RESULTS

METEOROLOGICAL - FEATURES

The weather of New Delhi can conveniently be divided into three main seasons, i.e. monsoon, from July to October including well demarcated post monsoon period of September and October, the cold weather period or winter season which falls in the months of November to February, and hot weather summer season from March to June. The same seasonal pattern is followed in the following results unless stated otherwise.

RAINFALL:

Rainfall data is shown in Fig. 3. It is clear from the figure that 81.9% of total rainfall was recorded only in the rainy season months July to October of which 60.6% rainfall was claimed in the single month of July 1980. In other months except July 1980 and August 1979 rainfall was scarce. In cold weather period from November to February 1980 rainfall counted to only 3.6% of total rainfall. In months October and November there was practically no rainfall. Summer showers were claimed mostly in March, May and June counted only to 14.3%. The total rainfall during one year period under study was 610.1 mm. The average rainfall was 500.9 mm in monsoon season, 22.3 mm in winter period, and 86.9 mm in Summer, during period of this investigation. In 1979 October, November and December
Fig. 3: Climatological features of New Delhi and physical characteristics of J.N.U. lake water in 1979-80.

Average values are expressed except pH, E.C. (m Mhos), Rainfall (m.m.) in mg/l.
had the least rains followed by January and February of 1980, while April was the driest month in 1980 and May fairly dry (Fig. 3).

**AIR TEMPERATURE**

Air temperature noted here (Fig. 3) was the temperature at 8.30 A.M. on the same day of sampling. Air temperature varied from 7.8°C to 34°C. The minimum air temperature was recorded in the month of January and the highest of 34°C in the month of June 1980. There was a gradual decline in air temperature from August 1979 with comparatively tremendous fall in November till it reached to its lowest of 7.8°C in January 1980. Later, it steadily increased to reach its highest peak in the month of June 1980 which also subsequently dropped in July 1980 again.

**PHYSICAL CHARACTERISTICS OF LAKE WATER**

**pH AND ELECTRICAL CONDUCTIVITY**

The pH of water ranged from 7.5 at spot IV in August to 8.6 at spots II, VII and VIII in June 1980. The pH of water lowest in August 1979, slightly increased in months of September and October 1979, and again declined near to minimum towards the month of January 1980. pH of water steadily increased from March onwards until it reached its highest in June and again abruptly dropped
Fig. 4: Chemical characteristics of J.N.U. lake in 1979-80. Average values are expressed in mg/l.
FIG. 4

RESULTS EXPRESSED IN mg/l

D.O. B.O.D. NITRATE NITRITE AMMONIA PHOSPHATE SULPHATE SILICA IRON

1979 1980

AS O N D J F M A M J J
Fig. 5: Hydrogen ion concentration (pH) and electrical conductivity of the water.
with the monsoon rains in July 1980. The pH value of water at different spots did not show extreme variations (Figs. 3 and 5). Average pH was 7.8 (7.5 - 8.1) in monsoon, 7.82 (7.6 - 8.2) in winter and 8.26 (7.9 - 8.6) in summer months (Table II).

Electrical conductivity (E.C.) of water ranged from 0.36 m Mhos in August at station IV to 0.63 m Mhos at stations III and VI in the month of June. Electrical conductivity was consistently lower at station IV than in all other spots throughout the study period. There was steady increase in E.C. in summer months attaining maxima in June. Interestingly, in monsoon months July and August it was lower and lowest respectively (Figs. 3 and 5). Compared to August 1979, E.C. had slightly increased in post monsoon months September and October. It lowered continuously in winter but did not touch the minimum. Averages and ranges of variations in different seasons were, monsoon season 0.45 m Mhos (0.36-0.52), winter season 0.46 mMhos (0.42-0.50) and in summer months 0.55 m Mhos (0.48-0.63) (Table II). Electrical conductivity was running more or less parallel to pH of the lake water.

WATER TEMPERATURE:

The temperature of lake water ranged from 15°C to 30°C. The mean temperature of water in winter being 17.2°C and in
TABLE II

Seasonal changes in physico-chemical characteristics of lake water. (Average values for 8 spots are expressed in mg/l except temp., pH and E.C.)

