justly so called, a judgment of God. Yes, a judgment on those who neglect cleanliness in its widest sense, on those who allowed the filth of our towns to accumulate and ferment in cesspools, foul ditches, bad sewers, dust-bins, and such like. It was proposed to the Prime Minister that a national fast day should be appointed, and that by direct intervention of the Almighty, the evil might be removed or alleviated. At the risk of much adverse criticism he refused to entertain the request. He told people instead to turn to the work of sanitary reform, to whitewash their houses, and to clear away their filth.

An old classic fable tells us how a carter, unable to get his vehicle up a hill, implored Jupiter for help, and the carter was told first to put his own shoulder to the wheel. "God helps those who help themselves," is a well-known and well-appreciated legend.

Many condemned Lord Palmerston as being irreligious and flying in the face of Providence. But one at least of the clergy—that grand muscular Christian, Charles Kingsley—approved, and in these words publicly thanked His Lordship:

"As a clergyman I feel bound to express my gratitude to Lord Palmerston for having refused to allow a national fast day on the occasion of the present reappearance of pestilence, and so having prevented fresh scandal to Christianity, fresh excuses for the selfishness, laziness, and ignorance which produce pestilence, fresh turning men's minds away from the real causes of this present judgment to fanciful and superstitious ones. It was to be hoped that after the late discoveries of sanitary science, the clergy of all denominations would have felt it a sacred duty to go forth on a crusade against filth, and so to save the lives of thousands, not merely during the presence of cholera, but every year."

Cleanliness is a positive necessity, and I trust that some good may follow from this our Congress at Bolton. I am but trying to teach that doctrine which was impressed upon the Israelites of old by that first great sanitarian, Moses, and which, as I before said, lies at the root of all our well being. Cleanliness of ourselves, and of our dwellings and our surroundings, is imperative upon us as one of our duties to our neighbour—not the least of our obligations. "Wash and be clean" was a divine command. This is Saturday night, and I must not trench upon the province of those who teach in your various places of public worship. I merely wish to draw a moral from the teachings of One who "went about doing good," and I think you will have no difficulty in realising what that moral is.

Cleanliness is next to godliness, and where cleanliness fails, absence of godliness soon follows.

I cannot do better than close this address in the words of the Great Teacher with which I opened it—"If I wash thee not thou hast no part with me."

SELF-HELP.

AN ADDRESS TO THE WORKING CLASSES.

By A. Wynter Blyth, M.R.C.S., L.S.A.

In the South of France there were two neighbouring vineyards: in the one, the property of Alphonse, the vines were sickly and diseased; in the other, the property of Peter, the rich grapes hung in heavy clusters amid green untainted leaves.

Said Alphonse to Peter: "How is it the blight has not touched your vines?"

Peter replied: "I have sulphured them."

"Sulphured them!" rejoined Alphonse; "so have I."

"Did you do it yourself?"

"Myself! No; have I not labourers?"

"Ah!" cried Peter triumphantly, "there is the reason: I put my own hands to the work, then I was sure it was done and done well."

Self-help, my fellow workers, is the title of my address: self-help in the preservation of your own health and in that of your families.

Much has been done for every one in this country: laws of a beneficent character have been passed, enforcing the removal of the more evident injurious conditions; in most places there are hospitals for the infectious sick; there are elaborate systems of drainage and water supply. But from all these the people themselves will never reap the full benefit unless each individual in his sphere, be it small or great, adopts as the rule of conduct the principle of self-help. This principle of self-help may be developed especially in three directions:—

Self-help in the home.
Self-help in daily work.
Combined or organised self-help.

Self-help in the home.—Self-help begins in the selection of a home. A man has generally some kind of choice. If a dwelling,

on account of some serious defect of structure or position, lets at a cheap money rent, it is a dear bargain and you are best quit of it. In the selection of the place where you are to live always make good use of three inspectors of nuisances—your two eyes and nose; look out for signs of rats—rats as a rule mean bad drains; examine the basement and see the course of the soil-pipes, sink-pipes, and waste-water pipes, and whether the two latter discharge, as they ought, in the open over a trapped gully; look yourselves to all the traps, light a bit of paper and see if there is an up-draught; more especially dread dampness, as evidenced by stains on the walls; be very suspicious of match-boarding in a basement—match-boarding in nine cases out of ten is to conceal not to remedy dampness. Of all the definite nuisances to health, dampness is the one concerning which the proof of its insanitary character is the most abundant. Any obvious nuisance must be at once removed: do not wait on the leisure of others, do it yourself if you can.

Two families, Dawdle and Spry, living in the same quarter, had their drains stopped up and their basements flooded by the violent thunderstorm which burst over the metropolis a few weeks back. Dawdle put his hands in his pockets and said: "It's the landlord's duty to unstop the drain; he is coming to-day for the rent; a good thing too, for the stink is enough to make us all ill."

But the landlord did not come that day, nor the next, and by the time the drain was unstopped Dawdle's family, including himself, were all seriously sick with bad sore throats.

Very different was the action of Spry; he came home from his work, saw the state of things, pulled off his coat, opened the drain, cleared the drain, washed the filth out of the basement, disinfected it with a few pennyworths of carbolic acid, and after a couple of hours' work his house was as sweet and clean as before the accident. Self-help again!

