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**A Twenty-Year
Review Of Androscoggin River
Pollution Control Activities**

**A Report to the Androscoggin River
Technical Committee**

by

WALTER A. LAWRENCE

LEWISTON, MAINE

June 6, 1961

SUMMARY

1. This report contains a brief account of the formation and major activities of the Androscoggin River Technical Committee.
2. The legal history and the control procedures are reviewed.
3. The outstanding accomplishments have been
 - a. elimination of a serious odor nuisance,
 - b. reduction of the sulphite waste liquor pollution discharge to the river to 15% of the 1941 load, and
 - c. additional reduction in 1961 to lower the discharge percentage to about 5% of the 1941 tonnage.
4. Expenditures for nitrate, testing, and compliance with control requirements exceed \$2,000,000. Over \$20,000,000 have been spent to provide in-mill process changes to reduce the pollution discharge to the river.
5. No public money has been employed either for control or reduction of pollution. All costs have been borne by Brown Company, Oxford Paper Company and International Paper Company.
6. The appendix contains a bibliography of the literature relating to the Androscoggin River pollution problem, also a map of the river basin. The map is an adaptation of that issued by the New England New York Inter-Agency Committee, January, 1953.

A TWENTY-YEAR REVIEW OF ANDROSCOGGIN RIVER POLLUTION CONTROL ACTIVITIES

A Report to the Androscoggin River Technical Committee

by

Walter A. Lawrance

Lewiston, Maine

June 6, 1961

Anniversaries provide an opportunity for reminiscing, reviewing the past, and planning for the future. Now as we begin the twentieth year of Androscoggin River pollution control, it is appropriate and desirable that we review the transactions and accomplishments of the past and, as best we can, formulate plans for the future.

Inevitably during a period of twenty years the membership of this Committee has undergone numerous changes due to retirement, promotion, etc. Of the many men who have served as members only two have served continuously from the early 1940's until the present time — these are Al Webber and the writer — but all who served have made valuable contributions and in a most cooperative spirit. The formation of the Committee and its role over the years will be touched upon later in this report.

Almost a year ago your Committee discussed the desirability of preparing a report covering the major activities of the Committee since its inception and summarizing the progress made to date. It is hoped that this survey of achievement, brief as it is, will be of value to the recently appointed members and to those who become members in the future.

The Androscoggin River as it existed in the days of the early settlers was a rough and rugged stream. From Berlin to the sea, a distance of 136 miles, the river drops 1,090 feet; an average of 8 feet per mile. In the spring and often in the fall it was a raging torrent, often surging over its banks and flooding the lowlands. In many a summer the flow of water became so small that in some areas the river resembled a brook. Under such variable conditions it is doubtful if the Androscoggin River water was

ever pristine pure; it must have been heavily silted during high water and contaminated with organic debris from the extensive forest areas during the hot, dry summers when flow was very low.

The river, fed by a drainage area of 3,470 square miles, had a tremendous potential value as a servant of man but in order for that value to be realized, the river's destructive forces had to be harnessed by the construction of storage dams at suitable and strategic locations. The first dam was built at Topsham in 1753, and the most recent at Gulf Island in 1926-1927. Today 21 dams are in use for the storage of water but not all are for direct power production. These dams are valuable assets and make a great contribution to the economic life of the valley, but their presence necessarily retards the flow of water thus reducing the capacity of the river to oxidize industrial and domestic wastes without development of nuisance.

To support the growing population of the valley, industries were established, the first of these being sawmills and gristmills. The sulphite pulping process, invented in 1867, was first put into commercial use in 1885. During the next two decades, sulphite pulp mills were built on the Androscoggin at Berlin, Rumford and Chisholm. Growth of this industry was rapid and by 1941 mills on this river were producing about 5,800 tons of sulphite pulp per week. Because no alternative method of disposal was economic, the waste liquor resulting from sulphite pulping was discharged into the river.

