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RARITAN RIVER SURVEYS

1955

INTERSTATE SANITATION COMMISSION

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1955

Technical Report No. 55-8
INTERSTATE SANITATION COMMISSION

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INTRODUCTION

The waters of the Raritan River flow into the waters of the Interstate Sanitation District at Victory Bridge, close to the mouth of the Raritan. As an entrant water into the Interstate Sanitation District, the Raritan River comes within the purview of Article VIII of the Tri-State Compact which states:

> "1. Each of the signatory States agrees, that insofar as waters within its jurisdiction may flow into any portion of the district, all sewage discharged or permitted to flow into any stream tributary to the tidal waters of the district shall be treated to that extent, if any, which may be necessary to maintain such tributary immediately above its confluence with the tidal waters of the district in a sanitary condition at least equal to the classification requirements determined by the commission for the tidal waters of the district into which it discharges. . . ."

The waters in the vicinity of the mouth of the Raritan River are of contemporary interest due to the imminent construction of the Middlesex County Authority Sewage Treatment Works. The Middlesex County Authority Sewage Treatment Works will discharge treated sewage into Raritan Bay, within New Jersey State waters, south of Wards Point on Staten Island. Thus, the Raritan River survey in addition to serving as an entrant water survey will also give some data about the "before" conditions in the general area. (Arthur Kill has also been surveyed and it is intended that a report on the Kill survey will be issued in the near future.) Samples in the immediate vicinity of the proposed Middlesex County Authority Sewage Treatment Works discharge site were collected and analyzed by the New York State Department of Conservation and the New Jersey Department of Health. Although several past surveys have been conducted in the Raritan Bay and the Raritan River, the determination of "average" conditions in the Bay and River and the deviation from these average conditions has not been made. The determination of representative "average" conditions requires a knowledge of the magnitude of tidal and seasonal variations which heretofore have only been roughly approximated.

This report utilizes the results of surveys conducted on the following dates:

May 31, 1955	- 34 samples
June 7, 1955	- 34 samples
June 14, 1955	- 3 samples
June 21, 1955	- 3 samples
June 28, 1955	-102 samples
July 7, 1955	- 3 samples
July 19, 1955	- 3 samples
July 26, 1955	- 3 samples
August 2-3, 1955	-144 samples
Total	329 samples

SURVEY METHODS

Sampling Stations (See Figure I)

Sampling was conducted most frequently in the immediate vicinity of the Victory Bridge. Sampling at Stations 1 and 2 was at three depths; top (5 feet), middle (15 feet), and bottom (25 to 30 feet). Station 3 is also located near Victory Bridge in the shallow waters near the south shore.

Station 4 is located at Black Buoy Number 1 at the junction of the main ship channel that continues up the Raritan, and "Titanium Reach", which extends to the Titanium Pigment Company docks. Station 5 is located off the Raritan Arsenal dock in the main ship channel and corresponds to Station Number 3 of the 1950 Raritan River Survey conducted by Rutgers University and the New Jersey State Department of Health. Station 6 is located in the main ship channel close to Crab Island at the location of a flashing green buoy. Samples at Station 3-6 inclusive were obtained at a depth of five feet below the surface.

Sampling Methods

All samples were obtained by means of a 2.2 liter Foerst water sampler. The sampler was lowered to the desired depth and then closed by means of a metal "messenger". (See Figure II) Once at the surface the samples was discharged into a standard dissolved oxygen bottle. About 1000 milliliters of the sample were allowed to flow through the dissolved oxygen bottle and another 900 milliliters through a bottle for biochemical oxygen demand. The spill-over from the dissolved oxygen and biochemical oxygen demand bottles was collected in a quart mason jar, which jar was retained for further analyses. Sterile tubes, for the determination of the most probable number of coliform organisms, were filled with the water from the sampler.

The temperatures of the water samples were obtained by means of a Weston Dial Thermometer (0 to 50°C.).

Laboratory Procedures

A temporary laboratory was set up on shipboard in order to facilitate the analyses for the May 31 and June 7 surveys. Dissolved oxygen concentrations, pH, specific gravity determinations and the innoculation of lactose tubes for an estimate of coliform concentrations were carried out on shipboard immediately after collection of the sample. Wherever applicable, "Standard Methods" were employed. Biochemical oxygen demand bottles, the innoculated coliform tubes, and the filled quart mason sample jars were returned to the Commission laboratory for further testing. The principal analyses performed in the laboratory were the determination of iron concentration, and the completion of the B.O.D. and coliform tests after the required incubation periods.

The June 27 and August 2-3 surveys were carried out from the north fender of the Victory Bridge pier. A temporary laboratory was established on the fender where dissolved oxygen and temperature determinations and the innoculation of lactose tubes were performed.

Samples obtained on other than the May 31, June 7, June 28, and August 2-3 surveys were brought back to the Commission laboratory for further tests, except for the preliminary innoculation of lactose tubes and fixing of dissolved oxygen samples which was performed in the field immediately after sampling.

RESULTS

The interpretation of survey data such as that shown in Table I offers considerable difficulty because of the variability of the data. The variability is such that one cannot, with any degree of objectivity, take the results of any of the survey days and by a simple averaging, point to the one average so obtained and state with confidence, "This is the dissolved oxygen content, typical of the river." The willingness of many individuals to accept the results of a single stream survey in regards to pollutional characteristics as definitive is surprising in view of the fact that marked seasonal changes in streams are commonly accepted. Furthermore, it is becoming increasingly plain, though not so commonly known, that changes of considerable magnitude may occur in a stream within a given season. In other words, streams have a "meteorology" as well as a "climatology" of their own.

Statistical techniques are available for the analysis of any data that are subject to a variety of influences and such techniques were applied to the survey data. Although there was cognizance of the fact that the river was subject to many other influences such as the height of the tidal range, and the degree of industrial activity, which would effect the pollutional characteristics of any tidal river, the statistical analyses were confined to four general topics.

1. Tidal effects
2. Diurnal effects
3. Seasonal effects
4. Stratification

In the sections that follow, each of the major surveys is first discussed individually, and following these, data from all of the surveys is interpreted.

MAY 31 AND JUNE 7, 1955 SURVEYS

Combined Tidal and Stratification Effects

The data for the May 31 and June 7 surveys have been arranged in rows and columns in Tables II A and II B. If there were no difference with respect to time of this data, then one logically expects that the sums of the trip columns for MPN, dissolved oxygen, and salinity will not differ radically from any one trip to another. However, such does not appear to be the case for the data. By glancing at the totals it appears that a maximum in the MPN total occurs for trip No. 2 on May 31 with minimums for dissolved oxygen and salinity on the same trip. A similar lack of homogeneity also seems to occur in the totals of the rows.

Statistics provide us with a method whereby we can investigate whether the data for trip No. 2 on May 31 was in fact different from that of the other dates. The detailed statistical analyses for the data of both May 31 and June 7 appears in Tables II B and II C.

