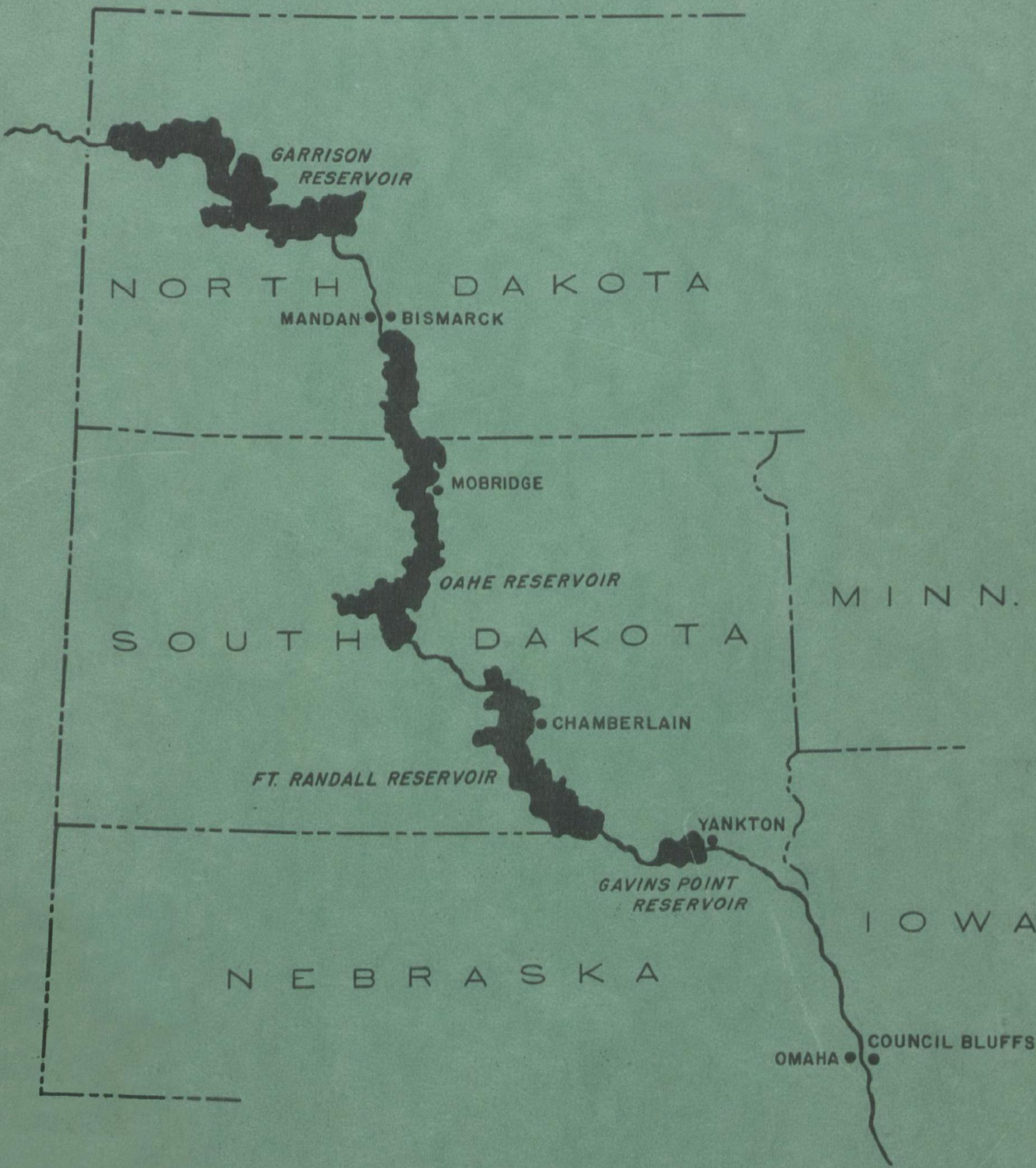
CENTRAL MISSOURI RIVER WATER QUALITY INVESTIGATION

1955



U. S. DEPARTMENT OF HEALTH, EDUCATION AND WELFARE
PUBLIC HEALTH SERVICE

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PUBLIC HEALTH SERVICE

REGION VI

WATER SUPPLY AND WATER POLLUTION CONTROL SECTION

KANSAS CITY, MISSOURI

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SUMMARY

This report covers 1955 operations of a cooperative, investigative program initiated in August 1952. The study has been subsidized by the Missouri River Division Office, Corps of Engineers, and has been conducted by the Water Supply and Water Pollution Control Section, Region VI, U. S. Public Health Service, in cooperation with the Missouri River Division, Corps of Engineers, and State Health Departments of Iowa, Nebraska, South Dakota, and North Dakota, and waterworks personnel at Council Bluffs, Iowa; Omaha, Nebraska; Yankton, Chamberlain, and Mobridge, South Dakota; and Mandan, Bismarck, and Williston, North Dakota.

Reservoir operation permitted a 36.29-foot increase in elevation of Garrison Reservoir and a 1.2-foot drop in level of Ft. Randall Reservoir. River discharges were largely regulated by reservoir releases, and available capacity ironed out peak discharges during seasons of greatest runoff.

Discharge and turbidity relationships remained as described in previous reports, but average annual turbidities were in most instances lower than those of former years. Examination of water plant records in lower river reaches disclosed that reservoirs had produced clear-cut turbidity reductions all the way to the Mississippi.

Temperature rises and declines were slowed by impounded water; and warming effects of cooling water discharges were evident at one water intake.

Chemical features again varied with seasonal changes; but reservoirs made a considerable impression upon natural river trends in this respect, slowing appearance of seasonal low hardness concentrations by three months. Ft. Randall Reservoir again decreased hardness and alkalinity concentration of impounded water, but soil leaching augmented alkalinity and hardness in water passing through Garrison Reservoir. Oxygen supersaturation again resulted from air draft to reservoir flood control release tunnels, but supersaturations due to photosynthesis were either quite rare or poorly represented by the sampling schedule.

Organic nitrogen concentration was greater than recorded in previous years, and nitrite nitrogen made its first appearance in areas unaffected by pollution. These changes bespeak possible greater nitrogen concentration from water by micro-organisms, and changes in some aspects of nitrogen utilization. Factors associated with nitrite production could not be evaluated within the limitations of established procedures. Concentration of phosphorous compounds closely approached that of previous years, although phosphate contributed by pollution occurred more commonly in the vicinity of Omaha.

Phytoplankton development in individual reservoirs exhibited fewer differences in composition than in 1954; and one population originating in Garrison Reservoir eventually spread to Ft. Randall Reservoir and to all sampled river reaches. The total annual crop was greater in Ft. Randall, but each reservoir discharged plankton concentrations at times high enough to necessitate modifications in water treatment for suppression of tastes and odors. Special procedures for taste and odor control were required at Yankton, Chamberlain, Mandan, and Bismarck. Advance notice of impending algal increases permitted water plant operators to institute control measures prior to taste and odor development.

Algal densities in critical ranges for taste and odor development are expected to be an annual feature in water supplies taken from the Missouri River at Mandan, Bismarck, Chamberlain, and Yankton. Public water supplies at Mobridge are apt to be similarly affected in the near future, and a much lesser probability exists for Omaha and Council Bluffs.

The investigation appears to have rather definitely established various modifications of chemical water quality, and causes therefor, that may be expected to result from varied aspects of reservoir operation.

Reservoirs are expected to continue production of plankton crops large enough to occasion taste and odor difficulties in water supplies, although it is possible that such crops may sometimes be withheld from reservoir releases by thermal stratification. Possibilities exist for river reaches to develop critical plankton populations independently of reservoirs.

The investigation should be carried on in its present form through Fiscal Year 1957 and may then be modified until reservoir elevations more closely approach the general levels to be maintained with planned integrated operation, after which, study should be intensified for about two years. During the interim period, a plankton surveillance should be maintained in critical river reaches to furnish water operators advance notice of algal increases necessitating special action; and continuity of chemical records should be assured by arrangements on a negotiated contract basis with State Health Department laboratories and waterworks personnel.

FORECASTS

Review of predictions made in 1954 and the extent of their realization in 1955, again appears appropriate before mention of those future developments that appear likely from analysis of 1955 events.

Hardness and alkalinity reduction resulting from factors other than dilution during seasons of heavy runoff was predicted to continue; although reversals were considered likely from soil leaching in impoundment areas. These estimates turned out to be quite descriptive of 1955 conditions. Ft. Randall Reservoir continued demineralizing trends, whereas Garrison increased hardness and alkalinity by the soil-leaching process.

Reservoir stratification was not expected during open water seasons in 1955 and 1956, and it was absent in 1955. Similar alterations of natural river trends in mineral content variation were expected of each reservoir, and each delayed appearance of annual low-mineral concentrations.

The reservoirs differed considerably in plankton composition, density, and seasons of greatest growth in 1954. Recognition was given the fact that each reservoir might continue along its own course in these respects; yet reservoirs were not expected to differ greatly on an annual basis, as typical Missouri River forms would eventually achieve dominant positions in each. Greater similarity was evident in 1955. Periods of active growth in each reservoir were not as widely separated as in 1954; dominant plankton composition was frequently the same in each; and a bloom beginning in Garrison Reservoir apparently initiated a growth of the same dominant organism in Ft. Randall.

Taste and odor problems associated with algal growths were envisioned for public water supplies at Mandan, Bismarck, Mobridge, Chamberlain, and Yankton. Mobridge was considered to have a less critical position than the other four in this regard, and did not develop taste and odor problems in 1955. Each of the four other water plants experienced difficulties.

Predictions of future occurrences at this time, as with those made in the past, must be qualified with respect to several possible eventualities. As 1955 developments rather closely followed their expected course, it appears that most probable reservoir influences upon mineral content of water have been anticipated; and future predictions along that line now appear unnecessary since various reservoir operational procedures have been considered. Before leaving this subject, however, it appears advisable to mention that hardness and alkalinity increases may be expected from water level rise and thermal stratification, whereas operation promoting uniformity of depth should generally lower concentration of these minerals.

Various factors influencing plankton growth during early stages of reservoir operation have been taken into account within the limitations of this investigation. The two reservoirs may not be expected to consistently agree or differ in various aspects of plankton development, which is influenced by both general and local river and climatological conditions. However, each reservoir has demonstrated the ability to produce plankton crops that will occasion taste and odor problems in domestic water supplies; and this characteristic of each may be expected each year although well-defined thermal stratification, which appears likely to develop in later years, may prevent discharge of some algal crops to the river below dams.

Unimpounded river reaches have initiated their own plankton growths at several localities. So far, most taste and odor problems have been associated with algal crops developed in reservoirs; but future conditions related to thermal stratification may result in problems produced independently of growths in the lakes.

Domestic water supplies taken from the river at Mandan, Bismarck, Chamberlain, and Yankton should continue to be affected by undesirable aspects of algal growths. Mobridge is likely to encounter such difficulties in the near future, and will eventually have to contend with plankton growths in Oahe Reservoir. Williston, North Dakota, may possibly experience problems during those rare occasions when Garrison Reservoir extends up to that locality.

RECOMMENDATIONS

It now appears that an additional year of study will disclose the majority of Missouri River water quality modifications to be expected of reservoirs during initial filling phases. At the beginning of this investigation, it appeared that at least one reservoir would soon reach depths comparable to those envisioned for future integrated operation; but adverse climatological conditions and other factors have postponed realization of this condition beyond the next few years. It, therefore, seems logical to modify the investigation in its present form at the end of Fiscal Year 1957, or as soon thereafter as funds allotted to this type of study are exhausted, and intensify it at a later date when reservoir elevations more closely approach the general levels to be maintained with integrated operation.

Studies to date have afforded data for quite accurate predictions of phenomena associated with filling processes, and a considerable backlog of information that will apply when the impoundments are filled. However, it is not possible to ignore variable effects of filling procedures with regard to prediction of developments to be expected with the completed reservoir system. Studies covering a two-year period at that time should allow essential filling of gaps in the present array of data, providing thereby information for long-range prediction of water quality relationships within desirable ranges of accuracy.

Advance notices of algal increases to troublesome levels have been of value to water plant operators; and continuance of an algal surveillance in critical stretches of the river during the interim period appears highly desirable. Maintenance of a current knowledge of algal densities may be accomplished by centralized analysis of samples collected and shipped by cooperating personnel, with infrequent inspection trips.

Continuity of chemical records at selected localities should be maintained over the next few years. Arrangements may be made for collection and analysis of samples on a negotiated contract basis with State Health Department laboratories and Waterworks personnel.

INTRODUCTION

This progress report concerns 1955 operations of the Central Missouri River Water Quality Investigation initiated in 1952. Earlier phases of the study (August 1952 - December 1953 and 1954) have been described in previous reports issued in April 1954 and August 1955.

1955 Operations

During this year the study proceeded mainly along lines established in 1954, with sampling at the same stations and the continued assistance of the cooperating agencies listed in the 1954 report. Gavins Point closure was effected in early August, but consideration of effects of that reservoir during its initial operation was limited to samples below Ft. Randall Dam and at Yankton.

Acknowledgments

The Missouri River Division, Corps of Engineers, contributed financial assistance, furnished information on reservoir operation and other phases, assisted in the sampling program, and provided drafting and reproduction services. North Dakota and South Dakota State Health Department laboratories performed total hardness, total phosphorous, organic nitrogen, and nitrate nitrogen analyses. The South Dakota State Department of Health collected samples at Pierre. Cooperating waterworks personnel were: F. B. Jensen and M. E. Rew, Council Bluffs, Iowa; F. B. Lasell and Joseph Erdei, Omaha, Nebraska; R. N. Whiting, Erwin Hirschman, and William Wallner, Yankton, South

Dakota; A. J. Campbell and Forest Seely, Chamberlain, South Dakota; Don Wessel, Mobridge, South Dakota; William Yegen, Bismarck, North Dakota; Robert Shaw and Bevan Shaw, Mandan, North Dakota; and James Fudge, Williston, North Dakota.

CLIMATOLOGICAL FEATURES

Temperature and precipitation departures from normal on a monthly and annual basis appear in Table 1, Appendix. Precipitation was below normal in all states except Montana. The year was slightly warmer than normal in Iowa and Nebraska, normal in South Dakota, and colder than usual in Wyoming, Montana, and North Dakota. Montana was the coldest and wettest area contributing runoff to the Central Missouri River, and Iowa and Nebraska experienced the warmest, driest weather. Deficient runoff from Iowa was partly responsible for lowered turbidity in the river at Omaha; and lesser amounts of inflow from some lower tributaries were in a measure the cause of more marked reservoir influences that will be described in following sections.

North Dakota river reaches and Garrison Reservoir were frozen prior to January 1, 1955. The river froze at Pierre and Chamberlain on January 3 and 4, respectively, but ice cover was delayed until January 22 at Yankton. Ft. Randall became completely frozen on January 27. Omaha never advanced beyond the heavy floating ice stage.

Ice breakup was in early April in North Dakota river reaches, in mid-April on Garrison Reservoir, and from March 12 to April 2 from south to north in South Dakota. In the winter of 1955-56, ice cover extended down to Pierre by November 18. Ft. Randall Reservoir and Yankton remained unfrozen until December 10.

PHYSICAL FEATURES

Discharge

River discharge below Garrison Dam was largely regulated by reservoir releases (Table 2, Appendix). Garrison releases were influential down to Ft. Randall Reservoir, and Ft. Randall discharges were mainly responsible for river volumes at Omaha. Gavins Point Dam closure was effected in early August, and it retained 210,200 acre feet of water between August and December 31. This quantity, however, accounted for only part of the accretion between Ft. Randall and Yankton (Table 2) and did little to impair Ft. Randall influences in downstream reaches.

Water from sources other than reservoir releases had little effect in the Missouri between Garrison Dam and Omaha. Maximum discharges occurred above Garrison Reservoir. Inflow into Garrison exceeded releases except during the months of May, September, and November. Ft. Peck releases were augmented to assist filling of Garrison during the period June to October. Accretion below Ft. Randall Dam was evident at Yankton (mainly from the Niobrara) and at Omaha.

Maximum discharge recorded was 65,000 cfs entering Garrison Reservoir on July 1. Highest daily discharge at Omaha was 38,000 cfs on July 11 and 12. From these figures it is evident that reservoirs leveled off peak discharges, as Omaha's maximum in 1955 was about one-half of its greatest 1954 discharge.

Reservoir Operation

Total monthly inflow and discharge, and average monthly pool elevations, for Garrison, Ft. Randall, and Gavins Point Reservoirs appear in Figure 1.

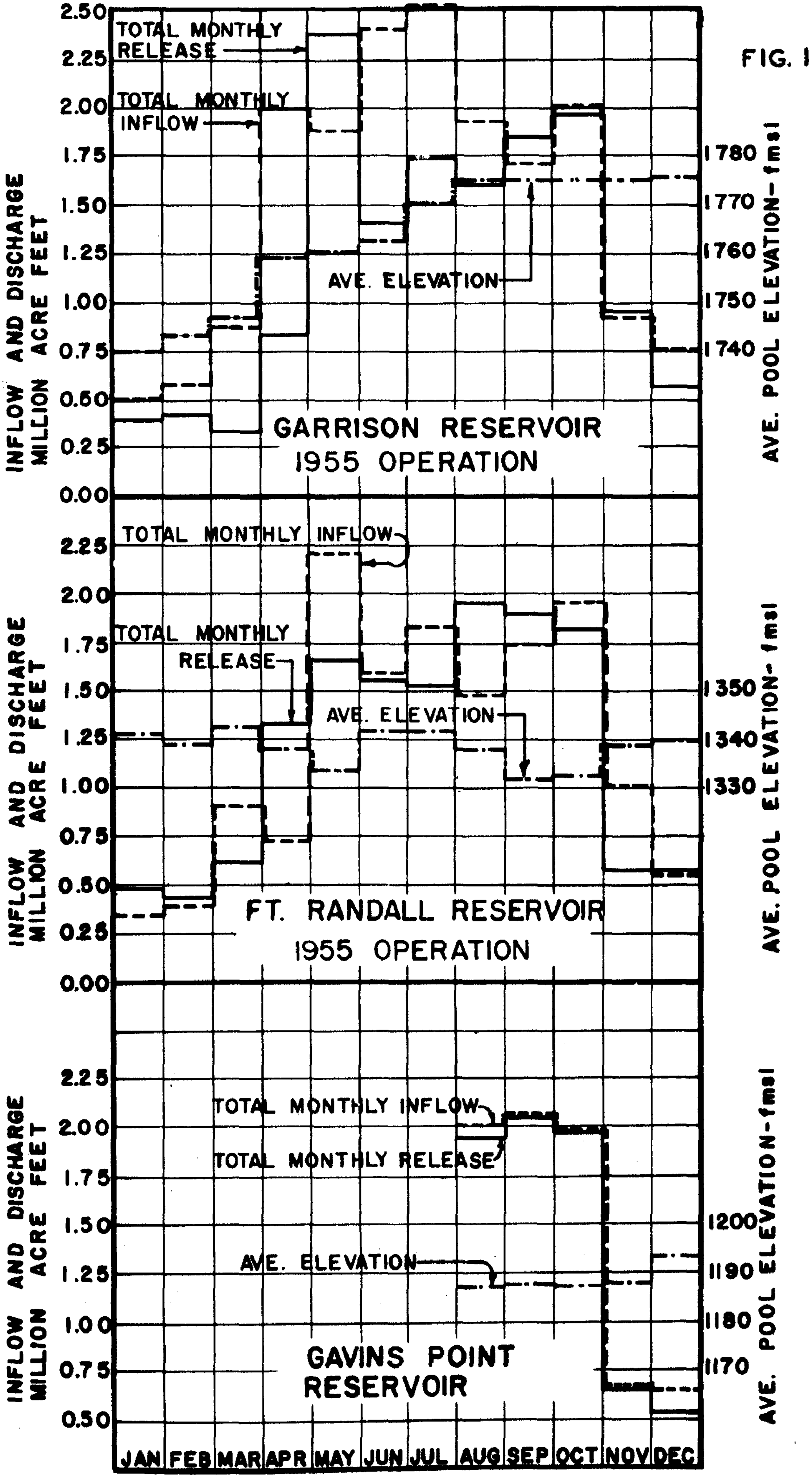
Water level rose 36.29 feet in Garrison during the year. A continuous increase occurred over the first 7 months, but the surface remained near its August elevation for the remainder of the year. Pool elevation moved up and down between 1,332 and 1,342.5 feet msl in Ft. Randall Reservoir, and its height on December 31 was 1.2 feet below the level of January 1. Lowest stages occurred in May, September, and October. Elevation of the Gavins Point pool varied within a narrow range during the first 4 months' operation, but showed marked increase in December.

As is evident in Figure 1 and Table 2, Appendix, operation during 1955 had filling of Garrison Reservoir as one of its major objectives. Stepped-up release from Ft. Peck Reservoir assisted in this process from June through October. Discharges from Garrison were insufficient to permit Ft. Randall to hold its level, but losses from the latter reservoir were not excessive. Gavins Point served largely as a flow-through reservoir until December. Releases from Ft. Randall were sharply reduced to facilitate closure of Gavins Point Dam in early August.

Temperature

Temperature variation (Table 5, Appendix) was not unusual when the degrees of latitude covered by the spread of sampling stations

FIG. 1



TOTAL MONTHLY RELEASE
TOTAL MONTHLY INFLOW
AVE. ELEVATION
GARRISON RESERVOIR
1955 OPERATION
INFLOW AND DISCHARGE MILLION ACRE FEET
AVE. POOL ELEVATION- fmsl
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
1780
1770
1760
1750
1740
TOTAL MONTHLY INFLOW
TOTAL MONTHLY RELEASE
AVE. ELEVATION
FT. RANDALL RESERVOIR
1955 OPERATION
1350
1340
1330
TOTAL MONTHLY INFLOW
TOTAL MONTHLY RELEASE
AVE. ELEVATION
GAVINS POINT RESERVOIR
1200
1190
1180
1170
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

are considered. Water temperature maximums occurred at Omaha, and there was a general upstream decrease in monthly maximums and averages. Reservoirs slowed temperature rise in spring and delayed its decline in autumn. Their effects in this regard resulted from resistance to temperature change inherent in large bodies of water, which, with this system of reservoirs at least, is aided by reduced turbidity and restrictions in the exposed area per volume relationship. Temperature relations between reservoirs, their inflows, and downstream stations are evident in the table and merit no discussion here. The extent of Garrison influences in the fall is masked by lack of October records. Omaha and Council Bluffs appeared to be below the area of marked influence from Ft. Randall Reservoir. Above normal winter temperatures at Mandan were due to return of cooling water from a steam power plant shortly upstream. These discharges maintained open water along the west bank.

Turbidity

Average monthly and annual turbidities at routine sampling points and Bismarck (Table 3, Appendix) show great uniformity of reservoir discharges and, at most stations, annual average below those recorded in 1954. Reduced turbidities at Yankton and Omaha were probably influenced to some degree by impoundment of Gavins Point Reservoir; however, such influences were restricted to a period when river turbidity was near its annual low, and this reservoir may have more pronounced effects when its operation extends over all seasons. At Chamberlain and Pierre, turbidity exceeded 1954 levels.

Maximums at Chamberlain occurred when water levels declined in Ft. Randall Reservoir and silt that had been precipitated in the upper end was stirred up by water action. Coincidence of high turbidity and low water levels may be noted by reference to Figure 1. The increase at Pierre cannot be fully explained at this time, but it appears likely that construction activities at Oahe Dam were involved. Bismarck showed a reduction over 1954 levels.

Turbidity maximums were generally below those occurring in 1954. At Omaha, where turbidity almost reached 10,000 ppm upon occasions in 1954, the 1955 maximum was around 2,000. Chamberlain was an exception with regard to maximum as well as to average turbidity.

To gain information concerning reservoir effects upon turbidity in reaches downstream from Omaha, water plant records over the last several years were obtained; and annual averages at various river-mile locations are shown in Table 4, Appendix. These data leave little doubt that turbidity reductions extended all the way to the Mississippi. Another feature indicated by this table, and also by Table 3, Appendix, for Omaha and Council Bluffs, is that turbidity can vary markedly between nearby points. At St. Louis City and St. Louis County water plants the difference in turbidity was more marked in post-impoundment than in preimpoundment years. Variation between Kansas City, Kansas, and Kansas City, Missouri, was not very great. Intake locations appear responsible for differences between Omaha and Council Bluffs. The Omaha intake is thrust against the main path of the flow, while that at Council Bluffs draws from slower currents near the bank.

CHEMICAL FEATURES

Hydrogen Ion Concentration

Average monthly pH values (Table 5, Appendix) show that the general range for the river was again above 8.0. The average monthly mean was 8.2 at all stations, except Council Bluffs, Bismarck, and above Garrison Reservoir, where it was 8.1. Only at Bismarck did monthly averages decline below 8.0; and, as in previous years, pH decline there occurred during warm water seasons (June - September) when organic decomposition affected the local stretch of river.

Maximum pH recorded was 8.5 at Council Bluffs in November and at Bismarck in April. The lowest pH (7.6) occurred at Bismarck in December. On a monthly basis, hydrogen ion concentration was quite resistant to fluctuation induced by alkalinity variation, and consequently was little affected by phytoplankton influences upon monocarbonate levels.

Alkalinity

Monocarbonate

Phenolphthalein alkalinity was generally present at all stations subject to that analysis, and in most instances its higher concentrations were associated with plankton populations in the upper density ranges (Tables 5, Appendix, and 19, Appendix). In Garrison Reservoir it appears that monocarbonate was augmented by leaching of the reservoir floor, although photosynthesis was involved in increases occurring during the first 4 months. Monocarbonates decreased in the river at Mandan, but showed an elevation at Mobridge that resulted chiefly from plankton development in April.

Ft. Randall Reservoir had a higher monocarbonate concentration than its discharge--an expected condition by virtue of greater plankton densities in surface water and acid production in the depths. Yankton exhibited a slight annual increase over Ft. Randall discharges, probably from impoundment of Gavins Point Reservoir.

1955 results indicate that reservoirs increased phenolphthalein alkalinity (monocarbonate) levels. Such increases arose from the opportunity afforded photosynthetic organisms by clarification, and initial leaching of soluable carbonates.

Bicarbonate

Concentration of bicarbonate alkalinity increased slightly in Garrison Reservoir, but declined in Ft. Randall (Table 5, Appendix). Ft. Randall influences along this line were augmented by inflow of the Niobrara River, which provided a lower annual concentration at Yankton despite increases attributable to rise of water level in Gavins Point Reservoir in September, November, and December. Increases arising in Garrison Reservoir evidently affected the river down to Chamberlain. Bicarbonate was somewhat more concentrated in reservoir releases than in surface waters, indicating some carbonic acid production in deeper waters in the absence of stratification.