As early as 1930, the managements of several Maine pulp and paper mills evidenced their awareness of the need for information on the condition of five industrial rivers of the State, including the Androscoggin, by arranging for and financing river surveys which were carried out under the supervision of Professor C. L. Walker of Cornell University. The Androscoggin River survey was made over the period July through October 1930 and the results were submitted to the Governor and Council on March 9, 1931 in a report entitled "Survey and Report of River and Stream Conditions in the State of Maine." As might be expected, dissolved oxygen concentrations were found to be lowest in the river just above Lewiston but even there the weekly average dissolved oxygen figures were all above 2 ppm. Results of this survey showed that while the Androscoggin River was heavily polluted, the situation was not serious at that time. The report stated, however, that "with the dissolved oxygen content of the river water just above Rumford at 4 ppm, it is apparent that improvement of the condition of the water of the Androscoggin involves the States of New Hampshire and Maine, and that joint action will be required should the load of the stream be material-

ly increased, or the river flow be decreased relatively to the volume of waste now entering it."

Metcalf & Eddy of Boston made tests of Androscoggin River water in 1940 for the Central Maine Power Company but their report was not published. No record could be found of any other large scale tests being made until 1941.

In the summer of 1941, the twin cities of Lewiston-Auburn and the surrounding area experienced an especially serious and prolonged nuisance caused by hydrogen sulphide and other odors emanating from the river. Less severe attacks had taken place in certain areas in the previous summer, in the summer of 1937, and to a much lesser degree in the summer of 1935, but the combination, in 1941, of very low river flow, hot weather, and heavy discharges of sulphite waste liquor gave rise to an intolerable situation which very properly aroused public indignation to the point where remedial action was sought. Because of this public clamor, the first matter brought before the newly created Maine Sanitary Water Board was the grossly polluted condition of the Androscoggin River. At the August 22, 1941 meeting of the Board, the firm of Metcalf & Eddy of Boston was employed to conduct a survey of the river and to recommend remedial measures.

Field investigations made by Metcalf & Eddy covered the period August 27 to December 5, 1941, and were summarized with recommendations in a report dated February 5, 1942. As you will recall, this report, issued as Bulletin No. 1 of the Sanitary Water Board, stated that of the total pollution load on the river, 96% was from industrial waste, 92% was from pulp and paper mills and approximately 71% originated as sulphite waste liquor which could be separated from other mill wastes and impounded in storage lagoons during the summer months and discharged from the lagoons into the river in the fall as soon as river flow and water temperature permitted.

Company managements established informal consultations in 1941 and these eventually led to the formation of this Committee in May, 1942. Membership usually included one technical man and one representative of management, from each of the companies. Very often other technical, management, and engineering personnel attended meetings. The writer became a consultant member in 1943, and since 1947 in his capacity as River Master and then as Administrator has acted as chairman, although meetings continued to be conducted in an informal manner.

Upon this Committee fell the responsibility of assessing the elements of the problem presented to it in 1942, of keeping in close

touch with developments, and of integrating the efforts of the companies with objectives expressed by the Court to the end that company managements might be given accurate and unbiased information to aid them in reaching objectives as quickly as possible, consistent with the necessity of economic survival.

Specifically, this Committee considered its chief functions to be 1) to cooperate with regulatory agencies in providing weekly river test data, and daily odor observations in the Lewiston-Auburn area, 2) to study the mechanism of and factors affecting biochemical action upon the wastes in the river, 3) to evaluate all known and many new methods for treatment of sulphite waste liquor to reduce its pollutional effects; such methods included heat hydrolysis, furfural production from hardwood liquors, and lime treatment, to name only a few, which were considered and found not to be feasible, 4) to evaluate methods for utilization of waste liquor, and 5) to assist in determining the degree of abatement necessary, first to minimize the possibility of nuisance and then to eliminate any such possibility. As you know, the Committee has over the years on many occasions requested the assistance of the National Council for Stream Improvement; such help was always generously given.

During the time the Committee was gathering data and formulating its attack upon the problem, arrangements were made to obtain information on odor intensity in the area of Gulf Island Dam to be correlated with sulphite waste discharges, river flow and water temperature. This program initiated in 1941 was expanded and placed on a scientific basis starting on June 13, 1943, when the writer undertook the task of making daily odor observations at eight stations in the Lewiston-Auburn area. These studies have continued throughout the critical season of each year since that time.

During these eighteen years the river odor intensities have decreased from a severe city-wide odor nuisance to a zero level for the past three years. This is no mean achievement; it has meant years of hard work, planning, and the expenditure of over \$22,000,000. Incidentally, I have traversed over 15,000 miles in these two cities identifying river odor and its intensity.

