

Thermal Algae of Western India

V. Algae of the hot Springs at Tuwa

by

JOSEPH THOMAS
Institute of Science, Bombay

&

ELLA A. GONZALVES
St. Xavier's College, Bombay

(with 11 figs.)

The results of investigations on the hot springs at Tuwa are incorporated in this paper, which is the fifth in the series (cf. THOMAS & GONZALVES, 1965; 1965 a, b, and c) on the algal flora of the hot springs of Western India. Tuwa is a village on the Anand-Godhra line of the Western Railway, about forty miles from Anand in Gujerat State. A total of 109 taxa has been recorded from these springs (44 diatoms, 64 members of the Cyanophyceae and one member of the Chlorophyceae). These include three new species, two new varieties and two new forms. The specimens are preserved in the Blatter Herbarium, St. Xavier's College, Bombay.

Many springs occur at Tuwa within an area of approximately 440 square metres. The most prominent spring erupts into a central tank which is divided into four equal parts. Around this tank are situated eight other tanks 0.62×0.62 metres in dimension. In addition, several earthen pots forming basins of hot water have been fixed in this area. The temperature of these pools varies from 25°C to 65°C . The flow of water is about 2,500 litres per hour. The algae grow fairly vigorously in these pools. The springs were visited thrice during the years 1958—1961, in the months of November 1958, June 1960, and January 1961. The taxa marked with an asterisk have been recorded and described earlier by the authors in other hot springs. Diatoms, when reported above 52°C were observed only in the non living condition.

BACILLARIOPHYCEAE

1. *Melosira islandica* Ö. MÜLL. var. *helvetica* Ö. MÜLL.*
At 38° C, 48°C, and 60.5°C.
2. *Melosira grnaultata* (EHR.) RALFS var. *angustissima* Ö. MÜLL.*
At 51°C.
3. *Cyclotella meneghiniana* KÜTZ. var. *rectangulata* GRUN.*
At 32°C.
4. *Cyclotella meneghiniana* KÜTZ. var. *plana* FRICKE*
At 29°C, 31°C, 32°C, 33°C, 34°C, 35°C, 38°C, 41°C, 41.5°C,
52°C, and 65°C.
5. *Fragilaria capucina* MAYER var. *gracilis* (OESTR.) A. CLEVE
Length of valve 44—45 μ ; breadth 3—3.5 μ ; striae 18—19 in 10 μ .
At 33°C.
6. *Mastogloia braunii* GRUN.*
At 28°C, 29°C, 31°C, 32°C, 33°C, 34°C, 35°C, 38°C, 40°C, 41°C,
42°C, 43°C, 44°C, 48°C, 50°C, 51°C, 57°C, 58°C, 59°C, 60°C,
60.5°C, 61°C, 62°C, and 65°C.
7. *Mastogloia lacustris* GRUN. var. *amphicephala* GRUN.
Length of valve 40—50 μ ; breadth 12—13 μ ; loculi 5—6 in 10 μ ;
striae 15—18 in 10 μ .
At 41°C. and 48°C.
8. *Caloneis amphisbaena* (BORY) CLEVE var. *fenzlii* (GRUN.) CLEVE*
At 29°C and 41.5°C.
9. *Gyrosigma spencerii* (W. SMITH) CLEVE var. *smithii* (GRUN.) A.
CLEVE
Length of valve 88—90 μ ; breadth 10.5—13.5 μ ; transverse striae
18—20 in 10 μ ; longitudinal striae 24—25 in 10 μ .
At 41°C and 50°C.
10. *Pleurosigma elongatum* W. SMITH
Length 120—130 μ ; breadth 16—17 μ ; transverse striae 25—27 in
10 μ ; oblique striae 20—22 in 10 μ .
At 31°C.
11. *Pleurosigma elongatum* W. SMITH var. *fallax* GRUN.

Length of valve 99—107 μ ; breadth 15.5 μ ; transverse striae 22—24 in 10 μ ; oblique striae 20—22 in 10 μ .
At 31°C.

12. *Pleurosigma delicatulum* W. SMITH

Length of valve 130—150 μ ; breadth 13—15 μ ; striae 23—25 in 10 μ .
At 41°C.

13. *Pleurosigma stuxbergii* CLEVE & GRUN.*

At 37°C, 41°C, and 42°C.

14. *Diploneis latefurcata* (FONT.) A. CLEVE

Length of valve 35—36 μ ; breadth 16 μ ; costae 10—12 in 10 μ .
This form is slightly smaller than the type.