Total Alkalinity

Total alkalinity concentration exhibited an increase in Garrison Reservoir and a decline in Ft. Randall, as would be expected from the behavior of bicarbonate alkalinity (Table 5, Appendix). Gavins Point Reservoir effected increases at Yankton as its water level rose in September, November, and December. Niobrara River influences were still operative in lowering the average annual concentration at Yankton.

Computation of alkalinity loads deposited onto, or leached from, reservoir floors (Garrison and Ft. Randall) according to the method developed for the 1954 report, gives the values appearing in Table 8, Appendix. Ft. Randall continued the trend of alkalinity precipitation noted in 1953 and 1954, removing approximately 119×10^6 pounds from inflowing water during 1955. Garrison, on the other hand, leached around 206×10^6 pounds from its floor during the same period. Due to the infrequency of reservoir records, accuracy of these computations is considered precise enough to indicate only the trend of events. Alkalinity loads based upon annual totals of inflowing, outflowing, and retained volumes of water and average annual alkalinity concentrations in each, appear in Table 6.

Table 6. Alkalinity Loads Depicting Gain or Loss in Water Entering Reservoirs. Values are Pounds-Per-Year x 10^3

		Garrison	Ft. Randall
1.	Inflow	7,431,203	6,358,599
2.	Outflow	6,264,843	6,001,548
3.	Retained	1,630,615	155,829
4.	Sum of 2 and 3	7,895,458	6,157,377
5.	1 Minus 4	-464,255	201,222
6.	% Gain or Loss	6.2% Gain	3.2% Loss

When percentage loss or gain is based upon the annual monthly accumulative totals shown in Table 8, Appendix, Garrison shows a 3.3 percent gain and Ft. Randall a 2 percent loss in alkalinity of impounded water. Monthly loads are based upon a limited number of analyses, and individually are not considered truly representative. Therefore, the actual percentage gain or loss is not accurately shown by either method of computation. All analyses and computations indicate that alkalinity was augmented by storage in Garrison and reduced by retention in Ft. Randall. In the absence of daily records, actual quantities can be only provisionally depicted.

Table 9. Average Total Alkalinity and Total Hardness (ppm)

Station	Alkalinity			Hardness		
	1953	1954	1955	1953	1954	1955
Above Garrison Reservoir		169*	150		246*	221
Below Garrison Dam		158*	160		216*	235
Bismarck#	160	158	166	224	211	229
Pierre				268	231	246
Chamberlain	157	154	158	271	247	248
Below Ft. Randall Dam	147	144	153	259	240	236
Yankton	150	145	150	264	238	232
Omaha#		172	170	261	241	247
Council Bluffs#			161			234

* July - December Records
\# Water Department Daily Records

Alkalinity concentration in 1955 generally exceeded 1954 levels at stations below Garrison Dam (Table 9). It appears that quantities entering solution from soils inundated in that reservoir were largely responsible for the concentration increases. Reduction in Ft. Randall Reservoir was to a less degree, 5 ppm as contrasted with 10 ppm during previous years. Yankton exhibited an increase over 1954, but Omaha showed no significant difference.

Weighted average annual alkalinity concentration (based on summations of monthly loads and discharges) was 146 ppm above Garrison Reservoir (no records in January and October), 153 ppm below Garrison Dam (no October reccrds), 161 ppm at Bismarck, 148 ppm at Chamberlain (no November records), 152 ppm below Ft. Randall Dam, 146 ppm at Yankton, and 168 ppm at Omaha. With allowance for months of no analyses, weighted concentrations indicate the same sequence of events shown by simple annual averages.

Hardness

The story of hardness during 1955 was essentially as has been described for alkalinity--namely, it increased in Garrison Reservoir, declined in Ft. Randall, decreased again at Yankton, and increased at Omaha (Tables 5, Appendix, and 9). This similarity indicates that reservoir influences chiefly concerned carbonate hardness. Computation of hardness deposited onto, or picked up from, reservoir floors (Table 7, Appendix) showed a deposit of about $270x10^6$ pounds in Ft. Randall and approximately $103x10^6$ pounds brought into solution from inundated soils in Garrison. On the basis of annual average concentration times total yearly volumes of water, Garrison exhibited a 6.1 percent increase in hardness, while Ft. Randall showed a 4.8 percent removal. When based upon monthly accumulative totals (Table 7, Appendix), Garrison increase was only 1.1 percent and Ft. Randall loss, 3.0 percent. As indicated for alkalinity, neither annual nor monthly average concentrations are considered truly representative, and actual percentages involved are not indicated by either value.

Comparison of 1955 annual concentrations with other years of record (Table 9) shows an increase over 1954 at all stations from Garrison Reservoir to Chamberlain, lower 1955 values below Ft. Randall Dam and at Yankton, and a slight increase in 1955 at Omaha.

Seasonal hardness lows have been observed following the "June rise" each year since the beginning of this investigation. In 1953, the annual minimum concentration occurred in July and August at all stations (Pierre to Omaha). In 1954, annual low concentrations appeared at Pierre and Chamberlain in July and August, but were delayed about one month in flow through Ft. Randall Reservoir, extending through the dam and down to Yankton and Omaha in August and September. In 1955, the annual low was evident during June and July above Garrison Reservoir, but did not appear in reservoir releases until August and September. Pierre and Chamberlain experienced low concentrations during the same two months, and flow through Ft. Randall Reservoir delayed annual low concentrations at Omaha until October and November.

From the above account it is evident that in 1955 reservoirs exerted considerably more effect upon native river patterns of mineral content fluctuation than during former years. The major influence was exerted by storage in Garrison Reservoir, in which volumes or stored water were markedly augmented in June and July. Ft. Randall Reservoir gained slightly in volume of storage water in June and July, but lost elevation in August and September. Greater buildup in volumes of stored water in each reservoir should result in greater alteration of the native river pattern of seasonal hardness variation.

Water operators at Chamberlain, South Dakota, claim that hardness varies at that point, in Ft. Randall Reservoir headwaters, with direction of the wind--downstream air movements inducing greater hardness, and upstream winds affording reductions.

Examination of hardness records at major water plants downstream from Council Bluffs has shown no such marked trends as exhibited by turbidity following reservoir impoundment. Hardness records have been modified by changes in analytical procedures, and a few more years will be required for justifiable comparison of post-reservoir and older data.

Oxygen

Oxygen concentration was markedly influenced by air draft to flood control tunnels during periods of their operation. Average values above 100 percent saturation (Table 10, Appendix) were evident every month except March below Garrison Dam, and during the period April - July below Ft. Randall. As described in the 1954 report, supersaturation so occasioned persists for but a few miles below each dam.

The reservoirs never exhibited supersaturation over a monthly period, but supersaturated concentrations were noted in each during May. Supersaturation of reservoir surfaces results only from algal photosynthesis, and high algal densities were evident in each reservoir that month. At river stations other than just below dams, supersaturation was observed only at Mobridge during a high-plankton concentration in April. In 1954, supersaturation occurred at Yankton and Chamberlain, and was the prevailing condition in Ft. Randall Reservoir from January through August.

Nitrogen

Organic Nitrogen

Variation in average monthly concentration ranged from 0.04 - 2.76 ppm (Table 11, Appendix). Periods of upper-range concentration (1.0 or above) varied with locality. In South Dakota reaches, seasonal differences were less marked than at North Dakota stations. Most seasonal variation and greatest concentrations occurred above Garrison Reservoir; and the lowest monthly average, within it. Upper ranges appeared in North Dakota only in spring and summer, but were present also in the fall in South Dakota. Lower ranges characterised winter months at all stations except Pierre and above Garrison.

Garrison Reservoir influences upon organic nitrogen content in the river were not very noteworthy, as concentration at Mandan frequently deviated considerably from that of reservoir releases, which often differed from reservoir surface water. Ft. Randall Reservoir surface and discharged waters exhibited greater similarity, and its releases appeared to be the major factor influencing concentration at Yankton. River influences upon reservoirs were not especially significant, except for the month of April, in Garrison; but from

May - December, concentrations at Chamberlain and in Ft. Randall Reservoir showed essentially the same pattern of increase and decrease on a monthly basis. Discharged water differed somewhat during November and December.

Annual average concentration was significantly greatest above Garrison, and significantly lowest in and below that reservoir. Differences among other stations (0.94 - 1.07 ppm) are considered insignificant. Average concentration for all stations was 0.99--a marked increase over the 1954 annual mean of 0.48.

Ammonia Nitrogen

Ammonia nitrogen exhibited limited seasonal variation at any station, and little difference was evident among various stations down to Yankton (Table 11, Appendix). Much larger quantities were contributed by pollution at Council Bluffs. All upstream stations except Chamberlain and Mandan had a marked increase in December; Ft. Randall Reservoir had another elevation in April; and a similar rise occurred above Garrison Reservoir in September. At all other times, monthly averages ranged from less than 0.1 to 0.2 ppm. Except for December, individual stations rose and declined quite independently of each other; and only in December did ammonia content appear to reflect general river conditions in reaches above Yankton. Average annual concentration differed but slightly at these various stations, and can be considered significantly different only in and below Ft. Randall Reservoir. The 1955 annual average for all Dakota stations (0.12 ppm) differed but little from that of 1954 (0.10 ppm) (Table 12, Appendix). The annual average at Council Bluffs (0.5 ppm) was not significantly different from the 1954 annual average at Omaha (0.47).

Nitrite Nitrogen

For the first year of record, nitrite nitrogen occurred at all stations (Table 11, Appendix). Previously, its appearance was limited to Williston, Bismarck, Omaha, and discharges from Ft. Randall Reservoir. At the first three points, nitrite evidently originated in organic pollution; and its presence below Ft. Randall Dam coincided with a brief period of reservoir stratification in 1954. Its presence at all stations in 1955 indicated a widespread change in nitrogen utilization and cyclic relationships.

A common source of nitrite in unpolluted or relatively unpolluted waters is the excretory products of zooplankters. However, routine plankton samples taken specifically to afford analysis of phytoplankton, are not very demonstrative of relative densities attained by zooplankters; so no correlation in this respect is possible. Nitrite showed no definite relationship to other nitrogen compounds. Its widespread occurrence appeared to be a natural river phenomenon, unassociated at most points with pollutional discharge. Available data allow little insight into factors involved.

At Omaha and Council Bluffs, nitrite arises from organic contamination and usually occurs at all seasons. Nitrite increased in Ft. Randall Reservoir during the refilling period after levels were dropped to combat carp spawning in June.

Nitrate Nitrogen

Nitrate showed little relationship to other nitrogen bearing compounds, and had little similarity at various stations, even between reservoirs and their releases (Table 11, Appendix). North Dakota and South Dakota values are not strictly comparable--the South Dakota results tending to show lesser concentration. These differences notwithstanding, it is evident that the river and reservoir upstream from Ft. Randall generally contained more nitrate than this reservoir, its releases, and the river at Yankton.

Comparison of annual average concentrations (Table 12, Appendix) shows a general increase in organic nitrogen in 1955, little change in ammonia over the past two years, much more widespread occurrence and general increase of nitrite, and a significant rise in nitrate concentration over 1954 levels. Whether these differences indicate the influences of more stabilized reservoir conditions, or are merely the result of normal river variation, remains to be seen. In general, 1952-53 ammonia nitrogen concentration has exceeded that of later years--apparently as a result of the 1952 flood, whose influences lingered on during the first 6 months of the investigation. Other natural phenomena could be involved in nitrogen increases in 1955. However, increases in organic nitrogen and nitrate could represent concentration from water by more widespread growths of micro-organisms.

Phosphorous

Available phosphorous (phosphates) occurred in quantities reaching lowest range (0.5 ppm) of the field analysis apparatus only at Council Bluffs, where it was present from August to December. This analysis was not conducted at Omaha. Phosphates in that area are undoubtedly contributed by pollution.

Average annual total phosphorus concentration (Table 13, Appendix) showed a general uniformity at all stations, except just above and just below Garrison Reservoir. Concentration was reduced by passage through this reservoir, and its surface waters retained more phosphorous than was passed through its discharge tunnels. Ft. Randall Reservoir increased phosphorous concentration slightly in surface waters, but its discharge was of the same average annual concentration as water entering the reservoir. Greater retention of phosphorous in the surface layers of each reservoir indicates the involvement of phytoplankton, although maximum phosphorous concentrations were associated with generally low plankton densities (Table 15, Appendix) in each. It appears that some decay of plankton growths is necessary for liberation of phosphorous in the form detectable by the standard technique. Average monthly averages show a phosphorous increase at most stations following plankton decline at the end of the growing season. Concentration at all stations was generally within the range considered stimulative to algal growth.

Annual averages (Table 12, Appendix) show a relatively constant concentration at all stations over the last two years of record, with the exception of a slight increase above Garrison Reservoir in 1955.

Discussion of Chemistry

Analyses conducted indicated pollutional influences at Omaha and Council Bluffs, and possibly at Bismarck. With regard to nitrogen and phosphorous compounds, Council Bluffs exhibited more local influences than Omaha. Differences between the lower two stations in other respects stem from the fact that the Council Bluffs intake does not draw from the main path of flow which, however, bears directly upon the Omaha intake. Variation between the two stations is generally what would be expected between main channel and shoreline samples; and samples from Omaha are considered more representative of the major discharge. Cross-sectional composites would in all likelihood iron out differences in turbidity, hardness, and alkalinity. This study has been primarily concerned with water quality at various intakes, and reservoir induced changes have followed the same trend at Council Bluffs and Omaha.

Reservoir influences upon water chemistry were more widespread in 1955 than during previous years. Certain elements were affected over longer periods of time, and some native river trends were altered. Annual low hardness concentrations, normally occurring in all river reaches shortly after recession of the "June rise," were delayed three months in reaching Yankton and Omaha.

Ft. Randall Reservoir continued to withdraw hardness and alkalinity from inflowing water, whereas Garrison added to quantities of responsible minerals in solution. Water quality, therefore, deteriorated in Garrison and improved in Ft. Randall. Garrison will probably continue to add to hardness as its filling continues. Ft. Randall has never exhibited that tendency on an annual basis and should continue demineralizing trends unless its level is substantially raised, or until long periods of stratification occur.

Variation in nitrogen content was largely the result of processes present in individual river reaches, such occurrences being modified only to a slight degree by existence of reservoirs. Nitrite, previously undetected unless introduced by pollution and reservoir stratification, was generally produced in 1955. Its relationship to other nitrogenous compounds or biological elements may not be determined within the limitations of present investigational procedures. A more frequent appearance of nitrite at Omaha and Council Bluffs strongly suggests that organisms involved in its production were better represented than during previous years of record. Organic nitrogen increases probably reflect the concentration activity of more widespread growths of micro-organisms.

Phosphorous analyses indicated that the supply of this element was largely incorporated in organic compounds or tied up within the bodies of various suspended organisms. On an annual basis, quantities have been rather constant at stations unaffected by pollution.

BIOLOGICAL FEATURES

Phytoplankton

Qualitative Aspects

This population has exhibited insufficient variation to necessitate any major change in taxonomic groupings adopted in 1952-53 (Table 7, 1952-53 report). Diatoms remained the predominant general group at most stations during most seasons; but blue-green algae, green algae, euglenophytes, and heterotrich yellow-green algae replaced them as monthly dominant groups at a number of stations.

Group predominance on a monthly basis appears in Table 14, Appendix, in which the three densest groups are shown in descending order for each station. It is evident from entries in that table that season and location both played definite roles in selection of the most numerous group. In January, *Asterionella* held dominance over the entire river and reservoir system from Garrison to Yankton. In February it was replaced by the blue-green alga *Dactylococcopsis* in Garrison Reservoir and downstream to Pierre, and by a small member of the Heterotrichales at Chamberlain, but still maintained dominance in Ft. Randall, extending downriver to Omaha. In March, *Asterionella* was still dominant in Ft. Randall and below; *Dactylococcopsis* had been replaced by *Cyclotella chaetoceras* in Garrison Reservoir, but was still dominant at Mobridge and Pierre, and had replaced the small Heterotrichales as the most numerous organism at Chamberlain. At Mandan, however, *Asterionella* had regained dominance. In April, a month of increasing plankton density in and below Garrison Reservoir, the small Cyclotella was still its dominant form, but Asterionella had decreased significantly in Ft. Randall. River stations exhibited considerable variation in April, dominance being held by Asterionella at Mandan and Pierre, by Chlorella at Mobridge (between Mandan and Pierre), at Chamberlain by Diatoma elongatum, by Heterotrichales at Yankton, and by the Rhizosolenia group at Omaha and Council Bluffs. In May the Cyclotella-Stephanodiscus group gained superiority in Garrison and extended its dominance over the river down to Ft. Randall Reservoir, in and below which Asterionella had again developed into the most numerous organism. In June, a month of general decline in plankton density, the Cyclotella-Stephanodiscus group still reigned in Garrison Reservoir and at most stations downstream to Ft. Randall Reservoir, where Euglena was most numerous. July was characterized by considerable variation between stations, even between reservoirs and their discharges. In August the blue-green Aphanizomenon gained dominance in Garrison Reservoir, but was not represented in the three most numerous groups at other stations. Cyclotella-Stephanodiscus plankters still held on at Pierre, Chamberlain, Omaha, and Council Bluffs, while Chlamydomonas was most numerous in Ft. Randall and at Yankton. In September the Cyclotella-Stephanodiscus group gained numerical superiority at all stations beginning with Garrison Reservoir. Aphanizomenon appeared below Garrison during this month. The Cyclotella-Stephanodiscus group maintained its general dominance in October, losing out to Stichococcus, a green alga, at Yankton, Omaha, and Council Bluffs. In November and December, Cyclotella-Stephanodiscus organisms prevailed or figured No. 2 in density at all locations.

Increase to a dominant position was limited to relatively few of the rather long list of phytoplankters. Diatoms attained that role more frequently than representatives of other algal groups, and were usually dominant when plankton densities reached their highest levels. Other algal groups whose representatives at times exhibited numerical superiority were: Green Algae--Volvacales (Chlamydomonas and Coccomonas), Chlorococcales (Chlorella), Ulotrichales (Stichococcus); Yellow-Green Algae--Xanthophyceae (Heterotrichales); Euglenophyta--Euglenophyceae (Euglena); Blue-Green Algae--Chroococcales (Dactylococcopsis) and Hormogonales (Aphanizomenon).

Reservoir influences upon qualitative aspects of plankton varied. In some instances it appeared that organisms gained a start in a reservoir and then spread downstream, assuming dominance at all points. The early Asterionella bloom spread from Garrison Reservoir in October 1954 to Chamberlain in November and December, through Ft. Randall Reservoir in January, and on to Omaha in February. It maintained its dominance in Ft. Randall in February and March, but lost out to other groups in Garrison after January. This downstream progression of an algal bloom from one reservoir through another in winter may result from north to south temperature decline. Asterionella exhibited dense development in Garrison in December when water temperature was 0° C. and attained its dominance in Ft. Randall in January and February when temperature was at or near 0° C. However, Asterionella attained greater density in Ft. Randall in May when water temperature was about 12° C. Thus, if Asterionella development is assumed due to a downstream temperature decline during winter, it will be necessary to assume also that different strains of the species were involved in the winter and summer blooms. In the river between the two reservoirs, the appearance of Asterionella is readily explained by the fact that the major part of discharge originated in Garrison releases. Its occurrence in Ft. Randall, however, may hardly be assumed due to replacement of impounded water, as water entering the reservoir amounted to only about 12 percent of that left in storage in January. Experimentation will be necessary to establish the details of Garrison Reservoir influence, and whether or not the growth in the lower reservoir was the result of temperature decline.

Water containing a dense growth of a certain phytoplankter may only seed areas into which it flows, but it may also introduce elements that stimulate growth of that particular group or species. For instance, Asterionella did not get started in Ft. Randall until three months after it had been carried to that locality in Garrison releases (Table 13, Appendix, 1954 report). Similarly, it required over a month to develop to a dominant position at Omaha, although constantly introduced in Ft. Randall releases going by that point. It may be argued that conditions eventually changed sufficiently to permit its greater development at Omaha, but what factor would have more influence than continued entrance of water in which the organism had been growing? In May, the Asterionella bloom immediately extended to Omaha; but the organism had ranged within the three dominant positions at Yankton and Council Bluffs in April.

The above account is not intended to belittle the role of local factors in inducing variation at individual stations, as it must be assumed that delays in initiating local populations of forms contributed from upstream are caused by local influences. Local factors were evident in dominance alteration (Table 14, Appendix), but individual station variation would have been less striking in some instances if samples had consisted of cross-sectional composites. The factor responsible for chemical differences at Omaha and Council Bluffs was also involved in plankton variation between the two stations. Blooms that appeared simultaneously at all stations, e. g., Cyclotella-Stephanodiscus in September, may be considered the result of general climatological and river conditions.

Inflow into Garrison Reservoir had little influence upon the composition of its plankton (Table 14, Appendix), and during several months Ft. Randall Reservoir resisted influences of upstream water and developed its own characteristic plankton population. However, reservoir algal populations were generally much more alike than in 1954, and Garrison conditions exerted some influence in Ft. Randall. Inflow of the Niobrara River, which developed dense plankton growths in late spring and summer, was sometimes instrumental in inducing qualitative changes at Yankton. Gavins Point Reservoir exerted no apparent influence upon plankton composition of its inflow.

Quantitative Features

Monthly average and maximum plankton densities (Table 15, Appendix) are illustrative of the range of plankton densities. Individual analysis results appear in Table 20, Appendix.

No significant concentrations appeared above Garrison Reservoir; and within that body of water, growths to near critical levels were noted only during the first 5 months. The densities recorded in January represented the continuation of an Asterionella proliferation which began in October 1954 (see 1954 report). The river below Garrison Dam showed close agreement with the reservoir down to the vicinity of Mandan. Mobridge density declined in May and increased again in July. Thereafter, numbers at that point exceeded those recorded at Garrison until December. At Pierre, higher densities were also evident over a greater part of the year, maximum numbers being observed in August. Chamberlain attained high concentrations in April, June, and August, but exhibited a decline in May. Ft. Randall influences upon numbers of river plankton extended down to Yankton; and maximum densities occurred in May, a time of decline in inflowing water at Chamberlain. Another increase occurred in August; levels showed little change in September. Influences of Niobrara River contributions were evident at Yankton in July and August, when water entering from that tributary augmented plankton concentration by introduction of such forms as the Rhizosolenia group and Ankistrodesmus. Concentration in the Niobrara far exceeded any found in the Missouri or its reservoirs.

Densities at Omaha and Council Bluffs generally ranged far below to slightly below those at more upstream stations, yet exhibited an increase in December that was completely out of line with events upriver, although involving practically the same organisms that were then dominant in Ft. Randall releases. Omaha and Council Bluffs infrequently exhibited concentrations in the same range.

Maximum densities recorded in and below Garrison Reservoir, at Mobridge, Chamberlain, Ft. Randall, Yankton, and Omaha, were high enough to be considered critical from a water quality standpoint. On a monthly basis such levels occurred at Yankton in May, at Chamberlain in April, and at Omaha in December.

Table 16. Average Annual Plankton Concentrations, No. per ml. Parentheses enclose number of records.

	1952-53	1954	1955
Above Garrison Reservoir		(7) 79	(16) 62
Garrison Reservoir		(24) 192	(51) 207
Below Garrison Dam		(24) 180	(51) 233
Mandan		(21) 174	(52) 175
Mobridge		(7) 181	(15) 339
Pierre	(16) 49	(24) 144	(23) 242
Chamberlain	(45) 60	(45) 185	(50) 295
Ft. Randall Reservoir	(21) 172	(50) 403	(52) 320
Below Ft. Randall Dam	(65) 100	(51) 430	(52) 277
Yankton	(62) 266	(52) 426	(51) 304
Omaha	(33) 131	(50) 264	(40) 259
Council Bluffs		(15) 63	(39) 228
Niobrara River		(3) 622	(8) 6304

Comparison of average annual concentration appears justified only where records are frequent enough (around 40 or more per year) for the annual mean to indicate differences in plankton production.

Entries in Table 16 show that maximum production in 1955 occurred within Ft Randall Reservoir The annual average at Yankton closely approached that of Ft. Randall, but the lower station benefited from growths introduced by the Niobrara River. With this exception, there was a general decline in plankton density (Mobridge and Pierre are excluded from this account) below reservoirs. A similar decline was evident below Garrison during the last 6 months of 1954, but Yankton showed no significant decline below Ft. Randall releases. Omaha's average was below that of Yankton each year of record.

During its early days of impoundment, plankton forms that developed in Ft. Randall Reservoir increased their concentration when discharged to the river below. Higher annual densities at Yankton during that period were not occasioned by Niobrara inflow, but by continued proliferation of plankters originating in the reservoir. In 1954 there was no significant annual difference in density between Yankton and the reservoir releases, and in 1955 a slight increase, referable to Niobrara River augmentation, was evident at Yankton. However, the highest 1955 density at Yankton in May resulted from continued growth of Ft Randall forms Plankters exhibited after-gorwth in 1955 upon release from Garrison Reservoir, beginning in the vicinity of Mobridge, following declines at Mandan. Decreases at Mandan may have resulted from sampling at a point unrepresentative of the major discharge.

Plankton growth in the reservoirs exhibited characteristic lentic fluctuations with months of very low densities following periods of maximum or near maximum concentrations River stations did not usually exhibit either tne high or the low extremes found in reservoirs

In previous years plankton densities have been expressed both by number and volumetric units (M units) per ml. Both systems have been illustrative of plankton fluctuation and, because of time limitations, computation of M unit values has been omitted from treatment of data incorporated in this progress report.

RESERVOIRS

Garrison Reservoir exhibited no marked thermal stratification in 1955, although temperature differences of less than 1° C per meter occurred from surface to bottom when a vertical series of samples was collected on July 19 (Table 17).

Table 17. Vertical Variation in Temperature and Chemistry, Garrison Reservoir, July 19, 1955, 1 Mile Above Dam, Total Depth 85 Ft.

Depth Feet	1.5	13	27	40	54	67	81
Temp. °C	21.5	21.0	20.5	20.0	19.5	18.5	18.0
pH	8.2	8.2	8.2	8.1	8.0	8.0	7.9
CO_3 Alk. ppm	8.0	8.0	10.0	4.0	0.0	0.0	0.0
HCO_3 Alk. ppm	134.0	135.0	133.0	140.0	146.0	147.0	148.0
Oxygen ppm	8.0	8.0	7.2	7.2	6.8	5.6	4.8
NH_3 N ppm	0.0	0.1	0.1	0.1	0.1	0.1	0.0
NO_2 N ppm	0.02	0.02	0.02	0.02	0.01	0.0	0.0
PO_4 ppm	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Chemical features indicate homogenous water extended down less than 27 feet during a day of bright, calm weather. Decreases in oxygen and increases in bicarbonate alkalinity with depth are referable to increased decomposition, a process utilizing oxygen and producing CO_2 to react with monocarbonate and increase methyl orange alkalinity while lowering pH. Available phosphorous did not occur at any depth, and trace amounts of ammonia nitrogen were present from 13 to 67 feet.

