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FISHERIES IN A CHANGING SCENE

by

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"The past is but the beginning of a beginning and all that is or has been is but the twilight of the Dawn".

— H. G. WELLS

Momentous trends are developing in the area of the Lancashire River Authority which will, by the turn of the century, bring tremendous pressures to bear on its natural resources, particularly land and water. A greatly increased population will be living in a shrunken countryside and competing for a share of the environment with the needs of growing industrial development; in addition, motorways will be effecting the influx of ever larger masses of people seeking facilities for leisure, provision of which will bring about still further strain. Rivers in the area already providing water both for consumption in industrial cities and leisure for their populations will be expected to provide more in the future. What changes have the indigenous fish specie of surviving man's continuing encroachment on their natural element ?

It will not, of course, be the first time that the area has been subject to a rape of the environment—parts of Lancashire were among the first to experience the ravages of the Industrial Revolution. 182 years ago, Martin's "Natural History of England, 1785," said " The Mersey greatly abounds with Salmon which in Spring strive to ascend the arm of the sea and with difficulty evade the nets of the fishermen before they reach Warrington Bridge. Here the river becomes narrower and there the landowners, having an exclusive right of fishery, each proprietor by his agent catches Salmon amounting annually to upwards of £1,000. By their capture the towns of Warrington, Manchester and Stockport are well supplied, and the overplus is either sent to London by the Stages or carried on Horseback to Birmingham or other inland towns." Today, after years of intensive restorative work by Dr. Klein and others, the Mersey is supporting a small head of coarse fish, but will the salmon ever return ? The same "Natural History" also records that the River Ribble, only fifteen miles away from where we are today, produce extremely high salmon catches varying according to the seasons. In 1871 this river produced 10,412 salmon—in 1965 the total catch was 745, but the catches are improving. Much of this decline has been brought about by environmental change, e.g. pollution and water abstraction. Must the River Lune, which has the second highest catch of salmon in England and Wales, and the rivers of the Lake District also deteriorate ? Is the progress being made in removing the abuses of the past to be hampered by the ever increasing demands of the present and future ?

Let us examine in detail some aspects of the changing scene in this area as it affects fisheries. A basic problem, as I see it, will be, in the coming years, the maintenance of an environment suitable for all, whether human or otherwise. In every natural situation the environment affects the organisms present and vice versa. The biologist is concerned with establishing reasons for the presence

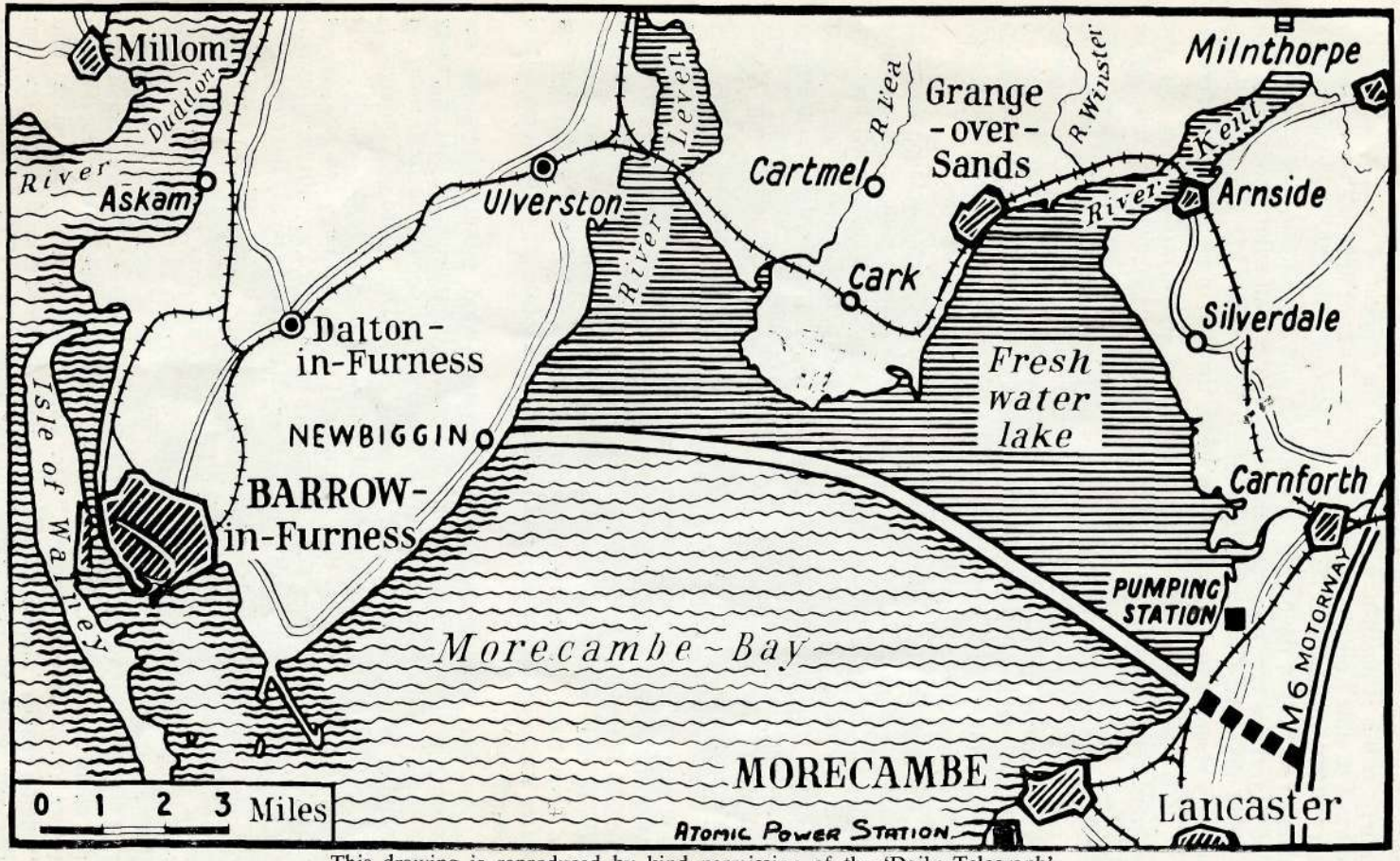
of organisms in a particular environment and their relationship to it; the (political) layman, on the other hand, is more concerned with the economic and social effects of change upon the environment, with particular emphasis on the needs of the human population. Let us explore in this paper a few factors which are likely to change the character of the area.