At 29°C, 31°C, 32°C, 33°C, 34°C, 35°C, 38°C, 41°C, 42°C, 51°C, and 60.5°C.

15. *Diploneis oblongella* (NÄG.) A. CLEVE var. *lapponica* A. CLEVE*

At 35°C, 38°C, 41.5°C, 51°C, 57°C, and 65°C.

16. *Diploneis elliptica* (KÜTZ.) CLEVE*

At 28°C, 29°C, 31°C, 32°C, 33°C, 34°C, and 62°C.

17. *Diploneis elliptica* (KÜTZ.) CLEVE var. *elliptica* f. *minor* GRUN.*

At 29°C, 31°C, 32°C, 33°C, 34°C, 38°C, and 52°C.

18. *Diploneis hyperborea* (GRUN.) CLEVE f. *minor* f. nov. (Fig. 1).

Valves elliptic; central nodule large; furrow linear lanceolate, enlarged at the region of the central nodule; costae strongly radial, with double rows of punctae between them. Length 36—38 μ ; breadth 23 μ ; costae 10 in 10 μ .

Valvulae ellipticae, nodulo centrali amplo; sulci lineari-lanceolati, dilatati in regione noduli centralis; costae fortes, radiales, duplici serie punctorum interjecta. Long. 36—38 μ ; latit. 23 μ ; costis 10 in 10 μ .

This alga is considered a new form because of its smaller size and larger number of striae than the type. (Slide H.S. 182).

At 31°C and 32°C.

19. *Diploneis smithii* (BRÉB.) CLEVE*

At 31°C, 32°C, 35°C, 41°C, 51°C, 58°C, 59°C, and 65°C.

20. *Diploneis smithii* (BRÉB.) CLEVE var. *borealis* GRUN.*

At 31°C, 32°C, 34°C, 41.5°C, 58°C, and 61°C.

21. *Diploneis smithii* (BRÉB.) CLEVE var. *rhombrica* MERESCHKOVSKY f. *major* THOMAS & GONZALVES*
At 29°C.
22. *Anomoeoneis polygramma* (EHR.) CLEVE
Length of valve 89—100 μ ; breadth 22—23 μ ; striae 15—17 in 10 μ .
At 31°C, 32°C, 33°C, 34°C, 35°C, 38°C, 41°C, 42°C, 50°C, 51°C,
and 57°C.
23. *Anomoeoneis sculpta* (EHR.) CLEVE var. *sculpta*
Length of valve 72—85 μ ; breadth 23—25 μ ; striae 15—17 in 10 μ .
At 28°C, 29°C, 31°C, 32°C, 33°C, 34°C, 35°C, 38°C, 40°C, 41.5°C,
42°C, 48°C, 50°C, 51°C, 52°C, 57°C, 59°C, 60.5°C, and 62°C.
24. *Anomoeoneis sculpta* (EHR.) CLEVE var. *rostrata* (PANT.) A. CLEVE*
At 28°C, 29°C, 31°C, 32°C, 33°C, 34°C, 35°C, 38°C, 40°C, 41°C,
42°C, 44°C, 48°C, 50°C, 51°C, 52°C, 57°C, 58°C, 59°C, 60°C,
60.5°C, 61°C, and 62°C.
25. *Navicula yarrensii* GRUN.
Length of valve 54—56 μ ; breadth 17.5—18 μ ; striae 5 in 10 μ .
At 51°C.
26. *Navicula palpebralis* BRÉB.
Length of valve 36—38 μ ; breadth 14.5—15 μ ; striae 5—8 in 10 μ .
At 40°C.
27. *Cymbella reinhardtii* GRUN.*
At 41°C.
28. *Cymbella ehrenbergii* KÜTZ. var. *elongata* MEISTER f. *orientalis*
THOMAS & GONZALVES*
At 61°C.
29. *Cymbella bipartita* MEYER var. *densestriata* A. CLEVE
Length of valve 23—24 μ ; breadth 5—5.4 μ ; striae fine, sub-
parallel, 15—17 in 10 μ .
At 31°C.
30. *Amphora commutata* GRUN.
Length of valve 40—50 μ ; breadth of cell 20—21 μ ; striae 10 in 10 μ .
At 31°C, 32°C, 33°C, 34°C, 38°C, and 41.5°C.
31. *Amphora holsatica* HUST*.
At 31°C, 34°C, 41°C, and 48°C.

