

A CONTRIBUTION TOWARDS A KNOWLEDGE OF INDIAN USTILAGINALES

FRAGMENTS I-XXV

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(With 2 Text-figures)

THE first records of Ustilaginales from India were made by M. J. Berkeley (1851, 1854). In those papers, he reported one already known species and four new species, which were included in the collections made by J. D. Hooker in the early part of the last century in north-eastern India. A second report on Indian smuts appeared in 1876 and a third in 1889, both by M. C. Cooke, who reported three new species among the collections made and sent by C. B. Clarke. One of these, however, has now merged into synonymy. Two new species were reported by American workers from Indian material, one by Ellis & Everhart (1890) and another by Ricker (1905); and nine new species were reported by Brefeld (1895), to whom collections were sent by D. D. Cunningham and A. Barclay.

Cunningham (1889) not only sent collections to Brefeld for determination but studied one of them in India. To him belongs therefore the credit for the first careful investigation of a smut in this country. In 1887 he erected the genus *Rhizophorsora* to accommodate a smut found in the leaves of two species of *Nymphaea*; his genus has been merged into *Entyloma* by Setchell (1894).

A more systematic collection of smuts and their identification was undertaken by Dr E. J. Butler at the beginning of the present century, on his appointment as Cryptogamic Botanist to the Government of India. He first endeavoured to identify the collections in India itself with the aid of such literature as was available. The specimens were then numbered and portions sent to H. Sydow for confirmation or correction. As a result thirty new species were named either by Sydow alone or in association with Butler (Sydow & Butler, 1906-12). H. & P. Sydow (1911, 1912) also described five other new species based on material sent from India; and three new species have been named by Indian mycologists (Kulkarni, 1922; Mitra, 1931; and Mundkur, 1938a).

Within recent years smuts have been collected in India by other botanists. Prominent among these are R. R. Stewart and I. D.

Stewart, whose collections were examined by Clinton & Zundel (1938). These contained no new species, but included four until then unrecorded for India.

Of the 109 species of smuts recorded for India in Butler & Bisby (1931), Clinton & Zundel (1938) and Mundkur (1938*b*), fifty-six species were first described from Indian material; the rest were already described from other parts of the world.

In the smuts, as indeed among obligate parasites in general, the tendency among mycologists has been to distinguish species by their ability to parasitize particular hosts. In the identification of a newly collected smut, a search would first be made to see if any species of the genus had already been recorded on that host; if so, the collection would often, after a most cursory examination, be referred to that species. If one had not been so recorded, the fungus was given a new specific name, often without critical and comparative studies of allied species. The correctness of the name applied to a fungus depended on the correctness of the host identification; this was not always correct, and consequently errors crept in.

On the other hand, some mycologists, e.g. G. H. Cunningham of New Zealand (1924), have gone to the other extreme of placing reliance solely on morphological characters, and rejecting other evidence used in differentiating species.

A middle course has been followed in these investigations. Wherever possible the species under study has been compared with the smuts recorded on the same species or nearly allied species of the host plant. Morphological characters, such as spore colour, shape, nature and thickness of the epispore and size, have been given primary importance. Reliance has also been placed on the capacity of the fungus to attack only certain parts of the host. The method of germination of the spores has been used as a diagnostic character of some importance. The capacity of a smut to attack only a certain species of plant has not therefore been made the sole criterion in separating species, though a certain amount of host specialization has been assumed to exist.

This has necessitated the correct identification of the host plants, and the author would like to express his hearty appreciation of the help rendered in identifying the hosts by Dr Kalipada Biswas, Superintendent, and Mr V. Narayanaswami, Curator, Royal Botanic Gardens, Calcutta.

The types and even the cotypes of Indian smuts described in the earlier years by workers outside India are unavailable in India. Later identifications of these smuts have therefore been based on the brief descriptions given in Saccardo. This has frequently led to mis-determinations of the smuts in the *Herbarium Cryptogamae Indiae Orientalis* of the Imperial Agricultural Research Institute at New

Delhi. An endeavour was therefore made to obtain fragments of type specimens for critical comparisons whenever possible. This effort was substantially assisted by Mr S. F. Ashby, Director, Imperial Mycological Institute, Kew, to whom most grateful thanks are here expressed, for the help given in securing the specimens. Full use has been made of the *exsiccatae* of Ustilagineae distributed by Sydow. Fragments of type specimens or authentic *exsiccatae* were also sent on loan by Sir Arthur Hill, Director, Royal Botanic Gardens, Kew, to whom grateful acknowledgements are due.

These efforts have led, after much deliberation and only when fully warranted by the facts, to changes in nomenclature of several Indian smuts.

A uniform set of methods has been followed. Invariably, unless material was scanty, at least 200 spores, mounted in lactophenol, were measured with a Leitz 2 mm. fluorite, oil immersion objective and a $\times 6$ periplanetic micrometer eyepiece. As sunlight is variable from season to season, a 100-watt bulb was used as a source of light, with a very dilute solution of cotton blue as a screen. The conditions of observation have, so far as possible, been standardized.

I. *USTILAGO ANDROPOGONIS-ANNULATI* BREFELD

A smut on *Andropogon annulatus* Forsk. was sent to Brefeld by Cunningham for determination sometime in the early nineties of the last century. Brefeld (1895) compared it with *Schroeteria annulata* Ellis & Everhart, a smut already reported on the same host, concluded that it was a new species and called it *Ustilago Andropogonis-annulati*. The name of the collector, the date of collection and the locality were probably not communicated, for this information is not given on the label of the type specimen deposited by Brefeld in the Herbarium of the Berlin Botanical Museum. Brefeld stated, however, that the specimen had been sent from Dehra Dun which, presumably, is the type locality.

Eleven collections of smuts, made since then at different times and in different localities in India, on the same or nearly allied hosts, have been labelled with this name in the *Herbarium Cryptogamae Indiae Orientalis*. A critical examination of these collections has shown that they contain three species, one of which is new.

The earliest collection of this smut was made by E. J. Butler (No. 462) at Poona in 1902; Sydow & Butler (1906) identified it as *U. Andropogonis-annulati*, presumably after comparison with Brefeld's type specimen. In Brefeld's account of this fungus, more importance was given to the description of the method of germination of the spores, and the conditions necessary to bring this about, than to the morphological characters which are, indeed, very meagrely treated.

The spores furthermore are stated to be 8-9 μ in diameter and these incomplete details are repeated in Saccardo (*Sylloge*, XIV, 419).

A good description of *U. Andropogonis-annulati* has been recently given by Zundel (1930) who examined a fragment of the specimen collected by P. A. Pandit (see I (3) below). He transferred it to the genus *Sphacelotheca*, accepting the broader definition of this genus given by Clinton (1904), and with this conclusion I am in agreement. It should be stated that the host plant is now called *Dicanthium annulatum* (Forsk.) Stapf.

Through the courtesy of Dr E. Ulbrich, Kustos and Professor, Berlin-Dahlem Botanical Museum, fragments of Brefeld's type specimens of this and other smuts were kindly obtained for me by Mr S. F. Ashby. A description and the frequencies of the spore measurements are given below.

Sphacelotheca Andropogonis-annulati (Brefeld) Zundel

Ovaricolous. Sori completely destroying the ovaries, later protruding from the glumes by forcing them apart, 3-4 mm. long; covered by a dusky cream false membrane, the cells of which are brownish. Spores subglobose to globose, Kaiser Brown (Ridgway), clearly echinulate under an oil immersion objective, with a diameter range of 7-13 μ and mean of 10.1 μ .

On *Dicanthium annulatum* (Forsk.) Stapf, and *D. caricosum* (L.) A. Camus, at Dehra Dun, Samalkota, Poona, Nagpur, Andheri and other parts of India including the Punjab. Syn.: *Ustilago Andropogonis-annulati* Bref.

I. (1) Brefeld's type specimen. Morphological characters as above.

Diameter (μ)	8	9	10	11	12	13	
Frequency (n)	1	14	75	104	5	1	=200
	Mean = 10.3 μ .						

I. (2) Collected by E. J. Butler on *Andropogon annulatus* (= *Dicanthium annulatum*) at Kirkee, Poona, on 9 September 1902. This specimen bears Butler's accession no. 462 and is a part of the specimen examined by Sydow. Morphological characters as above.

Diameter (μ)	8	9	10	11	12	13	
Frequency (n)	1	30	52	102	14	1	=200
	Mean = 10.6 μ .						

A note left with the specimen by S. N. Mitra states that the spores had a larger diameter than that given by Brefeld, and that this fact had been brought to Sydow's notice.

I. (3) Collected by P. A. Pandit on *A. annulatus* (= *D. annulatum*)

at Nagpur in August 1904. This also, in error, bears Butler's accession no. 462. Morphological characters as above.

Diameter (μ)	8	9	10	11	12	13	
Frequency (n)	3	52	89	44	8	4	= 200

Mean = 10.0 μ .

I. (4) Collected by R. T. Pearl on *A. caricosus* L. (= *Dicanthium caricosum* (L.) A. Camus) at Nagpur on 24 October 1922. Morphological characters as above.

Diameter (μ)	7	8	9	10	11	12	
Frequency (n)	4	0	79	55	61	1	= 200

Mean = 10.0 μ .

I. (5) Collected by T. F. Main on *A. annulatus* (= *D. annulatum*) in the Punjab in 1917. Morphological characters as above.

Diameter (μ)	7	8	9	10	11	12	13
Frequency (n)	3	1	45	79	62	6	4

Mean = 10.2 μ .

I. (6) Collected by C. A. Barber (no. 920) on *A. annulatus* (= *D. annulatum*) at Samalkota on 3 March 1903. Morphological characters as above.

Diameter (μ)	7	8	9	10	11	12	13
Frequency (n)	1	4	49	64	57	20	5

Mean = 10.2 μ .

I. (7) Collected by J. F. Dastur on *A. annulatus* (= *D. annulatum*) at Andheri, Bombay. Morphological characters as above.

Diameter (μ)	7	8	9	10	11	12	
Frequency (n)	9	26	43	59	54	9	= 200

Mean = 9.9 μ .

