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STREAM POLLUTION STUDIES IN THE STATE OF MISSISSIPPI

by

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Explanatory Note

This is the third in a series of mimeographed Special Scientific Reports, published in limited quantities for the official use of Federal offices and cooperating agencies. Previous reports in this series are as follows:

1. Pollution of Coeur d'Alene River and adjacent waters by mine wastes, by M. M. Ellis.

2. Water purity standards for fresh water fishes, by M. M. Ellis

STREAM POLLUTION STUDIES IN THE STATE OF MISSISSIPPI

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Introduction

At the request of Mr. Si Corley, Director of Conservation, State of Mississippi, one of the mobile field laboratory units of the U. S. Bureau of Fisheries with a personnel of six in two cars proceeded from headquarters at Columbia, Mo., to Jackson, Miss., December 20, 1936. There the State officials provided additional transportation facilities and boats so that various members of the party were assigned to follow particular phases of the pollution problems in hand. Subsequently the entire party moved to Laurel, Miss., and from there to Gulfport, Miss. Throughout the entire stay in the State of Mississippi the continued interest of various wardens and other officials from Mr. Corley's office did much to expedite our work and added greatly to its efficiency. This helpful cooperation is gratefully acknowledged.

After completing the field work in the State of Mississippi, a large amount of material was returned to the Columbia, Mo., laboratories of the U. S. Bureau of Fisheries. Several other shipments of samples were made subsequently to the Columbia, Mo., laboratories by various representatives of the State Fish and Game Department, particularly from Crosby, Miss.

At the Columbia, Mo., laboratories these various effluents have been subjected to numerous analyses and bioassays following procedures described by Ellis (1937). These operations have involved the use of several thousand test animals and have been carried forward through observation periods of several weeks.

Considering all of these studies collectively our pollution investigations in the State of Mississippi may be grouped into:

1. Pollution problems of the Pearl River in the vicinity of Jackson, Miss.

2. Pollution problems near Laurel, Miss.

3. Pollution problems near Gulfport, Miss.

4. General and miscellaneous pollution problems.

Pollution Problems Near Jackson, Miss.

1. The Pearl River: The pollution of the Pearl River in the vicinity of Jackson, Miss., was found to be the result of the combined action of several types of effluents which this river was receiving at the time of our studies. These several effluents will be discussed separately, but as a background to all of these pollution problems the character of the Pearl River itself must first be considered.

The Pearl River water assayed as definitely "soft" and was almost unbuffered; i.e., the salt and mineral contents of the river water were very low as shown by the specific conductance values, the pH readings, and the carbonate determinations. Collectively these physico-chemical features presented a complex which although quite satisfactory for fish and other aquatic life placed the Pearl River in the class of easily polluted streams. Without the protection of buffer substances, relatively small quantities of any pollutant tending to disturb the pH; i.e., the acid-alkali balance of the water would cause changes in the Pearl River dangerous or even lethal to aquatic life and fish. Again, the toxic action of many stream pollutants is greatly enhanced in waters low in carbonates and other dissolved inorganic substances which in many natural waters tend to neutralize or detoxify such pollutants. The summarized data on the physico-chemical conditions in relatively unpolluted portions of the Pearl River near Jackson, Miss., during December 1936 showed that pH values of this river water lay between pH 6.6 and pH 6.9, and that the specific conductance was between 175 and 181 mho* x 10^{-6} at 25° C. The fixed carbonates were almost negligible as might be expected from the pH readings which were found to be slightly on the acid side of neutrality. It may be repeated that these findings merely mark the waters of the Pearl River as "soft", slightly acid and of a type very easily polluted, but that these conditions in themselves are not unfavorable for aquatic life.

2. Filtrol Plant: In studying the specific pollutants entering the Pearl River near Jackson, Miss., our attention was directed first to the Filtrol Plant. This concern is engaged in processing raw clays into prepared clay for special filtering and clarifying agents. Through the cooperation of the officials of this plant we were given helpful discussions of the processes and free access to the effluents from the factory.