"It ain't my work to clean up this yard," says Sally.

"Nor mine neither," retorts Betty. So between the two the yard is left and the filth accumulates, to the discredit and injury of both. If the house was on fire, think you would these two wrangle as to who should fetch the water or fetch the fire-engine? Ah! preventable disease, disease preventable by our own efforts, is more destructive than fires or railway accidents, even though they be as terrible as the Exeter fire or the Doncaster collision.

Division of responsibility in sanitary matters is always wrong. It is essential in tenement houses that the tenants themselves come to a just agreement as to who should keep the yards, stairs, and passages, common to all, soiled by all, in a cleanly

state. I know hundreds of working men's dwellings where this arrangement is adopted, and the results are most creditable, and there are others where, from a want of mutual understanding, dirt is not the exception, but the rule.

In the home it is specially to women we look to show us what self-help can do. It is woman that makes our dull homes bright, with her kindly presence and attention to little details, trifling in themselves, but of immense importance in the aggregate. It is her instinct of self-help that adorns the windows with flowers, cleanses floors and walls, and has a place for everything and puts everything in its place.

On the woman lies the responsibility of rearing, feeding, and instructing the young. Not the least of her duties is that of preparing and cooking the food for the family. Now, in the matter of food, self-help allied to knowledge will prevent us being infected by our food, otherwise what should be nourishment becomes destruction. The most essential matter is to cook nearly everything eaten or drank, and to cook it well. It is the great discovery of modern times to have found that the infectious fevers are produced by small living particles called germs; they are very minute and quite invisible to the unaided sight, so small that they can hold a family party on the point of a needle; they belong to a large race, most of whom are perfectly harmless; those that cause disease are the wicked members of the community. Their tenacity to life is sometimes very considerable: some will stand the heat of boiling water for a brief time, but none will stand it long. Many foods and drinks may become infected with disease germs, but milk is specially liable to this infection; sometimes it becomes injurious from being derived from a diseased cow, sometimes from being contaminated by a diseased person. It has been fairly proved that consumption, scarlet fever, diphtheria, typhoid fever, ulcers in the mouth, and a few other maladies have arisen from taking infected milk. In all these cases the milk has been taken unboiled. There is no authentic case of injury from boiled milk; of course, milk infection is only occasional; large populations may take unboiled milk for a considerable period without injury, but the time will come when it shows itself as a dangerous fluid. The old lady looked under the bed for the burglar for twenty years and found him at last. No chemical test will distinguish healthy from diseased milk, therefore it is a golden rule to drink no unboiled milk, and for similar reasons the thorough cooking, or in biological language, the sterilisation, of meat and vegetables is most essential.

Self-help in daily work.—There is no trade, handiwork, or occupation whatever by which a man earns his bread but

what has some special dangers to his health. Open-air workers are liable to be struck by the hot summer sun or to be chilled by the winter's damp and cold. Indoor workers have specially to battle with all kinds of bad air, causing many maladies, chief of which in fatality and incidence is consumption. Consumption is a preventable disease; recent researches have shown it to be intimately connected with a little germ, a parasite, and it is believed that this germ adheres to minute particles of dust, and in this way gets entrance to the lungs with the dust. Consumption is one of those complaints the contagion of which the people have been carefully and erroneously taught not to believe in; there is no pretence at precaution. Healthy husbands sleep with consumptive wives; children play about in the sick room; what is coughed up from the chest is allowed to be spat anywhere, as for example on the floor of a workroom, where it may dry and get converted into dust and be breathed as dust. Experiments have been made with such dust, and it has been found to readily infect animals, giving them a disease of the lungs; so there is little doubt those who have consumptive relatives or friends should adopt themselves, and cause to be adopted simple precautions; such for instance, as at night the separation of the sick from the healthy, and the reception of what is spat up from the chest on to rags or paper, so that it can be burnt or otherwise destroyed. To return to dust, it has been found that mineral or metallic dust is more injurious than vegetable dust; but all kinds breathed day by day are a fertile cause of various and fatal chest complaints. Now, if any of you work in crowded dusty rooms, you can, if you choose to follow a bit of advice, always breathe dust-free air; the advice is breathe through your nose only, keep your mouth shut. You will find in this Exhibition a collection of very ingenious respirators, little pieces of apparatus which, by filtering the air through cotton wool, will deprive it of dust and smoke. But the cavity of the nose is the finest respirator ever invented; it is carpeted throughout with a living velvet pile, always moist, so as to catch and fix the little particles of dust: the mouth for speaking and eating, the nose for breathing. Breathing through the mouth is a bad habit; those of you who have got it, get out of it as soon as you can. As for other measures a workman should take to preserve his health, in their detail they are as various as the trades themselves, and must not to-night detain us. I therefore pass on to consider what can be done by