I. (8) Collected by P. A. Pandit on "*Andropogon* sp." at Nagpur on 26 July 1907. As the conception of the genus *Andropogon* has been considerably changed in recent years, it is doubtful if the host is in fact an undetermined species of *Andropogon*. Morphological characters as above.

Diameter (μ)	8	9	10	11	12	13	
Frequency (n)	5	30	62	79	20	4	= 200

Mean = 10.4 μ .

II. *SPHACELOTHECA ANNULATA* (ELLIS & EVERHART) MUNDKUR

Three collections of smuts on *Andropogon annulatus* (= *Dicanthium annulatum* (Forsk.) Stapf) and labelled *Ustilago Andropogonis-annulati* Brefeld (see previous note) in the *Herbarium Cryptogamae Indiae Orientalis* were found, on critical examination, to have larger spores

and to differ in certain essential characters from the type specimen of *Sphacelotheca Andropogonis-annulati*. They agree, however, with *Ustilago Duthiei* Ricker.

Ustilago Duthiei was collected by J. F. Duthie on a grass then designated *Andropogon Bladhii* Retz. (= *D. annulatum*) at Dehra Dun on 22 October 1888. It is not known how the specimen found its way to the United States of America, where Ricker (1905) described it. Ricker fortunately stated that the specimen bore Duthie's field no. 7699, and with this clue the type was traced to the University of Wisconsin and the cotypes to Dehra Dun and to Kew. Fragments of the former were kindly sent by Dr E. M. Gilbert of that University and of the cotypes by N. L. Bor, Forest Botanist, Dehra Dun and by Sir Arthur Hill. Duthie's plant bearing his field no. 7699 is not a grass. Ricker's type specimen in the Herbarium of the University of Wisconsin, however, bears the no. 7679, and so do the cotypes at Kew and at Dehra Dun, where on the sheet of the specimen Duthie has written "ergotized".

The cotypes received from Dehra Dun and Kew agreed very well with Ricker's type, and there is now no doubt that among the specimens in the *Herbarium Cryptogamae Indiae Orientalis* three labelled *Ustilago Andropogonis-annulati* are really *U. Duthiei*. Zundel (1930) transferred *U. Duthiei* to the genus *Sphacelotheca*, a change with which I am in agreement.

At the time this smut was under investigation by me, an *exsiccata* of *Schroeteria annulata* was received from F. J. Seaver of the New York Botanic Garden through the courtesy of S. F. Ashby. This smut was described and named by Ellis and Everhart (1890) from the ovaries of *Andropogon annulatus*. The collector is stated to be S. M. Tracy, an American mycologist, but neither the exact locality in India nor the date of collection is given on the type specimen in the New York Botanic Garden. Ellis and Everhart stated that the spores were in twos or occasionally threes, flattened on the line of contact, hyaline, 12–15 μ in diameter at first, becoming brown and separating into two distinct spores, 7–10 μ in diameter; they placed the smut in the genus *Schroeteria*. It is not clear if Brefeld (1895) had actually seen this smut when he compared his *Ustilago Andropogonis-annulati* with it.

An examination of the specimen has not shown any hyaline spores. The spores, which are brown, do not occur in twos or occasional threes, but they are of the usual *Sphacelotheca* type. Ellis and Everhart either mistook for mature spores the sterile cells of the membrane, which are hyaline, and sometimes occur in chains or groups, or mistook the host tissue or immature spores for them. When the spores were compared with the spores of *Schroeteria Delastrina* (Tul.) Winter (Sydow, *Ustilagineen*, no. 336), the species on which the

genus *Schroeteria* was founded, it became apparent that there was nothing in common between these two fungi which would justify one in retaining Ellis and Everhart's smut in that genus. The name written on the specimen received from Seaver is *Ustilago annulata* E. & E., but no record has been found that Ellis and Everhart ever effectively published this binomial.

The smut belongs in fact to the genus *Sphacelotheca*, as each sorus has a false membrane and a columella. It agrees in all respects with *Ustilago Duthiei*. This species was created, however, in 1905 and Ellis & Everhart's (1890) specific epithet *annulata* of 1890 has priority; the names *Ustilago Duthiei* and *Sphacelotheca Duthiei* must be reduced to synonymy.

Sphacelotheca annulata (Ellis & Everhart)
Mundkur comb.nov.

Ovaricolous. Sori slightly bullate, at first hidden by the glumes but later protruding; 4-6 mm. long; covered by a cream-coloured and evanescent false membrane, which breaks up at maturity into groups or chains of hyaline, irregular cells slightly larger than the spores themselves. Spores Carob Brown (Ridgway), globose to subglobose, with a moderately thick epispore, smooth or at the most with contents minutely granular, presenting a pitted appearance, but by no means "verruculose" as stated by Zundel; diameter from 9 to 15 μ with a mean of 11.2 μ .

On *Dicanthium annulatum* (Forsk.) Stapf at Dehra Dun, Coimbatore, Bassein, and presumably other parts of India. Synonyms: *Schroeteria annulata* E. & E., *Ustilago Duthiei* Ricker, *Sphacelotheca Duthiei* (Rick.) Zundel.

II. (1) Collected by S. M. Tracy(?) on *Andropogon annulatus* (= *Dicanthium annulatum*) in India. Type of *Schroeteria annulata* E. & E. and of *Sphacelotheca annulata* (E. & E.) Mundkur, ex Herb. New York Botanical Gardens, U.S.A. Characters as above.

Diameter (μ)	9	10	11	12	13	14	15	
Frequency (n)	15	36	67	51	20	17	4	= 210
	Mean = 11.6 μ .							

II. (2) Collected by J. F. Duthie (no. 7679 and not 7699 as stated in diagnosis) on *A. Bladhii* Retz. (= *D. annulatum*) at Dehra Dun on 22 October 1888. Type of *Ustilago Duthiei*, ex Herb. Univ. Wisconsin, U.S.A. Morphological characters as above.

Diameter (μ)	9	10	11	12	13	14	15	
Frequency (n)	10	30	92	56	10	1	1	= 200
	Mean = 11.2 μ .							

II. (3) Collected by Inayat Khan on *A. annulatus* (= *D. annulatum*) at Dehra Dun on 21 June 1904. Morphological characters as above.

Diameter (μ)	9	10	11	12	13	14	15	
Frequency (n)	13	28	102	33	18	4	2	= 200
	Mean = 11.3 μ .							

II. (4) Collected by S. Sundararaman on *Dicanthium annulatum* at Coimbatore on 29 May 1935. Morphological characters as above.

Diameter (μ)	9	10	11	12	13	14	15	
Frequency (n)	18	38	96	33	14	0	1	= 200
	Mean = 11.0 μ .							

II. (5) Collected by H. M. Chibber (no. 228) on *A. annulatus* (= *D. annulatum*) at Bassein on 22 November 1908. Morphological characters as above.

Diameter (μ)	9	10	11	12	13	14	15	
Frequency (n)	22	46	82	29	15	3	3	= 200
	Mean = 11.0 μ .							

III. A NEW SMUT ON *DICANTHIUM ANNULATUM*

A smut on *Andropogon annulatus* (= *Dicanthium annulatum*) was collected by E. J. Butler on 30 August 1905 at Chatrapur, Ganjam District, and the specimens in the *Herbarium Cryptogamae Indiae Orientalis* were labelled *Ustilago Andropogonis-annulati*. On comparing this smut with the type specimens of *Sphacelotheca Andropogonis-annulati* and *S. annulata* (see Notes I and II), it at once became manifest that the identification was incorrect. As it does not agree with any of the smuts known on this or nearly allied hosts, it is no doubt a new species. It belongs to the genus *Sphacelotheca* and is named *S. Sahayai* after Mr C. B. Sahaya, the author's colleague who has rendered considerable help in these investigations.

Sphacelotheca Sahayai Mundkur spec.nov.

Soris in ovariis evolutis, ovoideis, ad 2 vel 3 mm. longis, primo inter glumas compressas occultis, deinde inter eas patentes manifestis, massam sporarum semi-agglutinatum, nigrobrunneam membrana evanescenti tegentibus, postremo columellam prominentem, nudatam exhibentibus. Cellulis sterilibus, hyalinis, irregularibus, nonnihil angulatis et sporis magnitudine praestantibus. Sporis constanter globosis, Vandyke Brown (Ridgway), epispora crassissima propter aculeos magnos et extantes quasi serrata praeditis, 9-15 (in medio 12.2) μ diam.

Hab. In ovariis *Dicanthii annulati* (Forsk.) Stapf, Chatrapur, Ganjam District, Indiae or. (E. J. Butler; Aug. 1905.)

Sori ovaricolous, ellipsoidal, about 2-3 mm. long, at first hidden by the glumes but later becoming manifest as the glumes spread; covered by an evanescent membrane which encloses the semi-agglutinated blackish brown spore mass; as the membrane and the spores wear away, displaying a prominent columella. Sterile cells hyaline, irregular, slightly angled, and larger than the spores. Spores Vandyke Brown (Ridgway), regularly globose, with prominent and large echinulations that give a serrated appearance to the edges; epispore very thick; diameter ranges from 9 to 15 with a mean of 12.2 μ .

On *Dicanthium annulatum* (Forsk.) Stapf, at Chatrapur, Ganjam District. Specimens of original material deposited in the *Herbarium Cryptogamae Indiae Orientalis* at New Delhi and at the Imperial Mycological Institute, Kew.

The spores of this smut differ from those of *Sphacelotheca Andropogonis-annulati* in having a larger diameter, a thicker epispore and more prominent echinulations. They differ from the smooth spores of *S. annulata* in having a larger diameter and a thicker, echinulate epispore. They are deeper brown than the spores of the other two species.

III. (1) Collected by E. J. Butler on *Dicanthium annulatum* at Chatrapur, Ganjam District, on 30 August 1904. *Type*.

Diameter (μ)	9	10	11	12	13	14	15	
Frequency (n)	6	13	103	39	21	7	11	= 200
			Mean = 12.2 μ .					