Within the next five to ten years, two of the largest Atomic Energy Stations in the world are likely to be constructed. One will be at Heysham, about two miles from here, and will have a capacity of two and a half million kilowatts comprising four advanced gas cooled reactors with associated turbines and ancillary equipment. This station will be sited near the main seaward channel of the River Lune and is likely to use 1,000 million gallons of sea water per day for cooling purposes. The water leaving the power plant by tunnel into Heysham lake is likely to add 23 degrees farenheit to the sea temperature on immediate discharge. These high temperatures may affect sea fisheries as well as migratory fisheries. It is probable that large and somewhat complicated fishery works will be necessary. The second station is likely to be sited south of Preston near the River Douglas and will involve the abstraction of a large quantity of water from an already polluted river and the temperature tolerances of the returned water from the cooling towers will again require careful control. The daily loss to the river is likely to be about 15 million gallons a day. The improvements secured in removing pollution from this river must not be allowed to deteriorate as a result of the power station being sited thereon, and especially is this so as this river, with care, can once again develop as a fishery.

Concurrent with the increasing populations of existing towns and villages in the area, there are plans for further new towns. At Skelmersdale, south of Preston, a new town is already in the process of development for a population of 150,000 and further large scale development plans are proposed for the Morecambe area. In addition to the obvious pressures that an increase in population brings to bear on natural resources, building on this scale, by waterproofing the land, brings about changes in the environment, as does the submerging of land by water as in the Morecambe Bay scheme. Are we giving sufficient attention to assessing these changes in the environment which must not only support the population of today but the greatly increased population of tomorrow ?

The scheme to harness the waters of Morecambe Bay is a case in point. The illustration of the proposed Morecambe Bay Barrage shows the extent of a project which is likely to effect a considerable change of scene in the area. The rivers flowing into the basin formed by the barrier will comprise the River Leven, flowing from Windermere, the River Crake from Coniston, the Rivers Kent and Keer and a number of minor tributaries. This mass of impounded water will cover approximately thirty square miles. The scheme at present envisaged is likely to secure a future major supply unit for the North West, and possibly in addition the North East of England.

