WATER-BORNE TYPHOID FEVER.

PAPER INTRODUCING A DISCUSSION,

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WHEN I was invited to introduce a discussion on "Water-borne Typhoid Fever," I felt that a great honour was conferred upon me, and, at the same time, a grave responsibility. One could not help wishing that the introduction of such a difficult and important question had been entrusted to one of greater ability and wider experience.

At the same time I felt conscious of possessing two qualifications (shared, I believe, by all those who have given much consideration to this subject), which have emboldened me to undertake the task assigned to me. The first qualification is the distress which, as a medical man, I have always felt on witnessing the vast amount of suffering, loss, and death, which is allowed to take place in this country through one of the most preventable of diseases; together with a loathing of the filthy habits through which such foul and widespread pollution of our springs, streams, rivers, &c., is still suffered to go on, and through which doubtless much of the prevalent typhoid fever is propagated.

The second qualification is the long cherished determination to do my humble best, whenever the opportunity came, for the abolition of this widespread pollution, and for the prevention of this destructive plague of typhoid fever.

In dealing with this question it will be convenient to consider separately three aspects of the subject:—

- (1) Proofs that typhoid fever is frequently water-borne;
- (2) Ways in which the infectious material is conveyed from the patient into water used for drinking;
- (3) Means by which this pollution may be prevented.

The third of these (*i.e.*, the prevention of pollution) will be chiefly considered in this paper.

Ample evidence with regard to the convection of typhoid fever by water is to be found in the numerous reports to the

Privy Council and to the Local Government Board; in the history and summary of 205 outbreaks between 1858 and 1893 by the late Ernest Hart; in the careful records by Dr. Budd, and numerous other observers.

It must be admitted that in many of these records the evidence is very defective.

The custom is too common in this country to look only for a polluted water-supply as the cause of typhoid outbreak; to make no further enquiry when such pollution has been detected; and to rest content with this evidence as a positive demonstration of cause and effect.

The strength of proof, however, that the drinking water has been a frequent cause of outbreaks lies in the large accumulation of evidence, which, if not certain, is at least in the highest degree probable; and in the fact that in a considerable number of these recorded cases the evidence hardly seems to admit of any reasonable doubt.

NATURE OF THE TYPHOID FEVER POISON.

The poison of typhoid fever is contained in the bodies of those suffering from this disease, especially in the discharges from the intestine, and in the urine.

The poison, in the opinion of our best authorities, consists of living organisms,—the typhoid bacilli,—and their products. These bacilli can grow and multiply in the body of man, causing the disease which we know as typhoid fever. After they have left the body of the patient these bacilli can grow and multiply in the surroundings and in the food of man, *e.g.*, in polluted soil, in water, and in milk.

They may thus become capable of infecting a very large number of people.

The poison of typhoid fever is very rarely conveyed directly from the sick to the healthy, excepting where there is neglect of cleanliness, of disinfection, and of ordinary sanitary precautions.

WAYS IN WHICH THE TYPHOID FEVER POISON MAY BE CONVEYED.

The poison of typhoid fever may be conveyed from a patient to other individuals—

(1) By contact with the body, clothing, bedding, utensils, and other things which have been polluted with the discharges of the typhoid fever patient; unless care has been taken with regard to cleanliness and disinfection.

(2) Through the air, coming either from the soil, or from drains, sewers, cesspits, or other deposits which have been contaminated with the discharges from typhoid fever patients.

(3) Through ordinary food, especially drinking-water and milk, which have been exposed to air contaminated in the ways mentioned above, or have been polluted by deposits, leaking cesspits, drains, sewers, &c., containing discharges of typhoid fever patients.

It is probable also that the poison is not unfrequently conveyed through oysters and other shell fish which have been in contact with polluted water; and possibly through ices, water-cress, and various other food materials which have not been cooked before being eaten.

That it is possible for the typhoid fever poison to be conveyed by any of the ways thus summarised will be generally admitted; but authorities differ as to which is the most probable, or the most frequent channel through which it is carried.

(I have myself recently had the opportunity of bringing before the Epidemiological Society of London the remarkable prevalence of typhoid fever in Munich up to the year 1880, and its rapid abolition from that city since that time. The history of typhoid fever in Munich indicates that the conditions of soil near and underneath houses may be an important factor in the production of typhoid fever, and that in tracing out the causes of an epidemic the conditions of the soil should not be overlooked. This possible source of typhoid fever has not received sufficient attention in this country.)

Whatever differences of opinion may prevail with regard to the most probable or most frequent channel of infection, we are bound to take all these possibilities into consideration in tracing out the origin of attacks of typhoid fever.

More than this, it is desirable to make allowance for some possible channel or manner of convection with which we are as yet unacquainted.

THE PREVENTION OF POLLUTION OF OUR WATER SUPPLIES.

If, in dealing practically with the complicated problems presented to us in the outbreaks of infectious disease, we are to wait until we obtain absolute proofs of their origin and manner of convection, we shall remain continuously inactive.

However much we may doubt and differ with regard to the most usual origin and manner of infection with typhoid fever, we may at any rate predict this much—

That, if we make full and proper use of the acquired know-

ledge which is at our disposal with regard to the causes of typhoid fever, we shall reduce the mortality of that disease to a minimum;—from several thousands of deaths per annum in the United Kingdom to, at most, a few hundred, or even less.

