REPORT

of the

Bureau of Health

of the Department of Health and Welfare

on

Pollution Conditions of the Androscoggin River Waters

To

The 90th Legislature

Printed by Order of the House of Representatives

January 1, 1941

To the Honorable Senate and House of Representatives of the Ninetieth Legislature:

Gentlemen:

In accordance with the legislative order of the Eighty-ninth Legislature dated October 22, 1940, I am herewith submitting a report of an investigation of the Bureau of Health of the Department of Health and Welfare relating to pollution conditions of the Androscoggin River waters.

Respectfully submitted

ROSCOE L. MITCHELL, M. D.
Director of Health

JOEL EARNEST
Commissioner of Health and Welfare

REPORT RELATING TO THE ANDROSCOGGIN RIVER

During the past summer numerous complaints were received by the Bureau of Health concerning undesirable odors emanating from the Androscoggin River in the vicinity of Lewiston, Auburn, Rumford, Lisbon Falls, and other points along the river course. Following a period of hot, dry weather during the month of July odoriferous gases arose from the river in such quantities as to be objectionable and even nauseating in certain areas.

A similar condition of considerable intensity was called to our attention during the summer of 1937 and in a lesser degree two years before that, and each succeeding year up to the summer of 1940 when the more serious condition prevailed.

Inspections of the river were made at various dates starting at the time of the initial complaints and at frequent intervals thereafter until the objectionable condition had abated with decreasing temperatures of late fall and early winter.

As a result of these inspections and tests it may be said that the river, which arises in the Rangeley Lakes region in the western part of Maine, generally shows the characteristics of lake waters, being clear with a small amount of natural color and some free-floating plants, but no objectionable materials. This condition is true above Errol, N. H., and the water remains substantially in the same condition until it reaches Berlin, N. H.

At Berlin, a city of 20,000 inhabitants, the domestic sewage and also a substantial volume of industrial waste is emptied directly into the river. About two miles below Berlin masses of floating vegetation, such as customarily called "sludge", were seen floating on the surface of the water. This material, having grown or accumulated on the bottom of the river, collects gas when decomposition sets in and subsequently rises to the surface. Some of this material was in masses two or three feet in diameter and four or five inches thick. Below Gorham, N. H., a some-

what lesser amount of this sludge material was noted floating in the river, but it was in evidence in places along the river banks.

After arriving at the Maine-New Hampshire border the waters of the river receive additional increments of sewage and industrial wastes from various cities and towns in the following order:

Bethel,	Population,	2,025	Turner,	Population,	1,362
Rumford,	"	8,726	Auburn,	"	18,571
Mexico,	"	4,761	Lewiston,	"	34,939
Dixfield,	"	1,518	Lisbon,	"	4,002
Canton,	"	767	Topsham,	"	2,111
Jay,	"	3,106	Brunswick,	"	7,604
Livermore Falls,	"	3,148			

(Population figures taken from 1930 census.)

The first samples were collected at Gilead, Maine, where the river showed some free-floating sludge material or plant growths with a considerable amount of gelatinous, filamentous plant growths on brush extending into the river and clinging to stones which comprise the river bed. Some of this plant growth was continually breaking away and floating downstream. The dissolved oxygen content of the water at this point was below the critical point for fish life and a few dead fish, mostly suckers and chubs, were seen along the river bank.

Continuing downstream a similar condition existed at the Rumford Point Ferry, but at the highway bridge crossing the river above the power dam at Rumford a considerable quantity of floating sludge material, such as previously described, was seen. As the river flowed over the dam, foul gases were liberated from the water in such volume as to permeate the atmosphere of the main business section and were noticeable even 200 or 300 feet from the river. The odors included the characteristic odor of hydrogen sulphide, but this was most noticeable in the vicinity of the dam and rapids where agitation of the water flowing over such obstructions seemingly caused the gas to be released.

Conditions at the Dixfield bridge were observed, where some free-floating sludge and similar plant material was

noted, that were very much like those at Rumford Point and above.

At the North Turner bridge more of the gelatinous, filamentous plant growths were observed on rocks and tree branches projecting into the river and the water gave off similar odors to those mentioned above.

At Turner Center bridge a large amount of the sludge material had been carried by wind and wave action back into the cove alongside the causeway, covering an area estimated to be approximately five acres in extent and from four to six inches deep. This material was constantly giving off gas and had a general odor similar to that of a pig pen. Microscopic examination of this material showed the presence of a heavy growth of the blue green algae, oscillaria, which we believe to be the source of the pig pen odor. The rest of this material appeared to be mostly a variety of living and dead plants of the green algae group, diatoms and protozoans, mingled with a small amount of wood fibres, leaves, silt and sand.

At Gulf Island Dam more of this floating sludge material was observed constantly flowing over the dam and the water as it flowed over the dam released gases as previously described, giving the general odor of hydrogen sulphide. At times this was noticeable 300 or 400 yards away from the river.

At Lewiston and Auburn no free-floating sludge material was noticed, but the emission of gas was very pronounced and probably because of the power canals and falls it was distributed over a greater area than at the other points which have been described. The odors permeated the downtown district and in the evening could be detected as much as two miles away. A peculiarity of this gas was that its odor appeared to be more intense in dilute amounts at a considerable distance than when it was in greater concentration near the river.

The next point of observation was at the Lisbon Falls dam where a similar condition prevailed as the water flowed over the dam. Some floating sludge material was likewise noted at this point.

The locations of the various sampling points are illustrated by the accompanying map and were as follows:

Station	Location	Distance from Gilead	
1	Gilead Highway Bridge	0	miles
2	Rumford, Virginia Bridge	27	"
3	Dixfield Highway Bridge	38	"
4	North Turner Bridge	64	"
5	Turner Centre Bridge	70	"
6	Face Gulf Island Dam	78	"
7	Lewiston, 4 miles below	87	"
8	Lisbon Falls Bridge	98	"
9	Brunswick, Upper Highway Bridge	105	"

Testing on the Androscoggin was started on August 30th and continued to November 22nd. Detailed results of these tests are shown in the following tables and graphically in the diagrams immediately following.

