

ON THE STRUCTURE AND LIFE-HISTORY OF A NEW SPECIES  
OF *ANABAENA*

(*A. RANDHAWAE* SP. NOV.)\*

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(Communicated by M. S. Randhawa, F.N.I.)

(Received October 26, 1957 ; read June, 26, 1958)

ABSTRACT

A detailed account of the structure and life-history of a new species of *Anabaena* (*A. Randhawae* sp. nov.) has been given here. The alga is characterised by terminal heterocysts and spherical akinetes which are usually remote from the heterocysts but are extremely variable in position.

INTRODUCTION

The object of the present communication is to describe the structure and life-history of a new and interesting form of *Anabaena*, which was found free-floating in one of the rain-water puddles on 5th January, 1957, inside the Indian Agricultural Research Institute grounds, New Delhi, India.

GENERAL MORPHOLOGY

The plant body consists of a broad mucilagenous expanse, the outer layer of which is firmer than the inner, enclosing numerous trichomes. Very rarely, an individual sheath is also discernible around some trichomes, after prolonged immersion in the aqueous methylene blue (Text-fig. 2).

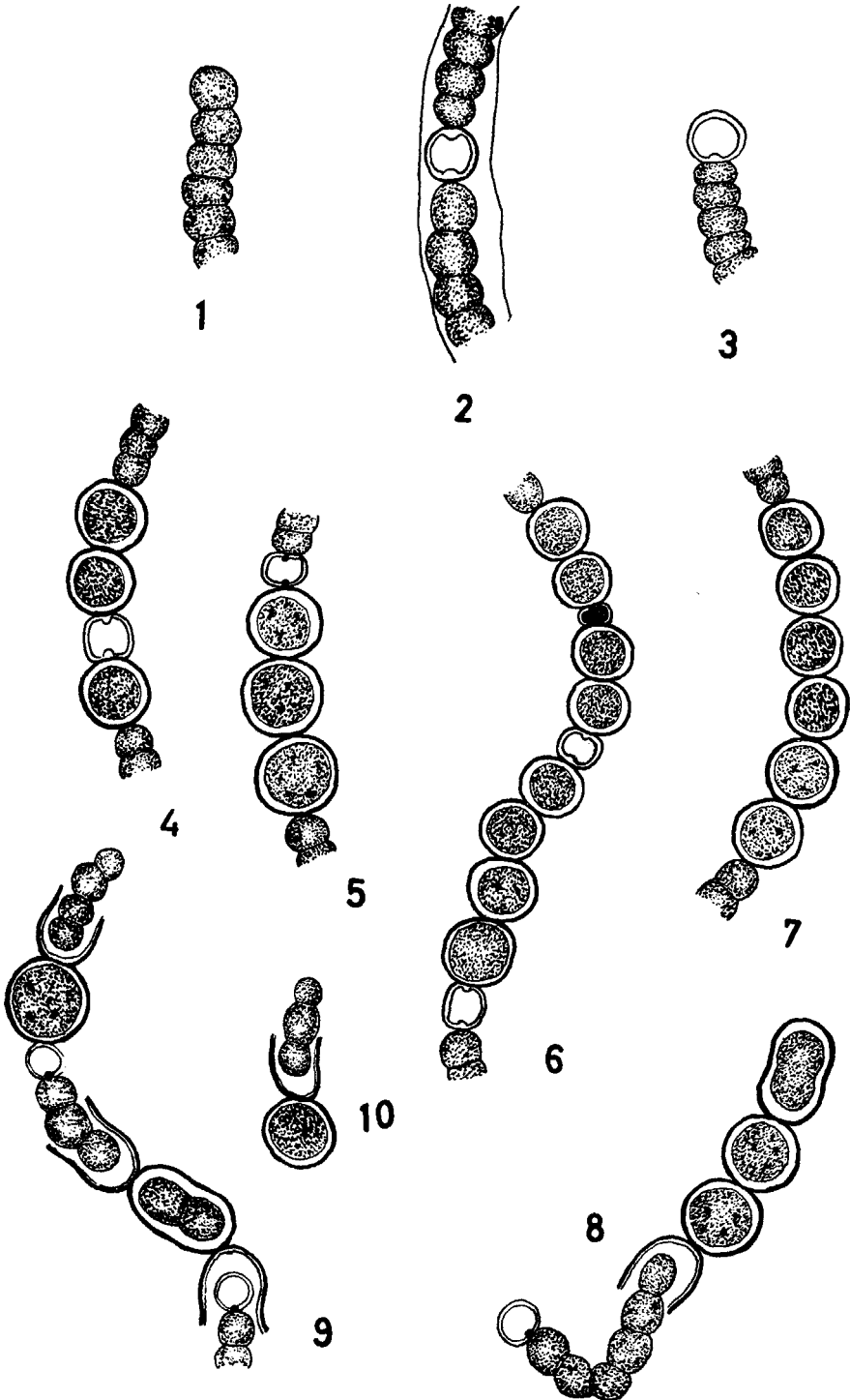
The cells are barrel-shaped, 3.8–4.7 $\mu$  broad and 3.8–5.7 $\mu$  long. The cross wall regions are constricted. The cell contents are coarsely granular and blue green in colour. The cell wall is coloured light blue after treating with iodine and sulphuric acid. The end cell is rounded (Text-fig. 1).