What fishery advantages and disadvantages arise from such a scheme, should the project become practicable from an engineering aspect? First the disadvantages. The sea fisheries and habitat of whitebait and the famous shrimp will both be restricted in area—the latter severely so—affecting productivity, whilst at the same time, the environment will be undergoing serious biological changes behind the barrier. The licensed salmon netsmen will no longer be able to ply their skill with Lave or Stake nets in the estuary and a time-honoured



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occupation will become extinct. Maintenance of the habitat as a migratory fishery, if this is possible, will depend on the amount of water which can be allowed to flow from the barrage out to the seaward limit and on whether or not it will be possible to establish and maintain a suitably sized and formed channel seaward of the barrier for upstream and downstream migration. These two factors are very important, especially as the spates and floods from this part of the Lake District will not always be available for keeping open the seaward channels on which, in my opinion, the runs of migratory fish depend.

It is essential to carry out thorough and urgent investigations into the seaward and inshore migration of fish in the estuaries involved and this may be achieved by tagging some of them with radio-active tags for tracing their estuarine movements. An objection may be raised here that it will be difficult to trap or net salmon in sufficient numbers for this purpose, but echo soundings already taken in the Bay have revealed shoals of fish in the deeper channels off Heysham and the outlying areas of Fleetwood and it should not be impracticable for some of these to be captured. The same sytem can be applied to smolts also, but in neither case can operations be carried out on a shoestring.

We know that tidal surveys will be made; little change has taken place over the last half-century, but a bay barrage will probably result in the complete silting-up of many of the existing channels, with large expanses left high and dry at low tides. Thus, the problems of quantity, timing and siting of water discharges from the barrage for the formation of a seaward-going migratory fish channel is not an easy—or inexpensive—question to answer. A pre-requisite of the planning of such works must be, therefore, full fishery instrumentation on the rivers concerned so that some assessment of stock and their value may be carried out. The River Leven, as many are aware, already has a full range of electric instruments recording upstream movements of salmon and sea trout, and a similar installation is projected for the River Kent; a site has been selected for an installation on the same lines on the River Crake and some work is proceeding. Simple counting arrangements will be required on the River Keer and perhaps the other minor tributaries. It is hoped that the Water Resources Board may find itself able to allocate grants for some of this research work.

Another problem has to be answered—what salinity tolerances are necessary for inshore migratory fish movement? It has been said that migratory fish come in with flood tides, stay in estuaries, and move into fresh water on ebb tides. In December 1884 at a meeting of the Dee Board of Conservators held in Chester, three interesting but varied views were expressed, viz:— (1) salmon run with the flood tide, (2) they rest during the flood tide and run up with the ebb, and (3) they allow themselves to be carried up with the stream of the flood tide with their heads pointing towards the sea. As far as (3) is concerned, this is a phenomenon that I have neither heard of before nor had experience of—perhaps it explains the origin of "tail-races"! (Certainly, in the unlikely event of this observation of over eighty years ago ever being proved to be correct, then any fish pass in the barrier will have to be constructed to enable the fish to go through tail first . . . . . and a lot of fishery thought revised!) In 1799, in "The Art of Angling", Dr. Brookes observed, "where salmon have not dams to stop them, they will change the salt for fresh water several times before ascending into the river." Dr. Bunter, in the same book, states that "salmon change from salt to fresh water and vice versa several times a year, but this only occurs in rivers falling into the Moray Firth." There were as many

differences of opinion in the past, regarding fish migration, as there are today, and it is easy to see why water and civil engineers, with their exact sciences, look upon "Fishery Types" with some scepticism. But, for centuries, the human eye was almost the only means available for the gathering of fishery information and it is only in recent years that improved electronic techniques have led to reliable fish monitoring devices, When such aids to fish husbandry are in general use, then the precise pattern of fish migration in individual rivers will become clear, and the stock held in the rivers known.

No matter what the difficulties of the Morecambe Bay scheme are—and they are many—I feel that a number of pertinent questions will require answers before the migratory fisheries of the area can be secured. In my view, it should not be beyond the ingenuity of man to obtain a balance between the salmon and sea trout and his appropriation of their environment for his own use.

The advantages of the Morecambe Bay scheme, where leisure activities are concerned, are many, for this vast expanse of water and its surrounding area could support yachting, boating, canoeing, camping and fishing, though not necessarily selective fishing for migratory fish. It is likely that the water, by its very composition and the nature of the environment, could develop into an extremely good coarse fishery. It might well be that an eel fishery could be established; the impounds of Holland (Zuider Zee), which debar sea fish normal access to their former habitat and environment, have produced an extensive eel fishery which supplies large quantities of food with high nutritional value, and this might apply in the bay scheme, although the known elver runs are not very large. Whether the area develops as a commercial fishery or as a national playground, (which is more likely) more opportunities for fishing will be available to the angler than is the case at present and this must surely be to the good.