IV. *USTILAGO SUPERFLUA* SYD.

This smut was collected by F. J. F. Shaw on *Andropogon foveolatus* Del. at Samalkota on 21 November 1910. The specimen in the *Herbarium Cryptogamae Indiae Orientalis* bears E. J. Butler's accession no. 1431, and is a part of the specimen submitted to Sydow (see Sydow & Butler, 1906) for determination. The accepted name of the host plant is *Eremopogon foveolatus* (Del.) Stapf.

Sphacelotheca superflua (SYD.) ZUNDEL

Inflorescence entirely destroyed. Sori at first hidden by the leaf sheath but later protruding; deep dark brown, 5-14 mm. long, covered by a false membrane which gradually disintegrates; provided with a prominent columella, seen on teasing the sorus. Cells of the membrane hyaline or slightly tinted, smooth and sterile. Spores Kaiser Brown (Ridgway) and slightly opaque, subglobose but often irregular in outline and frequently angled; epispore thin, covered with prominent echinulations that give the edge a serrated appearance.

The smut was transferred to *Sphacelotheca* by Zundel (1930), and this appears to be justifiable only so far as our present knowledge of the smut goes. The appearance of the sorus, the size of the spores and the prominent echinulations which can almost be termed spines, and the fact that many of the spores are subopaque, lead to the suspicion that it may belong to *Tilletia*. Species belonging to that genus, however, usually have a thick epispore, while in the present fungus the epispore is rather thin. The method of germination of the spores is of course the chief distinguishing generic character and until that has been observed, the smut can only be tentatively placed in the genus *Sphacelotheca*. Syn.: *Ustilago superflua* Syd.

IV. (1) Collected by F. J. F. Shaw on *Andropogon foveolatus* (= *Eremopogon foveolatus*) at Samalkota on 21 November 1910. *Cotype*.

Diameter (μ)	10	11	12	13	14	15	16	
Frequency (n)	1	6	29	106	38	16	4	= 200
	Mean = 13.2 μ .							

V. *USTILAGO NARDI* SYD.

A smut on *Andropogon Nardus* Hooker f. (non L.) was collected by E. J. Butler at Vayitri, Wyanaad Hills, Malabar, on 2 November 1904, and described as a new species, *Ustilago Nardi* by Sydow (in Sydow & Butler, 1906). A duplicate of Butler's no. 470, on which Sydow founded the species, is in the *Herbarium Cryptogamae Indiae Orientalis* at New Delhi. A second collection was made by W. McRae at Panora, Wyanaad Hills, on 17 November 1909.

Petch (1912) suggested that this species might be *Ustilago spermoidea* of Berkeley & Broome (1875), recorded on *Cymbopogon Martini*, which, as understood by Thwaites, is a synonym of *Andropogon Nardus*.

Specimens of the host plant collected by Butler (no. 470) were submitted to the Royal Botanic Gardens, Calcutta, for redetermination, and it was stated, in reply, that the host plant was *Cymbopogon confertiflorus* (Steud.) Stapf (= *Andropogon Nardus* var. *confertiflorus*), as was also the specimen collected by McRae.

It will be noted that neither of the Indian specimens is on *Cymbopogon Martini*, and Petch's suggestion (1912) that *Ustilago Nardi* may be *U. spermoidea* was tested by comparison of the two smuts. A cotype of the latter species (Thwaites no. 589) was kindly sent by W. R. C. Paul, mycologist, Peradeniya, Ceylon, and critical examination has shown that in *U. spermoidea* the spores are larger, deeper brown and have thicker epispores. In my judgement, these two smuts are not the same species. Zundel (1938) transferred *U. Nardi* to the genus *Sphacelotheca* on valid grounds. Berkeley and Broome's smut also belongs to *Sphacelotheca* on account of its papyrus-like false membrane and a columella which is, however, rather indistinct.

Sphacelotheca Nardi (Syd.) Zundel

Sori ovaricolous, 2–3 mm. long, linear, covered with a delicate false membrane which later disintegrates revealing a brown spore mass and a well-developed columella, nearly concealed by the leaf-sheath. Sterile cells in groups or chains, rectangular, brownish and $4.5\text{--}7\ \mu$ in diameter. Spores globose to subglobose, irregular, Carob Brown (Ridgway), smooth, ranging in diameter from 6 to $10\ \mu$ with a mean of $7.7\ \mu$; epispore not thick. Syn.: *Ustilago Nardi* Syd.

V. (1) Collected by E. J. Butler on *Andropogon Nardus* (= *Cymbopogon confertiflorus*) at Vayitri, Wyanaad Hills, Malabar, on 2 November 1904. Butler's no. 470, which is a part of the *type* specimen, was examined. Morphological characters as above.

Diameter (μ)	6	7	8	9	10	
Frequency (<i>n</i>)	16	120	46	17	1	=200

Mean = $7.6\ \mu$.

V. (2) Collected by W. McRae on *Andropogon Nardus* (= *Cymbopogon confertiflorus*) at Panora, Wyanaad Hills, on 17 November 1909. Morphological characters as above.

Diameter (μ)	6	7	8	9	10	
Frequency (<i>n</i>)	7	93	48	48	5	=201

Mean = $7.7\ \mu$.

Sphacelotheca spermoidea (B. & Br.) Mundkur comb.nov.

Sori ovaricolous, 4.5 mm. long, at first hidden by the glumes but later somewhat protruding; covered by a false membrane of papyrus-like consistency, which may later flake away. Columella rather indistinct. Spores globose to subglobose or slightly irregular with a thick but smooth epispore, Kaiser Brown (Ridgway); diameter ranging from 7 to $12\ \mu$ with a mean of $9.8\ \mu$. Syn.: *Ustilago spermoidea* B. & Br.

V. (3) Collected by Thwaites (no. 589) on *Cymbopogon Martini* in Ceylon. *Cotype*.

Diameter (μ)	7	8	9	10	11	12
Frequency (<i>n</i>)	1	3	56	86	52	2

Mean = $9.8\ \mu$.

VI. *USTILAGO SCHOENANTHI* SYD. & BUTLER

This smut was found by C. A. Barber (no. 3347) on "*Andropogon Schoenanthus* L." at Alanacolum, Tinnevely District, on 1 July 1901 and sent to E. J. Butler for determination. The specimen in the *Herbarium Cryptogamae Indiae Orientalis* bears Butler's accession no. 449 and is a part of that on which Sydow and Butler (1906) founded

the species, *Ustilago Schoenanthi*. An earlier specimen of "*A. Schoenanthus*" collected by Barber (no. 2677) at Palamcottā, Tinnevely District, on 11 May 1901, also bears, in error, the same accession no. 449. A third specimen of the same host, collected at Bargur, Krishnagiri, Salem District, on 31 October 1924, is also labelled *Ustilago Schoenanthi*. Zundel (1930) has transferred the smut to the genus *Sphacelotheca* on grounds which I consider as valid.

A redetermination of the grasses by the Curator, Royal Botanic Gardens, Calcutta, showed that the specimens from Alanacolam and from Bargur were *Cymbopogon flexuosus* (Steud.) Watson, and that the specimen from Palamcottā was *C. coloratus* Stapf. Examination of the smut affecting the latter specimen showed that that smut was not *Ustilago Schoenanthi* but an undescribed species.

A critical examination of part of the type specimen (no. 449) and the collection from Bargur has shown good agreement with the description given by Sydow & Butler (1906), but considerable disagreement with the description given by Zundel (1930).

Sphacelotheca Schoenanthi (Syd. & Butler) Zundel

Sori ovaricolous and completely destroying the ovaries. About 10–15 mm. long with a false membrane which finally disintegrates, revealing a dark brown non-granular spore-mass. Columella non-flattened, simple or multiple, hidden at first by the sheath; sterile tissue breaking up into large, hyaline, subglobose cells. Spores regular, globose to subglobose, Carob Brown (Ridgway) with a very thick epispore which is smooth (not echinulate as stated by Zundel); diameter ranges from 5 to 9 μ with a mean of 7.0 μ . Syn.: *Ustilago Schoenanthi* Syd. & Butler.

On *Cymbopogon flexuosus* (Steud.) Watson (= *Andropogon Nardus* Hooker f. var. *flexuosus* Steud. but at first incorrectly identified as *A. Schoenanthus* L.) at Alanacolam, Tinnevely District, and Bargur, Krishnagiri, Salem District.

VI. (1) Collected by C. A. Barber (no. 3347) on "*Andropogon Schoenanthus*" (real name = *Cymbopogon flexuosus*) at Alanacolam, Tinnevely District. Butler's no. 449. Type. Morphological characters as above.

Diameter (μ)	5	6	7	8	9	
Frequency (n)	3	54	118	15	10	= 200
	Mean = 7.0 μ .					

VI. (2) Collected on *A. Schoenanthus* (real name = *Cymbopogon flexuosus*) at Bargur, Krishnagiri, Salem District, on 31 October 1924.

Diameter (μ)	5	6	7	8	
Frequency (n)	12	118	69	1	= 200
	Mean = 6.1 μ .				

Even though the spores of this specimen have a smaller diameter, there are no other morphological characters by which the one can be distinguished from the other.

VII. A NEW SMUT ON *CYMBOPOGON COLORATUS* STAPF

A specimen at first determined as *Andropogon Schoenanthus* L., and collected by C. A. Barber (no. 2677) at Palamcotta, Tinnevely District, on 11 May 1901, was found to be attacked by a smut which has been labelled *Ustilago Schoenanthi* Syd. & Butler in the *Herbarium Cryptogamae Indiae Orientalis*. The smut is not, however, *U. Schoenanthi*, as its sori lack a false membrane and a columella, and its spores are larger and have a warty epispore. A redetermination of the host shows that the grass is *Cymbopogon coloratus* Stapf. The smut does not agree morphologically with any species of *Ustilago* reported on the genus *Cymbopogon* or allied genera, and is new. The name *Ustilago Barberi* is proposed for it, in honour of its collector.

Ustilago Barberi Mundkur spec. nov.

Soris ovaria inficientibus eaque omnino destruentibus, 7-12 mm., longis, columella destitutis et e massa sporarum fusca inter glumas retenta constitutis. Sporis plerumque irregulariter globosis, subglobosis vel ovoideis, Brussels Brown (Ridgway), epispora crassa, sine ordine verrucosa, praeditis, 7-13 (in medio 9.9) μ diam.