The heterocysts are usually intercalary, but also occasionally found to occupy the terminal position and in such cases the heterocysts are terminal at one end of the trichome only (Text-fig. 3; Pl. XX. Fig. 1). The contents are homogenous and pale blue green in colour. The heterocysts are more or less barrel-shaped with flat ends or sometimes spherical in shape; 5.7–6.6 $\mu$  broad and 4.7–6.6 $\mu$  long. The wall of the heterocysts shows the usual deep blue colouration with iodine and sulphuric acid.

During akinete formation, any vegetative cell which is to form an akinete, becomes richer in contents, increases in size and finally develops a thick wall around it, while the other adjoining cells maintain their original barrel-shape. The akinetes are usually formed remote from the heterocysts (Text-fig. 7), but occasionally they are contiguous to the heterocysts also, viz., one on either side or one to many

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\* Named after Dr. M. S. Randhawa, Vice-President, I.C.A.R., for his valuable contributions to the field of Algology.



Text-figs. 1-10. *Anabaena randhawae* sp. nov. Fig. 1, portion of a trichome showing the spherical end cell; fig. 2, part of the trichome enclosed by an individual sheath; fig. 3, trichome with a terminal heterocyst; figs. 4-6, akinetes contiguous to heterocysts; fig. 7, akinetes remote from heterocyst; figs. 8-10, different stages of germination of the akinetes. (All figures under  $\times 1600$ ).

on one side only or a short chain on either side of the heterocysts (Text-figs. 4, 5, 6). The contents of the mature akinetes are granular, occupying the whole protoplast. The outer envelope is thick, smooth and dark brown in colour. The akinetes are spherical, 5.7-7.6 $\mu$  in diameter.

#### GERMINATION OF THE AKINETES

The akinetes were found to germinate *in situ* (Text-figs. 8-10; Pl. XX. Figs. 2-5). Prior to germination, the contents of the akinetes contract from the wall and in some cases the akinetes themselves slightly elongate with a slight median constriction (Text-figs. 8, 9). The contents divide transversely into two to form a two-celled germling (Text-fig. 9; Pl. XX. Fig. 2), which later undergoes further transverse divisions to form a trichome. The wall of the akinete was found to thin off at the point of rupture in the median portion and the dissolution of the akinete wall at this region may be probably due to some enzymatic action although a mechanical stretching force may also be operative due to the increasing number of the cells of the germling. Germlings up to four-celled stages were clearly seen inside the mother akinete wall (Pl. XX. Figs. 3, 4). In some cases the terminal cell of the germling is transformed into a heterocyst thereby arresting the further development of the trichome on that side (Text-figs. 9, 10).

#### SYSTEMATIC POSITION

The present form in its more or less straight trichomes and variable position of the akinetes resembles *A. wernerii* Brünn., *A. scheremetievi* Elenk., and *A. planktonica* Brünn., but differs from the first in its much narrower trichomes, heterocysts and akinetes, in the absence of pseudovacuoles, in the occasional terminal heterocysts. *A. scheremetievi* differs from the present form in its S-forming trichomes, broader trichomes, occasional ellipsoidal akinetes and trichomes enclosed within a broad mucilage. *A. planktonica* differs in having a broad mucilage, smaller cells, planktonic habit and in the absence of terminal heterocysts. This form resembles *A. sphaerica*, *A. fertilissima*, *A. spiroides*, *A. gelatinicola* and *A. anomala* in possessing spherical akinetes but differs from all mainly in having akinetes extremely variable in position and in possessing terminal heterocysts. The presence of terminal heterocysts brings this form near to *A. oryzae* Fritsch, but the latter differs in having the akinetes characteristically next to the terminal heterocysts and in the attenuating trichomes with a conical terminal heterocyst.