That is to say, if we can ensure general notification of the disease, isolation of cases where necessary, complete disinfection of the patient and his excreta, protection from sewer gas and fæcal emanations, prevention of pollution of soil and of water with organic refuse and typhoid excreta, we shall every year in England and Wales alone save some 4,000 lives, prevent the prolonged sickness and suffering—otherwise to be expected—of some 40,000 to 50,000 individuals, and lighten the rates by some hundreds of thousands of pounds.

Of all the measures available for the prevention of typhoid fever, thorough disinfection, correction of insanitary conditions in houses, drains, sewers, etc., protection of the soil, and protection of water from pollution are the most important; and of these the last-named, the protection of our water supplies, is the one measure calling for immediate action.

Up to the present time little or no effective attempt has been made to secure a thorough and systematic prevention of pollution of our water supplies throughout the whole kingdom.

The clauses relating to water supply in the Public Health Act of 1875, the Rivers Pollution Prevention Act of 1876, and the Public Health (Water) Act of 1878 are practically quite inadequate for securing a general protection of our waters from pollution.

We rely chiefly upon our Waterworks Companies and our Sanitary Authorities for securing us against the introduction of poisonous material into the water with which the Companies supply us, and which we have to drink, if we drink any water at all. But under the existing state of the law, the obligations laid on the Companies, and the powers granted to the Authorities for thorough and constant supervision are so insufficient that we have little or no ground for such confidence.

For long we have adopted the pernicious habit of trusting almost entirely to Chemical Analysis,—more recently also to Bacteriological Analysis,—for detecting pollution; generally without investigating the surroundings of the source, of the tributaries, and of the course of the water supply; nearly always without securing the constant inspection and supervision which are necessary for the prevention of accidental, careless or wilful pollution of the water.

Even if the analyses were made daily they would not enable us to prevent pollution. They can only detect the pollution

after it has taken place. As a rule water-borne outbreaks of typhoid fever occur with explosive violence; so that most of the victims have imbibed the poison before the alarm conveyed by means of analysis can possibly save them from infection.

Combined with thorough and regular inspection of the water supply, from its source to its distribution, chemical and bacteriological analysis are of great service; for they can give indication of pollution which could not be detected merely by inspection.

If relied upon alone they give a false sense of security.

Too often the pollution of a water supply is detected by the occurrence of an outbreak of typhoid fever. Then it is realised, but too late, that the expenditure, which might have been made for the proper supervision of the water, would have been a very safe and wise investment; would have prevented much sickness, loss of life, and loss of money.

CHIEF REQUIREMENTS FOR THE PREVENTION OF POLLUTION.

Thorough, systematic, and regular inspection of our water supplies, from their source to their distribution, is the first requirement for the prevention of pollution; such inspection being supplemented by analyses (chemical and bacteriological) made and reported on by experts at frequent intervals.

In order to secure thorough and reliable inspection it is essential that complete records of each water supply should be prepared and published. Such records should be fully illustrated by maps, plans, and sections, showing every source and tributary of the water, any reservoirs and filtering beds (if they exist), all conduits, mains, &c.; showing also the relations of all parts of the sources, tributaries, and course of the water to the surrounding rocks and soil; and to any houses, cesspits, drains, sewers, and other receptacles of organic refuse which may be in their immediate neighbourhood.

These records, maps, plans, &c., should be prepared and published by the Waterworks Companies (or other owners of the Waterworks) and should be made easily accessible to the local Sanitary Authorities within whose district the water is distributed, and to every customer of the companies.

The Waterworks Companies should be required to make constant systematic and adequate inspection of all parts of their water supply—from source to distribution; and should be responsible for the consequences of pollution, if such pollution could reasonably have been prevented.

The Sanitary Authorities should have free access to all parts

of the water supply for their district, for the purpose of inspection, taking samples for analysis, &c., whether the water be within or outside their district; and should be required to make adequate and regular inspection, and to publish reports regularly on the results of their inspections and analyses.

Wilful or careless pollution of any water supply should be regarded and treated as a penal offence.

Authorities, representative of the chief interests concerned, should be appointed for each watershed area of the kingdom, who should have the care and supervision of the waters within each respective watershed; should take prompt measures to prevent any threatened pollution, and to abolish any detected pollution of any water; and should be responsible for the administration of the laws respecting the protection of water within their district.

A study of the existing laws respecting water supplies and the pollution of water (as set forth in the Acts of 1875, 1876, and 1878) will show that they fall very far short of the requirements mentioned above. Probably the public are quite unconscious of the very inadequate protection which is afforded to them by these statutes against the dangers arising from the pollution of water.

No requirement is made in them for sufficient inspection and analysis of the water supplies, either by the Sanitary Authorities or by the Waterworks Companies; no free power of access to their water supplies is secured for the Sanitary Authorities; no responsibility for the consequences of pollution, which might easily have been prevented, is thrown upon the Water Companies; worst of all, as Major Lamorock Flower and others have frequently insisted, the powers for taking action against pollution are entrusted to the Sanitary Authorities, and these powers are enabling, not compulsory. That is to say, the Authorities have the power to take such action, but are not compelled to do so.

Now, considering that Sanitary Authorities are too often the greatest polluters, and are constantly subjected to the influences of local and vested interests, and to the incessant cry for the reduction of rates, it is not to be wondered at that the administration of these Acts has not been attended with success. For my own part, I cannot conceive how local Authorities, as at present constituted, could ever be expected to maintain a constant and complete supervision and protection of our water supplies; excepting those cases where the local Sanitary Authorities have wisely determined to purchase and take under their own control the whole of the watershed from which they obtain their water supply.

Most recently Torquay has set an honourable example by resolving to do this; an example which, it is hoped, will be followed by local Authorities wherever it is possible.

