RIVER POLLUTION:

WITH SPECIAL REFERENCE TO SECURING STEPS WHICH CAN BE TAKEN FOR ITS PREVENTION.*

BY

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THERE must be very few medical men who have not at one time or another had their attention drawn to the polluted condition of our rivers, but there are fewer still who can remember the foulness of some of the streams in our industrial areas thirty or forty years ago, when little had been done to check their pollution.

To give some picture of the conditions of the streams at that time, I cannot do better than repeat the often quoted paragraph in the report of the Royal Commission of 1865 (pages x and xi):

"The Rivers Aire and Calder throughout their whole course are abused, obstructed, and polluted (to an extent scarcely conceivable by other than eye-witnesses) from Skipton on the Aire, from Todmorden on the Calder down to Castleford. The Rivers Aire and Calder, and their tributaries, are abused by passing into them hundreds of thousands of tons per annum of ashes, slag, and cinders from steam-boiler furnaces, ironworks, and domestic fires; by their being made a receptacle to a vast extent of broken pottery and worn-out utensils of metal, refuse brick from brick-yards and old buildings, earth, stone, and clay from quarries and excavations, road scrapings, street sweepings, etc.; by spent dye-woods and other solids used in the treatment of worsteds and woollens; by hundreds of carcasses of animals, as dogs, cats, pigs, etc., which are allowed to float on the surface of the streams or putrefy on their banks; and by the flowing in, to the amount of very many million gallons per day, of water poisoned, corrupted, and clogged by refuse from mines, chemical works, dyeing, scouring, and fulling worsted and woollen stuffs, skin cleaning and tanning, slaughterhouse garbage, and the sewage of towns and houses."

This description of the Rivers Aire and Calder may be said to apply, with more or less accuracy, to many of the streams in the industrial areas, particularly in Yorkshire and Lancashire.

Incidentally, it will interest you to know that at this time the town of Wakefield poured all its sewage and trade refuse into the river without any attempt at purification, and drew its water supply from the river at a point only some three or four miles below the town. The water was purified and supplied to the town, discharged to the river as sewage without treatment, and again abstracted and circulated.

The above picture, black as it is, probably does not represent the worst condition of some of the rivers, although the Calder was then so foul and discoloured that the owner of a riverside mill wrote a complaint in water taken from the River Calder, of which a facsimile is given on page 12 of the third report of the Royal Commission of 1868. Even after this date pollution of the streams materially increased, owing to the rapid increase in population of the industrial areas, the great expansion of trade, the extension of water supplies in towns and villages, and the introduction of water-closets and water carriage of sewage.

After the reports of the Royal Commissions of 1865 and 1868 some spasmodic attempts at the purification of sewage and trade refuse were made, but the results of these did not keep pace with the increasing pollution. During this time of inaction there was one body which was in a way forced to take steps to prevent river pollution—the Thames Conservancy Board—whose duty it was to guard the London water supply. They have always been an active body, working under powers granted by special Acts of Parliament, commencing in 1857.

The passing of the Public Health Act of 1875 and the Rivers Pollution Prevention Act, 1876, showed that the public conscience was becoming stirred by the recognition of the foul condition of the rivers, and during the following years some further attempts were made towards improvement, but these amounted to very little. In 1889, when

the county councils and the county boroughs were set up, some of them turned their attention to the improvement of the rivers in their areas, and as one result three joint committees were formed. These were statutory bodies constituted under Section 14 of the Local Government Act, 1888, with the sole duty of administering the Rivers Pollution Prevention Act: the Mersey and Irwell Joint Committee and the Ribble Joint Committee in Lancashire, and a joint committee (now the Rivers Board) for the West Riding of Yorkshire.

These bodies at once began to take action, and coincident with this one or two of the county councils turned their attention specially to the matter—for example, Durham under Dr. Eustace Hill, Derby under Dr. Barwise, and Warwick under Dr. Bostock Hill.

The joint committees and county councils were given no fresh powers for dealing with river pollution; they had to administer the general Rivers Pollution Prevention Act, which could have been brought into use by any sanitary authority. Later, however, special Acts were obtained by the Mersey and Irwell Joint Committee (Mersey and Irwell Joint Committee Act, 1892), and by the West Riding of Yorkshire Rivers Board (West Riding of Yorkshire Rivers Act, 1894), but these added very little to the powers given by the general Act of 1876.

So far as the general sanitary authorities and most of the county councils were concerned little or no use was made of their powers. The reasons for this inaction are not far to seek, at least in the case of sanitary authorities—other than the county councils. They were themselves, for the most part, great offenders, and could not take action against other offenders without drawing attention to their own sins. The inaction of many of the county councils is not so easily explained. Probably the general reason was that their powers were new, their medical officers had a number of new duties placed upon them, and were not provided with the special staffs required to deal with river pollution. They had, in fact, duties of more immediate importance, such as water supplies, removal of crying sanitary nuisances, and duties in connexion with epidemics.