32. *Rhopalodia gibberula* (EHR., KÜTZ.) Ö. MÜLL. var. *rupestris* (W. SMITH) Ö. MÜLL.
 Length of valve 80—83 μ ; breadth 9—10.5 μ ; ribs radial, arranged at a distance of 2—8 μ ; rows of areoles 15—19 in 10 μ .
 This form is slightly bigger than the type.
 At 28°C, 31°C, 32°C, 34°C, 40°C, 42°C, 44°C, 50°C, 52°C, 58°C, 60.5°C, and 61°C.
33. *Rhopalodia gibberula* (EHR., KÜTZ.) Ö. MÜLL. var. *producta* (GRUN.) A. CLEVE*
 At 28°C, 31°C, 32°C, 33°C, 34°C, 35°C, 38°C, 41°C, 48°C, 52°C, 58°C, 59°C, 61°C, 62°C, and 65°C.
34. *Rhopalodia gibba* (EHR.) Ö. MÜLL. var. *ventricosa* (KÜTZ.) GRUN.*
 At 51°C.
35. *Hantzschia amphioxys* (EHR.) GRUN. var. *rupestris* GRUN.
 Length of valve 120—130 μ ; breadth 16—17 μ ; keel punctae 5—6 in 10 μ ; striae 10 in 10 μ .
 At 42°C and 58°C.
36. *Hantzschia amphioxys* (EHR.) GRUN. var. *aequalis* A. CLEVE*
 At 28°C.
37. *Nitzschia hungarica* GRUN. var. *hungarica**
 At 32°C and 65°C.
38. *Nitzschia latestriata* (OESTR.) A. CLEVE var. *minor* A. CLEVE f. *intermedia* THOMAS & GONZALVES*
 At 28°C, 48°C, and 50°C.
39. *Nitzschia thermalis* KÜTZ. var. *intermedia* GRUN.*
 At 42°C.
40. *Nitzschia obtusa* W. SMITH var. *scalpelliformis* GRUN.*
 At 28°C, 29°C, 31°C, 33°C, 34°C, 35°C, 38°C, 41°C, 41.5°C, 42°C, 48°C, 50°C, 51°C, 52°C, 57°C, 58°C, 61°C, 62°C, and 65°C.
41. *Nitzschia obtusa* W. SMITH var. *lepidula* GRUN.*
 At 41°C.
42. *Nitzschia capitata* OESTR.*
 At 65°C.

43. *Nitzschia subtilis* GRUN. var. *paleacea* GRUN.*
At 38°C.

44. *Campylodiscus bicostatus* W. SMITH.*
At 28°C, 29°C, 31°C, 32°C, 33°C, 34°C, 35°C, 38°C, 40°C, 41°C,
41.5°C, 42°C, 44°C, 48°C, 50°C, 51°C, 52°C, 57°C, 58°C, 59°C,
60°C, 61°C, 62°C, and 65°C.

CYANOPHYCEAE

45. *Microcystis elabens* (BRÉB.) KÜTZ.*
At 32°C and 33°C.

46. *Chroococcus macrococcus* (KÜTZ.) NÄG.*
At 42°C and 61°C.

47. *Chroococcus turgidus* (KÜTZ.) NÄG.*
Cells without sheath 12—20 μ in diameter, with sheath 20—32 μ .
This form agrees with the type, but has a somewhat broader sheath.
At 33°C.

48. *Chroococcus turgidus* (KÜTZ.) NÄG. var. *solitarius* GHOSE
Cells with sheath 12—13 μ in diameter, without sheath 8—9.4 μ .
At 33°C.

49. *Chroococcus turgidus* (KÜTZ.) NÄG. var. *thermalis* (KÜTZ.) RA-
BENH.*
At 28°C and 50°C.

50. *Chroococcus tenax* (KIRCHN.) HIERON.*
At 34°C, 40°C, and 60.5°C.

51. *Chroococcus schizodermaticus* WEST*
At 28°C.

52. *Chroococcus turicensis* (NÄG.) HANSG.
Cells without sheath 13—14 μ in diameter, with sheath 23—24 μ .
At 28°C.

53. *Chroococcus minor* (KÜTZ.) NÄG.*
At 50°C and 65°C.

54. *Chroococcus limneticus* LEMM.*
At 40°C and 50°C.