Interpreting these charts we may first consider the dissolved oxygen content as one of the important criteria of river pollution and recovery by describing the conditions on a particular day for the length of the river. On August 30th dissolved oxygen at Station No. 1, at Gilead, showed the dissolved oxygen to be 2.1 p.p.m., which was 22% of saturation. It is generally conceded that the minimum amount of dissolved oxygen for the support of fish life is 3 p.p.m., or approximately 25% of saturation and it is generally recommended that dissolved oxygen should be at least 5 p.p.m. for maintaining healthy fish life. Obviously, this amount was lacking and there were, in fact, a few dead fish along the river bank.

At Rumford, Virginia Bridge (Station No. 2), dissolved oxygen had nearly vanished, being only .15 p.p.m., which is far below that necessary to support fish life. A considerable degree of recovery was noted at Station No. 3 at the Dixfield Highway Bridge, there being 2.44 p.p.m. dissolved oxygen, which was nearly enough to support fish life. At Station No. 4, North Turner Bridge, the dissolved oxygen had increased slightly with a further improvement in conditions. At Station No. 5, Turner Center Bridge, the dissolved oxygen had dropped to one-half of that at North Turner Bridge, and at Station No. 6, Gulf Island Dam, was

completely absent, which was also indicated by the odors previously mentioned.

At Station No. 7, Lewiston, 4 miles below, there was a considerable degree of recovery with 2.1 p.p.m. oxygen, although still lower than the amount necessary to support fish life. At Station No. 8, Lisbon Falls Bridge, dissolved oxygen had returned to 5.7 p.p.m., which is ample for fish life and at Station No. 9, Brunswick, Upper Highway Bridge, although there was some reduction to 3.8 p.p.m., it was still enough to support fish life.

A comparison of the carbon dioxide content and the oxygen consumed for each station is likewise given in the same tables, the carbon dioxide content in general following an inverse ratio to that of the dissolved oxygen, and the oxygen consumed showed a similar trend.

By September 24th a very material improvement is noted at all but two points, namely Stations No. 2 and No. 6, and by October 10th a very great improvement is noted although Station No. 6 still remained at zero. With falling temperatures improvement continued at all sampling points so that by October 31st the dissolved oxygen content at the lowest point, that of Station No. 6, Gulf Island Dam, had increased to 3.5 p.p.m. and with recovery at points below, the highest point being 8.6 p.p.m. at the Upper Bridge in Brunswick. This improvement continued and at the time of the last collections on November 21st the dissolved oxygen content at Gulf Island Dam, Station No. 6, was 9.25 p.p.m., which is ample to support fish life and prevent nuisance conditions.

A consideration of the total bacterial content of the water showed that on August 30th at Station No. 1 total bacteria were 2,900, on September 10th—30,000, September 24th—510,000, October 10th—1,300, October 30th—124, and November 20th—130. Usually there was a reduction at Station No. 2 although on two occasions there was an increase. At Station No. 3 there was, generally speaking, a marked increase in bacteria, but then a very rapid decrease until below Lewiston where there was another rise with a decrease down river to Brunswick where there was a slight increase. By November 21st the bacterial content at all sampling points had dropped below 300 per cubic

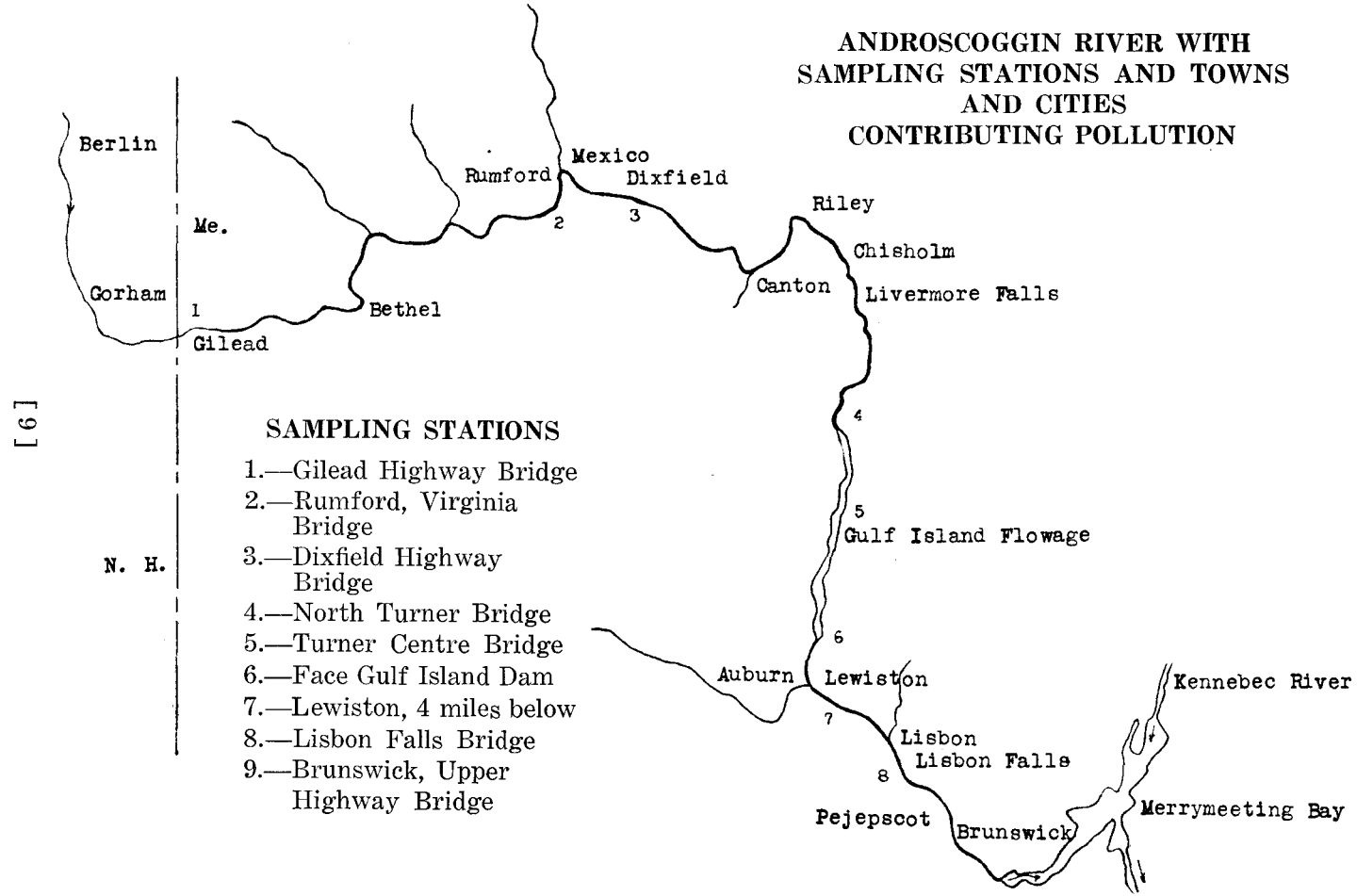
centimeter, indicating a nearly stabilized condition at the prevailing temperatures.

