

REFERENCES

1. Rivers (Prevention of Pollution) Act, 1951, Sec. 5(1).
2. Editorial, *Wat. & Wat. Engng.*, vol. 60, p 376 (Sept. 1956).
3. Martin Lovett, "Effluent disposal problems in the chemical and allied industries", *Chem. & Proc. Engng.*, vol. 37, p. 86 (1956).
4. *Parliamentary Debates (Hansard)*, House of Commons, vol. 488, No. 11, Col. 745 (June 1951).

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CORRESPONDENCE on this Paper should be forwarded to reach the Institution before 15 May, 1957. Contributions should not exceed 1,200 words.—SEC.

Discussion

Mr C. B. Townend (Chief Engineer, Middlesex County Council Main Drainage) said that in coming to the Institution of Civil Engineers, he felt that the Author was rather preaching to the converted, but there was, of course, always a considerable amount of mutual benefit to be gained by getting together—the chemist with the engineer and the river board with the sewage works designer and operator. It gave an opportunity to pool ideas which might help towards a common goal. Although the Author sat on one side of the fence and had an obvious axe to grind, he had given an outstandingly balanced and impartial summary of the whole situation. His views on sewage purification and what could be achieved in an industrial country were very realistic. The common law position, referred to in § 8, had led to a situation in which it had been held that the discharge of nitrates was illegal, so that theoretically, even when the perfect sewage works was realized, giving 100% purification from the biochemical standpoint, the common law would still be broken. The Author had dealt adequately with the absurdity of the general position which arose from that, and the balanced judgement which he had given in about three lines in § 14 could scarcely be bettered.

47. With regard to water resources, the Author had asked whether the recurrent shortage of water was the result of a succession of droughts or of an increased demand for water. Of course, both factors entered the picture, but clearly a rising water demand would aggravate any adverse situation. It was probably necessary in many places to provide a storage of upwards of 200 days' supply to overcome drought conditions, and that could be very expensive. So seriously had that been regarded on occasion that in one case some years ago, when a drainage authority had proposed to close down a number of small sewage works which discharged their effluent into a river above certain water intakes and to replace those sewage works by a central works discharging the effluent below the water intake, the water authority had at first intended to oppose the scheme on the ground of the loss of water in times of drought when a statutory minimum had to be maintained in the lower river. In consequence of the loss of no more than 5,000,000 gal/day of sewage effluent, it had been claimed that an increased reservoir capacity of more than 1,000,000,000 gal would be necessary, and that the cost of that would be indeed very great. Thus even to water authorities sewage effluent was sometimes very acceptable.

48. The Author had shown very logical reasoning on the general question of compensation water and on the necessity for maintaining an adequate dilution in a river accepting heavy discharges of effluents. As the Author had said, there was in fact a limit to the extent where it could reasonably be expected to mulct any river while keeping a balance between the various factors involved. Mr Townend wondered whether those considerations ought to be applied to the same extent in cases where the water supply

was taken from entirely rural country, such as the Welsh mountains and where the water authorities were under obligations to maintain better conditions for riparian owners than formerly existed.

49. On sewage treatment the Author had been very kind to the engineering profession in saying that the design of new sewage works had now reached a commendably high standard, and had certainly soft-pedalled his adverse comments on the lack of thought sometimes given to details which could so greatly affect operation. The Author had thrown out a challenge, but Mr Townend had to agree with him. In the old days it had been common practice for engineers to circulate from the operational side of sewage undertakings to the designing staff both of authorities and of consultants, and back again, thereby gaining all-round experience. In gaining it, there was indeed no substitute for the hard way of getting down to things as a junior in top-boots and donkey-jacket on a practical works. Today that practice was dying out. In the present days of inflation, public authorities could not or would not pay an adequate price to compete in the national market for technical staff, whether engineers or chemists, with the result that the supply had completely dried up. In those conditions it was inevitable that more and more work would be designed by specialist engineers who were getting less and less contact and experience with practical work. The consulting engineering staff could not afford to serve public authorities even for a few years, with the result that there was a general trend towards deterioration in design and a slowing-down of development. Mr Townend supposed that that was all part of the general background of the national situation or outlook at the present time. In the Welfare State, the masses of the people wanted to spend every penny of their income on consumer goods and regarded everything else as a burden. They were ready to spend (before the credit squeeze) over £500,000,000 a year in buying new motor-cars, but not more than £8,000,000 a year could be afforded to build roads for them to run on. That was only one illustration of very many. The whole cost of the drainage services did not amount to more than that of one or two cigarettes per head of the population per week, and yet the rivers could not be cleaned up. He did not know what the answer was. The Author had referred to the position with regard to the Thames. Sometimes Mr Townend thought that was the right way to produce results—to let the whole thing go until conditions were very bad, when people would really sit up and then decide to spend £20,000,000 or £30,000,000 in clearing up the mess.