Nitrite occurred in considerable concentration from the surface down to 54 feet, but disappeared at greater depths.

Results of three vertical series in Ft. Randall Reservoir on July 26 and 27 appear in Table 18. It is evident from this table that Ft. Randall deviated from Garrison in some respects, and was not quite the same at different locations within itself. The upper series in shallow water near Chamberlain was characteristic of upper reservoir reaches in the deep layer of soupy suspended silt and general uniformity of water above. At the midway point (Table 18b), suspended silt occupied only the lower two feet of water, and chemical variation was evident at different depths. Nitrite was absent in upper water and increased with depth, beginning at 27 feet—quite the reverse of Garrison on July 19. Oxygen exhibited a sharp decline at

Table 18. Vertical Variation in Temperature and Chemistry, Ft. Randall Reservoir, July 26 and 27, 1955

Table 18a. Eleven Miles Below Chamberlain, Total Depth 27 Feet, Suspended Silt Below 18 Feet, July 26, 1955

Depth Feet	1.5	9	18
Temp °C	26.0	25.5	25.5
pH	8.4		8.4
CO_3 Alk. ppm	18.0		18.0
HCO_3 Alk. ppm	127.0		128.0
Oxygen ppm	8.0		8.0
NH_3 N ppm	0.1		0.1
NO_2 N ppm	0.0		0.0
PO_4 ppm	0.0		0.0

Table 18b. Forty-Five Miles Above Dam, Total Depth 63 Feet, Suspended Silt Below 61 Feet, July 27, 1955

Depth Feet	1.5	13.5	27	40.5	60
Temp °C	26.75	26.5	26.0	26.0	26.0
pH	8.3	8.2	8.2	8.2	8.2
CO_3 Alk. ppm	14.0	12.0	10.0	10.0	8.0
HCO_3 Alk. ppm	137.0	139.0	142.0	141.0	144.0
Oxygen ppm	7.2	6.4	6.4	6.4	4.8
NH_3 N ppm	0.1	0.1	0.1	0.1	0.3
NO_2 N ppm	0.0	0.0	0.005	0.005	0.01
PO_4 ppm	0.0	0.0	0.0	0.0	0.0

Table 18c. Two Miles Above Dam, Total Depth 98 Feet, July 27, 1955

Depth Feet	1.5	13.5	27	40.5	54	67	80.5	94
Temp °C	29.0	27.0	26.75	26.0	26.0	26.0	24.75	23.5
pH	8.3	8.3	8.3	8.2	8.2	8.2	8.1	7.8
CO_3 Alk. ppm	12.0	12.0	10.0	8.0		8.0	4.0	0.0
HCO_3 Alk. ppm	135.0	132.0	135.0	137.0		137.0	141.0	148.0
Oxygen ppm	8.0	7.2	7.2	7.2	6.4	6.4	5.6	2.4
NH_3 N ppm	0.1	0.1		0.1		0.1	0.1	0.1
NO_2 N ppm	0.005	0.005	0.01	0.01	0.01	0.005	0.0	0.005
PO_4 ppm	0.0	0.0		0.0		0.0	0.0	0.0

60 feet; pH did not change with depth, but some decrease and increase with depth were apparent in monocarbonate and bicarbonate alkalinity, respectively. Ammonia nitrogen increased abruptly at 60 feet;

Two miles above the dam (Table 18c), the reservoir had changed little. Temperature at 67 feet was the same as recorded at 60 feet, 43 miles above. Similarly, pH, alkalinity, and oxygen variations were essentially the same down to 67 feet. The oxygen decline near 60 feet at the middle reservoir station resulted from proximity to the bottom. The same sudden change was evident at 94 feet near the dam. Nitrite occurred at all depths except 80.5 feet at the lower station. Greatest concentration was found between 27 and 54 feet, a decline to 0.0 occupied the distance from 54 to about 81 feet, but it reappeared at 94 feet. Ammonia nitrogen was most concentrated at the surface and at middle depths.

Vertical series samples, and differences at times evident between surface waters and discharges, indicate that chemical variation occurs from surface to bottom in the absence of a definite thermal stratification with three or more density layers. The absence of thermal layers was definitely shown by a decline of only 3° C over a vertical distance of 81 feet in Garrison, and by declines of only 0.75° C in 60 feet and 3.5° C in 94 feet in Ft. Randall.

Variation in nitrite over vertical distances in these reservoirs strongly suggests its major production by zooplankters, many of which carry on diurnal vertical migrations.

Longitudinal variation in Ft. Randall Reservoir was not marked with respect to any features analyzed in the vertical series. Hardness in surface water, however, increased from 208 ppm 11 miles below Chamberlain to 228 ppm 2 miles above the dam.

THE NIOBRARA RIVER

This river had its chemistry altered by very dense phytoplankton growths in May, June, July, and August (Tables 19, Appendix, and 15, Appendix). Bicarbonate and total alkalinity were reduced, and monocarbonate alkalinity and pH were elevated. Inflow of the Niobrara tended to dilute mineral content as measured by hardness and alkalinity at Yankton.

Phosphorous never occurred in the available form; ammonia nitrogen concentration never exceeded 0.1 ppm, and was at times 0.0; and nitrite nitrogen was observed upon two occasions. The presence of nitrite in this stream strengthens the supposition that its widespread occurrence in the Missouri resulted from natural phenomena not present during previous years of investigation.

Plankton concentration in the Niobrara was at times nea[illegible] times as great as the maximum noted in the Missouri and its reservoirs. Development to that level in most instances involved increases in green algae as well as in diatoms. Superficially, the lower Niobrara, a shallow stream running over a wide sandy bed, may not have the appearance of a river promoting plankton development; yet, each year of record has found it with substantial populations.

TASTE AND ODOR OCCURRENCES

In March, Garrison discharges had a fishy odor, and severe tastes and odors developed at Yankton from materials contributed by cleaning the settling basin. The fishy odor was still evident below Garrison Dam in April; and foam floating there had a greenish-yellow color that was not associated with algal cells but with a color in solution. Mandan water plant operators received several complaints about tastes and odors in their finished water. April was a month of high plankton concentration in Garrison releases. Mandan had a less dense population, but was not immune to the effects of plankton detritus. Operators alleviated the condition with increased dosages of appropriate chemicals.

On April 18, the Chamberlain water department was notified by the Public Health Service through the South Dakota State Department of Health of a probable algal increase to a nuisance level. Water operators immediately increased carbon and chlorine dosages and suffered no complaints from tastes and odors in finished water. Yankton water operators were similarly notified on May 9, and they promptly instituted remedial measures. Their attempts were not completely successful, as some odor was present in finished water until May 31. However, they received few complaints from city residents.

Mild tastes and odors were evident in finished water at Mandan on May 21, shortly after carbon application was reduced. Several complaints arose from poor palatability of Bismarck water in early May, but objectionable substances disappeared about May 20.

In June the Public Health Service notified the Mobridge water plant, through the usual channels, of increasing algal density; but no problem occurred. A minor taste and odor problem developed at Chamberlain in early July, but proved amenable to control through increased use of carbon. Mandan experienced some impairment of water quality on July 5 and 6. In August the Public Health Service again furnished notice of impending plankton increases to water operators at Chamberlain and Yankton; and they were able to maintain a palatable water through increased application of carbon and chlorine. Chamberlain experienced some trouble with oil slicks that were windblown upstream from the sewer outfall.

In recent years the ray fungi (Actinomycetes) have received considerable attention as causative agents of unsavory tastes and odors in water supplies, the claim being made in some quarters that all naturally occurring problems of this sort are associated with these fungi, either by their growth in turbid water or as parasites in algal cells (see 1952-53 report). Opportunity to evaluate the role of Actinomycetes in water supplies taken from the Missouri River has not existed; yet, very few tastes and odors have occurred unassociated with algal blooms (refer to Table 15), the few exceptional cases occurring during declines of dense growths. It is, therefore, obvious that algae have been involved, either directly or indirectly, in establishment of conditions leading to taste and odor production.

Experiences with taste and odor problems indicate that control would have been more adequate if adjustable continuous feed carbon applicators had been available at all water plants. Because of the expected frequency of reoccurrence of these problems in the reach of Garrison Dam to Yankton, it is highly desirable that such equipment be installed at all plants now depending upon uncontrolled methods of application.

RESERVOIR INFLUENCES UPON WATER TREATMENT COSTS

In the first two progress reports (1952-53 and 1954), this section has been largely restricted to records of the the Yankton, South Dakota, water treatment plant, which in 1953 and 1954 showed substantial savings in coagulating and softening chemicals after Ft. Randall impoundment.

In 1955, available yearly chemical consumption records were obtained at all major Missouri River water treatment plants from Mandan, North Dakota, to St. Charles, Missouri. Analyses of these data indicate that many factors, process and personnel changes, alterations, improvements, enlargements, intake relocations, construction of new plants, etc., have contributed to variation in usage of treatment chemicals. These occurrences prevent comparison of pre- and post-reservoir records at the present time. When data for a few more years are available, a more adequate basis for comparison with historical records will exist. Operational changes at Yankton in 1955 now delay any further consideration of that plant in this respect.

In general terms, all operators have noticed reduced turbidities during the last three years; and most of them believe the clarification has produced savings in coagulants. At some plants practicing softening, a trend toward savings in raw materials has been evident. This trend was quite apparent at Yankton in 1953 and 1954, but operational change resulted in increased use of such chemicals in 1955 when average hardness of raw water was the lowest on record. Because of such occurrences it appears unjustified to assume that treatment plant operations will consistently reflect changes in river water quality unless records cover a period of several years.

APPENDIX

Table 1. Temperature and Precipitation Departures from Normal - 1955

	Iowa		Nebraska		North Dakota		South Dakota		Wyoming		Montana	
	Temp. °F	Precip. (inches)	Temp. °F	Precip. (inches)	Temp. °F	Precip. (inches)	Temp. °F	Precip. (inches)	Temp. °F	Precip. (inches)	Temp. °F	Precip. (inches)
January	+1.3	-0.08	+0.4	+0.08	+4.3	-0.07	+3.7	-0.33	+0.6	-0.30	+1.8	-0.28
February	-1.8	+0.21	-4.9	+0.19	-3.0	+0.05	-3.9	+0.33	-3.5	+0.14	-3.0	+0.22
March	-1.8	-0.72	-1.1	-0.69	-6.1	-0.28	-2.3	-0.75	-5.2	-0.16	-7.6	+0.01
April	+7.6	+0.88	+5.7	-1.12	+6.8	+0.05	+6.6	-0.68	-0.5	-0.57	-2.1	+0.72
May	+3.2	-1.24	+4.1	-0.39	+3.6	-0.35	+5.1	-0.36	+1.7	+0.01	-2.5	+0.97
June	-2.4	-1.47	-3.4	+0.42	-1.0	-0.24	-2.3	-0.34	-1.4	+0.35	-1.6	-0.74
July	+4.9	-0.32	+4.6	-1.55	+1.8	+0.71	+3.7	-0.08	+1.8	-0.33	-1.6	+1.10
August	+4.6	-1.97	+4.8	-1.43	+4.2	-0.38	+4.9	-0.24	+3.4	+0.03	+1.9	-0.90
September	+2.3	-1.00	+2.3	+0.62	-0.5	+0.08	+0.6	+0.31	+1.0	-0.15	-1.3	-0.62
October	+0.9	-0.80	+1.7	-1.06	+3.3	-0.52	+2.4	-0.91	+2.6	-0.56	+1.9	-0.15
November	-6.4	-1.49	-6.0	-0.49	-12.0	+0.27	-9.8	-0.28	-5.7	+0.29	-12.3	+0.55
December	-4.1	-0.60	-4.4	-0.11	-8.5	-0.13	-8.2	+0.34	+1.7	+0.70	-5.6	+0.70
Annual	+0.7	-8.61	+0.4	-5.53	-0.6	-0.11	0.0	-2.99	-0.2	-0.55	-2.7	+1.58

Table 2. Approximate Average Daily Discharges, cfs

	Yellowstone at Sidney	Ft. Peck* Discharge	Garrison Inflow	Garrison Discharge	Bismarck	Ft. Randall Inflow	Ft. Randall Discharge	Yankton	Omaha
Jan	3,900	5,300	8,000	6,400	6,400	6,500	7,700	9,700	8,700
Feb	4,600	5,100	10,600	7,400	7,300	6,900	7,700	9,000	11,250
Mar	6,100	6,000	13,900	5,400	5,500	15,100	10,600	15,100	21,100
Apr	12,500	6,100	33,800	13,200	13,800	11,800	22,300	25,900	29,400
May	13,300	9,300	30,100	38,500	38,800	33,200	26,900	30,400	31,100
Jun	27,750	11,800	38,800	23,200	23,900	26,900	26,100	30,100	30,800
Jul	15,200	24,000	41,100	28,800	28,800	29,900	25,400	28,700	31,200
Aug	5,400	25,000	31,100	26,100	25,700	23,900	31,100	31,200	29,000
Sep	5,000	25,700	28,500	30,800	30,700	31,000	32,000	34,500	34,800
Oct	6,000	27,300	33,600	32,000	32,000	31,200	29,900	32,300	32,100
Nov	5,400	9,900	15,700	17,000	17,400	19,300	10,000	11,200	13,400
Dec	5,000	5,600	12,200	9,200	9,200	9,000	9,300	8,700	8,300
1955	9,000	13,600	24,800	19,900	20,100	20,600	20,000	22,400	23,500

*Not all daily discharges available.

Table 4. Average Annual Turbidities ppm, Water Plant Records

River Mile:	470.5	434.5	408.8	385.0	382.0	226.8	196.7	36.6	36.0
	ST. JOSEPH MISSOURI	ATCHINSON KANSAS	LEAVENWORTH KANSAS	KANSAS CITY KANSAS	KANSAS CITY MISSOURI	GLASGOW MISSOURI	BOONVILLE MISSOURI	ST. LOUIS CITY	ST. LOUIS COUNTY
1918				2,329					
19				1,820					
1920				2,549	2,500				
21				1,817	2,000				
22				2,477	2,600				
23				3,264	3,800				
24				2,208	3,100				
25				2,162	2,500				
26				2,203	2,600				
27				3,251	3,100				
28				2,881	2,600				
29				2,246	2,000				
1930				2,040	2,200			1,881	
31				1,812	1,900			1,578	
32				3,162	2,400			2,637	
33				2,857	2,000			1,920	1,900
34				1,668	1,700			1,300	1,300
35				2,308	2,200			1,400	1,400
36				1,654	1,800			1,600	1,500
37				2,692	2,700			2,000	2,300
38				2,304	2,300			1,800	2,000
39				1,933	1,700			1,600	1,800
1940	3,300		2,810	2,110	2,400			1,900	1,900
41	4,800	1,500	3,196	2,899	2,700			2,100	2,300
42	3,700	2,200	3,237	2,192	2,200		6,300	1,610	1,700
43	2,600	1,200	2,161	1,668			1,800	1,250	1,300
44	3,100	1,500	2,380	2,052			1,900	1,800	1,900
45	3,100	2,000	1,073	2,085	2,300		1,800	2,100	1,500
46	2,800	2,500	1,048	2,330	2,500		2,200	2,000	2,200
47	2,900	3,000	1,793	1,450	1,700		1,100	1,278	1,100
48	1,700	900	1,994	1,849	2,200		1,600	1,600	1,700
49	1,600	1,000	1,551	1,450	1,800		1,500	1,300	1,500
1950	2,375	2,000	1,861	1,870	2,200		1,800	1,760	1,700
51	2,539	1,500	2,060	1,890	3,200		1,300	1,400	1,400
52	1,970	2,000	1,400	1,308	1,600		1,200	1,100	1,100
53	998	1,500	775	803	850	891	800	760	800
54	1,066	1,200	770	810	900	928	1,000	890	800
55	714	350	534	570	480	668	1,000		600*
Preimpoundment Years	2,800	1,775	2,043	2,194	2,977		2,045	1,692	1,675
Postimpoundment Years	826	1,017	693	728	743	829	933	825	733

* January through November only.

Table 3. Average Turbidities ppm

	COUNCIL* BLUFFS	OMAHA*	YANKTON	BELOW FT. RANDALL RESERVOIR	FT. RANDALL RESERVOIR	CHAMBERLAIN	PIERRE	MOBRIDGE	BISMARCK*	MANDAN	BELOW GARRISON	GARRISON RESERVOIR	ABOVE GARRISON
January	78	80	26	<35	<35	<35	<35	<35	21	<35	<35	<35	
February	38	28	<35	<35	<35	<35	<35	<35	20	<35	<35	<35	<35
March	446	782	729	<35	<35	267	500	35	53	220	<35	<35	112
April	415	640	112	<35	<35	94	645	80	142	144	<35	<35	2,000
May	250	367	73	<35	<35	834	460	460	168	125	<35	<35	680
June	264	352	53	<35	<35	327	470	220	78	78	<35	<35	1,500
July	319	564	62	<35	<35	610	275	145	69	64	<35	<35	1,115
August	219	377	37	<35	<35	424	230	165	66	70	<35	<35	455
September	226	316	40	<35	<35	2,005#	230	160	76	67	<35	<35	230
October	218	300	38	<35	<35	364	560		80	55	<35	<35	
November	160	205	<35	<35	<35	135	270	170	128	66	<35	<35	145
December	60	35	<35	<35	<35	<35	<35	<35	26	<35	<35	<35	<35
1955	225	338	93	<35	<35	431	299	152	77	75	<35	<35	633

* Daily records furnished by water plant operators.
# Silt deposited when reservoir conditions prevailed stirred up by wind and water action.

Table 5. Average Temperature, pH, Alkalinity, and Hardness

	Temp. °C	pH	CO_3 Alk. ppm	HCO_3 Alk. ppm	Total Alk. ppm	Total Hardness ppm	Temp. °C	pH	CO_3 Alk. ppm	HCO_3 Alk. ppm	Total Alk. ppm	Total Hardness ppm	Temp. °C	pH	CO_3 Alk. ppm	HCO_3 Alk. ppm	Total Alk. ppm	Total Hardness ppm
	ABOVE GARRISON RESERVOIR						GARRISON RESERVOIR						BELOW GARRISON DAM					
January							0.5	8.2	14	163	177	270	0.5	8.2	16	168	184	270
February	0.0	8.1	4	166	170	250	0.0	8.2	12	167	179	260	0.5	8.1	12	178	190	292
March	0.5	8.1	2	151	153	212	2.0	8.2	10	186	196	297	2.0	8.2	12	186	198	296
April	18.0	8.0	0	119	119	218	5.0	8.2	11	166	178	284	5.0	8.2	11	170	181	288
May	16.0	8.2	2	154	156	222	9.5	8.2	6	145	151	216	9.7	8.2	6	146	152	214
June	18.0	8.0	0	122	122	177	16.5	8.2	10	131	141	206	16.0	8.2	10	133	144	203
July	22.5	8.0	3	132	135	186	20.0	8.2	10	136	146	194	18.0	8.2	8	140	148	194
August	21.0	8.2	9	147	156	223	21.1	8.1	5	121	126	182	21.0	8.1	4	126	130	182
September	15.0	8.2	10	150	160	240	15.0	8.2	12	126	138	186	16.0	8.2	12	129	141	186
October												232						228
November	2.0	8.2	10	156	166	256	7.0	8.3	14	146	160	240	7.0	8.3	14	146	160	240
December	1.0	8.1	10	180	190	300	1.5	8.3	12	157	169		2.0	8.3	10	160	170	
Monthly Avg.		8.1	5	148	153	228		8.2	10.5	149	160	233		8.2	10.4	153	163	236
Annual Avg.			4.5	145	150	221			9.8	146	157	233			9.7	151	160	235
	MANDAN				PIERRE		MOBRIDGE						CHAMBERLAIN					
January	5.0	8.1	12	174	None	296	0.5	8.2	8	178	186	272	1.0	8.2	14	171	185	292
February	4.5	8.2	6	185	Avail.	308	0.0	8.2	8	188	196	288	1.0	8.2	10	185	195	307
March	3.0	8.1	0	170		250	0.5	8.2	10	148	158	268	1.1	8.0	7	143	150	182
April	6.2	8.2	14	169		274	13.0	8.2	18	169	187	264	12.2	8.2	10	158	168	272
May	11.0	8.2	8	145		254	13.5	8.2	8	160	168	229	18.0	8.2	6	168	174	260
June	15.7	8.2	6	137		225	18.5	8.2	8	129	137	207	21.5	8.2	7	128	136	227
July	22.0	8.2	12	135		216	25.0	8.1	2	144	146	200	26.0	8.2	7	146	154	219
August	20.7	8.2	7	124		195	23.0	8.3	12	123	135	180	24.0	8.3	12	134	146	201
September	15.0	8.2	10	125		192	12.0	8.2	10	126	136	180	13.0	8.2	4	135	139	184
October						211						206	10.2	8.2	12	135	148	220
November	4.0	8.2	12	146		236	4.0	8.2	12	142	154	237						255
December	2.0	8.3	10	163		293	1.0	8.4	10	164	174	259	0.5	8.2	10	175	185	289
Monthly Avg.		8.2	8.8	152		246		8.2	9.7	152	162	232		8.2	9	153	162	242
Annual Avg.			9.0	148		246			9.6	152	161	232			8.8	149	158	248
	FT. RANDALL RESERVOIR						BELOW FT. RANDALL DAM						YANKTON					
January	0.0	8.2	6	147	153	250	0.0	8.2	8	145	153	249	0.0	8.2	6	148	154	248*
February	1.5	8.2	6	150	156	256	2.0	8.2	6	151	157	259	4.5	8.2	4	140	144	258
March	3.0	8.2	11	149	160	260	3.3	8.2	8	155	163	266	2.2	8.1	3	138	142	216
April	6.2	8.2	7	161	168	275	6.1	8.2	6	162	168	275	9.7	8.2	7	152	160	267
May	12.3	8.2	13	146	160	266	14.5	8.2	11	147	158	267	16.9	8.2	11	143	154	261
June	18.2	8.2	10	149	160	268	18.0	8.2	9	150	160	268	20.5	8.2	11	147	158	249
July	24.0	8.2	10	135	145	225	21.5	8.2	6	143	149	231	25.0	8.2	11	138	149	227
August	25.2	8.2	10	141	152	227	25.2	8.2	9	144	154	228	25.2	8.2	12	140	152	220
September	20.0	8.2	9	136	145	204	15.7	8.2	10	134	144	106	19.0	8.2	12	143	155	208
October	15.5	8.2	11	125	136	197	5.5	8.2	10	126	136	197	14.3	8.2	13	125	138	194
November	5.5	8.4	10	130	140	199	2.0	8.4	10	129	139	203	6.0	8.3	8	137	145	200
December	1.5	8.2	8	134	142	210		8.2	8	135	143	210	5.0	8.1	6	144	150	223
Monthly Avg.		8.2	9.2	142	151	236		8.2	8.4	143	152	230		8.2	8.6	141	150	231
Annual Avg.			9.6	143	153	237			8.7	145	153	236			9.1	140	150	232
	BISMARCK*						OMAHA*						COUNCIL BLUFFS*					
January	0.0	8.3			191	245	0.4	8.2	5	188	194	285	1.1	8.1	3	185	188	282
February	0.0	8.3			201	263	0.0	8.3	4	177	179	274	1.1	8.1	3	172	175	264
March	0.1	8.2			203	256	1.0	8.0	1	161	161	228	1.6	8.0	3	144	147	219
April	7.7	8.3			197	256	13.0	8.1	1	176	179	267	12.1	8.1	4	157	161	255
May	12.6	8.1			164	231	18.9	8.2	3	172	175	274	18.7	8.1	3	162	165	261
June	17.6	8.0			157	210	21.6	8.2	5	172	170	260	21.2	8.1	4	163	167	244
July	22.0	8.0			156	205	27.5	8.2	3	166	171	234	26.9	8.0	1	157	158	217
August	23.4	7.9			141	187	26.0	8.2	4	166	170	240	26.9	8.1	2	153	155	217
September	18.7	7.9			140	189	19.6	8.3	3	159	165	233	20.7	8.2	2	147	149	215
October	12.8	8.1			154	215	15.5	8.3	4	146	149	211	14.0	8.2			142	197
November	4.7	8.1			169	244	4.4	8.2	4	156	161	222		8.1			157	212
December	0.0	8.0			175	248	0.8	8.2	3	165	168	236		8.0			165	230
Monthly Avg.		8.1			171	229		8.2	3.3	167	170	247		8.1			161	234
Annual Avg.					166	229			3.5	167	170	247					161	234

* Water Plant Records

Table 7. Hardness Load Entering, Leaving, and Remaining in Theoretical Storage; and Computed Hardness Load Lost from, or Gained in, Impounded Waters

	H_2O Lbs. x 10^6			ppm Hardness			Hardness Lbs. x 10^3			Lbs. x 10^3		
	(1) Inflow	(2) Outflow	(3) Retained in Theoretical Storage	(4) Inflow	(5) Outflow	(6) Retained in Theor. Storage	(7) Inflow	(8) Outflow	(9) Retained in Theoretical Storage	(10) Sum Discharged Plus Retained Load	(11) Column 7 Minus Column 10	(12) Accumulation on Reservoir Floor
FT. RANDALL RESERVOIR												530,731*
January	970,649	1,291,662	-321,013	292	249	270	283,430	321,624	-86,674	234,950	48,480	579,211
February	1,058,445	1,167,171	-108,726	307	259	283	324,943	302,297	-30,769	271,528	53,415	632,626
March	2,488,189	1,684,434	803,755	182	266	224	452,850	448,059	180,041	628,100	-175,250	457,376
April	1,972,285	3,628,450	-1,656,165	272	275	273.5	536,462	997,824	-452,961	544,863	-8,401	448,975
May	5,835,855	4,520,273	1,315,582	260	267	263.5	1,517,322	1,206,913	346,656	1,553,569	-36,247	412,728
June	4,319,131	4,221,278	97,853	227	268	247.5	980,443	1,131,303	24,219	1,155,522	-175,079	237,649
July	4,985,076	4,142,723	842,353	219	231	225	1,091,732	956,969	189,529	1,146,498	-54,766	182,883
August	4,040,793	5,342,784	-1,301,991	201	228	214.5	812,199	1,218,155	-279,277	938,878	-126,679	56,204
September	4,782,303	5,160,668	-378,365	184	106	145	879,944	547,031	-54,863	492,168	387,776	443,980
October	5,332,727	4,956,807	375,920	220	197	208.5	1,173,200	976,491	78,379	1,054,870	118,330	562,310
November	2,943,750	1,556,409	1,387,341	255	203	229	750,656	315,951	317,701	633,652	117,004	679,314
December	1,515,093	1,553,147	-38,054	289	210	249.5	437,862	326,161	-9,494	316,667	121,195	800,509
												269,778#
GARRISON RESERVOIR												
January	1,376,468	1,056,543	319,925		270			285,267				
February	1,615,393	1,121,506	493,887	250	292	271	403,848	327,480	133,843	461,323	-57,475	-57,475
March	2,394,332	897,123	1,497,209	212	296	254	507,598	265,548	380,291	645,839	-138,241	-195,716
April	5,514,299	2,258,506	3,255,793	218	288	253	1,202,117	650,450	823,716	1,474,166	-272,049	-467,765
May	5,110,654	6,443,360	-1,332,706	222	214	218	1,134,565	1,378,879	-290,530	1,088,349	46,216	-421,549
June	6,480,599	3,757,834	2,722,765	177	203	190	1,147,066	762,840	517,325	1,280,165	-133,099	-554,648
July	6,875,817	4,732,561	2,143,256	186	194	190	1,278,902	918,117	407,219	1,325,336	-46,434	-601,082
August	5,278,636	4,371,319	907,317	223	182	202.5	1,177,136	795,580	183,732	979,312	197,824	-403,258
September	4,654,006	4,988,066	-334,060	240	186	213	1,116,961	927,780	-71,155	856,625	260,336	-142,922
October	5,690,163	5,365,616	324,547		228			1,223,360				
November	2,480,578	2,615,398	-134,820	256	240.5	288	635,028	629,003	-33,435	595,568	39,460	-103,462
December	2,070,410	1,547,439	522,971	300			621,123					

* As of December 31, 1954.
\# Accumulated in 1955.