The magnitude of the tidal effect is determined (by the C ratio in Table II B and II CO as is the combined horizontal and vertical stratification effects (indicated by the R ratio in Tables II B and II C). For the MPN data there appears to be an effect of both tide and stratification (both row and column totals are "non-homogeneous") although the magnitude of these effects does not appear to be constant. Somewhat similar conditions are apparent for the dissolved oxygen concentrations, and the percent of sea water present. However, in all cases, the changes evidenced with respect to the tide warrant further investigation, which investigation is presented in the following paragraphs.

Tidal Effects

The method employed to analyze tidal effects is essentially that developed by the Commission staff for the analysis of cyclical phenomena.* A modification of the usual method of analysis had to be used because of the fact that data for less than a full tidal cycle was obtained from the surveys. The analysis yield the following:

1. The maximum and minimum and average values consonant with the observed data. (From value of K and K_2.)
2. The phase relationship of the data for Dissolved Oxygen, etc., with the tidal current. (From value of t_0.)
3. The magnitude of the tidal effect and its statistical significance. (From analysis of variance. These analyses of variance are not here included.)

Some physical concept of the various constants can be obtained from Figure III, which Figure constitutes a graph of actual values and the curve derived from the statistical analysis of the MPN data

* Interstate Sanitation Commission Technical Report No. 55-5 "The Analysis of Water Samples for Cyclical Variations"

for Station 1-T.

Figure III indicates that the maximum value of MPN at Station 1-T occurs at the time of slack flood. (Predicted MPN maximum occurs at 12.22 EST while the time of current slack flood was 11.72 EST.) Since the Raritan River waters are most prevalent at the end of the ebb current period, i.e. at slack flood, this indicates that relatively high MPN's are associated with the Raritan River flow. On the basis of the May 31 analysis for Station 1-T alone the MPN/ml. values for Raritan River and Bay are 1080. and 1.4 respectively.

The data of Table III for May 31 indicate that waters of low salinity, dissolved oxygen and high coliform and iron concentrations are associated with the Raritan River waters. t_0 values that are close to those derived for the salinity values indicate that low values are associated with low salinities. On the other hand, t_0 values that are out of phase with the salinity values indicate that high values are associated with low salinities. For the data of May 31, it can be noted that the t_0 values for any given parameter such as MPN cluster about a central value. (It should be kept in mind that a t_0 of 12.63 hours, the length of a tidal cycle for May 31, is also equivalent to zero.)

A description of the dissolved oxygen changes during a full tidal cycle can be obtained from the May 31 data. Starting at the end of the ebb current when the Raritan River waters are most concentrated, waters varying from 12 to 21% of saturation are at the surface, while at the bottom waters of higher saturation are present with from 47 to 54% of saturation. The waters at all levels increase in percent of oxygen saturation as the flood current ensues, but the surface waters increase in percent of saturation more rapidly than the bottom waters. At the end of the flood current period, about 6.3 hours after the onset of the flood current, there is less stratification and indeed waters of relatively low dissolved oxygen may now underlay the surface waters. Specifically, at the surface are waters of from 52 to 75% of saturation while at the bottom are waters of about 67% of saturation with little horizontal variation.

A similar pattern obtains for the percent of salt water. For the surface iron concentrations, they appear to have an average value of about 0.4 ppm which increases to a maximum value of 0.5 at the end of the ebb current period and reaches a minimum of about 0.2 ppm at the end of the flood current period.

Coliform organisms (log MPN/ml.) are at their maximum at the end of the ebb current period and reach their minimum value at the end of the flood current.

The foregoing discussion is, as previously mentioned, based on the data from the May 31 survey. Attempting a similar analysis on the basis of the June 7 data shown in Table III, it becomes evident that comparable results are not obtained. For instance, the June 7 t_0 values for salinity display a much greater variation than the May 31 values. The reason for this discrepancy lies in the original data. Data obtained primarily on the flooding tide which is the case for the June 7 data, is not amenable to the type of mathematical analyses employed, since not as much variation occurs during a flood current period. Hence, it can be concluded that sampling should preferably be conducted on an ebb current rather than a flood, if a choice has to be made since it is easier to predict flood current conditions from sampling data on the ebb current rather than vice versa.

Stratification

As regards the degree of dissolved oxygen saturation there is apparently considerable stratification at the Victory Bridge section. The May 31 data indicate that waters with low dissolved oxygen saturations are at the surface. However, the data of the June 7 survey indicate that the bottom waters are deficient in oxygen. Since this comparison is on the basis of the computed average values from Table III, the change from May 31 to June 7 would indicate a considerable difference in the state of the river at these two times. However, it is important to note that the data of June 7 is not as reliable as that of May 31. This can be gleaned from the values of t_0 shown in Table III; it can be seen that these values vary considerably more for the data of June 7. The salinity data indicate a lesser degree of stratification for June 7. Considering all of these factors it appears that sampling primarily on a flood tide (which occurred on June 7) when the waters are well mixed does not give as reliable results as data obtained primarily on the ebb tide.

River Profiles

Figures IV and V are profiles of the surface waters of the Raritan during the periods of the surveys. These figures indicate:

1. Dissolved Oxygen. As the Raritan River water concentration increases (as one proceeds upstream) the amount of oxygen decreases.
2. Biochemical Oxygen Demand. Essentially constant through the stretch of water under investigation.
3. Iron. Exhibits considerable variation but apparently maximum values occur intermittently at sampling station No. 4.
4. MPN. Higher values appear to occur upstream at Victory Bridge.

TWELVE HOUR SURVEY OF JUNE 28, 1955

The survey of June 28, 1955 indicated the same general characteristics as the surveys of May 31 and June 7, 1955. The history of the survey in dissolved oxygen, salinity, temperature, iron, and coliform organism concentrations is discussed in detail below.

Dissolved Oxygen. (Figure VI) Both the average values for the parts per million dissolved oxygen (6.92 ppm) and the average percent saturation of dissolved oxygen (91.6%) were quite high at the surface. There was some lessening of these high values as one proceeded downwards from the surface, however, even at the bottom the average percent saturation was 80.5%. The stratification appeared to be quite similar to that experienced previously in the May 31 and June 7 surveys, insofar as the ranges of dissolved oxygen with the tide are concerned. At the surface there was indicated about 2.7 times the variation at the bottom. Some of the surface variation appears due to photosynthetic activities which caused high dissolved oxygen contents in the late afternoon. An analysis of the daily cycle appears in the discussion of the August 2-3 survey.

The values for the tidal analysis are presented in Tables IV, V, and VI. The t_0 values of approximately six hours indicate that the waters of high dissolved oxygen content were associated with the Raritan Bay waters.

Salinity. (Figure VII) The salinity values indicate some stratification, with waters of average salinity of about 11,600. ppm at the surface underlain by bottom waters of 13,600. ppm. However, what is more striking about the salinity pattern is the marked change in the tidal range of salinity with depth. At the bottom there was a comparatively small total range of about 570 ppm; at the surface this increased to 4,300 ppm. This would indicate that the river flow, for the period under investigation, was primarily restricted to the surface layers. The same general pattern was observed in the May 31 and June 7 surveys. High salinity values do not appear to be associated, as well as one might expect, with the high dissolved oxygen contents of Raritan Bay waters. It would appear that inasmuch as waters of high temperature were associated with the high dissolved oxygen waters (note the close agreement of the t_0 values in the tables for these parameters at all levels) that photosynthetic activity was marked.