Hab. In ovariiis *Cymbopogonis colorati* Stapf., Palamcotta, Tinnevely District, Indiae or. (C. A. Barber (no. 2677); Maius, 1901.)

Ovaricolous, completely destroying the ovaries. Sori about 7-12 mm. long; spore-mass dark brown and held together by the glumes; columella not present. Spores globose to subglobose, ellipsoidal, but usually irregular; Brussels Brown (Ridgway), epispore thick and warty, with warts placed irregularly on the surface, giving the edge an uneven appearance; diameter ranging from 7 to 13 μ with a mean of 9.9 μ .

On *Cymbopogon coloratus* Stapf at Palamcotta, Tinnevely District. Type specimens deposited in the *Herbarium Cryptogamae Indiae Orientalis*, New Delhi, and Imperial Mycological Institute, Kew, England.

VII. (1) Collected by C. A. Barber on *Cymbopogon coloratus* Stapf at Palamcotta, Tinnevely District, on 11 May 1901. Morphological characters as above. *Type.*

Diameter (μ)	7	8	9	10	11	12	13	
Frequency (n)	4	5	75	55	54	4	3	= 200

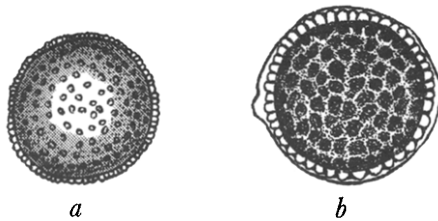
Mean = 9.9 μ .

VIII. *NEOVOSIA BARCLAYANA* BREFELD

A smut collected on *Pennisetum triflorum* Nees (= *P. orientale* Rich.) at Simla on 30 August 1889 by A. Barclay was sent for determination to Brefeld (1895) who found that it was an undescribed species of *Neovossia* and named it *N. Barclayana*. An examination of a fragment of Brefeld's type specimen has been made and a fresh description is given below.

Neovossia Barclayana Brefeld

Ovaricolous; sori bullate, covered by a firm membrane which consists of large, hyaline, smooth, sterile cells with very thick walls and encloses a pulverulent, black, spore-mass. Spores ellipsoidal to



Text-fig. 1. a. Chlamydospore of *Neovossia Barclayana* $\times 1120$. b. Chlamydospore of *Tilletia Pennisetina* $\times 960$.

subglobose, subopaque (but never completely so), Vandyke Brown (Ridgway) and without an appendage; with extremely minute warts which can be seen with great difficulty at the edges of the episporium. Diameter ranges from 15.5 to 22.0μ with a mean of 18.3μ .

VIII. (1) Collected by A. Barclay on *Pennisetum triflorum* (= *P. orientale* Rich.) at Simla on 30 August 1889. Morphological characters as above. *Type*.

Diameter (μ)	15.5	16.8	18.1	19.4	20.7	22.0	
Frequency (n)	9	22	34	18	12	5	= 100
Mean = 18.3μ .							

In 1899 Saccardo and Sydow (*Sylloge Fungorum*, XIV, 422) transferred this species to *Tilletia*, as Winter (1881) did not accept the genus *Neovossia*. But that genus is considered valid by Masee (1899), Magnus (1900), Schellenberg (1911) and Dietel (1928), and Saccardo and Sydow (*Sylloge Fungorum*, XVI, 375) have restored the species to the genus *Neovossia*.

As late as 1935 Yen used the name *Tilletia Barclayana* Sacc. & Syd., but his fungus, on *Pennisetum alopecuroides* (L.) Spreng., really agrees with *Tilletia Pennisetina* Sydow rather than with *Neovossia Barclayana*, as will be apparent from the perusal of the descriptions by Yen (1935) and by Sydow (1929).

Sydow (1929) states that Brefeld's fungus has somewhat brighter spores with a smaller diameter, and a thinner epispore than those of his *Tilletia Pennisetina*; further, that the sterile cells of *Neovossia Barclayana* are very large, smooth, and extremely thick-walled. These features were all present in the fragment examined by me.

A search for more material of *Neovossia Barclayana* on *Pennisetum orientale* in the vicinity of Simla is very desirable.

IX. *TILLETIA ELEUSINES* SYD.

The earliest collection of this smut was made by L. S. Subramaniam on *Eleusine aegyptiaca* Desf. at Pusa (Bihar) on 12 October 1914. He found that the spores ranged in diameter from 21 to 29 μ , and that the fungus was an undescribed species of *Tilletia*, but he failed to name it. The next collection was made on 18 November 1914 at Coimbatore (Madras) by the Farm Superintendent of that place, and a third was made at Sialkot (Punjab) on 8 September 1917 by G. S. Cheema.

Sydow (1935) described it as a new species, *Tilletia Eleusines*, from a specimen collected on the same host at Lahore in 1932 by H. Chaudhuri. It has a wide geographic range, as it is recorded from such different stations as Bihar, Madras and the Punjab.

The host plant does not, according to Blatter & McCann (1935), belong to *Eleusine*, and its accepted name is *Dactyloctenium aegyptium* Richt. It has been placed at different times in such genera as *Aegilops*, *Cenchrus*, *Chloris*, *Cynosurus*, *Eleusine* and *Rhabdochloa*. A search in Saccardo and other literature showed that no species of *Tilletia* has so far been reported on any of these with the exception of *Tilletia caries* (DC.) Tul. on *Aegilops*. The smut on *Dactyloctenium aegyptium* does not agree, however, with that species.

A fragment of the type specimen was kindly sent to me by Sydow and with this have been compared the earlier collections, all of which undoubtedly belong to this species.

Tilletia Eleusines Syd.

Sori formed in the ovaries which are completely destroyed, almost globose, oval, or oblong, olive-green, 2-3 mm. long; distributed unevenly in the spike, remaining single or several together. Spore-mass blackish. Spores globose, dark brown, 17-28 μ in diameter, with a mean of 21.0 μ . Epispore 2.5-3.5 μ thick with raised ridges, forming four- to six-angled reticulations, 3-5 μ broad; a smooth hyaline membrane can be made out in some of the spores. Sterile cells irregularly globose, hyaline, smooth, 8-14 μ in size with a 1.5-2 μ thick wall.

On *Dactyloctenium aegyptium* Richt. (= *Eleusine aegyptiaca* Desf.), at Pusa, Coimbatore, Sialkot and Lahore.

IX. (1) Collected by H. Chaudhuri on *Eleusine aegyptiaca* (= *D. aegyptium*) at Lahore in 1932. *Type*.

Diameter (μ)	17	18	19	20	21	22	23	24	25	26	27	28	
Frequency (n)	4	17	20	35	38	42	21	10	7	3	2	1	= 200
	Mean = 21.1 μ .												

IX. (2) Collected by L. S. Subramaniam on same host at Pusa on 12 October 1914. Morphological characters as above.

Diameter (μ)	17	18	19	20	21	22	23	24	
Frequency (n)	3	3	34	36	72	27	22	3	= 200
	Mean = 20.6 μ .								

IX. (3) Collected on same host at Coimbatore on 11 November 1914. Morphological characters as above.

Diameter (μ)	18	19	20	21	22	23	24	25	26	
Frequency (n)	1	17	13	91	35	30	7	5	1	= 200
	Mean = 21.2 μ .									

IX. (4) Collected by G. S. Cheema on same host at Sialkot on 8 September 1917. Morphological characters same as above.

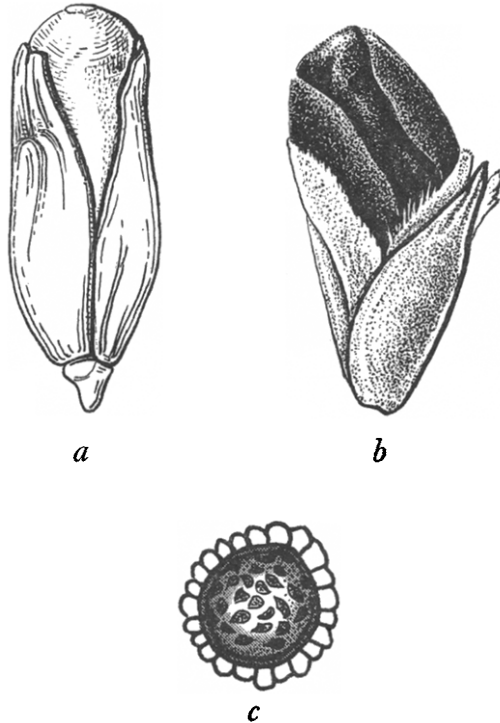
Diameter (μ)	18	19	20	21	22	23	24	25	26	27	
Frequency (n)	1	7	27	102	31	14	9	5	3	1	= 200
	Mean = 21.4 μ .										

X. A NEW SPECIES OF *TILLETIA* ON BAJRA, *PENNISETUM TYPHOIDES* STAFF (PEARL MILLET)

While conducting experiments on the Bajra smut, *Tolyposporium Penicilliariae* Bref., to determine the mode of its transmission, S. L. Ajrekar, Professor of Botany, Gujerat College, Ahmedabad, found a single grain of this cereal attacked by a species of *Tilletia*. The experiments were conducted in pots containing soil infested by *Tolyposporium* and were sown with seeds that had been obtained from

the College of Agriculture, Poona. These seeds were harvested from a crop in which no smut was present.

The panicles, as they emerged, were carefully examined by Ajrekar to detect the appearance of *Tolyposporium*. In one panicle he found a single grain that seemed to be attacked by some smut, but the chlamydospores proved to be those of a *Tilletia*. Examination of other panicles to collect more sori of this *Tilletia* proved futile and



Text-fig. 2. *a*. Healthy grain of Bajra, *Pennisetum typhoides* $\times 6$. *b*. Smutted grain of *Pennisetum typhoides* $\times 6$. *c*. Chlamydospore of *Tilletia Ajrekar* $\times 1120$.

careful search of Bajra fields at Ahmedabad has so far been fruitless. The smut was kindly placed at my disposal for critical study.