Combined self-help for health.—The working men of this country have combined, have co-operated for many purposes. You have co-operated to found great successful clubs like

the Oddfellows and Foresters' Societies, dealing and managing very ably with large sums of money; you have combined for political and social purposes; you have combined in strikes for higher rates of wages or to redress some grievance—why not combine for the purposes of health? and what better object, more conducive to health, is there than building yourselves healthy homes? Abolish landlordism—not by boycotting or shooting your landlords, not by refusal to pay rent or any other illegal way, but by becoming landlords yourselves, the owners of your own houses. It may be for the moment bad times, but these will pass; there are years when plums are scarce, and years when plums are plentiful; the good wife makes her jam in the plentiful years, the artisan can also make his jam in the plentiful years; the savings of ten men for five years might be enough to start building a row of small houses, or a block of houses whichever you choose; perhaps much would have to be borrowed, what matters? is it not better to pay interest and capital under the guise of rent, knowing that in a certain number of years the place will be your own, than pay rent which in the long run would buy the whole house twice over. Should you build your own houses, you will build them strong, healthy and convenient; none of the jerry building or house-grabbing structures. I hope there will come a time when the governing bodies of your cities will be told, we want no model dwellings built by either you or by speculators, we belong to the self-help gang, and will take all such matters into our own hands, and build them ourselves.

One last word: the leading rule in the social economy is that each man shall support himself; to do that he must have health and maintain health, and no trouble, no temperance, no exercise should be spared to that end. Preventive medicine is democratic; it is not alone for princes or for the wealthy, it is for the people; and the more the people know of the causes of illness, the more will the efforts of those who have made hygiene their special study be appreciated and assisted. Without the confidence, without the assistance of the people, we sanitarians can do but little—the full benefits of sanitary science will only be received when you help yourselves and take advantage of the work that has been done, the knowledge that has been acquired.

THRIFT.

AN ADDRESS TO THE WORKING CLASSES.

By Henry Law, M.Inst.C.E.

Fellow working men, for I claim to be a working man in as real and full a sense as any one of you who are here present to-night, and I know of no title more honourable or more to be desired than that of a working man.

A recent writer, speaking of working men, has remarked—"They belong to the ancient and honourable family of workers—that extensive family which constitutes the backbone of our country's greatness—the common working people of England."

The real measure of the worth of a man is not the social rank which he may hold—does not depend upon the number of generations through which he can trace his descent, or how many of his ancestors have been known to fame, or as the possessors of wealth; but it is—What has that man done in his own person and life to promote the welfare or the material progress of himself and his fellow men?

Assuming this as our gauge, we may confidently affirm that all men who have *attained* greatness have been working men; that is to say, men who have worked earnestly and continuously, either with their hands or their head, or with both, in that particular calling or occupation which the accident of birth or other circumstances may have assigned to them. And we may further assert that in a very great majority of cases the greatest men, and those who have proved the greatest benefactors to their fellow men, those to whom we owe some of the most important and useful inventions, have risen from the humblest ranks of working men.

The time allotted me this evening would not suffice to allow of my giving you the names of even a tithe of those men, who, born in the most humble ranks of life, have attained to greatness and

become the benefactors of their fellow men; amongst those, however, whose names will be most familiar to you I may mention the following, namely: George Stephenson, who rose from being a cowboy earning twopence a day, and became the father of the locomotive and of the existing system of railways; Thomas Telford, who rose from being a shepherd, to become one of the most noted engineers, the constructor of the Menai suspension bridge, and many other important works, and was the founder and first President of the Institution of Civil Engineers; James Brindley, who from an ordinary labourer, became the engineer of the Bridgewater canal and many other important engineering works; Sir Richard Arkwright, a name specially to be honoured in Bolton, who rose from being a barber, to make the most important improvements in the machinery for the manufacture of cotton goods; Samuel Crompton, another Bolton man, whose father was a small farmer, and who was the inventor of the spinning-mule; Robert Hawthorne, the father of the well-known Newcastle engineer, who was originally engineer at the same colliery at Dewley, at which George Stephenson was fireman; Michael Faraday, the chemist, who was a bookbinder's apprentice; Sir Isaac Newton, who was the son of a widow with an income of only £80 per year; Sir Humphrey Davy, who was an apothecary's apprentice; Turner, the well-known painter, who was originally a barber; George Bidder, the well-known engineer, who possessed such extraordinary powers of calculation, and was the son of a stonemason; Jesse Hartley, for many years the engineer of the Liverpool docks, who was a working mason; Shakespeare, Burns, Ben Jonson, Cook the navigator, Hugh Miller the geologist, the first Sir Robert Peel, Jacquard, the inventor of the loom which bears his name; Bunyan, the author of the Pilgrim's Progress, Newcomen, the improver of the steam engine, Chantrey the sculptor, Sir Thomas Lawrence the painter, Richard Cobden, Flaxman the Sculptor, Dr. Livingstone the African traveller, Gainsborough the painter, John Dalton, Sir William Herschel the astronomer, and many other eminent men, who want of time forbids me to mention, all rose from the most humble ranks of life.

It may be confidently said that nearly all the most important and useful discoveries and inventions have been made by those who have risen from the more humble ranks of working men. Smiles, in his life of George Stephenson, remarks,—"It is certainly a striking and remarkable fact that nearly all that has been done for the improvement of the steam engine has been accomplished, not by philosophers and scientific men, but by labourers, mechanics, and enginemen. The steam engine was but a mere toy until it was taken in hand by workmen.

Savery was originally a working miner, Newcomen a blacksmith, and his partner Cawley a glazier. In the hands of Watt, the instrument maker, who devoted almost a life to the subject, the condensing engine acquired gigantic strength; and George Stephenson, the colliery engineman, was certainly not the least of those who have assisted to bring the high-pressure engine to its present power."