55. *Chroococcus varius* A. BR.*
At 50°C.
56. *Chroococcus montanus* HANSG.
Cells without sheath 6—8 μ in diameter; with sheath 8—11 μ in diameter.
At 35°C.
57. *Gloeocapsa gelatinosa* KÜTZ.
Cells without sheath 2.8—3 μ in diameter; with sheath 9—10 μ .
At 34°C.
58. *Gloeotheca palea* (KÜTZ.) RABENH.*
At 62°C.
59. *Gloeotheca samoensis* WILLE*
Cells many in a common colourless envelope, without sheath 4.5—5 μ in diameter, 6—6.8 μ long.
At 50°C.
60. *Aphanocapsa koordersi* STROM
Cells 2—3.2 μ in diameter.
At 28°C.
61. *Aphanocapsa brunnea* NÄG.*
At 41°C, 44°C, 48°C and 51°C.
62. *Aphanocapsa thermalis* (KÜTZ.) BRÜGG.*
At 60°C.
63. *Aphanocapsa muscicola* (MENEGH.) WILLE
Cells 2—2.4 μ in diameter.
At 33°C.
64. *Aphanocapsa fusco-lutea* HANSG.*
At 28°C.
65. *Aphanothece clathrata* W. & G. S. WEST*
At 50°C.
66. *Aphanothece saxicola* NÄG.*
At 50°C.
67. *Aphanothece microspora* (MENEGH.) RABENH.*
At 29°C.

68. *Aphanothece castagnei* (BRÉB.) RABENH.*
At 38°C.
69. *Aphanothece microscopica* NÄG.
Cells 3—4.4 μ in diameter, one and a half to twice as long as broad.
At 40°C.
70. *Coelosphaerium kuetzingianum* NÄG.
Colony 114—134 μ in diameter; cells 4—4.4 μ in diameter.
At 33°C.
71. *Gomphosphaeria aponina* KÜTZ.
Colonies 32—40 μ in diameter; cells 4—5 μ in diameter, pyriform,
cordate, 6—8 μ long.
At 42°C.
72. *Merismopedia punctata* MEYEN*
At 31°C and 40°C.
73. *Merismopedia glauca* (EHR.) NAG.*
At 28°C, 33°C, 41°C, and 43°C.
74. *Chlorogloea microcystoides* GEITLER
Thallus gelatinous, made up of several colonies; cells arranged in
polygonal groups in the small colonies, regular or indistinct rows in
older colonies; cells 2—2.6 μ to sometimes 3.4 μ in diameter.
At 34°C.
75. *Johannesbaptistia whitfordii* sp. nov. (Fig. 2, 3)
Thallus linear, cylindrical, more than 5 mm long, filamentous;
cells greenish/blue, disc-shaped, broad, 10.8—12 μ in diameter,
2.5—3 μ (—4 μ) long, arranged mostly in pairs; cells with sheath 20 μ
in diameter; mucilaginous envelope hyaline, more or less indistinct.
Among filaments of *Spirogyra* sp.
Thallus linearis, cylindricus, quam 5 mm longior, filamentosus;
cellulae viridescenti-caeruleae, discoideae, latae, 10.8—12 μ diam.,
2.5—3 μ (—4 μ) longae, dispositae vulgo in paria; cellulae cum vagina
20 μ diam., involucro mucoso hyalino, plus minusve indistincto.
Simul cum filamentis *Spirogyrae* sp.
This alga is much broader than the other species of the genus
including *f. pellucida* (DICKIE) TAYLOR & DROUET and *f. (Hetero-*
hormogonium) schizodichotomum COPELAND. Moreover, the fila-
mentous thallus is much longer than in the other species. (No. 44).
At 32°C, 34°C, and 40°C.