It was first necessary for the Committee to develop a better understanding of the nature of the problem. It was recognized that while waste liquor as discharged from a mill digester is sterile, it contains, in addition to lignin compounds which are its chief component and which have no oxygen demand, wood sugars which can serve as nutrient for otherwise harmless bacteria which flourish in river water; thus when sulphite waste liquor

is discharged into the river at a time when the water is warm enough to allow bacterial growth, the sugars present are gradually consumed by these aerobic bacteria which at the same time consume oxygen dissolved in the water in their life processes. If this biochemical process proceeds to the point of complete oxygen exhaustion, then another bacterial type takes over, these bacteria being capable of obtaining much of their oxygen requirements from dissolved sulphates in the water. In the process of breaking down sulphates these anaerobic bacteria liberate hydrogen sulphide, which was the chief cause of the odor nuisance. In 1941 and occasionally later, hydrogen sulphide in moist air did darken the paint on some houses. Even though concentrations which could readily be detected in the air were objectionable, they were not high enough to be injurious to public health.

It was seen therefore that the key to avoidance of odor was the maintenance of at least some dissolved oxygen in all parts of the river. As the water flows to the first upstream sulphite mill in a relatively unpolluted condition, it contains dissolved oxygen in concentrations depending upon temperature. Warm water can hold in solution less oxygen than cold water; thus when water warms from 50°F to 70°F, and even to 80°F, its content of oxygen decreases, even at full saturation, from about 11 to about 7 or 8 pounds per million pounds of water.

Except for such oxygen as may be supplied by nitrate addition, the only other source of oxygen is by reaeration at the water surface, a process which is hastened when the water is agitated as when it passes over rips, a few of which still remain along the river.

Power dams were built at points of sudden drop in river elevation, that is at zones where previously considerable reaeration had taken place. From the viewpoint of pollution control there are other equally serious effects caused by the presence of dams, one is the considerable increase in water retention time, and another is the increase in river temperature resulting from the greater area of water surface exposed to the heat of the summer sun.

One notable example of a power dam which has greatly reduced the level of dissolved oxygen in the river is Gulf Island Dam, just above Lewiston, which was built in 1926-1927 and which at full capacity impounds 2½ billion cubic feet of water (increased in 1958 from 2 billion cubic feet), a volume equal to the average summer flow of the river over a 10-day period.

Having thus assessed the problem the Committee then set about to study methods of control and abatement.

The chief elements in the control of river pollution are river flow rate, water temperature and rate of sulphite waste liquor discharge. Another auxiliary control has been the addition of nitrate to provide oxygen to the water in Gulf Island Pond. The rate at which sulphite waste liquor can be discharged without complete loss of dissolved oxygen is a function of river flow rate and water temperature. The faster a river flows and the lower the water temperature, the greater is its capacity to transport wastes without nuisance.

Of the factors mentioned above, little control of flow rate is possible since flow rates from available storage are generally established to give maximum sustained water power development. No control is possible of water temperature. In general, sulphite waste liquor discharge rate is controllable only by lagooning the strong portion of the liquor, by evaporating and burning most of the liquor, or by reducing mill production rates. As mentioned above, the use of nitrate has been an important supplemental control.

The relationship between pollution load and river flow is best indicated by the Pollution Factor, defined as the number of tons of sulphite pulp, the liquor from which is discharged to the river, per million cubic feet of water flowing, both representing the same time interval. River flow is usually reported as cu. ft. per second and pulp tonnage for control purposes is generally expressed as tons per week. To determine the Pollution Factor for a given week, the tonnage of pulp produced in that week is divided by the number of million cubic feet of water which flowed during the week.

Pollution Factor does not take into account changes in effective pollution load resulting from changes in time of passage with changing river flows or from changes in water temperature. For these reasons, at a given Pollution Factor, river conditions are less favorable when flow is low or water temperature high than when flow is high and temperature low. However, summer flows are usually quite uniform and summer temperatures follow a general pattern; thus these complicating factors, especially if they are understood, do not lessen the value of Pollution Factor as an index of sulphite pollution and as an aid to predicting its effects.

A comparison of Pollution Factors for the June through September periods of 1941 and 1960 shows a decrease from a value of 5.0 in 1941 to one of 0.49 in 1960, this decrease confirming the figure of at least 85% reduction in sulphite pollution load on the river — a truly outstanding accomplishment.