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Monsoon (July-October)</th>
<th>Winter (November-February)</th>
<th>Summer (March-June)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature (°C)</td>
<td>26.7 (22-30)</td>
<td>17.2 (15-21)</td>
<td>24.3 (19-29)</td>
</tr>
<tr>
<td>pH</td>
<td>7.8 (7.5-8.1)</td>
<td>7.82 (7.6-8.2)</td>
<td>8.26 (7.9-8.6)</td>
</tr>
<tr>
<td>E.C. (m Mhos)</td>
<td>0.45 (0.36-0.52)</td>
<td>0.46 (0.42-0.52)</td>
<td>0.55 (0.48-0.63)</td>
</tr>
<tr>
<td>Ca-hardness</td>
<td>43.5 (34.0-50.0)</td>
<td>56.1 (48.0-60.0)</td>
<td>65.6 (58.0-72.0)</td>
</tr>
<tr>
<td>Mg-hardness</td>
<td>25.43 (18.0-34.0)</td>
<td>36.56 (32.0-44.0)</td>
<td>44.8 (38.0-50.0)</td>
</tr>
<tr>
<td>D.O.</td>
<td>6.33 (6.0-7.6)</td>
<td>7.23 (4.4-9.6)</td>
<td>4.95 (3.6-6.8)</td>
</tr>
<tr>
<td>B.O.D.</td>
<td>3.4 (2.4-4.4)</td>
<td>3.25 (2.4-4.0)</td>
<td>4.1 (3.2-5.6)</td>
</tr>
<tr>
<td>Sulphate</td>
<td>9.54 (8.0-10.8)</td>
<td>7.0 (4.8-8.8)</td>
<td>4.88 (2.8-6.0)</td>
</tr>
<tr>
<td>Phosphate</td>
<td>0.046 (0.028-0.07)</td>
<td>0.027 (0.018-0.045)</td>
<td>0.016 (0.01-0.024)</td>
</tr>
<tr>
<td>Nitrate</td>
<td>0.272 (0.16-0.48)</td>
<td>0.144 (0.09-0.205)</td>
<td>0.86 (0.04-0.13)</td>
</tr>
<tr>
<td>Nitrite</td>
<td>0.053 (0.032-0.07)</td>
<td>0.28 (0.018-0.045)</td>
<td>0.016 (0.008-0.022)</td>
</tr>
<tr>
<td>Ammonia</td>
<td>0.215 (0.144-0.29)</td>
<td>0.13 (0.1-0.176)</td>
<td>0.069 (0.03-0.011)</td>
</tr>
<tr>
<td>Silicate</td>
<td>10.56 (9.04-11.92)</td>
<td>8.72 (6.4-11.28)</td>
<td>5.39 (3.44-7.04)</td>
</tr>
<tr>
<td>Iron</td>
<td>0.372 (0.27-0.495)</td>
<td>0.262 (0.17-0.345)</td>
<td>0.15 (0.085-0.235)</td>
</tr>
</tbody>
</table>
summer it was 24.3°C (Table II). At different spots temperatures were almost same throughout the lake. The lowest temperature (15°C) was recorded in the month of January 1980, and highest (30°C) in August 1979. From August onwards there was gradual decrease in water temperature till the lowest was reached in January 1980. Then a continuous and fairly steady increase in temperature was marked in summer months (Figs. 3 and 6). The graph followed the course of that of air temperature except that air temperature started dropping after rains in July but water temperature was nearly constant in July 1980 without any draw down.

**Ca AND Mg HARDNESS:**

Calcium hardness of lake water ranged from 34 mg/l to 70 mg/l. It was at its lowest value in August 1979 and highest in June 1980. It steadily increased August onwards without any drop till it reached highest in June 1980. It was only at the onset of monsoon in July 1980 that calcium hardness abruptly dropped to its lowest value following heavy rains (Figs. 3 and 7). Seasonal averages and ranges of calcium hardness were, 43.5 mg/l (34.0-50.0); 56.1 mg/l (48.0-60.0) and 65.6 mg/l (58.0-72.0) in monsoon, winter and summer.
Fig. 6: Temperature of the water.
Fig. 7: Ca-hardness of the water.
seasons respectively (Table II). Calcium hardness was nearly double or more in concentration as compared to that of magnesium hardness throughout the study period.