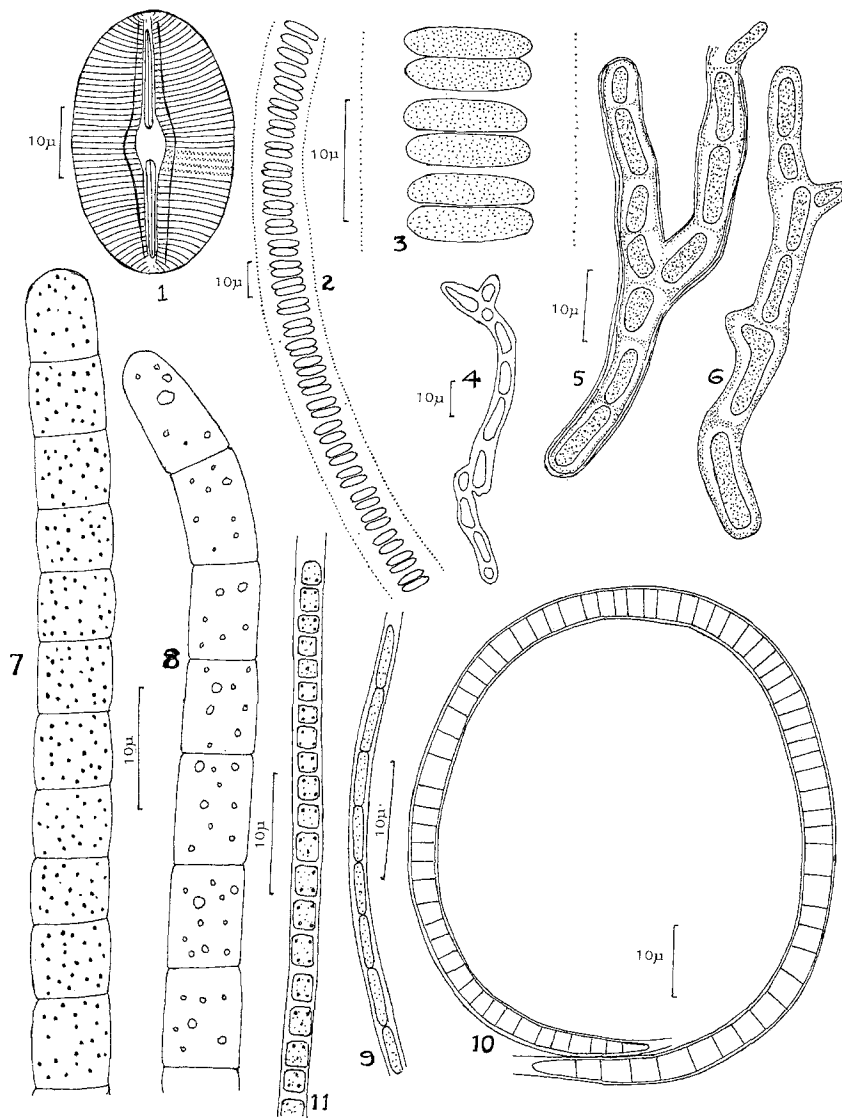


Fig. 1. *Diploneis hyperborea* (GRUN.) CLEVE f. *minor* f. nov.
 Fig. 2, 3. *Johannesbaptistia whitfordii* sp. nov.
 Fig. 4, 5, 6. *Tryponema indicum* sp. nov.
 Fig. 7, 8. *Oscillatoria tuvaensis* sp. nov.
 Fig. 9. *Phormidium africanum* LEMM. f. *elongatum* f. nov.
 Fig. 10. *Lyngbya holsatica* LEMM. var. *contorta* var. nov.
 Fig. 11. *Lyngbya putealis* MONT. var. *minor* var. nov.

76. *Trypanema indicum* sp. nov. (Fig. 4, 5, 6)

Thallus endolithic, penetrating into the rocky substratum, indefinite in shape, filaments uniseriate, branching; branches lateral or dichotomous; sheath hyaline in young condition, yellowish and lamellate when old, 6—8 μ in diameter; cells 3—5 μ in diameter, up to 14 μ long, cylindrical to dumb-bell shaped, with homogeneous or granulate protoplasm; endospore formation not observed.

Thallus endolithicus, penetrans in substratum saxatile, forma indefinita; filamenta uniseriata, 6—8 μ diam., furcata; ramuli laterales vel dichotomi; vagina hyalina in conditione juvenili, matura vero luteola et lamellata; cellulae 3—5 μ diam., usque ad 14 μ longae, cylindricae vel ad medium angustatae, protoplasmate homoganeo vel granulato; endosporarum formatione haud observata.

This alga differs from *T. endolithicum* ERCEG. (GEITLER, 1932, p. 378, fig. 206) in having narrower filaments and cells. Moreover, the sheath becomes stratified and coloured when old. The cells are only up to 14 μ long as against 80 μ in *T. endolithicum*. It is therefore considered a new species. (No. 51 a).

At 52°C, 57°C, and 58°C.

77. *Spirulina labyrinthiformis* (MENEGH.) GOMONT

Trichome 0.8—1.2 μ in diameter; spirals 2.2 μ in diameter.