The effluent as it finally leaves the Filtrol Plant is very strongly acid due to the presence of sulphuric acid. In addition to the acid the effluent carries (in the samples examined by us) small quantities of manganese, iron, aluminum, lead, calcium, and magnesium compounds with traces of other elements, and some suspended silica and silicates. Although this effluent is passed through two small settling basins before entering the flume which carries it into the Pearl River the waste fluid is still strongly acid and contains small quantities of the various compounds enumerated above.

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* mho is the reciprocal of the ohm, an electrical unit.

Bioassays of this effluent and of untreated samples of the clays used by this plant were made at the Columbia, Mo., laboratories of the U. S. Bureau of Fisheries and showed that the samples examined did not owe their detrimental affects to any of the contained metallic salts or compounds but that the pollution hazards of this effluent to fish and other aquatic life were of two sorts; namely, the high acidity of the effluent, and the sedimentation of suspensoids from the waste.

The last hazard may be dismissed with the statement that any clay when carried as a suspensoid in natural waters presents a definite pollution hazard to aquatic life if sufficient quantities are poured into the stream to form a bottom blanket, when the suspended particles are settled out either by gravity or by change in charges (see Ellis, 1936). In our samples the amounts of suspensoids were very small and practically negligible as far as hazards to fish and aquatic life are concerned, and our field examinations of the stream bed below the Filtrol Plant did not give evidence of bottom silting from this effluent. However, it must be pointed out that should the present system of impoundment fail either through an increase in the quantity of effluent discharged by the plant or through some accident which would suddenly release large quantities of the effluent directly into the river, the Filtrol waste could become a hazard to the Pearl River because of its suspensoids, since the effluent as it leaves the plant proper; that is, before it passes into the settling basins, carried an appreciable quantity of finely divided silica and silicates.

The main hazard to fish and aquatic life of the Filtrol effluent lay in the high acidity of this waste. Table 1 gives various physical and chemical data on this effluent as taken just before it entered the Pearl River. The dilutions were made by using Pearl River waters of the composition found during December 1936 about 100 yards above the Filtrol Plant and give, therefore, a true picture of the lack of buffer substances in the Pearl River waters into which the Filtrol effluent was being discharged. These dilutions also show the high pollution hazard of the Filtrol effluent under the conditions which exist in the Pearl River near Jackson, Miss.

From Table 1 it may be seen that the Filtrol effluent would require dilution with 1,000 volumes of Pearl River waters before the acidity of the resultant mixture would be reduced to a level which could be tolerated by fish, since sulphuric acid must be diluted to approximately pH 4.5 before fish will survive in water carrying this acid (Ellis, 1937). However, the dilution must be carried to pH 5.5 if various other aquatic organisms are to survive and if even fish are to escape cumulative injuries from this acid (Ellis, 1937). To attain a pH of 5.5 by dilution with Pearl River water, which is the minimum dilution which could be accepted for the Filtrol effluent, 5,000 volumes of Pearl River water would be required, since that value produced the bare minimum of pH 5.5 in actual tests.

Table 1 also confirms the bioassays of this effluent as regards the absence of any osmotic effect on fish and aquatic life if the effluent be diluted properly since the specific conductance of the diluted effluent dropped to the safety zone (800 mho x 10^{-6} at 25° C.) while the acidity was still dangerously high (pH 2.0) in the case of a 1:100 dilution.

Table 1

Filtrol effluent (Lno. 1360) as entering Pearl River December 1936. Dilution with Pearl River water as found just above the outlet of Filtrol Plant (Lno. 1361)

Dilution of effluent	pH	Specific conductance in mho x 10^{-6} at 25° C.	Dissolved oxygen parts per million	Acid in 100 cc. as cc N/44 Na_2CO_3
Full strength	0.8	35,761	0.27	12,550
1: 10	0.8	17,400	--	--
1: 100	2.0	800	--	--
1: 250	3.2	358	--	--
1: 500	3.6	253	--	--
1:1,000	4.8	195	--	--
1:5,000	5.5	190	--	--
Pearl River water	6.6	181	8.6	--

