ON A GONYAULAX BLOOM OFF MT DALLEY,
IN THE ARABIAN SEA

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Introduction

Several reports were published on the 'red tide' or 'discoloration of water' of the sea by Torrey (1902), Sommer et al. (1937), Allen (1946), Hayes and Austin (1951) and Brongersma-Sanders (1957). Various organisms were found to be responsible for such phenomenon in the west coast of India: an unidentified Peridinium was reported by Hornel (1917), two species of Coccolithus by Hornel and Nayudu (1923), Noctiluca miliaris by Bhimachar and George (1950), Gymnodinium sp. by Subrahmanyan (1959) and Gonyaulax polygramma by Prakash and Sarma (1964).

During regular research cruise of R/V Varuna, on November 13, 1963, at 12.20 hrs a thick tomato-soup like phenomenon of discoloured water was observed off Mt Dalley (position: N 12°53', E 75°15'; depth of station: 18 m) in the Arabian Sea. This occurred over an area of nearly 4 sq miles, and was moving eastwards. In the same locality, 'dirty water' was noticed during the following cruise on December 5, 1963, while during the return on the 13th of the same month, water was quite clear. Since there was no report on the stratification of the bloom organism, attempts were made to study this during the different phases of the bloom.

On all the three occasions water samples were drawn from three to four different spots in the bloom from the following depths: surface, 3, 5, 10 and 15 m. Surface water was collected in a bucket, while others, with reversing Nansen water bottles. All the samples were individually preserved in formalin and enumerated for the phytoplankton organism in them.

The distribution of the major organisms in the bloom is given in tabular form. The number indicates the number of specimens per litre of water sample. Besides these three major organisms given in Table 1, 78 other species of Dinoflagellates and 72 species of diatoms were recorded in the bloom. Since these
Table 1 — Vertical Distribution of Major Phytoplankton Organisms in the Red Water

(Calculated as number of organisms per litre of sea water)

<table>
<thead>
<tr>
<th>November 13</th>
<th>Surface</th>
<th>3 m</th>
<th>5 m</th>
<th>10 m</th>
<th>15 m</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Gonyaulax polygramma</em> Stein.</td>
<td>558,000</td>
<td>3,760,000</td>
<td>304,500</td>
<td>5,000</td>
<td>—</td>
</tr>
<tr>
<td><em>Ornithocercus magnificus</em> Stein.</td>
<td>10,000</td>
<td>4,000</td>
<td>12,000</td>
<td>117,500</td>
<td>500</td>
</tr>
<tr>
<td><em>Prorocentrum micans</em> Ehrenb.</td>
<td>—</td>
<td>—</td>
<td>500</td>
<td>500</td>
<td>—</td>
</tr>
<tr>
<td>Other Dinophyceae</td>
<td>2,000</td>
<td>—</td>
<td>500</td>
<td>3,500</td>
<td>2,500</td>
</tr>
<tr>
<td>Diatoms</td>
<td>3</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>3,500</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>December 5</th>
<th>Surface</th>
<th>3 m</th>
<th>5 m</th>
<th>10 m</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Gonyaulax polygramma</em> Stein.</td>
<td>16,500</td>
<td>151,240</td>
<td>57,810</td>
<td>4,700</td>
</tr>
<tr>
<td><em>Ornithocercus magnificus</em> Stein.</td>
<td>5,000</td>
<td>14,375</td>
<td>17,500</td>
<td>625</td>
</tr>
<tr>
<td><em>Prorocentrum micans</em> Ehrenb.</td>
<td>20,000</td>
<td>20,625</td>
<td>19,375</td>
<td>12</td>
</tr>
<tr>
<td>Other Dinophyceae</td>
<td>2,830</td>
<td>1,384</td>
<td>2,300</td>
<td>1,310</td>
</tr>
<tr>
<td>Diatoms</td>
<td>136</td>
<td>425</td>
<td>312</td>
<td>285</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>December 13</th>
<th>Surface</th>
<th>3 m</th>
<th>5 m</th>
<th>10 m</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Gonyaulax polygramma</em> Stein.</td>
<td>—</td>
<td>1</td>
<td>—</td>
<td>2</td>
</tr>
<tr>
<td><em>Ornithocercus magnificus</em> Stein.</td>
<td>20</td>
<td>22</td>
<td>1,120</td>
<td>20,600</td>
</tr>
<tr>
<td><em>Prorocentrum micans</em> Ehrenb.</td>
<td>—</td>
<td>33</td>
<td>—</td>
<td>18</td>
</tr>
<tr>
<td>Other Dinophyceae</td>
<td>10</td>
<td>67</td>
<td>48</td>
<td>6</td>
</tr>
<tr>
<td>Diatoms</td>
<td>15,145</td>
<td>12,400</td>
<td>15,400</td>
<td>1,300</td>
</tr>
</tbody>
</table>

species were unevenly distributed and fewer in numbers, only their total number is mentioned.

It is clear from the data given above that *Gonyaulax polygramma* is the most abundant single species in the bloom. It was invariably most concentrated at a depth of 3 m. Moreover, the results of different samplings in the bloom revealed that, though the pattern of vertical distribution of the major organism remained
the same, the density of the organism varied considerably in the
different patches showing thereby non-uniformity of the bloom.

Ornithocercus magnificus, though found conspicuously in the bloom,
differed from the former in its vertical distribution. Moreover,
it occurrence in similarly large numbers throughout the west coast
during the period (unpublished data) is an indication that this is
not directly responsible for the red tide. The occurrence of
Prorocentrum micans in fairly large numbers during the waning
period of Gonyaulax polygramma might have been due to its
regressive effect on the main bloom organism.

Moreover, when the counts of different organisms in different
stages of the bloom, i.e. when water was 'red', 'dirty' and 'clear',
were compared, Gonyaulax polygramma counted extremely high
in the first instance, declined in the second, and was almost absent
in the last; Ornithocercus magnificus counted fairly high throughout,
while Prorocentrum micans counted fairly high only in the second
stage. Moreover, other Dinoflagellates were counted high only
when Gonyaulax polygramma was less concentrated; similarly
diatoms were most when water was clear, indicating that 'tomato-
soup' like coloration of the water during the bloom was only due to
Gonyaulax polygramma and may not be due to other associated
phytoplanktons.

Acknowledgement

The author wishes to acknowledge the cooperation given by the
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References

Pathol., 20: 537.