WORKING PAPER NO. 16

COLUMBIA RIVER BASIN PROJECT
For Water Supply and Water Quality Management

SUMMARY REPORT

WATER QUALITY STUDIES

BROWNLEE RESERVOIR - SNAKE RIVER

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U. S. DEPARTMENT OF HEALTH, EDUCATION AND WELFARE
Public Health Service
Region IX

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This working paper contains preliminary data and information primarily intended for internal use by the Columbia River Basin Project staff and cooperating agencies. The material presented in this paper has not been fully evaluated and should not be considered as final.

SUMMARY REPORT ON THE BROWNLEE RESERVOIR SURVEYS

Purpose

On August 30, 1961, the Portland, Oregon, office of the Public Health Service, Division of Water Supply and Pollution Control, conducted a limnological survey of Brownlee Reservoir on the Snake River. This survey was initialed on the basis of the results of a limited amount of data collected by a number of agencies with responsibilities in this area. There was serious concern evidenced as to the water quality of Brownlee Reservoir and its affects on fish and aquatic resources in these waters. The results of our initial survey indicated oxygen depletion in portions of the reservoir, and that further follow-up surveys were needed to properly evaluate the extent of the problem. A second, and to date, last, in the series of limnological surveys was conducted on October 16-20, 1961.

Scope

The scope of the surveys had been of the reconnaissance type, through which an evaluation of the condition of the reservoir could be made.

The surveys conducted to date have consisted of sampling for dissolved oxygen, temperature, pH, bottom deposits, and plankton. Sampling stations have been located at approximately five-mile intervals throughout the length of the reservoir. A 20-foot Skagit outboard boat, equipped with a handwinch with 200 feet of 3/32-inch cable was used in the first survey. Four hundred feet of cable, which allowed for sampling the entire water column, was available for the second survey. Temperature has been measured by means of

a bathothermograph (0-200'), with temperatures below the 200-foot depth being taken with reversing thermometers. Surface temperatures were taken with an ordinary laboratory thermometer. Kemmerer and Frautschy water sample bottles were used for sampling beneath the surface. A Clarke-Bumpus plankton net was used in the collection of the plankton samples on the October 16-20, 1961, survey, and a Beckman model-N pH meter was used on the initial survey for the measurement of pH. Bottom samples were taken by means of Petersen and Ekman dredges. Dissolved oxygen determinations were made using the Alsterberg modification.

Summary of Findings

On the August 30, 1961, survey it was found that the dissolved oxygen concentration of a 17-mile reach of Brownlee Reservoir was less than or equal to 4 parts per million. At one sampling station some 21 miles upstream of Brownlee Dam, the dissolved oxygen concentration varied from a maximum of 3 parts per million at the surface to zero at the 130-foot depth and below. A study of the data collected immediately upstream of the Dam on this same date indicates that waters contained approximately 2 parts per million of dissolved oxygen were being released downstream and into Oxbow Reservoir. Samples were not collected below Brownlee Reservoir on the August 30, 1961, survey. The water temperature varied from a high of 25.5° C in the surface water to 21-22° C at 100 feet to a low of 9.6° C at 175 feet.

On the October 16-20, 1961, survey significant changes were recorded in temperature and dissolved oxygen. Dissolved oxygen concentrations showed increases, to a maximum of 6 parts per million, since the August survey with conditions generally improved at most sampling points. The deeper waters were still of inferior quality. Surface water temperatures had cooled some 8.5° C with lesser changes occurring throughout the water column.

On October 19, 1961, two dissolved oxygen samples were taken below Brownlee Dam at the highway bridge. The dissolved oxygen in the flowing water at the head of Oxbow Reservoir was then 5.3 parts per million. Data collected by Idaho Power Company on October 17, 1961, in and below Oxbow Reservoir, reported dissolved oxygen concentrations from the surface to bottom (100 feet) of Oxbow Reservoir at 5.0 parts per million. Unfortunately, similar data were not collected on the August 30, 1961, survey.

A more detailed explanation and evaluation of each of these two surveys, including data on the plankton sampling, is included in the appendix.

During the week of August 21, a cooperative survey by the Oregon State Sanitary Authority, Idaho State Department of Health, and Public Health Service was conducted on the Snake River from the upper end of Brownlee Reservoir to Adrian, Oregon, a reach of some 65 miles. The water quality of the Snake River, as measured on

this survey, did not detect or indicate any degraded water quality conditions which could be expected to adversely effect the waters of Brownlee Reservoir. Data collected on this survey are appended.

Water quality data collected in Brownlee Reservoir by the Idaho Department of Fish and Game during the summer and fall of 1961 are also appended as is a list of selected references pertinent to this problem.

Conclusions

As a result of these reconnaissance studies, it is evident that impoundments can and do seriously affect certain water quality factors both within the impoundment itself and downstream from the dams.

These studies were not sufficient to evaluate the effects of impoundments upon the total aquatic environment nor upon all of the water quality factors desirable for domestic and industrial water supplies.

The greatest changes in water quality factors within the impoundments were those related to dissolved oxygen and temperature, both of which are key factors in the problems associated with the anadromous fishery as well as resident fishes. In view of the large expenditures being proposed for future reservoir construction throughout the Pacific Northwest, many of which will also include

costly structures to facilitate fish passage, it would appear desirable to more fully evaluate the effects of impoundments upon the quality of the water stored in them. Unless this is done, this water quality degradation may well offset the other efforts being considered in the planning of fish passage facilities.

APPENDIX MATERIAL

RECONNAISSANCE SURVEY OF THE BROWNLEE RESERVOIR

August 30, 1961

R. J. Callaway

On August 30, 1961, Messrs, Callaway, Kari, and Hoffman participated in a reconnaissance survey of the Brownlee Reservoir. Ten stations were occupied; distance between stations was about five miles.

The surface and subsurface distribution of temperature, pH, and dissolved oxygen was observed. Vertical spacing of pH and oxygen samples in depths over 100 feet was determined by examination of the bathythermograph (BT) trace of temperature versus depth. Vertical plankton hauls were made at several stations. Bottom sediment samples were collected, depth permitting, for the Oregon State Sanitary Authority.

Temperature Distribution

Figure 1 shows the profile of temperature from the dam to 46 miles upstream. Stations 1-5 indicate very little stratification due to turbulent mixing in the shallower parts of the river. Stratification is evident from station 6 to the dam, the depth of the thermocline being about 100 feet. Temperatures of less than 10°C. existed from the dam to mile 15.

For complete overturn to occur, it would be necessary for the surface waters in the pool to cool below 10°C. If the upper river water (miles 46 to 26) cools at the same rate of change as the pool waters, it seems that they might slide along the bottom into the pool before overturn of relatively low dissolved oxygen water in the pool (miles 0 to 26). This is, however, speculation and additional data must be gathered for confirmation.

Dissolved Oxygen Distribution

Figure 2 shows the dissolved oxygen concentration along the river.

The anomalous values at station 9 were not contoured. They are, however, carried in the appended data sheets.

At station 6 no oxygen was found at the two lowest sampling depths of 130 and 145 feet. A noticeable odor of H_2S was observed. It seems likely that this condition was also present along the bottom at stations 7-10, but the length of wire on the winch would not allow us to go below 185 feet.

Figure 3 shows percent saturation of oxygen uncorrected for altitude. Again, the anomalous values at station 9 are not considered in contouring. As in the oxygen profile, the greatest rate of change of saturation occurs in the region of the thermocline.

pH Distribution

Figure 4 shows the pH profile. There is a general increase of pH towards the dam in the upper 25 feet with the exception of a ridge of pH 8.2 present at stations 7-8. A fairly rapid decrease in pH is seen at depths of 100-125 feet, the depth of most rapid decrease in temperature.

Some Questions to be Considered

1. Is the low dissolved oxygen concentration caused by decomposing organic matter present in the heavy summer phytoplankton population or by the upstream waste discharges?

There is probably an interaction here. Examination of sediments near the dam should be undertaken using an Emery-Dietz Corer.

Additional data should be gathered in the fall and winter months to determine whether or not there is a complete reoxygenation of the bottom waters. Flow data should be obtained from the agencies concerned.

2. Is the process of reoxygenation one of overturn near the dam, or does a convective circulation exist?

Because of the great stability of the water near the dam, overturn may be of secondary importance in reoxygenation. Rather, cold waters in the shallower parts of the river might slide along the bottom into the reservoir, with a resultant one or two layer convective circulation.

Sampling Station Data

Water samples were collected with a Kemmerer bottle.

pH was measured with a Beckman model N-2 pH meter.

Temperature in depths less than 100 feet was measured with a laboratory thermometer. Samples were taken from a Kemmerer water sampler, placed in a plastic bucket and the temperature recorded. In depths greater than 100 feet, a bathythermograph (BT) was used. The BT slides were adjusted using surface temperature and the temperature at depth as recorded by a pair of reversing thermometers.

Dissolved oxygen was determined immediately after completion of the survey. The Alsterberg (Azide) modification of the Winkler method was used.

Oxygen saturation was determined by the nomogram prepared by Richards and Corwin (Limnology and Oceanography I, 4. 1956) based on data of Truesdale, Downing, and Lowden.

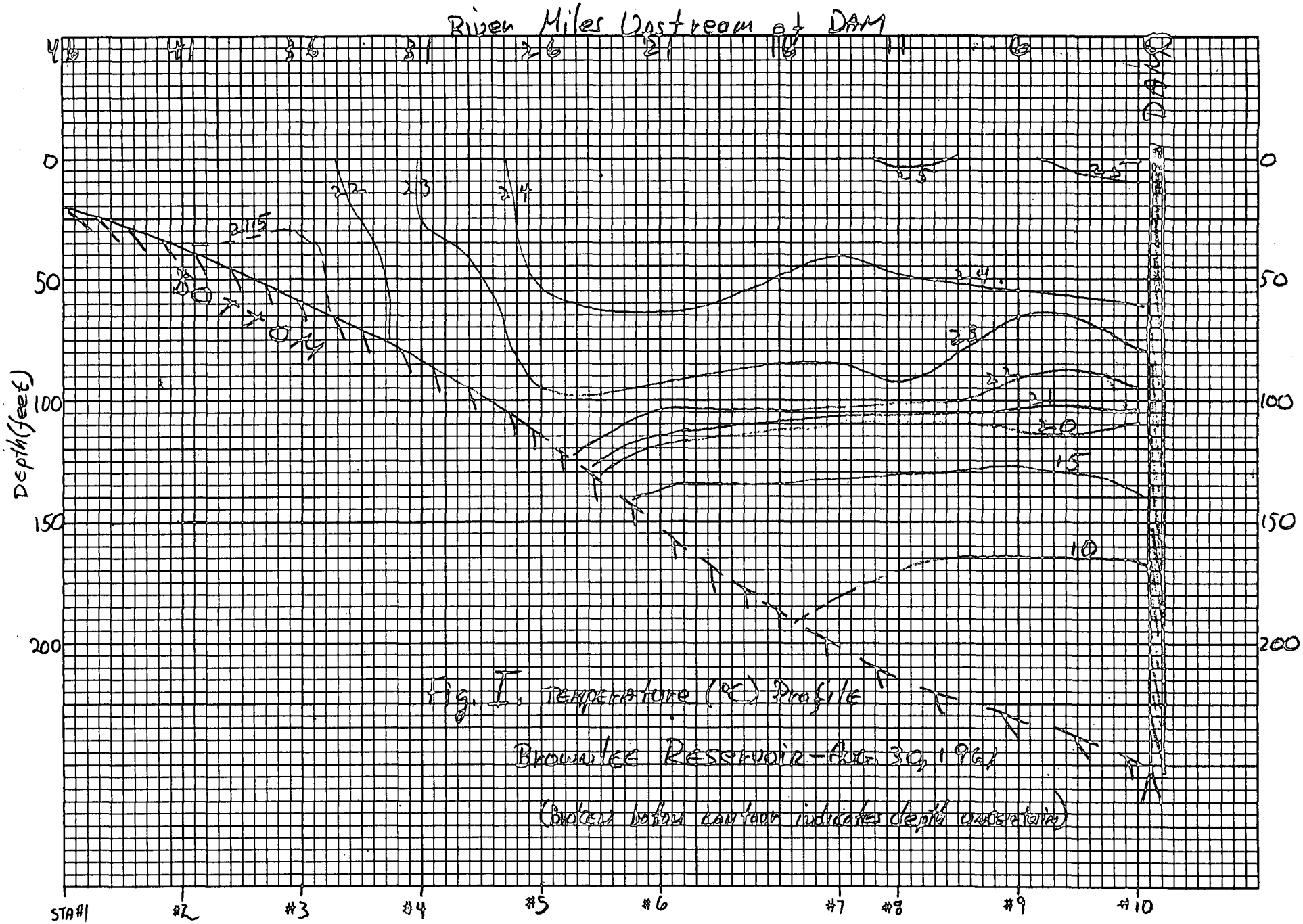


Fig. 7. Temperature (°C) Profile

Brownlee Reservoir - Aug. 30, 1961

(Dots on below contour indicates depth observation)

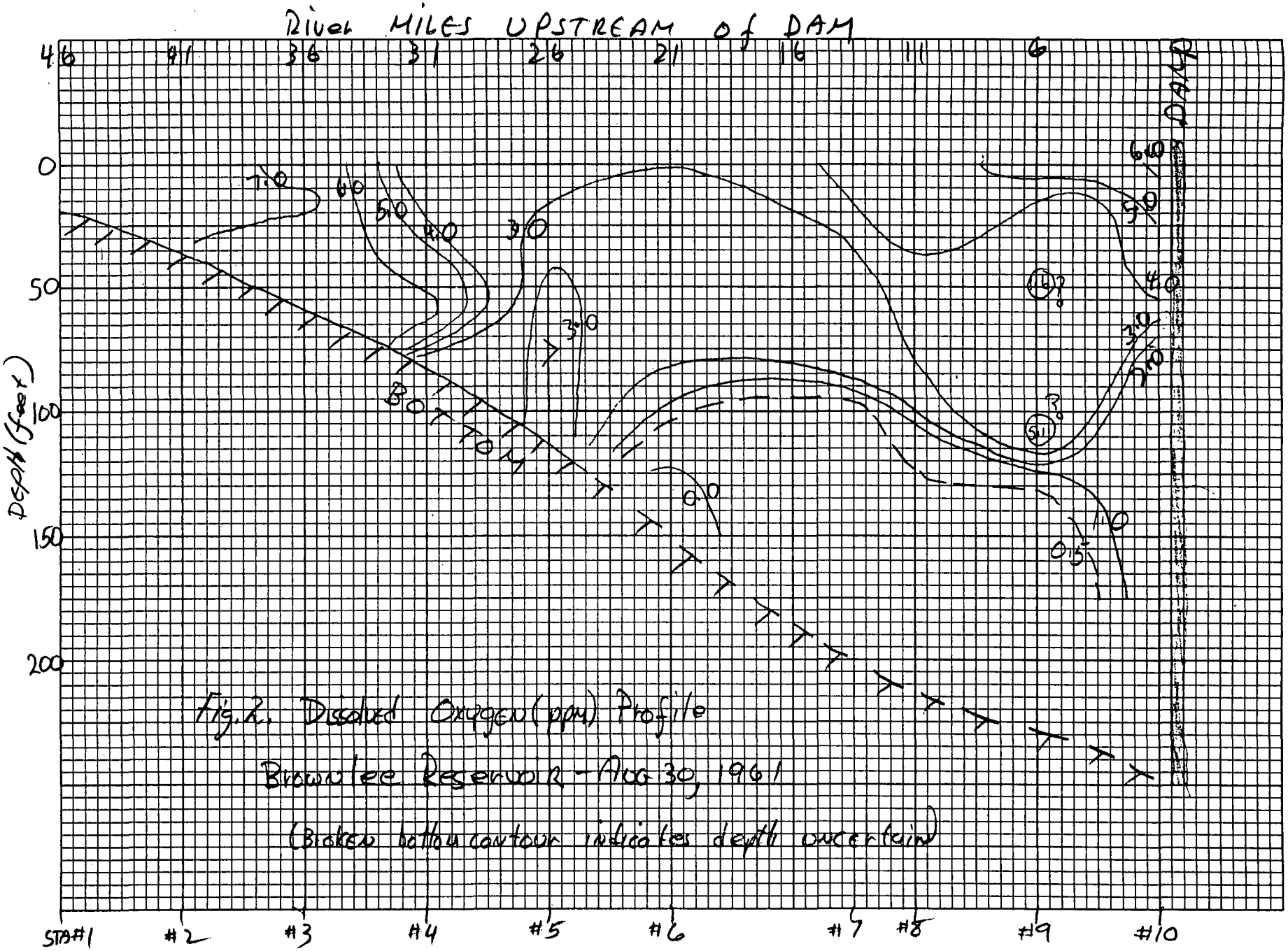


Fig. 2. Dissolved Oxygen (ppm) Profile

Brownlee Reservoir - Aug 30, 1961

(Broken bottom contour indicates depth uncertain)