From the bioassays, the field work, and the physico-chemical studies of the Filtrol effluent it is recommended that the Filtrol effluent be diluted with at least 5,000 volumes of river water (not well water) before being poured into the Pearl River, or that this waste be neutralized first by passing it through limestone towers and baffle traps to an acidity not exceeding pH 6.0 and then diluted with sufficient river water to reduce the specific conductance of the resultant effluent to 4,000 mho x 10^{-6} at 25° C. or less. The second procedure, the neutralization before dilution, would be both more satisfactory and less costly, and would have the additional advantage of being much more practical during seasons of low water and warm water when the hazards from this strongly acidic waste are maximum. These recommendations assume of course that the suspensoids will be held at the present low level by use of settling basins or other devices. The evidence from all of our tests and analyses show that the Filtrol plant effluent is a serious potential pollution hazard at all times to the Pearl River since this strongly acidic effluent may not be mixed readily by current action and may concentrate during the low water in portions of the stream to the very serious detriment of aquatic life in the river.

Should the State Commission decide to act upon these recommendations the Columbia, Mo., laboratories of the U. S. Bureau of Fisheries will be glad to cooperate with the Commission and the Filtrol Plant in the planning of satisfactory towers and baffles for the neutralization of this waste.

3. Gas well waste water:- Several gas wells in the vicinity of Jackson, Miss., were visited and the escape water from these wells studied. The escape water from natural gas wells presents well-known stream pollution hazards of three sorts, (1) the osmotic action of the brine waters, (2) toxic action of the contained magnesium and calcium salts as well as that of the brine itself, and (3) the toxic action of various dissolved hydrocarbons, mercaptans, and other organic compounds, chiefly derivatives of the petroleum series.

The bioassays of the waters collected from gas wells near Jackson, Miss., showed the hazards to fish and aquatic life from these waters to be primarily from the first cause, that is, the osmotic action, since the amount of dissolved organic compounds in these particular gas well waters was at the time very small. It must be pointed out here, however, that gas well waters vary greatly from time to time in content of these organic substances, and that these variations may occur so suddenly that the dissolved organic matter may become a serious hazard to fish and other aquatic life if these gas well waters be allowed to enter streams without sufficient dilution and aeration.

In Table 2 the effects of dilution with Pearl River water on the waste waters from the Love Gas Well near Jackson, Miss., are shown in terms of pH and specific conductance. The initial pH of this waste water which is taken as typical of the other gas well waters in the Jackson, Miss., field was definitely but not dangerously acidic, pH 6.2, and dilution with river water rapidly brought this acidity into the range of the Pearl River water itself, pH 6.6 to 6.9.

The specific conductance of this water due to the high content of salts was 57,590 mho x 10^{-6} at 25° C., and a specific conductance near 4,000 mho x 10^{-6} at 25° C., is approximately the upper limit of ionizable salts of the common sodium, magnesium, and calcium groups found in gas well waters, tolerated by fresh-water fish (see section on osmotic pressure, Ellis, 1937). It is evident, therefore, from Table 2 that the waste waters from the Love Well should be diluted with at least 100 volumes of river water to place the resultant mixture below the level dangerous to fresh-water fish as regards the combined osmotic pressure of these gas well water salts.

Although the particular gas well waste waters in the vicinity of Jackson, Miss., did not present a large hazard to fish and other aquatic organisms of the Pearl River, gas well waste waters are such potential hazards that they should be well aerated and diluted before given entrance into any fresh-water stream. Even with these precautions the organic content of these waters should be checked frequently to determine the adequacy of the aeration process.

Table 2

Waste water from Love Gas Well (Lno. 1373) near Jackson, Miss., December 1936. Dilution with Pearl River water.

Dilution of Effluent	pH	Specific conductance in mho x 10^{-6} at 25° C.
Full Strength	6.2	57,590
1: 10	6.4	6,892
1: 100	6.7	914
1:1,000	6.8	219
Pearl River water, average unpolluted samples	6.8	180

It is recommended that the gas well waters of the Jackson, Miss., area be concentrated into pounds by pipe lines instead of being turned into open ditches from which salts can spread to the surrounding soil and develop new pollution hazards after rains. From the ponds after proper aeration these waste waters should be properly diluted if they are to be poured into the Pearl River. Ideally gas well water should be excluded from all fresh-water streams, although proper aeration and adequate dilution can be used frequently in the disposal of these waters if the volume of gas well water be not too large and if the organic content be small.