There will be many other biological problems to be overcome in the scheme, amongst which may be extensive fly breeding, weed growths and decaying vegetation odours, but the advantages of the building of the barrage may well outweigh the disadvantages.

What about the immediate future and the pressures which may be exerted until the barrier is completed? In this direction our thoughts must centre on the River Lune. It is unfortunate that this river may have to be one of the major sources of supply of water. From this river Lancashire obtained its name and it is the only unspoilt major salmon and sea trout river in the whole of Lancashire. The monetary value of its fisheries has increased enormously over the last five or six years and now stretches of fishing can command a purchase price of anything up to £15,000 to £20,000 per bank mile. The average daily flow down this river is approximately 700 million gallons and so it is reasonable to suppose that some water can be made available for domestic consumption and industrial use. The question is, when and how much can be taken without harming the river? Clearly, the amount of water which can be spared must depend upon seasonal availability and hydrological surveys will show that a large quantity may be taken into storage between October and March when fisheries do not require high flows.

"Demands" of water in the region of 100 and even 150 million gallons per day before the century is out will not be improbable. Schemes have been

publicised whereby the headwaters of the Lune may be tapped, bringing into use pump storage reservoirs, and if these come into being, then storage water will be liberated down the river as a strictly regulated flow, subsequently to be taken into supply near its mouth. Whether or not flood water can be taken from a river and be stored quickly enough and in sufficient quantity is problematic, but if the salmon fisheries of this last unspoilt Lancashire river are to be preserved, a great many more facts will be needed. But is there time? Time is running out and it is likely that the threat of direct intakes will become reality before such regulation works can be completed. Even after completion, it is doubtful whether the amount of water released down a regulated river, with the major quantity being abstracted at its mouth, will leave sufficient volume in that river to induce fish to come in from the estuary. The responsibility for ensuring adequate prescribed flows after regulation and the *residual flows after abstractions has been placed fairly and squarely on River Authorities and they must accept this duty and apply it to fisheries as part of their statutory functions.*

Present knowledge indicates that artificial freshets are usually of small quantity and have little or no effect in maintaining fisheries, although they have some limited value when used as a factor for temperature regulation. A measure of security can be given to migratory fish only when freshets are large in volume, last for several hours and are timed to reach an estuary when the tide is at flood so that the added river water will be carried out seawards as quickly as possible; this is especially the case where regulated rivers have major abstractions occuring near an estuary. Here again, more investigation is required before definite conclusions can be drawn and this is where the regulation of the River Dee at Chester can, if a scheme is brought into operation as quickly as possible, give answers to some of the problems. It is known that the Water Resources Board are desirous of carrying out major investigations and it is to be hoped that the difficulties of this particular project will not impede progress.

