PART II
The physico-chemical variables, studied over a period of two years, at the three stations were:

1. Atmospheric temperature
2. Water temperature
3. Humidity
4. Rainfall
5. Dissolved gases (O₂ & CO₂)
6. Oxidizable organic matter
7. Hydrogen ion concentration
8. Calcium
9. Magnesium
10. Bicarbonate
11. Chloride
12. Sulphate
13. Albuminoid nitrogen
14. Ammonia nitrogen
15. Nitrate nitrogen
16. Nitrite nitrogen
17. Total nitrogen
18. Phosphate
19. Dissolved solids
20. Suspended solids
21. Total solids.
In this region, the climate is clearly marked out into three distinct seasons, namely monsoon (June to September), winter (October to January) and summer (February to May). The monsoon season is characterized by a cloudy sky, relatively more humidity and moderate to high temperature. The winter has relatively brighter days with a clear sky, but the duration of the day is lesser. During the summer the sky is clear, the duration of the day is relatively longer and the intensity of the sun light is comparatively more. Since the duration and intensity of sun light, the air and the water temperature and the humidity ultimately influence other ecological factors, the study of variables was done season-wise at the different stations.

1. **Atmospheric Temperature.**

The atmospheric temperature recorded at the first two stations was identical, in view of their close vicinity, while that of the third station was slightly different probably because of its greater elevation and different dates of sampling.
Table 1: Showing the variations in Atmospheric temperature (°C) at the three stations during 1976-77(*) and 1977-78 (+)

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The pattern of fluctuations of the atmospheric temperature at the three stations, over a period of two years is shown in Table 1. The annual range of temperature at the first two stations was 15.8 - 30.8°C during 1976-77 (Figs. 1A, 2A) and 17.0 - 32.8°C during 1977-78 (Figs. 1D, 2D). The range at the third station 16.6 - 30.4°C and 15.0 - 33.8°C during the two years respectively (Figs. 3A, 3D).

A season-wise analysis showed that the average temperature was maximum during summers (25.3 - 26.7°C), slightly lesser during the monsoons (23.4 - 25.0°C) and least during winter (21.3 - 22.3°C). During the monsoons the range of temperature was narrow (4.0 - 7.0°C) while during winters the range was wider (9.0 - 12.0°C). The maximum temperature was almost similar during the two seasons but the minimum was much lower in winter. During summers the range of temperature was much wider (13.0 - 17.0°C) since the minimum temperature was like winter, but the maximum had gone up.

In general the monsoon has moderate temperature with a narrow range, the winters a wider range with minimum going down and the summers the widest range with the maximum also going up.
2. WATER TEMPERATURE.

The pattern of fluctuations of water temperature at the three stations over the period of two years is shown in Table 2. It is consistently lower than the atmospheric temperature by 1 - 2°C throughout. Therefore the pattern of fluctuations are identical with that of atmospheric temperature (Figs. 1A-D; 2A-D; 3A-B).

3. HUMIDITY.

At all the stations and during both the years the percentage of humidity was maximum during the monsoons, being over 75%. It was around 50% during the winters and less than 40% during the summers. The details are shown in Table 3.

4. RAINFALL.

The total rainfall recorded during 1976-77 was 521.5 mm of which 417.3 mm was during the monsoon season. The rainfall was relatively much less during the winter 74.1 mm and summer 30.1 mm.

During 1977-78 the total rainfall was much higher, being 790.6 mm, of which 519.9 mm was during
Table 2: Showing the variations in water temperature (°C) at the three stations during 1976-77 (*) and 1977-78 (+)

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Table 3: Showing the variations in Humidity (%) at the three stations during 1976–77 (*) and 1977–78 (+)

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Fig. 1 A. Showing the physical-chemical variables during 1976-77 of station 1.
Fig. 2: Showing the physico-chemical variables during 1976-77 at station 2.
Fig. 3 A: Showing the physico-chemical variables during 1976–77 at station 3.
the monsoon. That winter had an unusually heavy spell of rain (259.8 mm), probably because of a prolonged monsoon. The rain was negligible (11.9 mm) during the following summer.

