TABLE II

Grain yield of rice (q/ha) under nitrogen levels, cultures and varieties

Cultures	Nitrogen levels kgs/ha								
	0		50		100		150		
	T.H.	JAYA	T.H.	JAYA	T.H.	JAYA	T.H.	JAYA	Mean
No culture	36·36	39·22	46·40	49·92	53·06	65·26	58·44	73·94	$52·8_c$
A. chroococcum	42·66	46·34	52·62	60·46	58·04	70·36	60·44	76·58	$58·4_b$
Blue-green algae	44·34	45·78	54·86	59·96	60·36	72·96	65·22	79·24	$60·4_b$
Azo + B.G.A.	50·40	52·12	58·04	65·60	63·40	75·74	66·86	79·56	$63·8_a$
Mean (V × N)	43·40	45·60	52·80	59·00	58·80	71·09	62·60	77·20	
Mean (N)	44·06		56·00		64·80		70·00		

Varieties· Tella Hamsa (T.H.)—54·46 Jaya—63·30.

Results of statistical analysis

Source of variation	*Significance* (5%)	$C.D._{0.05}$
Nitrogen levels	Highly signifi ant	3·2
Cultures	Significant	3·2
Nitrogen × cultures	Not-significant	..
Varieties	Significant	1·8
Varieties × Nitrogen	Significant	3·6
Varieties × cultures	Not significant	..
Varieties × Nitrogen × culture	Not significant	..

lised to take place through a recycling machanism as suggested by Venkataraman and Neelakantan[3].

The authors wish to record their sincere thanks to Dr. G. S. Venkataraman, Head, Division of Microbiology, IARI, New Delhi, for his thoughtful suggestions in writing this note.

College of Agriculture, Rajendranagar, Hyderabad,
April 24, 1976.

L. JALAPATHI RAO.
A. VENKATACHARI.
W. V. B. SUNDRA RAO.
K. RAJ REDDY.

1. Stewart, W. D. P., (Ed.). *Nitrogen Fixation by Free-living Microorganisms*, Combridge University Press, London, 1975, p. 471.
2. Venkataraman, G. S., *Algal Biofertilizers and Rice Cultivation. Today and Tomorrow*, New Delhi, 1972. p. 71.
3. — and Neelakantan, S., *Phykos*, 1968, 7, 242.

STOMATA IN *OPHIOGLOSSUM PALMATUM* L.

THE epidermal structure of the Indian species of *Ophioglossum* was briefly described by Mahabale[1], Pant and Khare[2] have studied the mode of development of stomata in four species of *Ophioglossum* and also in *Botrychium* and *Helminthostachys*. But as far as known, the epidermal features, which are being described here under, of *O. palmatum* are completely unknown. Statistical data on stomal index and other aspects are given for the first time.

The plants of *O. palmatum* (epiphytic gaint species) were obtained from U.S.A. (Fig. 1). Other species of *Ophioglossum* described in this paper were collected from several localities from Central India : *viz.*, Gwalior, Shivpuri, Narsinghgarh, Rewa, Ambikapur, Jagdalpur, Varanasi and Nainital. Excursion to these places have yielded eight species of the genus, *viz.*, *O. costatum* R. Br., *O. nudicaule* L., *O. petiolatum* Hook., *O. lusitanicum* L., *O. gramineum* Willd., *O. polyphyllum*. A. Braun apud Seubert, *O. vulgatum* L. and *O. costonudum* n. sp. Goswami and Khandelwal. The plants of *Botrychium* Swartz and *Helminthostachys* Kaulfuss were collected from Nainital and Gorakhpur respectively.

Epidermal features from mature leaves were studied from peels of the central portion. The peels were obtained by heating the material at 60° C for 15 to 30 minutes in the mixture of hydrogen peroxide, acetic acid water (4 : 4: 2 parts respectively). These were then stained with hematoxylin and mounted in glycerine.