At 28°C.

78. *Spirulina agilis* KUFF.

Trichome 1 μ in diameter, spirals 1.6—1.8 μ in diameter.

At 28°C.

79. *Spirulina laxissima* WEST, G. S. f. *major* DESIKACHARY

Trichome 1.3—1.8 μ in diameter; spirals 8 μ apart, about 6 μ in diameter.

At 40°C and 50°C.

80. *Spirulina major* KÜTZ., GOMONT

Trichome 1—1.2 μ in diameter; spirals about 2—2.5 μ apart, 2—3 μ in diameter.

At 35°C, 40°C, 41°C, and 42°C.

81. *Spirulina laxa* SMITH, G. M.

Trichome 1.8—2.4 μ in diameter; spirals very loose, 17—20 μ apart, 6 μ in diameter.

At 41.5°C.

82. *Oscillatoria hamelii* FREMY f. *minor* THOMAS & GONZALVES*

At 35°C, 41°C, 42°C, and 61°C.

83. *Oscillatoria tuwaensis* sp. nov. (Fig. 7, 8)

Trichomes single, blue-green, slightly constricted at the cross-walls, ends sometimes attenuated; 7—7.5 μ in diameter; cells 8—11 μ long, with prominent granules; end cell hemispherical to conical, not capitate, without calyptra.

Trichomata singula, caeruleo-viridia, paulum constricta ad septa, apicibus nonnumquam attenuatis, 7—7.5 μ diam.; cellulae 8—11 μ longae, granulis eminentibus ornatae; cellula terminalis hemisphaerica vel conica, haud capitata, absque calyptra.

This alga approaches *O. hamelii* FREMY in appearance, but has broader and longer cells with prominent granules. It is therefore considered a new species. (No. 58).

At 40°C.

84. *Oscillatoria geminata* MENEGH.

Trichomes 2.6—3.1 μ in diameter; cross-walls thick; cells 2.6—8 μ long.

At 34°C, 41°C, 48°C, and 52°C.

85. *Oscillatoria angustissima* W. & G. S. WEST*

At 42°C.

86. *Oscillatoria angusta* KOPPE*

At 29°C, 48°C, and 50°C.

87. *Oscillatoria quadripunctulata* BRUHL & BISWAS*

Trichomes 3—3.5 μ in diameter, cells 8—10 μ long.

The alga recorded from this spring is broader than the type.

It, however, agrees with the form described by BISWAS (cf. DESIKACHARY, 1959, p. 227).

At 41.5°C.

88. *Oscillatoria pseudogeminata* G. SCHMID*

At 29°C and 52°C.

89. *Oscillatoria amphibia* AG. ex GOMONT*

At 38°C and 42°C.

90. *Oscillatoria okeni* AG. ex GOMONT*

At 35°C, 40°C, and 42°C.

91. *Oscillatoria formosa* BORY ex GOMONT

Trichomes 3.6 μ in diameter; cells 2.4—3.5 μ long.

At 42°C.

92. *Oscillatoria animalis* AG. ex GOMONT*

At 50°C.

93. *Oscillatoria brevis* (KÜTZ.) GOMONT*

At 41.5°C and 50°C.

94. *Phormidium africanum* LEMM. f. *elongatum* f. nov. (Fig. 9)

Thallus thin, blue-green; filaments variously bent, sheath diffluent, not coloured violet by chlor-zinc-iodide; trichomes somewhat constricted at the cross-walls, not attenuated at the ends, 1.4—1.6 μ in diameter; cells 3—7.2 μ long; end cells without calyptra.

Thallus tenuis, caeruleo-viridis; filamenta varie curvata, vagina diffluente haud purpuree tincta chlor-zinc-iodido; trichomata aliquantum constricta ad septa, haud attenuata ad apices, 1.4—1.6 μ diam.; cellulae 3—7.2 μ longae; cellulae terminales absque calyptra.

This alga differs from the type in the absence of the calyptra and in having longer cells. (No. 52).

At 58°C.

95. *Phormidium bohneri* SCHMIDLE

Sheath thin, hyaline; trichomes 2.2 μ in diameter; cells mostly shorter than broad, quadratic or seldom longer than broad.

At 60°C.

96. *Phormidium valderianum* (DELP.) GOMONT*

At 60.5°C.

97. *Phormidium gelatinosum* WORONICH.