Temperature. Comparatively warm waters were associated with the Bay waters. However, there was not much change in temperature during a tidal cycle, about 2°C. in all. The average surface temperature was about 23.7°C., with slightly cooler waters of average temperature 22.8 C. on the bottom.

Iron. The average iron concentration was about 0.14 parts per million. Although there appeared to be a greater variation at the surface for the June 28 survey, any conclusions as to iron concentrations must be considered as tentative. The iron concentrations were all relatively low; this fact, coupled with the method of analyses used, tend to make the iron data somewhat unreliable.

Coliform Concentrations. (Figure VIII) The statistical analyses of the June 28 survey coliform data was carried out using both the actual MPN values obtained and the log MPN. The parameters derived from these analyses do not appear to differ significantly with either of the methods employed. With an increase of depth the analyses indicate that there was a diminution of coliform concentration both in average values and in the range of values. This was essentially the same type of stratification noted for the previous surveys; although the stratification appeared more distinct for the June 28 survey. High MPN values were associated with the Raritan River waters; MPN values on the whole increased as the percentage of river water increased. The average MPN/ml. values were 130., 60. and 30. for the top, middle, and bottom sampling points respectively.

TWENTY-FOUR HOUR SURVEY OF AUGUST 2-3, 1955

The August 2-3 survey demonstrated marked departures from the experiences of the major previously conducted 1955 Raritan River surveys. These changes indicated a change in regimen of the river itself insofar as the mixing of elements contained in the river waters are concerned; the changes are probably ascribable to the long, dry spell preceding the August 2-3 survey and possibly other effects. This dry spell presumably decreased the Raritan River flow and in effect changed the Raritan from a river to an arm of the sea. A detailed description of the changed river regimen evidenced by the August 2-3 survey and its departure from previous experience is presented in the following paragraphs. The change in the Raritan can perhaps best be considered by a perusal of the salinity data.

Salinity. The table below presents salinity data for the June 28 survey, when the riverlike characteristics of the Raritan were more in evidence, and the data for the August 2-3 survey after the riverlike characteristics of the Raritan had been considerably repressed.

Tidal Cycle
Salinity Parameters

	June 28, 1955			August 2-3, 1955		
	Top	Middle	Bottom	Top	Middle	Bottom
K_1	11,558.	12,819.	13,511.	14,062.	14,148.	14,312.
K_2	2,158.	885.	287.	807.	990.	721.
t_0	4.55	4.19	3.35	4.33	4.57	4.74

The K_1 values are average values of salinity (as ppm chlorides). They indicate that on August 2-3 there were comparatively minor differences in the average values from top to bottom, i.e. there was little vertical stratification. The plotted graph of salinity for August 2-3 (Figure IX) gives a visual demonstration of this lack of vertical difference. However, although the average value at a given sampling station may be the same as at another station, the range of values encountered may differ considerably.

The range in values for salinity at top, mid and bottom depths were about the same for the August 2-3 survey. This is indicated by the K_2 values which range between 807 and 990 ppm. The K_2 value gives the amplitude of the sine curve associated with the salinity. Thus, the maximum value can be obtained by adding K_2 to K_1 (for the top stratum on August 2-3 this amounts to 14,860 ppm) and the minimum value by subtracting K_2 from K_1 (for the top stratum on August 2-3 this amounts to 13,255 ppm). That this gives a reasonable representation of the range of salinity values can be ascertained by a perusal of the graphed salinity data.

The difference between the June 28 and August 2-3 surveys in both the average values and the range of salinity values is demonstrated in the graph (Figure X) showing the surface salinities on both these dates. It is apparent that the June 28 surface values were consistently below the August 2-3 values and that the range of values was considerably greater during the earlier survey.

If a t_0 of about six hours (6.0) occurs, this indicates that high salinity values are associated with a flood current, whereas if a t_0 value of zero hours (0.0) occurs, this indicates that high salinity values are associated with an ebb current. The observed values of t_0 (as shown in the table) indicate that high salinities are consistently associated with flood currents. The fact that the t_0 values are not closer to six hours may well indicate that the tabulated time of maximum ebb current as it appears in the "Current Tables" is somewhat in error, or that the salinity values themselves are somewhat out of phase with the tidal currents.

Dissolved Oxygen. The water quality changes that are indicated by the August 2-3 survey salinity data are also reflected in the pollutional character of the waters.

The accompanying table shows the changes in the oxygen parameters from June 28 to August 2-3. What is at first noticeable is the general decline at all depths of the average dissolved oxygen concentrations (K_1 values), a decrease of about 1.6 parts per million.

Secondly, there is the general decrease in the range of dissolved oxygen (K_2 values) from the June 28 to the August 2-3 survey, especially in the surface value where there is a decrease of about 2.5 ppm. A glance at the plotted graph of dissolved oxygen concentrations for June 28 (Figure VI) confirms the considerable range of surface K_2 values, while another glance at the chart of August 2-3 (Figure XI) indicates the absence of a comparable variation. (Care should be taken in the examination of these graphs inasmuch as they are drawn with different scales.) The decrease in K_2 values indicates that there is no longer any great difference in the maximum and minimum values of dissolved oxygen, i.e. that there is no longer any great difference between the ebb and flood waters.

Tidal Cycle
Dissolved Oxygen Parameters
values in ppm

	June 28, 1955			August 2-3, 1955		
	Top	Middle	Bottom	Top	Middle	Bottom
K_1	6.92	6.65	6.16	5.24	4.98	4.68
K_2	2.71	1.70	1.00	0.28	0.22	0.20
t_0	6.47	6.33	6.58 hrs.	0.42	5.52	3.93

Daily Cycle
Dissolved Oxygen Parameters

K_1	7.20	5.24
K_2	2.50	0.64
t_0	12.11	11.81

The decreased difference between flood and ebb waters is also indicated by the t_0 values. t_0 values for the August 2-3 survey are variable whereas in the June 28 survey low dissolved oxygen contents are clearly associated with ebb current waters at all depths, as shown by their close adherence to a value of 6.5 hours.

There is a daily cycle evident in both the June 28 and August 2-3 surveys. This 24 hour cycle is presumably due to photosynthetic activity. (It should be noted that to some extent the tidal cycle is involved with the daily cycle since mathematically it is considerably difficult, though not impossible, to separate the cycles. This mathematical separation has not been made for this analysis.) It appears that although the daily cycle oxygen increases reached a maximum at about 6:00 P.M. in both surveys, the magnitude of the increase was much greater, (about 1.9 ppm greater) for the June 28 survey.

The tidal and daily changes that took place August 2-3 can then be described as follows below.

