CYTOLOGICAL STUDIES IN INDIAN MOSSES*. III—*FUNARIA CALVESCENS* SCHW., *BRYUM CELLULARE* HOOK., *B. RAMOSUM* (HOOK.) MITT., *B. PSEUDO-PACHYTHECA* C. MÜLL., *POHLIA ELONGATA* HEDW. AND *P. FLEXUOSA* HOOK.

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ABSTRACT

The haploid number of chromosomes in *Funaria calvescens* Schw., *Bryum cellulare* Hook., *B. ramosum* (Hook.) Mitt., *B. pseudo-pachytheca* C. Müll., *Pohlia elongata* Hedw. and *P. flexuosa* Hook, is 14, 10, 10, 20, 11, 11, respectively.

INTRODUCTION

In the first paper of this series Pandé and Chopra (1957*a*) recorded their observations on the chromosome number in four Indian mosses, reporting the sex chromosomes in two of them viz. *Pogonatum stevensii* Ren. & Card. and *Bryum nitens* Hook. and subsequently (Pandé and Chopra, 1957*b*) the cytology of three more mosses was investigated. Pandé and Chopra (*unpublished*) studied the chromosome number and the presence of diplosporae in *Physcomitrium* sp., having the haploid number $n = 3$ which apparently is the smallest chromosome count recorded so far in the mosses.

The present contribution deals with the cytology of *Funaria calvescens* Schw., *Bryum cellulare* Hook., *B. ramosum* (Hook.) Mitt., *B. pseudo-pachytheca* C. Müll., *Pohlia elongata* Hedw. and *P. flexuosa* Hook.

MATERIAL AND METHOD

The material of all the species investigated for this communication was collected from Kud which lies at a distance of about 50 miles from Jammu, on Jammu-Srinagar Road, at an altitude of 5,000 ft. above sea-level and Batot another town in the same state situated 15 miles further ahead on the same road at an altitude of about 6,000 ft. above sea-level. Fixation was done in the field in acetic-alcohol (1 : 3). The observations recorded below are exclusively based on aceto-carmine squash preparations. Capsules in which the operculum is not pigmented were selected for the present study as they yielded the required stages.

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Observations

1. *Funaria calvescens* Schw., is a member of the family *Funariaceae*. In several capsule squash preparations 14 bivalents were counted at diakinesis and metaphase I in a number of sporocytes (Figs. 1–2). Meiosis is of the normal type.

2. *Bryum cellulare* Hook. belongs to the family *Bryaceae*. In several preparations of the capsule squashes 10 bivalents were counted at diakinesis and metaphase I. Two of the bivalents showed a marked difference in size from the remaining eight, one of them, A, being bigger than the others, while the other one B, is smaller. The rest of the bivalents are, more or less, of intermediate size. The position of the smaller bivalent, with respect to other chromosomes, is variable (compare Figs. 3–4). No laggards were observed during the process of formation of diad and tetrad nuclei.

3. *B. ramosum* (Hook.) Mitt. In a number of sporocytes in several capsule squashes 10 bivalents could be counted at metaphase I (Fig. 5). The meiosis follows the normal course.

4. *B. pseudo-pachytheca* C. Müll. In several acetocarmine capsule squashes 20 bivalents were counted at diakinesis and metaphase I. Two of the bivalents are small, two others are bigger, while the rest are intermediate in size (Figs. 6–7). *B. pseudo-pachytheca* shows two sets of ten bivalents and it can be inferred that this species might have originated from a stock with $2n = 20$ (18+mM) in the evolution of the species of the genus *Bryum*.

5. *Pohlia elongata* Hedw. belongs to the family *Bryaceae*. In several acetocarmine capsule squashes 11 bivalents could be counted at diakinesis and metaphase I (Figs. 8–9). One of these is conspicuously large as compared to the remaining 10. Meiosis is of the normal type.

6. *P. flexuosa* Hook. 11 bivalents were counted at Metaphase I in a number of sporocyctes in aceto-carmine capsule squashes. (Fig. 10).

Discussion and Conclusion

In their earlier papers Pandé and Chopra (1957*a*,*b*) presented in a tabular form the chromosome counts known for the various species of *Funaria* and the Cytological races of *Funaria hygrometrica*. The present communication includes a supplementary list of the chromosome numbers of a few other species. Obviously $n = 14$, reported for central European material (Wettstein, 1924) and Californian material of *Funaria hygrometrica* (Vaarama, 1953) is the basic number for the genus *Funaria*.