Table 8. Alkalinity Load Entering, Leaving, and Retained in Theoretical Storage; and Computed Alkalinity Load Lost from, or Gained in, Impounded Waters

	ppm Alkalinity			Lbs. Alkalinity x 10^3			Lbs. x 10^3		
	(1) Inflow	(2) Outflow	(3) Retained in Theoretical Storage	(4) Inflow	(5) Outflow	(6) Retained in Theoretical Storage	(7) Sum Discharged Plus Retained Load	(8) Column 4 Minus Column 7	(9) Accumulation on Reservoir Floor
FT. RANDALL RESERVOIR									471,243*
January	185	153	169	179,570	197,624	-54,251	143,373	36,197	507,440
February	195	157	176	206,397	183,246	-19,136	164,110	42,287	549,727
March	150	163	156	373,228	274,563	125,386	399,949	-26,721	523,006
April	168	168	168	331,344	609,580	-278,236	331,344	0	523,006
May	174	158	166	1,015,429	714,203	218,387	932,590	82,849	605,855
June	136	160	148	587,402	675,404	14,482	689,886	-102,484	503,371
July	154	149	151	767,702	617,266	127,195	744,461	23,241	526,612
August	146	154	150	589,956	822,789	-195,299	627,490	-37,534	489,078
September	139	144	141	664,740	743,136	-53,349	689,787	-25,047	464,031
October	148	136	142	789,244	674,126	53,381	727,507	61,737	525,768
November		139						**	525,768 **
December	185	143	164	280,292	222,100	-6,241	215,859	64,433	590,201 **
									118,958 **#
GARRISON RESERVOIR									
January		184							
February	170	190	180	274,617	213,086	57,586	270,672	3,945	3,945
March	153	198	175	366,333	177,630	262,012	439,642	-73,309	-69,364
April	119	181	150	656,202	408,790	488,369	897,159	-240,957	-310,321
May	156	152	154	797,262	979,391	-205,237	774,154	23,108	-287,213
June	122	144	133	790,633	541,128	362,128	903,256	-112,623	-399,836
July	135	148	141	928,235	700,419	302,199	1,002,618	-74,383	-474,219
August	156	130	143	823,467	568,271	129,746	698,017	125,450	-348,769
September	160	141	150	744,641	703,317	-50,109	653,208	91,433	-257,336
October								**	-257,336 **
November	166	160	163	411,776	418,464	-21,976	396,488	15,288	-242,048 **
December	190	170	180	393,378	263,065	94,135	357,200	36,178	-205,870 **

* As of December 31, 1954.
\# Accumulated in 1955.

Table 10. Average Monthly Oxygen Concentration, % Saturation

	Above Garrison Reservoir	Garrison Reservoir	Below Garrison Dam	Mandan	Mobridge	Chamberlain	Ft. Randall Reservoir	Below Ft. Randall Dam	Yankton
Jan		89	106	100	88	89	86	97*	92
Feb	76	88	100	98	87	95	90	90*	91
Mar	83	86	99	88	82	87	96	94*	91
Apr	99	99	117	93	104	96	96	125*	87
May	96	97	116	96	89	88	98	126*	93
Jun	86	90	124	93		85	84	122*	92
Jul	83	85	116	96	92	87	89	124*	90
Aug	86	81	114	89	98	84	81	75#	94
Sep	85	93	120	92	86	80	79	87#	98
Oct						93	83	79#	97
Nov	96	84	126	91	90		93	93#	100
Dec	91	97	117	98	102	95	96	96#	98
1955 Mo Avg	88.1	89.9	114	94	91.8	89	89.2	100.6	93.6

* Flood control discharges.
# Power plant discharges.

Table 11. Average Monthly Nitrogen Concentration, ppm

	Organic	NH_3	NO_2	NO_3	Organic	NH_3	NO_2	NO_3	Organic	NH_3	NO_2	NO_3
	ABOVE GARRISON RESERVOIR				GARRISON RESERVOIR				BELOW GARRISON DAM			
January					0.59	0.1	0.0	0.07	0.60	0.1	0.0	0.08
February	1.1	0.1	0.0	0.25	0.73	0.1	0.0	0.12	0.64	0.1	0.0	0.12
March	0.66	0.1	0.005	0.28	0.94	0.1	0.0	0.22	0.87	<0.1	0.0	0.23
April	2.76	0.1	0.01	0.38	1.72	<0.1	0.0	0.26	1.80	<0.1	0.0	0.25
May	1.31	<0.1	0.0	0.32	1.16	<0.1	0.005	0.42	1.16	<0.1	0.002	0.34
June	2.5	0.05	0.005	0.27	0.70	0.1	0.005	0.34	0.70	0.15	0.005	0.34
July	1.73	<0.1	0.0	0.26	0.73	0.1	0.005	0.28	0.79	0.2	0.015	0.26
August	0.58	<0.1	0.0	0.70	1.08	<0.1	0.002	0.24	1.06	<0.1	0.002	0.31
September	0.74	0.4	0.0	0.17	0.84	0.1	0.0	0.21	0.83	0.1	0.0	0.28
October					0.04			0.22	0.50			0.22
November	0.64	0.1	0.0	0.18	0.67	0.1	0.005	0.24	0.45	0.1	0.005	0.27
December	0.86	0.4	0.0	0.32		0.4	0.0			0.3	0.0	
Average	1.36	0.12	0.002	0.33	0.81	0.10	0.002	0.23	0.81	0.10	0.002	0.24
	MANDAN				MOBRIDGE				PIERRE			
January	0.65	0.2	0.0	0.08		0.2	0.0		0.86			0.02
February	0.65	0.2	0.0	0.12		0.1	0.0		0.64			0.04
March	1.54	0.2	0.01	0.34		0.2	0.0		1.26			0.02
April	1.38	0.1	0.002	0.30		<0.1	0.0		0.99			0.2
May	0.84	0.1	0.002	0.33		0.2	0.0		0.86			0.3
June	1.34	<0.1	0.002	0.40		0.1	0.005		0.94			0.16
July	0.92	0.15	0.001	0.27		<0.1	0.0		1.34			0.12
August	0.69	<0.1	0.0	0.27		0.1	0.0		1.04			0.04
September	1.00	0.1	0.0	0.22		<0.1	0.0		1.22			0.09
October	0.60			0.22					1.34			0.05
November		0.1	0.0			0.1	0.0		1.43			0.06
December	0.80	0.2	0.0	0.23		0.35	0.0		1.00			0.06
Average	0.96	0.12	0.003	0.26		0.12	0.0004		1.07			0.11
	CHAMBERLAIN				FT. RANDALL RESERVOIR				BELOW FT. RANDALL DAM			
January	0.74	<0.1	0.0	0.03	1.01	0.1	0.0	0.07	0.78	0.2	0.0	0.41
February	0.96	0.1	0.0	0.04	0.57	0.0	0.0	0.03	0.53	0.0	0.0	0.03
March	1.37	0.1	0.006	0.3	1.00	<0.1	0.0	0.02	1.01	<0.1	0.0	0.02
April	1.18	0.05	0.002	0.1	1.36	0.5	0.0	0.02	1.27	0.5	0.0	0.02
May	0.64	0.1	0.0	0.37	0.64	<0.1	0.002	0.02	0.66	0.1	0.002	0.02
June	0.88	<0.1	0.0	0.45	0.84	0.1	0.03	0.03	0.78	0.15	0.018	0.03
July	1.16	<0.1	0.0	0.02	1.22	<0.1	0.03	0.22	1.12	<0.1	0.012	0.30
August	1.00	<0.1	0.002	0.03	1.02	<0.1	0.002	0.12	1.04	<0.1	0.002	0.18
September	1.05	0.1	0.0	0.08	0.94	0.1	0.0	0.07	0.96	0.1	0.0	0.07
October	1.14	<0.1	0.0	0.04	1.12	0.15	0.0	0.09	1.22	0.1	0.0	0.08
November	1.19			0.05	1.40	0.1	0.0	0.08	1.05	0.1	0.0	0.15
December	0.88	0.1	0.0	0.08	0.92	0.4	0.0	0.08	0.92	0.4	0.0	0.08
Average	0.97	0.10	0.001	0.12	1.01	0.14	0.006	0.07	0.94	0.15	0.003	0.12
	YANKTON				OMAHA				COUNCIL BLUFFS			
January	0.80	<0.1	0.0	0.29			0.0			0.55	0.005	
February	0.60	<0.1	0.0	0.30			0.0			0.42	0.006	
March	1.16	0.15	0.0	0.04			0.005			1.20	0.018	
April	1.24	<0.1	0.0	0.04			0.003			0.55	0.17	
May	0.50	<0.1	0.002	0.02			Tr.			0.30	0.005	
June	0.78	<0.1	0.014	0.08			0.001			0.50	0.008	
July	1.15	<0.1	0.005	0.05			0.004			0.41	0.008	
August	0.97	0.1	0.0	0.04			0.005			0.32	0.005	
September	1.00	<0.1	0.0	0.08			0.005			0.38	0.004	
October	1.24	<0.1	0.0	0.03			0.005			0.50	0.004	
November	1.20	0.2	0.0	0.06			0.005			0.41	0.004	
December	0.91	0.3	0.0	0.06			0.025			0.35	0.005	
Average	0.96	0.10	0.002	0.11			0.005			0.50	0.007	

Table 13. Average Monthly Phosphorous Concentration, ppm

	Total Phosphorous									Phosphates
	ABOVE GARRISON RESERVOIR	GARRISON RESERVOIR	BELOW GARRISON DAM	MANDAN	PIERRE	CHAMBERLAIN	FT. RANDALL RESERVOIR	BELOW FT. RANDALL DAM	YANKTON	COUNCIL BLUFFS
January		0.028	0.028	0.10	0.18	0.18	0.20	0.24	0.20	0.0
February	0.20	0.09	0.10	0.14	0.21	0.21	0.18	0.18	0.20	0.0
March	0.11	0.08	0.04	0.42	0.24	0.27	0.24	0.18	0.22	0.0
April	1.44	0.08	0.11	0.22	0.17	0.21	0.18	0.25	0.26	0.0
May	0.32	0.20	0.20	0.22	0.22	0.25	0.22	0.21	0.18	0.0
June	0.56	0.17	0.20	0.24	0.22	0.16	0.16	0.15	0.19	0.0
July	0.52	0.06	0.04	0.44	0.16	0.11	0.15	0.15	0.17	0.0
August	0.17	0.10	0.08	0.24	0.20	0.18	0.14	0.16	0.16	0.5
September	0.22	0.72	0.70	0.22	0.25	0.22	0.25	0.27	0.22	0.8
October		0.21	0.22	0.29	0.26	0.21	0.27	0.26	0.26	1.0
November	0.58	0.11	0.16		0.27	0.71	1.12	0.58	0.88	0.5
December	0.47			0.27	0.21	0.28	0.20	0.21	0.22	0.2
Average	0.43	0.22	0.16	0.25	0.22	0.24	0.27	0.24	0.26	0.25

Table 12. Average Annual Nitrogen and Total Phosphorous Concentration, ppm

	Total Phosphorous			Organic Nitrogen			Ammonia Nitrogen			Nitrite Nitrogen			Nitrate Nitrogen		
	1952-53	1954	1955	1952-53	1954	1955	1952-53	1954	1955	1952-53	1954	1955	1952-53	1954	1955
ABOVE GARRISON RESERVOIR		0.31	0.43		0.72*	1.36		0.06*	0.12		0.0*	0.002		0.18*	0.33
GARRISON RESERVOIR		0.18	0.22		0.58*	0.81		0.08*	0.10		0.0*	0.002		0.10*	0.23
BELOW GARRISON DAM		0.14	0.16		0.56*	0.81		0.10*	0.10		0.0*	0.002		0.10*	0.24
MANDAN		0.26	0.25		0.59*	0.96		0.10*	0.12		0.0*	0.003		0.16*	0.26
PIERRE	0.094	0.22	0.22	0.75	0.44	1.07							0.08	0.008	0.11
CHAMBERLAIN	0.061	0.20	0.24	1.01	0.38	0.97	0.35	0.10	0.10	0.0	0.0	0.001	0.08	0.05	0.12
FT. RANDALL RESERVOIR		0.28	0.27	0.70	0.35	1.01	0.29	0.18	0.14	0.0	0.0	0.006		0.01	0.07
BELOW FT. RANDALL DAM	0.065	0.21	0.24	0.63	0.32	0.94	0.29	0.09	0.15	0.0	0.0005	0.003	0.11	0.006	0.12
YANKTON	0.063	0.37	0.26	0.75	0.41	0.96	0.40	0.10	0.10	0.0	0.0	0.002	0.11	0.03	0.11
OMAHA	0.097			0.80			0.45	0.47		0.002	0.0	0.005	0.15		
COUNCIL BLUFFS									0.50			0.007			

* July - December records only.

Table 14. Most Numerous Organisms at Each Station in Descending Order

	ABOVE GARRISON RESERVOIR	GARRISON RESERVOIR	BELOW GARRISON DAM	MANDAN, N. DAK. W.W. INTAKE	MOBRIDGE, S. DAK. W.W. INTAKE	MISSOURI RIVER AT PIERRE, S. DAK.	CHAMBERLAIN, S. DAK. W.W. INTAKE
January		Asterionella Euglena Heterotrichales sp.	Asterionella Euglena Heterotrichales sp.	Asterionella Heterotrichales sp. Dactylococcopsis	Asterionella Heterotrichales sp. Dactylococcopsis	Asterionella Heterotrichales sp. Ankistrodesmus & Chlamydomonas gr.	Asterionella Heterotrichales sp. Cyclo.-Steph. gr. & Chlamydomonas gr.
February	Cyclo.-Steph. gr.* Navicula gr.	Dactylococcopsis Asterionella Diatoma elongatum	Dactylococcopsis Asterionella Diatoma elongatum	Dactylococcopsis Diatoma elongatum Asterionella	Dactylococcopsis Asterionella Diatoma elongatum	Dactylococcopsis Asterionella Heterotrichales sp.	Heterotrichales sp. Dactylococcopsis Asteriopella
March	Navicula gr. Chlamydomonas gr. Nitzschia gr. & Rhizosolenia gr.	Cyclo. chaet.# Dactylococcopsis Asterionella & Diatoma elongatum	Cyclo. chaet. Asterionella Diatoma elongatum	Asterionella Dactylococcopsis Diatoma elongatum	Dactylococcopsis Asterionella Rhizosolenia gr.	Dactylococcopsis Asterionella Navicula gr.	Dactylococcopsis Asterionella Ankistrodesmus
April	Nitzschia gr. Diatoma vulgare Cyclo.-Steph. gr.	Cyclo. chaet Asterionella Rhizosolenia gr.	Cyclo. chaet Asterionella Rhizosolenia gr.	Asterionella Dactylococcopsis Diatoma elongatum	Chlorella Asterionella Diatoma elongatum	Asterionella Chlamydomonas gr. Diatoma elongatum	Diatoma elongatum Asterionella Cyclo.-Steph. gr.
May	Asterionella Nitzschia gr. Chlamydomonas gr.	Cyclo.-Steph. gr. Asterionella Chlamydomonas gr.	Cyclo.-Steph gr. Euglena Chlorella	Cyclo.-Steph. gr. Asterionella Diatoma elongatum	Cyclo.-Steph. gr. Asterionella Chlamydomonas gr.	Cyclo.-Steph. gr. Asterionella Chlamydomonas gr.	Cyclo.-Steph. gr. Asterionella Chlamydomonas gr.
June	Nitzschia gr. Navicula gr. Surirella	Cyclo.-Steph. gr. Asterionella Trachelomonas	Cyclo.-Steph. gr. Euglena Navicula gr.	Rhizosolenia gr. Fragilaria spp. Cyclo.-Steph. gr.	Cyclo. chaet. Rhizosolenia gr. Cyclo.-Steph. gr.	Cyclo.-Steph. gr. Rhizosolenia gr. Asterionella	Cyclo.-Steph. gr. Rhizosolenia gr. Asterionella
July	Cyclo.-Steph. gr. Rhizosolenia gr. Scenedesmus bijuga	Chlamydomonas gr. Navicula gr. Trachelomonas	Navicula gr. Diatoma vulgare Coelastrum	Navicula gr. Rhizosolenia gr. Schroederia	Rhizosolenia gr. Schroederia Navicula gr.	Cyclo.-Steph. gr. Rhizosolenia gr. Navicula gr.	Cyclo.-Steph. gr. Rhizosolenia gr. Navicula gr.
August	Navicula gr. Rhizosolenia gr. Nitzschia gr.	Aphanizomenon Chlamydomonas gr. Cyclo.-Steph. gr.	Aphanizomenon Cyclo.-Steph. gr. Euglena	Navicula gr. Rhizosolenia gr. Oscillatoria gr.	Rhizosolenia gr. Navicula gr. Stichococcus	Cyclo.-Steph gr. Rhizosolenia gr. Cyclo. chaet.	Cyclo.-Steph. gr. Rhizosolenia gr. Navicula gr.
September	Rhizosolenia gr. Navicula gr. Cyclo.-Steph. gr.	Cyclo.-Steph. gr. Aphanizomenon	Cyclo.-Steph. gr. Aphanizomenon Euglena	Cyclo.-Steph. go. Aphanizomenon Oscillatoria gr.	Cyclo.-Steph. gr. Aphanizomenon Navicula gr.	Cyclo.-Steph. gr. Rhizosolenia gr. Navicula gr.	Cyclo.-Steph. gr. Rhizosolenia gr. Navicula gr.
October		Cyclo.-Steph. gr. Aphanizomenon Euglena	Cyclo.-Steph. gr. Aphanizomenon Diatoma vulgare	Cyclo.-Steph. gr. Aphanizomenon Navicula gr.		Cyclo.-Steph. gr. Aphanizomenon Navicula gr.	Cyclo.-Steph. gr. Aphanizomenon Navicula gr.
November	Synedra gr. Navicula gr. Cyclo.-Steph. gr.	Cyclo.-Steph. gr. Euglena Asterionella	Cyclo.-Steph. gr. Euglena Gloeocystis	Cyclo.-Steph. gr. Navicula gr. Asterionella	Cyclo.-Steph. gr. Aphanizomenon Diatoma vulgare	Cyclo.-Steph. gr. Aphanizomenon Navicula gr., Nitzschia gr., & Gloeocystis	Cyclo.-Steph. gr. Aphanizomenon Cyclo. chaet.
December	Cyclo.-Steph. gr. Euglena Dactylococcopsis & Cyclo. chaet.	Cyclo.-Steph. gr. Euglena Asterionella	Cyclo.-Steph. gr. Euglena Asterionella	Cyclo.-Steph. gr. Asterionella Navicula gr.	Cyclo.-Steph. gr. Asterionella Euglena	Cyclo.-Steph. gr. Gloeocystis Euglena	Cyclo.-Steph. gr. Asterionella Euglena

	FT. RANDALL RESERVOIR	BELOW FT. RANDALL DAM	NIOBRARA RIVER AT NIOBRARA, NEBR.	YANKTON, S. DAK. W.W. INTAKE	OMAHA, NEBR. W.W. INTAKE	COUNCIL BLUFFS, IA. W.W. INTAKE
January	Asterionella Chlamydomonas gr. Euglena	Asterionella Chlamydomonas gr. Euglena		Asterionella Ankistrodesmus Trachelomonas	Chlorella Chlamydomonas gr. Cyclo.-Steph. gr.	Chlamydomonas gr. Chlorella Gloeocystis
February	Asterionella Chlamydomonas gr. Euglena	Asterionella Euglena Chlamydomonas gr.		Asterionella Ankistrodesmus Chlamydomonas gr.	Asterionella Cyclo.-Steph. gr. Chlamydomonas gr.	Chlamydomonas gr. Asterionella Chlorella
March	Asterionella Ankistrodesmus Euglena	Asterionella Chlamydomonas gr. Euglena		Asterionella Fragilaria spp. Heterotrichales sp.	Asterionella Nitzschia gr. Synedra gr.	Nitzschia gr. Asterionella Synedra gr.
April	Coccomonas Euglena Heterotrichales sp.	Euglena Heterotrichales sp. Ankistrodesmus	Fragilaria spp. Navicula gr. Nitzschia gr.	Heterotrichales sp. Asterionella Dactylococcopsis	Rhizosolenia gr. Navicula gr. Cyclo.-Steph. gr.	Cyclo.-Steph. gr. Asterionella Cyclo.-Steph. gr.
May	Asterionella Cyclo.-Steph. gr. Ankistrodesmus	Asterionella Cyclo.-Steph. gr Diatoma elongatum	Ankistrodesmus Chlamydomonas gr. Rhizosolenia gr.	Asterionella Cyclo.-Steph. gr. Diatoma elongatum	Asterionella Rhizosolenia gr. Cyclo.-Steph. gr.	Asterionella Rhizosolenia gr. Diatoma elongatum & Cyclo.-Steph. gr.
June	Euglena Gloeocystis Asterionella	Euglena Cyclo.-Steph. gr. Asterionella	Scene. dimorphus Ankistrodesmus Rhizosolenia gr.	Navicula gr. Cyclo.-Steph. gr. Rhizosolenia gr.		
July	Euglena Cyclo.-Steph. gr. Asterionella	Cyclo.-Steph. gr. Coccomonas Trachelomonas	Ankistrodesmus Rhizosolenia gr. Dictyosphaerium	Rhizosolenia gr. Navicula gr. Ankistrodesmus	Navicula gr. Rhizosolenia gr. Cyclo.-Steph. gr.	Navicula gr. Rhizosolenia gr. Cyclo.-Steph. gr.
August	Chlamydomonas gr. Coccomonas Cyclo.-Steph. gr.	Chlamydomonas gr. Coccomonas Cyclo.-Steph. gr.	Ankistrodesmus Rhizosolenia gr. Cymbella	Chlamydomonas gr. Cyclo.-Steph. gr. Ankistrodesmus	Cyclo.-Steph. gr. Rhizosolenia gr. Navicula gr.	Cyclo.-Steph. gr. Navicula gr. Dictyosphaerium
September	Cyclo.-Steph. gr. Chlamydomonas gr. Coccomonas	Cyclo.-Steph. gr. Chlamydomonas gr. Coccomonas		Cycle.-Steph. gr. Chlamydomonas gr. Heterotrichales sp.	Cyclo.-Steph. gr. Navicula gr. Rhizosolenia gr.	Cyclo.-Steph. gr. Navicula gr. Dictyosphaerium
October	Cyclo.-Steph. gr. Stichococcus Navicula gr.	Cyclo.-Steph. gr. Stichococcus Navicula gr.	Navicula gr. Fragilaria spp. Ankistrodesmus	Stichococcus Navicula gr. Cyclo.-Steph. gr.	Stichococcus Navicula gr. Cyclo.-Steph. gr.	Stichococcus Navicula gr. Cyclo.-Steph. gr.
November	Navicula gr. Stichococcus Cyclo.-Steph gr. & Euglena	Stichococcus Scene. quadricauda Cyclo.-Steph. gr.		Navicula gr. Cyclo.-Steph. gr. Stichococcus	Navicula gr. Cyclo.-Steph. gr. Rhizosolenia gr.	Cyclo.-Steph. gr. Navicula gr. Rhizosolenia gr.
December	Euglena Cyclo.-Steph. gr. Chlamydomonas gr.	Cyclo.-Steph. gr. Euglena Chlamydomonas gr.		Navicula gr. Cyclo.-Steph. gr. Diatoma vulgare	Cyclo.-Steph. gr. Chlamydomonas gr. Rhizosolenia gr.	Cyclo.-Steph. gr. Euglena Rhizosolenia gr.

* Cyclotella-Stephanodiscus group
\# Cyclotella chaetoceras

NOTE: In all cases when Average & Maximum counts for one month are the same, only one sample was collected for that month.

Table 15. Average Plankton Concentration, No. per ml.