It may, I think, without fear of contradiction be said, that we owe our greatness as a nation chiefly, if not entirely, to the labours of our working men.

Such being the case, it becomes an interesting and profitable subject for enquiry to ascertain what are those peculiar qualities in our working men which have led, in so many instances, to the attainment of such strikingly successful results, and I hope to be able to convince you that those qualities may be shown to be summed-up and expressed by the one word, THRIFT.

Now, "thrift" is derived from the verb to "thrive," and to thrive from the Icelandic word *throa*, to increase, and, according to Johnson, "thrift" means "profit, gain, riches gotten, state of prospering," while the verb to "thrive" means to "increase, prosper, grow rich, advance in anything desired."

I dare say, on first hearing the word thrift, your thoughts turned to the subject of money, and you associated with the word the saving of money; but I desire this evening to direct your attention, not so much to thrift as regards money, but rather as applied to thrift of time and health, both of which, however, mean gain of money and material wealth.

Now, while thrift of money means frugality, economy, and care in making investments, thrift of time means industry, perseverance, and punctuality, and thrift of health means that taking care of our bodies which leads to the maintenance of health, energy, and unimpaired powers, both of mind and body.

These are the qualities which lead to success in life, and enable working men to attain to the position of eminence and usefulness of which I have cited a few examples. This fact was expressed by Mr. Bright in addressing an assembly of working men at Rochdale just forty years ago, when he said: "There is only one way that is safe for any man, or any number of men, by which they can maintain their present position if it be a good one, or raise themselves above it if it be a bad one, that is, by the practice of the virtues of industry, frugality, temperance, and honesty. There is no royal road by which men can raise themselves from a position which they feel to be uncomfortable and unsatisfactory as regards their mental or physical condition, except by the practice of those virtues by

which they find numbers amongst them are continually advancing and bettering themselves."

The more you study the careers of such of these eminent men who have risen from the ranks of labouring men as have had their lives published, the more convinced you will become of the truth of the foregoing statements. If, for example, we take the career of George Stephenson, we find it marked by the utmost frugality, industry, and the devotion of all his leisure time to the acquirements of a knowledge of reading, writing, and mechanics, and we find him constantly engaged in athletic sports, presenting a remarkable instance of thrift of money, time, and health.

The early career of the firm of Yates, Peel, & Co., of which the first Sir Robert Peel and his father-in-law were the founders, exhibits the same striking instance of thrift. Smiles, in his "Self-Help," narrates as follows:—"The frugal style in which the partners lived may be inferred from the following incident in their early career. William Yates being a married man with a family, commenced housekeeping on a small scale, and to oblige Peel, who was single, he agreed to take him as a lodger. The sum which the latter first paid for board and lodging was only eight shillings a week, but Yates, considering this too little, insisted on the weekly payment being increased a shilling, to which Peel at first demurred, and a difference between the partners took place, which was eventually compromised by the lodger paying an advance of sixpence a week."

Passing, however, from the subject of the thrift of money to that of time, it is impossible to overrate the importance of the latter. I have already remarked that thrift of time involves industry, perseverance, and punctuality. Industry, not only during the hours given to the daily work, the necessity and importance of which is the character and reputation which it secures to the working man of an honest desire to faithfully perform his duty; but what I more especially refer to as the thrift of time is the habit of devoting those leisure moments, which must occur in the busiest man's daily life, to some useful purpose. Young has termed the leisure moments which occur in daily life the "gold-dust of time," and such they truly are. There is a well known anecdote of the great naturalist Buffon, which illustrates this subject. Constitutionally he was of an indolent disposition, but he formed the resolution to rise early in order to prosecute his great work on natural history. Finding, however, that the attraction of his bed was stronger than his resolution, he directed his servant Joseph to compel him to rise, promising him half-a-crown for every time that he made him leave his bed before six o'clock, and this Joseph faithfully did, notwithstanding the remonstrances and threats of his master of immediate dismissal, followed an hour or two after by the promised reward; and Buffon was accustomed to say that he owed to his servant Joseph three or four of the volumes of his work on natural history.

The importance of thrift of time will be appreciated when it is considered that lost time can never be recovered, it is irrevocably gone for ever, and no subsequent regret can ever recall it; lost money may be recovered, even lost health may sometimes be restored, but lost time is a loss which no effort or exertion can ever replace. Such being the case, it behoves every man whose desire is to succeed in life to be specially careful to save the "gold-dust of time" which may fall to his share.

In Smiles' "Life of George Stephenson," he remarks: "Perhaps the secret of every man's best success in life is the readiness with which he takes advantage of opportunities. George Stephenson was an eminent illustration of this readiness in turning all his time to profit, and everything that he knew to useful account. Every spare minute was laid under contribution, either for the purpose of adding to his earnings or to his knowledge. The smallest fragments of his time were regarded by him as precious; and he was never so happy as when improving them. He missed no opportunity of extending his observations, more especially in his own immediate department; he was always acquiring new facts, and aiming at improvements in his own calling. Sometimes he failed, but his very failures only served to strengthen his hardy nature, and they eventually conducted him to success."