During the monsoon of 1976, bulk of the rain was during June and July (117.4 & 204.4 mm), August and September recording relatively much less rainfall (49.6 & 45.9 mm). On the other hand rain was much more evenly spread out and heavier during the monsoon of 1977, the records for the four months being 135.8, 147.6, 76.3 and 160.2 mm respectively.

5. DISSOLVED GASES (Oxygen and Carbon dioxide)

The amount of dissolved oxygen showed fluctuations at the three stations and during the various seasons. It showed a range of 6.94 - 11.34 ppm at station 1 (Fig. 1A), 6.95 - 11.21 ppm at station 2 (Fig. 2A) and 6.23 - 10.57 ppm at station 3 (Fig. 3A) during 1976-77. During 1977-78 the range was slightly higher, being 7.63 - 11.35 ppm (Fig. 1B), 8.35 - 11.76 ppm (Fig. 2B) and 8.73 - 11.61 ppm (Fig. 3B) at the three stations, respectively. The details of amount recorded are shown in Table 4. The amount of dissolved oxygen...
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Table 4: Showing the variations in the quantity of Dissolved oxygen (ppm) at the three stations during 1976-77 (*) and 1977-78 (+)
was maximal in summer and minimal during the monsoon at station 1, during both the years. At station 2 the amount of dissolved oxygen during the winters was equal to or slightly more that during summer, while it was minimal during the monsoon of both the years. At the third station the pattern was different during the two years of study. In the first year it was more in summer as at the first station and in the second year it was similar to the pattern of station 2.

Carbon dioxide was absent at all the stations throughout the period of study.

6. OXIDIZABLE ORGANIC MATTER

The amount of oxidizable organic matter showed variations at the three stations, during the two years. It was 1.83 - 2.78 ppm, 1.32 - 2.87 ppm and 1.03 - 3.11 ppm at the three stations respectively during 1976-77 (Figs. 1a, 2a, 3a). In the second year it showed a range of 1.09 - 2.86 ppm, 1.56 - 2.73 ppm and 1.20 - 2.96 ppm respectively at the three stations (Figs. 1b, 2b, 3b). The details are shown in Table 5.

In general it was maximal during winters and minimal during the monsoons. The quantity during
Table 5: Showing the variations in the quantity of Oxidizable organic matter (ppm) at the three stations during 1976-77 (*) and 1977-78 (+)

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Fig. 1 D: Showing the physico-chemical activities during 1977-78 at station 1.
Fig. 2 D: Showing the physical chemical variables during 1977-78 at Station 2.
Fig. 3 D: Showing the physical-chemical variables during 1977 at Station 2.
summer was generally lower than in winters, except in the case of first station, where the summer and winter quantities were almost equal during 1976-77.

7. HYDROGEN ION CONCENTRATION

The pH showed an alkaline range throughout, the first two stations showing a range of 7.0 - 8.0 during both the years (Figs. 1A, 1D, 2A, 2D) and the third station showing a relatively narrower range of 7.6 - 7.8 during 1976-77 (Fig. 3A) and 7.5 - 7.7 during 1977-78 (Fig. 3D). The details of pH recorded during the study are shown in Table 6. The pH was relatively more in winters and almost the same during the summers and monsoons of both the years at station 1. The same pattern was seen at the second station during 1977-78, but during the first year the pH in monsoon was lower than during summer. At the third station there was practically no difference in the pH over the various seasons during the two years.

8. CALCIUM

The quantity of Ca showed distinct variations at three stations, being relatively more at station 2.
Table 6: Showing the variations in Hydrogen ion concentration at the three stations during 1976-77 (*) and 1977-78 (+)

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Here it was 16.98 - 30.72 ppm during 1976-77 (Fig. 2B) and 20.42 - 27.73 ppm during 1977-78 (Fig. 2E). The quantity of Ca at station 3 was about half of this, being 8.61 - 13.23 ppm and 8.92 - 12.53 ppm during the two years respectively (Figs. 3B, E). The quantity was lowest at the first station where it showed a range of 6.39 - 9.79 ppm and 7.63 - 12.53 ppm during the two years (Figs. 1B, E). The details of the quantities recorded at the different stations over the two years are shown in Table 7.