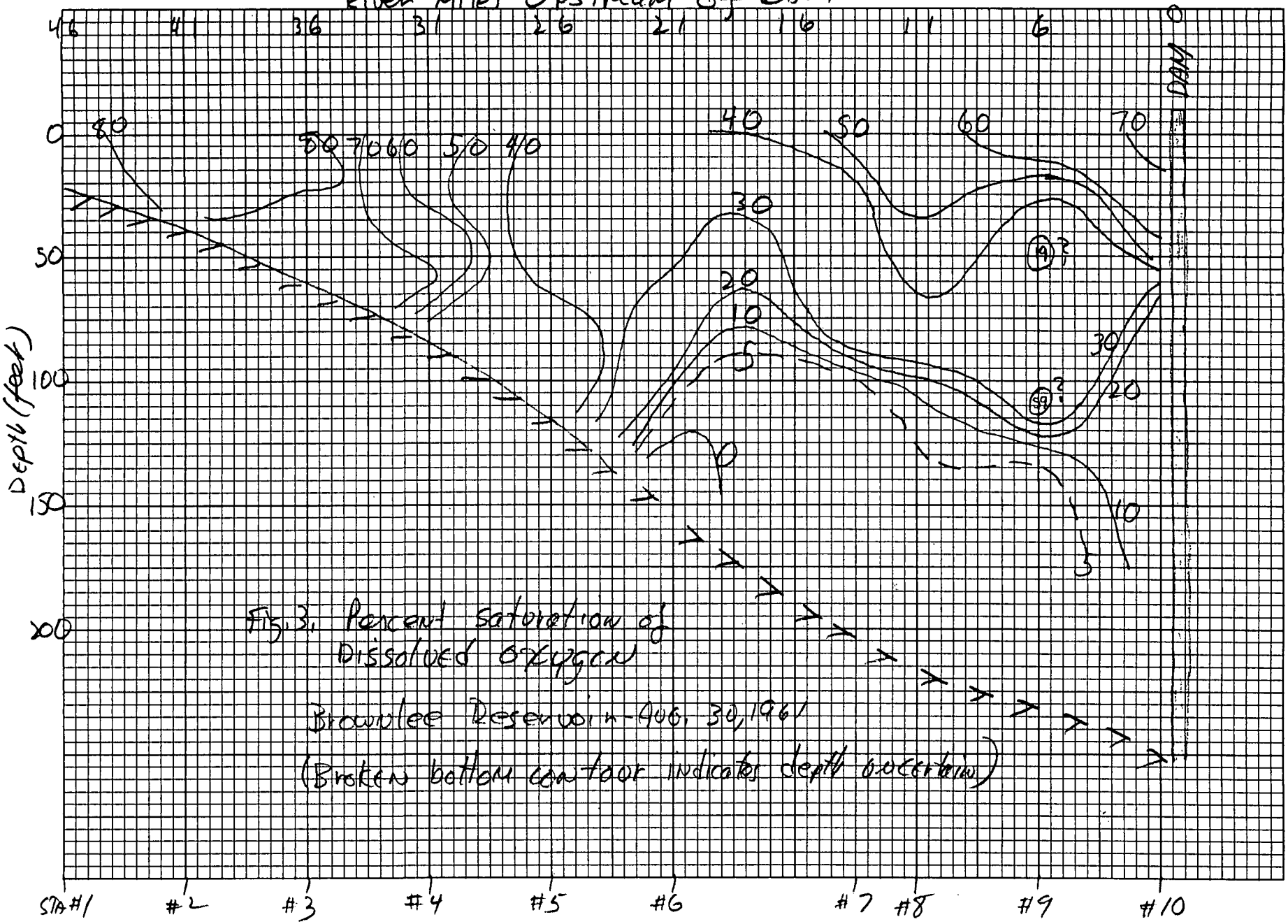


Fig. 3. Percent saturation of dissolved oxygen

Brownlee Reservoir - Aug. 30, 1961

(Broken bottom contour indicates depth of certainty)

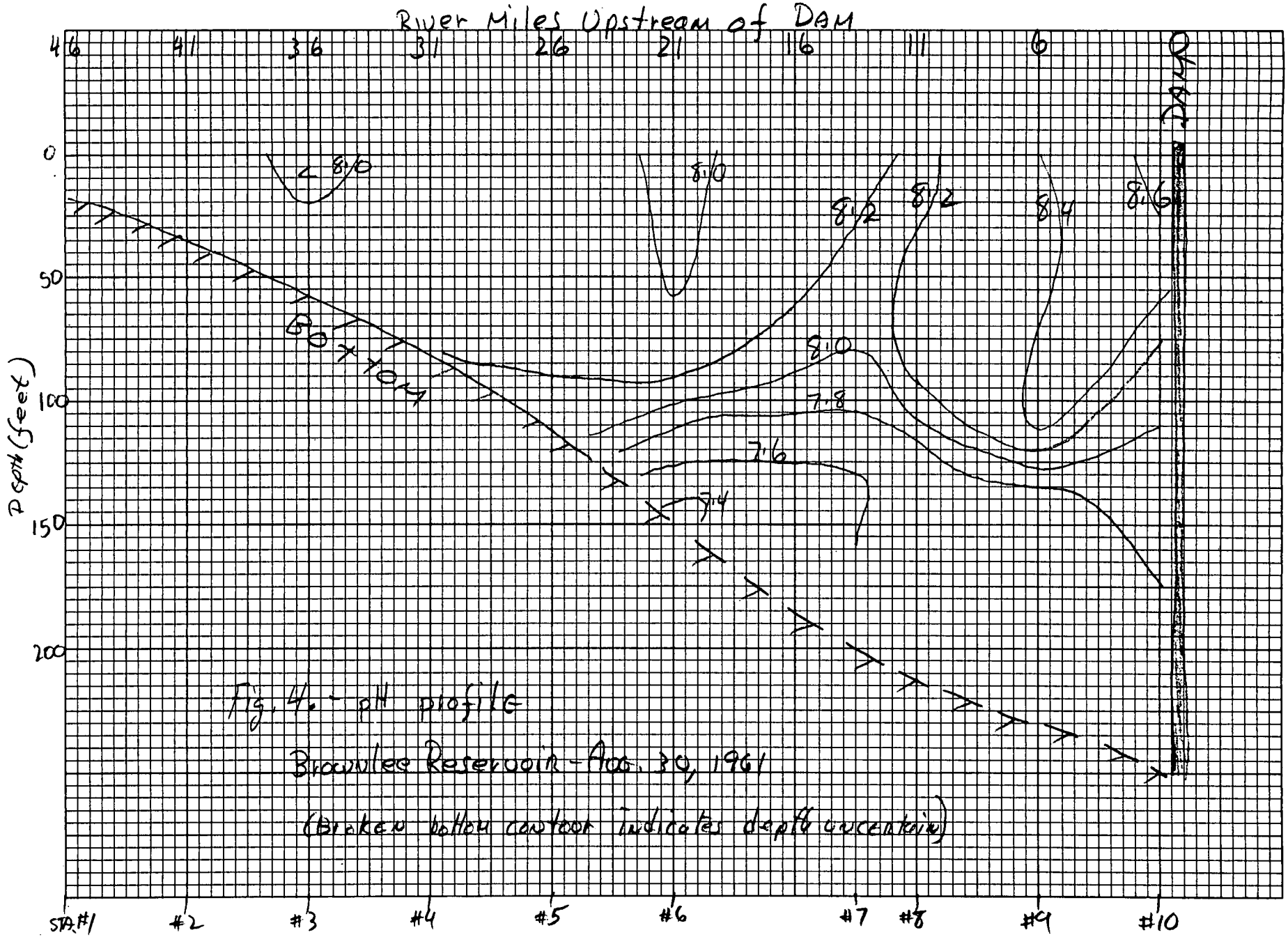


Fig. 4. - pH profile

Browns Reservoir - Aug. 30, 1961

(Broken bottom contour indicates depth uncertain)

BROWNLEE RESERVOIR

Station #1
River Mile Above Dam: 46

Time: 0747 PMT Date: August 30, 1961

Depth (Feet)	pH	Bucket Temp. °C	D.O. ppm	Oxy.Saturation (%)
0	8.2	21.7	6.7	78
16	8.2	21.5	6.5	76

Bottom sample taken.

Station #2
River Mile Above Dam: 41

Time: 0828 PMT Date: August 30, 1961

Depth (Feet)	pH	Bucket Temp. °C	D.O. ppm	Oxy.Saturation (%)
0	8.2	21.8	7.2	83
15	8.2	21.6	7.1	82
29	8.2	21.6	7.0	81

Bottom sample taken.

Station #3
River Mile Above Dam: 36

Time: 0910 PMT Date: August 30, 1961

Depth (Feet)	pH	Bucket Temp. °C	D. O. ppm	Oxy.Saturation (%)
0	7.9	21.6	6.9	80
15	7.9	21.6	7.3	85
30	8.2	21.5	6.8	79
45	8.3	21.5	6.6	77
55	8.3	21.5	6.8	79

Plankton haul 0-50 feet. Mesh size No. 25. Bottom sample taken with Petersen dredge.

Station #4
River Mile Above Dam: 31

Time:0950 PMT — Date: August 30, 1961

Depth (feet)	pH	Bucket Temp. °C	D.O. ppm	Oxy.Saturation (%)
0	8.3	23.0	4.9	58
20	8.2	23.2	4.3	51
40	8.2	22.3	5.6	66
60	8.2	22.2	6.2	73
80	8.2	22.1	2.9	34

Plankton haul 0-50 feet. Bottom sample taken.

Station #5
River Mile Above Dam: 26

Time: 1100 PMT — Date: August 30, 1961

Depth (feet)	pH	BT(No.1)Temp. °C	D.O. ppm	Oxy.Saturation (%)
0	8.2	24.3	3.2	39
30	8.2	24.2	2.8	34
60	8.2	23.9	3.2	39
90	8.2	23.1	4.0	49
110	8.1	22.8	3.9	48

Station #6
River Mile Above Dam: 21

Time: 1150 PMT — Date: August 30, 1961

Depth (feet)	pH	BT(No.2)Temp. °C	D.O. ppm	Oxy.Saturation (%)
0	8.0	24.8	3.0	37
30	8.0	24.1	2.6	32
60	8.0	24.1	2.5	30
90	8.2	23.5	1.8	22
110	7.8	21.2	0.2	2
130	-	15.7	0.0	0
145	7.4	12.9	0.0	0

Station #7
River Mile Above Dam: 18.5

Time: 1315 PMT Date: August 30, 1961

Depth (feet)	pH	BT(No.4)Temp. °C	D.O. ppm	Oxy.Saturation (%)
0	8.4	24.8	4.2	52
40	8.1	24.0	2.8	34
80	8.0	23.9	2.9	35
100	7.9	22.3	0.3	4
120	7.7	18.5	0.4	4
140	7.5	13.0	0.2	2
160	7.6	10.8	0.2	2
180	-	10.0	-	-

Plankton haul 0-50 feet. Samples at 140, 160 feet strained through net.

Station #8
River Mile Above Dam: 11

Time: 1440 PMT Date: August 30, 1961

Depth (feet)	pH	BT(No.4)Temp. °C	D.O. ppm	Oxy.Saturation (%)
0	8.1	25.1	4.6	57
45	8.4	24.1	3.9	48
90	8.3	23.6	2.8	34
120	7.8	18.7	0.6	7
150	7.7	11.7	0.3	3
175	-	9.9	-	-

Surface plankton haul between stations 8,9.

Station #9*
River Mile Above Dam: 6

Time: 1642 PMT Date: August 30, 1961

Depth (feet)	pH	BT(No.7)Temp. °C	D.O. ppm	Oxy.Saturation (%)
0	8.4	24.8	5.4	67
50	8.3_5	24.1	1.6**	19
111	8.4_5	20.4	5.1**	59
135	7.8	14.4	0.4	4
175	7.7	9.9	0.3	3

*Taken after station #10.

**Values questionable but retained because of pH value.

Station #10
River Mile Above Dam: 0.5

Time: 1545 PMT Date: August 30, 1961

Depth (feet)	pH	BT(No.6)Temp. °C	D.O. ppm	Oxy.Saturation (%)
0	8.6	25.5	6.1	77
25	8.6	24.5	5.0	62
50	8.5	24.4	4.7	58
75	8.2	23.5	1.1	13
100	8.1	21.8	1.2	14
125	7.9	18.0	1.2	13
175	7.8	9.6	1.7	15

LIMNOLOGICAL RECONNAISSANCE SURVEY OF BROWNLEE RESERVOIR

October 16-20, 1961

R. J. Callaway

During October 16-20, 1961, Messrs. Callaway, Hoffman, Kari, and Moore participated in the second of a proposed series of surveys on and below the Brownlee Reservoir. The first survey was made during August 28-September 1, 1961.

The surface and subsurface distribution of temperature and dissolved oxygen was observed at stations spaced about five miles apart. In addition, three cross-sectional stations were occupied, consisting of three stations in each section. The position of the cross-section stations was determined from a plot of the horizontal distribution of dissolved oxygen resulting from the first eleven stations. These cross section stations are numbered as: 9.5A, B, C; 10.5A, B, C; and are shown in Figure 1.

Bottom samples were obtained, using a modified Ekman dredge. The location of the samples is given in the data sheets.

Horizontal plankton tows of one-minute duration were made at various stations and depths using a Clarke-Bumpus sampler. Nannoplankton collections at various stations and depths were made using either a Kemmerer or Frautschy water sampler. The location of the samples is noted in the data sheets.

Temperature

Figure 2 shows the temperature profile along the reservoir. The bottom topography is taken as the maximum depth reached on each station, and differs from the topography shown in the figures of the August 30 survey.

Figure 3 shows the change of temperature that has occurred since the first survey. As can be seen, the water below 150 feet in about the first 15 miles above the dam has not changed in temperature. (Note that the contours of -1, -2, -3, -4° C. are not drawn.)

Oxygen

The vertical distribution of dissolved oxygen is shown in figure 4. The spacing of stations and the fact that full depth was reached on this survey, allowed better representation of the data. Above river mile 12, there is very little vertical gradient of dissolved oxygen, while near the dam a marked gradient exists, both vertically and horizontally. Whereas, the August survey showed low dissolved oxygen extending quite far upstream, the October survey shows only a portion of the reservoir deficient.