Magnesium hardness varied from 18.0 mg/l to 50.0 mg/l. The lowest value of magnesium hardness in August steadily increased till it reached its highest value in June 1980 and then subsequently dropped in the month of July 1980 to its lowest concentration on the onset of rainy season (Figs. 3 and 8). Magnesium hardness averaged and ranged as 25.43 mg/l (18.0-34.0) in monsoon season; 36.56 mg/l (32.0-44.0) in winter and 44.8 mg/l (38.0-50.0) in summer months (Table II). It paralleled calcium hardness in its pattern and periodicity.

CHEMICAL PROPERTIES OF LAKE WATER

DISSOLVED OXYGEN:

Concentrations of Dissolved Oxygen (D.O.) of water ranged between 3.6 and 9.6 mg/l. The maximum average D.O. of 9.2 mg/l (8.4-9.6) was estimated in the month of February 1980. In spots II, III, IV, VII and VIII maximum D.O. reached in February while in spots I and VI, it was highest in the month of January itself. The minimum average D.O. of 4.0 mg/ml (3.6-4.8) was in the month of May in spots III and IV while in remaining spots minima occurred in the month of June 1980. Dissolved oxygen
Fig. 8: Mg-hardness of the water.
MAGNESIUM HARDNESS mg/l

Fig. 8

1979

1980
concentration at spot IV remained lower than that at other spots throughout the study (Figs. 4 and 9). Averages and ranges for D.O. in different seasons were 6.33 mg/l (6.0-7.6) in monsoon, 7.23 mg/l (4.4-9.6) in winter and 4.95 mg/l (3.6-6.8) in summer (Table II).

**BIOLOGICAL OXYGEN DEMAND**

The Biological Oxygen Demand (B.O.D.) of the lake water ranged between 2.4 and 5.6 mg/l. Maximum average of 4.6 mg/l was recorded in the month of May in spots II, IV and VII while in remaining spots maximum was estimated in June 1980. The minimum B.O.D. was observed at spots III, VI and VII in the month of February while at spots I and V in January and spots II, IV and VII had their minimum B.O.D. record in the month of August (Figs. 4 and 10). The average B.O.D. in monsoon season was 3.4 mg/l (2.4-4.4); 3.25 mg/l (2.4-4.0); in winter and 4.1 mg/l (3.2-5.6) in the hot weather period of summer, 1980 (Table II).

**NITRATE-NITROGEN:**

Nitrate nitrogen in the water more or less ran parallel to that of ammonical nitrogen in its concentration, pattern and periodicity. The overall variations were from 0.04 to 0.48 mg/l. Like ammonia and nitrite nitrogen, the concentration was at its lowest value in June and later improved to great extent in July with the monsoon drains
Fig. 9: Dissolved Oxygen in the lake water.
Fig. 10: Biochemical Oxygen Demand (B.O.D.).
finding their way in the lake water. This was consistent with all the samples. The average minimum of nitrate was 0.061 mg/l (0.04-0.085) in June while maximum of 0.36 mg/l (0.28-0.48) was estimated in the month of August 1979 throughout the lake (Figs. 4 and 11). The average nitrate nitrogen was 0.27 mg/l (0.16-0.48) in monsoon; 0.144 mg/l (0.09-0.205) in winter and 0.086 mg/l (0.04-0.13) in summer (Table II).