TABLE I

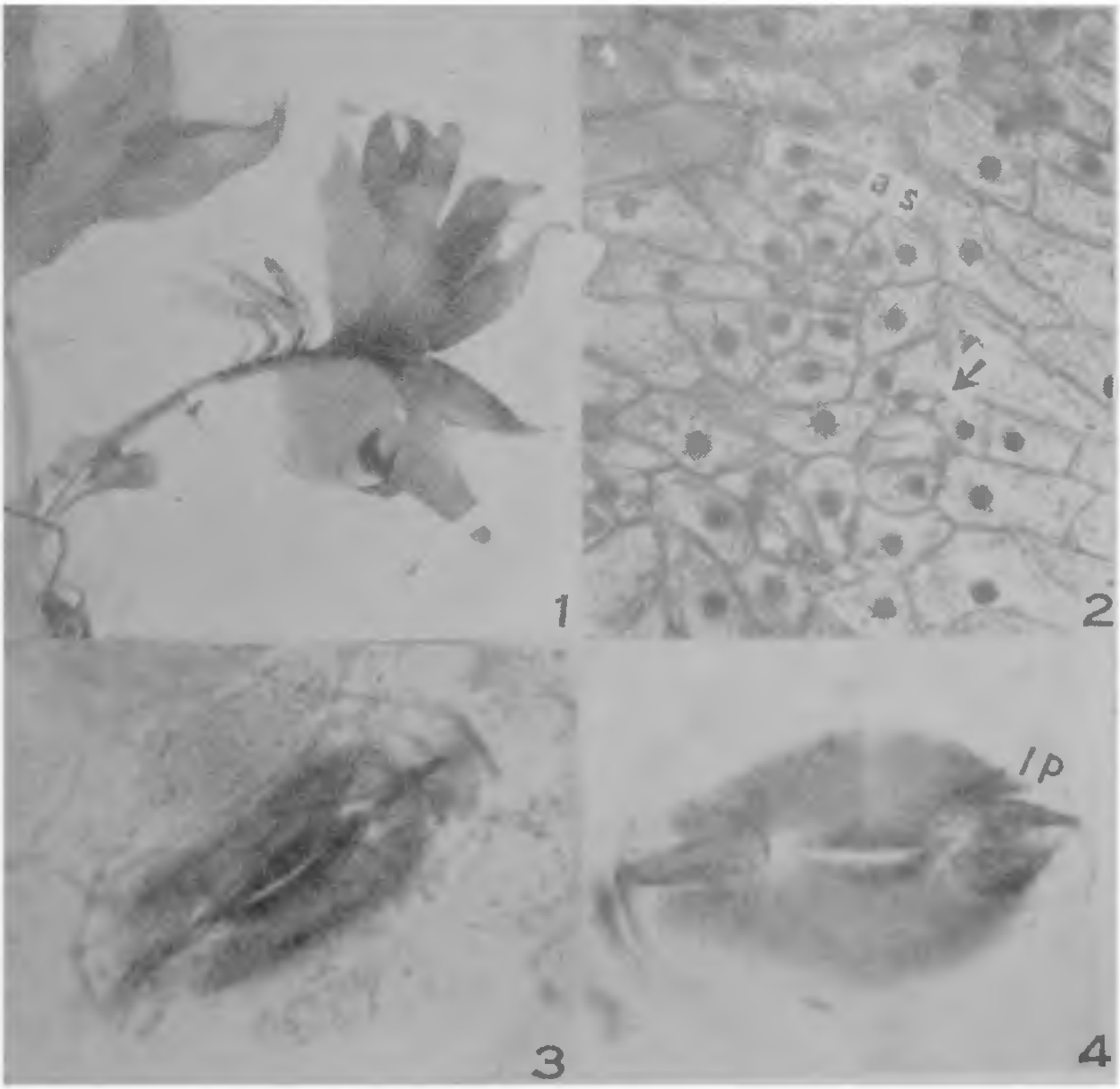
Epidermal features of the family Ophioglossaceae