Mr W. Fillingham Brown (Consulting Engineer) said that the Author, a chemist who had become an acknowledged authority on river pollution, had made it quite clear in §§ 8-14 that he was eminently fair and unbiased in his views on river pollution. He had put the whole position regarding pollution in relation to the needs of the community, both national and local, in the clearest and most straightforward way.

51. The Author's remarks on the present position of far too many sewage-treatment works in Great Britain were also most cogent and timely. Many such works were now so overloaded and in such need of modernization that they were incapable, however carefully operated, of producing an effluent that would not result in pollution of the river into which it was discharged. The longer the delay in bringing those works up to the standard required both in capacity and in ease and economy of operation the greater would be the cost eventually; in the meantime pollution continued.

52. In § 30 the Author had referred to the intermittent pollution of rivers by the practice of overflowing into them storm flows in excess of certain quantities, usually six times the mean dry-weather flow. He had suggested that much could be done at modest cost to minimize the effects of pollution by overflowing storm sewage, and Mr Fillingham Brown asked the Author what he had in mind. The maximum pollution was usually caused by the initial discharges when largely-undiluted sewage was displaced from the sewers by the following storm-water, and if such discharges could be kept in the sewerage system and the following diluted flows allowed to discharge to the river, far less pollution would occur; but it was not at all easy to achieve such a separation.

53. The Author had made a strong case for the discharge of all industrial wastes into the public sewers—and rightly so. The satisfactory treatment of most such wastes at the factory, to the standards required by river boards, would in most cases be impracticable and, in any event, expensive; and in some cases the only known method of purification was by admixture with domestic sewage. The Author, in referring to the discharge of such wastes into sewers, had made use of the qualifying phrase “under controlled conditions”—again quite rightly, since the uncontrolled discharge of many industrial wastes could have a disastrous effect on the operation of the sewage works. On the other hand, if they were controlled as to the rate of discharge, temperature, pH value, and certain constituents, particularly toxic substances restricted as to quantity, then most such wastes could readily be treated at the sewage works without detriment to the works themselves or to the treatment processes, and without danger to operating personnel.

54. With regard to the cost of treatment of industrial wastes, the Author had rightly inferred that manufacturers should regard such costs as a part of their own overheads. There was no more reason why manufacturers should expect to have water supplied to them free of charge than for them to expect that water to be removed after they had used it and be treated free of charge. In Mr Fillingham Brown's experience, however, when it had been explained to manufacturers what effects their wastes could have upon sewage treatment processes, and the relative cost of treatment in relation to domestic sewage, they generally had been prepared to accept the local authority's conditions and charges, especially if the latter had been shown to be the bare cost only, with no element of profit attached to them.

55. The Author had made a well argued plea for more co-operation between industrialists, planning authorities, sewage authorities, and river boards, and there was no doubt that such co-operation was needed in the very earliest stages if industrial development was to contribute its full share towards the continuing prosperity of Britain with an absolute minimum of pollution to her rivers. Only by such co-operation and the most careful planning could those two naturally opposed aims be made reasonably compatible.

Mr C. D. C. Braine (Consulting Engineer) said that ever since the Rivers (Prevention of Pollution) Act, 1951, had become law (as the Author had stated), the actions of one government department or another had consistently caused local authorities or industry to offend against the Act, and in effect the Author had merely asked the people concerned “Whither are you going?”

57. Undoubtedly the 1951 Act represented a great advance and it was a very useful Act to have on the Statute Book, but at the same time the withholding from local authorities for many years of the right to spend money on sewerage and sewage disposal was completely at variance with its intention.

58. Prescriptive rights permitted many industrial undertakings to cause grievous pollution in a manner which was completely against the spirit of the Act. He believed that most people considered that the sooner those rights disappeared the better it would be; but so far as sewerage and sewage disposal were concerned, it could not be denied that the great majority of works in the United Kingdom were becoming more and more inadequate and that most storm-water overflows now caused serious offence. Nevertheless, for years no money had been available to rectify those matters, and unfortunately there was now every indication that even less would be forthcoming in the immediate future.