But such possibilities are exceptional; and if we are to deal with this important question as a national question, reforms such as I have advocated are imperatively necessary.

Can anything be more obvious than that additional and more effective legislation is required, and that the administration of the new Acts should be entrusted to an Authority who shall be required to carry out their duties without delay, and who will act without fear or favour, unbiassed by local interests and local jealousies?

It might be suggested that these duties should be entrusted to the County Councils.

But it is very doubtful whether they would find sufficient time or take sufficient interest to maintain the necessary supervision, and to enforce the observation of the Acts in opposition to local influences and local interests.

That the Authority, to whom the supervision and protection of our water supply are to be entrusted, should have jurisdiction over a complete water shed area will, I think, be generally agreed. Such an Authority should be representative of the most important interests within its district; for instance, of the landowners, of important local industries, of the water companies, and of the communities who are supplied by those companies. Such an Authority should be strong enough to be independent of local interests and local influences which might operate against the right performance of its duties; and should concern itself entirely with the supervision and protection of the water shed under its control.

If we look for a precedent of such an Authority, we find an excellent model in the Lee Conservancy Board, which is constituted in the manner which I have described.

Whatever its defects and shortcomings may have been, this Board has worked continuously and systematically during thirty years for the purification of the River Lee, and has worked with pre-eminent success.

In a paper written by Major Flower, and entitled "The River Lee up to date" (which is to be found in the library of this Institute), a very interesting description of this watershed will be found, together with a history of the River Lee Conservancy Board, and an account of the numerous pollutions to which the river used to be subjected, and of the ways in which those pollutions have been gradually and systematically abolished.

Major Flower, who for so many years has acted as Sanitary

Engineer of the Lee Conservancy Board, strongly advocates individual action as compared with action by Committee.

To quote from his excellent address on River Pollution delivered at the Leeds Congress last year :—

“In River Pollution no half measure must be adopted. What the country requires is a sound and firm Act of Parliament having compulsory and not permissive powers, entrusted to competent men to carry out, administered in each watershed by a man who by his personal influence can induce polluters to abate their nuisances, not necessarily an autocrat, but one who knows how to exercise the duty entrusted to him with judgment and firmness, governed by Conservancy Boards, to legalise the acts of such officials. I find that it pays to ‘ask’ for that which the Courts might ‘compel.’ Nothing exasperates a man more than being served with a ‘notice.’ Such a man generally consults his solicitor, who, in the present state of the law, usually gets his client out of his trouble, and the pollution complained of remains.”

These sentiments and opinions will be appreciated by every true born Briton, and the history of the Lee Conservancy Board gives plenty of examples which illustrate the fact that individual diplomacy and tact may triumph where threats of the law, or manifestoes of a committee would almost certainly fail.

Three instances may be quoted as illustrations from the records of the River Lee :—

The first that of a town, the town of Luton, which formerly discharged its sewage into the river after treatment by a method sanctioned by the Lee Conservancy Act but obviously inadequate. This town with its 30,000 inhabitants,—to its honour be it recorded,—convinced by individual persuasion, decided to pump its sewage away from the river and distribute it over a sewage farm, the effluent from which has been shown to be innocuous to the river. This scheme, adopted after careful investigation and experiment, was carried out at a cost of over £40,000. Could such a reform have been carried out through insistence of a Committee or threats of legal action?

The second instance is that of a large riparian landowner, who was strongly opposed to the Lee Conservancy Act, and without doubt would have resented and opposed any compulsion by the Board or threats of legal action. When approached by the accredited representative of the Board, and convinced that through the conditions of his property he was contributing largely to the pollution of the river, he without hesitation decided to put a stop to this pollution, and carried out his intention at his own cost, although the expense was very considerable.

The third instance, and there are many such in this country, was a transgressor through ignorance, who when convinced of his transgression, at once repented and made more than ample compensation for the errors of the past. The town of Hatfield, with a population of 4,500, formerly discharged its sewage into dumb wells (*i.e.*, cesspits which are not watertight), in the chalk, to the detriment of the river Lee. But Lord Salisbury, at his own cost and charge, put an end to this eminently unsatisfactory state of things, and laid out an ample area as a sewage farm, where the water-carried refuse, not only of the town but the mansion is disposed of without nuisance to anyone.

These, together with many other instances of pollution removed from the very sources, the tributaries and the main river itself, as recorded in the history of the Lee, demonstrate the desirability of placing the watershed under the control of one competent authority, and of adopting the methods so long employed and strongly recommended by Major Lamorock Flower.

I have not touched upon the Thames Conservancy Board, partly because it seems a subject too large and too complicated to be dealt with in such a limited discussion as this.

It seems to be almost superfluous to be bringing forward these facts and arguments in order to prove the necessity for more effective legislation for the prevention of water pollution.

To many it must be a constant source of wonder and distress that the attempts at reforms in this direction have failed again and again. The cause, without doubt, lies chiefly in the ignorance and indifference of the people.

How is it that the people of this country have for so long tolerated with indifference the widespread pollution of its water supplies,—private and public,—with human excrement?

One would have thought that a nation which prides itself on its general common sense, cleanliness, and high sanitary instinct, would have rebelled against so revolting a custom, and that it would have spared neither effort nor expense to prevent the yearly sacrifices of thousands of victims which are the result of this pollution.

This indifference is not from want of warning, for our leading sanitarians have never ceased to proclaim the causes of our typhoid epidemics, and the means of preventing them; it is not from want of experience, for every year records its tale of sickness, death, and loss, resulting from these obvious causes; nor is it altogether from want of conviction, for throughout the country the pollution of water supply is the most commonly accredited cause of typhoid fever.