One species of *Tilletia*, *T. Pennisetina* Syd., on *Pennisetum alopecuroides* in China and another, of the allied genus *Neovossia*, *N. Barclayana* Bref. on *Pennisetum orientale* in India have so far been reported on the genus *Pennisetum* (Ciferri, 1931). The specimen on Bajra has been compared with the types of these two species and also with other species of *Tilletia* occurring in India. Descriptions of species of *Tilletia* given in Masee (1899) and Saccardo (85 species) have been examined to see if the smut on Bajra agreed with any

previously described species. There is little doubt that it has not been described and the name *Tilletia Ajrekari*, in honour of the collector, is proposed for it.

***Tilletia Ajrekari* Mundkur spec.nov.**

Soro ovarium omnino destruenti, e glumis extanti, ovoideo, ad 6 mm., longo, demum contracto et corrugato, membrana atra, crassa, tenaci, apice dehiscenti praedito. Cellulis sterilibus hyalinis, levibus, pariete modice crassa praeditis, 14-17 μ diam. Sporibus pulverulentis, plerumque globosis, raro diversis, "Diamine Brown" (Ridgway), translucensibus, aculeis, vel vero verrucis, complanatis, subrectangularibus, valde irregulariter dispositis ornatis, 13.8-21 (in medio 17.7) μ diam.

Hab. In ovario Penniseti typhoidis Stapf, in agellis experimento dedicatis, Ahmedabad, Indiae or. (S. L. Ajrekar; Sept. 1933. Typus est sorus unicus.)

Ovaricolous. Sorus completely destroying the ovary and protruding prominently from the glumes, ellipsoidal, about 6 mm. long, slightly folded upon itself and shrunk; clothed with a black, thick and firm membrane enclosing the spores, which escape from a slit formed at the apex. Spores pulverulent, mostly globose but occasionally aberrant; deep brown but by no means opaque, with an epispore 2-3 μ thick on which flattened, roughly rectangular, very irregularly placed, blunt spines or verrucae occur; diameter 13.8-21 μ with a mean of 17.7 μ . Sterile cells hyaline, smooth, with a not very thick wall, 14-17 μ in diameter. Germination unknown.

On *Pennisetum typhoides* Stapf (Bajra, pearl millet) in experimental pots at Ahmedabad. Type specimen (a single sorus) deposited in the Imperial Agricultural Research Institute, New Delhi, India.

X. (1) Collected by S. L. Ajrekar on *Pennisetum typhoides* at Ahmedabad on 2 September 1933. *Type.*

Diameter (μ)	14	15	16	17	18	19	20	21	
Frequency (n)	4	7	24	70	33	27	22	13	=200
	Mean = 17.7 μ .								

A fragment of the type specimen of *Tilletia Pennisetina* was kindly sent by Sydow. Macroscopically it resembled the sorus of *T. Ajrekari*, but under the microscope the spores were found to be more deeply dark brown to completely opaque, much larger, and with less blunt verrucae, arranged regularly on the epispore. These verrucae are smaller than those of *T. Ajrekari* but are larger than those of *Neovossia Barclayana*. The species of *Tilletia* which Yen (1935) has illustrated and determined as *T. Barclayana* is, in my opinion, *T. Pennisetina*. Spore measurements of *T. Pennisetina* are given below.

X. (2) Collected in ovaries of *Pennisetum alopecuroides* (L.) Spreng., in the province of Kiangsi, China. *Type*.

Diameter (μ)	16	18	20	22	24	26	28	
Frequency (n)	11	32	66	47	36	7	1	= 200

Mean = 21.3 μ .

It should be noted that *Neovossia Barclayana* has chlamydo-spores which are slightly larger in diameter, spines which are smaller and very regularly arranged, and larger sterile cells which have a thicker wall than those of *Tilletia Ajrekari*.

The sudden appearance of a single sorus of a hitherto unknown species of *Tilletia* in this millet is a biological problem which needs further investigation. Its sorus resembles somewhat those of *Tolyposporium Penicilliariae* for which it may be mistaken, and an examination of each and every smut sorus in panicles of Bajra in the fields in Gujarat is therefore desirable. The species seems very rare.

XI. *USTILAGO AMADELPHA* SYD. & BUTLER

A culmicolous smut, collected at Awapur, Muzaffarpur District, on a supposed species of *Andropogon*, on 15 April 1911, was described by Sydow & Butler (1912) as a new species, *Ustilago amadelpha*. Butler's specimen (no. 1425), which is a portion of the type collection, is available in the *Herbarium Cryptogamae Indiae Orientalis*. So far as is known, the smut has only been once collected. It has recently been redescribed by Zundel (1930).

Ustilago amadelpha Syd. & Butler

Culmicolous, destroying the entire inflorescence which is turned into a flagellum; at first hidden by the sheath, curled, or slightly twisted. Sori 2–12 cm. long, covered by a silvery membrane, and strikingly resembling the whip of the sugar-cane smut. Spores globose to subglobose, black in mass, prominently echinulate, so that the edge of the epispore appears slightly serrate; Chestnut (Ridgway), with a thick epispore; diameter of spores ranging from 5 to 9.5 μ with a mean of 7.9 μ .

On *Andropogon* (?) species at Awapur, Muzaffarpur District.

XI. (1) Collected at Awapur, Muzaffarpur District, on *Andropogon* (?) sp. on 15 April 1911. *Type* (no. 1425).

Diameter (μ)	5	6	7	8	9.5	
Frequency (n)	2	5	98	58	37	= 200

Mean = 7.9 μ .

A note accompanying the specimen states that the grass had no flowers and might be a species of *Saccharum*. An endeavour was made to get the specimen re-identified. The Curator of the Royal Botanic

Gardens, Calcutta, wrote that the specimen was so imperfect that it "may be anything". The Forest Botanist at Dehra Dun was of a similar opinion. The host genus of this smut must be considered, therefore, as undetermined.

A culmicolous smut, also on an undetermined grass from Java, was considered by Ciferri (1933) to be a new variety of this species. Ciferri hazarded the opinion that the host might be a species of *Andropogon*.

XII. *USTILAGO ELEUSINIS* KULKARNI

A smut on nachni, *Eleusine coracana* Gaertn. f., was collected by G. S. Kulkarni at Malkapur in October 1918. He studied the smut (Kulkarni, 1922), concluded that it was a new species and called it *Ustilago Eleusinis*. An *exsiccata* of this smut, collected in its type locality two years later and identified by Kulkarni, was kindly sent to me by B. N. Uppal, Plant Pathologist, Poona.

The sorus is covered by a membrane but there is no columella. The spores have a rough and minutely pitted epispore, and these pits give the margin an uneven appearance, which Kulkarni evidently mistook for spines or echinulations.

Ustilago Eleusinis Kulkarni

Ovaricolous and scattered in the spike, entirely destroying the ovaries with the exception of the ovary wall. Sori 3-15 mm. long, greenish at first but deep brown at maturity, covered by the ovary wall and without any columella. Spores pulverulent, globose to subglobose, Auburn (Ridgway); epispore densely pitted, with a rather uneven margin diameter ranging from 7 to 11 μ with a mean of 9.6 μ .

On *Eleusine coracana* Gaertn. (in cultivation) at Malkapur and other parts of the Bombay Presidency.

XII. (1) Collected by G. S. Kulkarni on *Eleusine coracana* at Malkapur, Bombay Presidency, on 26 October 1920. Authentic specimen.

Diameter (μ)	7	8	9	10	11	
Frequency (n)	9	27	60	75	29	= 200
	Mean = 9.6 μ .					

XII. (2) A smut on the same host was collected by J. McDonald at Nairobi, Kenya, on 21 October 1936, and sent for determination. It agrees very well with Kulkarni's fungus excepting that its spores have a wider range and a larger mean.

Diameter (μ)	8	9	10	11	12	13	14	
Frequency (n)	3	41	65	65	18	4	4	= 200
	Mean = 10.4 μ .							

Sydow (1929) described a culmicolous smut on *Eleusine indica* Gaertn., from China, to which he gave the name *Ustilago Eleusines*. The spores of this smut are echinulate and of smaller diameter than those of the foregoing. It is presumably a different species, but Sydow's specific epithet is not valid as it had already been used by Kulkarni.

XIII. *USTILAGO SPARSA* UNDERWOOD

L. S. Subramaniam collected a smut on *Eleusine aegyptiaca* Desf. at Pusa on 4 November 1914, and a second collection on the same host was made four years later. A specimen of this grass affected by a smut was also received recently from the Herbarium, Department of Agriculture, Victoria, Australia, for identification. It was collected by G. F. Hill at Darwin on 2 April 1916. The smuts in all the three collections agree among themselves in all major respects.

Eleusine aegyptiaca is a synonym of *Dactyloctenium aegyptium* Richt., and three species of *Ustilago* have so far been reported on *Dactyloctenium*. A smut on *D. aegyptium* in East Africa was described by P. Hennings (1895) as *Ustilago Dactyloctenii*. This is a culmicolous smut, entirely destroying the inflorescence and with spores of diameter 7–14 μ (see Zundel, 1938). The smut found at Pusa and at Darwin is, on the contrary, ovaricolous with spores ranging in diameter from 6 to 10 μ and is therefore not *U. Dactyloctenii*. Another smut, *U. Dactylocteniphila*, on *Dactyloctenium mucronatum* from Brazil, also described by P. Hennings, is ovaricolous, but its spores are 9–14 \times 8–13 μ in diameter and possess smooth episporous. The Pusa and the Darwin specimens agree, however, with the third smut *Ustilago sparsa* Underwood (1897), on *Dactyloctenium aegyptium*, in all respects and are undoubtedly that species.

Ustilago sparsa Underwood

Ovaricolous, infesting ovaries scattered here and there in the spike and entirely destroying them; sori 2–3 mm. long, olivaceous but later disclosing a dusty, brown-black spore-mass. Spores Morocco Red (Ridgway), globose to oval, echinulate (more distinct at the margin than on the surface), 6–10 μ in diameter with a mean of 7.8 μ .

On *Dactyloctenium aegyptium* Richt. (= *Eleusine aegyptiaca* Desf.) at Auburn, Alabama (U.S.A.), Pusa (India), and Darwin (Australia).