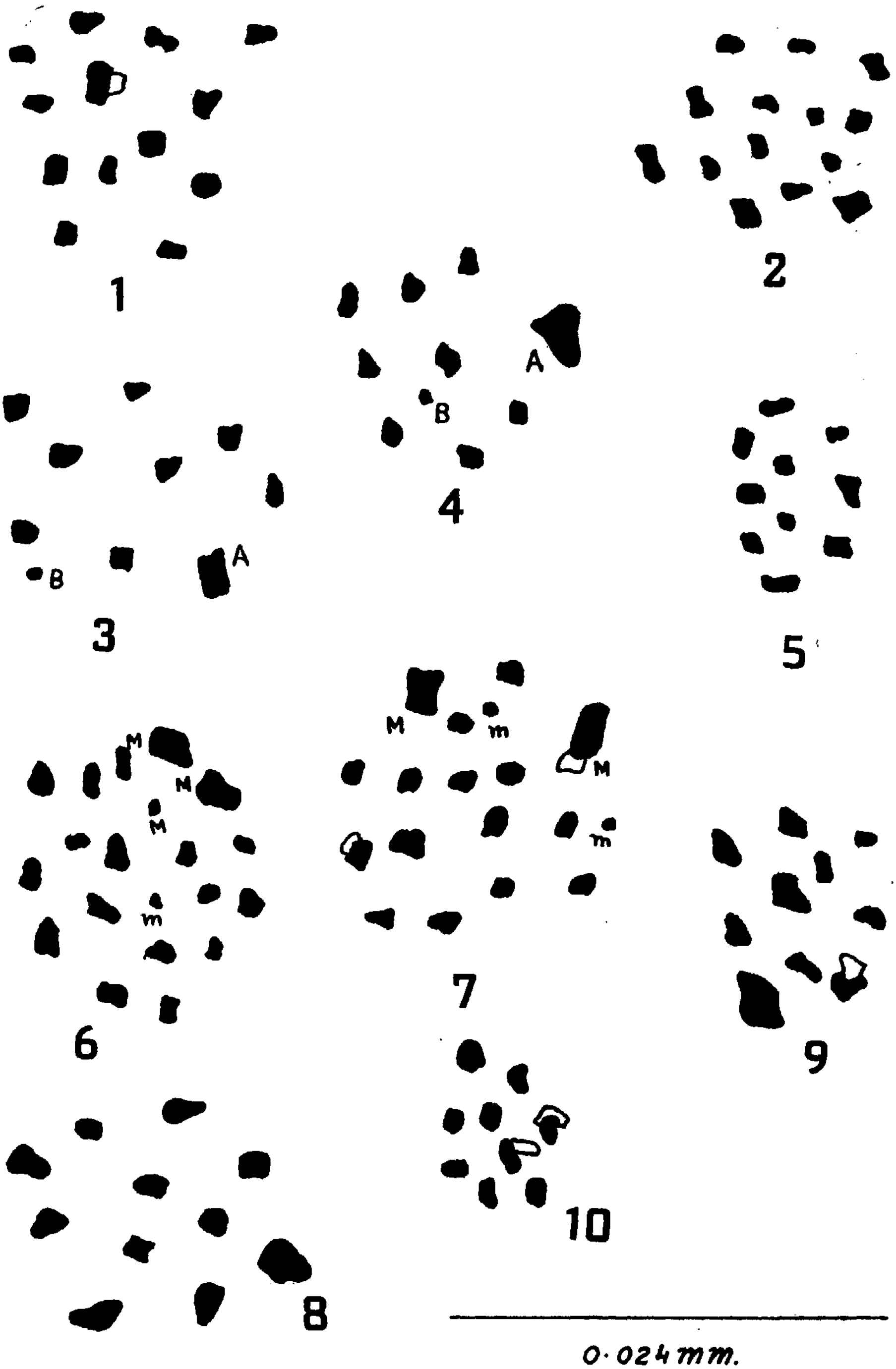
Wettstein (1924) reported $n = 16$ for *Physcomitrella patens*.

According to Schmidt (1931) the gametophytic chromosome number for the German material of *Physcomitrium pyriforme* is 36, while Pandé and Chopra (1957*a*) found $n = 9$ for the same species. In another species of *Physcomitrium* Pandé and Chopra (*unpublished*) observed two types of sporocytes in the same capsule with $n = 3$ and $n = 6$.

Pandé and Chopra (1957*b*) reported $n = 31$ for *Physcomitrellopsis indica*.

It will be evident from the table given below that the basic numbers for ***Funaria***, *Physcomitrella*, *Physcomitrium* and *Physcomitrellopsis*, of the family Funariaceae, is $n = 14$, $n = 16$, $n = 3$, $n = 31$ respectively which evolved independently and without any cytological inter-generic relationship whatsoever.