Thallus thick, gelatinous; sheath deliquescent; trichomes 1.4—1.6 μ in diameter; cells 1.6—4 μ long.

At 34°C.

98. *Lynngbya holsatica* LEMM. var. *contorta* var. nov. (Fig. 10)

Filaments single, free-swimming, 4 μ in diameter, bent in a circle; sheath very narrow, colourless; cells 3.5—3.8 μ in diameter, 2.4—4 μ long; cross-walls not constricted, not granulate; ends attenuated, end cell conical.

Filamenta singula, libere natantia, 4 μ diam. in circulum curvata; vagina angustissima, incolora; cellulae 3.5—3.8 μ diam., 2.4—4 μ longae, haud constrictae ad septa; apicibus attenutis, cellula terminali conica.

This alga differs from the type in the filaments being bent in a complete circle, while the cells are longer and slightly broader. The

ends of the trichomes are attenuated. It is therefore considered a new variety. (No. 59)

At 42°C.

99. *Lyngbya bipunctata* LEMM.*

At 35°C and 60°C.

100. *Lyngbya amplivaginata* VAN GOOR

Filaments 3—3.6 μ in diameter; trichomes 1.8—2.2 μ in diameter; cells 3.5—4 μ long.

At 50°C.

101. *Lyngbya digueti* GOMONT*

At 32°C and 37°C.

102. *Lyngbya semiplena* (C. AG.) H. AG. ex GOMONT*

At 31°C.

103. *Lyngbya putealis* MONT. ex GOMONT var. *minor* var. nov. (Fig. 11).

Filaments forming the thallus flexuous; sheath thin, hyaline, distinct beyond the end of the trichome; filaments 3 μ in diameter; trichomes constricted at the cross-walls, 2.2—2.4 μ in diameter; cells quadratic or longer than broad, 2.4—3.4 μ long, with 3—4 granules generally at the corners of the cell.

Filamenta thallum efformata, flexuosa; vagina tenuis, hyalina, distincta ultra apicem trichomatis; filamenta 3 μ diam.; trichomata constricta ad septa, 2.2—2.4 μ diam.; cellulae quadratae vel longiores quam latae, 2.4—3.4 μ longae, granulis 3—4 vulgo ad angulos cellulae.

This form is distinctly smaller than the type, with three to four granules in its cells. It is therefore considered a new variety. (No. 57).

At 40°C.

104. *Lyngbya martensiana* MENEGH. ex GOMONT var. *calcareae* TILDEN

Filaments 7—8 μ in diameter; trichomes 5.4—5.8 μ in diameter; cells 1.6—2.5 μ long.

At 38°C.

105. *Lyngbya major* MENEGH. ex GOMONT

Filaments 18 μ in diameter; sheath thick, about 2—2.5 μ thick; trichomes 13—13.5 μ in diameter; cells 2—3 μ long.

At 34°C.

106. *Cylindrospermum* sp.*

At 34°C.

107. *Pseudanabaena schmidlei* JAAG, O. f. *gracilis* SKUJA*

At 42°C and 59°C.

108. *Mastigocladus laminosus* COHN*

At 48°C, 49°C, and 50°C.

109. *Spirogyra* sp.

This alga was observed only in the vegetative condition and hence could not be identified.

At 31°C and 33°C.

ACKNOWLEDGEMENT

The authors wish to record their thanks to Rev. Dr. H. SANTAPAU, Director, Botanical Survey of India, for the Latin diagnoses of the new taxa.

REFERENCES

- DESIKACHARY, T. V., Cyanophyta. Indian Council of Agricultural Research, New Delhi, 1959.
- GEITLER, L., Cyanophyceae in Rabenhorst's Kryptogamenflora, Leipzig, 1932.
- THOMAS, J. & GONZALVES, E. A., - 1965 - Thermal algae of Western India. I. Algae of the hot springs at Akloli and Ganeshpuri. *Hydrobiologia* 25, 3—4: 330—340.
- & ——— 1965a - Thermal algae of Western India. II. Algae of the hot springs at Palli. *Hydrobiologia* 25, 3—4: 340—351.
- & ——— 1965b - Thermal algae of Western India. III. Algae of the hot spring at Sav. *Hydrobiologia* 26, 1—2: 21—28.
- & ——— 1965c - Thermal algae of Western India. IV. Algae of the hot springs at Aravali, Tooral and Rajewadi. *Hydrobiologia* 26, 1—2: 29—40.