The average value of dissolved oxygen was about 5.24 ppm. During the day and night there was no great regular departure from this average value due to the small range of the tidal effects. This was typical not only of the surface layers but also of the middle and bottom sections. However, to some extent there was a tendency for higher dissolved oxygen concentrations (about 0.64 parts per million greater) to occur during the late afternoon presumably due to photosynthetic activity. The actual surface observations and the curve of "best" fit is shown on the accompanying graph. (Figure XII)

Coliform Organisms. Comparative data for the June 28 and August 2-3 surveys are presented in the following table.

Tidal Cycle
Log MPN Parameters

	June 28, 1955			August 2-3, 1955		
	Top	Middle	Bottom	Top	Middle	Bottom
K_1	1.91	1.50	1.39	2.29	2.49	2.36
K_2	0.53	0.61	0.37	0.15	0.20	0.31
t_0	11.03	10.78	10.25 hrs.	4.48	2.12	10.37

The data indicate that the same general pollutional pattern was prevalent for the coliform organisms on August 2-3 as for the dissolved oxygen concentrations.

The August 2-3 K_1 values indicate a negligible amount of stratification with a slightly lower concentration of coliforms at the surface. As compared to the June 28 data there is an increase indicated at all depths.

The K_2 values for August 2-3 indicate that comparatively minor changes occur with the changes in current, and that these changes occur more or less uniformly at all depths.

The t_0 values indicate that the coliform organisms are roughly distributed equally both upstream and downstream of the sampling station; i.e. high log

MPN values are not especially associated with either the flood or ebb currents.

An examination of the plotted data illustrates the characteristics of log MPN for the August 2-3 survey (Figure XIII) and a comparison with the graph with the June 28 log MPN graph (Figure VIII)indicates the considerable differences that have occurred between the two survey dates.

CONCLUSIONS

The preceding sections give a detailed characterization of the Raritan River pollutional parameters in the vicinity of Victory Bridge for the survey dates. For a concept of the River in its average state and the magnitude of its transient departures from the average state, values have to be interpolated between the survey dates and extrapolated before and after the period of the survey, in the lack of other survey data. This interpolation and extrapolation can give values which differ considerably from the true values. For instance, if a survey had not been conducted on June 28, and it would have been necessary to interpolate a value of average surface dissolved oxygen saturation for that date on the basis of the other surveys, a linear interpolation between the average values obtained for June 7 and July 7 gives 62. percent of saturation (as can be ascertained from Figure XIV). The actual survey value was 91.6 percent.

To some extent the shortcomings of linear interpolations have been removed by the methods used in the statistical analyses of survey data. See, for instance, Figure III which indicates that the predicted average value is actually less than any of the survey values. However, although extrapolation over a tidal cycle, as shown in Figure III was considered justifiable, such is not the case for seasonal changes.

Seasonal changes in other parts of New York Harbor have been observed by the Commission staff and survey data in these areas are amenable to the statistical analyses for seasonal changes. However, for one, the marked diurnal components in dissolved oxygen as discussed in the August 2-3 survey section, indicate that these diurnal changes can be large enough in magnitude to alter the entire shape of the seasonal curve. Accordingly, no generalizations have been attempted.

A scanning of the totality of the survey parameters in Table VII indicates that perhaps the single most important fact to be gleaned is the change in the Raritan experienced in late July. After this change, there appeared to be little fresh water available for the dilution of waste materials introduced into the river waters and further that this fresh water does not appear to be concentrated at the surface.

The data available as a result of the surveys described in this report will probably have its greatest use as adjuncts to the contemporary and more comprehensive surveys conducted by state agencies of New York and New Jersey and as a comparison for future surveys.

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A P P E N D I X

Sheet 1

TABLE I-A

SUMMARY OF DATA
May 31, 1955

	Trip No.	Time E.S.T. Decimal Hrs.	MPN	% D.O.	% Salinity	Fe	BOD	Temp.
1T	1	10.0833	230	37	56	0.6	2.67	20.8
	2	11.0000	460	23	48	0.4	1.61	21.0
	3	13.3333	790	58	56	0.5	3.35	20.1
	4	14.9167	78	65	64	0.3	1.60	20.2
1M	1	10.1167	230	47	66	-	1.50	20.0
	2	11.0500	330	27	56	0.5	1.56	20.2
	3	13.4167	20	52	64	-	1.88	19.9
	4	14.9833	20	62	64	-	1.53	20.0
1B	1	10.1500	45	57	72	-	1.94	19.8
	2	11.1333	20	55	68	0.6	2.13	20.8
	3	13.4667	170	56	64	-	2.91	20.0
	4	15.0333	18	60	68	-	1.52	20.0
2T	1	10.2000	330	26	54	0.6	1.75	20.8
	2	11.1833	230	13	52	0.5	0.94	20.6
	3	13.5000	78	56	60	0.6	2.52	20
	4	15.1000	40	48	64	0.3	0.73	20.5
2M	1	10.2333	170	45	67	0.3	1.90	19.9
	2	11.2500	230	26	56	-	1.85	20.5
	3	13.5333	130	49	56	-	2.10	20
	4	15.1333	20	47	68	-	0.50	20.0
2B	1	10.2667	110	48	68	-	1.91	19.8
	2	11.2833	20	48	64	-	1.75	19.8
	3	13.5833	45	57	64	-	1.91	19
	4	15.1667	20	64	68	-	1.60	20.0
3T	1	10.4000	490	33	55	0.5	2.33	20.6
	2	11.3333	490	23	48	0.5	1.59	20.2
	3	13.6667	130	55	56	0.5	1.82	20.2
	4	14.8167	78	69	72	0.5	3.84	20.8
4T	1	10.6833	5400	14	52	0.6	1.00	21.5
	2	11.4167	5400	13	40	0.6	0.93	21.0
	3	13.8333	220	33	48	0.6	2.34	21.5
	4	14.6333	68	44	52	-	2.23	21.6
5T	1	14.0000	790	28	40	0.5	1.87	22.3
6T	1	14.2500	230	26	36	1.0	1.79	22.5

6T

TABLE I-B

SUMMARY OF DATA
June 7, 1955

	Trip No.	Time E.S.T. Decimal Hrs.	MPN	% D.O.	% Salinity	Fe	BOD	Temp.
1T	1	10.0833	1300	32	68	0.8	1.25	20
	2	11.4667	330	15	64	0.7	0.01	19.9
	3	12.5833	330	42	56	2.6	1.83	-
	4	13.5000	490	33	60	1.5	1.67	20
1M	1	10.1333	490	31	68	-	0.32	20
	2	11.5000	230	13	64	-	0.02	19.6
	3	12.6667	270	37	64	-	2.09	-
	4	13.5500	330	29	60	-	1.95	20
1B	1	10.2000	130	33	68	-	0.85	19.9
	2	11.5333	130	16	64	-	0.12	19.1
	3	12.7500	78	33	64	-	1.78	-
	4	13.5833	460	18	64	-	0.70	19.8
2T	1	10.2500	330	33	68	0.6	1.12	20
	2	11.5833	170	18	68	0.7	0.11	19.9
	3	12.8000	330	37	56	2.2	1.63	20.5
	4	13.6333	460	49	56	1.5	2.79	20.2
2M	1	10.3000	490	35	68	-	1.05	20
	2	11.6333	220	-	68	-	-	19.5
	3	12.8333	-	36	64	-	1.64	19.8
	4	13.6667	700	51	56	-	3.29	20.1
2B	1	10.3500	230	27	68	-	0.66	19.9
	2	11.6667	78	41	68	-	2.17	19.5
	3	12.8833	78	37	64	-	2.24	19.6
	4	13.7000	230	30	60	-	1.38	20.0
3T	1	10.4667	230	30	64	1.3	2.24	20
	2	11.7500	130	34	60	1.3	1.77	20
	3	13.0000	700	37	56	1.0	2.20	20.5
	4	13.7500	330	44	56	1.5	2.20	-
4T	1	10.5833	230	38	56	1.0	2.15	20.5
	2	11.9167	460	38	52	1.4	2.34	20.8
	3	13.0500	410	34	52	4.4	1.72	20.8
	4	13.8333	230	27	52	10.8	1.82	21
5T	1	10.8333	790	30	48	0.8	2.23	21.0
6T	1	11.0000	790	20	44	2.3	1.57	21.0