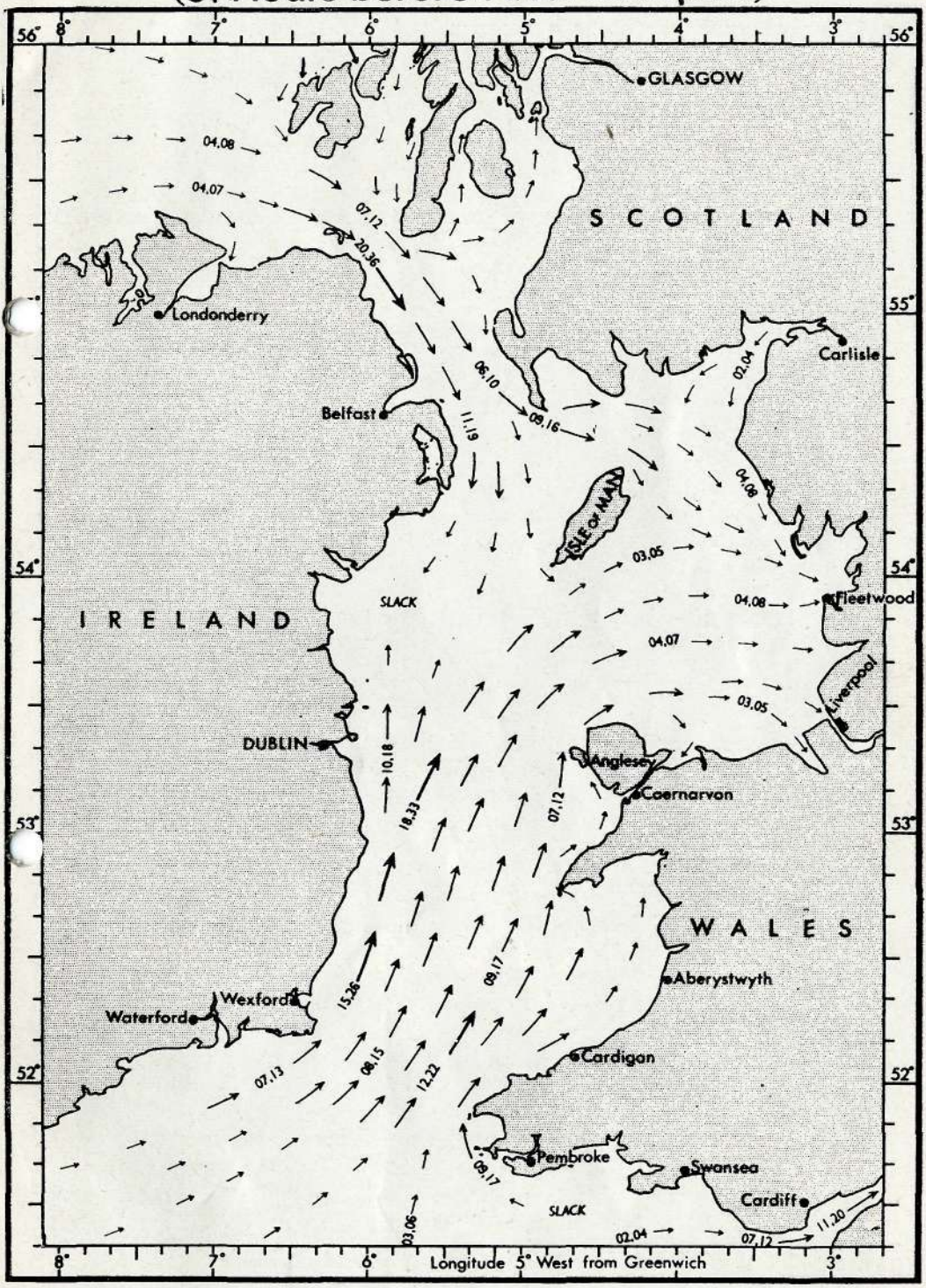
So much for man's interference with nature. Pasteur once said, "All living things in the environment cause death, but death produces the environment." Death of migratory fish in their environment has posed a serious problem since October 1966, with the recurrence in this area of a fish disease of epidemic proportions. The present outbreak has been blamed on the Irish Rivers, though there is no substantive proof, and the tidal flows show the influences affecting Fleetwood, Morecambe Bay and Carlisle.

The charts show a remarkably true flow from the Southern Irish coast to the Lune and from the Northern Irish coast (i.e. Foyle and Bush, infected in July) to the Solway.

These charts might raise the question as to whether the disease could possibly have emanated from Fleetwood, with its daily intakes of large quantities of different types of fish (a question to which most of the delegates, I am sure, would answer in the negative!). Epidemics do occur in sea fish and a review of the diseases affecting them could be undertaken to some advantage.

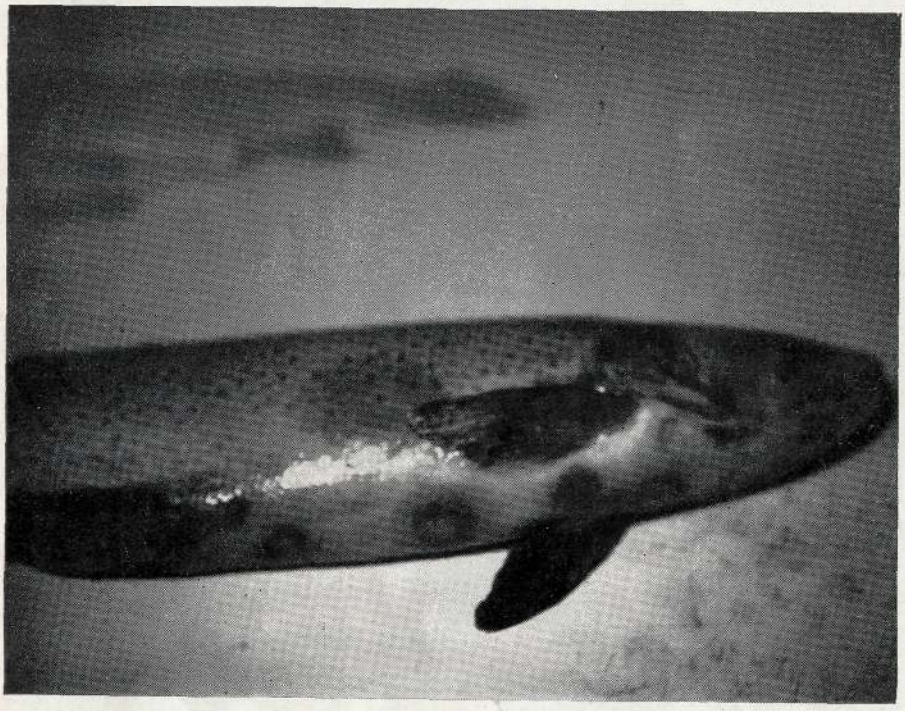
Before examining the present outbreak, it may be pertinent here to look first at the outbreak in this area of just under one hundred years ago. In the findings of the Salmon Disease Commission of the 2nd August 1880, the fish examined then showed similar symptoms to those in the present outbreak. In an endeavour to find the cause of disease, the Salmon Disease Commissioners