From these tests we may readily ascertain that from a bacteriological standpoint conditions of the water were nearly as bad when it arrived at the Maine-New Hampshire border as it showed at other places along the river.

The oxygen consumed, another index of pollution, on August 30th showed higher results as the water arrived at Gilead than at any other point along the river course, but this was closely approximated at Dixfield. This decreased rapidly after September 11th, but remained high at Dixfield and North Turner Bridge until the latter part of September. In October all stations showed a very substantial reduction in oxygen consumed, indicating a material improvement in the river conditions. This can be expected with lower temperatures, which is the experience noted in previous years.

In conclusion, it may be stated that the Androscoggin River shows a material degree of pollution both by domestic sewage and by industrial wastes when it arrives at the Maine-New Hampshire border, at which point a heavy growth of water plants is observed during warm weather. These continue downstream growing more profusely on the river bed in quiet ponds above the various dams. As these plants die, decomposition sets in and great masses rise to the surface at the same time producing offensive odors. Numerous protozoans and other forms of lower animal life are also found in this material. Additional increments of sewage and industrial wastes from cities and towns along the river course promote the growth of these various types of organisms and wherever there is a sufficient accumulation offensive conditions develop.

The above report and the accompanying charts were compiled from records of work done by the Sanitary Engineers of the State Bureau of Health. Data on amount and kind of waste discharged has been requested from all industries along the Androscoggin, in Maine. When received, additional tables will be prepared showing approximate amount of pollution from sewage and mill waste carried by this river.


ANDROSCOGGIN RIVER WITH
SAMPLING STATIONS AND TOWNS
AND CITIES
CONTRIBUTING POLLUTION
Berlin
Me.
N. H.
Gorham
Gilead
Bethel
Rumford
Mexico
Dixfield
Riley
Chisholm
Canton
Livermore Falls
Gulf Island Flowage
Auburn
Lewiston
Lisbon
Lisbon Falls
Pejepscot
Brunswick
Kennebec River
Merrymeeting Bay
1
2
3
4
5
6
7
8
SAMPLING STATIONS
1.—Gilead Highway Bridge
2.—Rumford, Virginia Bridge
3.—Dixfield Highway Bridge
4.—North Turner Bridge
5.—Turner Centre Bridge
6.—Face Gulf Island Dam
7.—Lewiston, 4 miles below
8.—Lisbon Falls Bridge
9.—Brunswick, Upper Highway Bridge

TESTS
ANDROSCOGGIN RIVER
1940

DATE	Aug. 30 Sept. 4–5	Sept. 10–11	Sept. 24–27	Oct. 10–11	Oct. 30–31 Nov. 1	Nov. 20–21–22	Aug. 30 Sept. 4–5	Sept. 10–11	Sept. 24–27	Oct. 10–11	Oct. 30–31 Nov. 1	Nov. 20–21–22	Aug. 30 Sept. 4–5	Sept. 10–11	Sept. 24–27	Oct. 10–11	Oct. 30–31 Nov. 1	Nov. 20–21–22
STATIONS	Dissolved Oxygen						Percent Saturation						Carbon Dioxide					
1	2.1	1.5	4.6	6.2	7.6	8.4	22	13.8	45.3	57.2	57.7	60.6	16	23	6	4.5	16	10
2	0.15	2.85	1.4	5.0	7.4	9.3	1.6	29.3	14.4	47.7	56.2	67.1	20	10	16	5.0	16	10
3	2.44	3.7	2.9	4.4	7.0	10.15	26.6	38	30.5	43.3	55	75.3	12	8	4	3.5	15	9
4	2.6	3.0	2.3	4.5	7.35	10	27.3	31	24.2	43.4	65	74.1	10	9	14	5.0	12	8
5	1.3	1.9	2.25	3.0	6.2	10.45	14.5	19.5	23.6	29.0	54.6	77.5	16	10	9	7.5	14	9
6	0	0	0	0	3.5	9.25	0	0	0	0	33.8	72.3	25	32	19	12	17	9.5
7	2.1	2.1	4.8	2.9	6.8	10.55	23.9	22.4	48.3	29.2	56	83.5	17	11	10	8	15	6
8	5.7	7.75	7.5	4.0	8.0	11.1	64	82	75.5	39	70.5	87.6	20	8.5	11	7	10	6
9	3.8	3.2	6.8	7.0	8.6	11.4	42.4	34	68.5	69	81	92.0	15	10.05	7	7	8	4.5