	ABOVE GARRISON Average	ABOVE GARRISON Maximum	GARRISON RESERVOIR Average	GARRISON RESERVOIR Maximum	BELOW GARRISON Average	BELOW GARRISON Maximum	MANDAN Average	MANDAN Maximum	MOBRIDGE Average	MOBRIDGE Maximum
January			425	868	450	795	250	408		193*
February		12*	206	239	196	243	159	222		227*
March		12*	415	853	387	670	200	253		160*
April		33*	711	1,397	982	1,787	412	578		1,592*
May	107	131	264	529	307	710	506	607	129	200
June	34	40	23	70	46	130	57	85	686	1,263
July	59	106	31	72	38	91	44	94	213	298
August	70	124	20	58	15	23	50	67	218	266
September		135*	69	85	58	88	118	222		146*
October			173	247	192	286	224	299		
November	104	149	106	146	110	146	92	132		257*
December	25	30	48	49	44	48	32	36		23*

	PIERRE Average	PIERRE Maximum	CHAMBERLAIN Average	CHAMBERLAIN Maximum	FT. RANDALL RESERVOIR Average	FT. RANDALL RESERVOIR Maximum	BELOW FT. RANDALL Average	BELOW FT. RANDALL Maximum	NIOBRARA RIVER Average	NIOBRARA RIVER Maximum
January	206	215	276	302	225	253	230	290		
February	240	287	345	411	323	357	274	312		
March	119	197	198	300	436	555	322	447		
April	252	390	850	1,103	258	444	321	428		83*
May	233	386	69	100	1,116	1,522	840	1,114	10,035	18,015
June	132	154	402	1,172	104	196	82	108		3,200*
July	332	364	179	418	46	70	22	35		17,929*
August	454	811	544	943	401	965	349	906		8,591*
September		142*	106	172	390	614	415	724		
October	393	447	364	473	269	495	274	566	282	325
November		243*	137	376	59	171	44	73		
December	28	34	21	26	82	144	67	91		

	YANKTON Average	YANKTON Maximum	OMAHA Average	OMAHA Maximum	COUNCIL BLUFFS Average	COUNCIL BLUFFS Maximum
January	106	132	326	462	268	375
February	150	192	120	154	92	106
March	123	182	48	70	36	52
April	161	345	90	197	60	118
May	1,067	1,986	270	270	325	325
June	201	312				
July	297	376	220	306	363	563
August	550	791	371	578	363	578
September	543	1,088	306	475	370	509
October	255	340	263	348	232	327
November	39	61	62	78	84	92
December	32	45	686	1,642	368	534

* Only one record.

Table 19. Summary of Individual Physical and Chemical Analyses - Niobrara River

Year - 1955	4/8	5/9	5/17	5/23	5/31	6/27	7/25	8/30	10/6	10/31
Temperature °C	15	17.5	23		22	20	29	21	14	13.5
Turbidity ppm	350	180		210		260		310		
pH	8.0	8.2	8.4		8.2	8.2	8.5	8.4	8.2	8.0
CO_3 Alk. ppm	4	10	16		8	10	20	12	10	0
HCO_3 Alk. ppm	136	125	105		111	116	116	107	105	126
Oxygen % Sat.	91	95	103		95	91	76	93	88	104
NH_3 N ppm	0	0.1	0		0.1	0.1	0.1	<0.1	<0.1	<0.1
NO_2 N ppm	0	0	0		0.005	0	0	0	0.005	0
PO_4 ppm	0	0	0		0	0	0	0	0	0

Table 20a. Individual Plankton Analyses - Above Garrison Reservoir

Year - 1955	2/15	3/17	4/12	5/3	5/19	6/7	6/22	7/6	7/19	8/9	8/23	9/28	11/4	11/26	12/9	12/22
PHYTOPLANKTERS																
BLUE-GREEN ALGAE																
Aphanizomenon										1	1	P				
Dactylococcopsis					1								1	1	3	2
Oscillatoria gr.											P		P			
YELLOW-GREEN ALGAE																
DIATOMS																
Asterionella	1	1		6	55	3			3			5	3	P		P
Cocconeis												2				
Cyclotella chaetoceras									1		1			7	5	
Cyclotella sp.											3			2	2	
Cyclotella-Stephanodiscus gr.	5		4	1	6	1	1		26	4	9	12	19	4	6	2
Cymbella					1		2	1					1			
Diatoma vulgare			7	10	6	2	4	2	2		5		5			
Fragilaria crotonensis									P		P	8				
Gomphonema				2							1		1			
Gyrosigma gr.				2							1					
Melosira (a)								P	2	1	2	P	1			
Melosira (b)									P							
Navicula gr.	3	4	1	15	9	6	8	2	7		30	22	17	9		3
Nitzschia gr.	1	2	15	14	24	9	7	3	4	1	17	5	15	4	1	2
Rhizosolenia gr.		2			10		1		18		30	58	5	12		2
Surirella			3	6	7		7						3			
Synedra gr.			2				3	1	2			5	78	3		2
XANTHOPHYCEAE																
Heterotrichales sp.												3		7		2
GREEN ALGAE																
Actinastrum							1		3	1	1					
Ankistrodesmus					1				1		3	1		4		
Chlamydomonas gr.		3	1	17	5	2	2		5					3	1	1
Chlorella	1														1	
Closteriopsis						1										
Coccomonas											3	3				
Coelastrum				1								4				
Crucigenia quadrata										4						
Crucigenia tetrapedia																1
Dictyosphaerium				1												
Gloeocystis	1			1	3		1		5		2	4				
Pandorina								1	2		2					
Scenedesmus bijuga							1		17		11					
Scenedesmus dimorphus									4			1				
Scenedesmus quadricauda										1		1				
Stichococcus									1		1	1		1		
Tetraedron duospinum				1												
Tetraedron quadratum											1					
EUGLENOPHYTA																
Euglena				3	2		2		1						6	2
Phacus									1							
Trachelomonas				3	1	5		2	1	2				1		1
ZOOPLANKTERS																
PROTOZOA																
Protozoa sp.														1	1	
Strombilidium															4	
Vorticella										1						
TOTAL	12	12	33	83	131	29	40	12	106	16	124	135	149	59	30	20

Table 20b. Individual Plankton Analyses - Garrison Reservoir (Cont.)

Year - 1955	5/2	5/9	5/16	5/23	6/1	6/6	6/14	6/20	6/28	7/5	7/11	7/18	7/25	8/1	8/8	8/15	8/22
PHYTOPLANKTERS																	
BLUE-GREEN ALGAE																	
Anabaena																	
Aphanizomenon														38		3	8
Dactylococcopsis	21	16	13	1	2												
Oscillatoria gr.	3																
YELLOW-GREEN ALGAE																	
DIATOMS																	
Asterionella	6	5	22	86	9	1		2	4				1				2
Cyclotella chaetoceras				11	2				1				1				
Cyclotella sp.			21					1									
Cyclotella-Stephanodiscus gr.	12	14	114	327	9	2	1	2	3		1		9	1	2		1
Diatoma elongatum			3	15		4		P									
Diatoma vulgare																	
Fragilaria crotonensis											2						
Fragilaria sp.																	
Gomphonema																	
Melosira (b)				3													
Navicula gr.	1	1	1	2		6		2	1			17	1	1			1
Nitzschia gr.		4		1								1			1		
Rhizosolenia gr.		1	1	7	1							1		1			
Surirella	4	1	10	16	3	1											
Synedra gr.		1															
XANTHOPHYCEAE																	
Heterotrichales sp.		4	10	5													
CHRYSOPHYCEAE																	
Dinobryon	6																
Mallomonas				1													
GREEN ALGAE																	
Actinastrum				1													
Ankistrodesmus	1	2	8	2	1				1	1				3			
Chlamydomonas gr.	13	27	40	9					3			38	3	7			
Chlorella	2	9	36	2	3	1							1				
Closteriopsis																	
Coccomonas					2								2				2
Coelastrum					1								1				
Crucigenia quadrata			1									1					
Dictyosphaerium																	
Elakatothrix				4													
Gloeocystis	4		4	2	2				1	1	1	1	1			1	1
Golenkinia												1					
Lagerheimia quadriseta		1															
Lagerheimia wratislawiensis																	
Micractinium			1														
Oocystis					2				2		2	1	4				1
Pandorina			1														
Planktosphaeria																	
Scenedesmus dimorphus																	
Scenedesmus opoliensis			1														
Scenedesmus quadricauda					2												
Schroederia				1							3	6	1	2		1	
Sphaerocystis				3						1		1					
Stichococcus			1														
Tetrastrum elegans																	
EUGLENOPHYTA																	
Euglena	7	15	25	13	17				5	1		3	2			2	1
Trachelomonas		4	6	6	10				2		7		4	3		1	1
YELLOW-BROWN ALGAE																	
DINOPHYCEAE																	
Ceratium														2		1	
Glenodinium																	
Gymnodinium			4														
ZOOPLANKTERS																	
PROTOZOA																	
Codonella	1		1														
Difflugia sp.				6													
Protozoa sp.		2	2														
Strombilidium				2	3								1				
Vorticella	4	7	2	3	1												
ROTIFERS																	
Brachionus sp.		1															
OSTRACODA																	
Ostracoda sp.																	
COPEPODA																	
Copepoda sp.												1					
TOTAL	85	115	388	589	70	15	1	7	23	4	16	72	32	58	3	9	18

Table 20b. Individual Plankton Analyses - Garrison Reservoir (Cont.)

Year - 1955	8/29	9/6	9/13	9/19	9/26	10/3	10/10	10/17	10/24	10/31	11/7	11/14	11/21	11/28	12/5	12/12	12/19
PHYTOPLANKTERS BLUE-GREEN ALGAE																	
Anabaena		1						P									
Aphanizomenon		67	39	6	12	125	105	12	P	5	1	3					
Dactylococcopsis																	1
Oscillatoria gr.																	
YELLOW-GREEN ALGAE DIATOMS																	
Asterionella						P					1	1	1	6	4	6	20
Cyclotella chaetoceras																2	
Cyclotella sp.																	
Cyclotella-Stephanodiscus gr.	3	10	15	42	72	120	64	129	168	99	116	93	80	55	29	9	14
Diatoma elongatum																	
Diatoma vulgare								2									
Fragilaria crotonensis																	1
Fragilaria sp.											6						
Gomphonema																	
Melosira (b)																	
Navicula gr.	1					1		2	1		1	1	1				1
Nitzschia gr.	1							4									
Rhizosolenia gr.												2					
Surirella																	
Synedra gr.																	
XANTHOPHYCEAE																	
Heterotrichales sp.			1														
CHRYSOPHYCEAE																	
Dinobryon																	
Mallomonas												1				2	
GREEN ALGAE																	
Actinastrum																	
Ankistrodesmus																1	4
Chlamydomonas gr.	3															1	
Chlorella	1														1		
Closteriopsis	1						1				1						
Coccomonas				1													
Coelastrum										1		1					
Crucigenia quadrata			1												1		
Dictyosphaerium		1															
Elakatothrix																2	
Gloeocystis							4			4	1	2				2	
Golenkinia																	
Lagerheimia quadriseta																	
Lagerheimia wratislawiensis																	
Micractinium																	
Oocystis									1	1		1		1	1		
Pandorina																	
Planktosphaeria															1		
Scenedesmus dimorphus																	
Scenedesmus opoliensis																	
Scenedesmus quadricauda																1	
Schroederia																	
Sphaerocystis																	
Stichococcus																	
Tetrastrum elegans																	
EUGLENOPHYTA																	
Euglena	3	2					4		4	1	17	8	3	12	8	19	5
Trachelomonas			1						1	1	1	1		1			
YELLOW-BROWN ALGAE DINOPHYCEAE																	
Ceratium				1	1												
Glenodinium																	
Gymnodinium														3		1	1
ZOOPLANKTERS PROTOZOA																	
Codonella																	
Difflugia sp.														1	1		
Protozoa sp.			1							1	1		1		1	2	1
Strombilidium		2	1			1		1								1	
Vorticella																	
ROTIFERS																	
Brachionus sp.																	
OSTRACODA																	
Ostracoda sp.																	
COPEPODA																	
Copepoda sp.																	
TOTAL	13	83	59	50	85	247	178	150	175	113	146	114	86	79	47	49	48

Table 20c. Individual Plankton Analyses - Below Garrison Dam

Year - 1955	1/3	1/10	1/17	1/31	2/7	2/14	2/23	2/28	3/7	3/14	3/21	3/22	3/28	4/4	4/11	4/20	4/26
PHYTOPLANKTERS																	
BLUE-GREEN ALGAE																	
Anabaena																	
Aphanizomenon																	
Chroococcus										1							
Dactylococcopsis	11	9	21	26	36	68	48	68	62	82	41	24	33			51	6
Oscillatoria gr.													1				
YELLOW-GREEN ALGAE																	
DIATOMS																	
Amphiprora																	
Asterionella	503	334	171	92	66	44	32	27	13	27	38	119	72	219	221	125	26
Cyclotella chaetoceras											151		280	810	756		13
Cyclotella sp.														11			
Cyclotella-Stephanodiscus gr.	3	1		8	8	11	4	16	4	11	11		12	29	12	28	3
Cymbella									1								
Diatoma elongatum	10	13	14	29	15	28	25	30	27	58	69	19	78	50	85	64	4
Diatoma vulgare																	
Fragilaria crotonensis											P					2	
Fragilaria sp.												3					
Gomphonema															3		
Gyrosigma gr.				1												4	
Melosira (a)																	
Navicula gr.				1			1	1	2		2		1	1	2		
Nitzschia gr.	5	5					1	2			1			1	5	8	
Rhizosolenia gr.	3	2	4	16	7	12	3	10	8	14	59	12	44	225	210	1	11
Surirella				1												1	1
Synedra gr.		3				1					31		36	13			
XANTHOPHYCEAE																	
Heterotrichales sp.	9	17	41	41	31	24	9	8	2	1	8	51	8	5	7	2	2
CHRYSOPHYCEAE																	
Dinobryon										1	11		20	81	51	45	7
Mallomonas	3	1			2				1					3	1		
GREEN ALGAE																	
Actinastrum	6	4	5		1		1				1	1	1	1			
Ankistrodesmus	8	3	9	6	7	21	4	1	9	16	11	6	16	20	14	8	6
Chlamydomonas gr.	11	15	1	14	7	6	7	6	10	9	15	3	14	122	45	20	6
Chlorella	7			2		1		5	7	7			7			36	
Closteriopsis																	
Coccomonas											2		3				6
Coelastrum	1													2			
Crucigenia quadrata	9	13	8	8	1	7		3	1		2	15	2	1	3		
Dictyosphaerium	4	1		3	2	1		1	1	1		3	1	6	1		1
Elakatothrix			2											2			1
Gloeocystis	14			2	1	2				2				12	20	3	
Lagerheimia quadriseta											3		1				
Lagerheimia wratislawiensis						3								1			
Nephrocytium																	
Oocystis	2																
Pandorina	1														1		1
Pediastrum duplex	1																
Rhizochrysis																	
Rhizoclonium																	
Scenedesmus bijuga		1			1												
Scenedesmus dimorphus			1														
Scenedesmus opoliensis																	
Scenedesmus quadricauda												1					
Schroederia																	
Sphaerocystis																	
Staurastrum paradoxum																	
Tetrastrum elegans	3							2			1	1		2			
Ulothrix																	
EUGLENOPHYTA																	
Euglena	163	14	15	4	4	10	7	9	11	30	86	6	30	108	93	30	2
Eutreptia																	
Trachelomonas	5	3	4	3	3	1	1	3	2	1		3	5	4			3
YELLOW-BROWN ALGAE																	
DINOPHYCEAE																	
Ceratium																	
Gymnodinium	7	3	2	5	1	1	5	1	5	10	11	6	5	45	35	1	4
Peridinium											1						
ZOOPLANKTERS																	
PROTOZOA																	
Difflugia sp.					1									1	1		
Paramecium																	
Protozoa sp.	5				4	1					1			12	7	34	
Strombilidium																1	
Vorticella	1	2	1													2	
ROTIFERS																	
Polyarthra platyptera																	
OSTRACODA																	
Ostracoda sp.						1											
COPEPODA																	
Copepoda sp.																	
TOTAL	795	444	299	262	198	243	148	193	166	271	556	273	670	1,787	1,573	466	103

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Table 20c. Individual Plankton Analyses - Below Garrison Dam (Cont.)

Year - 1955	5/2	5/9	5/16	5/23	6/1	6/6	6/14	6/20	6/28	7/5	7/11	7/18	7/25	8/1	8/8	8/15	8/22
PHYTOPLANKTERS																	
BLUE-GREEN ALGAE																	
Anabaena															P		
Aphanizomenon														1		10	15
Chroococcus																	
Dactylococcopsis	10	2	13														
Oscillatoria gr.			3								3						
YELLOW-GREEN ALGAE																	
DIATOMS																	
Amphiprora		1			1												
Asterionella	6	2		71	13	2	1				1						
Cyclotella chaetoceras		12		22													
Cyclotella-sp.																	
Cyclotella-Stephanodiscus gr.	17	8	83	494	59	4	2	1	4		2	3	8	1	1	4	1
Cymbella																	
Diatoma elongatum		1	2	13	1	4			2								
Diatoma vulgare									10	2	23						
Fragilaria crotonensis												1	2				
Fragilaria sp.											4						
Gomphonema							1		2								
Gyrosigma gr.																	
Melosira (a)																	
Navicula gr.			2			3	4	2	19	5	43	1	1	3	1	1	
Nitzschia gr.	1	2	1				4		2	1							
Rhizosolenia gr.		5	2		1											1	
Surirella		1	15	15	6												
Synedra gr.				2	1							1					
XANTHOPHYCEAE																	
Heterotrichales sp.	3	2	12	2	1												
CHRYSOPHYCEAE																	
Dinobryon	2	P	2	2													
Mallomonas				1													
GREEN ALGAE																	
Actinastrum			1														
Ankistrodesmus	8		5	5	1	2											
Chlamydomonas gr.	16	13	29	8						3					1		
Chlorella	22		58	7	4							1	1				
Closteriopsis				1													
Coccomonas		4			2									1			
Coelastrum			1	3									14	1			
Crucigenia quadrata			2	1													
Dictyosphaerium				1													
Elakatothrix			5		2	1											
Gloeocystis	4		1	2	2	5			3		2						
Lagerheimia quadriseta	1		1	1													
Lagerheimia wratislawiensis				1													
Nephrocytium																	
Oocystis									1				1			1	
Pandorina				2	1												
Pediastrum duplex				1													
Rhizochrysis				2													
Rhizoclonium	10																
Scenedesmus bijuga																	
Scenedesmus dimorphus			1		1												
Scenedesmus opoliensis			1														
Scenedesmus quadricauda			1	1	1												
Schroederia												1					
Sphaerocystis				1						1							
Staurastrum paradoxum																	
Tetrastrum elegans																	
Ulothrix											5						
EUGLENOPHYTA																	
Euglena	33	7	37	35	22	2	1	4	5			9	2			5	
Eutreptia			3														
Trachelomonas	3	2	8	5	8		1	1	7		7	4	1	2	1		5
YELLOW-BROWN ALGAE																	
DINOPHYCEAE																	
Ceratium														1			2
Gymnodinium	3	1	1	1													
Peridinium		1															
ZOOPLANKTERS																	
PROTOZOA																	
Difflugia sp.				3													
Paracineta				1													
Protozoa sp.	8	1	6	1													
Strombilidium	1			3	3												
Vorticella	1	5	3	1													
ROTIFERS																	
Polyarthra platyptera				1													
OSTRACODA																	
Ostracoda sp.																	
COPEPODA																	
Copepoda sp.											1						
TOTAL	149	70	299	710	130	23	14	8	55	12	91	21	30	10	4	22	23

Table 20c. Individual Plankton Analyses - Below Garrison Dam (Cont.)

Year - 1955	8/29	9/6	9/13	9/19	9/26	10/3	10/10	10/17	10/24	10/31	11/7	11/14	11/21	11/28	12/5	12/12	12/19
PHYTOPLANKTERS																	
BLUE-GREEN ALGAE																	
Anabaena	P	1															
Aphanizomenon	5	21	13	28	18	154	146	14	2	8	1	P	P				
Chroococcus																	
Dactylococcopsis																	
Oscillatoria gr.		P			1												
YELLOW-GREEN ALGAE																	
DIATOMS																	
Amphiprora																	
Asterionella													3	2	2	10	16
Cyclotella chaetoceras			1	1											1		3
Cyclotella sp.																	
Cyclotella-Stephanodiscus gr.	5	10	22	8	62	131	80	120	142	131	124	100	83	32	21	10	8
Cymbella																	
Diatoma elongatum																	
Diatoma vulgare		2			4			9					5				
Fragilaria crotonensis																P	P
Fragilaria sp.																	
Gomphonema																	
Gyrosigma gr.																	
Melosira (a)								P		P							
Navicula gr.		10			1							1	1	1			
Nitzschia gr.	1	1				1											
Rhizosolenia gr.															1		
Surirella																	1
Synedra gr.																	
XANTHOPHYCEAE																	
Heterotrichales sp.																	
CHRYSOPHYCEAE																	
Dinobryon																	
Mallomonas		1												1			2
GREEN ALGAE																	
Actinastrum																	
Ankistrodesmus										1						2	2
Chlamydomonas gr.	2											2	1	1		1	1
Chlorella																	
Closteriopsis											2		1				
Coccomonas				1					1								
Coelastrum					1				1					1			
Crucigenia quadrata											2					1	
Dictyosphaerium																	
Elakatothrix												5		2			
Gloeocystis		1					2		1	2	2	2	2	2			1
Lagerheimia quadriseta																	
Lagerheimia wratislawiensis																	
Nephrocytium																2	
Oocystis							1	1	1			1			1	1	
Pandorina																1	
Pediastrum duplex																	
Rhizochrysis																	
Rhizoclonium																	
Scenedesmus bijuga											4						
Scenedesmus dimorphus																	
Scenedesmus opoliensis																	
Scenedesmus quadricauda																	
Schroederia				1			1										
Sphaerocystis																	
Staurastrum paradoxum												2					
Tetrastrum elegans																	
Ulothrix																	
EUGLENOPHYTA																	
Euglena	4	8	2	7	1		1		3	2	11	5	14	21	13	18	3
Eutreptia																	
Trachelomonas		1	1					1	1				2				
YELLOW-BROWN ALGAE																	
DINOPHYCEAE																	
Ceratium																	
Gymnodinium														1		1	
Peridinium																	
ZOOPLANKTERS																	
PROTOZOA																	
Difflugia sp.								1					1		2	1	1
Paramecium																	
Protozoa sp.								1							1		2
Strombilidium			4						2				1				1
Vorticella																	
ROTIFERS																	
Polyarthra platyptera																	
OSTRACODA																	
Ostracoda sp.																	
COPEPODA																	
Copepoda sp.																	
TOTAL	17	56	43	46	88	286	231	147	154	144	146	118	114	64	42	48	41

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Table 20d. Individual Plankton Analyses - Mandan

Year - 1955	1/3	1/10	1/17	1/24	1/31	2/7	2/15	2/21	2/28	3/7	3/14	3/21	3/28	4/4	4/11	4/19	4/25
PHYTOPLANKTERS																	
BLUE-GREEN ALGAE																	
Anabaena																	
Aphanizomenon																	
Dactylococcopsis	4	7	18	26	26	32	50	35	62	11	10	39	84	14	121	99	18
Nostoc gr.																	
Oscillatoria gr.																	
Phormidium																	
YELLOW-GREEN ALGAE																	
DIATOMS																	
Amphora																	
Asterionella	285	188	77	70	83	35	52	34		33	28	53	31	209	140	284	82
Cyclotella chaetoceras																	
Cyclotella sp.																	
Cyclotella-Stephanodiscus gr.	7	5	7	9	10	8	16	6	1	11	4	1	8	4	23	18	9
Cymbella					1						1						
Diatoma elongatum	3	7	12	14	17	15	50	49	13	38	32	56	10	48	45	31	14
Diatoma hiemale												4	3				
Diatoma vulgare										1							1
Fragilaria crotonensis	1				P				31								P
Fragilaria sp.																	
Gomphonema									1	18	10	2		13		6	1
Gyrosigma gr.					1					1	1			1	1		
Melosira (a)																	
Melosira (b)																	
Navicula gr.	7	3	1	3	1		4	3	1	32	19	14	2	9	1	27	14
Nitzschia gr.		1	1		2	1	1	2		6	9	6	1	7	1	18	9
Rhizosolenia gr.	1	5	3	9	9	10	8	13	5	21	18	23	12	22	20	12	2
Surirella							1	3		4		3				2	4
Synedra gr.			2		1				1	2							
XANTHOPHYCEAE																	
Bumilleria																	
Heterotrichales sp.	16	19	7	33	33	7	19	6	4			5	1	6	1	1	2
CHRYSOPHYCEAE																	
Dinobryon													1		9	33	1
GREEN ALGAE																	
Actinastrum	2	1	1	1			2						1		1		
Ankistrodesmus	8	6	7	2	9	3	7	3	4	6	2	4	12	3	15	1	4
Chlamydomonas gr.	20	8	3		11		1			1			21	5	16	12	1
Chlorella												3	47		131	4	2
Closteriopsis										1							
Coccomonas																	
Coelastrum																	
Crucigenia fenestrata																	
Crucigenia quadrata	16	14	10	7	6	8	2	3	5			1				1	
Crucigenia tetrapedia																	
Dictyosphaerium													1				
Elakatothrix																	
Eudorina																1	
Gloeocystis	16	4	1	1	3	1	2			4					5	1	
Lagerheimia quadriseta															1		
Lagerheimia wratislawiensis	1			1	1								1				
Oocystis																	
Pandorina			1	1	1			1								1	
Pediastrum duplex																	
Scenedesmus bijuga													1				
Scenedesmus dimorphus		1															
Scenedesmus quadricauda	1	1							1								
Schroederia																	
Sphaerocystis																	
Stichococcus													5				
Tetraedron elegans	1																
Tetraedron staurogeniaeforme																	
EUGLENOPHYTA																	
Euglena	8		8	4	2		4	2	2		1	1	5	5	21	21	
Eutreptia													3				
Trachelomonas	7	4	8	2	2	2	1		1	1	3			3	3	1	2
YELLOW-BROWN ALGAE																	
DINOPHYCEAE																	
Ceratium																	
Gymnodinium	4												2	1			
ZOOPLANKTERS																	
PROTOZOA																	
Difflugia sp.							1										
Protozoa sp.																3	
Strombilidium																	
Vorticella										3	1						
ROTIFERS																	
Brachionus sp.																	
Keratella cochlearis							1										
TARDIGRADA																	
Tardigrada sp.																1	
TOTAL	408	274	167	184	219	188	222	141	132	194	139	215	253	380	585	578	166

Table 20d. Individual Plankton Analyses - Mandan (Cont.)