At the first station the quantity of Ca is maximum during monsoon and minimum during winters. At the second station, there was a marked difference in the two years of study. In the first year, it was maximum during the monsoon while in the second year the summer and monsoon quantities were almost equal. At the third station it was maximum during the monsoons of both the years, but the minimum was during the winter in first year and in summer in the second year.
Table 7: Showing the variations in the quantity of Calcium (ppm) at the three stations during 1976-77 (*) and 1977-78 (+)

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Fig. 2 Showing the physico-chemical variables during 1975-77
or section 2. (cont'd)
Fig. 3 B: Showing the physico-chemical variables during 1976-77 at station 3. (contd)
9. MAGNESIUM

The relative quantities of Mg present showed interesting fluctuations at the three stations over the two years. During the first year of study it was maximum at the second station (5.71 - 11.29 ppm) followed by the third station (3.64 - 7.97 ppm) and the first station (2.16 - 4.23 ppm). During the second year however the third station recorded more Mg (5.13 - 6.23 ppm) while the quantity at the first two stations was almost similar (3.98 - 6.21 ppm at the first station and 2.16 - 6.72 ppm at the second station). The details of the content recorded at the different stations are shown in Table 3 and Figs. 1B,E; 2B,E; 3B,E).

The pattern of fluctuations did not show any definite seasonal relevance. At the first station it was maximum during winter and minimum during summer during first year and just the reverse of it during the second year. At the second station it was maximum during winter and minimum during monsoon of first year while being maximum during monsoon and minimum during summer during second year. At the third station it was maximum in Summer and minimum in monsoon during the first year and just the reverse of it during the second year.
Table 8: Showing the variations in the quantity of Magnecium (ppm) at the three stations during 1976-77 (*) and 1977-78 (+)

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10. BICARBONATE

The bicarbonate content was relatively more at station 2 than the other two stations. The record at station 2 for 1976-77 was 116.1 - 129.3 ppm (Fig. 2B) while that for 1977-78 was 97.5 - 152.1 ppm (Fig. 2C). The quantity recorded at the other two stations was much lesser and almost equal. The first station showing the range of 55.57 - 74.67 ppm (Fig. 1A) and 42.35 - 93.04 ppm (Fig. 1B) and the third station 46.37 - 76.52 ppm (Fig. 3A) and 56.76 - 86.11 ppm (Fig. 3D) respectively during the two years. The details of quantities recorded are shown in Table 9.

At the first station, the quantity recorded was maximum during the winter and minimum during the summer during the first year, while it was more during the monsoon and lesser during the winter during the second year.

At the second station, the minimum was during the monsoons of both the years but the maximum was during the winter in the first year and summer in the second year.

At the third station it was more during monsoons and least during the summers of both the years.
Table 9: Showing the variations in the quantity of Bicarbonate (ppm) at the three stations during 1976-77 (*) and 1977-78 (+)

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11. CHLORIDE

The amount of chlorides recorded showed considerable variations from station to station and year to year. During the first year, the second station showed a greater amount (40.54 - 57.69 ppm) than the third (20.12 - 42.69 ppm) and the first (18.58 - 29.52 ppm).

During the second year, the second station showed a very wide range (18.32 - 72.63 ppm) while the first station recorded 30.37 - 46.64 ppm and the third station 25.37 - 31.97 ppm. The details of quantities recorded are shown in Table 10 and Figs. 1B, E; 2B, E; 3B, E.

At the first station it was more during summer than winter and monsoon, the latter two quantities being almost equal.

At the second station the minimum was during the summers of both the years, while the maximum was during the winter of the first year and monsoon of the second year.