XIII. (1) Collected by L. S. Subramaniam on *Dactyloctenium aegyptium* at Pusa on 4 November 1914.

Diameter (μ)	6	7	8	9	10	
Frequency (<i>n</i>)	8	101	65	25	1	= 200
	Mean = 7.8 μ .					

XIII. (2) Collected by L. S. Subramaniam at Pusa on the same host on 14 November 1918. Morphological characters as above.

Diameter (μ)	6	7	8	9	
Frequency (n)	16	95	57	32	= 200
	Mean = 7.6 μ .				

The specimen collected on 2 April 1916 by G. F. Hill at Darwin and sent by the Herbarium, Victoria Department of Agriculture, gave the following measurements:

Diameter (μ)	6	7	8	9	10
Frequency (n)	10	72	78	33	7 = 200
	Mean = 7.8 μ .				

An *exsiccata* of *Ustilago sparsa* from Seymour and Earle's *Economic Fungi*, Clinton Ust. Supp. C 86, received from the Herb. Hort. Bot. Reg. Kew., gave the following measurements:

Diameter (μ)	6	7	8	9	10
Frequency (n)	4	94	59	40	3 = 200
	Mean = 7.8 μ .				

A specimen of Ravenel's Fungi Amer. no. 790 was also examined and found to be the same as *Ustilago sparsa*.

XIV. *USTILAGO COICIS* BREFELD

Smuted plants of *Coix Lachryma-Jobi* Linn. collected in the vicinity of Simla in February 1891 were sent by Barclay to Brefeld for determination. Brefeld (1895) found that the ovaries were not only entirely destroyed but that all in the raceme were smuted; compared with healthy ones, however, they were not much swollen. He called the fungus *Ustilago Coicis*. The smut has been reported in Java. The two later collections from India, cited by Butler & Bisby (1931) are different smuts. A fragment of the type specimen has been examined and Brefeld's (1895) description, which is rather brief, is emended as follows.

Ustilago Coicis Brefeld

Ovaricolous, completely destroying the ovaries, all of which in a raceme are destroyed. Sori 9-13 mm. long and 5-9 mm. broad, brown-black and containing a pulverulent spore-mass. Spores held together by the hard floral glumes, Liver Brown (Ridgway) subglobose to ellipsoidal with minute but clear echinulations which give the margin a serrate appearance; rather prominent, circular pits also present. Diameter ranges from 7 to 13 μ with a mean of 9.2 μ .

On *Coix Lachryma-Jobi* Linn. near Simla.

XIV. (1) Collected by A. Barclay on *Coix Lachryma-Jobi* near Simla in February 1891. *Type*. Morphological characters as above.

Diameter (μ)	7	8	9	10	11	12	13	
Frequency (n)	7	17	108	55	6	6	1	=200

Mean = 9.2 μ .

XV. *USTILAGO BENGALENSIS* SYD. & BUTLER

Cymbopogon pendulus Stapf, affected by a smut, was collected by I. H. Burkill at Banarhat, Doars, Bengal, on 8 September 1908. The grass was so badly affected by the smut that Burkill seems to have had difficulty in getting healthy specimens for study. A specimen of the smutted grass was sent to the *Herbarium Cryptogamae Indiae Orientalis* for the determination of the fungus, which Sydow & Butler (1912) found to be a new species and called *Ustilago bengalensis*.

The smut clearly belongs to the genus *Sphacelotheca*, as the sori possess an evanescent false membrane consisting of smooth, hyaline sterile cells and a prominent, dark brown columella nearly 1 cm. long.

Sphacelotheca bengalensis (Syd. & Butler) Mundkur comb.nov.

Ovaricolous, sori entirely destroying the ovaries, linear, 5–10 mm. long, with a long, simple columella, and covered by an evanescent false membrane which flakes away into sterile, hyaline cells. Spores pulverulent, dark brown in mass, globose to subglobose, Carob Brown (Ridgway), with a smooth epispore (not slightly echinulate as stated by Sydow and Butler); contents granular, whence the spores present a minutely pitted appearance; diameter ranges from 9 to 14 μ with a mean of 11.1 μ .

On *Cymbopogon pendulus* Stapf at Banarhat, Doars, Bengal.

XV. (1) Collected by I. H. Burkill on *Cymbopogon pendulus* at Banarhat, Doars, Bengal, on 8 September 1908. *Type*.

Diameter (μ)	9	10	11	12	13	14	
Frequency (n)	14	22	87	57	16	4	=200

Mean = 11.1 μ .

The smut does not agree with any of the species of *Sphacelotheca* or *Ustilago* reported on other species of *Cymbopogon* either by Zundel (1938) or others.

XVI. AN UNDESCRIBED SMUT ON *DINEBRA RETROFLEXA* PANZER

A smut on *Dinebra arabica* Jacq. (= *D. retroflexa* Panzer) was collected by I. H. Burkill at Banarhat, Jalpaiguri District, on 24 August 1908 and sent to the *Herbarium Cryptogamae Indiae Orientalis*

for identification. Beyond placing it in the genus *Ustilago*, no further effort was made to establish its identity. For reasons stated below the smut is considered to be an undescribed species of *Sphacelotheca*, and the name *S. Dinebrae* is proposed for it.

***Sphacelotheca Dinebrae* Mundkur spec.nov.**

Soris omnia ovaria spiculae cujusque infectae omnino destruentibus (neque tamen ea omnium spicularum totae inflorescentiae), ovoideis, nigris, viridi-tinctis, 3-4 mm., longis, membrana cornea, persistenti, e cellulis olivascentibus agglutinatis constituta cinctis; aliis (maturis) columella indistincta et sporis pulverulentis praeditis; aliis (immaturis) columellam manifestam et sporas centripetali-productas exhibentibus. Sporis subglobosis vel oblongo-angulatis, Raw UMBER (Ridgway), epispora nonnihil lata, crasse contigueque verrucosa praeditis, 5-7 (in medio 5.8) μ diam.

Hab. In ovarii Dinebrae retroflexae Panzer, Banarhat, Jalpaiguri District, Bengal, Indiae or. (I. H. Burkill, Aug. 1908.)

Ovaricolous, sori entirely destroying the ovary, all the ovaries in a spikelet being destroyed but not all the spikes in the inflorescence being smutted. Sori, oval, black with a slight greenish tinge, 3-4 mm. long, with a horny, persistent covering consisting of an olivaceous green, agglutinated layer of cells. In mature sori the columella is not clearly distinguishable and the spores are pulverulent. In immature sori a prominent columella is present and the spores are formed in a centripetal manner. Spores subglobose to oblong-angular with a coarsely and closely verrucose rather thick episporium; diameter ranges from 5 to 7 μ with a mean of 5.8 μ .

On *Dinebra retroflexa* Panzer at Banarhat, Bengal. Collected by I. H. Burkill on 24 August 1908. Type specimens deposited in *Herbarium Cryptogamae Indiae Orientalis*, New Delhi, and the Imperial Mycological Institute, Kew, England.

XVI. (1) Collected by I. H. Burkill on *Dinebra retroflexa* at Banarhat, Jalpaiguri District, Bengal, on 24 August 1908. *Type.*

Diameter (μ)	5	6	7	
Frequency (n)	27	159	14	= 200
	Mean = 5.8 μ .			

W. McRae, who studied the germination of the spores at the time, has left a note stating that they germinate in water, but not freely, forming a promycelium, with transverse walls, and conidia. He suggested that the smut comes near *Ustilago Kusanoana* P. Hennings (1904). *U. Kusanoana* possesses a hard false membrane, but its spores are 6-9 \times 5-7 μ and therefore much larger. It occurs only on *Eragrostis ferruginea* P.B., a grass not even closely related to *Dinebra retroflexa*.

The genus *Dinebra* belongs to the tribe Chlorideae and is closely

related to *Chloris*, *Cynodon*, *Dactyloctenium*, *Eleusine*, *Leptochloa* and *Microchloa*. The smut on *Dinebra retroflexa* stands out from those reported on the species belonging to these genera by its small and closely verruculose spores and its horny "cuticle".

XVII. *USTILAGO CORNUTA* SYD. & BUTLER

The smut on *Ophiurus corymbosus* Gaertn. f. was collected by E. J. Butler on 16 August 1903 at Surat and described as a new species by Sydow & Butler (1906). A portion of the type specimen, Butler, no. 447, is available in the *Herbarium Cryptogamae Indiae Orientalis*. The fungus was only once collected. The presence of a smoky coloured membrane and of a prominent columella, which extends above the sorus into a curved structure, undoubtedly places the smut in the genus *Sphacelotheca*.

Sphacelotheca cornuta (Syd. & Butler) Mundkur comb.nov.

Culmicolous; sori destroying the spike, but partially destroyed spikes, which Sydow and Butler speak of as rare floral infections, occasionally occur; false membrane smoky brown, consisting of hyaline, globose cells, 9–14 μ in diameter, at first present, very soon flaking away and revealing a black spore-mass that surrounds a long, simple columella. Spores mostly globose, Carob Brown (Ridgway), with a slightly thick smooth epispore but with spore contents minutely granular giving the spores a faintly pitted appearance; diameter ranges from 5 to 8 μ with a mean of 6.7 μ . Syn.: *Ustilago cornuta* Syd. & Butler.

On *Ophiurus corymbosus* Gaertn. f. at Surat. Collected by E. J. Butler on 16 August 1903.

XVII. (1) Collected by E. J. Butler on *Ophiurus corymbosus* at Surat on 16 August 1903. *Type*.

Diameter (μ)	5	6	7	8	
Frequency (<i>n</i>)	4	79	107	10	=200
	Mean=6.7 μ .				

XVIII. *USTILAGO ROTTBOELLIAE* SYD. & BUTLER

This smut was collected on 28 July 1907 by E. J. Butler on *Rottboellia compressa* at Pusa and described as new by Sydow & Butler (1907). It has not been collected anywhere else, since then, in this country. According to Blatter & McCann (1935) the name of the host accepted at present is *Hemarthria compressa* (Linn. f.) R.Br. Butler's specimen no. 723, which is part of the type, is available in the *Herbarium Cryptogamae Indiae Orientalis*.

The smut has a very definite, brown, false membrane and a prominent columella, and hence is a *Sphacelotheca*.