4. Creosoting plant wastes: The wastes from creosoting plants containing mixtures of phenol, cresols, and several related compounds which are present in varying amounts depending upon the inevitable loss of the creosoting fluid into the stream and waste waters during the course of processing timbers. These creosoting plant wastes also contain a large series of organic extractives which are leached from the wood by the steaming and other treatments during the course of the preparation of the timbers.

The mixture, popularly known as "creosoting waste," is therefore highly variable in composition depending upon details of the processing, upon the kind of wood used, and upon the "greenness" of that wood. In general the toxicity of this type of effluent centers around the benzine ring compounds of the phenol and cresol series. Both groups are highly toxic to fish life. The toxicity of these compounds to fish and other aquatic organisms increases rapidly if the dissolved oxygen in the water is decreased and if the temperature of the water is raised, hence these phenolic and cresolic wastes are particularly dangerous to aquatic life during the summer months when high air temperatures and low water levels combine to reduce the dissolved oxygen in the river water as well as to raise the temperature of that water.

As creosoting plants present pollution hazards in several parts of the State of Mississippi (we have studied samples from Jackson, Crosby, and Gulfport, Miss.) and since the pollution problems of this type of effluent are essentially the same wherever this waste is found, the general discussion of these effluents as affecting Mississippi streams is given here under the Pearl River heading although the recommendations are applicable to the entire State.

Creosote wastes kill because of the specific toxicity of these benzine ring compounds, as little as 6 ppm. of some of the components of these effluents killing many varieties of fish in less than 10 hours. The immediate lethal hazard is not, however, the greatest hazard in the case of these effluents. The cumulative effects of these benzine ring compounds in the creosote wastes have also been demonstrated, namely, that even small traces of creosote wastes although not immediately lethal are stored by the tissues of fish and other aquatic animals particularly in the oily portions of the flesh, with the results that fish inhabiting waters containing only minute quantities of the creosote wastes for any length of time have a definitely "carbolic acid" or "tarry" taste if eaten by man. Fish exposed to even very small quantities of creosote wastes gradually decline in health. In addition to the cumulative effects creosote wastes are also insidious in that they are not easily destroyed in the stream and, therefore, tend to accumulate on the bottom and in the deeper holes often for many miles below the source of the pollution, conditions which we were able to verify at Jackson, at Crosby, and at Gulfport, Miss. This accumulation of creosote wastes is very destructive to fish food, to the bottom fauna of the river, and to fish eggs. Moreover, the accumulation of such wastes allows the contamination to spread steadily through the stream involving more and more of the main water course.

The several creosoting plants visited in Mississippi were not making adequate provision for the removal of creosote compounds from their wastes. The system of baffles used by these plants reclaimed considerable quantities of the creosoting oil and related substances, but the effluents from all of these plants, as finally turned into the nearby streams were highly toxic to fish life, as proven by our bioassays, because of the phenolic and cresolic compounds carried by these effluents both in solution and suspension.

It is recommended first that creosoting wastes of all sorts be completely excluded from direct access to all streams, and second, that the practice of turning these wastes into marshes and moist lands adjacent to streams be discontinued, since the toxic substances subsequently reach the stream. It is further recommended that the capacity of the baffle systems now used by several plants in Mississippi be greatly increased so that a larger per cent of the escaping creosote oils will be trapped and that the efficiency be maintained by the use of carefully constructed baffles instead of the makeshift baffles which are now commonly employed. It is still further recommended that no water or other effluent from the system of baffles be admitted as such into the stream but that the aqueous effluent from the baffle system be run out into confined ponds with definite walls from which these toxic effluents cannot escape. After settling in such holding basins the run-off waters should be properly aerated and chemically treated to destroy or remove the remaining phenolic and cresolic compounds. There are several processes by which this can be accomplished and the plant engineer should be given choice in these matters, but the adequacy of the methods should be checked by analyses and bioassays of the effluents before these are permitted access to the streams of the State.