59. It was a deplorable fact, as Mr Townend had put it, that £500,000,000 was spent on motorcars but only £8,000,000 on the roads, with the result that the roads were now getting into a hopeless state. Mr Braine observed that the same position was arising with regard to sewage disposal. It had been interesting to note that while the Bill for the prevention of river pollution had been in contemplation, Harwell had been located, presumably for administrative convenience, near Oxford, and its potentially dangerous wastes were discharged into the Thames. At about the same time a very

large gasworks had been planned nearby in which the disposal of effluent without offence would be almost impossible. The cooling-water from power stations often caused immense harm to the rivers into which it was discharged. All those plants were essential to the well-being of the country, but their location did not fit the pattern of the Act; hence the query "Whither are you going?"

60. It was obvious that there was a conflict of high policy which had not been resolved, and until it had been resolved that kind of anomaly would continue. Meanwhile, Mr Braine feared that the British people, with their usual empiricism and expediency, would have to put up with the situation until the Author and his followers had aroused public opinion to a sense of the real dangers of river pollution.

61. There had been a tendency to try to produce a single policy suitable for the whole country, but the facts showed that for the present it was scarcely practicable. Mr Braine felt that temporarily some river boards might have to accept the fact that their rivers were primarily industrial, particularly in the lower reaches, and that for years to come those boards might have to plan accordingly. For instance, the requirements on the upper reaches of some rivers with potential value as sources of water supply were entirely different from those in the case of, say, the River Mersey. Obviously the former rivers needed all the protection they could get so far as their headwaters were concerned, whereas the latter required less.

62. Mr Braine considered that the Author had been a little hard on the water engineer who had been faced with greatly increased demands for water from a dam which had hitherto been of sufficient size. It many cases dams could not be raised, and even if an additional dam were required for the proper exploitation of a stream, there was not always a suitable site available. Moreover, certain catchments could not now be fully exploited. In some cases a considerable reserve of water had to be held in a dam because one or more constituent authorities had a statutory right to a specific share of the water at any time, and although that reserve might not be used for many years, nevertheless the impounded water could not be released as compensation water or be discharged into the mains of some other distribution authority if it should be necessary.

63. Mr Braine fully agreed with the Author that a national water policy was required, but surely the Author did not think that it called for a nationalized water-supply system, as the Paper appeared to imply. However, even if a national water policy were decided upon, was there really any likelihood at present that the money would be available to implement it? Mr Braine doubted it. The bugbear of prescriptive rights would have to be dealt with, and that entailed further legislation and further money to make good the extra load on the disposal works. Since that money was not available, Mr Braine asked if the Author would agree that for the time being a piecemeal approach to the problem was advisable. It should be ensured that the upper reaches of all streams were kept clean and for the time being reluctantly accede to the pollution of certain streams as they approached the coast, for in any case they were mostly shockingly polluted at that stage. In present times of financial stress it might be better literally to abandon those streams so far as pollution was concerned, or at any rate the lower reaches of them, and to concentrate the available money on the upper reaches rather than try to do too much with too little, as was being attempted at present. It was surely more important to clean up, say, the Tame, the Rea, and the Goyt than to try to rescue the Mersey, the Tyne, and the Taff from their present plight. Mr Braine did not believe that view was defeatist; he believed that with the present financial shortage it was good tactics and practical engineering politics. The Government were encouraging the amalgamation of small water companies with larger ones on the grounds of economy, efficiency, and improved water supply. He felt sure that if the same policy were to be adopted in respect of sewage disposal, it would be a great step forward in the campaign for cleaner rivers which the Author had been waging for many years—and which it was to be hoped would be successful.

Mr J. T. Calvert (Consulting Engineer) stated that in § 40 the Author had said that it was almost certain that river boards would continue their efforts little daunted, but

that if, notwithstanding, the 1951 Act should become almost a dead-letter, the blame would not lie with them. If the Author had said that the blame would not lie "entirely" with them, Mr Calvert would have agreed, but he thought that the river boards might consider whether their attitude was not partly responsible for some of the deficiencies in the application of the Act. By that he meant that in many cases the river boards were asking for too much and were asking for it in the wrong place. He wished to mention three points.

65. First, with regard to the Royal Commission standard, the Author had stated in § 28: "It should not be forgotten that the Royal Commission standard presupposes at least an eight-fold dilution of the effluent by clean stream-water, and that where such dilution does not exist, a river board would be justified in calling for a significantly higher standard." Mr Calvert considered that the Royal Commission's statement was very much vaguer than that. The Royal Commission had actually said: "There are some exceptional cases in which, owing to the relatively small volume of the river-water, a more stringent standard than the normal will be called for." The Royal Commission went on to say (Mr Calvert was paraphrasing) that under those exceptional conditions each case had to be considered on its merits and that there might—the Royal Commission did not say that in all cases there must—be a case for a higher standard of effluent.