Sl. No.	Name of species	Stomatal Index		Average size of epidermal cells in microns				Average size of stomata in microns			
				Upper		Lower		Upper		Lower	
		Upper	Lower	Length	Width	Length	Width	Length	Width	Length	Width
1.	*Ophioglossum costatum*	9·3	12·5	63± 9·9	33± 7·8	57± 19·18	31± 8·16	48±5·05	32±3·87	50± 3·74	38±6·48
2.	*O. nudicaule*	18·7	21·4	105±30·98	28± 7·80	94± 39·28	29±11·18	54±4·47	36±3·09	57± 4·84	36±5·05
3.	*O. gramineum*	10·8	12·6	108±22·80	45±19·02	115± 33·78	25± 8·77	57±4·12	33±3·13	67± 6·83	31±4·3
4.	*O. polyphyllum*	20·5	23·0	92±27·18	46±12·03	114± 26·94	31± 8·31	63±3·49	43±5·19	68± 7·60	41±5·39
5.	*O. petiolatum*	8 8	12·5	110±33·37	43±17·67	110± 39·52	26± 8·81	54±5·14	31±3·38	66± 8·31	34±4·09
6.	*O. lusitanicum*	13·6	18·1	129±35·60	30±22·67	156± 26·95	43±25·08	64±7·27	48±3·35	70± 3·69	40±5·51
7.	*O. vulgatum*	9·0	14·0	115±17·46	54±20·65	99± 55·26	52±30·20	75±6·39	55±3·49	76± 9·79	58±4·09
8.	*O. costonudum* (n.sp.)	9·6	12·5	66±23·89	34±12·16	84± 29·15	28± 6·45	47±7·34	36±5·8	56± 8·09	37±3·60
9.	*O .palmatum*	..	6·6	273±67·01	77±20·81	190±121·506	64±15·39	..	..	110±11·73	69±6·81
10.	*Helminthostachys zeylanica*	..	8·7	87±3.·97	29± 6·94	86± 36·73	18± 4·94	..	..	57± 7·17	31±3·49
11.	*Botrychium ternatum*	..	7·6	117±40·81	37± 9·39	97± 42·26	26± 7·21	..	..	78± 6·51	36±5·19

Mean of 10 values, ± = standard deviation.

Cells of epidermis are straight. They do not possess stomata on their upper surface. Both features are unlike other species of *Ophioglossum* (sinuous epidermal cells) but similar to *Helminthostachys* and *Botrychium*. The size of epidermal cells (273 × 77 μ) and the stomata (110 × 69 μ) are the largest among the Ophioglossaceae (Table I). But as expected, the number of stomata and epidermal cells on the lower surface are the lowest (Table I).

of perigene divided by radial walls before or after the formation of guard cells and increase their number. The meristemoid divides by two successive walls formed at right angles to each other cutting off two mesogene cells before the meristemoid functions as the guard cells mother cell. The guard cells of a mature stoma are surrounded by complete rings of subsidiary and encircling cells, each ring consisting of several cells (Fig. 2). The marginal cells of lower epidermis forming dome-



FIGS. 1–4. Fig. 1. A plant of *O. palmatum* (× ½). Fig. 2. Lower epidermal feature in *O. palmatum*. Note the anucleate guard cell mother cell (arrowed) and accessory subsidiary cells (*as*) (× 175). Fig. 3. Normal stomatal apparatus in *O. palmatum* (× 600). Fig. 4. Another stoma "showing lipped" projections (*lp*) in between the guard cells (× 600).

The mode of development of stomata in the present study essentially conforms to the pattern described by Pant and Khare[2]. Basically piper type, the stomatal development is perigenous in Ophioglossaceae. Frequently the neighbouring cells

like papillae such as noted in *H. zeylanica*[2] has not been observed in the present study.