NITRITE NITROGEN

Nitrate varied from 0.008 to 0.07 mg/l. Nitrate nitrogen values were highest in overall sampling sites in August 1979 with average of 0.0605 mg/l (0.048-0.070); while lowest average concentration of nitrite nitrogen recorded was 0.013 mg/l (0.008-0.017) in the month of June 1980. From August onwards nitrite declined continuously towards the end of June and on the onset of monsoon, nitrite further increased in concentration (Figs. 4 and 12). The average nitrite was 0.053 mg/l (0.032-0.07) in monsoon, 0.028 mg/l (0.018-0.045) in winter months and in summer months it was 0.016 mg/l (0.008-0.022) (Table II). Among all three nitrogen sources studied nitrite nitrogen was least in concentration. The summer decrease in nitrite however, was much greater than ammonia.
Fig. 11: Nitrate nitrogen (NO₃) in the water.
Fig. 12: Nitrite nitrogen (NO$_2$) in the water.
AMMONICAL NITROGEN

The figures ranged from minimum of 0.03 mg/l in June 1980 to a maximum of 0.29 mg/l in August 1979 (Figs. 4 and 13). The average ammonical nitrogen was 0.215 mg/l (0.144-0.29) in monsoon; 0.13 mg/l (0.1-0.176) in winter and 0.069 mg/l (0.03-0.1) in summer (Table II).

Interestingly, ammonia almost ran parallel to that of nitrate nitrogen. It also followed the same pattern and periodicity as that of nitrate nitrogen. It continuously declined from August 1979 onward towards its lowest in June and again increased in July 1980 near to its maximum. Samples III and VII did not show any marked variation in ammonical nitrogen (Figs. 4 and 13).

PHOSPHATE-PHOSPHORUS:

The phosphate varied from a minimum of 0.01 mg/l in June 1980 to a maximum of 0.07 mg/l in August 1979. Phosphate amount decreased from August till it reached a minimum in June 1980 and again recovered near to its maximum in July on the onset of monsoon (Figs. 4 and 14). The average phosphate concentration was 0.046 mg/l (0.029-0.07) in monsoon, 0.027 mg/l (0.018-0.045) in winter and 0.016 mg/l (0.01-0.024) in summer months (Table II).
Fig. 13: Ammonical nitrogen ($\text{NH}_4$) in the water.
Fig. 14: Phosphate ion (PO$_4$) in the water.
**SULPHATE-SULPHUR:**

It ranged from a minimum of 2.8 mg/l in June 1980 to a maximum of 10.8 mg/l in August 1979. Sulphate concentration decreased gradually from September 1979 to June 1980 and then it rose again in July 1980 to its higher concentration following monsoon rains (Figs. 4 and 15). The seasonal averages and range of variations were, monsoon season 9.54 mg/l (8.0-10.8), winter season, 7.0 mg/l (4.8-8.8), and 4.88 mg/l (2.8-6.0) in summer months (Table II). Variations in different spots were much higher as compared to other chemical ions of the water (Figs. 4 and 15).

**SILICATE-SILICA:**

Silica in form of silicates varied from 3.44 to 11.92 mg/l. The highest concentration of silicate recorded in the month of August 1979 was 11.46 mg/l (10.12-11.92). Lowest value of 2.44 mg/l (3.44-4.16) was established in the month of June 1980. Silicate did not show any peculiar changes like other chemical ions. The highest concentration in the month of August 1979, decreased towards June 1980, but with some fluctuations in spots I, III, V, VII and VIII in the months November to February, while in spots II, IV and VI, it fluctuated in the months of November, December and January. This may be attributed to the rocky silica rich boundary of the lake. However, the lowest value again increased tremendously in July 1980 (Figs. 4 and 16).
Fig. 15: Sulphate ion \((SO_4)\) in the water.
Fig. 16: Silicates silica concentration in the lake water.
The average and range concentrations of silicate were as follows: 10.56 mg/l (9.04-11.92) in monsoon, 8.72 mg/l (6.4-11.28) in winter and 5.39 mg/l (3.44-7.04) in summer (Table II).

It showed seasonal pattern more or less similar to other ions like sulphate, phosphate, nitrate, nitrite and ammonia but with some peculiar fluctuations in post monsoon months.