At the third station the pattern during the first year was the same as that of second station i.e.
Table 10: Showing the variations in the quantity of Chloride (ppm) at the three stations during 1976-77 (*) and 1977-78 (+)

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Fig. 1 E: Showing the physical-chemical variations June 1972-84
Fig. 2.2. Showing the physico-chemical variables during 1977-78 at station 2. (contd.)
more in winter and least in summer. However during
the second year the summer and the monsoon recordings
were almost similar and slightly more or equal to that
during winter.

12. Sulphate

The quantities of sulphate recorded at the three
stations were not significantly different during both
the years of study. It was 1.37 - 2.57 ppm, 1.20 - 2.97
ppm and 1.01 - 1.87 ppm at the three stations respect-
ively during 1976-77 (Figs. 1B, 2B, 3B). The corre-
sponding figures for the next year were 1.05 - 2.46 ppm,
1.09 - 2.31 ppm and 1.11 - 2.23 ppm respectively for
the three stations (Figs. 1E, 2E, 3E). The details of
the quantities recorded are shown in Table 11.

At the first station, it was maximum during the
monsoon and minimum during the summer during the first
year, but more during summer and least in winter during
the second year.

At the second station it was maximum during
summer and least during winter of the first year and
the reverse of it during the second year.
Table 11: Showing the variations in the quantity of sulphate (ppm) at the three stations during 1976–77 (*) and 1977–78 (+)

<table>
<thead>
<tr>
<th>Station No.</th>
<th>Seasons</th>
<th>Months</th>
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<td>1 I</td>
</tr>
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<td></td>
<td>Summer</td>
<td>1.02</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+</td>
</tr>
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</table>
At the third station it was minimal during summers of both the years but maximal in winter in the first year and monsoon in the second year.

13. ALBUMINOID NITROGEN

During both the years of study, the albuminoid nitrogen recorded at the first two stations was relatively more than at the third station. The amount recorded at the third station was: 0 - 0.03 ppm (Fig. 3C) and 0.02 - 0.09 ppm (Fig. 3F) during the two years, as against the first station where it was 0.02 - 0.23 ppm (Fig. 1C) and 0.06 - 0.57 ppm (Fig. 1F) and the second station where it was 0.06 - 0.19 (Fig. 2C) and 0.02 - 0.49 ppm (Fig. 2F) during the two years respectively. The details of the quantities recorded are shown in Table 12.

At the first station it was maximum during summer and minimum during monsoon of the first year but maximum in monsoon and minimum in the summer of the second year.

At the second station the maximum was during monsoons of both the years but the quantity was lowest in winter of first year and summer of the second year.
Table 12: Showing the variations in the quantity of Albuminoid nitrogen (ppm) at the three stations during 1976-77 (*) and 1977-78 (+).

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<th>Months 3</th>
<th>Months 4</th>
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<td>0.14</td>
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<tr>
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<td>Summer</td>
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<td>0.12</td>
<td>0.09</td>
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</tr>
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<td>0.02</td>
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</tr>
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<td>0.03</td>
<td>0.02</td>
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</tr>
<tr>
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<td>Summer</td>
<td>0.02</td>
<td>0.03</td>
<td>0.03</td>
<td>0.01</td>
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</table>
Fig. 1 C: Showing the physico-chemical variables during 1976-77 at station 1. (cont'd)
Fig. 2 C: Showing the physical chemical

water during 1926-27
at station 2 (cont'd)
Fig. 3 C: Showing the physico-chemical variables during 1976-77 at station 3. (contd.)
At the third station it was more during monsoons of both the years and the lowest during the winters of both the years.

14. AMMONIA NITROGEN

The quantities of ammonia nitrogen, like albuminoid nitrogen, was lower at the third station than the other two. The quantity recorded at the third station was 0.04 - 0.41 ppm during the first year (Fig. 3C) and 0.23 - 0.39 ppm (Fig. 3F) during the second year. As against this, the first station had a record of 0.12 - 0.98 ppm (Fig. 1C) and 0.65 - 1.98 ppm (Fig. 1F) during the two years, while the second station had 0.06 - 1.34 (Fig. 2C) and 0.45 - 0.98 ppm (Fig. 2F) during the corresponding period. The details of contents recorded are shown in Table 13.