Sphacelotheca Rottboelliae (Syd. & Butler) Mundkur comb.nov.

Culmicolous; entire inflorescence destroyed by the sorus which may be 5-7 cm. long. Sori covered by a false membrane which flakes away into globose, hyaline, smooth, sterile cells; columella simple but prominent. Spores pulverulent, deeply brown in mass, mostly ellipsoidal, subglobose to globose, and Kaiser Brown (Ridgway), with smooth epispores and granular contents hence appearing minutely granular; diameter ranges from 5 to 9 μ with a mean of 7.3 μ .

On *Hemarthria compressa* (Linn. f.) R.Br. (= *Rottboellia compressa*) at Pusa. Collected by E. J. Butler on 28 July 1907. Syn.: *Ustilago Rottboelliae* Syd. & Butler, *U. Rottboelliae* Miyake, *Cintractia densa* McAlpine, and *Sphacelotheca densa* (McAlp.) Cif.

XVIII. (1) Collected by E. J. Butler (no. 723) on *Rottboellia compressa* (= *Hemarthria compressa*) at Pusa on 28 July 1907. Type.

Diameter (μ)	5	6	7	8	9	
Frequency (<i>n</i>)	3	34	114	27	22	=200
	Mean=7.3 μ .					

A smut was described on the same host by McAlpine (1910) and named *Cintractia densa*. It was transferred to *Sphacelotheca* by Ciferri (1928). As the descriptions given by McAlpine (1910) and by Zundel (1938) agreed in general with that of *S. Rottboelliae*, a fragment of the type specimen of *S. densa* was obtained from the Herbarium of the Department of Agriculture, Victoria, Australia, for comparison. The two specimens agree very well and there is little doubt that *S. Rottboelliae* and *S. densa* are the same. The former specific epithet has priority.

Spegazzini (1925), while revising the smuts attacking the species of *Stenotaphrum*, referred to the following as synonyms of *Ustilago affinis* Ellis & Everhart: *U. Stenotaphri* McAlp., *U. Stenotaphri* P. Henn., *U. Stenotaphri* Masee and *U. americana* Speg., while Ciferri (1931) suggested that *U. Rottboelliae* Syd. & Butler and *U. Rottboelliae* Miyake be also added to the synonymy. Of these, the smuts described by Hennings, Masee, and Spegazzini were on *Stenotaphrum glabrum* Trin. which was once considered to be the same as *Rottboellia compressa* Beauv. non Linn. f. The Indian *R. compressa* is the one described by the younger Linnaeus and is now known as *Hemarthria compressa* (Linn. f.) R.Br.

In a later publication (Ciferri & Herter, 1932), Ciferri corrects his previous statement as a result of an examination of the type specimens of *Ustilago affinis* and *U. Rottboelliae* Syd. & Butler, and states that they are distinct. The description given by Miyake (1913) leaves little doubt that his fungus is also *Sphacelotheca Rottboelliae* (Syd. & Butler)

Mundkur, and this it is hoped to establish with certainty after a comparison of the types. The distribution of the species would then be India, China, Australia and South Africa. *S. Rottboelliae* differs from *S. flagellata* (Syd.) Zundel in having smooth and smaller spores.

The genus *Rottboellia* is very closely allied to *Ophiurus* and *O. corymbosus* was, in fact, originally called *Rottboellia corymbosa* by the younger Linnaeus. But *Sphacelotheca cornuta* on *Ophiurus corymbosus* differs from *S. Rottboelliae* in having smaller spores, a thicker epispore and a deeper colour.

XIX. *UROCYSTIS BRASSICAE* MUNDKUR

The smut which causes galls on the roots of sarson, *Brassica campestris* L., was originally collected in the neighbourhood of Pusa in February 1920, identified at the Imperial Mycological Institute, Kew, as *Urocystis coralloides* Rostrup and again studied by me in 1938a. After comparing the spore-balls and the spores with those of the type collection of *U. coralloides* and testing the pathogenicity of the smut, the conclusion was reached that the sarson root-gall smut was a new species, which was called *Urocystis Brassicae*. A brief description is given below.

Urocystis Brassicae Mundkur

Sori in roots, forming galls which are 8–22 mm. in diameter, and which consist of spore-balls, hyaline anastomosing mycelial strands, and xylem elements of the host. Spore-mass agglutinated and black; spore-balls 25–59 × 20–45 μ with a mean of 38 × 32 μ, with 1–5 fertile cells, 2 or 3 predominating. Fertile spores Liver Brown (Ridgway), 13–25 × 9–20 μ, with a mean of 20 × 16 μ, and surrounded by numerous, small bright-brown to hyaline, somewhat longish, sterile spores, forming a continuous layer.

In underground parts of *Brassica campestris* L. Type collected on 5 February 1935 by M. Azmatullah Khan at Pusa.

The genus *Urocystis* was founded by Rabenhorst to accommodate those smuts in which the spore-balls have an enveloping cortex of sterile cells and from one to several interior fertile cells, which alone have the power of germinating. Liro (1922) combined this genus with the earlier *Tubercinia* of Fries, as emended by Woronin, on the assumption that both these genera have a sterile layer of cells; but in doing so he has added confusion to the taxonomy of the Ustilaginales because the members of the two genera are cytologically and morphologically dissimilar. Ciferri, Sydow, Savulescu, and Zillig follow Liro, but Dietel, Naumov, Zundel, and others do not. Should Liro's view ultimately prevail as a result of further cytological study, the name of this fungus will need re-consideration.

XX. *USTILAGO ARUNDINELLAE* BREFELD

This smut on *Arundinella* sp. was sent for determination by D. D. Cunningham to Brefeld who described it (1895) as new. A fragment of the type was kindly sent by Dr E. Ulbrich and has been carefully studied. The date and place of collection are not given and were not presumably communicated, but Brefeld stated that he received the specimen from Calcutta which may be the type locality. The species of the host does not seem to have been determined.

A smut on *Arundinella setosa* collected in the Kumaon Hills by Butler in 1907 was referred to *Ustilago Arundinellae* by Sydow & Butler (1907). A note left by Butler with this specimen in the *Herbarium Cryptogamae Indiae Orientalis* states: "I have not seen the original of this species which is not fully described by Brefeld." Comparison with the type showed at once that the smut on *Arundinella setosa* is a different species.

Examination of the type specimen shows that *Ustilago Arundinellae* is a *Sphacelotheca*; for each sorus possesses a false membrane, and a columella. It further shows that the spores are not readily released, unless the false membrane is placed in mounting medium and teased; and that the columella is slightly coiled at the apex.

Sphacelotheca Arundinellae (Brefeld) Mundkur comb.nov.

Ovaricolous; sori 2.5-3 mm. long, covered by a firm false membrane consisting of hyaline, globose, smooth, sterile cells; columella slightly coiled at the top. Spores mostly globose, some round and flattened when they have a concavity on both sides at the centre which looks like a large vacuole; mostly Vandyke Brown (Ridgway) but those that are flat, Cameo Brown; epispore markedly thick with a smooth edge, with surface minutely pitted; diameter 7-10 μ with a mean of 8.9 μ .

On *Arundinella* sp. collected only once, by D. D. Cunningham at Calcutta(?). Syn.: *Ustilago Arundinellae* Brefeld.

XX. (1) Collected on *Arundinella* sp. at Calcutta(?). *Type*.

Diameter (μ)	7	8	9	10	
Frequency (n)	15	21	131	33	= 200
	Mean = 8.9 μ .				

XXI. *USTILAGO BURKILLI* SYD. & BUTLER

On 6 September 1906, I. H. Burkill collected at Gauripur, Mymensingh District, a smut on *Aneilema nudiflorum* R.Br., a Com-melinaceous herb; it affected the ovaries, producing sori with a rusty, greyish, membrane. Sydow & Butler (1912) described it as a new

species, and a part of the type (no. 1421) is available in the *Herbarium Cryptogamae Indiae Orientalis*. The smut was collected once only and the material is very scanty. It has not been possible to demonstrate the nature of the enclosing membrane nor the presence of a columella. The description given by Sydow and Butler is not completely correct, for they state that the epispore surface is smooth, while I have found it to be minutely pitted, so that the margin presents a closely serrate appearance. Furthermore, the measurements, taken from only twelve spores, hardly present a true picture of the range.

Ustilago Burkilli Syd. & Butler

Ovaricolous; entirely destroying the ovaries. Sori 4–6 mm. long, rusty in appearance and covered by a greyish membrane; the presence of a columella not made out with certainty. Spores globose, subglobose to angularly round, usually Lemon Yellow (Ridgway) but more mature spores Aniline Yellow; contents granular, surface minutely pitted giving the edges a serrate appearance; diameter ranges from 9 to 15 μ with a mean of 12.4 μ .

In ovaries of *Aneilema nudiflorum* R.Br. at Gauripur, Mymensingh District, and collected by I. H. Burkill on 6 September 1906.

XXI. (1) Collected by I. H. Burkill on *Aneilema nudiflorum* at Gauripur, Mymensingh District, on 6 September 1906. *Type*.

Diameter (μ)	9	10	11	12	13	14	15	
Frequency (<i>n</i>)	4	11	28	66	41	45	5	= 200
			Mean = 12.4 μ .					

The name of the host is incorrectly given in Saccardo (*Sylloge Fungorum*, xxiii, 607) as "*Asseilema nudiflorum*". Outside India, this smut has been reported by Sydow & Petrak (1928) in the Philippine Islands, in the inflorescence of *Aneilema malabaricum* (L.) Merr.

XXII. AN UNDESCRIBED SMUT ON *CHRYSOPOGON COERULEUS*

On 19 September 1903 C. A. Barber collected at Bilikere, Mysore, a perennial grass which was severely affected by a smut. The host, which has only recently been identified, is *Chrysopogon coeruleus* (Steud.) Watson, a name considered by some agrostologists to be a synonym of *C. montanus* Trin. An examination of the smut showed that it belonged to *Sorosporium*, of which no species have so far been reported on any member of the genus *Chrysopogon*. It does not agree with the descriptions of any of the thirty odd species of *Sorosporium* reported on *Andropogon* and other genera allied to *Chrysopogon*, and there is little doubt that it is new. The name *Sorosporium Azmatii* is proposed for it, after Mr Azmat Ullah Khan of the *Herbarium Cryptogamae Indiae Orientalis*, New Delhi.