In conclusion as regards the creosoting wastes, these effluents should be completely excluded from the streams until properly treated as creosote wastes collectively constitute dangerous pollution hazards of a cumulative sort from which the stream cannot rid itself by simple oxidation or stream flow.

The extractives derived from the wood itself by the steaming and other procedures incident to the processing of the timbers for creosoting, present some minor pollution hazards particularly through the presence of tannic acid. However, the treatment of the creosote wastes for phenol and cresols will very largely remove the tannic acid hazard which is trivial in these effluents as compared with the hazards from these benzine ring compounds. Actual bioassays showed that once the phenolic and cresolic compounds were removed from these creosoting plant effluents the remaining extractives particularly those carrying nitrogen linkages may yield substances of some value in increasing the production of fish food. For example, one sample of creosote effluent from the Gulfport creosoting plant after being properly diluted and detoxified as regards the phenolic and cresolic compounds, increased the production of daphnia and other microscopic fish food animals when mixed with river water. Properly treated creosote wastes therefore might become something of an asset to fisheries interests after proper treatment for the removal of the known dangerous phenolic and cresolic compounds.

5. Miscellaneous wastes near Jackson, Miss.: As was to be expected, the organic content of the water of the Pearl River rose below Jackson, Miss., due to the introduction of various wastes from the city. Drainage from abattoirs and slaughter houses below the city were suggested as possible causes but during a trip by a boat downstream from Jackson to a point near Cade Lake no striking organic pollution was found at the time of our visit. What conditions might be in this stretch of river during the summer months cannot be determined from data collected in December but at that time the organic pollution of Pearl River below Jackson was not bad.

Pollution Studies at Laurel, Miss.

At Laurel, Miss., our attention was directed specifically to the wastes from the Masonite Plant, a concern manufacturing composition building products from fiber. The effluents from this plant, consisting of various chemical wastes, loose fiber and some pigments, were carried into a settling basin and the effluent from this settling basin flumed into Tallahala Creek. The plant was not running at the time our party visited Laurel but samples were taken from the flume conveying the escaping fluid from the settling basin into Tallahala Creek.

Table 3 gives the summarized data on this effluent and its dilution as compared with Tallahala Creek both above and below the entrance of the effluent.

The Masonite effluent was found to be strongly acidic, pH 4.0, but a dilution of 1:50 with Tallahala Creek water sufficed to reduce this acidity to pH 5.7, a value within the limits tolerated by fish for simple acidity alone. The specific conductance of this effluent was low, indicating the absence of any large quantities of ionizable substances. These findings show that the toxicity of this effluent was not the result of either large amounts of acid or salts.

The bioassays of the Masonite effluent revealed the presence of some substance or substances of highly toxic nature. This effluent killed fish in from 1 to 3 days in dilutions of 1:100,000. No cumulative effects were noted as the effluent seemed to decompose after 3 to 5 days in high dilutions. The nature of the toxic constituent or constituents of this settling basin waste from the Masonite plant was not determined but the material seemed to be an unstable compound producing an oxygen demand judging from the change in composition after several days in high dilution. This supposition was confirmed by the finding of a marked drop in dissolved oxygen, from 9.9 ppm. to 5.8 ppm. (see Table 3) in the water of Tallahala Creek after receiving the Masonite effluent. Additional studies concerning the nature of the toxic substance present in this waste are in progress.

As has been noted already the effluent from the Masonite plant carried considerable quantities of loose fiber. Following Tallahala Creek downstream from Laurel, Miss., to the Oldtown bridge east of Ellisville, Miss., fiber mats were found on the stream bottom and attached to submerged objects throughout this sector of Tallahala Creek. It can be stated with certainty that these fiber mats were present in sufficient quantities to be definitely detrimental to fish life and other aquatic organisms for at least 12 miles below the plant.