66. He asked the Author how he calculated an 8-to-1 dilution. It seemed that many river boards took the minimum stream flow and the peak winter flow of the sewage effluent and said that it must be 8 to 1—which to Mr Calvert was illogical. In the summer, when the river flow was low, a better effluent was obtained from a sewage-treatment works, and Mr Calvert thought it was wrong for a river board, because in certain conditions it did not get an 8-to-1 dilution, immediately to say that it wanted a better effluent and to lay down the standard applying, without considering the case on its merits. The standard should be determined by the requirements of the river, particularly from the point of view of nuisance, biological condition, and its future use.

67. Secondly, Mr Calvert referred to the river boards' attitude to industrial effluents. He thought everybody would agree that it was better to have the industrial effluents in the sewage works. His experience certainly was that that led to better river conditions. But he knew of some river boards which had taken the attitude that the trade effluent could be put into the sewer and the river board need give it not another thought. That entailed a large increase in the load on the treatment works but the river board rarely gave sympathetic consideration to the consequent deterioration of the effluent. He knew of one case where there had been an unsuitable trade effluent going into a stream but which had been just as unsuitable for a sewage works because of its acidity and enormous pollution load. He thought that if the river board had applied some coercion to the industrialists to pre-treat that effluent so that it was suitable to go into the sewers, it would immediately have achieved an improvement in the condition of the stream and then the local authority could have accepted it without unreasonable harm being done. But river boards seemed to be a little afraid to attack industrialists; they said, "Get it into the sewers and then we can go for the local authority, who are only spending the ratepayers' money."

68. Mr Calvert's third point was on finance. On presenting a scheme to a river board it would say, "Put in more humus tanks; put in more filters"; when it was protested that that was unnecessary it was implied that there was no regard for a clean river. There was only a certain amount of money available, and the question was where it could best be spent. Removing an additional 1% or 2% from an effluent already 98% purified was very expensive, and he thought that in many cases the same amount of money could be better spent in increasing the purification from 90% to 95% in a different place. He had sometimes wondered whether, if the pollution authorities, the river boards, were also executive authorities and had the money to spend (as was the case with some German river boards), they would actually spend the money on the works which, under the present arrangement, they demanded.

69. The fact that some river boards could be quite reasonable was shown by an inter-

view Mr Calvert had recently had with one of the boards about an extremely difficult effluent. The river inspector had finished by saying that he would like to see some experimental work carried out before a lot of money was spent on a scheme which might not work. Mr Calvert believed that to be the right attitude which encouraged co-operation between the river boards and the local authorities and made for the ultimate improvement of the quality of rivers and streams.

Mr L. B. Escritt (Principal Assistant (Professional) Chief Engineer's Department, London County Council) said that a private sample survey had shown that, whereas most large towns in Great Britain had almost complete sewerage, most of them had overloaded sewerage works, and most rural areas had both inadequate sewerage and inadequate sewage treatment. When there was added to that the trade effluents it was obvious that rivers must be polluted to a much greater extent than was desirable.

71. Mr Calvert had already dealt with one of the points that he had intended to raise, namely, the reference to the Royal Commission standard in § 28. As Mr Calvert had said, the Royal Commission standard had been vaguely stated, but it had been stated that a dilution of 8 to 1 was normally desirable. However, the subsequent practice that had been followed throughout Britain had been to neglect dilution and in many places Royal Commission effluents had been produced where the dilution was much greater than 8 to 1, and there were other places where no better than a Royal Commission effluent had been aimed at, although the stream consisted of 100% effluent. That was not altogether illogical, because the dilution of a particular discharge did not take into account all the other discharges into the same stream. There might be one sewage works discharging a large quantity and being permitted to have the Royal Commission effluent because its discharge had an 8-to-1 dilution, whereas if there were fifty small discharges they would all be considered individually negligible but together could discharge a large quantity of much cruder effluent. One had to consider the standard of an effluent with regard to the stream, and there Mr Escritt said he foresaw trouble.

72. River authorities would be considering what standard of effluent they should permit, and different circumstances would call for different standards. The result would be that engineers would be called on to design works for all manner of standards of effluents, which would be difficult, even with the improving knowledge of how to relate strength of sewage to treatment works. Anything in the nature of a statutory effluent would be, he thought, dangerous; but, on the other hand, even from the point of view of the sewerage authority, there should be some protection against the purely legal interpretation of pollution and there should be some standard of effluent which in normal circumstances should be considered as not amounting to pollution. On that question he said that the time had come for the experts to get together and to sort out the problem before it became one of urgency. He asked the Author for his views on that point.