It is true that many distinguished authorities on Public

Health, many Medical Officers of Health and other Sanitary officials, private individuals, and influential associations have appealed again and again to the people and to Parliament for reforms by which this disreputable and disastrous toleration of a filthy and prevalent national habit may be abolished.

They have appealed in vain.

We cannot hope for thorough and effective legislation against water pollution until the people have been roused from this indifference; until they are made conscious of the disgusting contamination to which our water supplies are so commonly liable, are convinced of the consequent danger to which they are themselves constantly exposed, and insist upon those reforms which will afford them reasonable protection.

The indifference of the people, therefore, is the first and the greatest obstacle in the path of the necessary reforms; and the important question is—how to overcome it?

There can be no doubt that the chief cause of this indifference is ignorance;—ignorance of different kinds and degrees, but common throughout all classes. There is ignorance of the lowest degree;—ignorance of the simplest laws of Nature, ignorance of the most obvious laws of health, ignorance of the nature and causes of typhoid fever, and of the way in which it spreads from man to his neighbour or to a large community. Such ignorance can be dispelled only by persistent and systematic education; and it is for this reason that I have ventured to suggest (by proposing a resolution to this effect) that this Institute, one of whose primary objects is “to diffuse knowledge relating to Sanitary Science,” should (through its Council) consider a scheme “for diffusing knowledge relating to the causes of typhoid fever and the ways of preventing it.”

Without pretending to dictate in any way with regard to the details of such a scheme, it may be suggested that much might be done by encouraging education with regard to the laws of health in our elementary and other schools (so ably advocated by my friend and colleague, Dr. Kenwood) by inviting the co-operation of philanthropic associations, such as the St. John Ambulance Association and the National Health Society, and of the Fisheries Preservation Association; and by invoking the aid of the Pulpit, the Press, and the Platform.

Might not the Conference on River Pollution form a constant item in the Annual Congresses of this Institute?

There is another degree of ignorance, common probably to nearly all of us, the ignorance, that is, with regard to the history and character of the water which we purchase for daily consumption by ourselves, our families, and our households. How many are there here who could give us an accurate

account of the nature and history of the water which he purchases year by year for his household, of the character of its sources and surroundings, of its remoteness from cesspits, from deposits of excrement, of its security from pollution by leaking sewers and contaminated soil?

As parents, as householders, or in both capacities, it is our bounden duty to those under our protection, as well as to ourselves, to inquire into these matters; and, seeing that we pay well for the water which we purchase, and that there is always a risk of poisonous contamination of that water, we ought to claim the right of being able to assure ourselves that due provision is made for the protection of our water supply.

For this reason I have inserted amongst the requirements for the prevention of pollution a demand that the description, plans, &c., of any water supply should be made readily accessible to every customer of the water company, as well as to the Sanitary Authority.

If the people of this kingdom only knew what has been learnt and established with regard to the origin, course, and prevention of typhoid fever; if they only knew how common and widespread is the pollution of our water supplies, and how constant the risk of typhoid invasion through such pollution, there can be little doubt that fresh legislation would be insisted upon without delay.

In this paper I have tried to deal with the question before us as a National question. The subject of the water supply of our Metropolis is so large, so complicated, and so exceptional that I presume it is quite beyond the scope of our discussion to-night.

For brevity's sake also it has been necessary to omit several most important considerations, which ought not to be excluded in a discussion of water-borne typhoid; for instance, the pollution of private wells and small collections of water, especially in our rural districts, and the means by which such pollution may be prevented; a subject so important that it would well afford material for another separate discussion.

The same applies also to "milk-borne typhoid." It seems impossible however to mention this subject without protesting against the ludicrously inadequate protection of our milk supplies provided by the existing statutes.

The demands which I have advocated on behalf of the protection of our water supplies may seem too large, too exorbitant, too adverse to vested interests, too exacting from our water companies.

But I maintain that, if these companies are doing their duty there would be little or no extra burden laid upon them:—if they are to ensure the exclusion of excremental matter from the

water which they supply, a complete record of all parts of the waterworks from source to distribution, illustrated by maps, &c., as I have suggested, is a first necessity; constant and vigilant inspection is equally requisite; nor does it seem too great a tax to insist that the Companies shall expend as much for safeguarding the health and lives of their customers by constant inspection as a fishing association would for the protection of its trout.

That the companies should be held responsible for the consequences of pollution which has been suffered to occur through culpable negligence on their part appears to me to be as natural and as just as that Railway Companies should be responsible for accidents which have occurred to their passengers through similar neglect.

But, however great these demands may appear, they sink into utter insignificance when compared with the results which may be confidently looked for from a wholesale abolition of water pollution.

We will say nothing with regard to the æsthetic side of the question, however strongly that may appeal to us; of the rescue of our lovely streams and rivers from hideous desecration; of recreation ground restored or preserved to all that love the use of boat and oar; of the revived hope of the angler we say nothing, only because we hope, through these much-needed reforms, to attain results of far greater import.

Is it not worth while to us as a nation to make and insist on far greater sacrifices and to do the utmost within our power, if thereby we may ensure the prevention of so much death, suffering, and financial loss; if by well considered and combined action we can expel from our midst this plague which is such a constant reproach to us; the subtle disease which preys above all upon the young and active, the flower of the flock, the breadwinner of the family?

If you agree with me, as I feel assured you do, support and co-operate with those who are engaged in repelling the enemy from our gates. The protection of our water supplies is but one of our lines of defence, but it is one of the most important. It is for us to see that there is no weak point in that defence. To be effective it must be complete.