IRON:

Iron concentration in the lake water ranged between 0.065 and 0.495 mg/l. Average maximum of 0.432 mg/l (0.345-0.495) was recorded in overall sampling spots in the month of August 1979 while minimum of 0.095 mg/l (0.065-0.12) was seen in the month of June 1980. It also followed the seasonal pattern similar to other ions like, sulphate, phosphate, nitrate, nitrite and ammonia, i.e., having its highest concentration in August 1979 which reduced continuously till it reached its minimum in June 1980 and June onwards again there was an increase in iron concentration on the onset of monsoon rains in July 1980 (Figs. 4 and 17). The seasonal averages and ranges were, 0.372 mg/l (0.27-0.495); 0.262 mg/l (0.17-0.345) and 0.15 mg/l (0.85-0.235) in monsoon season, winter season and summer weather respectively (Table II).
Fig. 17: Iron (Fe) concentration in the water.
BIOLOGICAL PROPERTIES OF LAKE WATER

COLIFORM BACTERIA:

Figs. 18 and 19 indicated that total coliform counts varied from 1.7 x 10^2 to 2.4 x 10^3/100 ml and faecal coliform from 1.09 x 10^2 to 1.6 x 10^3/100 ml. Interestingly, there were seen extreme variations in the bacterial counts both total and faecal in different samples collected from the lake water at the same time. This observation clearly indicated the presence of variable population of coliform bacteria at different locations of the lake water at the time of sampling. Average highest total coliform of 2.202 x 10^3/100 ml (1.6 x 10^3 - 2.4 x 10^3) and faecal coliform of 1.451 x 10^3/100 ml (0.918 x 10^3 - 1.609 x 10^3) were recorded in the month of June 1980. Average lowest counts for total coliform were 2.36 x 10^2/100 ml (1.7 x 10^2 - 3.45 x 10^2) and 1.73 x 10^2/100 (1.09 x 10^2 - 2.4 x 10^2) for faecal coliform which were recorded in the month of February 1980. However, lowest total coliform were recorded in August in spots I and V, while in spot VII it was recorded in January and in remaining spots in February 1980. Lowest faecal coliforms in spots I and III were seen in August and in spots V and VI in January and in remaining spots in the month of February 1980 (Figs. 18 and 19).

It was seen that average counts were lower in August. It slightly increased till October and later continuously dropped during November-February till it reached its lowest
Fig. 18: Counts of coliform bacteria in water samples (at different spots).
FIG. 18
Fig. 19: Counts of coliform bacteria in water samples (Spots V to VIII).
average value again in the month of February 1980. This was true for both total coliform and faecal coliform. However, from March, coliforms continuously showed increasing trend in growth - which was more vigorous in summer months March to June and attained its peak in June 1980. The highest coliform counts suffered big set back in July with the onset of monsoon (Fig. 20).

It is also evident from Fig. 20 that there appeared some positive relationship between total coliform and faecal coliform. An increase in the number of total coliform showed predictable increase in the faecal coliform and with decrease in one variable there was corresponding decrease in the other. If it is assumed that total coliform represented coliform group as such i.e. faecal plus non faecal coliform, then by subtracting corresponding faecal coliform value from total coliform, it can be inferred that faecal coliforms were substantially more than those of non faecal throughout the study, thus pointing towards reliable index of faecal pollution in the true sense.

The water samples varied in their degree of pollution. Spots III, V, VI and VII were highly polluted as these were
FIG. 20

1979

1980

AVERAGE COUNTS OF COLIFORM BACTERIA/100 ml

TOTAL COLIFORM

FAECAL COLIFORM
usually used as washing and bathing ghats. While spot IV was least polluted and other spots were moderately polluted. Total and faecal coliform at station IV showed lower values throughout the study period. Water here was clear, while spot VIII recorded comparatively higher values (Figs. 18 and 19). Seasonal and spotwise distribution of total as well as faecal coliform is depicted in Table III. Corresponding averages and ranges in total coliform were $4.616 \times 10^2 / 100$ ml ($2.88 \times 10^2 - 6.517 \times 10^2$) in monsoon, $3.185 \times 10^2 / 100$ ml ($2.41 \times 10^2 - 3.89 \times 10^2$) in winter and $11.812 \times 10^2 / 100$ ml ($8.07 \times 10^2 - 13.69 \times 10^2$) in summer. While faecal coliforms were $3.15 \times 10^2 / 100$ ml ($2.37 \times 10^2 - 4.10 \times 10^2$), $2.126 \times 10^2 / 100$ ml ($1.71 \times 10^2 - 2.49 \times 10^2$) and $7.285 \times 10^2 / 100$ ml ($4.46 \times 10^2 - 7.988 \times 10^2$) in monsoon, winter and summer months respectively.