The change in oxygen content between August and October is shown in figure 5. The greatest change is at about 125 feet from miles 10-20. It would appear from this data that a tongue of relatively high oxygen water has penetrated along the bottom and either mixed with or replaced low dissolved oxygen. To substantiate this idea, however, more closely spaced surveys would be needed.

Although the depth attained on the first cruise did not reach the bottom, it is apparent that little or no change in oxygen content is evident below 150 feet, where, as seen in figure 3, there was also little change in temperature.

Figures 6-9 are plots of temperature and dissolved oxygen versus depth for all stations occupied during October 18-20, 1961.

Recommendations

In order for complete reoxygenation of waters to occur near the dam, temperatures of the upper river water will have to be cooled to less than 8° C. It is felt that the deep water will be replaced by water moving in along the bottom, rather than by overturn.

Arrangements should be made with the U. S. Fish and Wildlife Service to provide us with their surface water temperature data near Weiser. This data should include minimum, maximum, and mean air and water temperatures, and should be forwarded to us daily, if possible, over the next few weeks. When temperatures at Weiser approach 10° C., a survey should be made. If temperatures fall below about 7° C., another survey should be made; perhaps it will be possible to remain on the reservoir for a period of about two weeks when and if the water temperature of the upper river comes into the 10° C. to 1° C. range.

Since the volume of water below 150 feet is small, only a few days runoff of cold upper river water will be necessary to completely replace that now present.

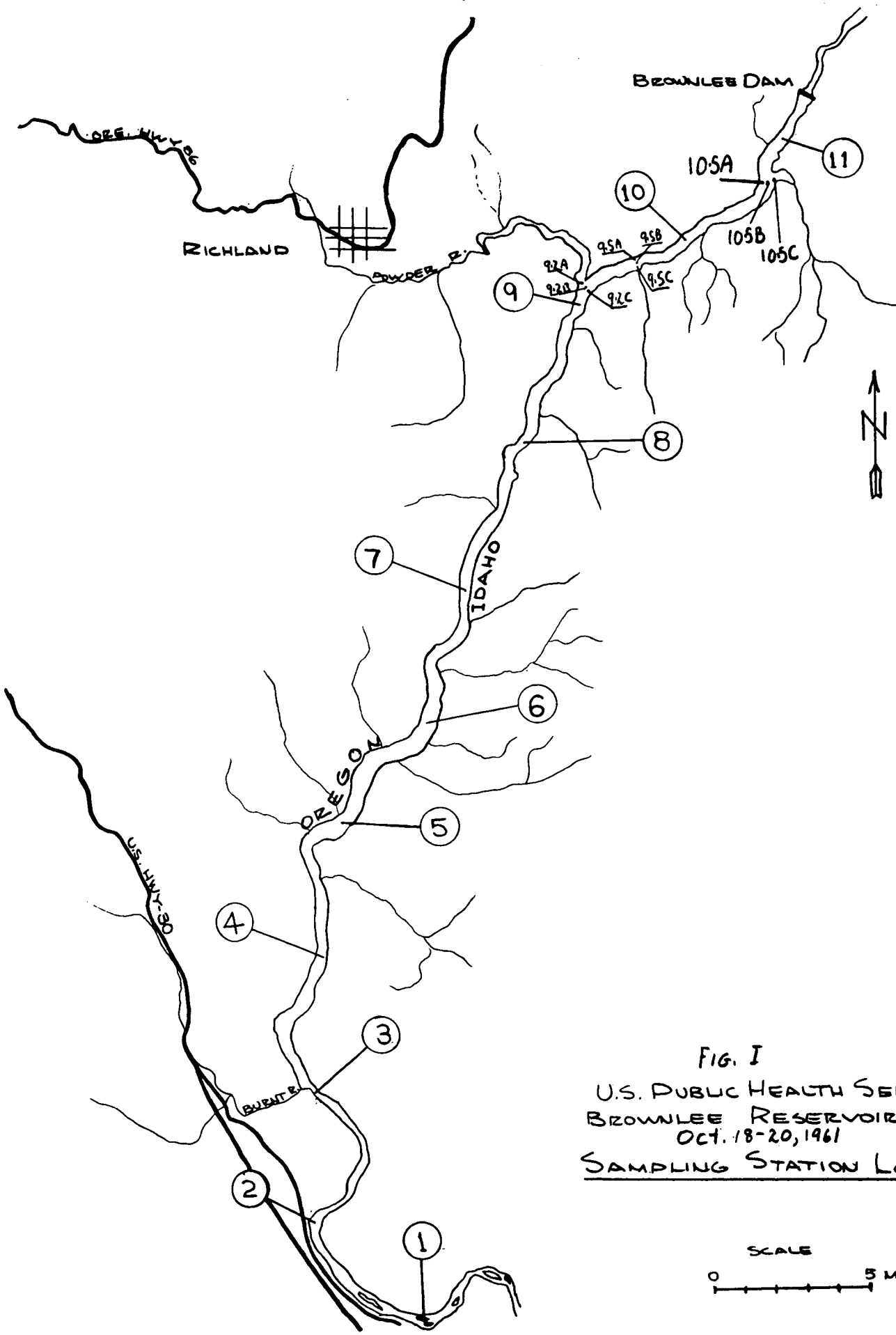


FIG. I

U.S. PUBLIC HEALTH SERVICE
BROWNLEE RESERVOIR SURVEY
OCT. 18-20, 1961

SAMPLING STATION LOCATIONS

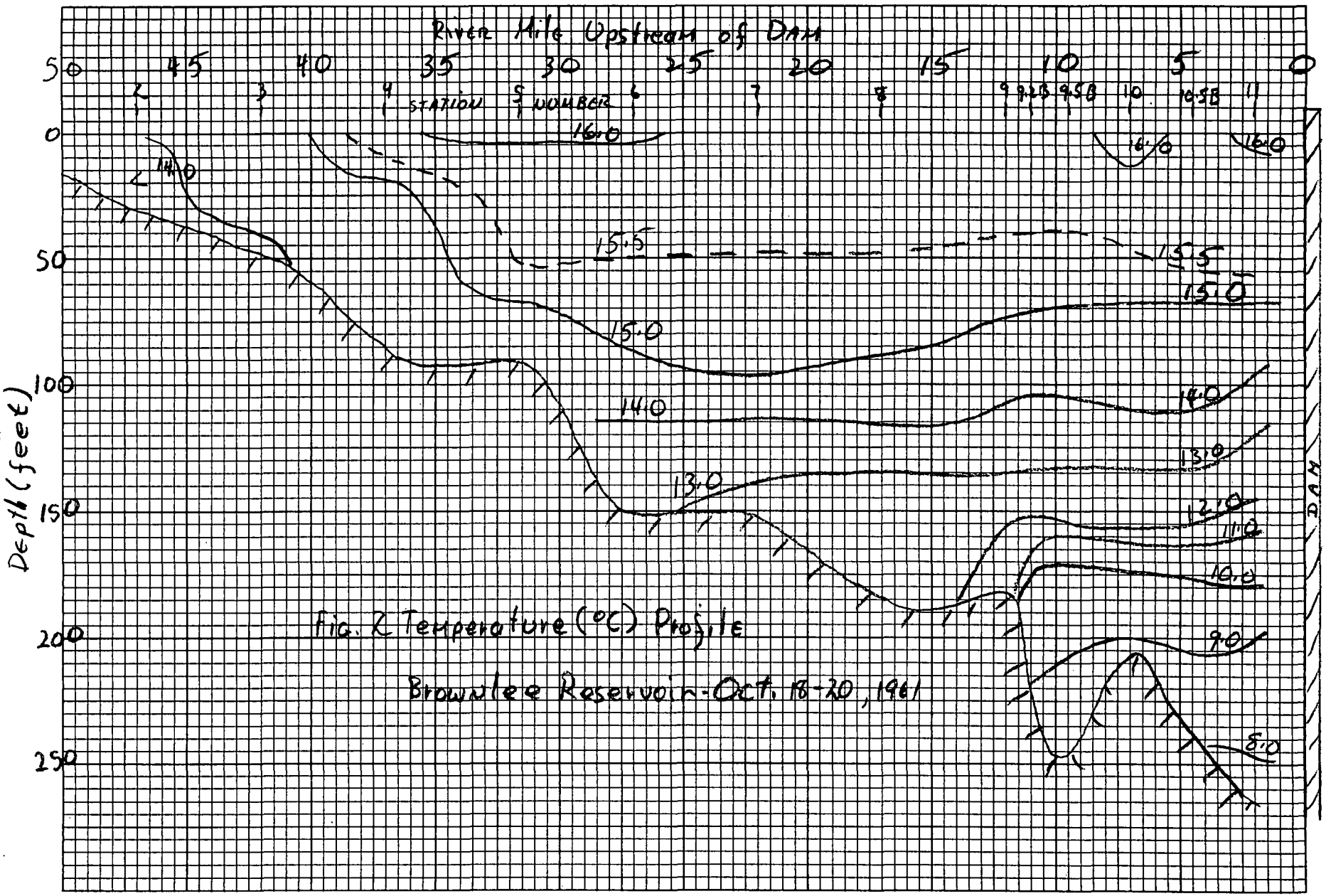


Fig. 2 Temperature (°C) Profile

Brownlee Reservoir - Oct. 18-20, 1961

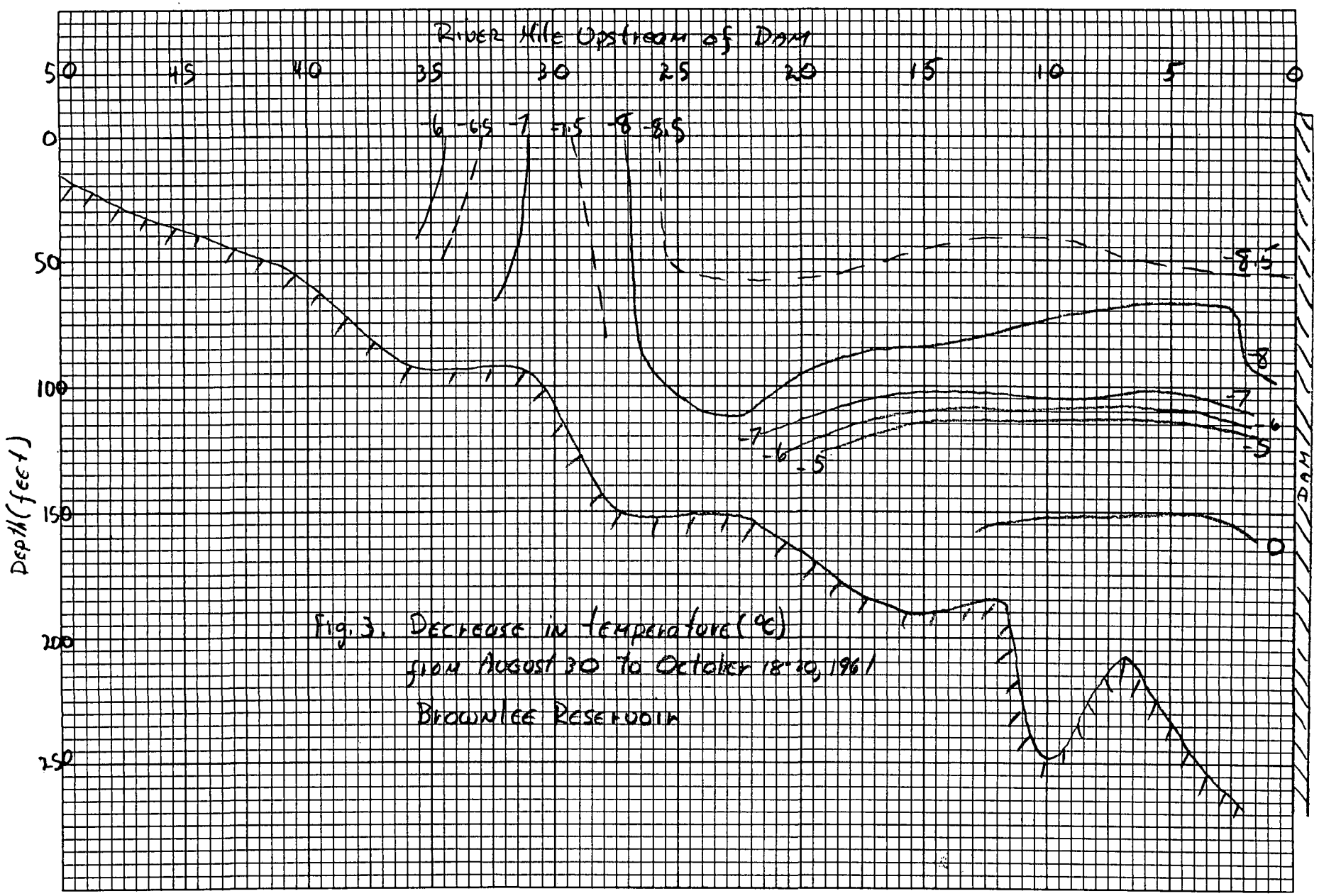


Fig. 3. Decrease in temperature (°C) from August 30 to October 18-19, 1961 Brownlee Reservoir

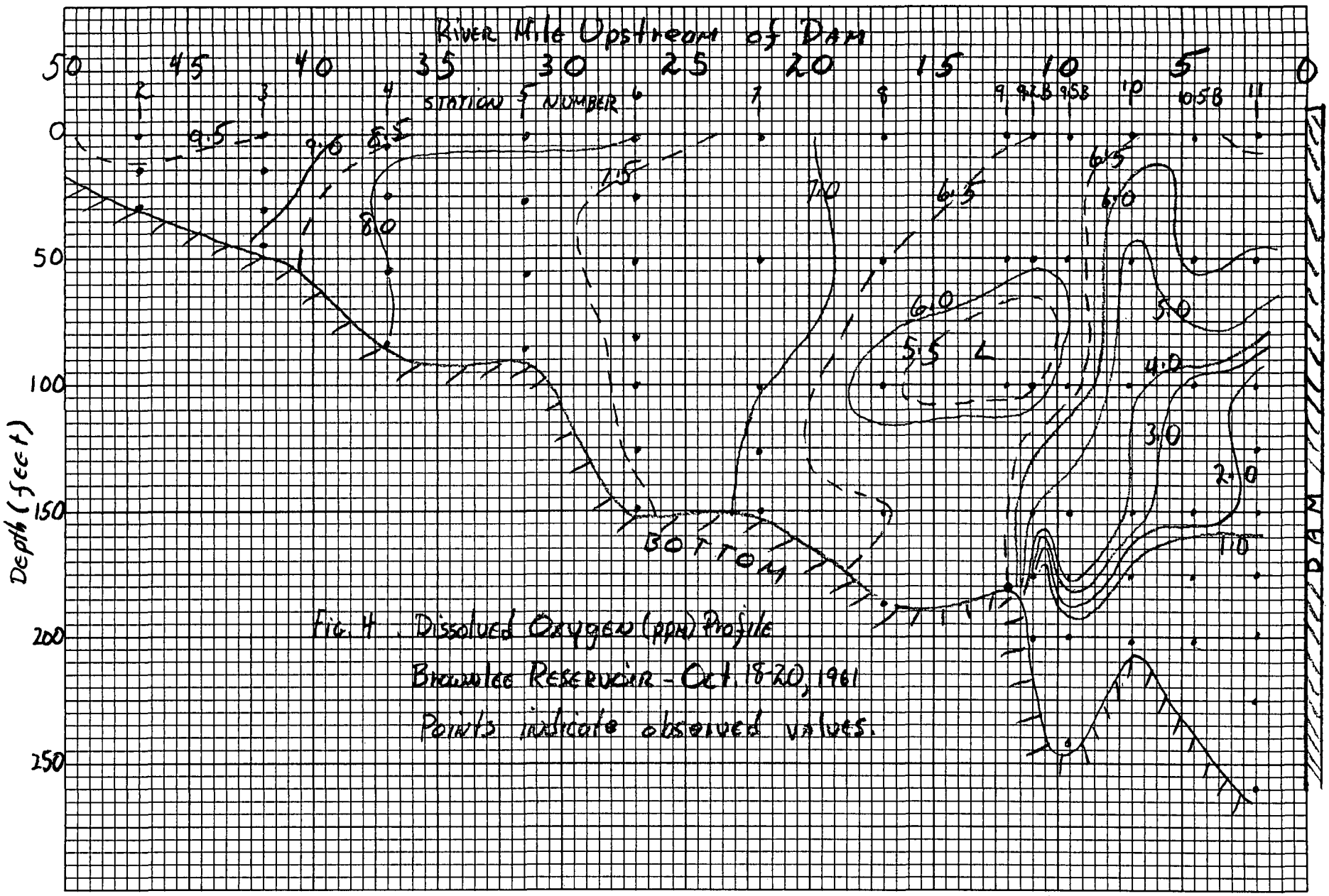


Fig. 4. Dissolved Oxygen (ppm) Profile

Brownlee Reservoir - Oct. 18-20, 1961

Points indicate observed values.