It may be inquired what has been the result of the action of the joint committees and those county councils which have taken up the question of prevention of river pollution seriously. I can, of course, speak with some authority mainly of the rivers in the West Riding.

The condition of the Rivers Aire and Calder, which was so vividly described in the Royal Commission Report of 1865, is now vastly different. Even thirty years ago the River Aire at Leeds was so foul and septic in its course through the city that frequent complaints were received of the injury to health of workpeople in the factories on the river banks. In dry summers the nuisance was felt in the streets of the city, even as far as the town hall, half a mile from the river. This was the condition within the city of Leeds, and the state of matters was worse lower down, after the Leeds sewage and trade refuse, with very little treatment, had been discharged into the river. For example, from Castleford, where the river is churned up by passing over a considerable weir, complaints were frequent, strong, and bitter.

The condition of the River Calder was very similar. There is a fairly large weir across the river at Wakefield, just above Kirkgate Bridge (which is well known to motorists by its Chantry Chapel), and here the smells from the water, broken up by passing over the weir, were extremely offensive; and particularly in times of flood, after a dry spell, the water was so thick with solids washed down from the bed of the river that it might be said to roll rather than flow over the weir. The Aire and Calder Navigation Company, in dredging both rivers for the passage of their boats, had to remove thousands of tons of cinders and other solid refuse.

These rivers are now in a very different condition; there arise no offensive smells from them; their waters are now only slightly discoloured, and the amount of suspended matters they ordinarily carry is less than that of a natural stream in times of flood. These improvements have been carried out in spite of steadily increasing discharges of sewage and trade refuse. The population of the two

* Read in opening a discussion in the Section of Public Health at the Annual Meeting of the British Medical Association, Manchester, 1929.

valleys has increased enormously, with an accompanying increase of sewage; there has also been a great increase in the volume of sewage owing to the spread of the water carriage system of drainage and the extension of sewers, and the amount of trade refuse has greatly increased. Had no attention been paid to the prevention of pollution, the condition of the rivers that would have resulted from all this vast increase of sewage and trade refuse which has been poured into them can scarcely be realized. One is tempted to wish that for a month all treatment of sewage and trade refuse in these two valleys could be brought to a standstill, so that the inhabitants could more fully understand what the work of the Rivers Board has meant to them.

The burden these rivers have to bear in the way of sewage, sewage works effluents, and trade refuse is very great. The Calder below Wakefield, with a dry weather flow of some 100 million gallons a day, has received over 30 million gallons of these liquids; the Aire below Leeds, with a daily dry weather flow rather less in amount, has received about 50 million gallons.

It has also to be noticed that the sewage works of many of the towns are far from complete, although their extension is now in progress. When these various works are brought into full use, and the trade refuse discharges are connected up, as many of them will be in the near future, the improvement in the rivers will be still more marked. There will, however, always remain considerable pollution caused by the discharges from sewers in wet weather. Pollutions by storm water have, indeed, during recent years become more serious owing to the rapid run-off of rainfall from impervious road surfaces, and the Ministry of Health regulations relating to treatment of storm water stand in need of revision, if this form of pollution is to be lessened.

In addition to the work done by the Rivers Board in lessening pollution of what may be called the industrial rivers, like the Aire and Calder, their attention has been constantly directed to the prevention of pollution of the cleaner and more natural streams, such as the Wharfe and the Nidd, rivers which are full of fish. In these valleys there is now no considerable village unprovided with sewage purification works; even small hamlets and detached farmhouses have made some provision for preventing their sewage reaching the streams. As a consequence, these streams have been kept from deteriorating, and their waters are purer than those of some of the rivers which form the source of public water supplies. The water of the Wharfe, for example, below the towns of Ilkley and Otley is purer than the water of the Thames at Hampton.

These are some of the results of thirty-five years of the work of the Rivers Board, although it must be acknowledged that a great deal still remains to be done; it must, however, be remembered that during this thirty-five years there were six or eight years' inactivity because of the war and its effects. All this work may be said to have been done under the general Rivers Pollution Prevention Act of 1876, and the provisions of that Act could have been set in motion by any sanitary authority.

I wish particularly to draw your attention to this statement: any sanitary authority during the last fifty years could have taken the same action to prevent pollution of streams within its districts as that taken by the rivers boards, and could do so to-day, because the legal powers of the rivers boards are no greater than those which every sanitary authority and every county council possesses under the 1876 Act. The only difference is that the jurisdiction of the rivers boards extends over a greater area.