Another most important practice of the thrift of time is the habit of observation and attention to passing circumstances and events. Hugh Miller, the well-known geologist, has truly observed: "That the training of the mechanic,—by the exercise which it gives to his observant faculties, from his daily dealing with things actual and practical, and the close experience of life which he acquires,—better fits him for picking his way along the journey of life, and is more favourable to his growth as a man, emphatically speaking, than the training afforded by any other condition."

Perseverance is clearly involved in the thrift of time, for nothing can be a more useless or extravagant waste of time than to engage in pursuits, and to abandon them, when only partly accomplished.

Punctuality is not only essential to the thrift of our own time, but is a duty we owe to our fellow men, as a want of punctuality occasions a loss of other people's time besides our own.

I pass on now to speak of the thrift of health, a subject the

importance of which it is impossible to overrate. For, not only will strict attention to sanitary principles prolong your lives, but it will render those lives better worth living for.

A very large proportion of you have to do with machinery, and to such it is not necessary to point out, how essential to the well working of every machine it is, that it should be kept constantly in good order, free from grit and dirt, properly oiled, and not put to heavier or rougher work than that for which it was designed; and in the case of a steam engine, the fires must be fed with a sufficient supply of proper fuel and fresh air, while the boiler must have a due supply of clean and pure water.

But the human body is a far more delicate machine than the most delicate piece of machinery ever constructed;—much more delicate even than the smallest and finest watch, and in order that the human body shall be capable of working to the greatest advantage,—to perform the greatest amount of work, of the best description, with the least wear and tear, the same care and attention must be bestowed upon it as is necessary in the case of every other machine; whilst to maintain the living power or energy, the human body must be supplied with a due amount of fresh and pure air, and be fed with a sufficient supply of wholesome and proper food.

As in the case of the steam engine: unless the fire is fed with sufficient fuel of good quality the engine will not work satisfactorily; so with the human body: strength and the power of vigorous action cannot be maintained without a due supply of food of good and wholesome quality.

As in the case of the engine: if the boiler becomes covered with deposit, and the moving parts clogged with grease and dirt, much power will be lost; so is it also with the human body: if through neglect and want of care and cleanliness the lungs and stomach become clogged from breathing bad air and consuming unwholesome food, or if the functions of the skin, so essential to perfect health, are checked through want of frequent washing and suitable clothing.

Again, as the engine will lose power unless the boiler, cylinder, and steam-pipes be kept warm by being lagged, or covered with some non-conducting material, and unless the condenser be kept cool, so will your health suffer unless the body be maintained at the proper temperature.

And, inasmuch as the mechanism of the human body is so much more delicate and intricate than the finest piece of machinery ever constructed, so is it more susceptible to injury and more affected by want of care and proper and constant attention.

The time allotted me is utterly inadequate to allow of my describing to you the mechanism of the human body, even were I competent to do so, which I am not, and I must therefore content myself with such a general sketch as will enable you to understand how essential to the health and well-being of men it is to attend to those sanitary precautions which constitute the thrift of health.

We may describe the human body as consisting of a framework of bone, termed the *skeleton*, jointed in various parts to allow of freedom of motion, and protected from injury by a covering of flesh, which constitutes the main substance of the body; throughout this substance are distributed cords, or *muscles*, which are so attached to the several bones as to produce movements in the several parts of the body by their contraction; in the head there is a central electric telegraph station, termed the *brain*, which transmits through a system of conductors, termed *nerves*, the desires of the individual to every part of the body, controlling and directing the action of the muscles, and the movements of the body.

Now the machines with which you are familiar are constructed at first of their full dimensions, being incapable of growth, only requiring at stated intervals, the renewal of such parts as have been worn or deteriorated by constant use. In the human machine, however, up to a certain age the whole structure increases in size or *grows*, requiring a constant addition of fresh materials to build up the various parts of the body to the increased dimensions. But, further, the materials composing the human body are not of a permanent character, but are always being gradually removed and replaced by fresh material, so that the whole substance of the human body, even to the bones, becomes changed once in about every seven years.

Now the machinery by which this change of material and growth of the body is produced, consists of an arrangement by means of which the food is subjected to a combined mechanical and chemical process termed *digestion*, by which the materials suitable for the renewal and building up of the several parts of the body are separated, and reduced to a liquid form, constituting the *blood*.

Then within the body is a very beautiful four-barrel pump, termed the *heart*, fitted with proper valves, and producing a pumping action by the alternate contraction and dilation of the barrels. By the action of two of the pump barrels the blood is distributed through a system of pipes, termed *arteries*, which traverse every part of the body, leaving on its way the material required for the renewal and growth of the body, and taking up the effete or worn out material which the former is meant to

replace. Another system of pipes, termed *veins*, receives and collects the blood which has thus been rendered impure, and return it through two main veins to the heart. The pure blood as it leaves the heart is bright red, while the impure blood returned to it is dark purple, and it is necessary, before it is again circulated through the body, that it should be restored to its original state of purity.

In order to effect this, the impure blood is conveyed to the second two pump barrels of the heart, and by them is pumped through two bags, termed *lungs*, in which it is brought into contact with air in a very finely divided state, and undergoes a process of slow combustion, by which the whole body is maintained at the temperature of about 98 degrees, which is marked upon our thermometers as *blood-heat;* and by this combustion the impurities are burnt up, forming carbonic acid gas, watery vapour, and ammonia, the purified blood being changed from a dark purple to bright red, and passing away to the heart to be again distributed throughout the body. But in order that this process of combustion may be efficiently carried on, it is necessary that the surface of the lungs should not become clogged with foreign matter.