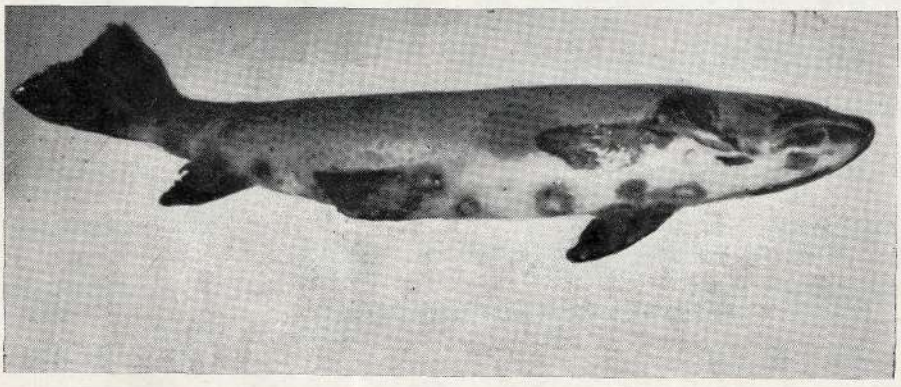
5 HOURS BEFORE H.W. AT DOVER
(5¼ Hours before H.W. Liverpool)



5 HOURS AFTER H.W. AT DOVER
(4¾ Hours after H.W. Liverpool)

held enquiries at Annan, Ayre, Berwick, Carlisle, Cornhill, Dumfries, Edinburgh, Girvan, Kelso, Keswick, Kircudbright, Lancaster, Melrose and Newton Stewart. They recorded that William Irvin, a river watcher to the Keswick Angling Association, saw the disease in salmon and sea trout for the first time in 1876. James Gornall, a river watcher on the River Lune, said he had seen the disease since 1873, whilst William Seed, a river watcher on the same river, stated that the disease began to arrive about 1860. Captain B. J. Jackson of Keswick, said in evidence that he had removed from the River Eamont a number of salmon which were quite blind. John Harker of Lancaster, then Medical Officer of Health, gave evidence, and, on being examined regarding the ulcers found on fish, stated that if a skin disease broke out in people, he would look for general cause and then look for any further cause that might affect the spread, especially so in the case of a ringworm infection. Regarding coarse fish, the report records that a coarse fish disease persisted from 1850 to 1874, in a





moat surrounding an old house at Ightham in Kent and that this disease had the appearance of a ringworm. Compare these observations with the photograph of a diseased sea trout taken recently from the Lune.

The symptoms of the disease in its present form in the early stages are lesions on the skin of the head, the soft tissue of the mouth and at bases of the caudal and dorsal fins; The lesions are usually colonised by fungus and, as the disease develops, the areas of necrotic tissue spread and further lesions appear on various parts of the body, many of them having the typical appearance of a ringworm infection. Crater lesions become haemorrhagic and sometimes haemorrhagic lesions appear in one or both eyes, followed by a bloody exudation from the vent. Death always follows. The numbers that have so far died in the rivers of Lancashire and Cumberland are given below, and I am grateful to Mr. N. Mackenzie, Fishery Officer of the Cumberland River Authority for supplying me with the figures for rivers in his area:—

LANCASHIRE RIVER AUTHORITY

Numbers of Dead and Dying fish removed from October 1966 to 30th March 1967

River	Salmon		Sea Trout		Brown Trout	Salmon Parr	Others	Totals
	Hens	Cocks	Hens	Cocks				
Lune and Tributaries	2566	3011	1117	968	610	24		8296
Wyre	51	21		4	1	3		80
Conder	2	4	2	21	13			46
Duddon	92	79	299	309	113	3		895
Crake	55	113	16	14	2	7		207
Leven	6	14						20
Gilpin	56	112	37	27	3			235
Kent	404	485	51	36	120	14	2 Pike	1112
Totals	3232	3839	1526	1379	862	51	2	10891