From even our incomplete data on the Masonite effluent the following recommendations can be made. First, all loose fiber should be trapped at the plant. This can be accomplished easily by the construction of proper settling basins and a suitable system of screens and baffles in the outlet of these settling basins. The damaging actions of pulp and fiber waste are too well known to require comment, but it may be pointed out in summary that these fiber wastes blanket the bottoms of the streams, destroying both fish food and nesting sites, and that the mats of fiber harbor various undesirable bacteria which complicate stream and fisheries problems both from the standpoint of the health of the fish and from that of the purification

Table 3

Effluent from Masonite Mill, Laurel, Miss., (Lno. 1376). Dilution with Water from Tallahala Creek Two Miles Above Masonite Mill (Lno. 1374)

Dilution of Effluent	pH	Specific conductance in mho x 10^{-6} at 25° C.	Dissolved oxygen parts per million
Full strength:	4.0	554	--
1:10	4.5	197	--
1:50	5.7	160	--
Tallahala Creek, two miles above Masonite Mill (Lno. 1374)	6.6	150	9.9
Tallahala Creek, one mile below Masonite effluent entrance (Lno. 1377)	6.0	200	5.8
Tallahala Creek, Oldtown bridge east of Ellisville, Miss., (Lno. 1380) 10 or 11 miles upstream from Laurel, Miss.	6.4	174	7.7

of the stream itself. Natural forces as oxidation and stream flow can do little to rid the stream of these fiber blankets. The fiber pollution of Tallahala Creek system by the wastes from the Masonite plant is unnecessary. It presents definite and serious pollution hazards which could be easily remedied by cooperation on the part of the plant officials.

The hazards accruing from the chemical constituents of the wastes are not so easily handled, especially since our knowledge of the exact composition of these substances is at present incomplete. However, it is recommended in view of the toxicity of this effluent as proven by bioassays that a dilution of at least 1:100,000 be required before this effluent be admitted into the stream. It is possible that when additional information is available a more satisfactory solution will appear but at present the high toxicity of this waste must be pointed out as a serious pollution hazard to aquatic life in Tallahala Creek for a considerable distance downstream, both because of the specific toxicity of the Masonite effluent, and because of the biochemical oxygen demand of this waste which caused a marked drop in the dissolved oxygen of Tallahala Creek even in December when the possible oxygen saturation was high and the water temperature low, conditions which would be reversed during the summer season.

Pollution Studies Near Gulfport, Miss.

In company with wardens from the State Conservation Commission, U. S. Bureau of Fisheries party proceeded to Gulfport, Miss., to study the effluents from several industrial concerns with reference to the pollution of the fresh water bayous in the vicinity of Gulfport.

1. Gulfport Fertilizer Company: This company manufactures fertilizer from Florida phosphate rock, Chile saltpeter, and sulphuric acid. As the sulphuric acid used is manufactured at the plant the usual Gay Lussac tower fumes are produced but at this plant these fumes are allowed to escape into the air and are not caught by falling water so that there is no acid effluent from the tower. The only waste produced by this plant is the so-called "nitre cake" which is a mixture of acid sodium sulphate and normal sodium sulphate, together with some pyrosulphate and various other sulphate-sulphite compounds. Some 150 pounds of this "cake" are piled on the adjoining waste land daily. These piles of this "cake" may in time produce pollution hazards if the salts are dissolved and carried away by surface runoff after rains. No indication of this type of pollution was found at the time of our visit but it is suggested as a precautionary measure that these piles of "nitre cake" be surrounded by earthern work dykes such as could be thrown up with plows and scoops, to prevent surface runoff from carrying this sulphate mixture which is increasing daily in volume, into the adjacent bayous.

As this sulphate has a relatively low toxicity (100 to 500 ppm. being required to produce dangerous conditions for most aquatic life when mixed with river water) the dyking of these piles of "nitre cake" should provide ample protection for the nearby waters.

2. Phoenix Naval Stores Company: This concern manufactures turpentine, pine oil, and rosin from pine stumps and roots. The combined effluents consist of water from the cooling system and waters from the processing, draining into a pool which acts as a settling basin and from which the overflow of clear water escapes into a nearby bayou.