Now, on an average, the heart makes 70 strokes per minute, discharging at each stroke about $1\frac{1}{2}$ ozs. of blood against a pressure of about $4\frac{1}{4}$ lbs. per square inch, and consuming an amount of energy in the 24 hours of 600 foot-tons, that is to say, 600 tons lifted to a height of one foot.

As mechanics, many of you know that a pump which has to force water through a considerable length of pipe, will not act satisfactorily without an air-vessel to equalise the flow, and in the human pumping machinery even this is provided for by the pipes being elastic, so that the pulsating motion of the heart is converted into a nearly uniform flow through the arteries and veins.

The air in the lungs having been deprived of a portion of its oxygen, and mixed with the products of combustion, namely, the carbonic acid and water, requires to be changed, and this is effected by the action termed *breathing*, which consists in the alternate expansion and contraction of the lungs produced by the action of the muscles on the chest. The quantity of air which is thus pumped into and out of the lungs of a grown-up person in 24 hours, varies from 400 cubic feet when no exertion is being made, to 900 cubic feet in the case of a hard-working labourer; and it has been calculated that the work which has to be performed by the muscles in the act of breathing amounts to 21 foot-tons in the 24 hours—that is equivalent to the lifting of a weight of 21 tons to a height of one foot.

Having thus described to you the nature of the machine which constitutes the human body, you will be the better able to understand the conditions which are necessary to maintain this machine in the best possible working order.

You will immediately perceive, that if no less than from 400 to 900 cubic feet of air are passed through the lungs daily, unless the air is pure and free from dust or other foreign matter, the lungs must become clogged and their efficient action be prevented; and thus you will understand the vast importance that the air which you breathe should be pure, and provided in sufficient quantity to avoid the same air being breathed over a second time.

Again, you will understand, that the blood must be supplied with sufficient food, containing in the proper proportions the various materials required to provide for the waste constantly taking place in the several parts of the human body.

Thus for each day, the bones will require for their renewal from half to one ounce of mineral matter, such as common salt, and phosphates of lime and magnesia; for the nourishing of the body generally we require from $2\frac{1}{2}$ to $4\frac{2}{3}$ ounces of nitrogenous or albuminous food, such as eggs, meat, cheese, milk, bread, peas, lentils, &c.; and for the production of muscular energy from 13 to $17\frac{1}{3}$ ounces of fat and carbonaceous food, such as butter, lard, suet, sugar, and the starch of wheat, potatoes, rice, peas, &c.; making a total of solid food, free from water, varying from 18 to 23 ounces, depending upon the greater or less muscular labour which the man has to perform.

Thus you will see, that in order to maintain the most perfect health, both the nature and quantity of the food should be varied, according to the occupation of each individual person, being increased in quantity, and especially in that of the carbonaceous food, as the person has to exert a greater or less amount of muscular energy—in other words, to perform more manual labour.

It may be taken that the total amount of energy absorbed by a living man, when in a comparative state of rest, is about 2500 foot-tons in the 24 hours, equivalent to a weight of 2500 tons being lifted to a height of one foot; and when engaged in performing an average amount of manual labour the energy exerted amounts to about 3900 foot-tons, equivalent to lifting 3900 tons to a height of one foot.

Now, I have never known a mechanic worthy of the name who did not take a pride in the engine or other machine entrusted to his care, bestowing all the attention possible to keeping it clean, bright, and in the best working order. Each one who I address to-night has been entrusted with a machine

far more perfect and beautiful in its design—far more delicate and intricate in its mechanism—than any machine constructed by human hands; and will you not take the same pride and exercise the same care, in keeping and maintaining the machine thus entrusted to you in the highest possible state of preservation, and rendering it capable of performing the largest possible amount of work of the best possible description? I feel confident that, as true working men, such is your desire, and since thrift leads to the attainment of that which we desire, let me commend to you the practice of thrift in every form—thrift of money, thrift of time, and thrift of health. Let it be your ambition, although only working men, to equal in real worth the highest in rank of your fellows; let your constant desire be the possession of a wise head, a pure heart, and a sound body.

CLOSING GENERAL MEETING OF THE CONGRESS.

THE Closing General Meeting of the Congress was held on the afternoon of Friday, September 23rd, at the close of the Sectional Meetings. His Worship the Mayor of Bolton took the Chair, supported by the members of the Local Committee, and the Chairman and Council of the Institute.

Votes of thanks were passed to the President, the Local Committee, the Judges, and others who had been engaged in the work of the Congress and Exhibition.

The following reports upon the subjects brought forward for consideration at the Sectional Meetings were read by the Senior Secretaries of the respective Sections.

SECTION I.—SANITARY SCIENCE AND PREVENTIVE MEDICINE.