Year - 1955	5/2	5/9	5/20	5/23	5/30	6/6	6/13	6/20	6/27	7/4	7/11	7/18	7/25	8/1	8/8	8/15	8/22	8/29
PHYTOPLANKTERS																		
BLUE-GREEN ALGAE																		
Anabaena													1				P	
Aphanizomenon									P			2	6	4	4	5		1
Dactylococcopsis	19	9	16		2	2	1											
Nostoc gr.																		
Oscillatoria gr.				P		6		1								1	14	
Phormidium																		
YELLOW-GREEN ALGAE																		
DIATOMS																		
Amphora																		
Asterionella	14	14	60	73	123	5	2	1	5			3	4					
Cyclotella chaetoceras								4						1			1	
Cyclotella sp.	56		9					3										
Cyclotella-Stephanodiscus gr.	54	13	324	410	419	7	9	8	4	3	2	7	4	1	2	5	5	1
Cymbella														1				
Diatoma elongatum	1	13	6	13	38	P			P			P						
Diatoma hiemale																		
Diatoma vulgare	1											1						
Fragilaria crotonensis												2	3	P				
Fragilaria sp.		17					26		9				4					
Gomphonema		3																
Gyrosigma gr.						1												
Melosira (a)						P			P			P						
Melosira (b)									1								P	
Navicula gr.	3		1	4	1	5	1	3	12	6	10	24	8	28	14	26	37	20
Nitzschia gr.	2	5	4	2	4	1		6	3	1		3	1	2	1		2	
Rhizosolenia gr.	2	3	1	1	3	7	1	33	14	3	8	13	4	14	12	4	3	1
Surirella		5	18	15	3		1											
Synedra gr.																		
XANTHOPHYCEAE																		
Bumilleria												2						
Heterotrichales sp.	5	5	16	4	5											P		
CHRYSOPHYCEAE																		
Dinobryon	5																	
GREEN ALGAE																		
Actinastrum			1		2	2		1										
Ankistrodesmus	2	1	8	7	2	3	2	4		4		10			4			
Chlamydomonas gr.	39	12	14		1		1					2		1				
Chlorella	25	4	2		1			10		1		1			1			
Closteriopsis																		
Coccomonas												1						
Coelastrum						1		1							1	1		1
Crucigenia fenestrata																		
Crucigenia quadrata								1										
Crucigenia tetrapedia						1												
Dictyosphaerium				1									1				1	
Elakatothrix				6														
Eudorina																		
Gloeocystis	1		11					3		1	1	3		1	2		1	
Lagerheimia quadriseta																		
Lagerheimia wratislawiensis																		
Oocystis								2										
Pandorina	1	1																
Pediastrum duplex						1												
Scenedesmus bijuga						1												
Scenedesmus dimorphus																	1	
Scenedesmus quadricauda														3				
Schroederia									1		1	18	3	1	8		1	
Sphaerocystis								4										
Stichococcus				1		1						1						
Tetrastrum elegans																		
Tetrastrum staurogeniaeforme																		
EUGLENOPHYTA																		
Euglena	1		12	1						1				1	1			
Eutreptia																		
Trachelomonas	4	4	10	3	2	2	1					1	2		1			
YELLOW-BROWN ALGAE																		
DINOPHYCEAE																		
Ceratium													1	1		3	1	1
Gymnodinium	1																	
ZOOPLANKTERS																		
PROTOZOA																		
Difflugia sp.			1			1												
Protozoan sp.																		
Strombilidium		1												1				
Vorticella	1	8	3	3	1													
ROTIFERS																		
Brachionus sp.		1																
Keratella cochlearis				1														
TARDIGRADA																		
Tardigrada sp.																		
TOTAL	137	119	511	545	607	49	45	85	40	20	22	94	48	60	51	45	67	85

Table 20d. Individual Plankton Analyses - Mandan (Cont.)

Year - 1955	9/5	9/12	9/19	9/27	10/3	10/11	10/17	10/24	10/31	11/7	11/14	11/21	11/28	12/5	12/14	12/21	12/26
PHYTOPLANKTERS																	
BLUE-GREEN ALGAE																	
Anabaena	P				P												
Aphanizomenon	36	42	35		71	156	83	6	13	2	1	P				P	
Dactylococcopsis																	
Nostoc gr.								1									
Oscillatoria gr.				109		3	4		2								
Phormidium																	
YELLOW-GREEN ALGAE																	
DIATOMS																	
Amphora							4										
Asterionella										1	1	1	3	4	6	13	16
Cyclotella chaetoceras																1	1
Cyclotella sp.																	
Cyclotella-Stephanodiscus gr.	15	20	52	96	160	133	136	32	245	93	103	123	27	17	24	9	10
Cymbella			2	1								1					
Diatoma elongatum																	
Diatoma hiemale																	
Diatoma vulgare								2	2								1
Fragilaria crotonensis											P		P	P		P	P
Fragilaria sp.																6	
Gomphonema																	
Gyrosigma gr.																	
Melosira (a)			P	1					P			P					
Melosira (b)								3					P				
Navicula gr.	9	12	2	8	5	5	10	5	10		2	5		4	4		
Nitzschia gr.		1		2			2	1	8								1
Rhizosolenia gr.	3	6	3	2	3	1	2	1				1			1		1
Surirella									1								
Synedra gr.												1					
XANTHOPHYCEAE																	
Bumilleria																	
Heterotrichales sp.	P	4	2														
CHRYSOPHYCEAE																	
Dinobryon																	
GREEN ALGAE																	
Actinastrum																	
Ankistrodesmus		1											1	1			1
Chlamydomonas gr.														1	1		
Chlorella																	
Closteriopsis														1			
Coccomonas	1													1			
Coelastrum																	
Crucigenia fenestrata																	
Crucigenia quadrata																	
Crucigenia tetrapedia																	
Dictyosphaerium																	
Elakatothrix																	
Eudorina																	
Gloeocystis																	
Lagerheimia quadriseta																	
Lagerheimia wratislawiensis																	
Oocystis																	
Pandorina																	
Pediastrum duplex																	
Scenedesmus bijuga								4									
Scenedesmus dimorphus																	
Scenedesmus quadricauda											1						
Schroederia		1															
Sphaerocystis																	
Stichococcus																	
Tetrastrum elegans																	
Tetrastrum staurogeniaeforme																	
EUGLENOPHYTA																	
Euglena									1					1		1	
Eutreptia																	
Trachelomonas			2	2		1			2	1			1				
YELLOW-BROWN ALGAE																	
DINOPHYCEAE																	
Ceratium				1													
Gymnodinium																	
ZOOPLANKTERS																	
PROTOZOA																	
Difflugia sp.																	
Protozoa sp.	1																
Strombilidium																	1
Vorticella																	
ROTIFERS																	
Brachionus sp.																	
Keratella cochlearias																	
TARDIGRADA																	
Tardigrada sp.																	
TOTAL	65	87	98	222	239	299	241	55	284	97	109	132	32	30	36	30	32

Table 20a. Individual Plankton Analyses - Mobridge

Year - 1955	1/26	2/15	3/17	4/13	5/4	5/18	6/6	6/21	7/5	7/18	8/8	8/22	9/26	11/2	12/23
PHYTOPLANKTERS															
BLUE-GREEN ALGAE															
Aphanizomenon						1			6	3	1	14	25	30	
Dactylococcopsis	31	63	63	136	3	13		35			2				
Oscillatoria gr.											2			1	
YELLOW-GREEN ALGAE															
DIATOMS															
Asterionella	41	35	26	441	11	25	20	1		1				P	4
Cyclotella (s)					1										
Cyclotella chaetoceras								537	4	3	2		1		1
Cyclotella spp.						1				6	1				
Cyclotella-Stephanodiscus gr.	10	14	4	47	10	85	23	138	13	36	13	9	109	208	9
Diatoma elongatum	5	20	10	211	1	5	1	5							
Diatoma vulgare														9	
Fragilaria crotonensis				P											
Fragilaria spp.										9					
Gyrosigma gr.					1	1	1								
Melosira (s)							1								
Navicula gr.	6	3	7	11	1	8	9	27	26	39	79	50	6	3	2
Nitzschia gr.	1		3	23	3	3	4	1	5	1	8	9	2		
Rhizosolenia gr.	8	8	15	64	1	5	12	197	35	54	116	56	2	1	
Surirella	1	2	1	3	2	4	6								1
Synedra gr.										1	2				
XANTHOPHYCEAE															
Heterotrichales sp.	41	39	5	9	1	8	1	9							
CHRYSOPHYCEAE															
Dinobryon			4	11											
Mallomonas		1													
GREEN ALGAE															
Actinastrum	2	1	1			1	3	38		7	5				
Ankistrodesmus	13	15	9	61		2	1	49	31	23	2				
Chlamydomonas gr.	6	6		41	12	18	2	30	1	1	3	1			
Coccomonas										2					
Chlorella	2	1		495						2	1				
Closteriopsis			1				3					1	1		
Coelastrum							3	4		2					
Crucigenia quadrata	9	4		6		7		18			1	3			
Crucigenia tetrapedia								1							
Dictyosphaerium	1	2	1	2			1	7		1	1				
Elakatothrix							2	3							
Gloeocystis	5	2		1		1	7	1	2	10	1			4	
Lagerheimia quadriseta								1							
Lagerheimia wratislawiensis				2											
Oocystis															1
Pandorina						2									
Pediastrum duplex							1	1			1				
Scenedesmus dimorphus							1	5							
Scenedesmus quadricauda							2	3	2		1	1			
Schroederia										80	2				
Sphaerocystis							1	3							
Stichococcus				1				139	1	17	18	18			
Tetraedron								1							
Tetrastrum elegans	1			2											
Ulothrix			4												
EUGLENOPHYTA															
Euglena	4	10	4	11	5	7		2	2		2	1			4
Phacus							1								
Trachelomonas	1	1	1	10	4	1	3	6			1	4			1
YELLOW-BROWN ALGAE															
DINOPHYCEAE															
Ceratium												1			
ZOOPLANKTERS															
PROTOZOA															
Difflugia sp.				2										1	
Protozoa spp.	2			2				1				1			
Vorticella	2		1			1									
Strombilidium											1				
ROTIFERS															
Brachionus spp.					1										
Keratella cochlearis						1									
NEMATODA (s)															
Nematoda spp.					1										
TOTAL	192	227	160	1,592	58	300	109	1,263	128	298	266	149	146	257	23

Table 20f. Individual Plankton Analyses - Pierre

Year - 1955	1/7	1/18	2/14	2/28	3/17	3/28	4/12	4/25	5/11	5/25	6/6	6/20	7/5	7/23	8/6	8/20	9/6	10/1	10/12	10/26	11/7	12/1	12/12
PHYTOPLANKTERS																							
BLUE-GREEN ALGAE																							
Aphanizomenon													2	23			21	183	112	30	9	1	
Dactylococcopsis	9	15	79	52	1	65	1	8	3	1			4										
Oscillatoria gr.																			1	P			
YELLOW-GREEN ALGAE																							
DIATOMS																							
Asterionella	121	84	60	62	7	36	189	43	13	79	46		11		1							1	3
Caloneis												1											
Cyclotella chaetoceras												2		15	106								1
Cyclotella spp.															11	3				1			
Cyclotella-Stephanodiscus gr.	13	10	6	11	1	4	9	4	5	280	62	30	111	71	294	17	53	167	324	327	213	15	14
Cymbella																				1			
Diatoma elongatum	1	2	12	16	7	14	48	12	3	5	2	1											
Diatoma vulgare								1	2								1				2		
Fragilaria crotonensis														12	3								F
Fragilaria spp.													50										
Gomphonema			1		1	3	3	1															
Gyrosigma gr.					1		1																
Melosira (a)				1							2				2								
Navicula gr.		2	9	9	7	21	18	13	11	2	4	18	14	68	55	24	25	4	5	9	5		1
Nitzschia gr.		1	1	4	1	2	15	8	9	3	3		13	7	9	8	4	2	3	1	5		
Pinnularia															1								
Rhizosolenia gr.	2	4	8	10	5	17	16	4	1	2	7	45	39	93	216	21	28		1	3	4	1	
Surirella	1				3	1	5	3	1	2	7												
Synedra gr.													1			3	1	2					
XANTHOPHYCEAE																							
Heterotrichales sp.	14	36	59	23	2	10	3	9	4	9	7												
CHRYSOPHYCEAE																							
Dinobryon						3																	
GREEN ALGAE																							
Actinastrum	8	3	3			2		1			1	2	5		11	3							
Ankistrodesmus	12	13	23	4		11						1	2	1	16	8							
Chlamydomonas gr.	19	6	7			2	62	1	15	1			1		4		2						
Chlorella																2							
Closteriopsis			2					1				1		3	7	1							
Coccomonas															1								
Coelastrum		1							1		3		2	3	3								
Crucigenia quadrata	10	11	12			1		3	4		4				1								
Dictyosphaerium											2		2		5	2							1
Elakatothrix	2										2	4											
Gloeocystis		5			1									4	7						5	3	5
Golenkinia								1															
Lagerheimia wratislawiensis			1																				
Oocystis															2								
Scenedesmus bijuga															1								
Scenedesmus dimorphus												1	3		6	1							
Scenedesmus quadricauda		1				1						1		1	2								
Schroederia													9	19	1								
Sphaerocystis														8		1							
Stichococcus													29	25	38	2	3						
EUGLENOPHYTA																							
Euglena	2		2	1	4	4	15		2				2	1			1						5
Trachelomonas	1		2				4		3	2	2	2	1	10	1	2	2	2	1	1			1
ZOOPLANKTERS																							
PROTOZOA																							
Protozoa spp.																	1						
Strobilidium																							3
Vorticella							1	2	3														
OSTRACODA																							
Ostracoda sp.		2																					
TOTAL	215	196	287	193	41	197	390	115	80	386	154	109	301	364	811	98	142	360	447	373	243	21	34

Table 20g. Individual Plankton Analyses - Chamberlain

Year - 1955	1/4	1/11	1/18	1/24	2/1	2/14	2/21	2/28	3/7	3/14	3/29	4/7	4/11	4/18	4/25	5/2
PHYTOPLANKTERS																
BLUE-GREEN ALGAE																
Anabaena																
Aphanizomenon																
Dactylococcopsis	4	6	11	15	63	86	106	66	100		125	165	79	118	16	
Oscillatoria gr.									2							
YELLOW-GREEN ALGAE																
DIATOMS																
Asterionella	106	141	134	76	84	40	54	17	45	13	13	39	94	168	224	24
Cocconeis																
Cyclotella chaetoceras																
Cyclotella spp.												1				
Cyclotella-Stephanodiscus gr.	17	18	16	31	33	19	14	8	28	6	9	66	111	173	129	14
Cymbella																
Diatoma elongatum		2	4		4	10	22	9	17	2	3	54	104	190	414	15
Diatoma vulgare																
Fragilaria crotonensis								P					P			
Fragilaria spp.																
Gomphonema											2	1	1	2	2	1
Gyrosigma gr.																
Melosira (a)																
Melosira (b)																
Navicula gr.			1		1	1	16	9		1		5	15	24	11	2
Nitzschia gr.			1		2	3			7	1		4	11	10	17	4
Rhizosolenia gr.	2	1	5	3	4	9	23	7	14	6	7	30	45	17	13	
Surirella		2										3	4	2	1	3
Synedra gr.																
XANTHOPHYCEAE																
Heterotrichales sp.	15	38	63	55	127	104	85	33	29		11	15	13	13	7	
CHRYSOPHYCEAE																
Dinobryon											1	1	9	12	1	
Mallomonas											1					
GREEN ALGAE																
Actinastrum	6	4	3	7	5	5	4	2			2	1	1	1		
Ankistrodesmus	12	18	22	27	32	23	28	24	19		37	18	30	32	8	
Chlamydomonas gr.	46	15	11	10	13	14	12	8	13	2	20	20	47	158	83	7
Chlorella		2	2	7	12	3					10	33	73		4	
Closteriopsis								1			1					
Gonomonas																
Coelastrum	1		1								3		2	1		1
Crucigenia quadrata	11	20	6	10	9	12	21	10	8		2	9	15	8	4	
Crucigenia rectangularis																
Crucigenia sp.																
Crucigenia tetrapedia																
Dictyosphaerium	3	1				2	2		1		1	1	2	2		
Elakatothrix	2		4					5					3	2		
Gloeocystis	15	1	5	13	1	10	7	3	7			2	11	1	15	
Lagerheimia quadriseta	1		2													
Lagerheimia wratislawiensis	1	1	1	3		5	1						1			
Oocystis																
Pandorina														2		
Pediastrum Boryanum														1		
Pediastrum duplex																
Scenedesmus bijuga			1		1										2	
Scenedesmus dimorphus				1			1							1	1	
Scenedesmus opoliensis																
Scenedesmus quadricauda		1	1	1									1	1	1	
Schroederia																
Selenastrum westii																
Sphaerocystis												1				
Stichococcus																
Tetraedron		1		1	3											
Tetrastrum elegans				1	4		2									
EUGLENOPHYTA																
Euglena	14	7	3	1	3	8	11	11	8	1	13	5	44	84	80	7
Phacus															1	
Trachelomonas	2		2				2	1				4	11	13	6	4
YELLOW-BROWN ALGAE																
DINOPHYCEAE																
Ceratium																
Gymnodinium	1								1		1			1	2	1
ZOOPLANKTERS																
PROTOZOA																
Codonella													1	2	3	
Difflugia sp.												5		1	1	
Protozoa spp.												3		42	50	
Strombilidium																
Vorticella				1					1			1			7	3
ROTIFERS																
Polyarthra platyptera																
OSTRACODA																
Ostracoda sp.			1								1					
TOTAL	259	279	302	263	401	354	411	214	300	32	863	487	728	1,082	1,103	86

Table 20g. Individual Plankton Analyses - Chamberlain (Cont.)

Year - 1955	5/9	5/16	5/24	5/30	6/6	6/13	6/20	6/27	7/5	7/11	7/18	7/25	8/1	8/8	8/15	8/22	8/29
PHYTOPLANKTERS																	
BLUE-GREEN ALGAE																	
Anabaena					P			1	1	P	1	P	1	2	1	P	1
Aphanizomenon			P							3		15			1		27
Dactylococcopsis		2				14		6			1		2	1			
Oscillatoria gr.	3					9		31	8		7	4	5		12	1	
YELLOW-GREEN ALGAE																	
DIATOMS																	
Asterionella	17	9	10	18	10	28	5	9	7	3	1	P	6				
Cocconeis													1	1	2		
Cyclotella chaetoceras						4	2	3				2	5	10	28		
Cyclotella spp.																	2
Cyclotella-Stephanodiscus gr.		30	45	11	52	32	40	845	122	11	22	176	448	529	289	31	37
Cymbella																	
Diatoma elongatum	7	2		1	P	10		1									
Diatoma vulgare																	
Fragilaria crotonensis												2	3	5	1	P	
Fragilaria spp.												8		2	9		
Gomphonema		1															
Gyrosigma gr.												1					1
Melosira (a)						3		1			1	1	P	3	1	1	P
Melosira (b)														P			
Navicula gr.	4	5	2	1	3	18	10	10	8	7	7	75	60	51	74	6	26
Nitzschia gr.	5	5			1	4	4	2	4		5	6	4	9	10	1	
Rhizosolenia gr.		3	1	1	4	48	17	127	9	4	3	65	107	164	262	6	22
Surirella	3	5		3	1	5			1								1
Synedra gr.								1	1			1	6	9	6	1	1
XANTHOPHYCEAE																	
Heterotrichales sp.	1	4	2		1	11	2	12							2		
CHRYSOPHYCEAE																	
Dinobryon																	
Mallomonas																	
GREEN ALGAE																	
Actinastrum		1			2	3		41		1		2	7	12	10		
Ankistrodesmus		2			1	16		26	3		2	2		15	4		
Chlamydomonas gr.	8	25				6	2	8	4			2		10	2	1	
Chlorella											1		1	4			
Closteriopsis				1		1		5	1	1		1	5	8	11		
Coccomonas								5		1		1		1	1		
Coelastrum						1		1		1	1	2		5			
Crucigenia quadrata						9	4						1	5			
Crucigenia rectangularis						1											
Crucigenia sp.														2			
Crucigenia tetrapedia						4								4			
Dictyosphaerium						1		10	1				4	13	1		
Elakatothrix						8		4	2								
Gloeocystis			2			13		1	4	1	1	14		12	1	3	
Lagerheimia quadriseta																	
Lagerheimia wratislawiensis																	
Oocystis												1		1			
Pandorina					1						4						
Pediastrum Boryanum																	
Pediastrum duplex								1				1	1	1			
Scenedesmus bijuga														2			2
Scenedesmus dimorphus						1		3	1			1	1	11	2		
Scenedesmus opoliensis						1											
Scenedesmus quadricauda						4		2	1					6	2		
Schroederia								7			3		2				
Selenastrum westii						4											
Sphaerocystis							2				3	22	1				
Stichococcus						3		1	1	1		10	134	83	30		
Tetraedron																	
Tetrastrum elegans																	
EUGLENOPHYTA																	
Euglena		2	1	1		2	3	3	8	1	2		3	9	8	6	
Phacus																1	
Trachelomonas	1	4	8	1	3		1	2	8		2	3	5	6	1	4	7
YELLOW-BROWN ALGAE																	
DINOPHYCEAE																	
Ceratium																	1
Gymnodinium								2									
ZOOPLANKTERS																	
PROTOZOA																	
Codonella																	
Difflugia sp.																	
Protozoa spp.								1		1				5	1		
Strombilidium														1			
Vorticella																	
ROTIFERS																	
Polyarthra platyptera														1			
OSTRACODA																	
Ostracoda sp.																	
TOTAL	49	100	71	38	79	264	90	1,172	195	36	67	432	813	943	772	62	188

Table 20g. Individual Plankton Analyses - Chamberlain (Cont.)

Year - 1955	9/7	9/12	9/21	9/26	10/5	10/10	10/17	10/24	10/31	11/7	11/14	11/21	11/28	12/9	12/12	12/20	12/26
PHYTOPLANKTERS																	
BLUE-GREEN ALGAE																	
Anabaena	P																
Aphanizomenon	1	8	10		55	23	151	16	22	28	3						P
Dactylococcopsis																	
Oscillatoria gr.			2														
YELLOW-GREEN ALGAE																	
DIATOMS																	
Asterionella										P	1		P			2	12
Cocconeis																	
Cyclotella chaetoceras											1	7	2				
Cyclotella spp.						4		1									
Cyclotella-Stephanodiscus	30	72	154	47	191	302	305	335	324	335	118	18	6	11	7	11	8
Cymbella								2									
Diatoma elongatum																	
Diatoma vulgare															1		
Fragilaria crotonensis		P	P														
Fragilaria spp.																	
Gomphonema																	
Gyrosigma gr.										1							
Melosira (a)								P									
Melosira (b)																	
Navicula gr.	14	16	1			8	5	6	16	5	2	1					2
Nitzschia gr.	2	2	1		4	4	7	7	2	6			1				
Rhizosolenia gr.	25	21	3		2	3	3	7	1		3		1			1	1
Surirella																	
Synedra gr.	2	4	1														
XANTHOPHYCEAE																	
Heterotrichales sp.														1			
CHRYSOPHYCEAE																	
Dinobryon																	
Mallomonas																	
GREEN ALGAE																	
Actinastrum		1															
Ankistrodesmus		1										1			1		
Chlamydomonas gr.												1	1		2		2
Chlorella														2		1	
Closteriopsis																	
Coccomonas		1				1											
Coelastrum																	
Crucigenia quadrata																	
Crucigenia rectangularis																	
Crucigenia sp.																	
Crucigenia tetrapedia																	
Dictyosphaerium																	
Elakatothrix																	
Gloeocystis					1		1	3							1		
Lagerheimia quadriseta																	
Lagerheimia wratislawiensis																	
Oocystis													1	1	1	1	
Pandorina																	
Pediastrum Boryanum																	
Pediastrum duplex																	
Scenedesmus bijuga																	
Scenedesmus dimorphus																	
Scenedesmus opoliensis																	
Scenedesmus quadricauda							1										
Schroederia																	
Selenastrum westii																	
Sphaerocystis																	
Stichococcus		1				3											
Tetraedron																	
Tetrastrum elegans																	
EUGLENOPHYTA																	
Euglena											1	3	1	3		3	1
Phacus																	
Trachelomonas	4					1			1	1					1		
YELLOW-BROWN ALGAE																	
DINOPHYCEAE																	
Ceratium					1												
Gymnodinium																	
ZOOPLANKTERS																	
PROTOZOA																	
Codonella																	
Difflugia sp.																1	
Protozoa spp.														1			
Strombilidium														1	3		
Vorticella									1								
ROTIFERS																	
Polyarthra platyptera																	
OSTRACODA																	
Ostracoda sp.																	
TOTAL	78	127	172	47	254	349	473	377	367	376	129	31	13	20	17	20	26

Table 20h. Individual Plankton Analyses - Ft. Randall Reservoir

Year - 1955	1/3	1/10	1/17	1/24	1/31	2/7	2/14	2/21	2/28	3/7	3/14	3/22	3/28	4/4	4/11	4/18	4/25
PHYTOPLANKTERS																	
BLUE-GREEN ALGAE																	
Anabaena																	
Aphanizomenon																	
Dactylococcopsis	1	2	4	2		2	5	2	5	4	1	6	4	9	1	3	8
Oscillatoria gr.																	
Synechococcus																	
YELLOW-GREEN ALGAE																	
DIATOMS																	
Amphiprora																	
Asterionella	10	38	51	98	116	182	143	244	249	312	385	452	186	20	5	8	28
Cocconeis																	
Cyclotella chaetoceras																	
Cyclotella spp.																11	6
Cyclotella-Stephanodiscus gr.	5	11	10		10	8	6	3	3	5	3						6
Cymbella	1																
Diatoma elongatum													1				
Fragilaria crotonensis												P					
Fragilaria spp.																	
Gomphonema																	
Melosira (a)																	
Melosira (b)																	
Navicula gr.			1								1						
Nitzschia gr.	1				1								1				
Rhizosolenia gr.	10	17	15	1	2	1		1		1		2	1	3	5	8	16
Surirella																	
Synedra gr.																	
XANTHOPHYCEAE																	
Heterotrichales sp.			1		3	1			2	2	10	11	6	16	4	48	76
CHRYSOPHYCEAE																	
Derepyxis																	
Dinobryon																6	13
Mallomonas	5	5	9	4	4	10	5	7	2	4	1	2	1	21		2	1
GREEN ALGAE																	
Actinastrum	1		1	1			1				1						
Ankistrodesmus	19	20	26	25	15	29	16	13	18	47	15	12	11	16	6	18	19
Chlamydomonas gr.	59	40	30	21	22	28	26	29	20	16	5	6	42	4	3	1	3
Chlorella	6	2			2	8	1	1	1					5		4	
Closteriopsis																	
Coccomonas															48	103	214
Coelastrum	2	1	1			1		1									
Cosmarium																	
Crucigenia quadrata	22	15	14	3	4	16	3	3		3		4	2				
Crucigenia sp.																	
Crucigenia tetrapedia	1	1		1	1				2		2						
Dictyosphaerium					1												
Elakatothrix																	
Gloeocystis	30	23	9	8	4	5		5	1		4	2		1		4	3
Golenkinia																4	3
Lagerheimia quadriseta																1	
Lagerheimia wratislawiensis		1							1				1				
Micractinium																1	
Oocystis																	
Pandorina																	
Pediastrum Boryanum																	
Pediastrum duplex																	
Pediastrum tetras																	
Scenedesmus bijuga			1	1	2						1						
Scenedesmus dimorphus					1				1								
Scenedesmus opoliensis		3															
Scenedesmus quadricauda	4	2	1	2	1	2	2	2	1	1							1
Schroederia																	
Selenastrum																	
Sphaerocystis										1							
Staurastrum																	
Stichococcus																	
Tetraedron caudatum																	
Tetraedron minimum																	
Tetrastrum elegans							1	1							1	1	
Tetrastrum heteracanthum																	
Tetrastrum staurogeniaeforme		1															
Treubaria setigerum																	
EUGLENOPHYTA																	
Euglena	27	34	23	21	28	20	16	30	32	31	8	27	15	45	75	32	35
Eutreptia																	
Phacus																	
Trachelomonas	7	29	18	19	9	10	11	2	11	10	3	11	1	8	3	4	3
YELLOW-BROWN ALGAE																	
DINOPHYCEAE																	
Gymnodinium	1	7	5	2	2	12	6	10	5	17	9	19	9	7	4	3	7
Peridinium																	
ZOOPLANKTERS																	
PROTOZOA																	
Codonella																	
Difflugia sp.												1					1
Paradileptus																	
Protozoa spp.		1	3	1	1		1	2					2	4	2	1	1
Strombidium															1		
Strombilidium															5	1	
Vorticella										1	1						
ROTIFERS																	
Keratella cochlearis																	
Polyarthra platyptera																	
COPEPODA																	
Copepoda spp.																	
CLADOCERA																	
Cladocera spp.																	
TARDIGRADA																	
Tardigrada sp.																	
TOTAL	212	253	223	210	289	335	243	356	357	456	450	555	283	159	163	264	444

Table 20h. Individual Plankton Analyses - Ft. Randall Reservoir (Cont.)