In *O. palmatum* the stomata were seen to possess uniform guard cells (Fig. 3) or some of them had the "lipped" gaurd cells (Fgig. 4). These extensions

from gaurd cells overlapped each other and gave a peculiar shape to the stomata. Such a state has not been reported in any member of Ophioglossaceae. It is very interesting to note that its stomata resemble more closely with that of *H. zeylanica* than with other species of *Ophioglossum*.

We are thankful to Mrs. Virginia Ault, California (U.S.A.), for sending the plants of *O. palmatum*.

Department of Botany, SHARDA KHANDELWAL.
Govt. Science College, H. K. GOSWAMI.
Gwalior, India, *April* 2, 1976.

1. Mahabale, T. S., *Bull. Bot. Surv. India*, 1962, 4, 71.
2. Pant, D. D. and Khare, P. K., *Ann. Bot.*, 1969, 33, 132, 795.

SOME FUNGI HITHERTO UNREPORTED FROM INDIA

Two interesting fungi, *viz.*, *Guignardia musae* Racib. and *Synchytrium aureum* Schroet. were collected from Banana "Hari Chall" sweet variety and "Sowthistle" plants respectively, from Gorakhpur (U.P.). This forms the first report of their occurrence from India.

1. *Guignardia musae* Racib. (Conidial state Fig. 1A)

On the living leaves of *Musa sapientum* L. (Musaceae); Asuran, Gorakhpur; November 1975, leg. Y. N. Srivastava.

The fungus incites minute, rusty, dark brown, circular to oval blisters on the lamina (0·5–1·0 mm in diam.).

Sections of the infected leaves through the blisters show the Mycelium as endophytic, branched, septate and intracellular; Hyphae profusely ramifying in the intercellular spaces also (2–4 μ in thickness); Conidia roughly spherical (10–15μ in diam.), thick-walled and produced in chains. The fungus with its perithecial state was recorded on the living leaves of *Musa paradisiaca* L., for the first time from Buitenzorg, Java[3].

2. *Synchytrium aureum* Schroet (Fig. 1B).

On the living leaves and stems of *Sonchus oleraceus* L. (Compositae); Kusmi forest, Gorakhpur; September 1975, leg. Y. N. Srivastava.

The fungus incites numerous, minute, granular galls unevenly distributed on the surface of the host stem and leaves (0·2–0·5 mm in diam.). Sections of the infected materials through the galls show host cells considerably enlarged in the infected region; mature prosori thick-walled. circular to oval (80–100 μ in diam.) but younger ones 7·0–7·5 μ in diam. and characteristically intracellular. Germinating prosori have also been observed; zoosporangia flatly oval (70–120 μ in diam.). The measurements of prosori of the causal organism, differ from those reported by Cook[1] (1945) for the same species recorded on *Lactuca* sp. but corresponds more to the original description of Schroeter on *Lysimachia numnularia*.