I have the honour to report that the President of Section I., Professor Russell Reynolds, opened the Section by a scientific, practical, and comprehensive address upon the extent of Present Knowledge in the Control of Human Diseases. The Medical Officer of Health of this Borough, Mr. E. Sergeant, placed before the Section the Records of the last ten years' advance in Sanitation in Bolton, and Dr. Livy traced the History of the Progress of Public Health. Dr. Alfred Carpenter introduced to the Section the Public Health Reports of Sir John Simon, in two volumes, and drew the attention of sanitarians to the works of "Our Pioneers" in sanitation, published by this Institute, of which the Vital Statistics of Dr. Farr was the first. The Right Hon. Lord Basing, President of the Congress, seconded by Dr. Tatham, Medical Officer of Health for Salford, proposed "That this Section, having heard Dr. Carpenter's address on the publication of the Reports of Dr. Farr and Sir John Simon by the Council of this Institute, recommend to the Council that there are many other medical essays on sanitary subjects which at present are only to be found in the Blue Books of the Privy Council and the Local Government Board; the publication of which, in an accessible form by the Sanitary Institute, would very much further the progress of sanitary science and practice." This resolution was carried *nemine contradicente*, about eighty members being present. Dr. McKeown then read a paper on the Prevention of Blindness. Mr. R. E. Middleton's paper

upon the Sanitary Registration of Buildings Bill being taken as read, for want of time, the labours of the Section were successfully brought to a close.

JOHN F. J. SYKES,
Honorary Secretary.

CONFERENCE OF MEDICAL OFFICERS OF HEALTH.

At the Conference of Medical Officers of Health, Professor Corfield, the President, opened proceedings by calling attention to the important position and growing responsibilities of Medical Officers of Health, and their established fitness to be charged with the control of the sanitary condition of dwellings and their surroundings. Dr. Vacher read an important paper on Death-causes and their Classification, and the President of the Congress expressed the opinion that some reform was necessary in the method of ascertaining the causes of deaths in doubtful cases. Dr. Armstrong, of Newcastle, seconded by Dr. Tatham, of Salford, one of the Vice-Presidents, proposed "That the Council of the Institute be recommended to consider the desirability of the Medical Officer of Health acting in the capacity of Assessor to the Coroner in all cases of death in which there has been no medical attendant, or none from whom a certificate of death can be obtained; and that in such capacity it should be the duty of the Medical Officer of Health to make full inquiry into all cases of suspicious or uncertified deaths." This resolution was carried *nemine contradicente;* from twenty to twenty-five persons being present. Dr. Kenyon raised an interesting discussion upon the provision of isolation for infectious cases.

Dr. Stopford Taylor read an account of the work of the Port Sanitary Authority of Liverpool, demonstrating the futility of the old system of quarantine and the value of the present English system of inspection and isolation. A paper upon the Supervision of Dairies, Cowsheds, and Milkshops, read by the Honorary Secretary, raised an interesting discussion, which elicited the opinion that nothing short of the *general* notification of infectious disease would suffice for the protection of milk from infection. Dr. Hope gave an account of the fearful amount of typhus fever that prevailed in Liverpool where no notification of disease takes place, and where typhus commits its ravages uncontrolled: hundreds of cases occurring every year. Dr. North, of York, one of the Vice-Presidents, seconded by the Honorary Secretary, proposed "That this meeting wishes to direct the attention of the Council of the Institute to the desirability of rendering the Conference of Medical Officers of Health (held for the first time at York) a permanent feature of the Annual Congress of the Sanitary Institute." This resolution was carried *nemine contradicente*, about a dozen persons being present; and I strongly recommend the Council to adopt the course suggested. This Conference was most successful.

JOHN F. J. SYKES,
Honorary Secretary.

SECTION II.—ENGINEERING AND ARCHITECTURE.

I have the honour to report that No. II. Section was opened by an able address by Thomas Hayter Lewis, F.S.A., President of the Section, upon the "*Sanitary Planning of Towns and Villages*," during which he satisfactorily demonstrated the right way of laying out streets in the near neighbourhood of a station, which had been most inappropriately planned and executed in a given instance.

Thanks were voted to the President for his interesting and useful address, proposed by Lord Basing and seconded by R. K. Freeman, F.R.I.B.A.

Mr. J. J. Bradshaw, F.R.I.B.A., of Bolton, read the first paper, on a subject recommended by the Council, viz., "*The Sanitary Condition of Cotton Factories.*" Mr. Bradshaw, in an eminently practical way, entered fully into the details of the construction, heating, and ventilation of such buildings; his own experience as an architect having specially fitted him for so doing.

The discussion was opened by the Chairman, and continued by Messrs. Robins, Eccles, Professor Robinson, Leach, Simmons, Norbury, Honeyman, Field, Nanson, Connolly, Fletcher, Darley, and Sergeant. Mr. Bradshaw briefly replied.

Mr. S. H. Terry then read a paper on "*The Water Supply of Villages*," which was followed by another paper by Mr. Robert Sutcliff on "*Artesian Wells and Water Supply.*"

Both papers were clearly and concisely written; the former being valuable as showing the small cost at which wholesome water might be supplied to villages.

The discussion of both papers followed. Mr. Rogers Field drew special attention to the use of windmills in raising water, and gave some valuable hints as to the mode of testing their working power, and as to the storage capacity of reservoirs dependent on windmill pumping for their water supply.

Messrs. Henry Law, Bradshaw, and Page followed; the latter seeking further information as to the purification and storage of rain water, in which he was supported by the President; Messrs. Railston Brown and Eccles continued the discussion.