If you agree with me I trust that you will give your assent to the following resolutions which I venture to bring before you:—

RESOLUTIONS TO BE PROPOSED.

That the Council of the Institute be requested to consider the possibility of organising and carrying out a scheme for

diffusing knowledge with regard to the causes of typhoid fever and the means of preventing it throughout the whole kingdom.

That the Council of the Institute be requested to consider the best means for obtaining new and effective legislation for the protection of our water supplies from pollution, whereby it shall be enacted that—

(1) All local Sanitary Authorities shall have free access to the water supplies—from source to distribution—which are distributed within their districts, whether the source and course of the water so supplied be within their district or not. That the Sanitary Authorities provide for the thorough and regular inspection of the water supplies distributed within their districts, and for the regular analysis of such water, as often as may be deemed sufficient, and that the results of such inspections and analyses shall be regularly recorded and published.

(2) That the waterworks companies shall prepare and publish records of their water supplies; such records containing a full account of every source and tributary of the water supply, and a full account of all reservoirs, conduits, filter-beds, mains, and pipes by which the water which they supply is collected, stored, or conveyed, to the houses supplied; such records also being fully illustrated by maps, plans, and sections, showing the relation of all houses, drains, sewers, cesspits, and all deposits of organic refuse in the immediate neighbourhood of any part of the water supplied by them, and that all such records, maps, plans, sections, &c., shall be freely accessible for the purposes of inspection to the sanitary authority within whose district the water is supplied, and to every customer of the waterworks company.

(3) That the Water Companies shall be required to make regular constant and thorough inspection of all parts of their waterworks—from source to distribution—with a view to preventing wilful, careless, or accidental pollution; also to make regular analyses of the water supplied by them, so often as may be considered necessary; and to make and publish reports of all such inspections and analyses.

(4) That Waterworks Companies shall be made responsible for the consequences of the pollution of water supplied by them, if such pollution could reasonably have been prevented.

(5) That wilful or careless pollution of any water supply shall be regarded and treated as a penal offence.

(6) That authorities, representative of the interests concerned, be appointed for each watershed of the Kingdom, who shall have the general care and supervision of the waters within each respective watershed; shall take prompt measures to prevent any threatened pollution, and to arrest any detected pollution

of any water; and shall be responsible for the due and effective administration of the laws respecting the protection of water within their districts.

The Chairman (MR. SHIRLEY MURPHY) said that a letter had been received from Dr. Sims Woodhead with reference to the subject, which they might like to have read before proceeding to the discussion of the paper:—

“In regard to the points raised under the first two headings, I am certainly fully in agreement with Dr. Childs that typhoid fever is very frequently water-borne, but that in our anxiety to fix the method of spread of the disease we too frequently overlook the conditions under which foci, from which the disease may spread, are formed. If there were no foci outside the water supply this method of spread might be entirely left out of account, as the typhoid bacillus in water is at a distinct disadvantage in every way, and all the evidence, we have, goes to show that the effects of a single infection of water, especially when the dilution is—as it usually must necessarily be—great, are soon lost, and that it is only when there is constantly recurring infection that the disease continues in anything like epidemic form. All the experiments carried out up to the present time with typhoid bacilli in contaminated soil, however, indicate that the typhoid bacillus may remain alive and active in *soil* for enormously longer periods than it can remain in *water*. For this reason it is necessary that although the utmost care should be exerted as regards the examination of every water supply, still greater care should be exerted in making the examination not only of the collecting grounds but also of the ground in which pipes and mains are laid.

“It is now generally accepted that the typhoid bacillus is the *fons et origo mali* and that being the case it is evident that if we can determine the conditions necessary for the growth and multiplication of the typhoid bacillus, we have at once in hand the means by the application of which we shall be able to circumscribe or destroy its power of doing evil.

“I am quite at one with Dr. Childs that, although chemical and bacteriological analyses are exceedingly valuable as indicating the conditions under which water is being taken and in determining the nature and source of the supply, careful supervision and an intelligent examination of all suggested supplies and the elimination of any of them that by any means at our disposal are proved to be suspicious, would ultimately lead to an enormous improvement in the water supplies in the country.

“It must be remembered that at present there appears to be a kind of natural antagonism developed between local sanitary authorities and waterworks companies. This attitude may be readily understood when it is remembered that the objects of the two sets of men may be said to be diametrically opposed. The sanitary authorities wishing to carry out sanitary improvements at as little cost as possible, often

interfere greatly with the collecting and distributing areas of the water-companies, whilst the sanitary authorities also naturally wish to throw the onus of keeping the water-supply pure on to the shoulders of the water-companies. These interests should not be allowed to clash and there can be no doubt that the sanitary authorities should have the right to impose certain restrictions such as those mentioned by Dr. Childs on the water-companies; but in return for this they should be compelled to assume the onus of examining the water and the water-collecting and distributing areas and determining whether such water is fit to be supplied in the areas over which they have control.

Considering, as has been pointed out by the author of the paper, that the sanitary authorities are very frequently the greatest sinners in the matter of pollution, it can scarcely be expected that under present conditions a just balance will be held by local authorities unless they are made responsible for the collecting areas, or some central authority has power given to it to advise and control wherever matters of dispute arise, and I cannot help feeling that Major Flower was right when he suggested that compulsory powers should be obtained to deal with many of these matters.