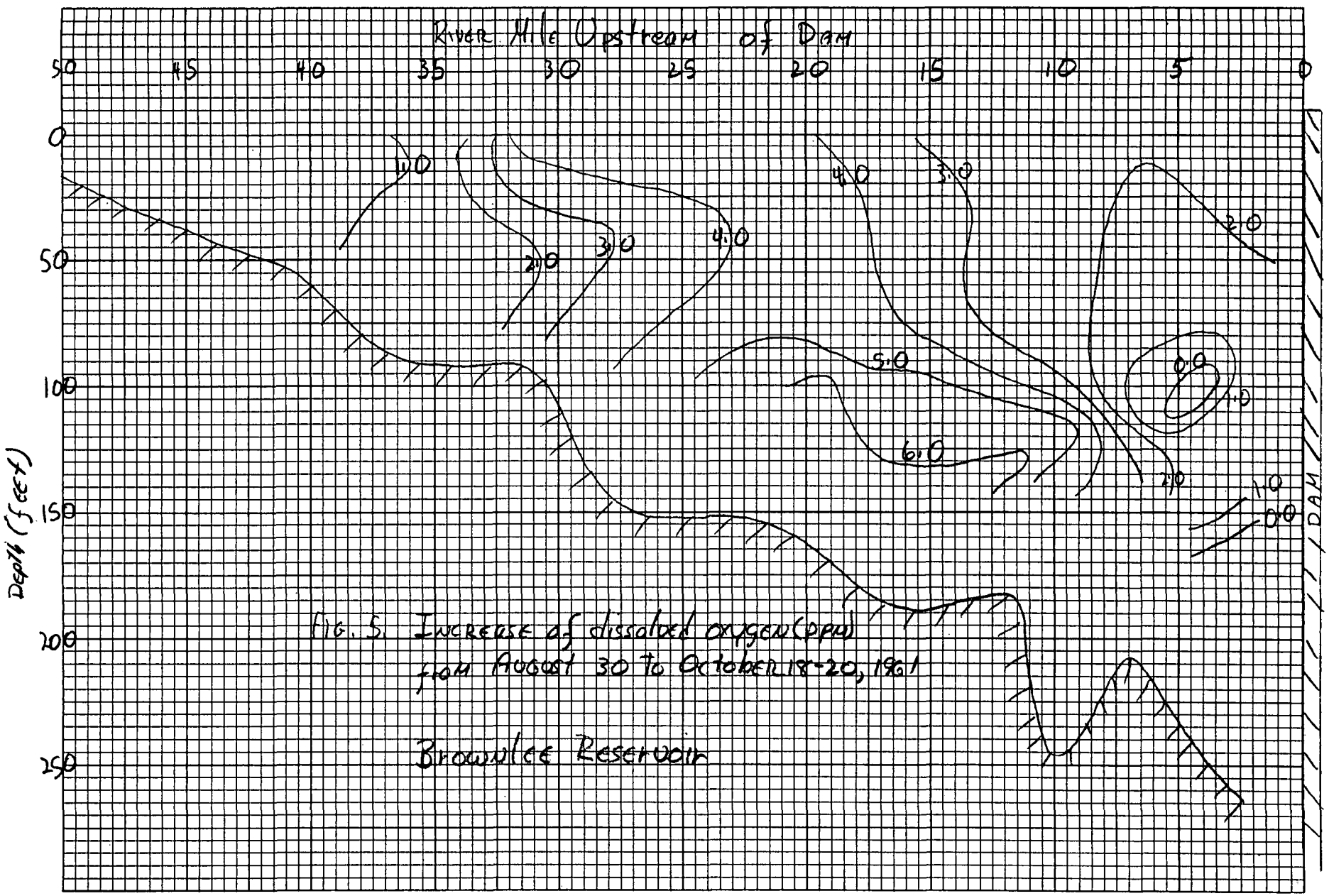


FIG. 5. Increase of dissolved oxygen (ppm) from August 30 to October 18-20, 1961

Brownlee Reservoir

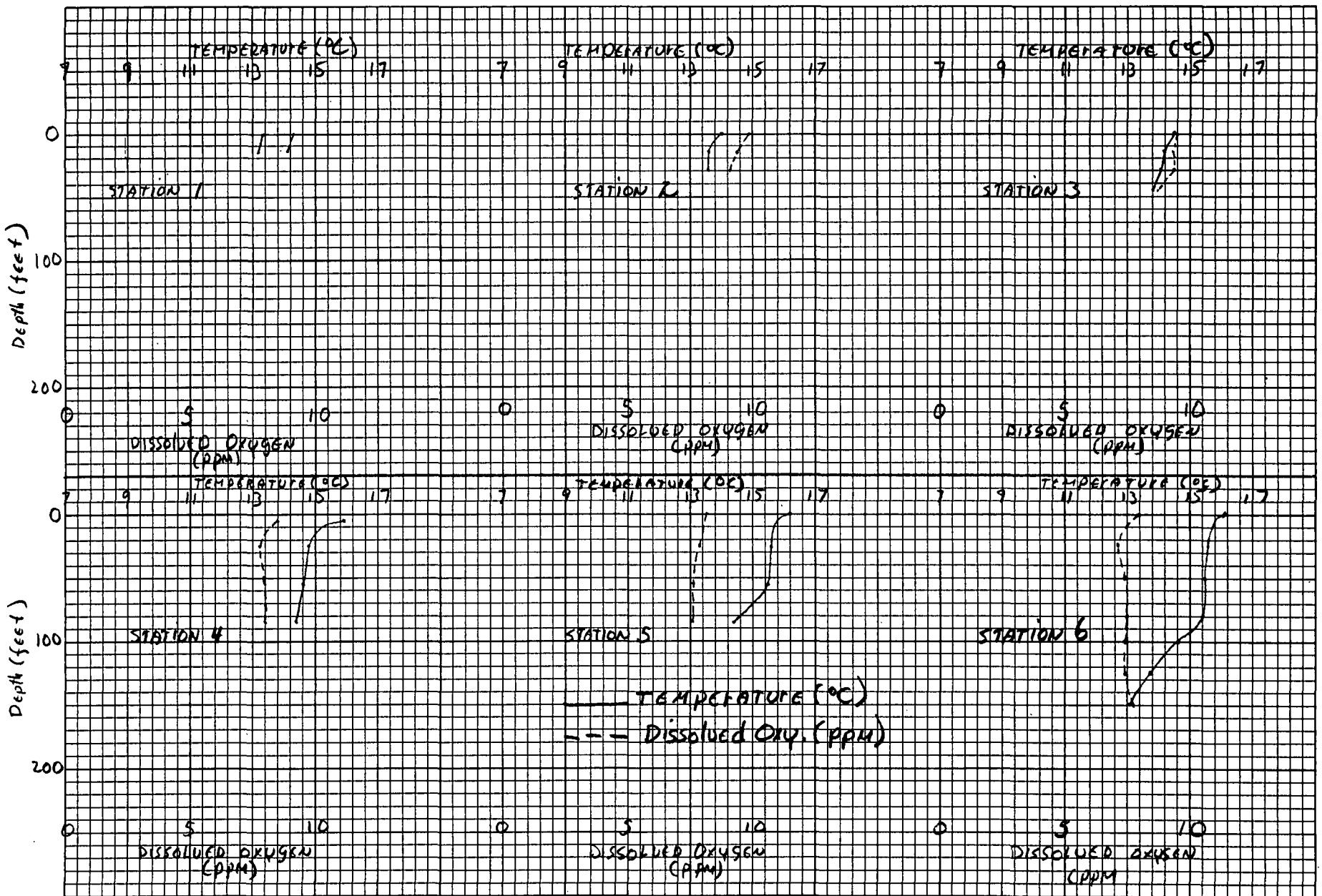


FIG. 6. Temperature and dissolved oxygen curves STATIONS 1-6. October 18, 1961 Brownlee Reservoir

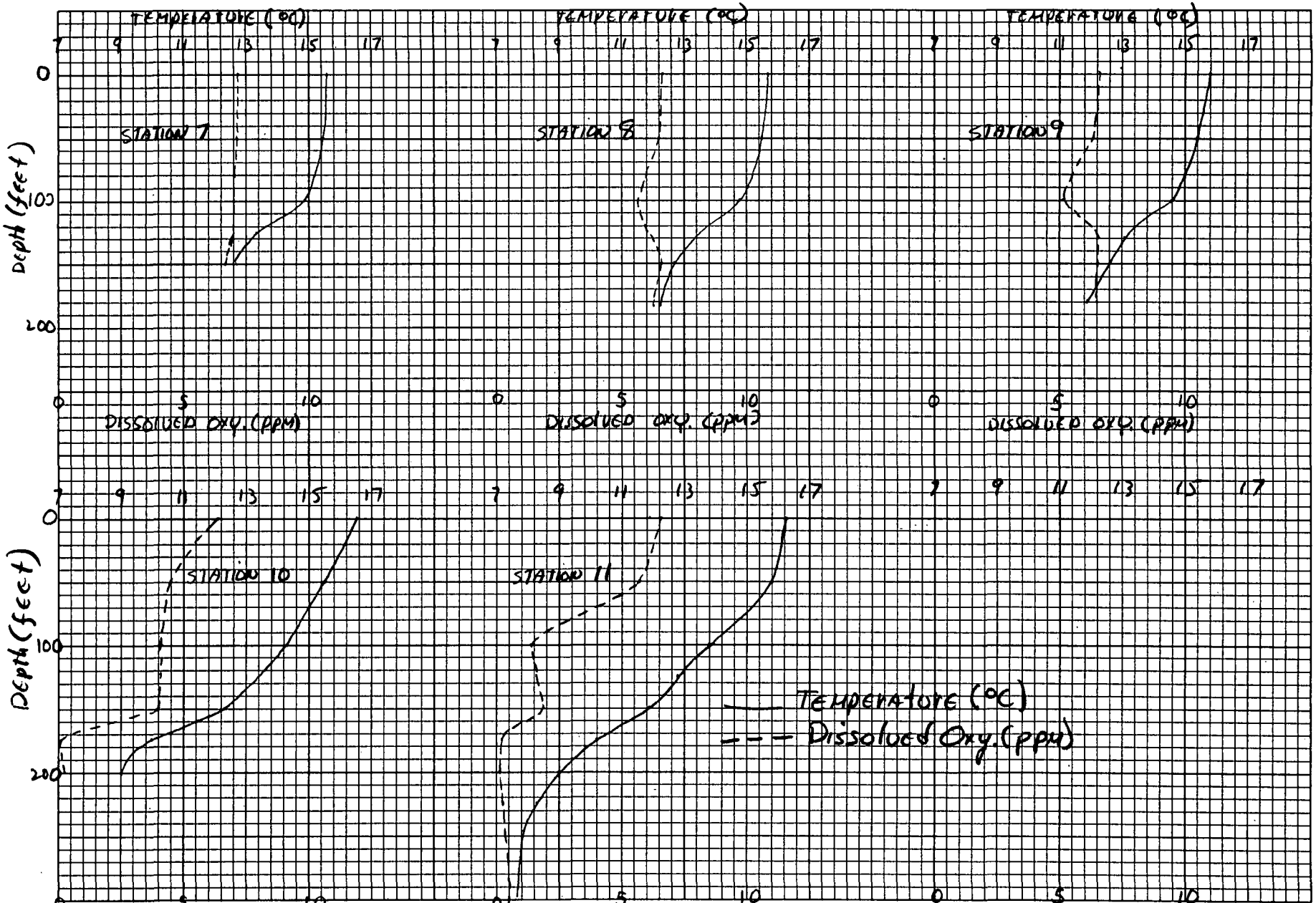


FIG. 7 TEMPERATURE AND DISSOLVED OXYGEN CURVES. BROWNLEE RESERVOIR. STATIONS 7-11 October 19, 1961

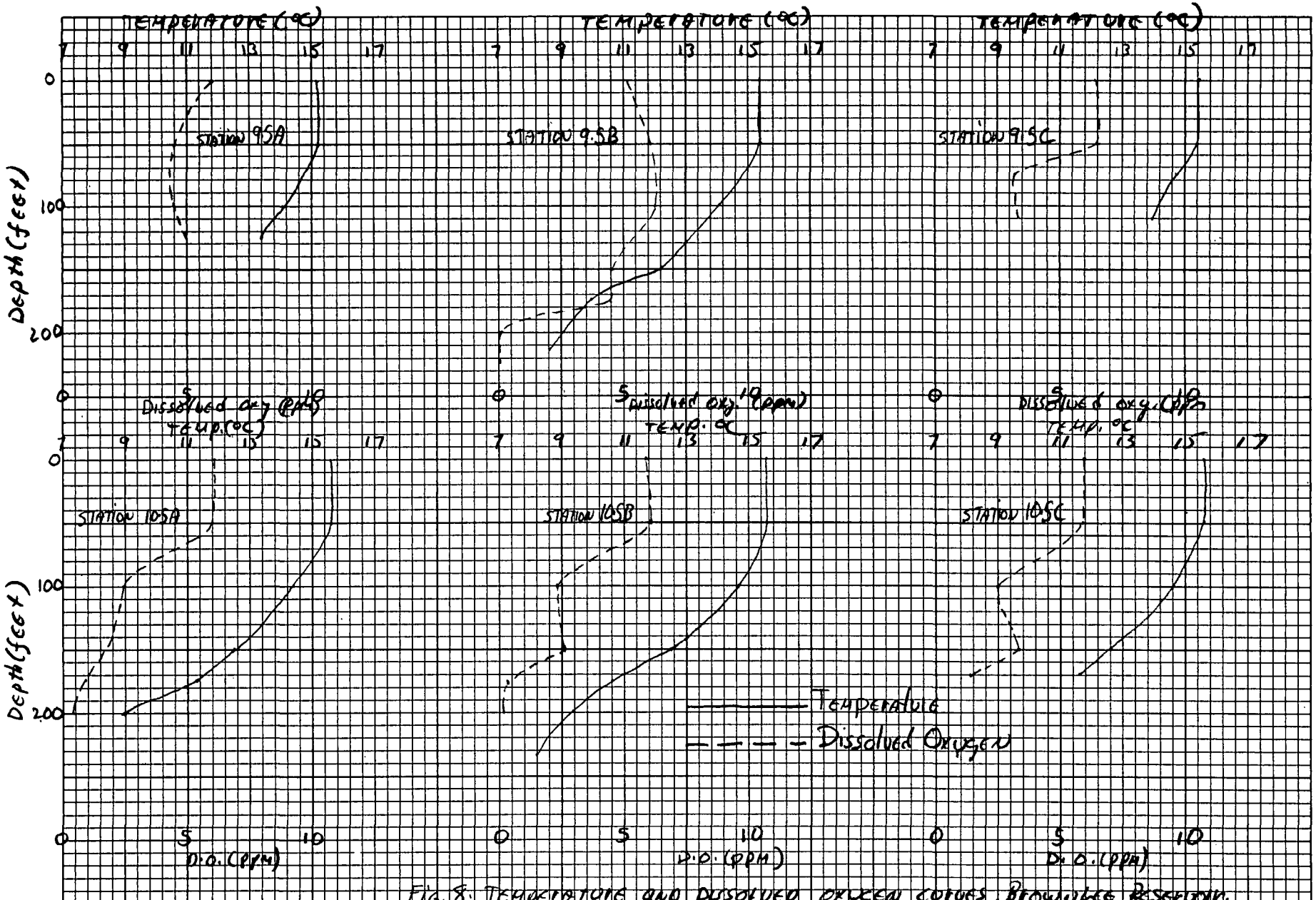


Fig. 8. Temperature and dissolved oxygen curves, Brownlee Reservoir, cross-section stations, October 20, 1961