Calculations indicated that bacterial population was lower in monsoon, lowest in winter and highest in summer months. Correlation coefficient between total coliform and faecal coliform: was $1:0.67$, $1:0.66$ and $1:0.61$ in monsoon, winter and summer months respectively. It denoted that nearly 60 to 70% of total coliform were faecal coliforms. Occasionally isolated pathogenic bacterial species belonged to genera, *Vibrio*, *Salmonella* and *Shigella* beside *E. coli* and non pathogenic *A. aerogenes*. 
TABLE III

Season and spotwise values of total and faecal coliform counts

<table>
<thead>
<tr>
<th>Spot No.</th>
<th>Total Coliform/100 ml</th>
<th>Faecal Coliform/100 ml</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Monsoon (July-Oct.)</td>
<td>Winter (Nov.-Feb.)</td>
</tr>
<tr>
<td>I</td>
<td>$3.65 \times 10^2$</td>
<td>$3.26 \times 10^2$</td>
</tr>
<tr>
<td>II</td>
<td>$3.96 \times 10^2$</td>
<td>$2.45 \times 10^2$</td>
</tr>
<tr>
<td>III</td>
<td>$4.92 \times 10^2$</td>
<td>$2.44 \times 10^2$</td>
</tr>
<tr>
<td>IV</td>
<td>$2.88 \times 10^2$</td>
<td>$2.41 \times 10^2$</td>
</tr>
<tr>
<td>V</td>
<td>$5.145 \times 10^2$</td>
<td>$3.78 \times 10^2$</td>
</tr>
<tr>
<td>VI</td>
<td>$5.21 \times 10^2$</td>
<td>$3.32 \times 10^2$</td>
</tr>
<tr>
<td>VII</td>
<td>$4.645 \times 10^2$</td>
<td>$3.84 \times 10^2$</td>
</tr>
<tr>
<td>VIII</td>
<td>$6.517 \times 10^2$</td>
<td>$3.98 \times 10^2$</td>
</tr>
<tr>
<td>Average</td>
<td>$4.616 \times 10^2$</td>
<td>$3.185 \times 10^2$</td>
</tr>
</tbody>
</table>
INTERACTION BETWEEN COLIFORM BACTERIA AND PHYSICO-CHEMICAL FACTORS

COLIFORM BACTERIA AND pH AND ELECTRICAL CONDUCTIVITY:

There seems to be a directly proportional correlation between coliform bacteria, pH and electrical conductivity of the lake water. When coliform counts recorded were highest in summer month June 1980, both pH and E.C. were at their highest, and with sudden drop in coliforms in the month of July the pH and E.C. values showed a decline. With decrease in coliform counts in winter months, pH and E.C. also lowered down. However, February onward pH, E.C. again started rising while coliforms dropped till February and showed increase from March onwards till it reached its highest in June. Thus, with fall of coliform counts, E.C. and pH also lowered down, whereas with increase in coliform, pH and E.C. also increased (Fig. 21).

COLIFORM BACTERIA AND WATER TEMPERATURE:

Temperature had a prepondering influence over coliform counts. High temperature favoured multiplication, while low temperature retarded the growth of coliforms. When temperature dropped in winter months (November-February), coliform counts also declined. However, temperature was lowest in January and coliforms were lowest in February. With increase in temperature in summer months (March to June) coliform count also increased. But interestingly
Fig. 21. Relationship between, pH, electrical conductivity and coliform bacteria.
Figure 21

Counts of Coliform Bacteria /100 ml

AS OND J F M A M J J

1979 1980

pH

E.C. (m MHOS)
Fig. 22: Relationship between temperature, iron and coliform bacterial counts.
COUNTS OF COLIFORM BACTERIA / 100 ml

TEMPERATURE °C

IRON mg/l

FIG. 22
1979
1980
A S O N D M F M A M A M J J

15 20 25 30

200 600 1000 1400 1800 2200

200 600 1000 1400 1800 2200
while coliforms suffered set back with monsoon rains in July, water, temperature increased to its highest in August, although air temperature dropped very much in July (Fig. 22).