It must be remembered that many of the water companies at present in existence have to work under very great disadvantages. They are frequently in the position of having to make bricks without straw, whilst in most instances, also, they have to rely entirely upon outside and unofficial advice, often very freely tendered and not always by those best fitted to advise, for their information of the advances in bacteriological and chemical knowledge. What strikes one more than anything else in connection with this subject is that the time has now come for the formation of some central board of advisers and of appeal to which water-companies, whether public or private, or sanitary authorities, might appeal in all matters concerning improvements and alterations, and to whom also consumers might appeal in cases where they are not satisfied with the present condition of any water supply. If, to such a board, compulsory powers could in any way be given, there can be little doubt that a considerable step would be made towards the solution of what is, at present, an exceedingly important but difficult problem.

Major LAMOROCK FLOWER (London) thanked Dr. Childs for the kind way in which he had mentioned his name and the Board under which he had acted for so many years. He quite agreed with Dr. Childs in following out the principle of the water-shed as the area for jurisdiction, and was entirely opposed to the manner in which the present protection of water is carried on, as emphasised in the small water-shed, only 600 square miles, over which he had the pleasure to preside. However valuable a committee might be, he did not believe that was the way to get rid of pollution of rivers. He took over his duty in 1871, and he asked the Lee Conservancy Board to give him a free hand; it was twenty-seven years ago, and he still retained that free hand. Wherever interference had taken

place with himself in the discharge of his duties there they had failed. Luton had been mentioned as a case where individual persuasion had produced certain good results, and he was glad to say that there were other cases besides Luton in which it had also been carried out satisfactorily. He was present at the opening of the new sewage works at Luton, and had told the town of Luton that if they would only follow his lead he would protect them from that profession which was so distinguishedly represented by his old friend the town clerk, now dead. In his reply that gentleman said he had made more money professionally by following the lead that had been given than if he had fought an action out in the courts of law. There was satisfactory protection so far as Luton was concerned, simply because he had asked them to do it. Another town might be mentioned, Hertford, which at that moment polluted the river Lee as it did in 1884, and why? Because the Lee Conservancy Board took action against the town and lost. The pollution was justified by the High Court and continues to this day. He did not blame the authorities for standing to their legal position, which they had been able to win, but the day must come when the pollution of Hertford will be abolished, because the Royal Commission over which Lord Balfour of Burleigh sat, said that pollution must be abated without delay. Individual action, he thought, must be the keynote of all their work, and he was pleased to testify to his complete agreement with Dr. Childs.

Prof. J. LANE NOTTER (Netley) said the question was a large one and involved many interests. It was only since people had begun to use water that the necessity for dealing with the supply at the other end had been recognised. He agreed with Major Flower as to an area being under the control of an individual rather than of a committee; he had seen the advantage of this over and over again and knew the benefit derived from it. A little talk would do what a committee with all their manifestoes was unable to accomplish. Many points in the paper deserved attention, but perhaps none more so than the criticisms upon the chemical and bacteriological examination of water. Experts very often differed and the matter had to be regarded in its broad sense. He was quite certain that we would learn more from looking at the page of everyday life, at the sources of the water, at its surroundings, at its distribution very often, than we would do from the exact knowledge which the chemist or bacteriologist could give. No doubt these were useful aids, but they would not supplant that individual observation, that individual study of the subject on the spot, which could only be done by one who had the interest of the community at large at heart, and who really was in a position, as Major Flower happily was, to superintend it, and with such admirable results. He was sure the paper would lead to the subject being taken up in the broad spirit it was intended.

Dr. S. RIDEAL (London) remarked that the paper was interesting and a useful contribution to our knowledge of the subject. The

difficulty to his mind was how to bring about these improvements which they all agreed ought to be effected. Conflicting interests were really the stumbling block in the path of reform. In London it was a question whether the authorities higher up the water supply should be compelled to purify their sewage to such an extent that the people of London could drink the water afterwards. The question was upon whom should the expense fall, as at present the counties objected to cost of purifying the water up to the London standard. This seemed to be the crux of the matter, and then came the question as to what standard should be regarded as absolute in such cases, whether the water should be purified up to a drinking water standard or whether they should purify their sewage up to a point at which it would be harmless when discharged into the river, and would not prevent that river from being navigable and available for rowing and fishing. If they adopted the higher standard the question was who should pay for it. It seemed therefore to him a question whether after all it would not be desirable in those cases in which a river supply is practically the only available source of water supply for a community, to begin at the other end instead of attempting to purify the river up to a drinking water standard; whether it would not be better to assume that the river is polluted, and that the water is not a safe water for drinking purposes, and to aim at a purification locally in the houses and at each water tank in the town. Such a system of purification in large towns would, he felt sure, cost far less than the attempt now being made to purify the water of our big rivers up to a drinking standard. In that case the people who really required to use the water for drinking purposes would pay for the cost of its purification.

Dr. A. NEWSHOLME (Brighton) said they were indebted to Dr. Childs for his excellent paper, within the scope of which the subject of the metropolitan water supply hardly came. But they could not have helped noticing that both in Dr. Childs' remarks and in the remarks of those who followed him the subject was dealt with almost entirely as a question of drinking water supply derived from rivers. That was an important branch of the subject, but he did not believe as a matter of fact that the greater proportion of the population of this country receive their supply from rivers, but from surface water or deep wells. The matter therefore also had to be considered from this point of view. The assumption throughout had been that polluted water was the cause of typhoid fever on a gigantic scale, but there had been some very interesting observations made by the Chairman in which he had shown very clearly that in London itself there had been minor explosions of typhoid fever occurring about a fortnight after storms in the Thames and Lee valleys, they being apparently caused by the rushing into the rivers of polluted matter and the subsequent imperfect filtration of the metropolitan water supply. Personally, he believed the relationship of cause and effect had been made out, and attention ought to be given to the subject, for the increase of typhoid fever cases had been confined to those