TESTS
ANDROSCOGGIN RIVER
1940

DATE	Aug. 30 Sept. 4–5	Sept. 10–11	Sept. 24–27	Oct. 10–11	Oct. 30–31 Nov. 1	Nov. 20–21–22	Aug. 30 Sept. 4–5	Sept. 10–11	Sept. 24–27	Oct. 10–11	Oct. 30–31 Nov. 1	Nov. 20–21–22
STATIONS	Oxygen Consumed						Total number of bacteria					
1	95	90	75	36	92	76	2900	30000	510000	1300	124	130
2	85	70	80	30	91	54	7200	41500	57000	600	88	170
3	90	95	105	81	121	60	9800	76000	465000	4700	2730	350
4	50	90	100	59	109	51	—	4150	490	110	94	260
5	85	65	95	52	106	42	—	2850	1320	220	20	150
6	70	80	85	71	57	35	—	2000	42	26	6	220
7	70	50	65	66	70	32	—	14600	1200	620	840	160
8	70	75	65	54	60	33	—	3450	1635	1000	795	250
9	65	75	65	53	56	33	—	20000	1000	1260	630	165

TESTS
ANDROSCOGGIN RIVER
1940

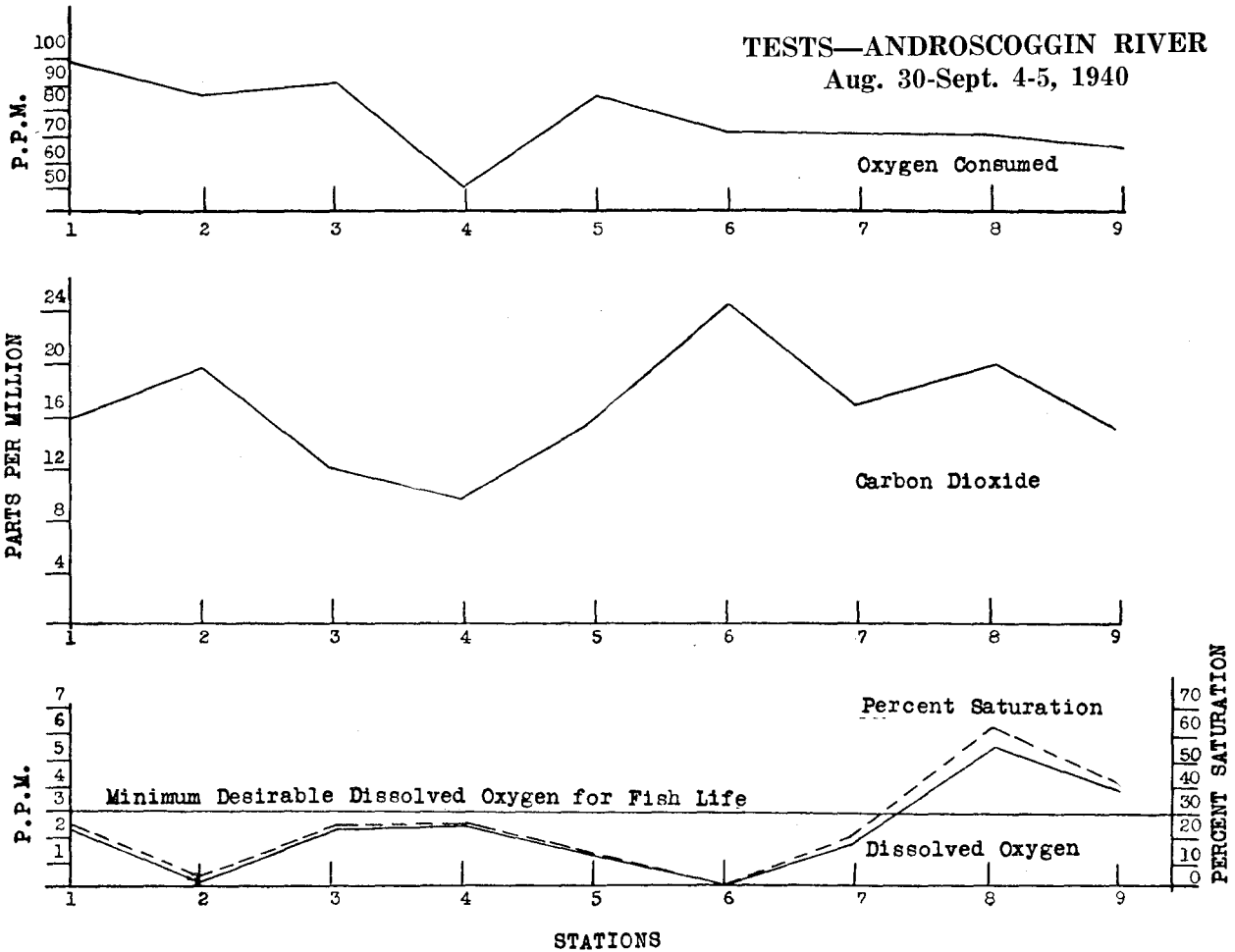
DATE	Aug. 30–Sept. 4–5					Sept. 10–11					Sept. 24–27				
STATIONS	*D.O.	% Sat.	CO_2	O.C.	T.C.	D.O.	% Sat.	CO_2	O.C.	T.C.	D.O.	% Sat.	CO_2	O.C.	T.C.
1	2.1	22	16	95	2900	1.5	13.8	23	90	30000	4.6	45.3	6	75	510000
2	0.15	1.6	20	85	7200	2.85	29.3	10	70	41500	1.4	14.4	16	80	57000
3	2.44	26.6	12	90	9800	3.7	38	8	95	76000	2.9	30.5	4	105	465000
4	2.6	27.3	10	50	—	3.0	31	9	90	4150	2.3	24.2	14	100	490
5	1.3	14.5	16	85	—	1.9	19.5	10	65	2850	2.25	23.6	9	95	1320
6	0.0	0	25	70	—	0	0	32	80	2000	0	0	19	85	42
7	2.1	23.9	17	70	—	2.1	22.4	11	50	14600	4.8	48.3	10	65	1200
8	5.7	64	20	70	—	7.75	82	8.5	75	3450	7.5	75.5	11	65	1635
9	3.8	42.4	15	65	—	3.2	34	10.05	75	20000	6.8	68.5	7	65	1600