TABLE 1-C
RARITAN RIVER SURVEY OF JUNE 28, 1955

Time	MPN/ML.			Dissolved Oxygen (P.P.M.)			Salinity (P.P.M.)			Temperature°C.			Iron (P.P.M.)		
EDST	T	M	B	T	M	B	T	M	B	T	M	B	T	M	B
0830	240	49	17	4.29	4.33	6.25	9660	11510	13290	22.4	22.3	21.5	.1	.1	.1
0850	350*			3.65	5.03	5.79	8860	11660	13090	22.8	22.2	21.9	.1	.1	.1
0910				4.17	4.89	5.54	9860	11400	13040	22.3	22.5	22.0	.1	.1	.1
0930	540	280	22	4.45	5.38	5.75	9270	12230	13100	22.6	22.3	22.2	.1	.1	.1
0950				4.11	5.29	0.50	8610	12050	12890	23.0	22.2	21.7	.2	.0	.1
1010				4.45	5.13	6.08	8940	11960	13890	23.0	22.0	21.3	.2	.2	.1
1030	130	130	49	4.81	5.26	5.32	8460	11410	14030	23.5	22.0	20.8	.2	.2	.1
1050	350*			4.79	5.82	6.18	9070	12850	14050	23.4	21.9	21.4	.1	.1	.1
1110				3.49	4.60	4.43	9960	13470	13870	23.4	21.6	21.4	.1	.1	.1
1130	130	23	23	4.50	5.49	6.11	11570	13650	13730	22.8	21.5	21.2	.1	.1	.1
1150	170*			6.10	6.10	6.20	11890	13050	13670	22.8	21.9	21.3	.2	.2	.2
1210				5.55	6.28	6.04	12200	13490	13490	23.6	22.0	21.9	.1	.1	.1
1230	49	23	70	6.40	6.05	6.13	12900	12140	13550	22.8	22.3	22.0	.3	.2	.2
1250	49*			6.85	6.90	6.35	12850	13160	13350	23.4	22.8	22.3	.2	.2	.2
1310				6.95	-	7.10	13090	13070	13540	23.0	22.5	22.3	.2	.3	.2
1330	79	22	13	6.43	6.85	6.07	13360	13360	13630	22.7	23.2	22.3	.1	.1	.1
1350	79*			2.82	-	1.90	12970	13100	13590	24.3	23.7	22.9	.3	.3	.3
1410				5.63	5.80	6.05	13060	14160	13570	23.9	23.2	22.6	.4	.2	.0
1430	23	11	23	7.60	7.70	6.70	13390	13460	13690	24.8	24.1	23.2	.3	.3	.3
1450	22*			7.70	6.90	6.62	13250	13360	13600	23.8	22.8	23.1	.2	.1	.0
1510				8.26	6.70	6.42	13190	13460	13750	23.4	22.7	22.3	.1	.0	.1
1530	33	4.5	14	7.70	6.35	4.95	13470	13800	13830	24.2	22.9	22.6	.1	.1	.1
1550	17*			8.00	7.41	6.41	13360	13530	13990	24.7	23.5	22.9	.1	.1	.1
1610				7.88	7.34	7.10	13340	13470	13890	24.0	24.3	23.3	.1	.2	.1
1630	13	7.8	17	8.75	7.40	9.05	13310	13470	13950	23.6	22.6	22.6	.2	.1	.1
1650	11*			9.12	8.35	6.90	12770	13170	13750	24.4	23.5	23.0	.2	.1	.1
1710				9.65	7.49	7.19	12900	13670	13650	24.5	23.7	22.5	.2	.1	.1
1730	49	17	6.8	11.88	7.50	7.10	10910	13860	13940	26.2	23.6	22.9	.1	.2	.2
1750	49*			9.70	8.05	7.50	12660	12720	13440	25.0	23.5	23.0	.1	.1	.1
1810				10.20	7.80	7.05	12260	13060	13410	25.2	23.7	23.4	.1	.1	.2
1830	79	70	130	10.60	8.40	7.40	12190	12830	12970	24.1	23.4	22.6	.2	.2	.1
1850	79*			8.75	7.45	6.95	12260	12870	13170	24.0	23.1	22.6	.2	.2	.2
1910				9.52	8.80	6.90	12140	12390	13160	24.0	23.5	22.4	.2	.2	.1
1930	130	49	13	9.50	8.8 0	7.00	11760	12190	13010	23.7	23.5	22.6	.0	.2	.1
	130*														