Another factor employed in the control procedure is Time of Passage of polluted water in its course down the river. It is essential that the combined pollution load contributed by the three widely-separated mills does not at any time exceed the oxygen resources then existing in the river, and particularly in Gulf Island Pond just above the Twin Cities. The river travels 53 miles from Brown Company's mill at Berlin, New Hampshire, to Oxford Paper Company's mill at Rumford, Maine, then 27 miles to International Paper Company's mill at Livermore Falls, Maine, then 13 miles to upper Gulf Island Pond at North Turner Bridge, then 14 miles through the Pond to Gulf Island Dam, and finally 4 miles more to reach the Canal in the heart of Lewiston.

In order for the Administrator to arrive at values of permissible discharge of sulphite waste liquor for each mill during a particular week, and at times for particular days of a week, he must have information on the time of passage of river water between these points at flow rates commonly encountered during control seasons.

By remarkable foresight, time of passage information was obtained four years before the Administrator's control was instituted; specifically from August 11 to September 6, 1945, during which period river flows were quite uniform and at normal summer levels. Advantage was taken of mill shutdowns (Brown Company from August 12-19, Oxford from August 15 through 16) which gave marked decreases, then increases, in pollution load at all points in the river below Berlin. Many determinations were made of the oxygen consuming capacity of river water at Berlin, above Rumford, at Chisholm, at several points in Gulf Island Pond, at Gulf Island Dam, and at the Canal in Lewiston.

Plots of oxygen-consuming capacity prepared by the writer showed times of passage to be as follows:

Berlin (Brown Company) to Rumford (Oxford Paper Company) $2\frac{1}{2}$ days, Rumford to Chisholm (International Paper Company) $2\frac{1}{2}$ days, Chisholm to North Turner Bridge $\frac{1}{2}$ day, North Turner Bridge to Gulf Island Dam $9\frac{1}{2}$ days, and Gulf Island Dam to Lewiston $1\frac{1}{4}$ days. These results and other research projects which have been published are listed in the bibliography which accompanies this report.

Still another control factor is the dissolved oxygen content of the water at certain critical locations. One of the Administrator's objectives has been to endeavor to maintain sufficient dissolved oxygen at North Turner so as to prevent objectionable odor conditions in the Lewiston-Auburn area. No other single test gives

as much information concerning the condition of the river as does that for dissolved oxygen content.

Two other control tests have proved invaluable in the day-to-day control program; these are the Oxygen Consumed from Permanganate test and the Methylene Blue Stability test, the former being frequently used at all critical locations and the latter used only in Gulf Island Pond to ascertain the number of days which would elapse before odor could develop.

Regular weekly tests included 5-day incubations to determine Biochemical Oxygen Demand, as well as tests for temperature, pH, hydrogen sulphide, and color.

In general, the testing program as suggested by the Administrator and faithfully carried out by the companies has been considerably more comprehensive than that specified by the Court but the results accomplished have amply justified the testing effort and expense. The average distance covered just for obtaining river water samples is about 120 miles while the Thursday sampling program exceeds 200 miles. The cost of river testing to date is \$226,000. At this point it should be stated that no public money has been used in this or in any other phase of the sulphite waste liquor pollution abatement program on the Androscoggin River. All costs have been paid by Brown Company, Oxford Paper Company and International Paper Company.

As you well know, the control program has required close attention each day, week-ends and holidays included — in fact week-ends were often the most critical times, one reason for this being changes in mill production scheduling and another the practice followed in operating the water storage in Gulf Island Pond by which the water level is gradually pulled down over the week — then over the week-end the outflow from the Pond is practically closed off resulting in greatly increased time during which odor could develop.

I am sure you realize the importance of lagoons as a means for reducing liquor discharge to the river during the critical summer months.

In 1943, the Oxford Paper Company built an experimental lagoon at Rumford, Maine. Owing to various technical difficulties, mainly extensive shrinkage of the soil by the waste liquor, this lagoon leaked badly and had to be abandoned after an expenditure of \$52,000 by the three companies.

In 1947, the International Paper Company, with the cooperation of Brown Company and Oxford Paper Company, installed a la-

goon at Jay, Maine, which had a capacity of 22,000,000 gallons. The cost of construction was \$150,000. This lagoon proved to be quite successful although slight leakage did take place. In 1953, the International Paper Company lined this lagoon with an impervious material at a cost to them of \$16,500. The lining has been very successful and to date the lagoon has remained tight. The lining did, however, reduce the capacity of the lagoon by some 2,000,000 gallons so that the usable capacity now is 20,000,000 gallons which is adequate for present needs.