parts of the metropolis supplied with river water, those supplied with deep wells having escaped. So that they might have a sprinkling of cases of water-borne typhoid as well as an epidemic. In the face of such a big epidemic as that at Maidstone they were apt to forget the possibilities of danger which lurk in our midst all the time. This seemed to him the strongest possible argument for the universal control of the water supply by the municipalities, and the taking of it away from the companies. Why should London have to wait for this reform when nearly every other part of the country is obtaining the control of its own water supply? The first object of a water company was to pay a dividend, and the first object of a local authority which knows its duty was to secure that the people should not be poisoned by the water they used. Consequently it was of the utmost importance that London as well as other towns and districts should have the control of its own water supply. Then came the question of inspection inside and outside the district of supply; who was to conduct those inspections? That was the crux of the whole question. Dr. Childs and Major Flower would like to create further authorities; but he thought that this would only create further confusion. It seemed a pity to multiply authorities, there were plenty of authorities in existence ready to do it if they only had the power conferred upon them. If they did not exercise their powers then it should come within the power of the Local Government Board to intervene. He objected very much to this duty being left in the hands of the larger authorities, and worse still solely in the hands of the Local Government Board, which was a political body, almost entirely impotent, and when not impotent it was obstructive, varying between these two extremes.

Mr. J. A. WANKLYN (London) said he agreed with a great deal that had been put forward, especially that the causes of typhoid fever were very numerous, and many of them little understood. It was his belief after forty years' experience in the examination of water that with the exception of the spread of typhoid fever by private wells, there is practically no spread of typhoid fever by the water companies.

Dr. LOUIS PARKES (London) said that the paper was a very valuable one, and the resolutions Dr. Childs proposed should be brought before the Council of the Institute; therefore he would second them. The Council would consider them and perhaps see its way, subsequent to the publication of the Local Government Board report on the Maidstone epidemic, to get up a strong deputation to wait upon the Government for the purpose of impressing upon them the necessity for taking some action in regard to safeguarding public water supplies. No doubt some steps ought to be taken, but exactly what steps did not transpire from the discussion. His own idea was that as the County Councils existed all over the country they might be invested with further powers, if necessary giving them the sanitary control and powers of inspection of the water-shed areas of the county. The

medical officer or engineer of the county could assist the medical officer of health to the local authorities, and do very much what Major Flower had done in regard to the Lee Conservancy Board, in advising and assisting water authorities, whether public or private, in safeguarding their sources of supply. He quite agreed that it was inadvisable to multiply the authorities. Of course, the County Councils should have the power to go outside their own areas if necessary, though there might be some overlapping, which doubtless could be overcome. He thought if they could impress some specific scheme—not generalities—upon the Government it would be productive of what they all wished. With regard to Dr. Woodhead's letter and the point as to the bacillus not living for any length of time in water, and it being necessary to have a continuous pollution to produce an epidemic, it had struck him that though the bacillus might not live for a long time in reservoirs or rivers, it was possible when it got into the cisterns and pipes, in the dark, in a suitable temperature, and in contact with the organic matter found in the cisterns, &c., that it might exist for some time and be capable of multiplying itself, so that when once polluted water arrived in the cistern it might remain infective for a long time, although in the reservoirs and mains it might quickly disappear. He did not know whether any evidence in this direction was taken at Maidstone. With regard to the multiplication of bacteria in the ground, he thought that there was no doubt this might take place under certain circumstances. Dr. Adams had shewn how the bacillus was probably washed through the cracks in the ground and clay by the heavy rains in the district. He did not know whether these points were brought out at the enquiry, but it appeared to him that if they had been considered they would rather strengthen the view entertained by most people that this particular outbreak was due to polluted water.

Dr. REGINALD DUDFIELD (London) rather hesitated to break up what was a very unanimous meeting. But three points occurred to him. First, while agreeing with Dr. Childs generally in his admirable paper, and admitting that the author was entitled to select his subject of water-borne typhoid, he thought that at the present day there was far too great a fixing of the attention on that one aspect of the case. He felt that he wanted to see dirty conditions got rid of, not merely in the water, but in the soil, in the houses, and in the food supplies generally. Next Dr. Childs seemed to carry his remarks as far as the filter and stopped there. The results published month by month by the Local Government Board examiners of the water supplies and water companies (which, he thought, all would accept as true) showed that the bacterial purification of the London filters was exceedingly good. But when the water left the London filters it had many vicissitudes to go through. London was riddled with defective sewers and house drains, and it was proved at Croydon that the water main acted as a sucker and sucked filth into it. They had no evidence how far this might be the case in London. Then Londoners went out of town and the autumn was

the time for typhoid fever. There were many instances of typhoid fever having been acquired outside London, and enquiries he had made gave 10 per cent. of the notifications of typhoid fever acquired in this way. In other districts the proportion might easily be higher. Then as to the inspection of sources, what would be the logical result? England was a small country, densely populated. Each town was anxious to have its own supply, and would acquire watershed areas. Experts would not like those water-sheds to be manured, and the country would be mapped out. Then he did not see where agricultural produce was to be grown. This was of course beyond the limits of the paper, but still the point had occurred to him.