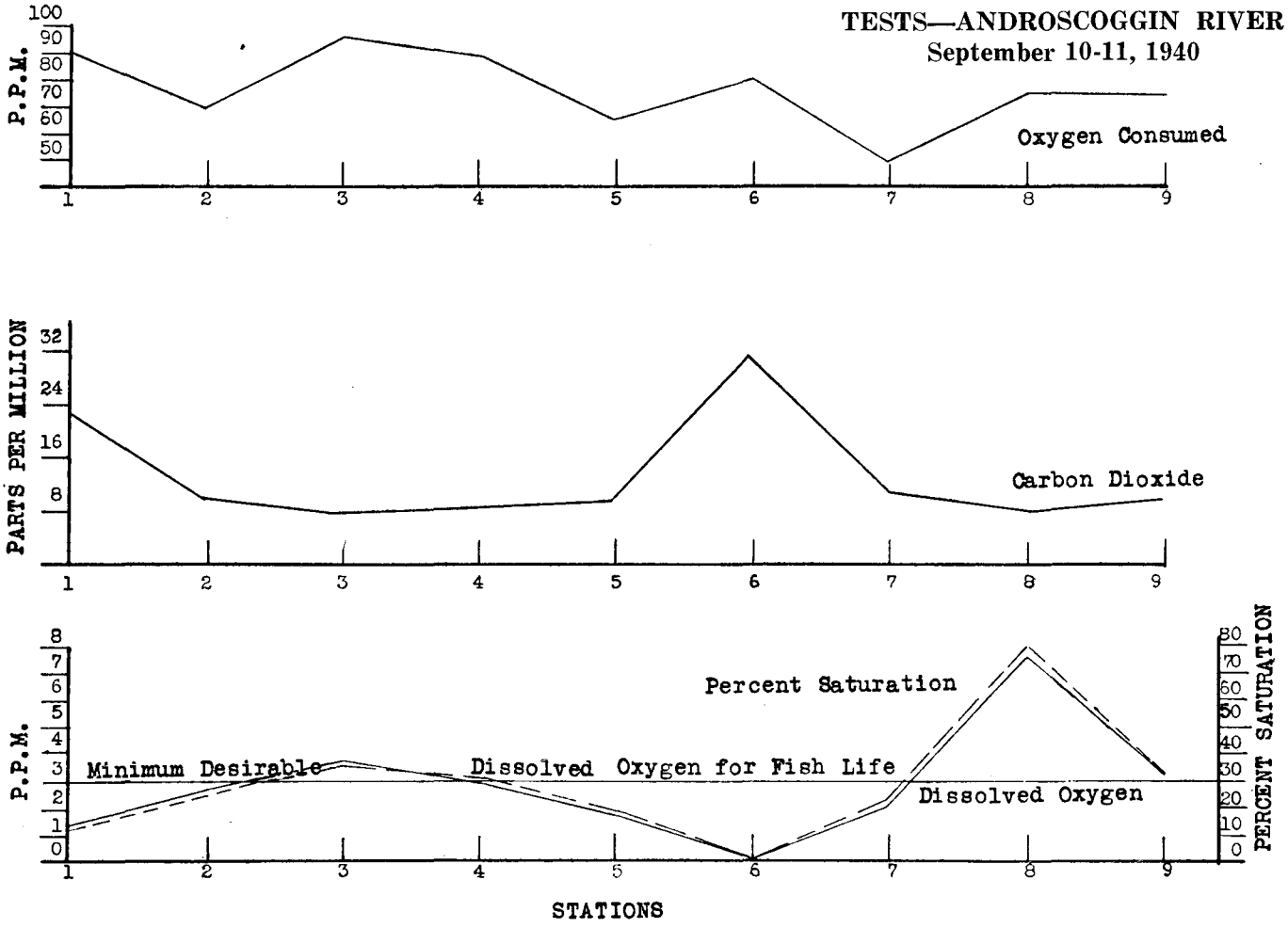
*D.O.—Dissolved Oxygen
CO_2—Carbon Dioxide
% Sat.—Percent Saturation
O.C.—Oxygen Consumed
T.C.—Total Count or Total number of bacteria