Brown Company has built two successful lagoons at Berlin, New Hampshire; the first was built in 1951 and the second in 1953. Another built earlier in 1953 proved unsuccessful because of excessive leakage and was abandoned. Near the close of the 1954 control season, in September, heavy rain associated with a hurricane damaged Brown Company's main lagoon. Repairs were made in the spring of 1955 at a cost of \$25,000. The total cost of construction of Brown Company's lagoons was \$328,000.

At the close of each control season waste liquor was allowed to remain in lagoons until the Administrator had determined that water temperature had dropped low enough to preclude any serious loss of dissolved oxygen, then, each in turn, the lagoons were drained gradually to the river.

Still another useful control procedure has been the addition of sodium nitrate to the water in Gulf Island Pond. From the start, the limitations of the nitrate program as well as its advantages were recognized. Use of nitrate was not considered as a permanent procedure but as one which would be very helpful while plans were being made for changes in mill process, and until such time as economic conditions permitted the costly changes necessary to reduce pollution on a permanent basis.

As you know, nitrate is in no sense a masking agent and was never so considered. Its value lies chiefly in the fact that it contains 50% by weight of oxygen; aerobic bacteria can utilize this oxygen when the dissolved oxygen is very low in the river water; odor producing anaerobic bacteria cannot function in the presence of nitrate. Thus, when dissolved oxygen was on the point of exhaustion in a critical part of the river nitrate was added to prevent bacterial decomposition of sulphates which would have caused development of hydrogen sulphide.

Areas of the Pond which required nitrate treatment were located by means of stability tests. The slow travel of water down the Pond permitted such testing well before the time the water reached the critical area where odor nuisance might have developed if no treatment had been given.

Nitrate was first used in the year 1948. With the exception of 1954 when river flow was unusually high and nitrate usage was only 18 tons, usage per season has varied from 92 tons in 1960 to 957 tons in 1950. The total quantity of nitrate used over the years from 1948 through 1960 has amounted to 6,694 tons. The cost of nitrate and the expense of adding it over the years 1948 through 1960 has totaled approximately \$500,000.

A search of the literature has disclosed no case of such large-scale use of sodium nitrate for the control of pollution. However, certain canning companies use sodium nitrate to prevent the formation of hydrogen sulphide in their cannery waste storage lagoons.

During periods of low river flow, the use of nitrate prevented even more drastic reductions than were made in production of the various sulphite pulp mills and thus avoided considerable additional economic loss as well as unemployment. Of even greater importance, nitrate has proved an invaluable tool for the avoidance of odor at times when river flow decreased or temperature increased unexpectedly.

Before reviewing the steps taken by the companies to reduce sulphite pollution on a permanent basis, reference should be made to legal actions brought in 1942 and subsequently, and to the record of the companies' compliance with orders of the Court.

On the basis of findings of Metcalf & Eddy, as published in Bulletin No. 1 of the Maine Sanitary Water Board, the Attorney General of Maine, on May 29, 1942, submitted to the Maine Supreme Judicial Court in Equity an **Information** which gave as the cause of recurrent obnoxious odors from the river, the discharge into the river of sulphite waste liquor by Brown Company, Oxford Paper Company, and International Paper Company.

The quantity of sulphite liquor which could be discharged to the river has been successively reduced by four agreements with the Court, the Stipulation of Dec. 17, 1942, and Decrees of Jan. 17, 1944, Dec. 5, 1947, and Dec. 30, 1948. The first three of these actions set maximum limits of weekly combined discharge, expressed as equivalent tons of pulp, whereas the fourth action, the Decree of Dec. 30, 1948, set only general limits and gave the Administrator the right and power to set weekly tonnage quotas within certain limits specified in the Decree.

As we examine the maximum limits established over the years one should bear in mind that the unregulated discharge in 1941 was that from 5,820 tons of pulp per week. The fixed maximums set are as follows: for 1943, 5,229 tons; for 1944 through 1947,

4,729 tons, and for 1948, 2,970 tons per week. For the years 1949 through 1960, weekly quotas have been established by the Administrator.