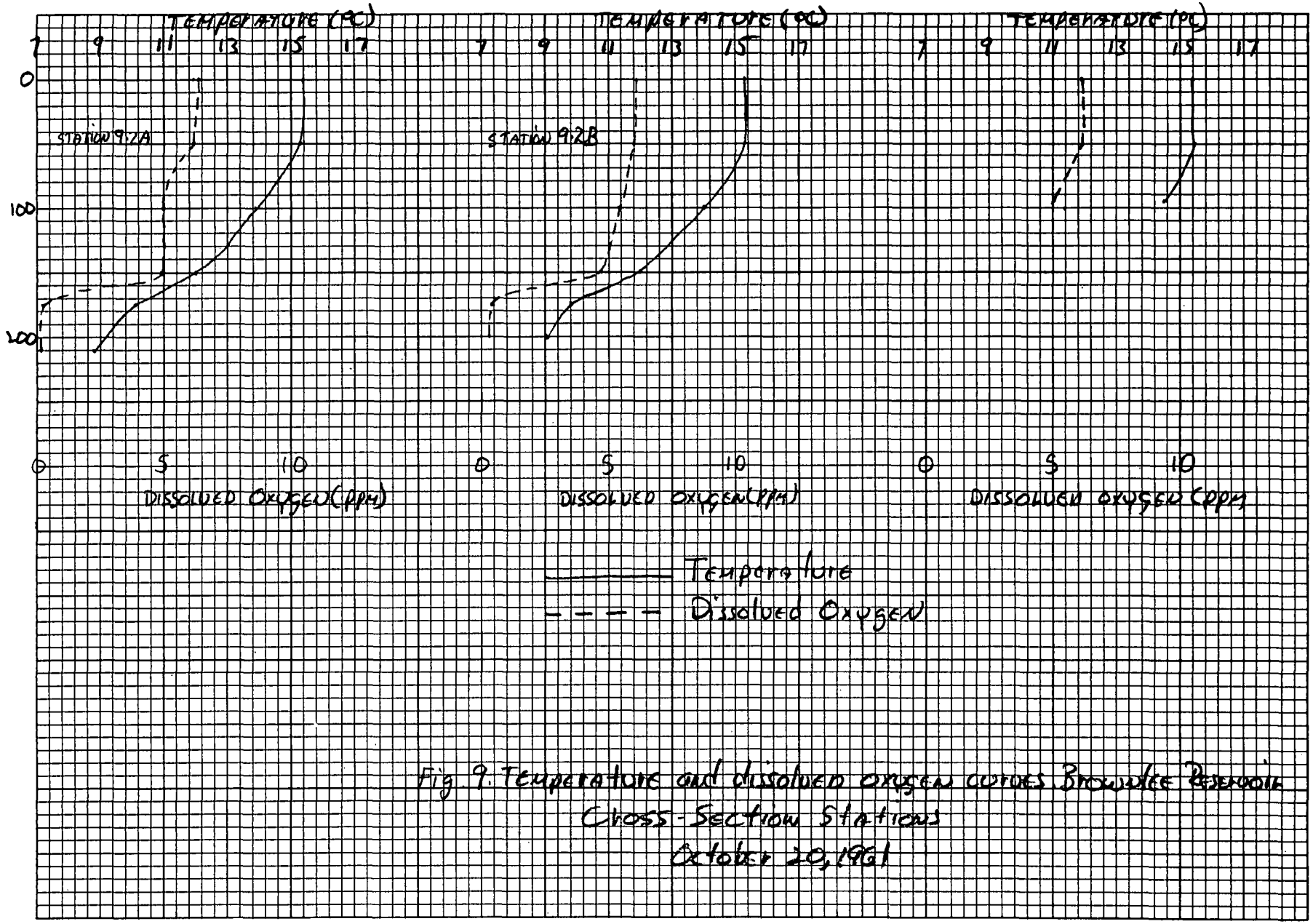


Fig. 9. Temperature and dissolved oxygen curves Brownlee Reservoir
Cross-Section Stations
October 20, 1961

BROWNLEE RESERVOIR

Station #1
River Mile Above Dam: 52

Time: 1050 PST Date: October 18, 1961

Depth (feet)	Bucket Temp. (° C.)	D.O. (ppm)
0	13.3	9.1
13	13.2	8.9

Bottom sample taken.
Horizontal plankton tow at 7 and 10 feet.

Station #2
River Mile Above Dam: 47

Time: 1130 PST Date: October 18, 1961

Depth (feet)	Bucket Temp. (° C.)	D.O. (ppm)
0	14.0	9.8
15	13.6	9.4
30	13.6	9.1

Station #3
River Mile Above Dam: 42

Time: 1215 PST Date: October 18, 1961

Depth (feet)	Bucket Temp. (° C.)	D. O. (ppm)
5	14.5	9.5
15	14.2	9.3
30	14.1	9.3
45	13.8	8.7

Horizontal plankton tows at 5, 15 and 30 feet.
Nannoplankton collection at 5, 15, and 30 feet.

Station #4
River Mile Above Dam: 37

Time: 1310 PST Date: October 18,1961

Depth (feet)	BT (#1) Temp. (° C.)	D. O. (ppm)
5	15.9	8.5
25	14.8	7.8
55	14.6	8.0
85	14.4	8.0

Bottom sample taken.

Station #5
River Mile Above Dam: 31.5

Time: 1345 PST Date: October 18, 1961

Depth (feet)	BT (#2) Temp. (° C.)	D. O. (ppm)
0	16.2	8.2
26	15.6	7.9
56	15.5	7.6
86	14.4	7.6

Bottom sample taken. Horizontal plankton tow at 5, 15 and 40 feet. Nannoplankton collection at 15 and 55 feet.

Station #6
River Mile Above Dam: 27

Time: 1415 PST Date: October 18, 1961

Depth (feet)	BT (#3) Temp. (° C.)	D. O. (ppm)
0	16.1	8.0
25	15.6	7.1
50	15.5	7.4
80	15.4	7.5
100	14.5	7.4
125	13.7	7.4
150	13.1	7.7

Bottom sample taken. Horizontal plankton tow at 5, 15, 30, 50, 75 and 100 feet. Nannoplankton collection at 15, 50, 100 and 125 feet.

Station #7
River Mile Above Dam: 22

Time: 0945 PST Date: October 19, 1961

Depth (feet)	BT (#4) Temp. (° C.)	D. O. (ppm)
0	15.6	7.2
50	15.5	7.2
100	14.9	7.0
125	13.3	7.0
150	12.6	6.7

Bottom sample taken. Horizontal Plankton tow at 50, 100, and 150 feet. Nannoplankton collection at 25, 100 and 150 feet.

Station #8
River Mile Above Dam: 17

Time: 1100 PST Date: October 19, 1961

Depth (feet)	BT (#5) Temp. (° C.)	D. O. (ppm)
0	15.7	6.7
50	15.5	6.5
100	14.8	5.7
150	12.7	6.6
187	12.2	6.3

Station # 9
River Mile Above Dam: 12

Time: 1130 PST Date: October 19, 1961

Depth (feet)	BT (#6) Temp. (° C.)	D. O. (ppm)
0	15.8	6.6
50	15.4	6.3
100	14.6	5.1
130	13.1	6.6
180	11.9	6.5

Bottom sample taken.

Station #10
River Mile Above Dam: 7

Time: 1418 PST Date: October 19, 1961

Depth (feet)	BT (#7) Temp. (° C.)	D. O. (ppm)
0	16.5	6.3
50	15.5	4.5
100	14.3	4.1
150	12.3	4.0
175	10.0	0.1
200	9.0	0.2

Bottom sample taken. Horizontal plankton tow at 25, 50, 100, 150 and 200 feet. Nannoplankton collection at 25, 50, 100, 150 and 200 feet.

Station #11
River Mile Above Dam: 2

Time: 1535 PST Date: October 19, 1961

Depth (feet)	BT (#8) Temp. (° C.)	D. O. (ppm)
0	16.3	6.6
50	15.8	5.7
100	13.8	1.3
125	12.8	1.6
150	11.9	1.8
175	10.2	0.2
200	9.0	0.2
225	(8.3)	0.2
260	(7.6)	0.5
264	7.6	-

Horizontal plankton tow at 50, 130, and 200 feet.
Temperatures at 225, 260 feet interpolated.
Temperature at 264 feet is average of two reversing thermometer readings.

Station #9.5A
River Mile Above Dam: 9.5

Time: 0915 PST Date: October 20, 1961

Depth (feet)	BT (#9) Temp. (° C.)	D. O. (ppm)
0	15.2	6.0
50	15.2	4.5
100	14.1	4.5
124	13.4	5.0

Station #9.5B
River Mile Above Dam: 9.5

Time: 0930 PST Date: October 20, 1961

Depth (feet)	BT(#10) Temp. (° C.)	D. O. (ppm)
0	15.4	5.1
50	15.4	6.1
100	14.1	6.3
150	12.2	4.6
175	10.0	4.5
200	9.1	0.1
213	8.5	-
242	-	0.1

Station #10.5A
River Mile Above Dam: 4.5

Time: 1100 PST Date: October 20, 1961

Depth (feet)	BT (#12) Temp. (° C.)	D. O. (ppm)
0	15.6	6.1
50	15.6	6.0
100	14.4	2.4
150	12.5	2.0
175	11.3	0.9
200	9.0	0.4

Station #10.5B
River Mile Above Dam: 4.5

Time: 1120 PST Date: October 20, 1961

Depth (feet)	BT (#13) Temp. (° C.)	D. O. (ppm)
0	15.6	5.9
50	15.6	6.1
100	14.6	2.3
150	12.5	2.6
175	10.6	0.3
200	9.3	0.2
232	8.2	-

Station #9.5C

River Mile Above Dam: 9.5

Time: 0945 PST Date: October 20, 1961

Depth (feet)	BT (#11) Temp. (° C.)	D. O. (ppm)
0	15.5	6.4
50	15.4	6.5
75	14.7	3.2
110	13.8	3.3

Station #10.5C
River Mile Above Dam: 4.5

Time: 1150 PST Date: October 20, 1961

Depth (feet)	BT (#14) Temp. (° C.)	D. O. (ppm)
0	15.6	6.0
50	15.6	5.9
100	14.6	2.5
150	12.6	3.3
170	11.6	1.4

Station #9.2C
River Mile Above Dam: 11

Time: 1300 PST Date: October , 1961

Depth (feet)	BT (#15) Temp. (° C.)	D. O. (ppm)
0	15.4	6.2
50	15.4	6.2
95	14.5	5.0

Station 9.2B
River Mile Above Dam: 11

Time: 1320 PST Date: October , 1961

Depth (feet)	BT (#16) Temp. (° C.)	D. O. (ppm)
0	15.3	6.1
50	15.3	6.0
100	14.0	5.4
150	12.0	4.7
175	9.8	0.4
200	9.1	0.3

Station 9.2A
River Mile Above Dam: 11

Time: 1350 PST Date: October 20, 1961

Depth (feet)	BT (#17) Temp. (° C.)	D. O. (ppm)
0	15.4	6.4
50	15.3	6.2
100	13.9	5.0
150	12.0	4.9
175	10.1	0.2
210	8.8	0.2

Bridge Below Brownlee Dam

Time: 1130 PST Date: October 21, 1961

Depth (feet)	Bucket Temp. (° C.)	D. O. (ppm)
16		5.3

BIOLOGICAL PHASE OF BROWNLEE RESERVOIR SURVEY
October 16-20, 1961
Dr. D. A. Hoffman

The data collected on this field trip show substantially nothing more than what was present at the time of collection. In order to determine the causes of oxygen depletion in Brownlee Reservoir, a more extensive study program will be necessary.

The numbers of Bacillariese decrease from the upper to the lower end of the reservoir (figure 1). This is to be expected, as the members of this group, Diatoms, are more characteristic of lotic (flowing) waters. However, it is interesting to note that the rate of decrease is greater in the upper waters than in the lower waters. This indicates that perhaps the colder, and denser, water entering the reservoir from the Snake River is flowing along the bottom until it meets a layer of water of lower temperature and greater density. At this point the incoming water may flow out on top of the colder layer. An examination of Callaway's figure 2, and Hoffman's figure 1, indicates this may have occurred at the 50-foot level between stations 4 and 6.

An examination of figure 2 indicates that the numbers of blue-green algae, Melosira, increased in the downstream areas of the reservoir, reaching maximum counts at stations 5 and 6. Since blue-green algae are conventionally used as indicators of organic pollution, this increase is worthy of future study. That is, studies to determine a correlation between nutrient quantity and quality with algae growth.

The numbers of crustacea were similar at the stations from which they were collected. It is interesting to note that the dependence of crustacea upon algae for food is indicated by their presence in, and downstream from, areas of large algae populations (figures 2 and 3).

The overall larger numbers of organisms in the upper layers of the water may account for a part of the oxygen depletion in the deeper waters. A lake can be divided into two general zones, an upper photosynthetic or tropholytic zone and a lower tropholytic zone. The volume of the upper trophogenic zone is dependent upon the depth to which sufficient light for photosynthesis will penetrate. This is the zone in which the autochthonous organic material is produced. The tropholytic zone is the area where the organic material is oxidized. If the ratio of the volumes of the two zones is large, one can see that the amount of organic material produced in the upper zone may be greater than the quantity of oxygen in the lower zone can oxidize; hence a depletion in the oxygen at the lower level. If allochthonous organic material is added -- say some pollutant -- then more oxygen is required and a greater depletion occurs.

The problem in Brownlee Reservoir is to determine the quantity of oxygen required to oxidize the organic material produced within the lake as well as that added from outside the lake.

Recommendations

If the Brownlee Reservoir is to be studied further, another trip in the immediate future is necessary -- no later than March 20th. The data from this trip will show the condition of the reservoir after over-wintering, i. e., whether or not there is an oxygen-depleted zone, the presence or lack of inverse thermal stratification, the quantity and quality of nutrients, and the composition of the plankton population. Nutrient analysis should definitely include phosphorus and nitrogen compounds. This will give an indication of the quantities of these nutrients that are added later in the year.

An additional trip will be necessary during April or May to measure the effects of the spring overturn. At least one trip each month should be made in June, July, August, September, and October.