73. The pollution of rivers by effluents discharged directly into the stream or other visible and obvious pollution was what was generally considered. But pollution of both rivers and water supplies could come from other less obvious sources. Any polluting effluent discharged on to the ground must eventually find its way to natural waters. For example, the contents of a soak pit which took the discharge from a factory or domestic premises soaked into the ground, and would have to go somewhere—either into a water supply, a river, or less likely, directly into the sea. Was it not desirable that all discharges should be controlled? Water authorities had their protected areas, but there were unprotected areas; river authorities could protect their streams against visible discharges, but could do nothing about the pollution under the ground.

74. Mr Escritt then referred to § 30, which related to the present standards regarding storm-water overflows. Although he had been designing sewage works for more than 30 years, he was not quite sure what, if any, was the accepted standard of storm-water treatment or disposal. The Royal Commission had referred to a discharge at storm overflows of flows exceeding six times dry-weather flow, and at one time that rule had been followed rather closely—now it was obsolescent. The Royal Commission had also said that there should not be overflows for untreated storm-water at sewage works; that had

been neglected by many. He thought that the Ministry of Health and the Ministry of Housing and Local Government had tried to raise the standards relating to storm-water disposal but they had never published any specific requirements.

75. Generally speaking, he did not think there was any justification for the construction of storm-water overflows for the discharge of crude sewage from any sewerage system other than old existing systems which could not be rendered adequate except at prohibitive cost. Any new sewerage system must be designed to accommodate, without surcharge, the heaviest storm liable to occur once a year. As to treatment of storm-water, the Royal Commission had recommended a stand-by tank capacity of 6 hours' dry-weather flow, which in many instances meant inadequate settlement. However, it appeared impracticable to suggest a definite figure for capacity. The storage in stand-by tanks, of all the storm-water likely to be discharged once a year would, in the average case of a combined system, require tanks capable of storing in the region of $3\frac{1}{2}$ days' dry-weather flow which might be considered impracticable for general application.

Mr H. D. Manning said that the Author's suggestion that there should be a Minister of Water Resources was unlikely to be accepted by any Government in the immediate future. The crux of the whole matter was the money which the Government was prepared to allocate and how it could be contrived that that money was spent in the most effective way. He wondered whether the Government might be persuaded to set up an advisory committee in each watershed representing the various interests—the industrialists, the local authorities, the river boards, the water-supply authorities, and so forth. At the present time there was no one at all who controlled expenditure. If a learned judge decided that money should be spent in "this or that" area in where the fish had died then there it must be spent and nobody seemed to be able to stop it being spent there, even though the people who knew something about it knew that it would be more advantageously spent elsewhere.

77. The suggestion he had in mind was that the Government could allocate the money as between catchments and then the committees which he had suggested might be set up should control the expenditure of the money within their own catchments to the greatest advantage of the catchments and the rivers in them. If that were done, he thought it might be possible to get a little better value for the expenditure than at the present time.

78. Finally Mr Manning referred to § 26 and deprecated the Author's implication that those responsible for design or research work had applied their discoveries to treating larger volumes of sewage more economically rather than to raising the standards of effluents. Mr Calvert had made the point, which he would certainly endorse, that the money could probably be much better spent, when it was limited in quantity, on the treating of large quantities to a reasonable standard than on refining already tolerably good effluents.

Mr W. F. Lester (Pollution and Fishery Officer, Kent River Board) said that he supported the Author's campaign for cleaner rivers. The feeling had been expressed that if there was not enough money available then the worst cases of pollution should be dealt with first. But if it was only a question of the cost of another cigarette per person per week he was of the opinion that there should be enough money made available. To say that could not be so was defeatism.

80. He proposed to deal mainly with the question of compensation water. Pollution resulted when the quantity of pollutant going into the stream was more than could be dealt with by the natural dilution available in the stream. In the past there had been financial limitations on improving the quality of polluting discharges, and the amount of dilution available had also been severely curtailed. In § 21 the Author had outlined the normal system for calculating compensation water, and had then inferred that the amount to be returned to a stream, if calculated to be 1,000,000 gal/day, was discharged to the stream at the same rate winter and summer alike. In a case in the Kent River Board

area, a water undertaking discharged its 1,000,000 gal/day not at the same rate throughout the year, but from May to November at the rate of 1,200,000 gal/day and at the rate of 800,000 gal/day for the remainder of the year. That was a step in the right direction, the water being much more valuable from the point of view of diluting the sewage and trade effluents during the summer months than in the winter. Did the Author agree with that view?