Table I and Chart I show for each year, 1941 through 1960, allowed tons, tons actually discharged, percent of allowed tons which actually were discharged, and discharge expressed as a percent of that in 1941. As we examine these figures several facts stand out clearly, 1) that 1960 discharge was only 15% of the 1941 discharge, 2) that actual discharges were well below the permitted amounts, and 3) that reductions in sulphite pollution load over the years have been accomplished at a reasonably steady pace. Parenthetically, the 1961 sulphite waste load to the river probably will not exceed five percent of the 1941 tonnage.

You will notice in Table I and Chart I that quotas of the Administrator in the year 1953 and following years are at a definitely lower level, except for the quota in 1954 which was placed high because of high, sustained river flow in that year. These lower quotas came about as the result of a voluntary agreement made by company managements at the suggestion of the Administrator, to accept quotas based on a Pollution Factor of 1.30 if the Administrator deemed such further curtailment advisable. It will be recalled that the most recent Decree, then in effect, did not give the Administrator the power to reduce quotas below those corresponding to a Pollution Factor of 1.75. This final and voluntary curtailment, together with reductions well below quotas in 1958 and 1959, and much below quota in 1960, brought about the complete eradication of odor nuisance, as will be seen in Table II and Chart II.

Because the basis of the legal actions taken was the occurrence of nuisance odors, the real criterion of progress made and final success in the abatement program is the change in odor factor over the years. Table II shows values of odor factor as well as pollution factors for the years 1943 through 1960.

Odor testing started in 1943 and has continued during each control season since that time. Although no systematic odor records are available for 1941, we can be sure that 1941 was the worst odor year; hydrogen sulphide was reported as present from Berlin to Brunswick. The next worst year was 1944, then, in order: 1947, 1945, 1943, 1946, 1948, 1957, 1952, 1951, 1950, 1953, 1955, 1956, 1949, 1954, 1958, 1959, 1960. The record shows that in 1958, 1959, and 1960, odor was not recorded at the downtown Lewiston-Auburn stations.

TABLE I

LEGAL RESTRICTIONS AND COMPLIANCE THEREWITH

	Legal Restriction In Effect	Equivalent Tons Per Week Maximum Allowed	Actual Discharge	Percent Of Allowed Actually Discharged	Percent Of 1941 Discharge
1941	None	No Limit	5820	—	100
1942	None	No Limit	5472	—	94
1943	Stipulation of Dec. 17, 1942	5229	3964	76	68
1944	Decree of	4729	3807	80	65
1945	Jan. 17, 1944	"	3764	80	64
1946		"	3841	81	66
1947		"	3360	71	58
1948	Decree of Dec. 5, 1947	2970	2480	83	43
1949	Decree of	2460	2280	93	39
1950	Dec. 30, 1948	3080	3040	99	52
1951	and rulings	3020	2660	88	46
1952	of Administrator	2560	2380	93	41
1953		2060	1980	96	34
1954		2790	2620	94	45
1955		2340	2180	93	37
1956		2020	1980	98	34
1957		1640	1630	99	28
1958		1590	1260	79	22
1959		1590	1100	69	19
1960		1480	860	58	15
1961	(Estimated)	—	275	—	5