Year - 1955	5/2	5/9	5/16	5/23	5/31	6/6	6/13	6/20	6/28	7/7	7/11	7/21	7/25	8/1	8/8	8/15	8/22
PHYTOPLANKTERS																	
BLUE-GREEN ALGAE																	
Anabaena					P												
Aphanizomenon																	
Dactylococcopsis	95	68	49	23	2												
Oscillatoria gr.																	P
Synechococcus									3								
YELLOW-GREEN ALGAE																	
DIATOMS																	
Amphiprora																	
Asterionella	346	481	416	339	66	9	2	20	11	9	3						
Cocconeis																	
Cyclotella chaetoceras		16	74	68			4				1	1					
Cyclotella spp.				8													
Cyclotella-Stephanodiscus gr.	23	40	84	198	354	12	16	1	4	4	4	3	2	1	13	11	6
Cymbella																	
Diatoma elongatum	27	48	102	302	11												
Fragilaria crotonensis		P	1	4	P						2						
Fragilaria spp.	26																
Gomphonema																	
Melosira (a)					P					2	4						P
Melosira (b)			4														
Navicula gr.	3	5		8	4				1		4	1	1	1		2	2
Nitzschia gr.	5	6	5	41	4			1	1		1		1				
Rhizosolenia gr.	7	33	132	55	5	1										2	2
Surirella	4	5	26														
Synedra gr.				1													
XANTHOPHYCEAE																	
Heterotrichales sp.	27	31	67	3	1												
CHRYSOPHYCEAE																	
Derepyxis				7													
Dinobryon	73	33	2	1													
Mallomonas	1			53	3	1		2		1					2	3	3
GREEN ALGAE																	
Actinastrum		1		10													
Ankistrodesmus	302	84	49	42	5			1									
Chlamydomonas gr.	42	90	19	16	3		1	24		1			1	12	59	818	205
Chlorella	15	58	31	61	15	1	2	7			2			7		1	6
Closteriopsis													1		3	1	1
Coccomonas												2	5	24	30	81	37
Coelastrum	1		2	5	3	10		2	1				1			10	
Cosmarium															1		
Crucigenia quadrata	2	8	11	28	11	2	1	1	1							1	
Crucigenia sp.															1		
Crucigenia tetrapedia						2											
Dictyosphaerium		3	2	4											1	1	6
Elakatothrix		2	2	4			4										
Gloeocystis	6	20	8	21	22	23	14	13	7	1			2	4	4	5	8
Golenkinia	17	6															
Lagerheimia quadriseta	19	16	8														
Lagerheimia wratislawiensis				1													
Micractinium																	
Oocystis				12				1	3	1		3	1	9		7	1
Pandorina	3	3															
Pediastrum Boryanum																	
Pediastrum duplex						1											
Pediastrum tetras				1													
Scenedesmus bijuga	2	2		2	1			1		1							4
Scenedesmus dimorphus				2	1	1											
Scenedesmus opoliensis																	
Scenedesmus quadricauda		1	1	7	3	3	1	1									1
Schroederia												3					
Selenastrum																	
Sphaerocystis		2		7	2					1		1					
Staurastrum																	
Stichococcus		3	7		1												
Tetraedron caudatum					1	1											
Tetraedron minimum																	
Tetrastrum elegans	5	11	1	1													
Tetrastrum heteracanthum																	
Tetrastrum staurogeniaeforme																	
Treubaria setigerum																1	
EUGLENOPHYTA																	
Euglena	24	72	21	143	12	51	8	114	7	36	48	10	4	2	11	15	4
Eutreptia		67	14	17													
Phacus				1													
Trachelomonas	7	7	15	12	6	2		2		7		1	1	1		3	9
YELLOW-BROWN ALGAE																	
DINOPHYCEAE																	
Gymnodinium	2	9	4	2													
Peridinium																	
ZOOPLANKTERS																	
PROTOZOA																	
Codonella	3	2	4	4			1	2									
Difflugia sp.																	
Paradileptus														1			
Protozoa spp.	3	13	10	2		1		3				1					
Strombidium											1						
Strobilidium												2	2		1	3	1
Vorticella	1	2	7														
ROTIFERS																	
Keratella cochlearis				2		2	1										
Polyarthra platyptera		1		2		1									1		
COPEPODA																	
Copepoda spp.												1					
CLADOCERA																	
Cladocera spp.						1											
TARDIGRADA																	
Tardigrada sp.				2													
TOTAL	1,091	1,951	1,178	1,522	536	125	55	196	39	64	70	29	22	62	127	965	296

Table 20h. Individual Plankton Analyses - Ft. Randall Reservoir (Cont.)

Year - 1955	8/30	9/6	9/12	9/19	9/26	10/3	10/10	10/17	10/24	11/1	11/7	11/14	11/22	11/29	12/5	12/12	12/19	12/27
PHYTOPLANKTERS																		
BLUE-GREEN ALGAE																		
Anabaena	1																	
Aphanizomenon					1													
Dactylococcopsis																		
Oscillatoria gr.																		
Synechococcus																		
YELLOW-GREEN ALGAE																		
DIATOMS																		
Amphiprora													1					
Asterionella					1							1				1	4	1
Cocconeis						2												
Cyclotella chaetoceras	2		1			9	7	7	1	8		1						1
Cyclotella spp.	9									4					1			
Cyclotella-Stephanodiscus gr.	92	248	397	116	172	354	49	11	10	5	4	6	5	4	18	2	27	31
Cymbella										4								
Diatoma elongatum																		
Fragilaria crotonensis																		
Fragilaria spp.																		
Gomphonema																1		
Melosira (a)	P	1	1	1	5	10	1	P	P	P			P	1			P	
Melosira (b)																		
Navicula gr.	6	6	19	8	14	39	12	11	10	72	1	3	3	1	1	2	1	1
Nitzschia gr.	1	1		1	1	3		3	5	12	2	2	1		1			2
Rhizosolenia gr.	5	2		2		1	1	3	7	3		1		1				1
Surirella			1									2						3
Synedra gr.		3	4	5														
XANTHOPHYCEAE																		
Heterotrichales sp.	85	20	6															
CHRYSOPHYCEAE																		
Derepyxis																		
Dinobryon																		
Mallomonas	4		2			6	3								2			2
GREEN ALGAE																		
Actinastrum													1			1		
Ankistrodesmus	2	1	1	4	2	7	1	14	4	1				1	1			4
Chlamydomonas gr.	199	100	104	61	14	1	8	1	2	2	1	2	1	1	1	2	13	17
Chlorella	4			2	6	7	10	4	1	4			1		1	3		
Closteriopsis	3	2	1	1	1		1						1					1
Coccomonas	78	49	41	2	3	8	7	12	6				2			1		3
Coelastrum	2	3	8	3	1	4	2	2					1	1		3		
Cosmarium		1																
Crucigenia quadrata		4	1	1	1	4		6	9	4		1		4	1		1	2
Crucigenia sp.							3											
Crucigenia tetrapedia	2								1									
Dictyosphaerium	8	7	3															
Elakatothrix																		
Gloeocystis	4	6	1	5	1	7	5	8	3	3			3	1	1	3	7	16
Golenkinia																		
Lagerheimia quadriseta																		
Lagerheimia wratislawiensis																		
Micractinium																		
Oocystis	1	1	3		2		1	1	1				1	1		2	5	8
Pandorina																		
Pediastrum Boryanum		1																
Pediastrum duplex	2																	
Pediastrum tetras																		
Scenedesmus bijuga	3	3		4	1	2	2	2	2									
Scenedesmus dimorphus	1					6	1	2										
Scenedesmus opoliensis																		1
Scenedesmus quadricauda	1			1	2	5	11	16	13	5		1	3		2	3	2	1
Schroederia	1																	
Selenastrum							1											
Sphaerocystis	1				1		1											
Staurastrum	1		1															
Stichococcus				1	6	12	25	110	70	25	9	8	8	3	7	3	2	1
Tetraedron caudatum			1				1			1								
Tetraedron minimum								2										
Tetrastrum elegans																		
Tetrastrum heteracanthum							1		1									
Tetrastrum staurogeniaeforme					2	3	6	6	2	2		1						
Treubaria setigerum			1															
EUGLENOPHYTA																		
Euglena	11	2	6	4	2	4	19	16	5	12	2	5	4	1	28	8	10	38
Eutreptia																		
Phacus																		1
Trachelomonas	25	10	9	4	1	1		1	2		2			1			2	
YELLOW-BROWN ALGAE																		
DINOPHYCEAE																		
Gymnodinium					1												1	1
Peridinium									1									
ZOOPLANKTERS																		
PROTOZOA																		
Codonella																		
Difflugia					1												2	3
Paradileptus																		
Protozoa spp.							3			1			1		1			3
Strombidium											1	1	2					1
Strobilidium	1	1	2	4			1	2		1	1		2		3	1	1	
Vorticella																		
ROTIFERS																		
Keratella cochlearias	1								1					1	1			
Polyarthra platyptera										2	1							1
COPEPODA																		
Copepoda spp.													1					
CLADOCERA																		
Cladocera spp.																		
TARDIGRADA																		
Tardigrada sp.																		
TOTAL	556	477	614	230	242	495	183	240	157	171	24	35	42	22	70	36	78	144

Table 201. Individual Plankton Analyses - Below Ft. Randall Dam

Year - 1955	1/3	1/10	1/17	1/24	1/31	2/7	2/14	2/21	2/28	3/7	3/14	3/22	3/28	4/4	4/11	4/18	4/25
PHYTOPLANKTERS																	
BLUE-GREEN ALGAE																	
Anabaena																	
Dactylococcopsis		2		5		4	2	1	2	3	5	3	4	10	14	57	52
Oscillatoria gr.																	
Synechococcus																	
YELLOW-GREEN ALGAE																	
DIATOMS																	
Asterionella	6	23	52	107	156	158	127	195	160	167	182	330	191	21	6	8	35
Cocconeis																	
Cosmarium																	
Cyclotella chaetoceras																	
Cyclotella spp.																1	
Cyclotella-Stephanodiscus gr.	4	12	6	9	3	4	3	2	4	1	3	3	1		2	3	6
Cymbella																	
Diatoma elongatum								'1		1							
Diatoma vulgare	7																
Fragilaria crotonensis																	P
Melosira (a)																	
Melosira (b)																	
Navicula gr.		2		2					1								
Nitzschia gr.	2		1									1		2		2	4
Rhizosolenia gr.	21	14	4	4	3	2	2		1	7	3	3					2
Surirella		1	2													1	1
Synedra gr.													1				
XANTHOPHYCEAE																	
Heterotrichales sp.				3		2	4	16		15	29	25	6	21	13	61	99
CHRYSOPHYCEAE																	
Dinobryon																17	17
Mallomonas	4	3	3	4	6	9	7	5	1	3		5	1	22		1	1
GREEN ALGAE																	
Actinastrum								1					2	1			
Ankistrodesmus	39	11	19	13	17	26	18	10	7	9	15	12	10	20	44	66	64
Chlamydomonas gr.	62	24	20	21	35	25	24	31	15	12	8	11	52	10	12	36	14
Chlorella	1			1			1	1		1	1	5	1	5	10	12	3
Closteriopsis																	
Coccomonas																	
Coelastrum		2	3	1		1			1								
Crucigenia fenestrata																	
Crucigenia quadrata	38	11	10	8	4	6	1	2	1	8	3	3	2		1		1
Crucigenia tetrapedia		1		1	1												
Dictyosphaerium	1				1		1						1				
Elakatothrix														2		4	3
Franceia										1							
Gloeocystis	27	6	11	4	10	3		1	5		4	2		3		1	
Gloeokinia																	
Lagerheimia quadoraita										1							
Lagerheimia wratislawiensis	1			1	1										2	4	6
Micractinium																	
Oocystis																	
Pandorina															1		1
Pediastrum duplex																	
Rhizochrysis																	
Scenedesmus bijuga	1	1	1	1		2											
Scenedesmus dimorphus																	
Scenedesmus opoliensis	1	2				1											
Scenedesmus quadricauda	6	2	2	1	1	2	2	1			1	1					
Selenastrum																	
Sphaerocystis		4											1				
Staurastrum																	
Stichococcus	1																
Tetraedron caudatum																	
Tetraedron duoppinum																	
Tetraedron sp.																	
Tetrastrum elegans							1				1			1			3
Tetrastrum heterocauthum																	
Tetrastrum staurogeniaeforme	2				1												
Treubaria setigerum																	
Westella																	
EUGLENOPHYTA																	
Euglena	20	20	24	42	35	45	23	17	20	18	15	28	19	96	1	96	15
Eutreptia															63		65
Trachelomonas	10	25	22	13	13	11	15	4	15	4	1	7	9	17	6	15	14
YELLOW-BROWN ALGAE																	
DINOPHYCEAE																	
Ceratium																	
Glenodinium																	
Gymnodinium	2	1	3	3	3	10	7	11	11	5	4	8	4	15	8	9	5
ZOOPLANKTERS																	
PROTOZOA																	
Codonella															3		2
Difflugia sp.			1														
Paradileptus																	
Protozoa spp.		6	2	1						2			5	3	7	18	14
Strombilidium																	
Vorticella									1					1	1		
ROTIFERS																	
Keratella cochlearias			1														
Polyarthra platyptera						1											1
COPEPODA																	
Copepoda spp.																	
HYDRACARINA																	
Acarina spp.																	
CLADOCERA																	
Cladocera spp.																	
OSTRACODA																	
Ostracoda sp.		1															
TOTAL	256	174	187	245	290	312	238	299	345	258	275	447	310	250	194	412	488

Table 20i. Individual Plankton Analyses - Below Ft. Randall Dam (Cont.)

Year - 1955	5/2	5/9	5/16	5/23	5/31	6/6	6/13	6/20	6/28	7/7	7/11	7/21	7/25	8/1	8/8	8/15	8/22
PHYTOPLANKTERS																	
BLUE-GREEN ALGAE																	
Anabaena		1															
Dactylococcopsis	81	76	18	14	4												
Oscillatoria gr.																	
Synechococcus									1							1	17
YELLOW-GREEN ALGAE																	
DIATOMS																	
Asterionella	307	439	308	309	61	6	8	26	8	2	1						
Cocconeis									12					1			
Cosmarium															2		1
Cyclotella chaetoceras			44	28	2								1				
Cyclotella spp.				1													
Cyclotella-Stephanodiscus gr.	22	44	53	195	338	20	17	13	5	5	8	6	19	6	7	6	17
Cymbella									1								
Diatoma elongatum	20	48	102	171	14				1								
Diatoma vulgare																	
Fragilaria crotonensis	P		P	1	1	1							P				
Melosira (a)			1	1	1							P	P		P		2
Melosira (b)				4													
Navicula gr.	4	3		1	2				31		4					2	2
Nitzschia gr.	6	10	1	35	6				6	1	4	1					
Rhizosolenia gr.	4	38	102	45	4		1		3		1	1					1
Surirella		5	16	6					1								
Synedra gr.				1													
XANTHOPHYCEAE																	
Heterotrichales sp.	22	25	15	9	1												6
CHRYSOPHYCEAE																	
Dinobryon	63	33	P														
Mallomonas	1			25	2										1	2	5
GREEN ALGAE																	
Actinastrum																	
Ankistrodesmus	76	65	7	16	7												1
Chlamydomonas gr.	38	67	11	4	1			6					1	3	41	780	89
Chlorella	2	43	19	45	19			2	1	1			1				
Closteriopsis																1	2
Coccomonas											1	1	8	17	38	92	40
Coelastrum	1		1	3		5	2	5	2		1				1		
Crucigenia fenestrata																	
Crucigenia quadrata	4	2	4	10	20												
Crucigenia tetrapedia							1						1				
Dictyosphaerium		1		1													
Elakatothrix	4				3			3							2		
Franceia																	
Gloeocystis		12	3	14	21	10	10	15	2				1		3	2	2
Golenkinia		2	5														
Lagerheimia quadriseta	7	21	1	1	1												
Lagerheimia wratislawiensis																	
Micractinium			1														
Oocystis				8	1	2	.3			1					4	1	1
Pandorina	2	5	2														
Pediastrum duplex		1										1					
Rhizochrysis																	
Scenedesmus bijuga				1	1				1						4		4
Scenedesmus dimorphus	1			2	3												
Scenedesmus opoliensis	1																
Scenedesmus quadricauda			1	10	9	3	1	1	1		1						
Selenastrum																	
Sphaerocystis		1	2	7	1				2						1	1	
Staurastrum																	
Stichococcus			2		4												
Tetraedron caudatum																	
Tetraedron duospinum									7								
Tetraedron sp.					1												
Tetrastrum elegans	2	6	3														
Tetrastrum heteracanthum																	
Tetrastrum staurogeniaeforme																	
Treubaria setigerum																	
Westella			2	1													
EUGLENOPHYTA																	
Euglena	30	60	10	50	25	27	9	36	1	2	3				5	12	
Eutreptia		63	2	2													
Trachelomonas	11	17	14	7	3		1		1	4		1	2	1	7	4	5
YELLOW-BROWN ALGAE																	
DINOPHYCEAE																	
Ceratium																	
Glenodinium																	
Gymnodinium	3	11	8							1							
ZOOPLANKTERS																	
PROTOZOA																	
Codonella	1	1	3	2	2												
Difflugia sp.			1		3												
Paradileptus															1		
Protozoa spp.	3	12	4										1		1		
Strombilidium											1					1	2
Vorticella	5	1															
ROTIFERS																	
Keratella cochlearis	1			1		1											
Polyarthra platyptera	1		1			1		1		1							
COPEPODA																	
Copepoda spp.		1														1	
HYDRACARINA																	
Acarina spp.				1													
CLADOCERA																	
Cladocera spp.					1	2											
OSTRACODA																	
Ostracoda sp.																	
TOTAL	723	1,114	767	1,032	560	78	53	106	87	18	25	11	35	38	118	906	197

Table 201. Individual Plankton Analyses - Below Ft. Randall Dam (Cont.)

Year - 1955	8/30	9/6	9/12	9/19	9/26	10/3	10/10	10/17	10/24	11/1	11/7	11/14	11/22	11/29	12/5	12/12	12/19	12/27
PHYTOPLANKTERS																		
BLUE-GREEN ALGAE																		
Anabaena	1	P																
Dactylococcopsis																		
Oscillatoria gr.						2		1	1									
Synechococcus																		
YELLOW-GREEN ALGAE																		
DIATOMS																		
Asterionella													1		2	2	3	3
Cocconeis					1													
Compsarium									1									
Cyclotella chaetoceras	2				2	1	1	7	11	4		1					1	5
Cyclotella spp.	5					3												
Cyclotella-Stephanodiscus gr.	109	162	540	133	188	427	33	17	16	5	2	6	4	5	16	6	23	17
Cymbella									1									
Diatoma elongatum																		
Diatoma vulgare									2									
Fragilaria crotonensis																		
Melosira (a)	P	2	1	2	3	10	P	1	1	P		1	1		1	1		
Melosira (b)																		
Navicula gr.	6	1	28	26	16	40	16	8	16	6		1			1	1		1
Nitzschia gr.	1				2	5	1	3	8	2	4	1	1					
Rhizosolenia gr.	5	3		3	1	5	1	5	5	1	2	1	1	1		1		1
Surirella																		1
Synedra gr.		1	1	2	1			1										
XANTHOPHYCEAE																		
Heterotrichales sp.	92	7	6															
CHRYSOPHYCEAE																		
Dinobryon																		
Mallomonas	5					5	1		1						1	1		3
GREEN ALGAE																		
Actinastrum						1												
Ankistrodesmus	1	4		10	5	6	2	5			1	1		1		1		1
Chlamydomonas gr.	133	84	83	92	19	2	3	3	2	6	1		1	3	3	6	13	9
Chlorella	1	2	1	5	4	3	2	3	5	7	7	3			1	1	4	2
Closteriopsis	2	2	1	1														
Coccomonas	84	32	36	2	10	14	8	6	5		1							
Coelastrum	4	9	2	5	2		2	4	4		1				1	2		1
Crucigenia fenestrata										1								
Crucigenia quadrata		1		9	5	9	7	5	6	3	4	1			1	1	1	6
Crucigenia tetrapedia	1	1			2	1			1									
Dictyosphaerium	5	2	5															
Elakatothrix																		
Franceia																		
Gloeocystis	11	3		5	5	5	6	3	12		1		8	1	1	5	12	9
Golenkinia																		
Lagerheimia quadriseta																		
Lagerheimia wratislawiensis																		
Micractinium																		
Oocystis	3	7		1	4		1					1			1		7	6
Pandorina																		
Pediastrum duplex			1					1										
Rhizochrysis					1													
Scenedesmus bijuga				1	1			2										
Scenedesmus dimorphus		1				7		8		1	1					1		
Scenedesmus opoliensis																		
Scenedesmus quadricauda	1		1		3	4	6	12	14	6	5	9	2	1			1	3
Schroederia	1		2															
Selenastrum					1													
Sphaerocystis				1	2	1				1	1							
Staurastrum	2																	
Stichococcus				2	4	4	5	102	57	22	20	11	8	4	5	3		
Tetraedron caudatum				1														
Tetraedron duospinum																		
Tetraedron sp.																		
Tetrastrum elegans				1														
Tetrastrum heteracanthum									2									
Tetrastrum staurogeniaeforme					1	4	2	5	3	1		1	1					
Treubaria setigerum					1													
Westella																		
EUGLENOPHYTA																		
Euglena	4	3	4	2	3	5	14	10	25	4	2	1	3	3	16	8	11	18
Eutreptia																		
Trachelomonas	13	9	11	1	1		2		1	1			1	1	3		1	
YELLOW-BROWN ALGAE																		
DINOPHYCEAE																		
Ceratium								1										
Glenodinium				1														
Gymnodinium												1					2	
ZOOPLANKTERS																		
PROTOZOA																		
Codonella																		
Difflugia sp.			1		2					1							1	2
Paradileptus																		
Protozoa spp.	1	1			2	1		1		1	1				1		2	2
Strombilidium	1				1	2	4	4	2				1				1	1
Vorticella																		
ROTIFERS																		
Keratella cochlearis								1			1							
Polyarthra platyptera	1																	
COPEPODA																		
Copepoda spp.	1																	
HYDRACARINA																		
Acarina spp.																		
CLADOCERA																		
Cladocera spp.																		
OSTRACODA																		
Ostracoda sp.																		
TOTAL	496	337	724	306	293	567	117	213	208	73	55	40	33	20	54	40	83	91

Table 20j. Individual Plankton Analyses - Niobrara River

Year - 1955	4/8	5/9	5/23	6/27	7/25	8/30	10/6	10/31
PHYTOPLANKTERS								
BLUE-GREEN ALGAE								
Anabaena			1		8	1		
Dactylococcopsis		3			2			
Oscillatoria gr.					7		1	1
YELLOW-GREEN ALGAE								
DIATOMS								
Cocconeis							1	
Cyclotella sp.				12		13		
Cyclotella-Stephanodiscus gr.	4	146	66	119	365	1,053	8	
Cymbella		1					2	6
Diatoma vulgare	3	1					6	3
Fragilaria crotonensis		P	P	1	1	1		
Fragilaria sp.	35	17	119	13	24	122	39	51
Gomphonema	2	1						2
Gyrosigma gr.	1	1				1		1
Melosira (a)	P		1		1			
Navicula gr.	13	128	1,053	332	554	107	64	116
Nitzschia gr.	12	24	31	13	19	30	7	25
Rhizosolenia gr.		575	3,173	566	3,173	1,431	34	6
Rhopalodia	1	1				14		
Synedra gr.					11	1		1
XANTHOPHYCEAE								
Bumilleria					1	4	3	2
GREEN ALGAE								
Actinastrum		2	30	74	581	119		
Ankistrodesmus		133	8,316	732	6,251	2,321	47	8
Chlamydomonas gr.	4	964	2,970	78	27	13	14	3
Chlorella		7	540			8		
Closteriopsis				1		1		
Coccomonas					41	12		4
Coelastrum		1	28	19	9	8	2	
Crucigenia quadrata		2	8	23	7	19	4	
Dictyosphaerium			20	10	1,674	891	4	
Elakatothrix				16	13	13		
Eudorina				2				
Gloeocystis	2		3	43	675	100	16	
Golenkinia					1		1	
Lagerheimia quadriseta		1						
Oocystis					26	4		
Pandorina		1	7	11	1	2	1	
Pediastrum Boryanum		1		3	1	3		
Pediastrum duplex		1	8	38	72	240	4	3
Pediastrum simplex					3	4		
Pediastrum tetras					1	5	2	
Scenedesmus bijuga		6	10	95	1,404	270	1	
Scenedesmus dimorphus		8	756	745	1,607	999	20	2
Scenedesmus opoliensis		1						
Scenedesmus quadricauda		18	864	243	1,337	756	38	3
Schroederia					4	9		
Selenastrum					8		1	
Sphaerocystis				2		1	1	
Staurastrum natator		2						
Tetraedron				3	3			
Tetrastrum elegans			1					
Ulothrix	P					1		
EUGLENOPHYTA								
Euglena	1	3	3	1	5	2	2	
Phacus				1	1			
Trachelomonas	5	3	6	4	8	11	2	1
ZOOPLANKTERS								
PROTOZOA								
Difflugia sp.					1			
Protozoa sp.					2			
Vorticella		3	1					
NEMATODA								
Nematoda sp.						1		
TOTAL	83	2,055	18,015	3,200	17,989	8,591	325	238

Table 20k. Individual Plankton Analyses - Yankton (Cont.)