Mr. WOLF DEFRIES (London) expressed concurrence both with Dr. Dudfield and Dr. Rideal in the view that the paper had stopped short at the distributing works, and had not contemplated the fate of the water afterwards. However much he might sympathise with Dr. Rideal's suggestion, from a considerable experience of the fate of purifying apparatuses, and the class of people who use them, he was bound to say he did not think it would answer the purpose contemplated. The effect would be to provide better for those persons who are already best provided for, and leave those persons who are most exposed to the stress of circumstances, who are most liable to catch infective disease, substantially as little protected as they are at present. This did not alter the fact, however, that it was a thoroughly good point that the water after it leaves the works required more protection than it had got. He did not think that in any part of its career it was possible to obtain for water an absolute final, definite, certain protection. They had to consider first, second, and third lines of defence, and it seemed to him that the only line of defence referred to in the paper was the first. He should be sorry to in any derogate from the importance of making good the first line of defence so far as it can be done, but at the same time the other lines of defence, the means of purification and the safeguarding of the means themselves, were equally important. As Dr. Newsholme had pointed out, those were matters which had to be considered jointly with the primary duty of protecting the water supplies, and the chain of defence must be measured by the strength of its weakest link. The term water company involved the assumption that the authorities responsible for the introduction of imperfect water were necessarily commercial bodies, trading commercial bodies who have monopolies. He thought that our recent experience by no means bore that out. At Kings Lynn it was a local authority with their eyes opened by the Local Government Board. This might be the only case at present, but it was possible there would be others. He felt very strongly that the interest of a town was a matter measured by pounds, shillings and pence. There were many instances of local authorities not regarding the health of their own towns. Could they expect one sanitary authority to send out of its own district and protect the water supply of a neighbouring town. When they recommended that further powers should be given to this class of authority they

incurred a grave risk of putting forward weapons which looked well on paper but which put into inexperienced or apathetic hands would be weapons to be turned against the cause of public health by reason of their results being so totally disproportionate to their elaboration. It was a point to be considered that the adoption of ineffective means was liable to operate ultimately against the cause sought to be promoted.

MR. SHIRLEY MURPHY (The Chairman) said that the great difficulty underlying the whole question was that human nature is not always to be relied upon. The machinery of administration has to be designed in such a way that the frailty of human nature can be least capable of inflicting injury. He thought that there was one broad principle which ought to govern the control of water supplies to communities, and that was that they ought not to be supplied for profit. The very moment water was supplied for profit, whether it be by a company or by a sanitary authority—for he was afraid that some sanitary authorities must be definitely accused of trading in water—they were exposed to risk. Water was a necessity to the community, it ought to be supplied in fit condition for its purpose, and it ought to be supplied without profit. The moment it became a trading interest difficulties arose, of which they had so much experience at the present time. This was a point which ought to be borne in mind, and it was one which he should be very glad if it received the attention of the legislature. They were much indebted to Dr. Childs for his paper, for not only had it been interesting in itself but it had drawn forth a very interesting discussion, and he would ask them to give Dr. Childs their cordial thanks.

The compliment having been accorded with acclamation,

Dr. CHILDS, in reply, thanked the Chairman for his remarks. He had expected much greater opposition during the discussion: that Dr. Woodhead, for instance, would have criticised what he had said with regard to the chemical and bacteriological analysis of water. He did not underrate the value of these analyses, but wished to emphasise the necessity of thoroughly examining the surroundings and conditions of the source and course of the water supplied, in addition to making these analyses. Bacteriological analysis was certainly of great service also in gauging the efficiency of sand filtration. Much as he respected Dr. Rideal's opinions, he could not agree with him in his advocacy of domestic filtration. Domestic filtration, as a general custom, could not be relied upon. If the nation were thoroughly in earnest about the matter and insisted upon being supplied with pure water, they would no doubt obtain it. More effective legislation and more effective administration of the law were required, and the first and greatest difficulty in the way of obtaining this were the ignorance and indifference of the people. For this reason he hoped that the Council of the Sanitary Institute

would favourably consider his first proposal—"that a scheme should be organised and carried out for diffusing knowledge with regard to the causes of typhoid fever and the means of preventing it throughout the whole kingdom." He would be glad, for instance, to see a Standing Committee formed, and a Conference held, at each annual Congress, to deal with the prevention of water pollution. Dr. News-holme had spoken of the mischief of multiplying authorities. But the formation of Conservancy Boards on the lines of the Lee Conservancy Board, which he (the speaker) advocated, did not necessarily imply the multiplication of authorities. He had brought forward the River Lee Conservancy Board only because it appeared to him to present an excellent model and to have afforded for many years an object lesson to the whole nation. Sir Francis Powell (who was prevented by indisposition from being with them), together with others, was at that very time engaged in promoting a Rivers Pollution Prevention Bill, one of the chief objects of which was to provide for the promotion of Conjoint Committees and Rivers Boards deputed by local authorities to take under control the streams, rivers, &c., within their respective watershed areas. The measures which he regarded as the most important for the prevention of convection of typhoid fever through public water supplies were—the diffusion of knowledge and the exciting of interest with regard to this question amongst all classes of the people; new legislation which should enforce constant and systematic supervision and inspection of the water supplies from source to distribution, and should secure effective administration of the law; whilst Waterwork Companies, or authorities in possession of the water supplies, should be held responsible for the results of preventable pollution. He hoped that the resolutions which he had proposed would be brought before the Council; for, though they might contain some impracticable suggestions, it would be for the Council to deal with them as they thought fit.

The resolutions were seconded by Dr. Louis Parkes, agreed to *nem. con.*, and stood referred to the Council.

NOTE.—A Standing Committee on River Pollution has been appointed by the Council, and these resolutions are under its consideration.