81. Reference had already been made to the cost of constructing impounding reservoirs. When a water-supply engineer wanted an additional supply of water, he did not think about impounding reservoirs and feeding compensation water to the river—certainly not in the south-east of England, at any rate. He looked for a likely valley and decided where he could best put down a borehole, denying representations by river boards and riparian owners, that the abstraction of water from the borehole would lessen the flow in the stream. A year or two after the borehole had been in operation, invariably the stream was dry or the rate of flow during the summer months was very much diminished. He asked for the Author's view on the equity of requiring the water-supply undertaking to feed some of the water it had pumped from the borehole to the stream when the rate of flow at the stream fell below a certain minimum. That might seem a revolutionary suggestion, although again, in the case of a relatively small stream in his board's area, a water undertaking did in fact discharge water into the stream when the rate of flow fell below a certain minimum. Mr Lester thought that there was no fundamental difference between taking the water from an impounding reservoir and from a borehole; in both cases the stream should be compensated when the rate of flow fell below a predetermined minimum.

Mr R. C. S. Walters (Partner, Herbert Lapworth Partners, Consulting Engineers) asked the Author whether he agreed that impounding reservoirs generally were useful providing that the river could get compensation water, and what were the Author's views on the proportion of compensation water compared with the dry-weather flow? Mr Lester's remark that boreholes were inclined to pump water which would ultimately go into the river depended on what storage there was underground. Pumping from underground was in a way just like pumping from a reservoir. If the reservoir was sufficiently large, pumping from it might not affect the river at all, or at any rate only to a negligible extent; but if the storage underground was small, then it might affect the river flow. If the strata were the same as that underground and there was not a blanket of clay, then it might affect a small river quite a lot. Where there was a large underground gathering ground, then it was just like pumping from a reservoir, and it would not necessarily affect the river for a considerable time. Every case should be treated on its merits.

The Chairman asked if the Author could express the proper quantity of compensation water in terms of the dry-weather flow.

The Author, in reply, dealt first with those comments relating to the utilization of water resources. Mr Townend's point about sewage effluent sometimes being useful to water undertakings provided one example of the need for a comprehensive policy for water conservation. Other comments by Mr Townend and subsequent speakers served to emphasize that need.

85. Controversies, such as that which had recently arisen in Wales about water abstraction, would probably be a good deal less bitter if such schemes were formulated as part of a national water policy. It had never been considered that the consumption of commodities such as coal or grain should be restricted to the areas in which they were produced, and it might well be argued that there was every justification for making use of Britain's water resources in the way that would best serve the nation's needs, and that did not necessarily mean that such usage should be restricted to a particular locality or to a particular water undertaking. Unlike coal and grain, for example, water was the only commodity for which there was no available alternative.

86. A very strong case could be made for the nationalization of water, which, in that

connexion, was almost synonymous with *all the water in all rivers and streams* (though not necessarily including their banks and beds). Under present conditions of riparian rights, it was theoretically possible in Britain for the whole of the water in a river system to be at the disposal of one person (or syndicate), a state of affairs which might well be contrary to the national interest. At the same time the Author felt he should make it quite clear that by the nationalization of water resources he did not mean the nationalization of water *undertakings*. He was neither advocating nor opposing the adoption of that measure, though it might be that the juxtaposition of the terms "nationalization" and "national water policy" in §§ 22 and 23 had given a contrary impression. There could be a national policy for the railways, which were nationalized; there could equally well be a national policy for agriculture, which was not nationalized. The Author's emphasis had been on the need for a national water policy, not on the need for nationalization. Neither was the Author criticizing water engineers who, he was sure, would welcome the opportunity of building bigger and better reservoirs if financial considerations permitted. Other public utilities were being encouraged to expand to meet increasing demands, and were given the necessary facilities. How then could water supply be expected to meet increased demand without corresponding expansion? At the same time it would appear that in some instances, better use could be made of potential storage capacity by the systematic removal of accumulated silt, or by the adoption of measures directed towards minimizing the inflow of silt. In one instance recently in which application had been made for authorization to reduce compensation water it was stated that although there appeared to be a considerable depth of water remaining in the reservoir the actual depth was comparatively small because of siltation.