Data from these trips will enable the determination of the O_2, P, N, temperature, pH, and other significant elements, their sources and utilization, as well as their influence upon the organisms within the reservoir.

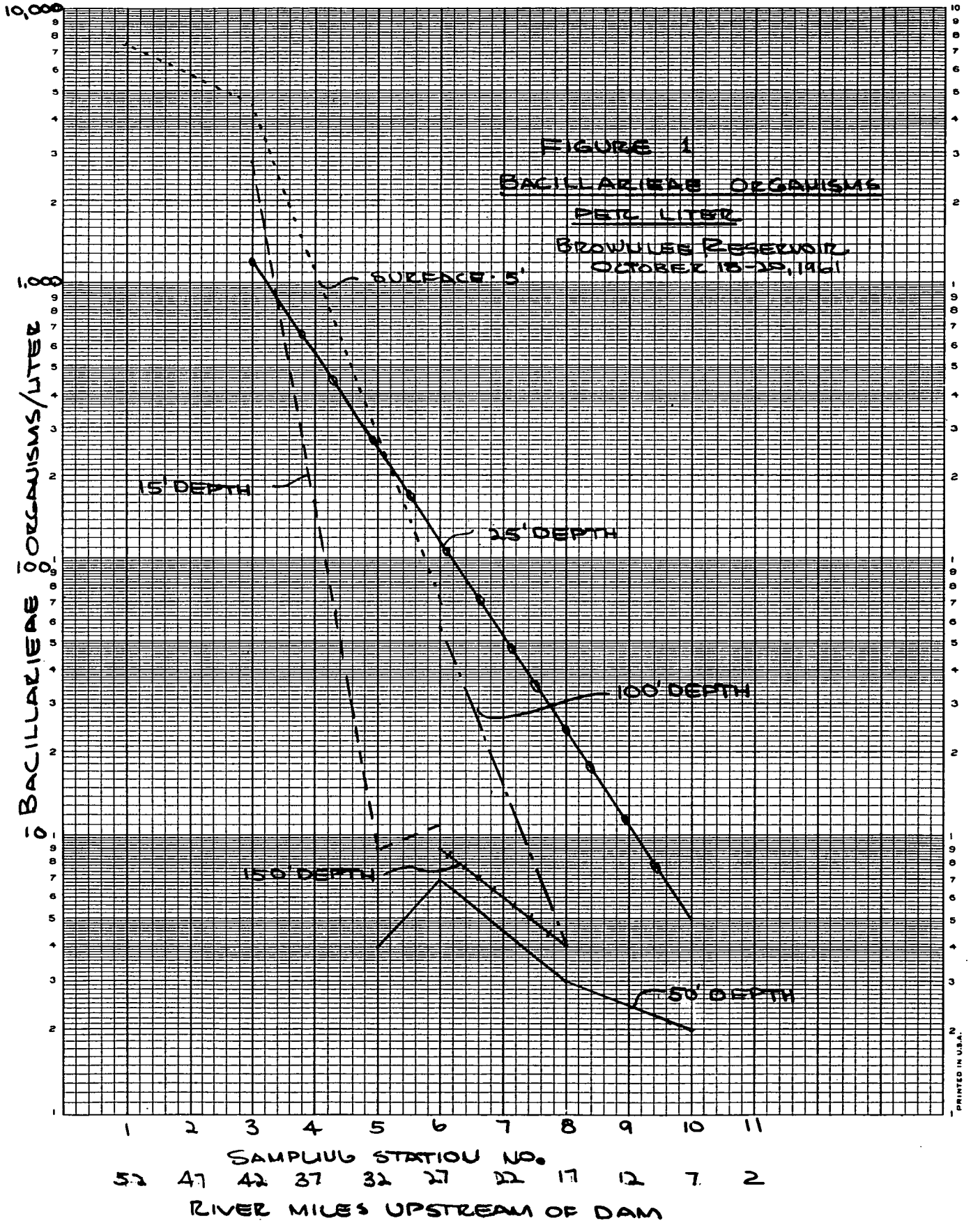


FIGURE 1
BACILLARIEAE ORGANISMS PER LITER
BROWNLEE RESERVOIR
OCTOBER 18-25, 1961
SURFACE - 5'
15' DEPTH
25' DEPTH
100' DEPTH
150' DEPTH
50' DEPTH
BACILLARIEAE ORGANISMS/LITER
10,000
1,000
100
10
1
1 2 3 4 5 6 7 8 9 10 11
SAMPLING STATION NO.
52 47 42 37 32 27 22 17 12 7 2
RIVER MILES UPSTREAM OF DAM
PRINTED IN U.S.A.

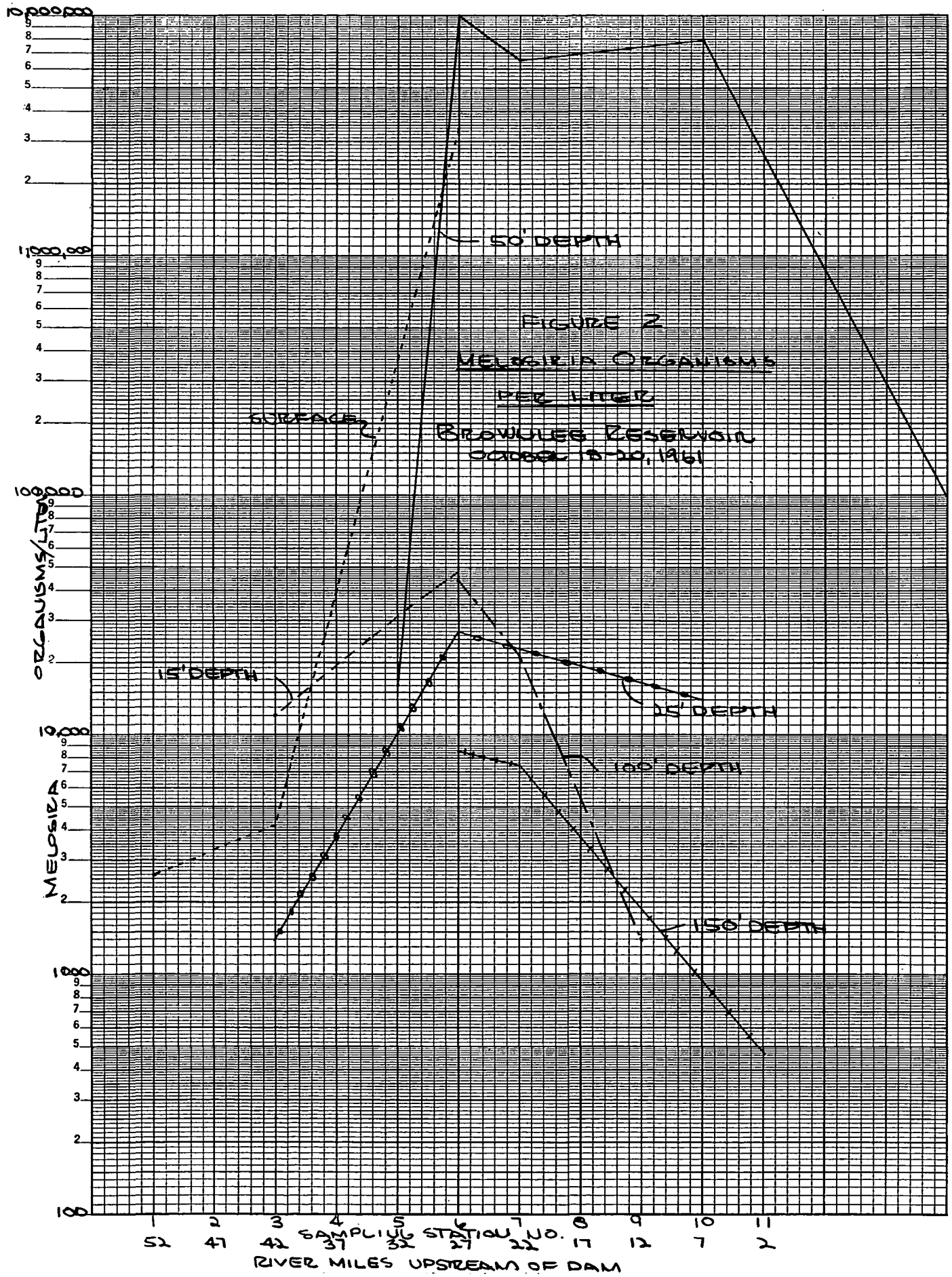


FIGURE 2

MELOSIRA ORGANISMS PER LITER

BROWNLEE RESERVOIR

OCTOBER 8-20, 1961

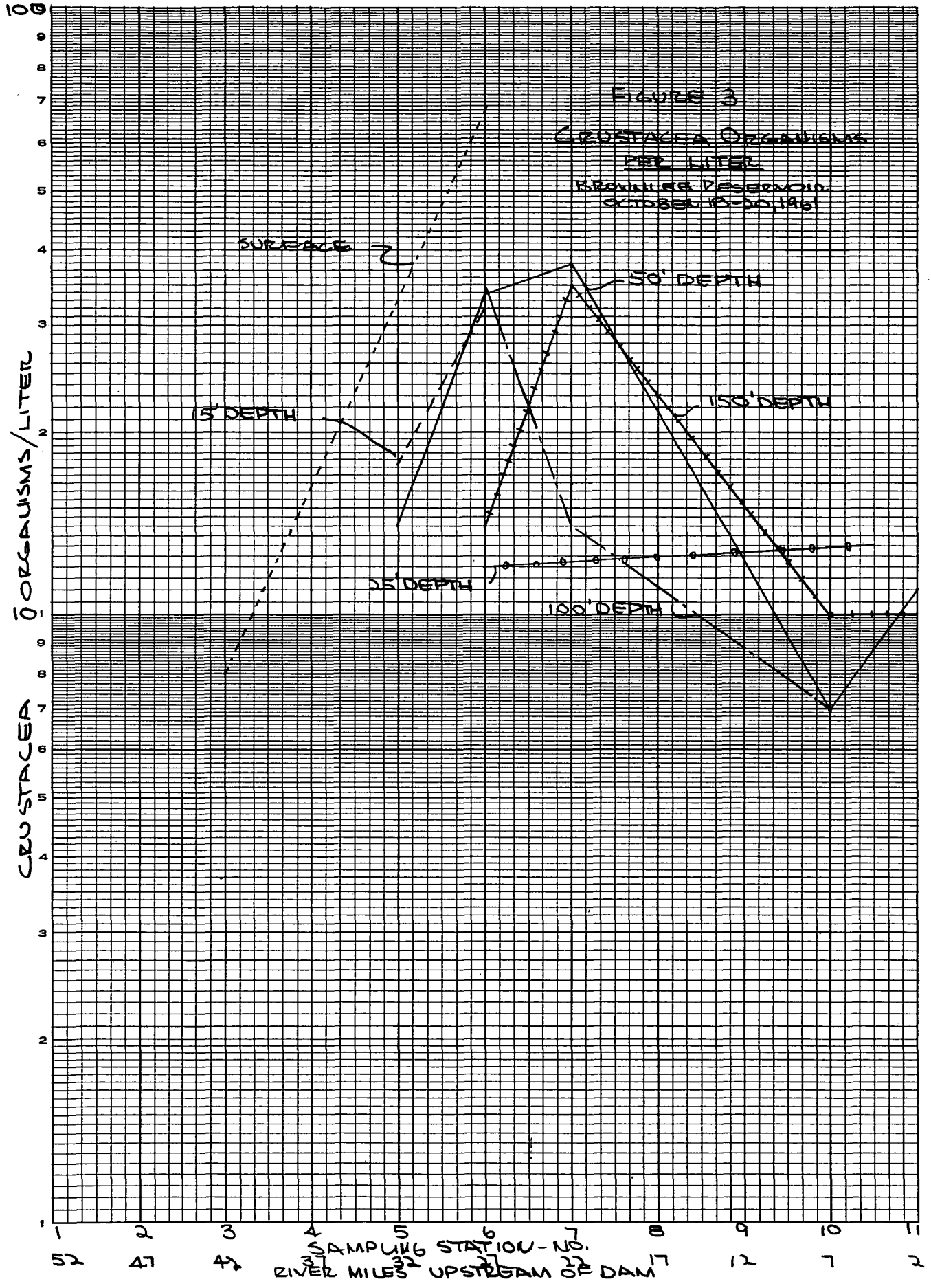


FIGURE 3
CRUSTACEA ORGANISMS PER LITER
BROWNLEE RESERVOIR
OCTOBER 18-20, 1961
SURFACE
50' DEPTH
15' DEPTH
150' DEPTH
25' DEPTH
100' DEPTH
CRUSTACEA ORGANISMS/LITER
SAMPLING STATION NO.
RIVER MILES UPSTREAM OF DAM

TABLE I

PLANKTON COLLECTED FROM STATION I, BROWNLEE RESERVOIR
OCTOBER 18, 1961
ORGANISMS PER LITER

Organism	Depth
Coelospharium	601
Staurastrum	49
Cyclotella	3,218
Dinobryon	49
Asterionella	244
Pediastrum	33
Synedra	2,909
Navicula	813
Amphora	244
Diatoma	244
Scenedesmus	125
Fragilaria	146
Tabellaria	146
Gyrosigma	33
Melosira	2,681

TABLE II

PLANKTON COLLECTED FROM STATION III, BROWNLEE RESERVOIR
OCTOBER 18, 1961
ORGANISMS PER LITER

Organism	DEPTH 5'	15'	30'
Coelospharium	1,338	235	345
Staurastrum	127	152	25
Cyclotella	98	1,171	254
Dinobryon	688	317	127
Asterionella	1,431	655	169
Pediastrum	140	90	17
Synedra	3,962	1,220	254
Navicula	64	145	59
Amphora	25	34	17
Diatoma	0	0	20
Scenedesmus	140	289	0
Fragilaria	510	172	169
Tabellaria	0	62	211
Gyrosigma	0	7	0
Melosira	4,204	11,596	1,424
Anabaena	2,051	210	1,331
Polyarthra	14	28	0
Keratella	17	28	8
Brachionus	3	14	0
Nauplius	0	0	8

TABLE III

PLANKTON COLLECTED FROM STATION V, BROWNLEE RESERVOIR
OCTOBER 18, 1961
ORGANISMS PER LITER

Organism	DEPTH 15'	DEPTH 40'
Coelospharium	350	50
Staurastrum	91	25
Asterionella	1	0
Pediastrum	43	9
Navicula	0	1
Fragilaria	9	2
Tabellaria	0	1
Melosira	31,624	16,735
Polyarthra	144	5
Keratella	28	3
Ceratium	31	6
Bosmina	4	0
Nauplius	4	1
Cyclops	8	2
Diaptomus	7	6
Daphnia	7	5

TABLE IV

PLANKTON COLLECTED FROM STATION VI, BROWNLEE RESERVOIR
OCTOBER 18, 1961
ORGANISMS PER LITER

Organism	DEPTH 5'	15'	30'	50'	75'	100'	125'
Coelospharium	55	38	211	293	164	116	138
Staurastrum	58	61	46	86	41	53	17
Asterionella	1	9	0	8	3	72	3
Pediastrum	48	59	15	32	12	15	10
Scenedesmus	0	0	0	1	0	13	0
Fragilaria	5	11	0	6	1	46	5
Tabellaria	0	0	0	1	0	13	4
Melosira	3,431,400	48,872	28,743	98,712,900	10,655	46,461	8,867
Polyarthra	148	197	45	30	17	11	3
Keratella	9	24	10	3	3	4	0
Ceratium	20	34	8	2	3	0	1
Bosmina	1	3	1	0	1	10	1
Nauplius	24	8	5	19	5	8	0
Cyclops	20	11	7	10	5	19	10
Diaptomus	25	9	3	2	3	6	2
Daphnia	0	13	0	3	2	2	2