TESTS
ANDROSCOGGIN RIVER
1940

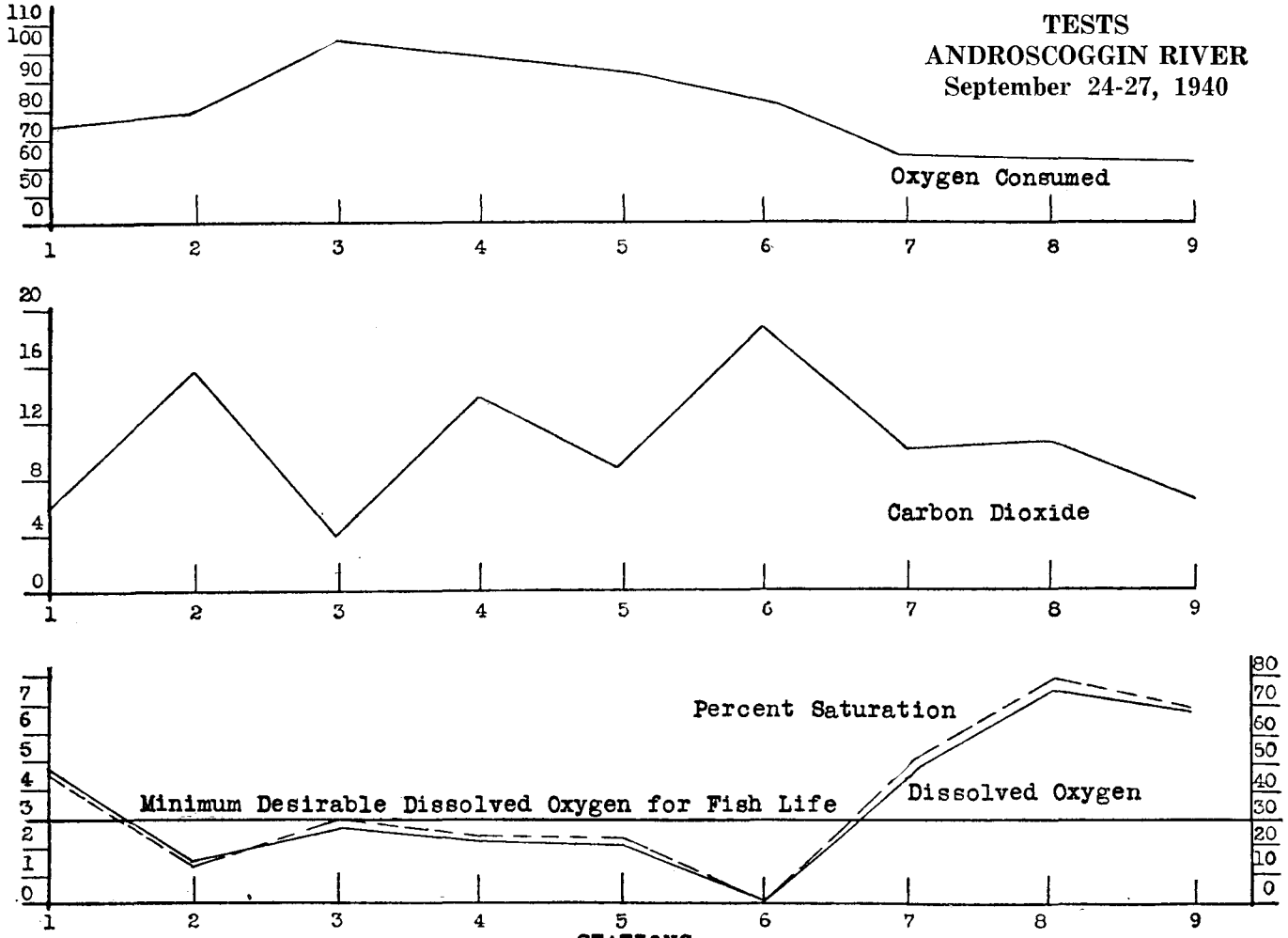
DATE	Oct. 10–11					Oct. 30–31—Nov. 1					Nov. 20–21–22				
STATIONS	*D.O.	% Sat.	CO_2	O.C.	T.C.	D.O.	% Sat.	CO_2	O.C.	T.C.	D.O.	% Sat.	CO_2	O.C.	T.C.
1	6.2	57.2	4.5	36	1300	7.6	57.7	16	92	124	8.4	60.6	10	76	130
2	5.0	47.7	5.0	30	600	7.4	56.2	16	91	88	9.3	67.1	10	54	170
3	4.4	43.3	3.5	81	4700	7.0	55	15	121	2730	10.15	75.3	9	60	350
4	4.5	43.4	5.0	59	110	7.35	65	12	109	94	10	74.1	8	51	260
5	3.0	29.0	7.5	52	220	6.2	54.6	14	106	20	10.45	77.5	9	42	150
6	0	0	12	71	26	3.5	33.8	17	57	6	9.25	72.3	9.5	35	220
7	2.9	29.2	8	66	620	6.8	56	15	70	840	10.55	83.5	6	32	160
8	4.0	39	7	54	1000	8.0	70.5	10	60	795	11.1	87.6	6	33	250
9	7.0	69	7	53	1260	8.6	81	8	56	630	11.4	92.0	4.5	33	165

*D.O.—Dissolved Oxygen
CO_2—Carbon Dioxide
% Sat.—Percent Saturation
O.C.—Oxygen Consumed
T.C.—Total Count or Total number of bacteria