Included in the above figures are 12 spring fish from the Lune
and 16 „ „ „ „ Kent

The following fish were removed before the Ministry Order:

River Lune 37 Salmon (15 Hens 22 cocks)
33 Sea Trout (10 Hens 23 Cocks

River Kent 172 Salmon (50 Hens 122 Cocks)
33 Sea Trout (19 Hens 14 Cocks)
3 Brown Trout

CUMBERLAND RIVER AUTHORITY

Numbers of diseased fish removed from October 1966 to 30th March 1967

8600	Salmon (This figure includes 146 spring fish)
5183	Sea Trout
1080	Brown Trout
92	Parr
83	Others
15038	Total
1517	Fish removed prior to the Ministry Order.

It would appear from the effects of the present outbreak that a combination of bacteria, fungi and viruses are present, amongst which have been isolated Aeromonas Liquifaciens, Pseudomonas, Saprolegnia, a Diplococcus and possibly Columnaris and Myxosoma Cerebralis. Whilst little is known about the present disease, the infection is out of all proportion to the limited sporadic infections normally encountered. In Devon, a few years ago, salmon with skeletal deformities were found and caused much speculation, and in salmon fry, the well-defined "Whirling Disease" had been seen. Brodganova (1960) and Hoffman (1962) suggested that whirling disease is the result of infection by Myxo Bacteria (Myxosoma); this highly infectious disease in salmon fry produced skeletal abnormalities in the adult fish. In Ireland, the term "U.D.N." (Ulcerative Dermal Necrosis) is being used but it is not new. This fish infection was observed by Alexander, 1911, Wells and Zobell, 1934, Sinderman and Rosenfield, 1954, and Conrey, 1963, and all described outbreaks of this ulcerative disease. Their conclusions reveal that the pathogen, Pseudomonas, which develops rapidly between temperatures of 41° to 48° F. (5° — 9° C.) was the causative organism, and that Pseudomonas and (Aeromonas) Punctata causes haemorrhagic scepticaemia in fresh water pond fish. Eye disease of salmon is thought to indicate the presence of a vibrio causing the destruction of the eye tissue, bacteremia and death.

Another form of ulcerative disease has been described by Bergman who found that a vibrio (vibrio anguillarium) caused the red disease in eels, and, whilst this infection appeared to attack fish in sea water only, Schaperclaus demonstrated that a similar disease occurred in fish in fresh water and that ulceration was symptomatic of a generalised response in the fish to abnormal temperatures coupled with reduced oxygen tension. In 1893, Canestrini described symptoms similar to the foregoing in roach and carp. In 1951, Earp found vibro infections were extremely lethal to salmon fingerlings reared at the Biological Station of the Washington State Fisheries, where the disease was characterised by erythema of the fins and the sides of the fish, necrotic areas in the musculature and inflammation in the intestinal tract. Aeser, in Norway (1925) found that pike were not immune and that vibrio could survive freezing for more than six months. This factor of low temperature may be important, especially as the rivers in this area, in 1963, were frozen solid for nearly three months. Could this extreme environmental change which, among other things, caused havoc with the forests and bee stocks of this country, be responsible for a bacterial mutation in our salmon and their natural element. It might be thought that this is a weak hypothesis if you consider that the first Waterville outbreak was found in adult salmon in 1964.

When observed at close range, fish mortalities appear catastrophic in extent and effect. The almost widespread extinction of the whole stock is followed by a period of long-term depression, usually associated with reactions on fish population and specie (decline in spring fish?). Ecologically, if, as a result of disease or other factors, a habitat is vacated long enough, it can happen that it will be taken over by a different specie or species of fish, to the detriment of the original stock. However, little can be done to institute adequate control and remedies. Where fisheries are involved, we are, to a large extent, placed in the same position as our mediaeval ancestors when faced with plagues and pestilences.

The extent of the difficulty can be seen from a report in the book "British and Irish Salmonids", (1911), "Mr. Murray experimented upon fish which were inhabiting aquaria at the South Kensington Museum and were suffering from a fungus, saprolegnia. The fungus was not present in the water supply. He found this fungus in some earthworms which he had obtained from outside the Museum and where the bones of fish had previously been buried, and from which spot worms had twice been obtained to feed the fish in the tanks. Mr. Murray concluded that the agreement thus established forced upon him the conclusions that the infections and the material were obtained from the dead fish cast out. That during the damp weather, it remained alive in its resting state and was spread by the earthworms and that it was finally conveyed by them into the tanks where subsequent outbreaks took place."