The reasons for the inaction of the sanitary authorities have already been briefly mentioned. There is, under present conditions, little prospect that this inaction will come to an end. What is the remedy? This has been pointed out by commission after commission. I need only direct your attention to the third report of the Royal Commission of 1898, page xxvii, and to the recent report of the Advisory Committee on River Pollution, both of which advise very clearly that joint committees or rivers boards should be set up with powers to deal with the question of river pollution.

Such a board should have under its jurisdiction the whole of a river and its tributaries; it should have an area large enough to justify the employment of its own special staff of inspectors and chemists, and the area should not be so large as to prevent the board's chief officers from becoming familiar with all sources of pollution.

The mode of establishing such a board or joint committee is set out in the report of the advisory committee referred to:

"It is therefore possible under the law as it stands at present for the Minister, on the application of any one of the county councils or county borough councils through whose jurisdiction a river passes to set up a rivers board to control the whole length of the river, including its tributaries, so far as it is subject to the Rivers Pollution Prevention Acts."

To this procedure I would earnestly direct attention. The Ministry of Health has already sent to all county authorities the report of the advisory committee, and it now lies with these authorities to make the necessary application to the Ministry of Health. The influence of the British Medical Association, and such action as it may take, will go a long way towards bringing about the desired effect.

The cost of such a joint committee need not be great. In the West Riding it amounts to one-seventh of a penny in the pound on the rateable value, and this cost is diminishing, as, owing to the present facilities of travelling, the number of inspectors required has been lessened. The Rivers Board staff consists of a chief inspector, his deputy, a number of district inspectors, and legal, laboratory, and clerical staffs, and these would be necessary for the proper equipment of any rivers board, their numbers, of course, depending upon the area and the number of pollutions to be supervised. Such a board, devoting its attention entirely to the question of river pollution, and with a staff trained for the purpose, is, in my view, necessary before river pollution receives the attention it so urgently needs.

It may not be a legal requirement that a prosecuting authority should suggest practicable means for the purification of a polluting liquid, but in practice the Ministry of Health, whose consent to legal proceedings against a trader is necessary, must be persuaded that such means do exist, and it generally falls to the prosecuting authority to prove this. It is, in fact, my own experience that in dealing with new kinds of pollution many researches and experiments must be undertaken, and the experience of others, both at home and abroad, ascertained, before any application to the Ministry of Health can be made with reasonable prospect of success.

A rivers board has for its first duty action compelling offenders to cease polluting the streams, but I would not have you think that its duties end there; in fact, this is the smaller part of its work. Its officers should be in constant touch with the officials of the sanitary authorities and with traders who have waste waters to dispose of, and should be able to suggest to them the best means to be adopted for the prevention of pollution. In this way a board is able to assist those whom it has power to compel, and the result in numberless cases has led to notable economies, particularly in the case of traders. In this way, and also by insisting that polluted waters are rendered fit for ordinary use, the establishment of a rivers board may be looked upon as economical rather than expensive.

What is the alternative to the establishment of such boards? Either, as in the past, the sanitary authorities will remain inactive, and pollution will go on as before, or, stirred by complaints of new pollutions, spasmodic action will be taken by an authority here and there—action taken without the assistance of any skilled staff, and without the authority being able to assist the manufacturer to put his house in order. This is a most regrettable position for an authority to be in, for every one of them is anxious to attract to its district the establishment of new factories, with their rateable value and their employment of the working classes; and, on the other hand, the traders are generally desirous of carrying out their processes without harming their neighbours, provided that they have confidence in the means to be adopted.

The matter is urgent. Complaints are being made from all over the country, not only of the condition of streams which are recognized as passing through industrial areas, but of some of our beautiful fishing streams in rural country, where until recently practically no pollution existed. These new trade pollutions are of immensely greater magnitude than the old. Formerly there were numberless comparatively small factories with discharges varying between twenty and thirty thousand gallons a day of dirty water. Now, from beet sugar factories, artificial silk factories, and large dairies, the volume of foul water may amount to millions of gallons from one factory in a day. Thus one such large factory may entirely change the character of a formerly clear and unpolluted stream, and I am sure that many of you are aware of this having happened. If such pollutions are not promptly and properly dealt with the deterioration of our streams is certain.

This is a serious matter from many aspects, but especially serious in view of our increasing industries and population, and the difficulty of obtaining sufficient water supplies.

The question of fishing deserves consideration, for instances are known where, by the establishment of one of these modern factories, fish have been utterly destroyed and gathered up literally in cart-loads; and the value of fisheries is very great, although rapidly lessening because of pollution. The pleasure given to countless thousands by the fishing available in our clean streams and their enjoyment of the amenities of our country valleys are also to be considered. Perhaps none but those who have lived in our industrial valleys near a stream fouled by sewage and trade refuse can fully appreciate the delight afforded by a clear running stream in beautiful surroundings. To improve the condition of streams which are already polluted, and to prevent the pollution of these clean streams, is certainly well worth a great effort.