* Duplicate surface sample

TABLE I-D

RARITAN RIVER SURVEY OF AUGUST 2-3, 1955

Sheet 2

Time E.S.T.	Air Temp. °C.	Wind Direction and Speed mph	Temperature °C. T	Temperature °C. M	Temperature °C. B	D.O. (p.p.m.) T	D.O. (p.p.m.) M	D.O. (p.p.m.) B	Salinity (p.p.m.) T	Salinity (p.p.m.) M	Salinity (p.p.m.) B	D.O. % Saturation T	D.O. % Saturation M	D.O. % Saturation B	M.P.N./ml. T	M.P.N./ml. M	M.P.N./ml. B
1930	32.5	NE 2-3	26.0	25.5	-	5.58	5.88	5.24	15050	14870	14990	79.5	82.8	73.7	240	-	-
2000	32.1	NE 5-7	26.1	26.1	25.9	7.32	5.56	5.22	14160	15090	15260	103.4	79.4	74.5	49	170	49
2030	29.8	NE 5-7	26.0	26.0	26.0	6.64	5.42	5.66	14280	15070	15030	93.8	77.2	80.6	240	-	-
2100	30.0	NE 1-2	26.2	26.4	26.0	6.09	5.23	5.11	14610	14700	14860	86.8	74.9	72.7	280	330	49
2130	29.0	NE 1-3	26.5	27.0	27.0	5.48	5.78	5.77	15260	14870	14650	79.1	83.9	83.5	130	-	-
2200	29.5	NE 1-3	27.0	26.5	27.0	5.41	5.80	3.70	14470	14230	14550	78.2	82.7	53.5	790	1300	330
2230	29.5	NE 1-3	27.0	26.5	26.5	5.53	5.58	5.35	14300	13850	14560	79.7	79.3	76.5	48	-	-
2300	29.0	NE 1-3	26.6	26.6	26.9	5.08	5.24	5.22	14230	14470	14230	72.6	75.1	74.7	330	790	1300
2330	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2400	27.0	NE 1-3	26.7	26.9	27.0	4.81	4.91	4.92	13300	13190	13360	68.1	69.7	70.2	170	170	490
0030	27.0	NE 2-3	27.0	27.0	26.4	5.39	4.73	4.96	14270	13130	13630	77.7	67.3	70.2	110	-	-
0100	26.0	NE 3-5	27.0	27.0	26.5	4.86	4.88	4.77	14310	12890	13970	70.0	69.2	67.9	18	490	230
0130	26.0	NE 3-5	27.0	27.0	26.6	4.81	4.59	3.71	12610	13350	13400	68.0	65.5	53.1	790	-	-
0200	26.0	NE 3-5	26.9	27.0	27.0	4.97	4.61	4.59	12660	13130	13690	70.3	65.6	66.5	170	220	330
0230	26.0	NE 5-7	27.0	27.0	26.8	4.33	4.67	4.54	12500	13330	13660	61.2	66.6	65.4	45	-	-
0300	25.5	NE 3-5	26.8	26.5	26.2	4.69	4.79	4.52	13250	13730	13910	66.2	67.9	63.9	<18	170	790
0330	25.0	NE 7-9	26.2	26.2	26.0	4.58	4.61	4.62	13800	13950	14330	65.0	65.2	65.3	490	-	-
0400	24.9	W 7-9	26.0	26.0	25.8	4.74	4.84	4.81	14200	14570	14760	66.9	68.6	68.0	330	220	170
0430	24.0	NNE 5-7	25.5	25.2	25.2	4.64	4.60	4.71	14810	14690	14480	65.4	64.4	65.8	790	-	-
0500	23.4	NNE 7-9	25.8	25.8	25.5	4.14	4.74	4.96	14870	14790	14510	58.6	67.0	69.6	490	220	130
0530	23.5	NNE 5-7	25.5	25.8	25.8	5.12	4.50	4.79	14830	14550	14670	72.2	63.5	67.6	490	-	-
0600	24.0	NNE 1-3	25.5	25.7	25.7	4.80	4.42	4.66	14990	15050	14950	67.7	62.6	66.0	110	170	170
0630	24.5	N 3-5	25.9	25.9	26.1	4.59	4.52	4.58	15060	14670	14490	65.3	63.9	65.0	79	-	-
0700	24.8	N 5-7	25.6	25.8	25.8	4.48	4.59	4.32	14930	14950	-	63.4	65.1	60.9	49	64	-
0730																	
0800																	

102055:p

TABLE I-E

RARITAN RIVER SURVEY OF AUGUST 2-3, 1955

Sheet 1

Time E.S.T.	Air Temp. °C.	Wind Direction and Speed mph	Temperature °C. T	M	B	D. O. (p.p.m.) T	M	B	Salinity (p.p.m.) T	M	B	D. O. % Saturation T	M	B	M.P.N./ml. T	M	B
0700	26.6	SW 3-5	25.3	25.1	25.1	4.10	4.30	4.10	14370	14660	14580	57.3	60.1	57.3	16000+	9200	280
0730	27.6	SW 5-8	25.2	25.1	25.1	4.20	4.40	3.90	14600	-	14700	58.7	61.5	54.5	5400	-	-
0800	28.8	SW 5-8	26.0	25.2	25.1	5.00	5.30	3.10	13460	14870	14500	70.0	74.3	43.2	79	460	130
0830	30.0	WNW 5-8	25.9	25.1	25.1	5.10	3.00	3.50	13530	13840	14390	71.3	41.6	48.6	79	-	-
0900	30.4	WNW 8-12	25.9	25.3	25.2	5.00	4.50	4.20	13960	14510	14500	70.3	62.9	58.7	2400	330	700
0930	31.2	-	26.1	25.6	25.5	5.30	4.80	4.70	14270	14410	14260	75.1	67.4	65.7	330	-	-
1000	32.2	W 8-12	26.2	25.6	25.5	5.15	4.60	4.65	13230	14060	13820	72.2	64.3	64.9	330	330	700
1030	-	NW 12-15	26.2	25.8	25.4	5.92	5.10	4.40	13370	13730	14350	83.1	71.3	61.5	<18	-	-
1100	33.9	N 8-12	26.9	26.0	25.4	5.80	5.40	4.30	13140	13700	13800	82.4	75.8	59.7	330	790	700
1130	33.6	NW 8-12	26.9	26.1	25.6	5.80	5.20	4.40	13080	13460	14090	82.4	72.9	61.5	170	-	-
1200	34.4	NW 8-12	27.1	25.9	25.5	5.80	4.70	4.10	13350	13010	13930	82.9	65.4	57.2	790	330	45
1230	34.8	W 15-18	27.9	26.6	25.8	2.30	5.40	4.50	12510	12660	12990	33.0	75.7	62.4	20	-	-
1300	-	NNW 12-15	27.7	26.0	25.6	6.20	4.40	3.71	13950	12490	13370	90.2	60.9	51.5	45	230	490
1330	35.5	W 8-12	27.7	26.0	26.8	6.09	4.40	6.40	13740	12570	13810	88.4	60.9	91.4	170	-	-
1400	-	W 12-15	27.7	26.2	25.6	6.40	4.51	3.79	13100	12680	12520	92.1	62.8	52.1	220	170	330
1430	36.1	WSW 8-12	26.8	25.7	25.4	5.00	4.40	4.15	13360	14130	13590	71.0	61.7	57.5	49	-	-
1500	-	-	26.6	26.1	25.9	5.40	5.10	4.70	14230	14670	14160	77.1	72.5	66.2	1100	700	330
1530	36.6	-	27.4	26.8	26.6	5.50	5.60	5.20	14310	14130	14500	79.9	80.2	74.5	210	-	-
1600	36.3	NW 15-18	26.6	26.6	26.2	3.45	3.85	2.80	14310	14550	14690	49.3	55.2	39.9	220	460	460
1630	-	N 20-25	26.8	27.0	26.4	5.90	5.85	5.55	14470	14680	14790	84.9	84.7	79.5	490	-	-
1700	36.4	N 15-18	26.6	26.8	26.3	5.90	5.90	5.50	14830	14830	14950	84.9	85.3	78.8	350	240	79
1730	36.0	N 15-18	26.5	26.2	26.0	6.20	5.80	5.55	14680	15030	15130	89.0	83.0	79.2	33	-	-
1800	35.6	N 12-15	26.4	26.4	26.0	5.95	5.79	5.91	14880	14790	15030	85.4	83.0	84.2	70	79	49
1830	36.4	E 3-5	26.6	26.4	26.2	6.30	6.00	5.40	14950	15050	15090	90.8	86.2	77.4	170	-	-
1900	35.1	NE 3.5	26.4	26.1	26.0	5.75	6.18	5.49	14930	15030	15160	82.6	88.3	78.3	240	70	95