**IRON AND COLIFORM COUNTS:**

Iron has shown an inverse correlation with coliforms. When iron concentration was highest in August, coliforms were near to lowest and when coliforms were highest in June, iron concentration was lowest. There had been a relative increase in counts with a decrease in iron concentration (Fig. 22).

**COLIFORM COUNTS AND CALCIUM, MAGNESIUM HARDNESS OF WATER:**

An attempt has been made to compare the Ca, Mg hardness of the water with that of total coliform bacterial counts. The striking observation was that the maximum counts of coliform bacteria coincided with the maximum values of the water hardness. Similarly, the counts were low when the hardness was also low as noted in Fig. 23.

**DISSOLVED OXYGEN IN WATER AND COLIFORM COUNTS:**

Dissolved oxygen in water had notable impact on coliform counts. When coliform counts were lowest in the winter (February), dissolved oxygen had its highest concen-
Fig. 23: Correlation between coliform counts and Ca, Mg-hardness of the water.
COUNTS OF COLIFORM BACTERIA / 100 ml

1979

1980

CALCIUM HARDNESS mg/l

MAGNESIUM HARDNESS mg/l
tration. Whereas in Summer (June) when coliform had highest values, D.O. levels were lowest, thereby indicating inverse correlation between them (Fig. 24).

**BIOCHEMICAL OXYGEN DEMAND AND COLIFORM COUNTS:**

Coliform counts were found to be directly proportional to Biochemical Oxygen Demand (B.O.D.). Fig. 24 shows that when B.O.D. had highest concentration in June, bacterial counts were also highest. Lowest counts of bacteria coincided with lowest B.O.D. in the month of February. Decrease in one variable was followed by decrease in second variable and vice-versa. Decline in coliform counts in winter were also followed by decrease in B.O.D. When bacterial density increased, B.O.D. also showed an increase, till both achieved their maxima in June 1980 (Fig. 24).

**DIFFERENT NITROGEN SOURCES AND COLIFORM COUNTS:**

An effort was made to correlate the different sources of nitrogen with that of coliform bacterial counts. Characteristically, NH₃, NO₂, NO₃ nitrogen, all indicated a more or less similar pattern. There was seen a relative increase in counts with decrease in nitrogen compounds. When lowest nitrogen sources in the month of June were found in lake water, bacterial counts were at its highest value. Similarly, when counts were low in August, the concentrations
Fig. 24: Relationship between Dissolved Oxygen, Biochemical Oxygen Demand and coliform bacterial counts.
Fig. 25: Interaction between phosphate, nitrate and coliform bacterial counts.
of $\text{NO}_3$ (Fig. 25), $\text{NO}_2$ (Fig. 26) and $\text{NH}_3$ (Fig. 26) had the maximum values.

**PHOSPHATE, SULPHATE, SILICATE AND COLIFORMS:**

Fig. 25 indicates a distinct correlation of phosphate concentration with that of coliform bacterial counts. The concentration of the phosphate was inversely proportional to the bacterial counts. During May and June bacterial counts recorded were highest, while during the same period, phosphate concentration was lowest. Similarly, the samples collected in the month of August showed maximum phosphate concentration in the lake water, whereas the bacterial counts were nearly lowest.

An almost similar pattern was seen while correlating coliform counts with that of sulphate concentration. Although the pattern was not as distinct as seen for phosphate ions, but nevertheless the bacterial counts were highest while sulphate concentrations were lowest. When sulphate concentration was highest i.e. in the month of August the bacterial counts were almost lowest (Fig. 27).

Although silicate showed a pattern of periodicity similar to that of sulphate and phosphate, it was marked by its peculiar fluctuations in contrast. However, generally it also showed that when silicate concentration was at its
Fig. 26: Interaction of nitrite, ammonia with coliform bacterial counts.
Fig. 27: Relationship of sulphate, silica concentration with that of coliform bacterial counts.
highest in August, bacterial counts were near to lowest, and while silicate concentration was lowest in June, highest bacterial counts were recorded (Fig. 27).