From the chromosome numbers that have so far been given for the species of *Bryum* it can safely be inferred that the basic number for this genus is 10. Out of the five Indian species of *Bryum* that have been worked out (Chopra, 1957*a*; Pandé and Chopra 1957*b*), in four of the species, the chromosome number is $n = 10$ while one shows $n = 20$. In *Bryum nitens*, by a treatment of the spores with colchicine, Chopra (1957*b*) obtained diploid gametophytes experimentally.



TEXT-FIG. 1.

For the genus *Pohlia* obviously the basic number is 11.

Table giving the chromosome number of some members of the Families Funariaceae *and* Bryaceae

Name of the family and the plant	n	Author and the year
Genus *Funaria*		
F. muhlenbergii Var. patula	28	Steere (1954*a*).
**F. calvescens*	14	Pandé and Chopra.
F. hygrometrica	14	Wettstein (1924).
,,	14	Vaarama (1953).
,,	28	Vaarama (1950, 1955).
,,	28	Steere (1954*a*).
Genus *Physcomitrium*		
P. pyriforme	36	Schmidt (1931).
,,	9	Pandé and Chopra (1957*a*).
P. sp.	3 & 6	Pandé and Chopra (*unpublished*).
Genus *Physcomitrellopsis*		
P. indica	31	Pandé and Chopra (1957*b*).
Genus *Physcomitrella*		
P. patens	16	Wettstein (1924)
Family *Bryaceae*.		
Genus *Bryum*.		
B. cyclophyllum	10	Yano (1956).
B. nagasakense	10	,,
B. pallescens	10	Yano (1952).
B. pseudo-alpinum	10	Yano (1956).
B. bicolor	10	Vaarama (1956).
B. caespiticium	10	Marchal and Marchal (1911).
B. caespiticium	10	Yano (1956).
,,	20	Sannomiya (1955).
B. correnсii	20	Griesinger (1937).
,,	20	Wettstein and Straub (1942).
,,	40 (Experimental)	Griesinger (1937).
B. capillare.	10	Marchal and Marchal (1911).
,,	20 (Experimental)	,, ,,
,,	10+2−3	Steere *et al.* (1954).
B. pseudotriquetrum	10	Heitz (1928).
,,	10+1m	Steere (1954*a*).

EXPLANATION OF TEXT-FIG. 1.

Figs. 1–2 *Funaria calvescens* Schw.,
Fig. 1. 14 bivalents at diakinesis.
Fig. 2. 14 bivalents at metaphase I.

Figs. 3–4 *Bryum cellulare* Hook.
Fig. 3. 10 bivalents at diakinesis.
Fig. 4. 10 bivalents at metaphase.

Fig. 5. *Bryum ramosum* (Hook.) Mitt.
Fig. 5. 10 bivalents at metaphase I.

Figs. 6–7 *Bryum pseudo-pachytheca* C. Müll.
Figs. 6-7. 20 bivalents at metaphase I, including 2m & 2M pairs.

Figs. 8–9 *Pohlia elongata* Hedw.
Fig. 8. 11 bivalents at diakinesis.
Fig. 9. 11 bivalents at metaphase I.

Fig. 10. *Pohlia flexuosa* Hook.
Fig. 10. 11 bivalents at metaphase I.

TABLE—*Contd.*

Name of the family and the plant	n	Author and the year
**B. cellulare*	9+1m	Pandé and Chopra.
**B. ramosum*	10	,,
**B. pseudo-pachytheca*	20 (18+Mm)	,,
B. nitens	10 (9+x or y)	Pandé and Chopra (1957*a*).
,,	20 (Experimental)	Chopra (1957*b*).
Genus *Pohlia*		
P. cruda	10	Steere (1954*b*).
P. scabridens	10	Yano (1956).
P. wahlenbergii	11	Yano (1956).
P. suzuckii	20	,,
P. acuminata	11	,,
P. columbica	11	,,
P. delicatula	11	,,
P. elongata	11	Yano (1953).
**P.* ,,	11	Pandé and Chopra.
P. revoluta	11	Yano (1956).
P. longicolla	22	Yano (1953).
P. nutans	22	Vaarama (1956).
P. nutans	22	Yano (1953, 1956).
P. nutans	21	Steere (1954*b*).
**P. flexuosa*	11	Pandé and Chopra.
P. longibracteata	12	Steere (1954*a*).

* based on the present study.

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*Not seen in original.

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