

slaughter of emaciated and weak specimens in their descent after spawning has no doubt had much to do with their deterioration.

Chemical pollutions are so varied and complicated, and their evil effects, though admittedly evil, are so diverse that they cannot be dealt with here as briefly as purely physical impurities. Examples could be cited almost without number of the deadly and disastrous effects of deposits of waste chemical substances in rivers. All the rivers in the great manufacturing districts in England and the United States once abounded with excellent fish, but they were used as mere drains for the reception of foul refuse of every description, and these waters were so loaded with offensive and poisonous matter that all fish life has practically disappeared. Scarcely one river can be named in England which is not at some part of its course chemically poisoned, and the inky black noisome rivers of West Yorkshire, of Lancashire and Cheshire are evidence of the direst extreme of chemical pollution, while the southern part of Scotland (except the extreme south-west) and Clyde basin, and the eastern part of Scotland from Dundee to Aberdeen, embrace portions whose rivers are largely contaminated by distillery refuse, tan, fibre, chemical and sewage pollution. The evidences of chemical pollution where it is disastrous should be readily seen. Schools of fish would of necessity be found floating in a dead or dying condition and in course of time the waters would become clearly uninhabitable and denuded of all fish life. The corporation of Newcastle-on-Tyne some years ago poisoned Byker Burn by using a disinfectant of which caustic soda was a principal component. A flood in July carried some of the poisoned water into the Tyne, and for eleven miles every kind of fish was found floating dead or in what was called a 'fuddled' or intoxicated condition. Caustic soda or soda leys is used in many industries, very largely for the purpose of dissolving resinous matters in grass and wood fibres. The dark-coloured fluid (soda and lime) which results is highly poisonous to fish and settles as a deadly putrescent sediment unless swept away by swift currents. If the fish survive, their quality, flavour and colour appear to be transformed. Indeed Mr. Harvie Brown has pointed out that they become utterly unfit for food. The chloride of lime used in bleaching works gives off a pungent and penetrating odour, and has exceedingly disastrous results upon fish life.

Chemical pollutions, as already stated, cannot be dismissed by any inclusive or general statement, though the noxious character of such impurities largely depends upon circumstances. The amount and the possibilities of dispersion and dilution must be taken into account, and it is certain that in some cases (as in bleaching operations) the waste liquids, if commingled, must tend to neutralize mutually their injurious effects. The alkaline and soapy solutions, and the admixture of calcium chloride and of bleaching powder and certain free acids, furnish precisely the elements necessary for neutralization and purification. The chloride of lime will precipitate the soapy solutions, while the free acids will precipitate the alkaline liquids and decompose the bleaching powder solutions. Advantage has been taken by some enlightened firms of this state of things, and without great expense they have adopted an arrangement for purification by mingling in ponds or tanks these antagonistic and neutralizing waste products. The chemical pollutions resulting from various manufactures are too numerous to refer to with any pretention to detail, but a number of more important examples may be mentioned as of special importance. Thus in paper making soda ash or caustic soda is largely used, resulting in a waste fluid of a dark brown hue charged with soda and lime and a certain amount of fibrous and resinous matter. This heavy fluid is harmful both chemically and physically, for it is poisonous, and of a nature so adherent that it lodges in and clings to the gills of fishes. Chloride of lime is also poured out from paper works, where white papers are made, calcium chloride being the bleaching agent used, while colouring matters are added to the waste in factories where blue and tinted papers are made. In recent years many other substances, china clay and mineral matters are mixed with paper pulp, all of which render still more injurious the waste fluids poured into the rivers.

Any one familiar with Yorkshire, Wiltshire and the west of England is well aware that the refuse from the wool-scouring, fulling, and dyeing works is of a most poisonous and polluting nature. The grease and impurities removed from the wool