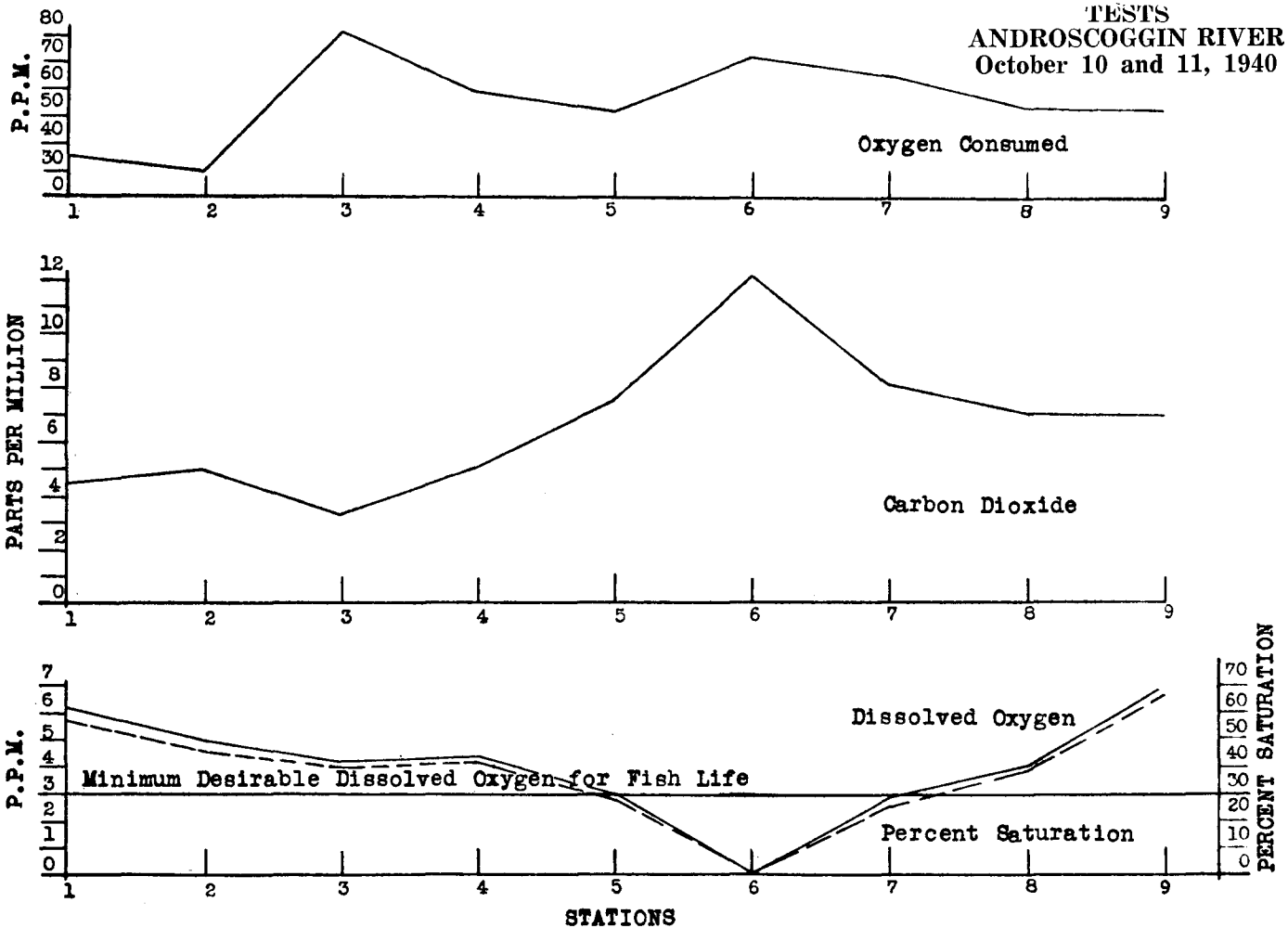

TESTS—ANDROSCOGGIN RIVER
Aug. 30-Sept. 4-5, 1940
P.P.M.
100
90
80
70
60
50
Oxygen Consumed
1
2
3
4
5
6
7
8
9
PARTS PER MILLION
24
20
16
12
8
4
Carbon Dioxide
P.P.M.
7
6
5
4
3
2
1
Percent Saturation
Minimum Desirable Dissolved Oxygen for Fish Life
Dissolved Oxygen
70
60
50
40
30
20
10
0
PERCENT SATURATION
STATIONS

