



THE BIOLOGICAL EFFICIENCY OF A SEWAGE-POLLUTED STREAM, AS OBSERVED IN THE ILLINOIS RIVER*

W. C. Purdy

U. S. Public Health Service

Sewage-polluted water from the Chicago Drainage Canal empties into the small Des Plaines river just above Joliet, Illinois, enlarging this river to about seventeen times its former volume. This great volume of polluted water is well seeded by the Des Plaines water, which contains large numbers of plankton organisms, particularly microscopic plants. Effective and prolonged mixing and aerating of these components now result from rapid turbulent passage of the combined waters for eight miles with a total fall of 50 feet meantime. Less rapid flow for nearly 100 miles to Chillicothe follows, during which much sedimentation takes place and just before reaching Chillicothe the water loses its odor of sewage and becomes reasonably clear.

Beginning at Chillicothe is a shallow mile-wide expansion of the river extending about eighteen miles to Peoria. The water spreading out here becomes further cleared and aerated, and exposure to sunlight increases growth of the microscopic green plants, which, by photosynthetic action, liberate oxygen to the water.

The wastes of Peoria and of Pekin, a small industrial city ten miles below, produced a slight secondary pollution. The lower 150 miles of the stream (from Pekin to the mouth) presents an apparently clean stream, so far as physical conditions are concerned.

The foregoing physical high spots—supplementary components, vigorous mixing and aeration, decreasing velocity, with increasing sedimentation, disappearance of sewage odor, and the clearing of the water, finally a period of recuperation in Peoria Lake and a fresh start therefrom—all of these are accompanied with a content of organisms which constitute the biological response to the series of environments as presented by this polluted river.

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But these organisms are to a considerable extent expressions of the dissolved and suspended organic material formerly present in the water. They represent the flux of much of this organic matter on the basis of food, beginning with bacteria, and continuing through various larger and higher forms of life including flagellates, ciliates, rotifers, larvae of certain insects, and numerous worms,—the latter chiefly “sludge worms” working in the bottom sediments in somewhat the same manner as do common earthworms in the soil,—and with somewhat analogous beneficial results expressed in terms of stream purification. In general, these many kinds of living things in a polluted stream are mechanisms whose activities help to solve the problem of their environment by consuming directly or indirectly much of the material which made the stream a “polluted” one. Rather than inert microscopic drift-wood these organisms are workmen exhibiting great energy obtained largely at the expense of the polluting organic matter, the potential energy of which is thus made kinetic and is visibly expressed chiefly in terms of motion and multiplication of the organisms themselves.

It is noteworthy that chlorophyll-containing oxygen-producing plants, microscopic or larger, were practically always more abundant volume for volume, than were the oxygen-using organisms, chiefly animals. Any given particle of water thus possessed assets which on occasion might function as a “balance of power” to insure continued aerobic disposal of such organic matter as might be present, preventing possible bankruptcy of the water as to dissolved oxygen.

A further matter of significance is the fact that gill-breathing insect larvae are entirely absent in the polluted upper portion of the stream, but are abundant in the lower reaches, apparently indicating that the dissolved oxygen content of the water here is normal and adequate.

Since biological activity depends largely on a favorable environment for the organisms concerned, it follows that purification of a polluted stream is a net resultant of the interaction of both physical and biological factors, and to some extent, the chemical. None of these factors can be ignored in the proper study of a polluted stream, for physical preparation must be seconded by adequate biological equipment and this, in turn, must be made possible by proper chemical conditions, including absence of certain substances toxic to the biological workmen.