The present form may, therefore, be regarded as a new species of *Anabaena* and it is proposed to name it as *Anabaena randhawae* sp. nov.

#### DIAGNOSIS

##### *Anabaena randhawae* sp. nov.

Trichomes more or less straight, embedded in a broad mucilage; trichomes with occasional terminal spherical heterocyst at one end of the trichome; cells barrel-shaped, 3.8-4.7 $\times$ 3.8-5.7 $\mu$ ; heterocysts barrel-shaped to spherical, 5.7-6.6 $\times$ 4.7-6.6 $\mu$ ; akinetes spherical, usually remote from the heterocysts, less commonly contiguous to the heterocysts; 5.7-7.6 $\mu$  in diameter.

Habitat: Free-floating in a rain water puddle inside the Indian Agricultural Research Institute grounds, New Delhi, India, January 5, 1957.

##### *Anabaena randhawae* sp. nov.

Trichomata plus minusve recta, immersa in gluten copiosum trichomata nonnumquam ad unum apicem ornata heterocystis singulis; cellulae doliiformes,

3.8–4.7 × 3.8–5.7 $\mu$ ; heterocysta doliiformia vel sphaerica, 5.7–6.6 × 4.7–6.6 $\mu$ ; akinetes sphaerici, ut plurimum remoti a heterocystis, rarius eisdem contigui, diametientes 5.7–7.6 $\mu$ .

Typus lectus natans in vado aquae pluvialis in campo Instituti Indici Investigationis Agricolae, in urbe New Delhi, die 5 januarii anni 1957.

#### DISCUSSION

Fritsch (1949) basing his classification on the shape of the akinetes, divided all the species under three groups, viz., akinetes spherical or subspherical, ellipsoidal and cylindrical. Under 'spherical or subspherical', he further classifies the species according to the position of the akinetes, whether contiguous to or remote from the heterocysts. Regarding the position of the akinetes, Fritsch (1949) states, "most of the species, which normally form their akinetes from cells contiguous to heterocysts, only rarely depart from their habit. On the other hand, species forming series of akinetes from cells not adjoining the heterocysts, do occasionally form one next to a heterocyst." In the present form though usually the akinetes are remote from the heterocysts, it is not uncommon to find either a single or a chain of akinetes contiguous to the heterocysts and the author is convinced that every cell is potentially capable of transforming into an akinete (Venkataraman, 1957).

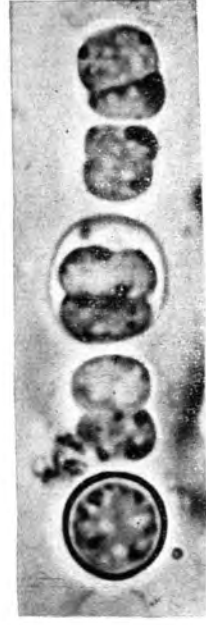
Since the formation of the akinetes remote from the heterocysts is the usual feature in the present form, it is thought advisable to place this alga along with the species which form spherical akinetes remote from the heterocysts like *A. fertilissima* and *A. gelatinicola*, although the present form is extremely variable in forming very frequently its akinetes contiguous to the heterocysts.

#### ACKNOWLEDGEMENT

The author records his sincere thanks to Dr. M. S. Randhawa for his continued interest and inspiration in the progress of this work. His grateful thanks are also due to Dr. B. P. Pal and Dr. S. M. Sikka for their keen interest and encouragement. His thanks are also due to Fr. H. Santapau for kindly providing the Latin diagnosis of this new form.

#### REFERENCES

- Fritsch, F. E. (1949). The genus *Anabaena*, with special reference to the species recorded from India and from the adjacent Asiatic mainland. *J. Ind. Bot. Soc.*, **28**, 135–161.  
 Venkataraman, G. S. (1957). A statistical study of a form of *Wollea Bharadwajae* Singh. *Curr. Sci.*, **28**, 180–1.

**1****2****3****4****5**

Figs. 1-5. *Anabaena randhawa* sp. nov. Fig. 1. Trichome with a terminal heterocyst; Fig. 2-5. Stages in germination of akinetes; Fig. 2. Two-celled germling; Fig. 3. Three-celled germling; Fig. 4. Four-celled germling; Fig. 5. Four young germlings with the broken akinete mother wall enclosing the basal portion of the germlings; (Note in Figs. 2-4, the akinete wall enclosing the germling; Figs. 1-4.  $\times 2400$ ; Fig. 5.  $\times 1600$ ).