TABLE V

PLANKTON COLLECTED FROM STATION VII, BROWNLEE RESERVOIR
OCTOBER 19, 1961
ORGANISMS PER LITER

Organism	DEPTH 50'	100'	150'
Coelospharium	3	2	37
Staurostrum	45	27	10
Pediastrum	13	7	3
Ankistrodesmus	3	0	0
Fragilaria	3	4	4
Melosira	6,698,640	21,727	7,447
Polyarthra	6	2	0
Keratella	4	2	1
Ceratium	3	0	1
Bosmina	1	0	3
Nauplius	15	3	1
Cyclops	9	6	24
Diaptomus	3	0	3
Daphnia	12	4	7

TABLE VI

PLANKTON COLLECTED FROM STATION X, BROWNLEE RESERVOIR
OCTOBER 19, 1961
ORGANISMS PER LITER

Organism	D E P T H 25'	50'	100'	150'	200'
Coelospharium	0	0	0	1	0
Staurastrum	88	111	2	0	0
Pediastrum	14	19	1	1	0
Fragilaria	5	2	0	0	0
Melosira	13,728	8,100,000	1,400	1,726	623
Polyarthra	4	0	0	0	0
Keratella	6	7	0	0	0
Ceratum	2	0	0	0	0
Bosmina	3	3	1	2	3
Nauplius	6	2	1	1	0
Cyclops	5	4	5	6	5
Draptomus	2	0	0	2	0
Daphnia	1	1	1	1	7
Leplodora	0	1	0	0	1

TABLE VII

PLANKTON COLLECTED FROM STATION XI, BROWNLEE RESERVOIR
OCTOBER 19, 1961
ORGANISMS PER LITER

Organism	D E P T H 50'	130'	200'
Staurastrum	168	0	0
Asterionella	1	0	0
Pediastrum	16	0	0
Fragilaria	1	0	0
Melosira	100,980	497	555
Polyarthra	1	0	0
Keratella	5	0	0
Ceratium	1	0	0
Bosmina	4	6	3
Nauplius	2	0	0
Cyclops	8	9	2
Daphnia	1	1	0

Memo to: Columbia River Salmon and Steelhead Technical Committee

From: Wendell E. Smith, Fish Biologist, Idaho Power Company

Subject: Temperature and Dissolved Oxygen Readings Pertinent to Oxbow Spillway Flushing Experiment

Throughout the occurrence of the fall chinook salmon run at Oxbow in 1961, the migration of fish around the bow and into the trap at the spillway remained relatively normal when compared to that of the past two years. This occurred despite the fact that the ratio of water flow around the bow to that of the powerhouse tailrace was only approximately 1:10. The reasons for the surprising lack of expected congregation of fish at the tailrace were investigated and one factor was apparent. This was that the water discharged over the spillway became aerated significantly more than that released below the powerhouse. Coupled with the effects of aerating the trap intake water, the flow around the bow contained a continuously higher dissolved oxygen content, amounting to approximately three parts per million, than that in the tailrace.

The purpose of an experiment conducted on October 18 was to determine if increased spill and flow around the bow would concurrently increase the dissolved oxygen levels in the greater amount of water. Such was not the case. In fact, an indication of the reverse was true, though the dissolved oxygen change was so slight as to not particularly offset any possible value to fish of increasing flow.

In the first of two tables following, a measure of the temperature and dissolved oxygen patterns in Oxbow reservoir is recorded. These data show that all available water for discharge downstream from Oxbow Dam contains only marginal quantities of dissolved oxygen for fish sustenance at this time of year. The second table demonstrates that little or no aeration occurs when water passes through the project turbines. It would appear, therefore, that spillway and trap aeration is a more desirable function than increased flow for fall chinook. There is no doubt that considerable difficulty would have been experienced in fish passage without the benefit of aeration.

Wendell E. Smith
Fish Biologist

10-23-61

TABLE I

TEMPERATURE AND DISSOLVED OXYGEN LEVELS
IN OXBOW RESERVOIR AND BELOW

(October 17, 1961, 3 PM - Clear, breezy, mild
day at buoy line upstream from intake)

Depth	Temp.	Dissolved Oxygen
Surface	62.5°F	5.0 ppm
10	62.0	
20	62.0	
30	62.0	
40	62.0	
50	62.0	5.0 ppm
60	62.0	
70	61.5	
80	61.5	
90	61.5	
100 (bottom)	61.5	5.0 ppm

Location	Time	D.O.	Temp.
Oxbow Tailrace	4:00 PM	5.0 ppm	60° F
Lowermost Bow Riffle	4:30 PM	8.5 ppm	61° F
Uppermost Bow Riffle	5:00 PM	8.0 ppm	60° F

W.E.S. - 10-23-61

TABLE II

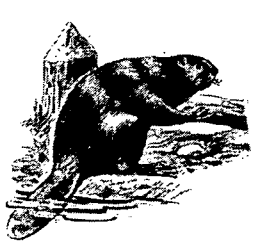
OXBOW SPILLWAY FLUSHING AND DISSOLVED OXYGEN EXPERIMENT

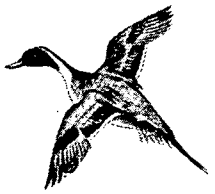
(October 18, 1961 - Clear, warm day)

Time	Location	Temp.	D.O.
10:15 AM	Oxbow Tailrace	60°F	5.0 ppm
10:30 AM	Lowermost Bow Riffle	60°F	8.0 ppm
11:00 AM	Uppermost Bow Riffle	61°F	8.0 ppm
	Spillway flow increased to 5000 cfs at 11:45 AM		
1:50 PM	Uppermost Bow Riffle	61°F	7.5 ppm
2:15 PM	Lowermost Bow Riffle	60°F	7.5 ppm
2:30 PM	Oxbow Tailrace	60°F	5.0 ppm
2:45 PM	Right Bank (Idaho) Bridge below Tailrace	60°F	6.0 ppm
3:00 PM	Left Bank (Oregon) Bridge below Tailrace	60°F	5.0 ppm
	Spillway returned to normal (1000 cfs) at 1:30 PM		
	(Following records considered to be post-flushing)		
5:00 PM	Uppermost Bow Riffle	60°F	8.0 ppm
*5:20 PM	Lowermost Bow Riffle	60°F	7.5 ppm

*Water level back to normal but water discoloration resulting from flushing still in evidence at lowermost riffle during 5:20 PM check.

W.E.S. - 10-21-61




STATE OF IDAHO

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Department of Fish and Game

ROSS LEONARD
DIRECTOR

518 FRONT STREET BOISE, IDAHO

November 29, 1961

Mr. W. W. Towne, Director
Columbia River Basin Project
Public Health Service
570 Pittock Block
Portland 5, Oregon

Dear Mr. Towne:

This is to acknowledge with thanks the receipt of data collected from Snake River and Brownlee Reservoir by members of your survey team during October. We appreciate receiving this information.

Enclosed are copies of some temperature and dissolved oxygen data collected by members of our Department at various places and at various times during the summer in Brownlee Reservoir. I mentioned the availability of this data to Mr. Earl Kari over the phone some time ago and am enclosing them for your use.

Sincerely yours,

Ross Leonard, Director

Forrest R. Hauck

Forrest R. Hauck, Coordinator
Basin Investigations

IDAHO TERRITORIAL CENTENNIAL 1863 1963

FRH:rmw

Enclosure

PUBLIC HEALTH SERVICE
Water Supply and Water Pollution Control, PNW
DEC 1 1961
570 Pittock Block
Portland, Oregon

Temperature and Dissolved Oxygen Records of Brownlee and Oxbow

as taken by Bill Webb

June 6, 1961, Brownlee Reservoir

Location I (upper 10 miles)

Depth	Temp.	D. O.
Surface	70°F	9.4 p.p.m.
10 ft.	70	9.2
25 ft.	68	7.8
50 ft.	64	6.4
67 ft.	62	2.6
70 ft.	62	3.2
97 ft.	60	0.6

Location II (30 miles downstream)

Depth	Temp.	D. O.
Surface	72°F.	9.4 p.p.m.
115 ft.	60	7.4
135 ft.	58	0.8
140 ft.	58	0.8
165 ft.	58	0.4

Air Temp. -- 77° F. to 84°F.

June 22 and 23, Brownlee Reservoir

Location: One Mile below Powder River

Depth	Temp.	D.O.
0 ft.	76°F.	11.6 p.p.m.
25 ft.	71	8.0
50 ft.	70	7.0
75 ft.	68	7.4
100 ft.	65	6.6
125 ft.	61	3.8
150 ft.	59	3.6
175 ft.	56	2.6
195 ft.	56	0.5
200 ft.	56	0.1

Air Temp. -- 85° F.

Location: Six Miles below Farewell Bend

Depth	Temp.	D.O.
0ft.	78°F.	9.8 p.p.m.
5 ft.	78	9.6
12 ft.	78	8.8
25 ft.	76	7.6
35 ft.	77	7.6
47 ft.	75	7.8

Air Temp. -- 91° F.

July 7, 1961, Brownlee Reservoir

Location: 3 miles below Farewell Bend

Depth	Temp.	D. O.
Surface	74° F.	8.2 p.p.m.
25 ft.	73	8.0
55 ft.	73	7.4
67 ft.	73	3.2

Several checks were made in the 3 to 10 mile portion of the section surveyed. The depths D.O.'s and temperatures were similar to those mentioned above.

Location: 10 to 15 miles below Farewell Bend

Depth	Temp.	D.O.
Surface	74° F.	6.9 p.p.m.
25 ft.	74	6.6
55 ft.	74	6.2
65 ft.	74	5.6
70 ft.	74	4.8
75 ft.	71	0.6
80 ft.	71	1.2
85 ft.	71	1.2
90 ft.	68	0.4

The maximum air temperature for the day was 83 degrees F.

July 13, 1961, Brownlee Reservoir

Location: 3 miles above Brownlee Dam

Depth	Temp.	D.O.
Surface	82° F.	8.2 p.p.m. (super saturation probably due to wind action)
25 ft.	73	7.2
50 ft.	73	6.6
75 ft.	70	5.0
100 ft.	68	4.8
125 ft.	63	3.8
150 ft.	58	1.8
175 ft.	58	0.6

Location: 3/4 mile upstream from sampling station

Depth	Temp.	D.O.
100 ft.	68° F.	4.8 p.p.m.
125 ft.	63	3.8
150 ft.	56	2.8
175 ft.	54	2.6
205 ft.	54	0.2

Air temperature on reservoir -- 92° F. at 2:45 p.m. (8 ° higher off of the reservoir)

July 21, 1961, Brownlee Reservoir

Depth	Temp.	D.O.
Surface	76°F.	6.4 p.p.m. (Approx.
25 ft.	74	5.6 5 miles below
50 ft.	74	5.2 Farewell Bend)
75 ft.	74	4.4

Depth	Temp.	D.O.
Surface	78.0°F.	7.6 p.p.m. (Approx.
25 ft.	76.5	5.2 9 miles below
50 ft.	76	4.2 Farewell Bend)
75 ft.	74	0.5
85 ft.	72	0.4

Depth	Temp.	D.O.
Surface	79.8°F.	8.8 p.p.m. (Approx. 17 miles below Farewell Bend.
25 ft.	77	6.4 Directly below Rock Creek.
50 ft.	77	5.2 (32 miles above Brownlee)
75 ft.	73	0.6
100 ft.	69	0.2
122 ft.	66	0.0

Air Temperature on Reservoir at 12:15 p.m. 86° F.

August 4, 1961, Brownlee Reservoir

Location: Burnt River

Depth	Temp.	D.O. (p.p.m.)
Surface	81° F.	12.0 (supersaturation
25 ft.	80	7.4 from wind)
35 ft.	80	6.8
60 ft.	79	4.6

Air Temp. 98° F. at 3:30 p.m.

Location: Rock Creek

Depth	Temp.	D.O. (p.pm)
Surface	82°F.	12.4 (supersaturation
25 ft.	79	5.1 from wind)
50 ft.	78	3.4
75 ft.	77	2.0
100 ft.	72	0.2
125 ft.	70	0.0

Air temp. 90° F. at 10:30 a.m.

Depth	Temp.	D.O. (p.p.m.)
Surface	78°F.	8.6 (supersaturation
25 ft.	77	4.8 from wind)
50 ft.	77	3.1
75 ft.	76	1.4
100 ft.	72	1.3
125 ft.	68	0.4
150 ft.	63	0.0
170 ft.	61	0.0

Air temp. 94° F. at 1:00 p.m.

August 18, 1961, Oxbow Pool

Location: Station I.

Depth	Temp.	D.O.
Surface	72° F.	5.2 p.p.m.
10 ft.	72	5.0
20 ft.	70	4.7
30 ft.	70	4.6

Air Temp. -- 92° F.

Location: Station Ia.

Depth	Temp.	D.O.
Surface	72° F.	5.0 p.p.m.
25 ft.	72	4.8
50 ft.	70	4.6
70 ft.	70	4.6

Location: Station III.

Depth.	Temp.
120 ft.	60.0° F.
110 ft.	61.0
100 ft.	61.5
90 ft.	63.5
80 ft.	66.5
70 ft.	69.0
60 ft.	69.5
50 ft.	70.0
40 ft.	70.5
30 ft.	71.0
20 ft.	71.0
10 ft.	72.0
0 ft.	75.0

August 25, 1961, Oxbow Pool

Location: Station II.

Depth	Temp.	D.O.
Surface	73.0° F.	5.4 p.p.m.
20 ft.	72.0	5.0
40 ft.	71.5	4.8
60 ft.	69.0	4.6

Air Temp. -- 81° F.

Location: Station III.

Depth	Temp.	D.O.
Surface	73.5°F.	5.2 p.p.m.
25 ft.	71.8	4.8
50 ft.	71.0	4.4
75 ft.	68.0	3.4
100 ft.	60.0	0.2
115 ft.	60.0	$<$0.1

August 25, 1961, Oxbow Pool

Location: Station III.