87. The Chairman and Mr Walters had asked what was the proper quantity of compensation water in relation to the dry weather flow. The Author did not think dry weather flow was a suitable basis in itself. It had to be remembered that the impounding of water deprived the stream of minor freshets which were often of great value to it, and that the substitution of a more consistent flow was part of the "compensation" for that. It was, of course, true that compensation water helped the stream when it most needed it (provided a temporary reduction was not in force), and also that impounding gave some measure of flood control. The Author thought that the hitherto accepted basis for the assessment of compensation water was a reasonable one if it took full account of local conditions, though he would agree with Mr Lester that there might well be good grounds for variation, seasonal or otherwise, in accordance with the actual need at any time. It was not true conservation to discharge compensation water when it conferred no benefit, and although there might be difficulties in devising an acceptable system of control, such difficulties were not insuperable. The decisions might, for instance, be placed in the hands of a duly appointed regional water controller, or of a responsible officer of the river board. Doubtless a Minister for Water Resources would give such matters due consideration!

88. Dealing next with sewage and industrial effluents, the Author said he was glad to have Mr Townend's support for the views expressed in the Paper, and it was a matter for regret that the former practice for engineers to circulate from the operational side to the design side was dying out. As regards Mr Calvert's criticisms of river boards, the Author could only speak for his own board, against which, as he would try to demonstrate, such criticisms could not fairly be levelled. It so happened that that board had the benefit of a tradition of reasonableness and co-operation which had been built up during more than 50 years before the passing of the River Boards Act, 1948; a tradition which owed a great deal to Mr Calvert's father, Dr H. T. Calvert.

89. The Author felt that both he and Mr Calvert had attempted the impossible in trying to summarize the Royal Commission's views in a sentence or two, and that had led to some confusion. The Royal Commission considered that streams might appropriately be classified as follows:—

	B.O.D.
Very clean	1 p.p.m.
Clean	2 p.p.m.

	B.O.D.
Fairly clean	3 p.p.m.
Doubtful	5 p.p.m.
Bad	10 p.p.m.

and that the B.O.D. of a "satisfactory" sewage effluent should not exceed 20 p.p.m. (For the sake of argument it might perhaps be observed that a sewage effluent of Royal Commission standard was still only equivalent to a "doubly bad" stream water!). The Commission considered that the average quality of streams under ordinary conditions should be "clean" (B.O.D. 2 p.p.m.), and that for the avoidance of nuisance the B.O.D. should not fall below 4 p.p.m., which in fact it termed the "limiting figure". From those considerations the Commission calculated by simple proportion that the minimum degree of dilution required for an effluent of B.O.D. 20 p.p.m. discharging to a stream of B.O.D. 2 p.p.m. was 8.

90. Having regard to conditions which it had investigated the Commission thought it might safely be assumed that the great majority of sewage effluents would be diluted by more than eight times their volume of stream water. Unfortunately in many populous areas of England that was no longer true, and in some instances the dilution afforded to the discharge from a single sewage works under normal weather conditions was less than two-fold and in a few instances was only fractional.

91. It was also important to recognize that where there was a chain of towns in a single river valley, although there might be an 8-fold dilution for the effluent from the uppermost sewage works, it did not always happen that the river had recovered (by self-purification agencies) to the postulated "clean" condition before it received further discharges of sewage effluent, so that the mere presence of even an 8-fold dilution at the point of discharge of a sewage effluent did not necessarily meet the conditions the Commission had in mind. In the River Calder (West Riding) the proportion of "used" water (sewage and industrial effluent, exclusive of usage of river water at electricity-generating stations), amounted to 60% of the total flow in normal dry weather conditions (not drought). (If the use of river water by generating stations was taken into account, the usage was not even limited to 100%, but might well be at least 200% or 300%.) Under such conditions, even assuming that all effluents were of Royal Commission standard, the river would be little better than a good quality effluent, and thus not as good as a "bad" river. To meet such conditions, the Commission recognized the possible need of what they called "specially stringent standards". At the same time it emphasized the need to place reliance "on the uniform enforcement of the appropriate standards in the higher reaches" of rivers. Neither should it be overlooked that the Commission considered that the "normal" standard (B.O.D. 20 p.p.m.) should apply when the dilution available by "clean" river water was between 8 and 150 times the volume of the effluent, and also *that it should be the aim of the river authority to ensure that the B.O.D. of the river water immediately below the first point of pollution did not exceed 4 p.p.m. and that it should not exceed 2 p.p.m. immediately above the second point* (see Royal Commission on Sewage Disposal, 8th Report, vol. I, § 32).