I have said that much good work could be done under the existing Acts of Parliament, but there is no doubt that in many respects these require amendment. This has been pointed out by various commissions, and will no doubt be dealt with by the advisory committee now sitting; but there is no reason to wait for an alteration in the law before putting into force the present powers. There is, however, one point where, possibly by agreement, an important change in the law would be of great value. The powers and rights of sanitary authorities and traders respectively, with regard to the admission of trade refuse into sewers, are by no means definite, and the practice in this matter varies from town to town. Some towns admit to their sewers, and deal with at their sewage works, all trade refuse without terms and without payment. Some towns absolutely refuse to admit any trade refuse into their sewers, and there are many modifications between these two extremes.

To my mind, in industrial areas, no satisfactory purification of the streams will be effected until trade refuse is dealt with along with the sewage of the towns. This, of course, ought only to be on terms of preliminary treatment of the trade refuse, or payment by the traders, or both. The matter has been dealt with by the Royal Commission of 1898 (see third report, paras. 22, 23, and 24, and the ninth report, para. 10). As the Royal Commission has pointed out, it is obviously inadvisable that the law should give the manufacturer "the absolute right" to discharge his refuse into the public sewer. This is evident on considering the case of one of the new large factories, already referred to, established in a small town or country village, where the amount of trade refuse may be a hundred times the volume of the domestic sewage of the place. In any change of the law provision would have to be made for dealing with such cases, but this is no time to discuss details.

I need only refer to one other desirable alteration in the law. Power should be given to some higher authority to decide between the authorities of adjacent districts when they propose, each of them, to set up their own sewage works. It is a scandal to see the countryside dotted with separate sewage works, where these could readily and more economically have been centralized. Without additional legal powers it is nearly impossible to overcome the

jealousies between many of these local authorities, although in numerous cases, soon after they have constructed separate sewage works, they wish the policy of combining and centralizing had been followed.

In conclusion, the measures for dealing properly with river pollution are not likely to be thoroughly undertaken until special boards are set up for the purpose. Such boards could be set up, and do good work, under the existing laws. The laws need amending, especially that relating to the admission of trade refuse into public sewers. Every county council and council of a county borough should consider the condition of the rivers and streams within its district, and where pollution exists should represent to the Ministry of Health the desirability of constituting a rivers board.

THE SIGNIFICANCE OF VITREOUS OPACITIES.*

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To assess the true significance of vitreous opacities in every patient is an impossibility, but certain factors help us to come to a decision as to their importance or otherwise in most cases.

In the first place it is essential to recall the embryology of the vitreous. Those of you who were present at the 1927 meeting of the Ophthalmological Society of the United Kingdom will have heard Miss Ida Mann's admirable paper on the development of the vitreous; if not, you have probably read the paper. Miss Mann¹ there states that from the union of the mass of fibrils derived from lens and retina with those from the walls of the hyaloid artery the primary vitreous is formed in the foetus. She goes on to describe the formation of vessels in this vitreous and their subsequent atrophy, forming near the retina an avascular area named the secondary vitreous. After the third month of foetal life fibrils from the growing margin of the cup help to form the tertiary vitreous with a condensation of fibrils from the hyaloid membrane separating the secondary from the tertiary fibres.

As development continues condensation takes place, so that the adult vitreous consists of the primary portion filling the retrolental space and passing along the canal of Cloquet to the optic disc; the secondary vitreous extending from the boundaries of the primary to the internal limiting membrane, and the tertiary forming the suspensory ligament of the lens. The point is emphasized that the vitreous body is not enclosed by a structureless hyaloid membrane, being separated from the retina only by the internal limiting membrane.

The slit-lamp has added much to our knowledge of the structure of the adult vitreous. With a dilated pupil the retrolental space can be made out, and behind it the anterior portion of the vitreous, with its delicate waving fibrils and nodules. Even a portion of the canal of Cloquet can be distinguished, and separate moving bodies in certain cases, pigmented or otherwise. The vitreous is seen to differ in appearance with the individual, and may show a disorganization of what we consider the normal. The rapidity of the movements of the fibrils, their density, or their altered appearance to that of cotton-wool fibres are examples of what is meant. Bedell² states that pathological changes in the vitreous depend on changes in the framework and pigmentation, and that framework characteristics are marked by absorption of some fibres and the massing of others. He describes floaters as appearing like fine white lines, isolated fibres, single short threads, as a skein or tangle of cotton-wool, as cotton-like masses, white dots, heavy dust, and as snowflakes. Blood appears as roundish clumps, ovals, granules, and large masses.

With the contact glass much more of the vitreous can be seen; but of this I have no personal experience.

The investigation of the chemical and physical properties of the vitreous has recently been fully undertaken by some

* Read in the Section of Ophthalmology at the Annual Meeting of the British Medical Association, Manchester, 1929.