Major Lamorock Flower then read a lively paper on the "*Fouling of Streams.*" An animated discussion followed, in which Messrs. Law, Bradshaw, Dr. Carpenter, Rogers Field, Wilkinson, and Macassey took part.

The various means of depositing and utilizing sewage were considered, and the good and evil of sewage farms and surface irrigation were discussed.

Major Flower replied, and insisted on the importance of making each manufacturer deal with his own refuse.

Mr. Reginald E. Middleton then read a paper on "*House Drainage*," and urged the more efficient ventilation of public sewers and the carrying out of the axioms upon which all sanitarians agree in regard to house drainage, as contained in the report of the Civil and Mechanical Engineers' Society, which formed the basis of the paper.

Mr. John Honeyman, of Glasgow, next read a paper on "*The Size of House Drains and the Use and Misuse of Traps.*" This was a very original paper, and proceeded on the principle that the air-space in drains is usually insufficient, and should be increased on a plan of his own.

The discussions on these two papers were taken together; Messrs. Emptage, Rogers Field, Corbett, Robins, and Wilkinson took part.

Mr. Newton, Weybridge, took the opportunity, before Mr. Honeyman replied, to explain his own views in opposition to Mr. Honeyman's; and broadly stated that air should be excluded from fouled water by making arrangements so that the pipes should always be full and overflowing.

The next paper was by Mr. Corbett, on "*Health, Comfort, and Economy in Cottage Construction*," which provoked considerable benevolent interest; the discussion was carried on by the President, Mr. Bradshaw, Canon Atkinson, and Mr. Coles.

The subject of *Smoke Abatement* was then taken up by the reading of three exhaustive papers by Messrs. Fletcher, Duncan, and Orvis, respectively; the discussion which followed was opened by Mr. Coles, and continued by Messrs. Head, Col. Winder, Howatson, Nicholson, Darley, Leach, Freeman, Lee, Wilkinson, and Scott.

The Chairman, in winding up the debate, remarked that they had not left the debate where they had found it, because an important recommendation had been forwarded to the Council of the Institute that they should appoint a committee to investigate and report on rival claims, and recommend such appliances as were found to be most suitable.

Two valuable contributions to the literature of the subject were put in by the veteran sanitarian, Edwin Chadwick, viz., one on "*Sanitary Sewage and Water Supply*," the other on "*The Sanitary Condition of Water Supplies.*"

The proceedings of Section II. then terminated.

EDWARD COOKWORTHY ROBINS,
Honorary Secretary.

Section III.—CHEMISTRY, METEOROLOGY, AND GEOLOGY.

Section III. met in the Council Chamber of the Town Hall, Bolton, at 10.30 a.m., on Friday, 23rd September, and Mr. Rogers Field, Vice-Chairman of the Council of the Institute, introduced Dr. August Dupré, F.R.S., as President of the Section.

Dr. Dupré then delivered an interesting address, dealing generally with the Chemistry of Water and Sewage; entering into a consideration of the pollution of Water Supplies, and of some of the methods

in use for the detection and estimation of such pollution. He advocated the collection of standards in respect of certain constituents of water, for different districts; and made several valuable remarks in connection with the treatment of sewage.

The President's address was listened to with much attention by a fairly good audience.

On the motion of Mr. Rogers Field, seconded by Mr. Gass, a vote of thanks to Dr. Dupré for his address was unanimously carried.

Dr. Percy Frankland read a paper on "The Application of Bacteriology to questions relating to Water Supply." The author dealt more especially with the value, from a sanitary point of view, of the estimation of the number of micro-organisms of all kinds in water, as compared with the detection of pathogenic organisms.

Dr. Louis Parkes read an able paper on Water Analysis, in which a number of important points were raised.

A discussion on both these papers took place, in which Dr. Alfred Carpenter, Messrs. De Rance, Pendlebury, Macassey, Dr. Dupré (President), and Mr. Cassal (Hon. Sec.) took part. Drs. Frankland and Parkes having replied, Mr. J. S. Haldane read a striking paper on "The Sources and Hygienic Significance of the Impurities of the Air of Buildings and Sewers." The paper was illustrated by several tables of results. In the discussion which ensued, Dr. Parkes, Dr. J. Martin, Dr. Carnelly, Dr. Dupré (President), and Mr. Haldane took part.

Mr. C. E. De Rance read a paper on "Underground Water Supplies." Several points of local interest and general importance were very ably dealt with in this paper. The following gentlemen took part in the discussion: Mr. Eccles, Mr. H. Crook, of Manchester, Mr. Tiddeman (Vice-President), and Dr. Dupré (President). Some valuable observations on the papers of Messrs. Haldane and De Rance were contributed by Mr. E. Chadwick, C.B., who regretted his inability to attend.

The discussions on the papers of Drs. Frankland and Parkes and of Messrs. Haldane and De Rance, would have been much longer had time permitted; a far greater number of points having been raised than could possibly be dealt with in the time.

The time for closing the meeting having arrived, the President announced that the papers of Messrs. J. Collins and G. S. Jones were taken as read. The Vicar of Bolton proposed a vote of thanks to Dr. Dupré for his conduct in the Presidential chair of the Section: this was seconded by Mr. Henry Law, and carried unanimously, and the work of the Section terminated.

CHARLES E. CASSAL,
Honorary Secretary.