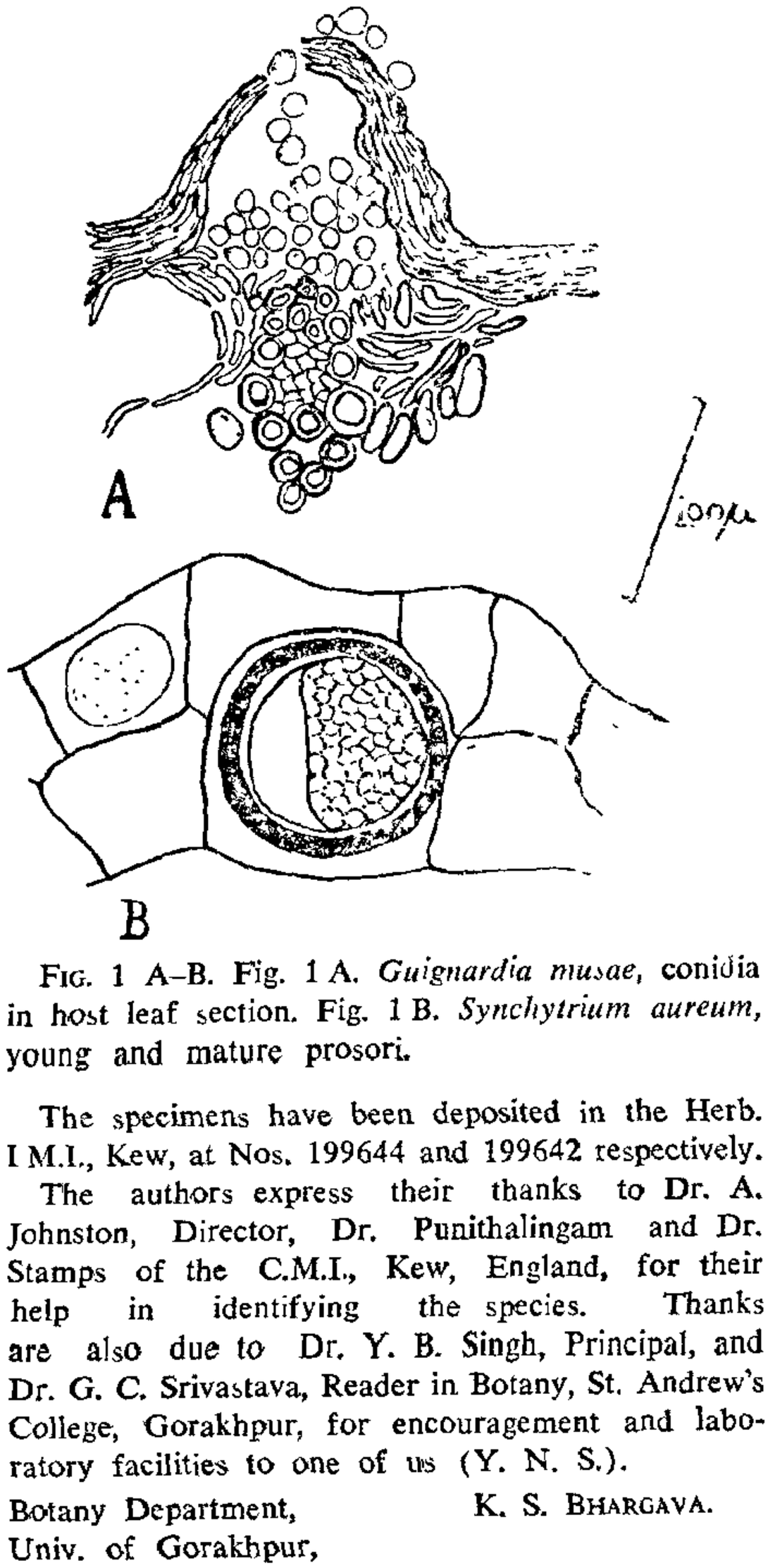


FIG. 1 A–B. Fig. 1 A. *Guignardia musae*, conidia in host leaf section. Fig. 1 B. *Synchytrium aureum*, young and mature prosori.

The specimens have been deposited in the Herb. I M.I., Kew, at Nos. 199644 and 199642 respectively.

The authors express their thanks to Dr. A. Johnston, Director, Dr. Punithalingam and Dr. Stamps of the C.M.I., Kew, England, for their help in identifying the species. Thanks are also due to Dr. Y. B. Singh, Principal, and Dr. G. C. Srivastava, Reader in Botany, St. Andrew's College, Gorakhpur, for encouragement and laboratory facilities to one of us (Y. N. S.).

Botany Department, K. S. BHARGAVA.
Univ. of Gorakhpur,
and
Department of Botany,
St. Andrew's College,
Gorakhpur, *May* 10, 1976.

1. Cook, M. T., *Mycol.*, 1945, 37 (5), 571.
2. Saccardo, P. A., *Syll. Fung.*, 1888, 7, 290.
3. —, *Ibid.*, 1913, 22, 75.