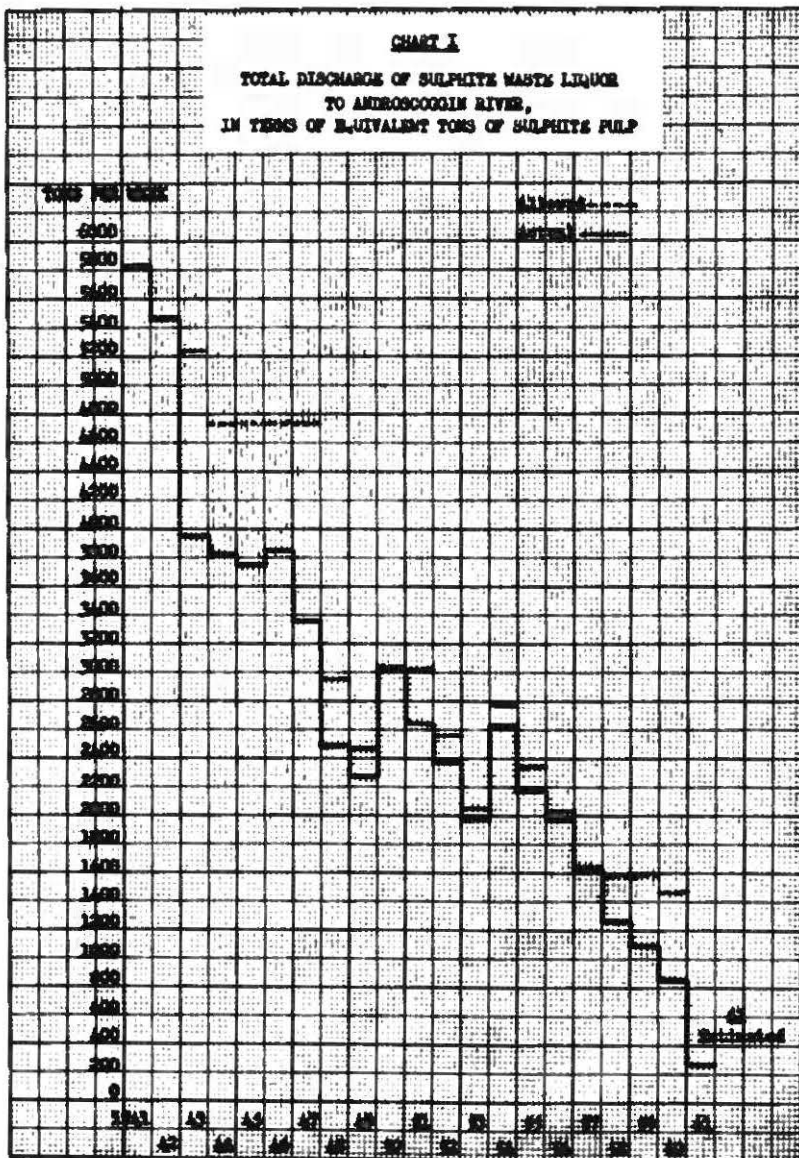
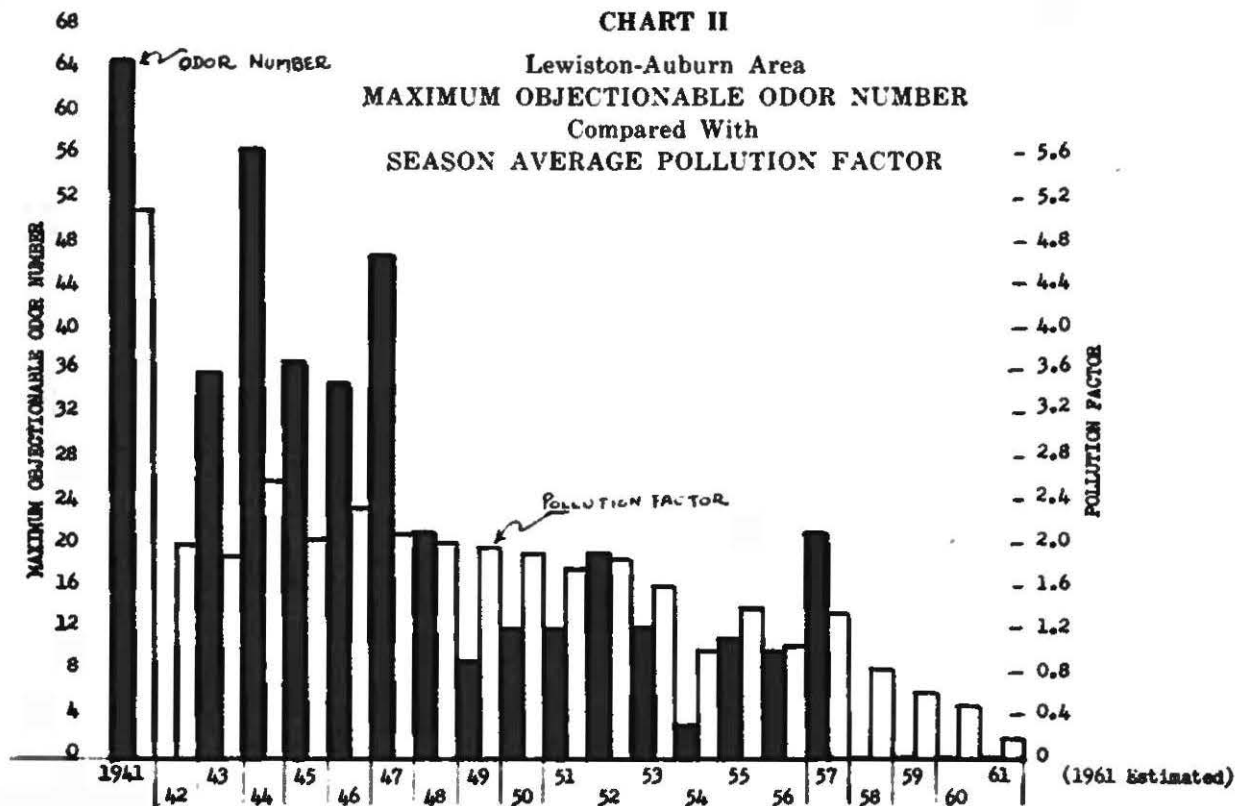