Control measures in the Lancashire area consist of the removal of all dead and dying fish and their burial in quicklime far removed from the rivers, though this method of river hygiene may be ineffective. Certain headwaters have been sealed off by physical and electrical barriers and are being implanted with artificially reared yearling salmon stock from an extended hatchery in a still disease free area (i.e. River Ribble). Liaison has been established with Biological, Pathological and Physiological research units, and an integrated study and investigation is being carried out into some of the aspects of the disease at the new University of Salford. An appreciation of present short comings reveals that it is little wonder that Patterson, in 1880, had difficulty in deciding the cause of the outbreak of that time but it is to be hoped that, with recent progress in bacteriology and virology, a better understanding will be obtained of the present outbreak which will alleviate any future epidemics.

In this paper, I have tried to emphasise the importance of the environment to living things, and posed the question as to whether enough is being done to preserve it; where fisheries are concerned work generally is still being carried out on the proverbial shoestring. Fishery representation in all River Authorities is in a minority, and it is only due to the excellence of this selected membership that so much is achieved on so little. Antagonism is often met from non-fishery representatives, when fishery finance comes under review, and all too often the allegation is heard that fisheries are being heavily subsidised by the ratepayers of centres of population. Analysis of the statistics, however, on "Fishery Income and Expenditure," as given in the Association of River Authorities' Handbook shows that this is a misconception. During 1966, 1,269,078 fishery licences were sold by River Authorities and produced an income of £349,880; fishery expenditure was £517,470. *The Subsidy from the ratepayer to maintain the fisheries of this country is less than three farthings per head of population per*

annum, and this amount could be reduced still further if the fishery and sporting rates paid by fishery owners and lessees to Local Authorities are take into account. These are not shown separately in any Local Government accounts and no credit is given to fisheries for them anywhere at any time. In some River Authority areas they more than offset the small visible deficit on fishery accounts which means that not only does the whole area have its fisheries for nothing but the economy of the area receives the benefit of the large sums of money brought in by visiting anglers, both directly and indirectly (viz. hotels, garages, tackle shops etc.) This in itself is a subsidy to the rate-payer. What nonsense all this argument on fishery finance is! The Water Resources Act of 1963 clearly provides that this is a benefit to be met out of precept where necessary. If the fishery owners are to pay sporting rates on their waters, surely they should be paid direct to River Authorities (rather than Local Authorities), where they can be seen, accounted for and applied directly to the benefit of the fisheries of the area.

How can river environments be preserved and efficiently managed on such a pittance, bearing in mind that, were it not for the demands made by the industrial towns and large centres of population, they could probably be maintained without any payment by the ratepayer whatever. Surely it is ethical to pay recompense for advantages gained at the expense of fishery interests and amenity. When considering fishery reforms, be they fiscal or technical, it must be said that progress is slow. Your Fishery Chairman, Mr. P. J. Liddell, at the Salmon and Trout Conference in London in November last, suggested the formation of a Salmon Research Trust larger than that established in Ireland, such a trust to be more international and all embracing. It is pleasing to note that the first reactions from principal countries are most favourable and preliminary dispositions are being made. The suggestions, however, made by Mr. W. J. M. Menzies at last year's Conference have not yet been implemented. For my part, respecting research, I feel more use should be made immediately of the vast potential available in the old and new universities, freshwater and sea fisheries laboratories in England and Scotland and by international interchange of information and personal contact.

Threats to the future of rivers and their fisheries will come mainly from human over-population and man's interference with the balance of nature. As far as fisheries are concerned, they must form an integral part of leisure and amenity in the community and the pressures on them are likely to bring about more active organisations for their protection, management and administration. The future may well see the setting up of a Ministry of Amenity, with fisheries divorced from the River Authorities. These River Authorities will be in larger units of lesser numbers responsible for water resources, land drainage and pollution prevention. *If this happens, it is likely that fisheries will have to be integrated into a similar number of regional organisations, having statutory powers for the protection of amenities and the wildlife of this land, including the fish in our rivers.*

What a sad thought it is, that in our crowded future, even leisure will have to be organised. It is tragic that restriction and regimentation of the enjoyment of man's natural heritage has to be the price paid by mankind for something which is termed "progress". Surely he must realise that he cannot continually flaunt all biological tenets and still retain the natural environment concurrent with his expoitation.

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