Year - 1955	5/2	5/8	5/16	5/23	5/31	6/5	6/13	6/19	6/27	7/3	7/11	7/17	7/25	8/1	8/15	8/22	8/28
PHYTOPLANKTERS																	
BLUE-GREEN ALGAE																	
Anabaena			P	P	P					1	P			P	P		
Dactylococcopsis	41	36	59	40	3	3			9	1			1				
Gomphosphaeria-Coelasphaerium																	
Lyngbya									P								
Oscillatoria gr.									1								
YELLOW-GREEN ALGAE																	
DIATOMS																	
Asterionella	196	299	453	524	205	34	9	6	16	18		3					
Cocconeis																	
Cosmarium															1		
Cyclotella chaetoceras			45	23	1				3	24	1		1			21	11
Cyclotella spp.					3								3				17
Cyclotella-Stephanodiscus gr.	13	23	129	300	464	38	28	6	12	19	18	7	30	30	101	58	35
Cymbella																	
Cystopleura																	
Diatoma elongatum	14	26	137	508	41						1						
Diatoma vulgare		1	1		1						2						
Fragilaria crotonensis		1		7	3					P							
Fragilaria spp.			71	4							16						
Gomphonema					1												
Gyrosigma gr.			1														
Melosira (a)				1	3					P		P			P	1	
Melosira (b)																	
Navicula gr.	8	11	22	52	73	28	29	40	39	71	108	28	64	5	43	24	18
Nitzschia gr.	5	7	20	76	20	9	5	2	6	1	5	3	6		6		1
Pinnularia															1		
Rhizosolenia gr.	13	40	213	165	35	10	11	14	42	86	80	23	91	33	16	27	20
Rhopalodia																	
Surirella			19	7	1				2		1						
Synedra gr.												1	3	1			
XANTHROPHYCEAE																	
Heterotrichales sp.	32	19	71	34	1	1						1				11	38
CHRYSOPHYCEAE																	
Dinobryon	33	8	2														
Mallomonas															1		
GREEN ALGAE																	
Actinastrum			1	3	1	1	1		8	13	13	2	3	5	5	5	5
Ankistrodesmus	20	13	44	84	23	13	3	1	46	35	14		29	13	49	37	25
Cerasterias staurastroides							1										
Chlamydomonas gr.	13	45	43	70	11	10	8	15	29	16	10	1	2	15	405	292	163
Chlorella		6	12	31	6	13	1	2	4	2	1		2	2	5	18	21
Closteriopsis					1									1	2	3	10
Coccomonas										2		1	4	10	11	44	40
Coelastrum			4	2	4	6	1	1	2	4	2	2		1	4	5	7
Crucigenia quadrata	1	1	4	6	5	12		3	4	3	3			2	8	7	1
Crucigenia tetrapedia		5															1
Crucigenia sp.										5		1			4	8	2
Dictyosphaerium			2	2		2			4	2	7	3	13	10	25	28	25
Dimorphococcus			1														
Elakatothrix		2	2		2						4		6		4	2	6
Eudorina									1								
Francaia									1								
Gloeocystis		6	5	9	21	13	38	4	9	13	4	10	10	7	7	43	15
Golenkinia											2						1
Lagerheimia quadriseta	1	1	2	1													
Lagerheimia subsalsa																	
Lagerheimia wratislawiensis										1						1	
Micractinium															1	1	3
Oocystis			1			3						4	1		3	1	2
Pandorina			1								1		1		1		
Pediastrum Boryanum											3				2		1
Pediastrum duplex				1					3	2	4	2	2		6	9	5
Pediastrum simplex																	
Pediastrum tetras																	1
Scenedesmus bijuga				2	5	4	4	4	9	6	9	5	15	4	24	5	18
Scenedesmus dimorphus		2	1	4	15	10	3	1	31	9	25	1	7	1	16	17	4
Scenedesmus opoliensis				2													
Scenedesmus quadricauda			2	8	23	10	5	3	22	17	8	2	11	5	13	10	6
Schroederia										1	5		2			3	8
Selenastrum											4						
Sphaerocystis						1		2	2	2	1	15	17				2
Staurastrum																	2
Stichococcus			6	11	8	6		1	1	15		2	6		24	21	25
Tetraedron caudatum										1							
Tetraedron cuspinum			1			1			1								
Tetrastrum elegans		1	1														
Tetrastrum staurogen																	
EUGLENOPHYTA																	
Euglena	1	1	4	4	6	1	3		5	5	7	2	1			5	2
Eutreptia	1		1														
Phacus																	
Trachelomonas	4	9	6	4	4	1	3	3		1	1	1		1	2	5	9
YELLOW-BROWN ALGAE																	
DINOPHYCEAE																	
Gymnodinium																	
ZOOPLANKTERS																	
PROTOZOA																	
Difflugia																1	
Protozoa spp.	1	1	1		2												
Strombilidium																	
Vorticella	1				1												
ROTIFERS																	
Keratella cochlearias	1				2	1									1		
Polyarthra platyptera					1												
CLADOCERA																	
Cladocera spp.				1													
TOTAL	399	564	1,388	1,986	996	231	153	108	312	376	360	180	331	146	791	713	550

Table 20k. Individual Plankton Analyses - Yankton (Cont.)

Year - 1955	9/6	9/11	9/19	9/25	10/3	10/9	10/17	10/23	10/31	11/6	11/14	11/20	11/28	12/5	12/11	12/18	12/26
PHYTOPLANKTERS																	
BLUE-GREEN ALGAE																	
Anabaena	P		P														
Dactylococcopsis	5	1				1											
Gomphosphaeria-Coelosphaerium									2								
Lyngbya																	
Oscillatoria gr.																	
YELLOW-GREEN ALGAE																	
DIATOMS																	
Asterionella													1		2	2	1
Cocconeis					1												
Cosmarium	1																
Cyclotella chaetoceras	16	10		1	9	5	6		4	1							
Cyclotella spp.								7									
Cyclotella-Stephanodiscus gr.	450	240	20	58	76	24	2	4	12	5	11	3	2	5	8	7	7
Cymbella	1			1		1											
Cystopleura																	
Diatoma elongatum																	
Diatoma vulgare									2	4	4				15		
Fragilaria crotonensis		1															
Fragilaria spp.	7				1												
Gomphonema									1								
Gyrosigma gr.																	
Melosira (a)	2	3	1	6	27	9	P	2	P	P		P	P			P	
Melosira (b)				4					P	P					2		
Navicula gr.	30	46	8	65	82	48	16		33	21	6	2	10	6	5	24	2
Nitzschia gr.	2			3	1	8	1	1	23	1	3		2	1			
Pinnularia																	
Rhizosolenia gr.	70	41	7	6	6	7	4	6	14	2	3		4		2	1	
Rhopalodia					2												
Surirella							1								1		
Synedra gr.	1		1	2	1				2			1					
XANTHROPHYCEAE																	
Heterotrichales sp.	110	38	3														
CHRYSOPHYCEAE																	
Dinobryon																	
Mallomonas					1			1									
GREEN ALGAE																	
Actinastrum	3	13	3														
Ankistrodesmus	51	21	12	7	12	10	12	4	2						1		1
Cerasterias staurastroides																	
Chlamydomonas gr.	122	74	67	19	4	1	2	2	1				1			3	2
Chlorella	4	4	5	5	1	4	9	2	1				1	2			
Closteriopsis	9	5	3	1													
Coccomonas	55	50	10	17	18	8	1		1		1						1
Coelastrum	6	10	1	3	1		6	2	3			1				1	
Crucigenia quadrata	10	13	11	3	4	8	7	11	4	1	5	4			1	1	
Crucigenia tetrapedia	1				6		1										
Crucigenia sp.	7					3											
Dictyosphaerium	32	16	16	3	1	2											
Dimorphococcus																	
Elakatothrix		3	2														
Eudorina																	
Franceia																	
Gloeocystis	40	15	5	7	16	2	5	4	6		4						
Golenkinia																	
Lagerheimia quadriseta																	
Lagerheimia subsalsa	1																
Lagerheimia wratislawiensis																	
Micractinium	1																
Oocystis		1	3		1		2									1	1
Pandorina																	
Pediastrum Boryanum																	
Pediastrum duplex	6	5	2	1													
Pediastrum simplex					2												
Pediastrum tetras		1			1		1										
Scenedesmus bijuga	2	6			2	2				1							
Scenedesmus dimorphus	10	13	4	3	5	5	1										
Scenedesmus opoliensis																	
Scenedesmus quadricauda	15	10	2	4	7	3	13	12	20	8	6	3		1		2	1
Schroederia	3	1									1						
Selenastrum																	
Sphaerocystis	7		1		2			1									
Staurastrum																	
Stichococcus	2	3	5	6	41	80	227	116	56	13	8			1			
Tetraedron caudatum							1		1								
Tetraedron duospinum																	
Tetrastrum elegans																	
Tetrastrum staurogen	1		2			3	8	4		1	1		1				
EUGLENOPHYTA																	
Euglena	2	1	4	1	4		13	3					2	5		2	2
Eutreptia																	
Phacus														1			
Trachelomonas	3	7	5	3	1	3	1	1		2	2	1		2	1	1	
YELLOW-BROWN ALGAE																	
DINOPHYCEAE																	
Gymnodinium										1							
ZOOPLANKTERS																	
PROTOZOA																	
Difflugia													1				
Protozoa spp.					1	1									1		
Strombilidium				1				1						1			
Vorticella														1			
ROTIFERS																	
Keratella cochlearias																	
Polyarthra platyptera																	
CLADOCERA																	
Cladocera																	
TOTAL	1,088	652	203	230	327	238	340	184	188	61	55	15	25	26	39	45	18

Table 20m. Individual Plankton Analyses - Omaha

Year - 1955	1/5	1/12	1/19	1/26	2/2	2/9	2/16	2/23	3/2	3/9	3/23	3/30	4/6	4/11	4/20	4/27	5/4	7/13	7/20	7/27
PHYTOPLANKTERS																				
BLUE-GREEN ALGAE																				
Anabaena																		P	P	
Aphanizomenon																17	2		5	
Dactylococcopsis																				
Microcystis																				
Oscillatoria gr.																		P	1	
Spirulina																				
YELLOW-GREEN ALGAE																				
DIATOMS																				
Amphora																				
Asterionella	4	5	2	10	11	34	40	37	28	3	12	9		3	4	14	136	2	3	
Cocconeis																2				
Cyclotella chaetoceras																			2	4
Cyclotella sp.																				
Cyclotella-Stephanodiscus gr.		117	21	113	56		39		7		2		3	17	11	9	23	10	51	22
Cymbella																				
Cystopleura																1				
Diatoma elongatum					2						2	4				4	12			
Diatoma vulgare																				
Fragilaria crotonensis																			1	
Fragilaria sp.		3								13	1	2	7	6		3	8	6	4	
Gomphonema									2											
Gyrosigma gr.											1									
Melosira (a)											1				8	14	4	1	5	P
Melosira (b)											1					4	20			
Melosira sp.																				
Navicula gr.	2					2		4	4			9	4	12	3	27	8	16	65	74
Nitzschia gr.		3			2	4	4	6	16	13	6	6	12	6	4	9	7	2	1	
Pinnularia																				
Rhizosolenia gr.	4					7			2		4			1	31	64	31	1	69	71
Rhopalodia											5	4	3							
Surirella	4								7						2		2			
Synedra gr.									4	9	8	5			11	11	6	1		
XANTHOPHYCEAE																				
Bumilleria																				
Heterotrichales sp.																				
GREEN ALGAE																				
Actinastrum																	1		12	16
Ankistrodesmus						3								6	4	1		2	22	10
Chlamydomonas gr.	12	46	268	55	39	18	17	13								4			1	15
Chlorella	47	96	82	218		41	16	12												
Closteriopsis																	1			1
Coccomonas																				
Coelastrum																				
Cosmarium															2					
Crucigenia quadrata																			1	4
Crucigenia rectangularis					4															
Crucigenia sp.		3																		
Dictyosphaerium								1									2		6	3
Elakatothrix																				
Gloeocystis	12	17	69	63		40	3												1	13
Golenkinia																				
Nephrocytium																			1	
Oocystis																				5
Pandorina																				
Pediastrum Boryanum																		1	1	
Pediastrum duplex																	1	1	2	
Pediastrum simplex																				
Pediastrum tetras																				
Scenedesmus bijuga																		7	12	39
Scenedesmus dimorphus																	4		10	2
Scenedesmus opoliensis																				
Scenedesmus quadricauda						2									2	8	1	1	3	1
Schroederia																		1	1	
Stichococcus																				
Stipitococcus capense					10														14	23
Tetraedron trigonum																				
Tetrastrum staurogeniaeforme						1														1
Treubaria setigerum																				
Ulothrix																			2	
EUGLENOPHYTA																				
Euglena	3												3					1		1
Phacus																2				
Trachelomonas		7	13	3		2	4	3			2					2			2	1
YELLOW-BROWN ALGAE																				
DINOPHYCEAE																				
Peridinium								4												
ZOOPLANKTERS																				
PROTOZOA																				
Centropyxis aculeata																1				
Difflugia sp.																				
Strobilidium																				
Vorticella																		1		
NEMATODA																				
Nematoda sp.																		1		
ROTIFERA																				
Keratella quadrata																	1			
Polyarthra platyptera																				
Polyarthra sp.																				
TOTAL	88	297	455	462	184	154	123	80	70	38	45	39	32	51	82	197	270	56	298	306

Table 20m. Individual Plankton Analyses - Omaha (Cont.)

Year - 1955	8/3	8/10	8/17	8/24	8/31	9/7	9/14	9/21	9/28	10/5	10/12	10/19	10/26	11/1	11/9	11/23	12/2	12/7	12/14	12/28
PHYTOPLANKTERS																				
BLUE-GREEN ALGAE																				
Anabaena	P	1	P	1	1	P														
Aphanizomenon			P	1	1	1														
Dactylococcopsis																	1			
Microcystis			1	1																
Oscillatoria gr.			1	5	P		2	1												
Spirulina			1	2																
YELLOW-GREEN ALGAE																				
DIATOMS																				
Amphora								1												
Asterionella																P			P	1
Cocconeis																				
Cyclotella chaetoceras			1	9	4												7		1	2
Cyclotella sp.																6				
Cyclotella-Stephanodiscus gr.	73	51	167	154	77	91	327	174	32	58	22	21	9	7	19	17	1,596	346	405	284
Cymbella							1						1	2						
Cystopleura																				
Diatoma elongatum																P				
Diatoma vulgare												1			1	2				
Fragilaria crotonensis																				
Fragilaria sp.	4	4	10			4				5		4	3							
Gomphonema		1																		
Gyrosigma gr.			1	1	1	1		2												
Melosira (a)	2	1	1	1	3	2	4	4	6	20	10	4	1	1	1	1				
Melosira (b)	2		3	3	1				1	4										
Melosira sp.			2																	
Navicula gr.	15	34	79	27	24	25	49	74	53	104	90	45	57	24	18	11	1	5	1	2
Nitzschia gr.	1	2	4	1	9	1	3	2		2	3	5	2	2	6	1				
Pinnularia										1			1							
Rhizosolenia gr.	12	7	52	93	33	39	29	12	4	14	25	10	10	9	7	2	8	2	2	4
Rhopalodia																				
Surirella									1											
Synedra gr.	2	3		1	2	3	4	2	4		1		1							
XANTHOPHYCEAE																				
Bumilleria												P								
Heterotrichales sp.			1	12	31	14										2				
GREEN ALGAE																				
Actinastrum	6	3	10	13	12	4	4	1												
Ankistrodesmus	5		18	24	24	18	6	1	2	5	9	8	3	1			3	4	5	1
Chlamydomonas gr.	1	2	23	47	26	8	4		1	1	2	1				2	7		3	11
Chlorella				4	4												7	1	2	2
Closteriopsis		3	12	23	35	11	11	5	1							1				
Coccomonas						18			1		1					1				
Coelastrum			3	1	9	2	1				1	1	4							
Cosmarium								1												
Crucigenia quadrata				10	2	5	3	1		1	10			3	1		2		1	1
Crucigenia rectangularis																				
Crucigenia sp.																				
Dictyosphaerium	6	4	34	36	16	20	2	1												
Elakatothrix						2														
Gloeocystis	3	4	9	27	17	13	5	9	1	9	2	1			2					
Golenkinia	1																			
Nephrocytium																				
Oocystis	1	2	9	13	2						1		2							
Pandorina				1																
Pediastrum Boryanum	3		3	1	4															
Pediastrum duplex	1	1	14	7	18	6	1	2		1					1					
Pediastrum simplex				1					1											
Pediastrum tetras										1										
Scenedesmus bijuga	44	22	18	18	15	8	6	5	2	5										
Scenedesmus dimorphus			5	7	27	9	1	2	3	7	8	1								
Scenedesmus opoliensis																		1		
Scenedesmus quadricauda		1	8	10	26	4	8		4	3	15	4	2	2	5	3	1	1		
Schroederia			1	5	5	3				1				1						
Stichococcus	4	1	3						5	29	114	239	15	2	12			1		
Stipitococcus sapense																				
Tetraedron trigonum			1								1									
Tetrastrum staurogeniaeforme											1	1								
Treuberia setigerum				1																
Ulothrix	1	P	1		1	2	1	1	P			1	1		2					
EUGLENOPHYTA																				
Euglena			1	13	3	2	1	2		1	1	1			1	1	8	2	2	2
Phacus																				
Trachelomonas	3		3	3	5	2	2		4	2			2		1	3			4	1
YELLOW-BROWN ALGAE																				
DINOPHYCEAE																				
Peridinium																				
ZOOPLANKTERS																				
PROTOZOA																				
Centropyxis aculeata																				
Difflugia sp.	1			1		1		1									1			1
Strombilidium																				2
Vorticella		1							1											
NEMATODA																				
Nematoda sp.								1												
ROTIFERA																				
Keratella quadrata																				
Polyarthra platyptera			1													1				1
Polyarthra sp.															1					
TOTAL	191	148	501	578	438	319	475	305	127	274	317	348	114	54	78	54	1,642	363	486	315

Table 20n. Individual Plankton Analyses - Council Bluffs

Year - 1955	1/6	1/26	1/27	2/3	2/10	2/24	3/3	3/10	3/17	3/24	3/31	4/7	4/14	4/21	4/28	5/5	7/14	7/21	7/28
PHYTOPLANKTERS																			
BLUE-GREEN ALGAE																			
Anabaena																	2	1	P
Aphanizomenon													1		12	13	14	P	
Gomphosphaeria															1				
Lyngbya								9											
Merismopedia																			
Microcystis																			
Oscillatoria gr.										4		1				3	20	10	1
YELLOW-GREEN ALGAE																			
DIATOMS																			
Asterionella	1	6	9	14	28	52	3	7	1	15	6		10	6	19	192	3	1	
Cocconeis																			
Cyclotella chaetoceros																		15	9
Cyclotella-Stephanodiscus gr.	33				2						3		6	4	8	22	3	81	83
Cymbella																			
Diatoma elongatum																22			
Diatoma vulgare																	1		
Fragilaria crotonensis																		2	P
Fragilaria sp.										4			11		1	4		4	
Gyrosigma gr.							1										1		1
Melosira (a)					2								1	1	4	10	P	7	1
Melosira (b)													4		4		15	3	
Melosira sp.																	2		
Navicula gr.							2	2			4				2	7	10	70	158
Nitzschia gr.	2			6			26	21	4	12	7	6	2		2	2	2	4	3
Pinnularia																			
Rhizosolenia gr.	8					1							4	27	48	28	7	97	124
Rhopalodia									12	2	1		2						
Surirella										1				4	4				
Synedra gr.							4	9	4	5	2	3			3	7		1	
XANTHOPHYCEAE																			
Bumilleria																			
Heterotrichales sp.																			
CHRYSOPHYCEAE																			
Dinobryon																			
Mallomonas																			
GREEN ALGAE																			
Actinastrum														3		7	1	11	10
Ankistrodesmus														1				14	9
Chlamydomonas gr.	6	254	286	61	43	21				1			6	5	1			11	7
Chlorella	52	26	80	9	18														
Closteriopsis															2	1		1	2
Coccomonas																			
Coelastrum																		3	1
Cosmarium																			
Crucigenia fenestrata																			
Crucigenia quadrata																		1	
Crucigenia tetrapedia																			
Dictyosphaerium															2	1		11	14
Elakatothrix																		2	
Gloeocystis	1	34		16													2	18	23
Golenkinia																			
Gonium																			
Micractinium																		2	
Oocystis																			3
Pandorina																			
Pediastrum Boryanum																		1	2
Pediastrum duplex																	2	3	1
Scenedesmus bijuga																	2	20	30
Scenedesmus dimorphus	2																	6	1
Scenedesmus quadricauda										2				2	1	1	1	1	1
Schroederia																		2	
Selenastrum																			
Sphaerocystis																		1	
Staurastrum																			
Stichococcus															1			24	70
Tetrastrum staurogeniaeforme						1													
Ulothrix																		3	5
EUGLENOPHYTA																			
Euglena																	1		4
Phacus																		1	
Trachelomonas	4									6		7		6	2	2		4	
YELLOW-BROWN ALGAE																			
DINOPHYCEAE																			
Ceratium																			
ZOOPLANKTERS																			
PROTOZOA																			
Difflugia sp.																			
Paramecium						1													
Protozoa sp.																		2	
Strombilidium																			
NEMATODA																			
Nematoda sp.																			
ROTIFERA																			
Cephalodella														1					
Keratella cochlearis																			
Keratella quadrata																2			
Notholca																			
Polyarthra platyptera																			
TOTAL	109	380	375	106	93	76	36	48	21	52	23	17	47	60	117	385	89	438	563

Table 20n. Individual Plankton Analyses - Council Bluffs (Cont.)

Year - 1955	8/4	8/11	8/18	9/1	9/8	9/15	9/22	9/29	10/6	10/13	10/20	10/27	11/3	11/10	11/17	12/1	12/8	12/15	12/22	12/29
PHYTOPLANKTERS																				
BLUE-GREEN ALGAE																				
Anabaena		P	P		P															
Aphanizomenon				P	P			P	P				P							
Gomphosphaeria																				
Lyngbya																				
Merismopedia			1	1				2												
Microcystis				1		1														
Oscillatoria gr.	1	1	3	3	1	1														
YELLOW-GREEN ALGAE																				
DIATOMS																				
Asterionella										P									P	1
Cocconeis										1										
Cyclotella chaetoceras	1	1	3	3				1		1					5	2	4	1	3	2
Cyclotella-Stephanodiscus gr.	164	58	151	71	109	289	351	37	56	41	14	11	15	33	57	502	481	305	180	254
Cymbella											1			2						
Diatoma elongatum																				
Diatoma vulgare			1									2		2						
Fragilaria crotonensis																				
Fragilaria sp.			3	1	6						8									
Gyrosigma gr.									1	1				1	1					
Melosira (a)	1	P	1	P	2	4	5	5	14	8	3	2	1	P		P				
Melosira (b)	9		1				2	P												
Melosira sp.		P	P	P																
Navicula gr.	17	42	63	15	31	49	78	64	89	67	32	26	19	8	5	1	1		2	2
Nitzschia gr.	4	3	7	8	1	4	1	4	1	4	12	11	13	2	4					
Pinnularia	1																			
Rhizosolenia gr.	11	5	47	20	19	20	6	3	11	13	8	16	6	12	5	6	2	2	5	2
Rhopalodia								1												
Surirella										1										
Synedra gr.		1	1		3	3	2	2	3				1							
XANTHOPHYCEAE																				
Bumilleria												P		P						
Heterotrichales sp.				44	3	6														
CHRYSOPHYCEAE																				
Dinobryon																	1			
Mallomonas																				2
GREEN ALGAE																				
Actinastrum	8	3	17	5	1	9			1					1					1	
Ankistrodesmus	9		21	14	19	12	4	6	2	9	9	1	1	3	1	3	1	4		1
Chlamydomonas gr.	6	3	21	37	7	12	7	2	2	1		1	1		2	4	2	2	4	
Chlorella								1				1								
Closteriopsis	4	7	5	35	6	15	7	1	1	1		1								
Coccomonas		1			11	9						1				1	1			
Coelastrum			2		5	2			1	1	1				1					
Cosmarium			1	1		2														
Crucigenia fenestrata												4								
Crucigenia quadrata			2	1		6		1	4	2	3	2		3	2	3	1	2	1	2
Crucigenia tetrapedia												1								
Dictyosphaerium	18	25	60	41	32	25	26	3	5	1										
Elakatothrix				3																
Gloeocystis	25	11	15	32	8	6		2						2		1				
Golenkinia															1				1	
Gonium																				
Micractinium				1																
Oocystis		4	5				2		2	1							1			
Pandorina										1										
Pediastrum Boryanum	3	2	5		1	1	1													
Pediastrum duplex	3	2	16	6	4	3	5	1			1									
Scenedesmus bijuga	47	14	37	10		4			3	4										
Scenedesmus dimorphus	3	1	8	17	2	2	1	1	4			2		2					1	1
Scenedesmus quadricauda		2	4	14	8	5	2	7	2	9	1	4	2	5	1	2	3		3	2
Schroederia	1		2	2	1	1						1								
Selenastrum																				
Sphaerocystis																	1			
Staurastrum				1		1														
Stichococcus	16		3		1	1	1	12	29	157	151	30	8	13	1					
Tetrastrum staurogeniaeforme										1	1			1	1					
Ulothrix	P	1	P	1	1		P	1	P	1	1		P	P						
EUGLENOPHYTA																				
Euglena	4	3		3	1															
Phacus									4	1			1	1	1	6	1	6	7	3
Trachelomonas	2	6	3	6	4		7	2	1			1	1			1	1			
YELLOW-BROWN ALGAE																				
DINOPHYCEAE																				
Ceratium				1																
ZOOPLANKTERS																				
PROTOZOA																				
Difflugia sp.	5	3	8	2	2		1				1			1	2				2	1
Paramecium																				
Protozoa sp.	7															1				
Strombilidium																				1
NEMATODA																				
Nematoda sp.					1															
ROTIFERA																				
Cephalodella																				
Keratella cochlearis																			1	
Keratella quadrata																				
Notholca		1																		
Polyarthra platyptera			1			1										1				1
TOTAL	370	300	318	408	190	[illegible]	309	159	[illegible]	387	[illegible]	[illegible]	[illegible]	[illegible]	90	534	[illegible]	[illegible]	[illegible]	[illegible]