92. The general policy of the Author's board was to secure the attainment of the Royal Commission standard more or less throughout the streams under its jurisdiction, and when that had been attained, to review the position to see whether higher standards were called for in particular instances. That attitude seemed a realistic one, particularly as it was generally accepted that the attainment of the Royal Commission Standard was neither difficult nor unduly costly; at any rate where domestic sewage was concerned.

93. It had never been the board's policy to get trade effluents into the sewer and then ignore any problems which might result therefrom. For example, in the case of a local authority which had a major trade effluent problem, there had been the fullest and frankest discussions, not as to the plant that would be necessary to guarantee the production of an effluent of Royal Commission standard, but as to what it would be reasonably practicable to attempt to achieve. Complete agreement had been reached and a scheme

had been devised which the board had accepted, without asking for any guarantee of a Royal Commission effluent.

94. The Author was frequently placed in the somewhat invidious position of being asked to advise both sides, local authority and trader, not only as to what was reasonable and practicable, but also what basis of charge would be equitable. Since such requests might well arise in any particular instance where possible discharges of trade effluent to sewer was envisaged, due consideration was essential, particularly as the sole responsibility for the advice given rested with the officer, not his board.

95. With regard to Mr Calvert's third point, the Author's board favoured preliminary experimentation, provided the intention was genuine and not just a mask for procrastination. In several instances, the Author had not only assisted in the design of the experimental plant, but, with the board's approval, had agreed to exercise a measure of supervision and to arrange for the analysis of samples. Moreover, in all cases where advice and assistance were given, it was done without any charge whatever to the local authority or trader. The Board was also prepared, where appropriate, to await results before pressing for the installation of additional plant.

96. For those reasons amongst others (so far as his board were concerned) the Author's categorical reply to Mr Calvert's query that if river boards were the executive authorities, would they in fact spend the money on works which under present arrangements they pressed for, was thus unreservedly in the affirmative!

97. The Author agreed with Mr Fillingham Brown that the worst pollution by storm-water sewage was caused by the initial stages of discharge, and for that reason everything possible should be done to ensure that overflows did not operate sooner than was necessary. Increasing the settings of overflows by even 2 d.w.f. (e.g., from 6 d.w.f. to 8 d.w.f.) would result in the complete elimination of numerous discharges of grossly polluting sewage. In many instances there was no reason why, with only minor alteration to conventional treatment plant, the flow to receive full treatment should not be 4 d.w.f. instead of 3 d.w.f., and the flow to be passed through conventional storm tanks a further 4 d.w.f. instead of a further 3 d.w.f. Nevertheless, the Author had until recently had great difficulty in persuading consulting engineers (and sometimes the Ministry) that that was sometimes an eminently practicable proposition entailing virtually no extra cost. (In the foregoing the Author had used multiples of d.w.f. for convenience. Since potential pollution by domestic sewage was a *per capita* function, he did not accept d.w.f. as a logical basis unless it referred to a "standard dry weather flow" of, say, 40 gallons per head per day.)

98. Mr Escritt would be interested to know that it had long been the policy of the Yorkshire Ouse River Board to ask for the most careful consideration to be given to the possibility of adopting the separate system for all new schemes of sewerage. He had stated that the setting of storm-water overflows at 6 d.w.f. was obsolescent. The Author hoped that was indeed the case, yet his board had recently been asked to approve settings of about 1 in. above the invert of 6-in. sewers, merely because that was the calculated depth of flow in the sewer at 6 d.w.f. The board had also been asked to approve an overflow controlled by a flume with a 3-in. throat. Those who devised overflows on such bases were surely ignorant even of the fundamental characteristics of crude sewage and of the fundamental principles of overflow design. Much could be achieved by ensuring that where the provision of storm-water overflows on sewers was considered unavoidable, the overflows were of the best possible design. The Author preferred to express no opinion as to whether they should be of the side-weir or siphon type!

99. There was much to be said for the sort of consultation to which Mr Manning had referred, but the Author saw no reason why a competent river board should not be capable of assessing priority needs, difficult as that sometimes was. The Author thought Mr Manning had read into § 26 a criticism which was not there. The research teams provided the information—they did not decide how it should be applied. Unfortunately neither water engineers nor sewage engineers were given a free hand, and were largely compelled to devise the cheapest scheme rather than the best scheme. The Author was confident

that, given the chance, consulting engineers would welcome the opportunity of designing works which were capable of producing effluents of improved qualities.

100. Much had been said about the financial implications of the campaign for cleaner rivers. The Author's final comment was that the 1951 Act made no provision for the abandonment of certain streams; that the duty placed on river boards of administering the Act was a statutory one; and that as the nation had willed the Act, the nation must therefore will the means to implement it.