Depth	Temp.
115 ft.	60.0° F.
100 ft.	60.0
90 ft.	61.0
87 ft.	62.0
83 ft.	65.0
78 ft.	67.5
75 ft.	68.0
65 ft.	69.8
61 ft.	70.0
50 ft.	71.0
33 ft.	71.0
25 ft.	71.0
0 ft.	72.4

September 20, 1961, Oxbow Pool

Location: Wildhorse River (mouth of)

Depth	Temp.	D.O.
Surface	68° F.	5.2 p.p.m.
25 ft.	68	4.8

Chemical and Physical Data of Snake River and Tributaries
from Samples Collected on August 22-24, 1961

River-Miles	Station	Date	pH Field	Temp °C	DO mg/l	BOD mg/l	MPN ~~mg/l~~ /100 ml	PO_4 mg/l	NH_3-N* mg/l	NO_3-N* mg/l	TS mg/l	SS mg/l	Turb	Color	pH lab	Alk mg/l	Hard mg/l	Cond. mho's
Snake - 348.7	Oasis-bank	8-22-61	8.5	27	9.5	3.4	1,100	0.021	0.96	0.89	369	36	5	5	8.38	163.0	187	465
	sample	8-24-61	8.8	25	10.2	4.9	2,400	0.012	0.63	0.23	393	45	13	5	8.60	168.0	176	540
	diurnal	8-24-61	8.2	25	6.7													
Snake - 353	Weiser Br. Sta.	8-22-61	8.3	26	8.6	3.7	24,000	0.003	0.95	0.79	491	120	19	10	8.05	158.0	189	430
	Eastside	8-24-61	8.7	25	9.5	4.1	9,300	0.183	0.57	0.73	357	27	5	10	8.30	153.5	54.8	505
	Middle Station	8-22-61	8.3	26	8.9	4.1	2,300	0.012	1.04	0.98	378	54	9	7	7.65	153.5	203	450
		8-24-61	8.7	25	10.4	4.9	11,000	0.000	0.75	0.47	396	40	9	5	8.45	162.0	181	545
	diurnal	8-24-61	8.3	25	6.4													
	West Side	8-22-61	8.3	27	9.4	4.0	24,000	0.015	1.04	0.96	405	52	10	7	8.50	167.0	191	450
		8-24-61	8.7	26	10.1	4.1	15,000	0.030	0.62	0.44	399	44	9	7	8.55	166.5	177	550
		8-25-60**	>7.6	18	8.8	4.3	> 700	0.12	- -	0.72	471	114	20	5	7.8	176	181	570
	Statistical Summary 9/60 - 7/61 **																	
	Maximum		8.5	25	12.3	5.2	70,000											708
	Minimum		7.6	3	7.8	2.2	600											450
	Mean		8.2	12.9	10.3	3.6	10,700											536
Snake - 368	Payette, Idaho	Bridge																
	Eastside	8-22-61	8.1	26	8.3	4.2	24,000	0.041	0.88	0.86	406	43	10	5	8.12	172.0	208	532
		8-24-61	8.7	24	8.4	3.8	4,300	0.000	0.66	0.90	362	33	7	10	8.18	148.5	181	530
	Middle Sta. diurnal	8-24-61	8.2	25	6.3													
	West Side	8-22-61	8.2	26	8.5	4.1	4,300	0.006	0.93	0.86	426	25	7	5	8.22	180.5	209	560
		8-24-61	8.7	24	8.6	4.4	1,500	0.006	0.60	0.90	410	35	7	5	8.30	176.5	190	580
	Statistical Summary 10/60-7/61																	
	Maximum		8.4	26	12.9	6.0	7,000											740
	Minimum		7.6	3	7.1	2.3	230											530
	Mean		8.2	12.6	10.1	3.7	3,500											569
Snake - 372	Ontario - Hwy. Br. 30																	
		8-22-61	8.7	26	8.9	- -	2,300	0.012	0.88	1.24	445	15	7	5	8.19	181.0	216	575
		8-24-61	8.7	24	9.2	3.5	2,000	0.000	0.70	1.17	457	31	4	5	8.20	190.5	172	635
		8- -60	>7.6	14	8.6	1.9	>700											

River-Miles	Station	Date	pH Field	Temp °C	DO mg/l	BOD mg/l	MPN ~~mg~~/100ml	PO_4 mg/l	NH_3-N* mg/l	NO_3-N* mg/l	TS mg/l	SS mg/l	Turb	Color	pH lab	Alk mg/l	Hard mg/l	Cond. mhos
	Statistical Summary																	
	9/60-7/61	Maximum	8.6	26	12.9	4.7	13,000											700
		Minimum	7.6	3	7.2	2.4	450											490
		Mean	8.3	13	10.5	2.9	710											553
Snake - 389	Nyssa Hwy. Br. 20																	
	Eastside	8-22-61	8.5	25	7.4	3.5	>1,100	0.018	0.95	0.53	416	43	7	7	8.05	172.5	195	445
		8-24-61	8.8	23	6.8	2.1	>11,000	0.045	0.60	1.24	427	53	9	5	8.02	173.0	214	550
	Middle Sta. diurnal	8-24-61	8.3	24	6.5													
	West side	8-22-61	8.4	24	7.5	3.3	1,100	0.000	0.71	1.01	431	57	12	5	7.98	164.0	205	450
		8-24-61	8.8	23	6.8	2.6	>11,000	0.018	0.64	1.19	426	51	7	5	7.95	161.0	205	545
	Statistical Summary 9/60 - 7/61																	
	Maximum		8.5	27	12.4	4.9	2,400											700
	Minimum		7.6	3	6.8	1.5	60											490
	Mean		8.3	13	10.5	2.9	710											553
Snake - 402	Adrian Bridge																	
		8-22-61	8.5	24	6.6	- -	>1,100	0.006	0.96	0.97	406	36	7	5	7.90	157.0	202	450
		8-24-61	8.3	23	6.1	2.0	2,400	0.000	0.60	1.22	388	42	7	5	7.72	155.5	214	500
	diurnal	8-24-61	8.2	24.5	6.8													
Weiser - 352	Hwy. 30 N. Br.	8-22-61	8.7	27	10.6	2.6	>1,100	0.108	0.87	0.59	314	62	29	20	8.25	142.0	125	355
	in Weiser,	8-24-61	8.8	25	9.3	3.1	11,000	0.316	0.68	0.34	314	64	26	20	7.95	137.5	132	360
	Idaho diurnal	8-24-61	7.8	23	5.3													
Payette - 368-2	on Hwy. Br. ½	8-22-61	8.7	25	9.3	3.2	11,000	0.060	0.92	0.42	197	61	9	15	8.02	83.5	79.4	191
	mi. S. of RR Br.	8-24-61	8.7	22	8.4	4.4	24,000	0.018	0.66	0.53	188	49	7	10	7.85	85.0	65.2	208
	diurnal	8-24-61	8.0	22.5	6.1													
Malheur - 369.1	Hwy. Br. 201	8-22-61	8.9	25	16.2	13.3	4,600	0.252	1.39	0.07	1375	84	24	17	8.45	335.0	430	1460
	N.W. of Ontario	8-24-61	8.8	23	13.0	9.7	9,300	0.480	1.12	0.58	1221	85	16	20	8.25	425.0	319	1680
	diurnal	8-24-61	8.0	23	5.0													
		8-25-60	>7.6	14	8.6	1.9	> 700											
	Statistical Summary																	
	9/60 - 7/61	Maximum	8.5	26	15.6	12.3	7,000											1700
		Minimum	7.6	1	7.2	0.4	230											130
		Mean	8.2	12	10.9	3.9	1,900											1300

River - Miles	Station	Date	pH Field	Temp °C	DO mg/l	BOD mg/l	MPN ~~mg/l~~ /100 ml	PO_4 mg/l	NH_3-N* mg/l	NO_3-N* mg/l	TS mg/l	SS mg/l	Turb	Color	pH lab	Alk mg/l	Hard mg/l	Cond. mho's
Boise - 391-3	Hwy Br. 20 and	8-22-61	8.2	23	8.1	3.2	4,600	0.392	1.04	1.15	80	15	10	17	8.30	271.0	331	610
	26 in Parma, Idaho	8-24-61	8.5	21	7.3	2.7	>11,000	0.557	0.79	1.14	626	67	13	20	7.81	274.5	232	720
Owyhee - 392-2	Hwy. Br. 201	8-22-61	8.3	21	7.1	3.3	> 1,100	0.045	0.94	1.57	908	103	26	15	7.71	255.0	299	840
	2 mi. S. of Owyhee	8-24-61	7.8	20	6.9	2.3	>11,000	0.132	0.91	2.00	934	72	24	10	7.75	283.0	176	1080

* a mg/l as nitrogen
** Composite of 3 station cross section

River Flows (cfs) 1961

	August 21	August 22	August 23	August 24
Snake River at Weiser	8,550	8,630	8,630	8,630
Weiser River at Weiser	258	230	251	247
Payette River at Emmett	1,740	1,720	1,790	1,760
Boise River at Boise	470	655	793	820
Brownlee Reservoir (equivalent cfs)	+ 994	- 710	- 710	+ 355

RESULTS OF A PRELIMINARY BIOLOGICAL SURVEY

of the

SNAKE RIVER AND TRIBUTARIES

between
Adrian, Oregon, and Weiser, Idaho

August 22-23, 1961

Biological samples were taken from the Snake River and its tributaries betwen Adrian, Oregon, and Weiser, Idaho, supplementary to a chemical and physical survey designed to identify general water qualities and possible sources of pollution. From the cursory classification of biological groups, Table I and Table II, and visual observations at each station a few general conclusions have been drawn:

1. All of the streams observed carried excessive loadings of sediments from irrigation return waters. The Owyhee, Malheur, and Boise Rivers were outstanding in this respect. Also, the addition of agricultural fertilizers and other nutrients via irrigation return waters is suspected because of great algal blooms in most areas.
2. The Snake River carried an exceptionally heavy load of algae in suspension. Dominant types at the time of the survey were Anabaena, Pediastrum, Spirogyra, Aphanizomenon, Staurastrum, and Anacystis.
3. The high organic content of the Snake River can be expected to deposit in the storage reservoirs downstream where, upon decomposition, it will have a high B.O.D.
4. The high organic loading of algae in Snake River appears to exceed by manyfold all sources of industrial and domestic wastes in the study area.

5. Two areas of gross organic pollution were found. Bacterial slimes blanket the bottom in both areas:

   a. the Snake River on the Oregon side below the city of Ontario

   b. The Payette River below the city of Payette.

6. Fish types, numbers and distribution indicate that all of the waters surveyed were suitable for maintaining warm water fishes - large and smallmouth bass, crappies, catfish, bluegills, carp and suckers.

   Undoubtedly the fish populations of the Malheur, Weiser, and possibly the Owyhee Rivers are limited by high turbidities.

7. Bottom fauna productivity followed rather closely the pattern of fish production. It was generally high in quality and quantity except for those streams with higher turbidities and the two zones of bacterial slime growth at Payette and Ontario.

Description of Sampling Stations

of Snake River and Tributaries

Miles	Location
348.7	Snake River - Oasis on Hwy. 30 one mile northwest of Wikiup Gulch (bank sample).
353	Snake River - Weiser, Idaho Bridge. Three stations at $\frac{1}{4}$ points on river.
368	Snake River - Payette, Idaho Bridge. Two stations at 1/3 points on river.
372	Snake River at Hwy. 30 Bridge in Ontario
389	Snake River at Hwy 20 Bridge in Nyssa. Two stations at 1/3 points on river.
402	Snake River at Hwy. Bridge in Adrian.
352	Weiser River - at Hwy. 30 N. Bridge in Weiser, Idaho.
368-2	Payette River - on Hwy. Bridge $\frac{1}{2}$ mile south of railroad bridge.
369-1	Malheur River - $1\frac{1}{2}$ mile northwest of Ontario Hwy. 201 Bridge.
391-3	Boise River - Hwy. Bridge 20 and 26 near Parma, Idaho.
392-2	Owyhee River - Hwy. Bridge 201 two miles south of Owyhee.

Table I

AQUATIC INSECTS - SNAKE RIVER SURVEY

August 22-23, 1961

Station	Order	Family	Number
Owyhee River (1)	Trichoptera	Hydropsychidae	2
(Hwy 201 Br. 1½ miles north of Adrian)	Diptera	Chrionomidae	18
		Simuliidae	2
8-22-61	Odonata	Coenagrianidae	2
	Ephemeroptera	Baetidae	1
	Mussels		6
	Oligochaetes		6
	Rhynchobdellida	Glossiphonidae	1
Owyhee River (2)	Diptera	Simuliidae	6
		Chrionomidae	14
(Br. north of Adrian)			
	Mussels		5
8-22-61			
	Oligochaetes		13
	Ephemeroptera	Baetidae	5
Snake River (3)	Odonata	Gomphidae	1
	Mussels		2
(½ mile above Adrian bridge)	Snail		1
	Trichoptera	Hydropsychidae	3
8-22-61	Ephemeroptera	Coenidae	24
		Heptageniidae	60
	Rhynchobdellida	Glossiphonidae	5
	Oligochaetes		1
Boise River (4)	Trichoptera	Hydropsychidae	46
(1 mile south of Parma)	Odonata	Gomphidae	1
	Diptera	Chrionomidae	8
		Simuliidae	12
	Ephemeroptera	Coenidae	25
	Lepidoptera	Pyralididae	6
	Rhynchobdellida	Glossiphoniidae	1
	Oligochaetes		

Table II

Fish Collections

Snake River Survey

August 23, 1961

1. Owyhee River one mile upstream from Hwy. 201 bridge 1½ miles north of Adrian

Pomoxis annularis	20
Micropterus salmoides	1
Pantosteus jordani	1
Acrocheilus alutaceus	1
Ptychocheilus oregonensis	5
Lepomis macrochirus	1
Ameiurus nebulosus	1
Astacus sp.	1.

2. Snake River ½ mile upstream from Adrian bridge

Pantosteus jordani	1
Ptychocheilus oregonensis	1
Micropterus dolomieui	1

3. Boise River one mile south of Parma

Pomoxis annularis	3
Micropterus salmoides	2
Richardsonius balteatus	1
Cyprinus carpio	1
Ameiurus nebulosus	1

4. Snake River 1½ miles below Nyssa

Cyprinus carpio	7
Pantosteus jordani	2
Ptychocheilus oregonensis	1

5. Malheur River one mile north of Ontario at Hwy. 30 bridge

Cyprinus carpio	17
Pomoxis annularis	1
Mylocheilus caurinus	1
Ptychocheilus oregonensis	1
Richardsonius balteatus	1

6. Snake River ½ mile north of Ontario

No fish found

7. Payette River 4 miles south of Payette, Hwy. 95 bridge

Micropterus salmoides	7
Astacus sp.	2

8. Snake River at Payette

No fish seining done

9. Snake River at Weiser

Micropterus salmoides	1

10. Weiser River at Weiser, Hwy. 30 bridge

No fish found

11. Snake River at Farewell Bend

No seining done

Station	Order	Family	Number
Snake River (5)	Mussels		12
	Trichoptera	Hydropsychidae	209
(1½ miles below Nyssa)			
	Odonata	Gomphidae	3
8-22-61		Coenagrionidae	3
	Lepidoptera	Pyralididae	5
	Ephemeroptera	Heptageniidae	66
	Diptera	Simuliidae	2
		Chrionomidae	4
	Rhynchobdellida	Glossiphaniidae	2
Malheur River (6)	Trichoptera	Hydropsychidae	29
(1 mile north of Ontario)	Diptera	Simuliidae	7
		Chrionomidae	6
	Oligochaetes	(earthworms)	10
	Arhynchobdellida	Erpodellidae	8
Snake River (7)	Diptera	Simuliidae	1
(½ mile north of Ontario)	Trichoptera	Hydropsychidae	2
Payette River (8)	Odonata	Gomphidae	1
(Hwy Br. 4 miles South of Payette)	Trichoptera	Hydropsychidae	20
	Ephemeroptera	Ephemeridae	1
		Heptageniidae	47
	Diptera	Chrionomidae	3
	Oligochaetes		1
	Lepidoptera	Pyralididae	2
Snake River (9)	Ephemeroptera	Heptadeniidae	15
		Coenidae	22
(at Payette Br.)	Trichoptera	Hydropsychidae	5
8-23-61	Arhynchobdellida	Erpodellidae	10
	Oligochaetes	(earthworms)	4

Station	Order	Family	Number
Snake River (10)	Trichoptera	Hydropsychidae	44
(Br. to Weiser - Oregon side)	Ephemeroptera	Heptageniidae	78
		Caenidae	12
	Lepidoptera	Pyralididae	3
	Rhynchobdellida	Glossiphaniidae	2
Weiser River (11)	Odonata	Gomphidae	2
(Hwy 30 Br., Weiser)	Trichoptera	Hydropsychidae	25
8-23-61	Lepidoptera	Pyralididae	26
	Diptera	Chrionomidae	8
		Tipulidae	3
	Oligochaetes		5
	Lepidoptera	Pyralididae	1
	Ephemeroptera	Baetidae	2
		Ephemerellidae	10
	Pelecypoda	(Mussel)	1

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