At the first station it was maximum during monsoons of both the years but the minimum was during winter in the first year and summer in the second year.

At the second station the quantity during the monsoon was slightly more or equal to that of summer, while the winter recordings were distinctly lower during the first year. During the second year however the quantities were more in winter and least in summer.
Table 13: Showing the variations in the quantity of ammonia nitrogen (ppm) at the three stations during 1976-77 (*) and 1977-78 (+)

<table>
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<td></td>
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<td>II</td>
<td>II</td>
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<td>1.98</td>
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<td>0.32</td>
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<td>0.69</td>
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<tr>
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<td>1.05</td>
<td>0.99</td>
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<tr>
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<td>+</td>
<td>0.67</td>
<td>0.97</td>
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<tr>
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<td>1.11</td>
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<td>+</td>
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<td>0.27</td>
<td>0.39</td>
<td>0.38</td>
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<td>Summer</td>
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<td>0.23</td>
<td>0.31</td>
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<td>+</td>
<td>0.30</td>
<td>0.29</td>
<td>0.35</td>
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</table>
At the third station, the quantity during the monsoon was lower than that of winter and summer which were almost equal. In the second year the quantities were almost equal during the three seasons or showed a slight decline from summer towards monsoon and winter.

15. NITRATE NITROGEN

The quantities of nitrates showed significant differences during the different seasons being more in summers in general. The details of quantities recorded are shown in Table 14 and Figs. 1C, F; 2C, F; 3C, F.

At the first station it was maximum during summers and minimum during monsoons of both the years. The same pattern was present at the second and third stations during 1976-77. However, 1977-78 the quantity was maximum in monsoon and minimum in winter at the second station and reverse of it at the third station.

16. NITRITE NITROGEN

The quantities of nitrite did not show any significant difference in the range at the three stations, and over the seasons. The details of quantities are shown in Table 15 and Figs. 1C, F; 2C, F; 3C, F.
Table 14: Showing the variations in the quantity of Nitrate nitrogen (ppm) at the three stations during 1976-77 (*) and 1977-78 (+)

<table>
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<th>Station No.</th>
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</tr>
<tr>
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<tr>
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<td>0.04</td>
<td>0.03</td>
<td>0.05</td>
<td>0.02</td>
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<td>0.12</td>
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<td>0.04</td>
</tr>
<tr>
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<td>*</td>
<td>0.12</td>
<td>0.14</td>
<td>0.09</td>
<td>0.16</td>
<td>0.15</td>
</tr>
<tr>
<td></td>
<td>+</td>
<td>0.08</td>
<td>0.14</td>
<td>0.17</td>
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</tr>
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<td>0.02</td>
<td>0.01</td>
<td>0.03</td>
<td>0.04</td>
</tr>
<tr>
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<td>0.09</td>
<td>0.08</td>
<td>0.12</td>
<td>0.14</td>
<td>0.09</td>
</tr>
<tr>
<td>Winter</td>
<td>*</td>
<td>0.03</td>
<td>0.04</td>
<td>0.06</td>
<td>0.08</td>
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<td>0.04</td>
<td>0.14</td>
<td>0.02</td>
<td>0.08</td>
</tr>
<tr>
<td>Summer</td>
<td>*</td>
<td>0.14</td>
<td>0.16</td>
<td>0.17</td>
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<tr>
<td>3. Monsoon</td>
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</tr>
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</tr>
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Table 15: Showing the variations in the quantity of Nitrite nitrogen (ppm) at the three stations during 1976-77 (*) and 1977-78 (+)

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<td>0.02 0.04</td>
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<td></td>
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<td>0.01 0.03</td>
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<td>0.04 0.05</td>
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<td></td>
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<tr>
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</table>
In general it was more in summer and winter than during the monsoon at all the stations.