The bioassays showed the pollution hazards of this effluent to be of two sorts, (1) from the varying quantities of turpentine, pinene and other derivatives of the pine wood which although not intentionally allowed to escape do find their way into the waters from this plant, and (2) the acidity of the combined effluent which averaged at the time of our visit about pH 4.0.

The pine derivatives proper, that is, the pinene, terpene, and related compounds are quite toxic to fish and aquatic life as has been shown not only by bioassays of material from the Phoenix Plant but also by bioassays of various other pine wood products. However, the actual amounts of these substances in the effluents from the Phoenix Naval Stores plant in the samples examined by us were not large.

Although the acidity of the Phoenix plant effluent as it ran into the pool was approximately pH 4.0 in December 1936, that is, well within the lethal zone for most fishes and other aquatic organisms, this acidity was readily controlled by dilution with 500 parts of river water.

The lethality of the Phoenix effluent which was demonstrated by bioassays resulted, therefore, apparently from a combination of the specific toxicity of certain organic acids contained in this effluent (in part acetic acid) and of the turpene derivatives. A dilution of 1:1,000 of this effluent was rapidly lethal for fishes and few survived a dilution of 1:10,000. In view of the small quantities of the effluent from this plant it would seem that the construction of settling basins into which lime could be placed to control the acidity of the effluent and where opportunity would be afforded for natural aeration to dispose of most of the turpene compounds, would solve the major pollution problems of the effluent from this plant. It must be borne in mind, however, that such treatment with lime and such aeration in suitable settling basins even though of adequate size, would not suffice to detoxify this effluent should the amounts of pinene, and turpene compounds carried by this effluent be increased.

3. <u>Gulfport Creosoting Company</u>: This plant pours considerable volumes of creosoting wastes into Bernard Bayou by way of Turkey Creek, developing all of the pollution hazards attendant on this sort of waste. As the discussion of creosoting waste has already been given under the Pearl River findings, the statements of the hazards of this type of waste and the recommendations for the rectification of these hazards made in that section apply equally well to the Gulfport situation.

General and Miscellaneous Pollution Problems

Several cases of stream pollution resulting from waste dye effluents leaving cloth mills, from paper mill processing, and from packing plant wastes were reported to us, but as these particular plants were not visited by our field party during our December sojourn in the State of Mississippi only generalities concerning these pollutions can be offered here.

In the neighboring State of Georgia the data from another pollution survey made by the field party of the U. S. Bureau of Fisheries have shown that cloth mill wastes although often of amazing colors are not as a rule pollution hazards because of the dyes contained in these effluents, but because of the various chemical mordants and adjuvants used in fixing these dyes or in the production of mercerized cloth. When these wastes are added to the spent dyes the pollution hazards vary accordingly and are often quite dangerous. It is, therefore, difficult to evaluate dye pollution from cloth mills without field studies at the particular plant involved.

In exactly the same way the effluents from paper mill processing vary in toxicity and in their pollution hazards since the admixtures are not uniform in composition and since the severity of the oxygen demand produced by many of these waste products varies greatly with local stream conditions. Therefore, one can only state that in general paper mill effluents present very serious stream pollution hazards but the specific cases must be examined and evaluated as such.

In general, however, packing plants give very much the same picture of pollution wherever found, namely, high oxygen demand, high ammonia content and a sludge blanket on the bottom of the stream, all of which conditions are dangerous and are usually lethal to fish and aquatic life if any large volumes of these wastes are placed in streams. The general recommendations, therefore, for packing house wastes are either complete exclusion, or adequate treatment to destroy the organic matter (usually impoundment and activated sludge methods are satisfactory in this particular) before the effluent is released into the stream. Chlorination of the organic wastes in packing house effluents is to be condemned as far as fisheries interests are concerned.

It is obvious that additional surveys will be necessary to complete the pollution studies in the State of Mississippi.

References

Ellis, M. H.

1936. Erosion silt as a factor in aquatic environment. Ecology, Vol. 17, pp. 29-42.

1937. Detection and measurement of stream pollution. Bulletin of the Bureau of Fisheries, Vol. XLVIII, Bulletin No. 22, pp. 365-437.