TABLE II

	Maximum Odor Factor (Lewiston-Auburn)	Pollution Factor (Tons sulphite pulp per million cu. ft. river water)
1941	65 (Estimated)	5.1
1942	—	2.0
1943	36	1.90
1944	57	2.60
1945	37	2.09
1946	35	2.38
1947	47	2.07
1948	21	2.03
1949	9	1.96
1950	12	1.90
1951	12	1.75
1952	19	1.85
1953	12	1.60
1954	3	1.00
1955	11	1.38
1956	10	1.13
1957	21	1.33
1958	0	0.81
1959	0	0.60
1960	0	0.49
1961 (Estimated)	0	0.2



In this brief review of sulphite pollution reduction and odor nuisance abatement on the Androscoggin River, I have purposely left until last a summary of the major changes made at the mills which have reduced sulphite pollution on a permanent basis. These are as follows:

March 8, 1930. The Berlin, New Hampshire, sulphite mill of the International Paper Company, which had a capacity of 60 tons per day, was shut down permanently.

July 4, 1943. The Cascade Sulphite Mill of Brown Company, which had a daily capacity of 200 tons per day, was shut down permanently.

January 11, 1958. Brown Company put into operation its new magnesium base sulphite recovery process which resulted in the reduction of sulphite waste liquor discharge to about 25 tons per day pulp equivalent. In this process about 90% of the sulphite waste liquor is evaporated and burned for the recovery of heat and chemicals.

July 2, 1959. The Oxford Division Sulphite Mill of the Oxford Paper Company, which had a capacity of 160 tons per day, was shut down permanently on July 2, 1959. This mill was dismantled in order to make room for Oxford's new kraft mill which is now in operation.

In about two or three weeks' time Oxford's Island Division mill with a capacity of about 125 tons of sulphite pulp per day will be shut down permanently.

As the result of the use of the lagoons and the permanent in-mill process changes, the daily probable sulphite pollution load to the river this summer will be only 4.8% of that discharged during the summer of 1941.

Thus, we enter the twentieth year of the Committee's existence with the knowledge that through your own and your predecessor's efforts the three companies have built lagoons and made expensive in-mill changes which have —

1. Eliminated the severe odor nuisance along the river especially in the Lewiston-Auburn area
2. Reduced the sulphite pollution load to the river to about 5% of the 1941 load
3. Reduced the Biochemical Oxygen Demand to such an extent that anaerobic conditions due to sulphite waste liquor will not occur in the future
4. Increased the dissolved oxygen content of the river water to much safer levels.

What of the future? Your Committee has solved the major problem but others, though smaller, will arise in due course of time. Some of these will center around proposals for eventual classification of the various sections of the river.

Since the companies pay a very large percentage of local taxes, the treatment of domestic wastes and their possible integration with residual mill effluents will require considerable time and effort and probably you will have to furnish much of this time and effort. The Committee's collective experience should be invaluable in dealing with these problems.

Although the nature of the problems change, the goal should remain the same; to make as much progress as possible within a sound economic frame of reference.

Acknowledgments. This report must not be closed without reference to some of the outstanding past members of this Committee who have rendered valuable service. The late Dr. Alan Wooley of Oxford who organized the Committee and served it well for several years, Oscar Anderson and Tom Mangan of International, Ted Spear, Ed Lamb and Paul Schaffrath of Oxford and Wentworth Brown and Perley Churchill of Brown Company.

Special reference must be made of Al Webber of Brown Company for his twenty years of continuous service on the Committee and for doing much of the "leg-work" for this report.

Finally, as the Administrator of the Decree and as the public's representative on the Committee, may I thank you and the executive officers of the three companies for the wholehearted support and cooperation given to me at all times. Without this and a common long-range program, the remarkable progress recorded in this report would not have been possible.

APPENDIX

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