17. TOTAL NITROGEN

The quantity of total nitrogen was relatively lower at the third station during both the years of study, being 0.10 - 0.60 ppm (Fig. 3C) and 0.39 - 0.60 ppm (Fig. 3F) during the two years. The quantity was more at the second station than the first (0.23 - 1.65 ppm as against 0.30 - 0.87 ppm) during the year 1976-77 (Figs. 1C, 2C). However during 1977-78 the quantity was more at the first station than the second (0.97 - 2.46 ppm as against 0.49 - 1.39 ppm) (Figs. 1F, 2F). The details of quantities are shown in Table 16.

At the first station, the maximum was during monsoons of both the years, while the minimum was during winter of the first year and summer of the second year.

At the second station the quantity in winter was lesser than that of summer and monsoon during the first year, while it was lower in summer than in monsoon and winter of second year.

At the third station the quantities were slightly more in summers than in winters and monsoons of both the years.
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Fig. 1 F: Showing the physico-chemical variables during 1977-78 at station...
Fig. 2 F: Showing the physicochemical variables during 1977-78 at station 2.
Fig. 3 F: Showing the physical chemical variables during 1977-78 at station 3. (contd)
18. PHOSPHATE

The quantities of phosphate recorded showed an overlapping range, being 0.01 - 0.12 ppm and 0.02 - 0.19 ppm at station 1 (Figs. 1B, E), 0.05 - 0.14 and 0.01 - 0.16 ppm at station 2 (Figs. 2B, E), and 0.01 - 0.16 ppm and 0.01 - 0.19 ppm at the station 3 (Figs. 3B, E) during the two years respectively. The details of quantities are shown in Table 17.

In general the recording during winter are slightly more or equal to that of summer at all stations over all the seasons. The quantities are more during the monsoons except at the first station during the second year.

19. DISSOLVED SOLIDS

The quantities of dissolved solids recorded during the two years showed a range of 138.6 - 253.6 ppm and 117.2 - 251.6 ppm at the first station, 161.3 - 253.5 ppm and 207.5 - 282.2 ppm at the second station, 169.4 - 217.6 ppm and 114.5 - 229.8 ppm at the third station. The details are shown in Table 18.

The quantities are generally more during monsoons and the least during summers, the only exception to that
Table 17: Showing the variations in the quantity of Phosphate (ppm) at the three stations during 1976-77 (*) and 1977-78 (+)

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Table 18: Showing the variations in the quantity of Dissolved solids (ppm) at the three stations during 1976-77 (*) and 1977-78 (+)

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was the third station which during the first year showed a minimum during monsoon and maximum during winter.

20. SUSPENDED SOLIDS

The quantities of suspended solids recorded during the two years showed a range of 217.3 - 347.6 ppm and 218.6 - 326.5 ppm at station 1, 92.8 - 227.6 ppm and 205.9 - 394.6 ppm at station 2 and 223.6 - 270.3 ppm and 176.6 - 309.5 ppm at the station 3 during the two years. The details of quantities are shown in Table 19.

It is seen that the maximum is in monsoons and the minimum during summers, the only exception to the pattern was found at station 1 during second year where the quantities were minimum during winter.

21. TOTAL SOLIDS

The amount of total solids recorded during the two years showed the range of 355.9 - 601.2 ppm, 349.8 - 551.9 ppm at station 1 (Figs. 1c, F), 254.1 - 479.2 ppm and 413.4 - 670.7 ppm at station 2 (Figs. 2c, F) and 393.0 - 469.0 ppm and 289.1 - 539.3 ppm at station 3 (Figs. 3c, F). The details of quantities are shown in Table 20.
Table 19: Showing the variations in the quantity of Suspended solids (ppm) at the three stations during 1976-77 (*) and 1977-78 (+)

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<td>447.1</td>
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<td>467.4</td>
<td>448.4</td>
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<td>242.3</td>
<td>249.6</td>
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<td>216.6</td>
<td>186.2</td>
<td>181.7</td>
<td>174.6</td>
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Table 20: Showing the variations in the quantity of total solids (p.p.m) at the three stations during 1976-77 (*) and 1977-78 (+)

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The amount of total solids in general was maximum during the monsoons and minimum during the summers. The only exception to this was third station which during 1976-77 showed almost equal quantities or slight variations with winter showing slightly more than the monsoons.