TABLE II A

ANALYSIS OF MPN DATA - MPN PER ML.
STATIONS 1 & 2 - MAY 31, 1955

Trip No. / Sta.No.	1	2	3	4	Total
1T	230	460	790	78	1558
1M	230	330	20	20	600
1B	45	20	170	18	253
2T	330	230	78	40	678
2M	170	230	130	20	550
2B	110	20	45	20	195
Total	1115	1290	1233	196	3834

ANALYSIS OF MPN DATA - MPN PER ML.
STATIONS 1 & 2 - JUNE 7, 1955

Sta.No.	1	2	3	4	Total
1T	1300	330	330	490	2120
1M	490	230	270	330	1050
1B	130	130	78	460	720
2T	330	170	330	460	960
2M	490	220	-	700	1410
2B	230	78	78	230	538
Total	2970	1158	-	2670	6798

ANALYSIS OF D.O. DATA - % Saturation
STATIONS 1 & 2 - MAY 31, 1955

Sta.No.	1	2	3	4	Total
1T	37	23	58	65	183
1M	47	27	52	62	188
1B	57	55	56	60	228
2T	26	13	56	48	143
2M	45	26	49	47	167
2B	48	48	57	64	217
Total	260	192	328	346	1126

ANALYSIS OF D.O. DATA - % Saturation
STATIONS 1 & 2 - JUNE 7, 1955

Sta.No.	1	2	3	4	Total
1T	32	15	42	33	107
1M	31	13	37	29	97
1B	33	16	33	18	84
2T	33	18	37	49	119
2M	35	-	36	51	122
2B	27	41	37	30	94
Total	191		222	210	623

ANALYSIS OF SALINITY DATA - % Saturation
STATIONS 1 & 2 - MAY 31, 1955

Sta.No.	1	2	3	4	Total
1T	56	48	56	64	224
1M	66	56	64	64	250
1B	72	68	64	68	272
2T	54	52	60	64	230
2M	67	56	56	68	247
2B	68	64	64	68	264
Total	383	344	364	396	1487

ANALYSIS OF SALINITY DATA - % Saturation
STATIONS 1 & 2 - JUNE 7, 1955

Sta.No.	1	2	3	4	Total
1T	68	64	56	60	248
1M	68	64	64	60	256
1B	68	64	64	64	260
2T	68	68	56	56	248
2M	68	68	64	56	256
2B	68	68	64	60	260
Total	408	396	368	356	1528

TABLE II-B

ANALYSIS OF VARIANCE
Stations 1 & 2
May 31, 1955

MPN/ML.

		Sum of Squares	Degrees of Freedom	Mean Squares
1,372,442	612,481.500	759,960.500	-	
744,338.333	612,481.500	131,856.833	3	43,952.2776
912,895.500	612,481.500	300,414.000	5	60,082.8000
		327,689.667	15	21,845.9778

C ratio (3,15) = 2.01 P = .20 - .05

R ratio (5,15) = 2.75 P = .20 - .05

DISSOLVED OXYGEN (% SATURATION)

57,532.0000	52,828.1667	4,703.8333		
55,294.0000	52,828.1667	2,465.8333	3	821.9444
54,061.0000	52,828.1667	1,232.8333	5	246.5667
		1,005.1667	15	67.0111

C ratio (3,15) = 12.265 P = .001

R ratio (5,15) = 3.679 P = .05

PERCENT SEA WATER

93,025.	92,132.0416	892.9584		
92,389.5000	92,132.0416	257.4584	3	85.8194 667
92,566.2500	92,132.0416	434.2084	5	86.8416 800
		201.2916	15	13.4194 400

C ratio (3,15) = 6.395 P = .01

R ratio (5,15) = 6.471 P = .01

TABLE II-C

ANALYSIS OF VARIANCE
Stations 1 & 2
June 7, 1955

MPN/ML.

			Sum of Squares	Degrees of Freedom	Mean Squares
T	3,926,084	2,567,378.	1,358,706.00	-	
C	3,104,814.67	2,567,378.	537,436.67	2	268,718.335
R	2,881,794.00	2,567,378.	314,416.00	5	62,883.200
			506,853.33	10	50,685.333

C ratio (2,10) = 5.30   P = .05

R ratio (1,24) = 1.24   P = greater than .20

DISSOLVED OXYGEN (% SATURATION)

T	22,529.	21,562.7222	966.2778	-	
C	21,931.6667	21,562.7222	368.9445	2	184.4723 0
R	21,644.1667	21,562.7222	81.4445	5	16.2889 0
			515.8888	10	51.5888 8

C ratio (2,10) = 3.58   P = .20 - .05

R ratio (5,10) = 0.32   -

PERCENT SEA WATER

T	97,728.	97,282.6667	445.3333		
C	97,320.0000	97,282.6667	37.3333	3	12.4444
R	97,573.3333	97,282.6667	290.6667	5	58.1336
			117.3333	15	7.8222

C ratio (3,15) = 1.59   P = less than .20

R ratio (5,15) = 7.43   P = .001

TABLE III

TIDAL ANALYSES

Station	K		K_2		t_0(hours)	
	DISSOLVED OXYGEN SATURATION					
	(1)	(2)	(1)	(2)	(1)	(2)
1T	53.2214	70.0101	22.5	51.3	5.28	1.14
1M	61.8077	46.7171	25.7	24.9	6.50	1.21
1B	60.5040	33.0972	6.04	10.9	7.02	2.39
2T	32.5480	75.3528	20.1	54.4	3.71	1.16
2M	48.0779	-	12.1	-	6.51	-
2B	57.6683	5.1665	9.97	35.9	5.59	7.86
Average	52.3046	46.0687	16.07	35.48	5.77	2.75
	SALINITY (PERCENT SEAWATER)					
1T	64.5316	69.0767	14.7	2.11	6.71	1.01
1M	66.8411	63.6567	7.38	3.10	7.15	4.27
1B	73.1264	69.9467	9.21	6.48	8.06	2.27
2T	60.1336	57.4719	7.13	11.4	5.63	5.83
2M	75.0984	-	22.5	-	7.57	-
2B	70.6360	58.0873	7.85	10.6	7.64	6.78
Average	68.3945	63.6479	11.46	6.74	7.13	4.03
	LOG (MPN PER ML.)					
1T	1.5939	3.6207	1.44	1.16	0.91	1.89
1M	1.9375	2.4211	0.728	0.12	10.16	6.88
1B	1.0524	3.1015	0.917	1.19	1.33	1.17
2T	2.0481	3.1322	0.476	0.84	11.61	1.30
2M	1.4519	-	0.996	-	0.39	-
2B	1.7112	3.3375	0.324	1.52	9.88	1.73
Average	1.6325	3.1226	0.814	0.97	12.03	2.59
	IRON					
1T	0.4117	0.7564	0.111	1.07	11.30	9.17
2T	0.3523	0.7964	0.262	1.00	0.50	9.73
Average	0.3820	0.7764	0.187	1.04	12.22	9.45