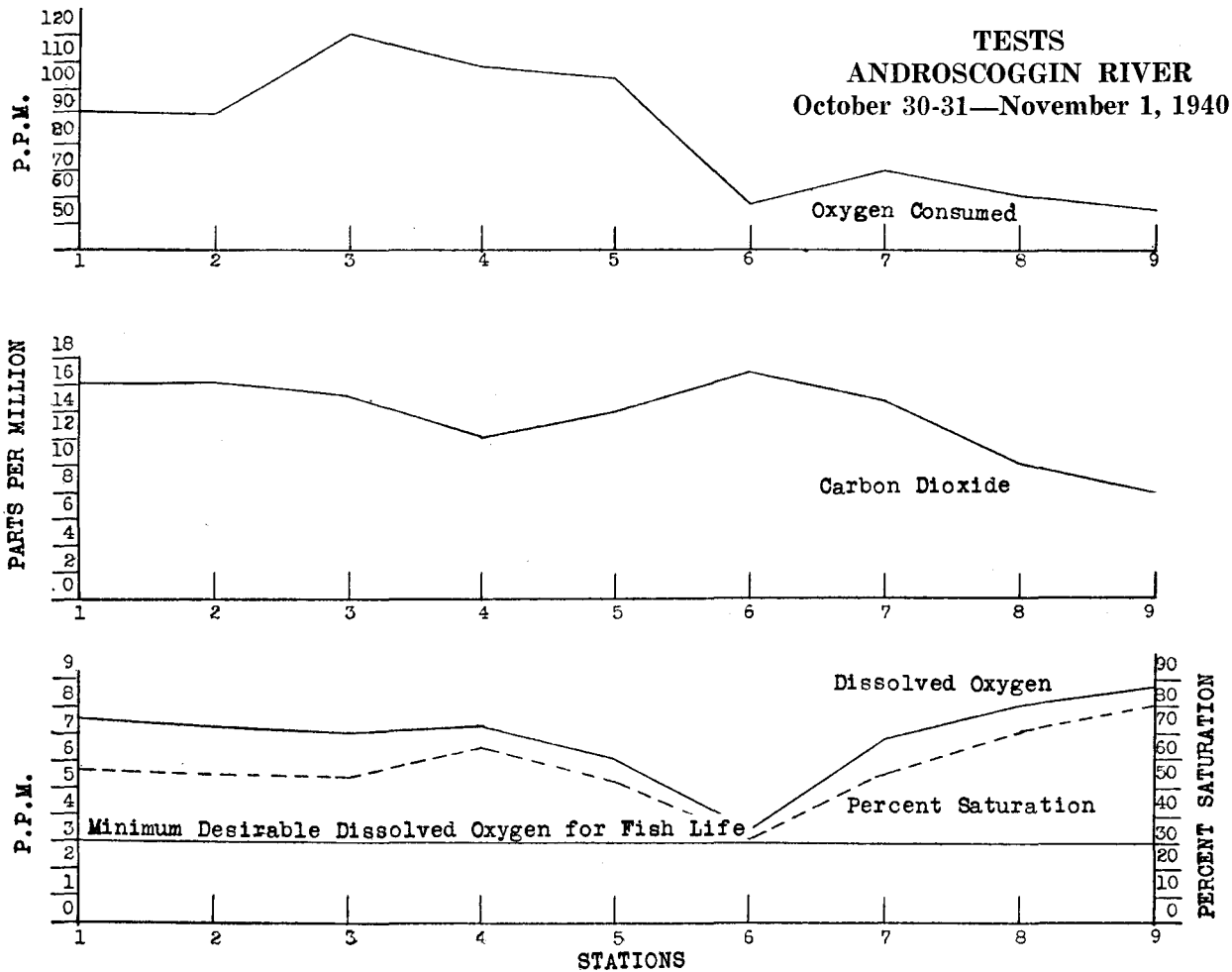

TESTS—ANDROSCOGGIN RIVER
September 10-11, 1940
P.P.M.
100
90
80
70
60
50
Oxygen Consumed
1
2
3
4
5
6
7
8
9
PARTS PER MILLION
32
24
16
8
Carbon Dioxide
P.P.M.
8
7
6
5
4
3
2
1
0
Minimum Desirable
Dissolved Oxygen for Fish Life
Percent Saturation
Dissolved Oxygen
PERCENT SATURATION
80
70
60
50
40
30
20
10
0
STATIONS

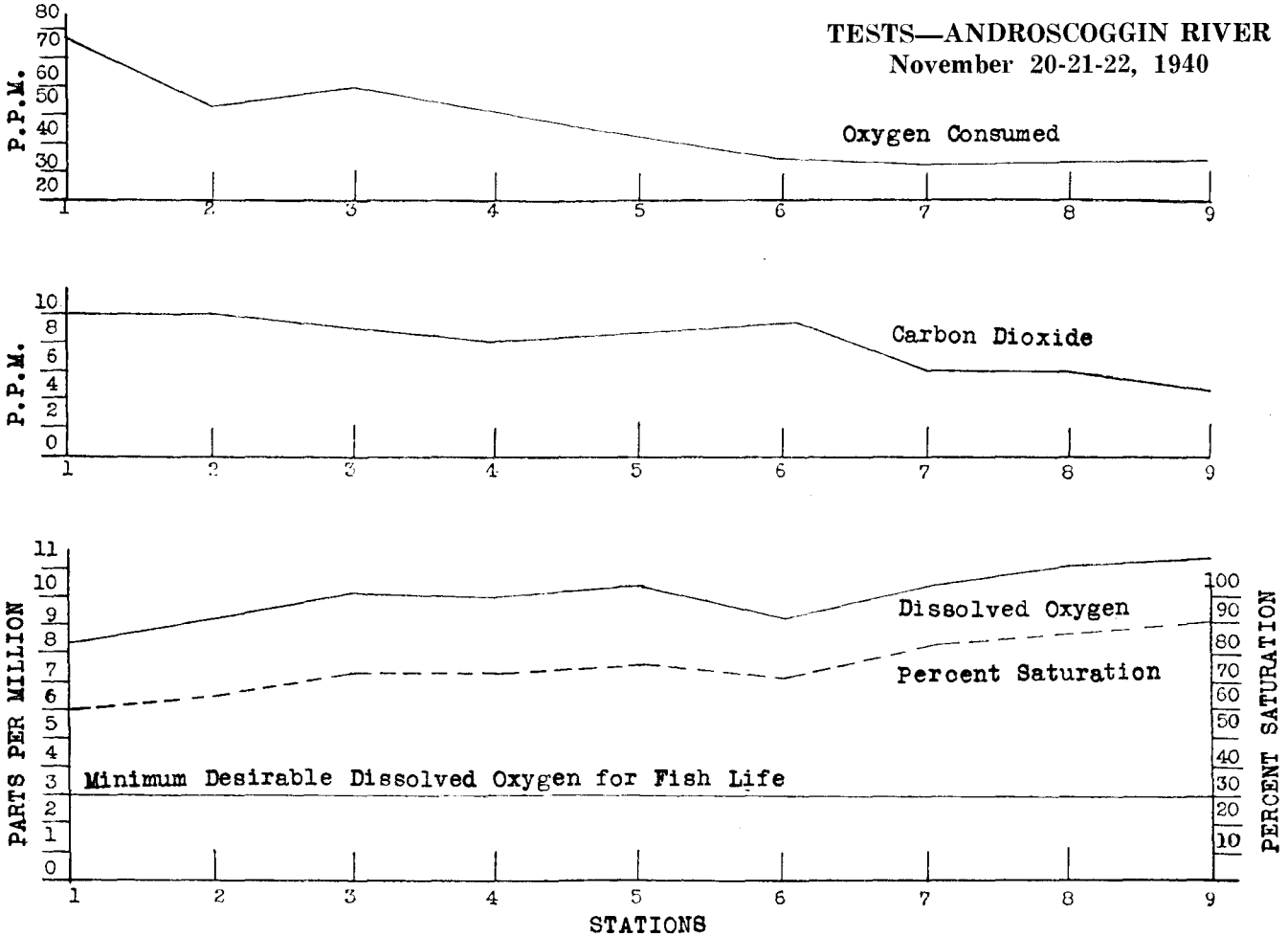
TESTS
ANDROSCOGGIN RIVER
September 24-27, 1940



TESTS
ANDROSCOGGIN RIVER
October 10 and 11, 1940




TESTS
ANDROSCOGGIN RIVER
October 30-31—November 1, 1940
P.P.M.
120
110
100
90
80
70
60
50
Oxygen Consumed
1
2
3
4
5
6
7
8
9
PARTS PER MILLION
18
16
14
12
10
8
6
4
2
0
Carbon Dioxide
P.P.M.
9
8
7
6
5
4
3
2
1
0
Dissolved Oxygen
Percent Saturation
Minimum Desirable Dissolved Oxygen for Fish Life
PERCENT SATURATION
90
80
70
60
50
40
30
20
10
0
STATIONS


TESTS—ANDROSCOGGIN RIVER
November 20-21-22, 1940
P.P.M.
Oxygen Consumed
Carbon Dioxide
PARTS PER MILLION
Dissolved Oxygen
Percent Saturation
Minimum Desirable Dissolved Oxygen for Fish Life
PERCENT SATURATION
STATIONS