(1) Data for May 31, 1955 Survey
(2) Data for June 7, 1955 Survey

TABLE IV

STATION 1T

June 28, 1955

	DO (ppm) Y1	DO (%) Y2	Sal. (ppm) Y3	Temp(°C) Y4	Iron(ppm) Y5	MPN/ml. Y6	Log MPN/ml. Y7
K	+ 6.1630	+ 80.5224	+ 13,511.1429	+ 22.2691	+ 0.1243	+ 33.6383	+ 1.3875
A_1	- 1.0038	- 14.1764	24.2568	- 0.7409	+ 0.000683	- 0.3959	+ 0.1267
A_2	+ 0.1106	+ 0.9156	- 285.0880	- 0.2123	- 0.0176	+ 7.5896	+ 0.3490
Cot t_0	+ 9.0759	+ 15.4832	- 0.0851	- 3.4899	+ 0.0388	+ 0.0522	- 0.3630
t_0 (°)	186° 20'	183° 40'	94° 50'	164° 0'	87° 50'	267° 0'	290° 0'
t_0 (hrs.)	6.58	6.49	3.35	5.79	3.10	9.43	10.25
Sine t_0	0.1103	0.0640	0.9964	0.2756	0.9993	0.9986	0.9397
Cosine t_0	0.9939	0.9980	0.0843	0.9613	0.0378	0.0523	0.3420
K_2	1.0100	14.205	287.74	0.77073	0.018069	7.5698	0.37047
K_2	1.0027	14.306	286.12	0.77032	0.017612	7.6002	0.37140

TABLE ~~III~~ V

STATION 1M

June 28, 1955

	DO(ppm) Y1	DO (%) Y2	Sal.(ppm) Y3	Temp(°C) Y4	Iron(ppm) Y5	MPN Y6	Log.MPN/ml. Y7
K	+ 6.6465	+ 87.2768	+ 12,818.9267	+ 22.8271	+ 0.1443	+ 60.5852	+ 1.5027
A_1	- 1.6917	- 23.7617	424.5931	- 0.8142	- 0.000825	+ 46.7657	+ 0.3528
A_2	- 0.0250	- 1.0196	- 778.0885	- 0.1165	- 0.0334	+ 55.7653	+ 0.5011
Cot t_0	- 67.6680	- 23.3049	- 0.5457	- 6.9888	- 0.0247	- 0.8386	- 0.7041
t_0 (°)	179° 10'	177° 30'	118° 40'	171° 50'	91° 40'	310° 0'	305° 10'
t_0 (hrs.)	6.33	6.27	4.19	6.07	3.24	10.95	10.78
Sine t_0	0.0145	0.0436	0.8774	0.1421	0.9997	0.7660	0.8175
Cosine t_0	0.9999	0.9990	0.4797	0.9899	0.2333	0.6428	0.5760
K_2	1.6919	23.785	885.12	0.82251	0.035362	72.753	0.61250
K_2	1.7241	23.385	886.81	0.81985	0.033410	72.801	0.61297

TABLE VI

STATION 1T

June 28, 1955

	DO(ppm.) Y1	DO (%) Y2	Sal. (ppm) Y3	Temp.(°C) Y4	Iron (ppm) Y5	MPN/ml. Y6	Log MPN/ml. Y7
K_1	+ 6.9199	+ 91.5662	+ 11,558.3579	+ 23.6713	+ 0.1374	+ 130.8914	+ 1.9098
A_1	- 2.7135	- 39.0322	- 1,353.2696	- 0.8699	+ 0.00488	+ 93.8581	+ 0.3564
A_2	+ 0.1425	+ 0.7526	- 1,677.8754	- 0.1486	- 0.05500	+114.1486	+ 0.3946
Cot t_0	+19.0421	+ 51.8631	- 0.8065	- 5.8540	+ 0.0887	+ 0.8222	+ 0.9032
t_0 (deg.)	183° 0'	181° 10'	12850'	170° 20'	85° 0'	309° 30'	312° 10'
t_0 (hrs.)	6.47	6.40	4.55	6.02	3.00	10.94	11.03
sine t_0	0.0523	0.0204	0.7790	0.1679	0.9962	0.7716	0.7412
Cosine t_0	0.9986	0.9998	0.6271	0.9858	0.0872	0.6361	0.6713
K_2	2.7173	39.040	2158.0	0.88243	0.055963	147.55	0.53091
K_2	2.7247	36.892	2153.9	0.88505	0.055210	147.94	0.53238

TABLE VII

SURVEY SUMMARY - STATION I

		No. Obs.	Dissolved Oxygen P.P.M. K	K2	to	% Saturation K	K2	to	Salinity P.P.M. K	K2	to	% Seawater K	K2	to	Log (MPN/Ml.) K	K2	to
May 31	Top	4				53.2	22.5	5.28	11,600.	2646.	6.71	64.5	14.7	6.71	1.5939	1.44	0.91
	Middle	4				61.8	25.7	6.50	12,024.	1328.	7.15	66.8	7.38	7.15	1.9375	0.728	10.16
	Bottom	4				60.5	6.04	7.02	13,158.	1658.	8.06	73.1	9.21	8.06	1,0524	0.917	1.33
June 7	Top	4				70.0	51.3	1.14	12,438.	380.	1.01	69.1	2.11	1.01	3,6207	1.16	1.89
	Middle	4				46.7	24.9	1.21	11,466.	558.	4.27	63.7	3.10	4.27	2,4211	0.12	6.88
	Bottom	4				33.1	10.9	2.39	12,582.	1166.	2.27	69.9	6.48	2.27	3,1015	1.19	1.17
June 28	Top	34	6.92	2.72	6.47	91.6	39.0	6.40	11,558.	2155.	4.55				1,9098	0.531	11.0
	Middle	34	6.64	1.70	6.33	87.3	23.5	6.27	12,818.	886.	4.19				1,5027	0.613	10.8
	Bottom	34	6.16	1.00	6.58	80.5	14.3	6.49	13,511.	287.	3.35				1.3875	0.371	10.3
July 7	Top	1				58.1	29.9*										
	Middle	1				60.3	18.3*										
	Bottom	1				67.0	11.4*										
July 19	Top	1				57.6	17.8*										
	Middle	1				47.9	11.4*										
	Bottom	1				52.2	7.6*										
July 26	Top	1				55.8	10.7*										
	Middle	1				36.0	7.4*										
	Bottom	1				41.9	5.4*										
August 23	Top	48	5.24	0.28	0.42	74.7	3.6	0.48	14,062.	[illegible]07.	4.33				2,2899	0.150	4.48
	Middle	48	4.98	0.22	5.52	70.5	3.4	5.32	14,148.	992.	4.57				2,4921	0.210	2.12
	Bottom	48	4.68	0.20	3.93	66.2	3.1	3.91	14,312.	722.	4.74				2.3638	0.306	10.37

* Assumed Values