Sorosporium Azmatii Mundkur spec.nov.

Soris culmicolis, totam inflorescentiam destruentibus, modice contortis, 2-4 cm., longis, primo vagina perfecte obductis, deinde apicem columellae oculis subjicientibus. Membrana sterili primo griseo-brunnea, postea in cellulas oblongo-ovoideas vel globosas, hyalinas, diverse magnas secedenti. Massa sporarum nigra, granulari, columellam prominentem sed simplicem circumstanti. Glomerulis 50-135 μ diam., irregulariter ovoideis, opacis, e sporis 15 ad 50 compositis, firmis, sed sub pressione levi secedentibus. Sporis globosis vel subglobosis, "Liver Brown" (Ridgway), epispora crassa praeditis, aliis externis abundante verrucis circumdati, aliis internis pallidioribus vel hyalinis et laevibus, 7-11 (in medio 9.0) μ diam.

Hab. In culmis *Chrysopogonis coerulei* (Steud.) Watson, Bilikere, Indiae or. (C. A. Barber; Sept. 1903 (Typus); id. Sept. 1904.)

Culmicolous, entirely destroying the inflorescence which is turned into a slightly coiled solitary sorus, 2-4 cm. long, effectively concealed by the leaf sheath, the tip of the columella alone later becoming uncovered; at first clothed with a greyish brown false membrane which later flakes away into oblong-oval to globose, hyaline, sterile cells of variable size, revealing a black, granular spore-mass, surrounding a well-developed but simple columella. Spore-balls 50-135 μ in diameter, irregularly elliptical, opaque, breaking up under slight pressure, otherwise semi-permanent and composed of 15-50 spores. Spores globose to subglobose, Liver Brown (Ridgway), with a diameter range of 7-11 μ and a mean of 9.0 μ ; epispore thick, outer spores abundantly verruculate all round, inner spores less brown to hyaline and smooth.

On *Chrysopogon coeruleus* (Steud.) Watson at Bilikere; collected by C. A. Barber on 19 September 1903. Type specimens deposited in the *Herbarium Cryptogamae Indiae Orientalis*, New Delhi, and the Imperial Mycological Institute, Kew.

XXII. (1) Collected by C. A. Barber on *Chrysopogon coeruleus* at Bilikere, Mysore, on 19 September 1903 and 7 September 1904. *Type.*

Diameter (μ)	7	8	9	10	11	
Frequency (n)	9	16	132	36	7	=200
	Mean=9.0 μ .					

Clinton (1904) reported an ovaricolous smut, *Sphacelotheca Chrysopogonis* Clinton, with obscurely verrucose spores, chiefly 8-11 μ in diameter, on *Chrysopogon nutans* from Mexico, and a foliicolous smut, *Tolyposporella Chrysopogonis* Atkinson, with smooth spores, chiefly 9-12 μ in diameter, from Alabama. Both these smuts are clearly distinct from *Sphacelotheca Azmatii*.

XXIII. *UROCYSTIS SOROSPORIOIDES* KOERNICKE

The smut on a species of *Delphinium* (either *D. denudatum* Wall. or *D. vestitum* Wall.) was collected at Simla in July 1935, and this record has already been published by me (1938c). A brief description of the smut is given below.

Urocystis sorosporioides Koernicke

Foliicolous and culmicolous; sori erumpent, elliptical to circular. Spore-mass black, pulverulent. Spore-balls ellipsoidal-globose or oblong, compact, opaque, $19-51 \times 24-61 \mu$ average $29 \times 38 \mu$; each spore-ball with three to seven fertile cells surrounded by a layer of light-coloured secondary sterile cells. Fertile cells spherical to hemispherical, $11-16 \mu$ in diameter with smooth, dark brown epispore. Sterile cells $8-12 \mu$ in diameter with smooth, brown to subhyaline cell wall.

On *Delphinium* spp. at Simla. Collected by B. B. Mundkur in July 1935 and by K. Bagchee at Chakratha (latter specimen not critically examined).

The fungus forms numerous pustules on both sides of the leaf and the petiole, just below the epidermis. Reasons for not placing it in the genus *Tuburcinia* are already stated (see note XXI).

XXIV. A NEW SMUT ON *PENNISETUM CILIARE* LINK

Smuted plants of *Pennisetum ciliare* were collected on the Ridge at Delhi on 3 August 1938. The smut proved to be a species of *Sorosporium* and when compared with those species of Ustilaginaceae that have been reported on the genus *Pennisetum* and the closely allied *Cenchrus*, it was found to be new. The name *Sorosporium Penniseti* is proposed for it.

It should be noted that *Pennisetum ciliare* has also been called *P. cenchroides* Richt., and *Cenchrus ciliaris* Linn.

Sorosporium Penniseti Mundkur spec.nov.

Soris in ovariiis evolutis, eaque omnino destruentibus, 3-5 mm. longis, initio inter glumas occultis et membrana manifesta, albido-grisea, apice a poro magno dehiscenti cinctis. Columella conspicua, interdum furcata, inter massas sporarum atras, granulares producta. Glomerulis late ovoideis vel irregulariter globosis, pro more 35-58, raro ad 65μ , diam., funebre-castaneis, opacis, secedentibus, e sporis 20 vel pluribus compositis. Sporis globosis vel ovoideis, "Cinnamon Brown" (Ridgway), epispora gracili, tenuissime echinulata praeditis,

7-11 (in medio 9.7) μ diam. Tubibus germinationis sporidiolis destitutis.

Hab. In ovariis *Penniseti ciliaris* Link, Delhi, Indiae or. (M. A. Khan; Aug. 1938.)

Ovaricolous. Sori entirely destroying the ovaries, 3-5 mm. long, at first concealed by the enveloping glumes, and covered by a conspicuous whitish grey membrane, dehiscing to form a large pore at the apex. Columella very prominent, sometimes forked, traversing the black, spore-masses. Spore-balls broadly ellipsoidal or irregularly globose usually 35-58 μ , a few up to 65 μ , dark brown, opaque, evanescent with 20 or more spores per spore-ball. Spores globose to ellipsoidal Cinnamon Brown (Ridgway), diameter ranging from 7 to 11 μ with a mean of 9.7 μ , minutely echinulate; epispore thin. Germination by germ tubes without the formation of sporidia.

On *Pennisetum ciliare* Link at Delhi. Collected by M. A. Khan on 3 August 1938. Type specimens deposited in *Herbarium Cryptogamae Indiae Orientalis*, New Delhi, and at Imperial Mycological Institute, Kew.

XXIV. (1) Collected at Delhi on *Pennisetum ciliare* on 3 August 1938. *Type.*

Diameter (μ)	7	8	9	10	11	
Frequency (<i>n</i>)	2	6	76	90	26	= 200
	Mean = 9.7 μ .					

This species shows affinities with, but differs in certain essential characters from, the following which are given by Ciferri (1931*b*) in the key to the smuts affecting species of *Pennisetum* and of the allied genus *Cenchrus*.

Tolyposporium Penicilliariae Bref., reported on *Pennisetum typhoides* (and of which the type specimen has been re-examined), differs from *Sorosporium Penniseti* in having no columella, in possessing more permanent spore-balls and smooth or slightly pitted spores of 8-13 μ diameter.

Tolyposporium senegalense Speg., reported on the same host and described by Saccardo (*Sylloge Fungorum*, xxiii, 620) and by Ciferri (1931*a*), agrees with *T. Penicilliariae* in all except that it has larger spores with a different kind of epispore marking. As such it decidedly differs from *Sorosporium Penniseti*.

Ustilago Penniseti Rabenh., of which the type specimen has been re-examined, differs from *Sorosporium Penniseti* in possessing neither a conspicuous false membrane, nor a prominent columella, and in having spores that are pitted or punctulate, rather than echinulate as in the latter.

Sorosporium Cenchrus (Bref.) Zundel reported on *Cenchrus ciliaris* Linn. (= *Pennisetum ciliare*) differs from *Sorosporium Penniseti* in having more

permanent spore-balls and smooth spores ranging in diameter from 7 to 8 μ .

Sorosporium Syntherismae (Peck) Farlow, of which Sydow's *exsiccata* no. 348 has been examined and which has been recorded on several species of *Cenchrus*, differs from *Sorosporium Penniseti* in being culmicolous; the spores at the periphery of its spore-balls are verruculose, those within smooth, and their diameter varies from 9 to 13 μ .

There is little doubt therefore that *Sorosporium Penniseti* is a previously undescribed species on *Pennisetum ciliare*.

XXV. A NEW SMUT ON *POLYTOCA BARBATA* STAPF

Smuted racemes of a grass were collected by G. S. Kulkarni at Gosenhatti, Belgaum District, on 2 September 1916. The host was identified as *Coix Lachryma-Jobi* L. and the smut as *Ustilago Coicis* Brefeld. A comparison of the smut with Brefeld's type (see Note XIV) showed that the identification was incorrect, and the grass itself is now identified as *Polytoca barbata* Stapf (= *Coix barbata* Roxb., = *Chionachne Koenigii* (Spr.) Thw.). The smut does not agree with any of those reported on the genera allied to *Polytoca*, and none has been recorded either on this genus or on *Chionachne*. There is little doubt then that it is undescribed and the name *Ustilago Polytocae* is proposed for it. It was collected again on the same host by Mr Kulkarni on 30 October 1916 on the Charodi Farm.

Ustilago Polytocae Mundkur spec.nov.

Soris in ovariiis nonnullis, aliquanto amplioribus racemi evolutis, tegumento hospitali coriaceo, lugubre brunneo cinctis, apice dehiscens. Sporis pulverulentis, irregulariter subglobosis et aliquanto angulatis, lugubre "Hessian Brown" (Ridgway), epispora crassa, aculeis gracilibus, brevibus et obtusis ornata, sed foveolis carenti, praeditis, 9-15 (in medio 12.4) μ .

Hab. In ovariiis *Polytocae barbatae* Stapf; Gosenhatti, Belgaum District, Indiae or. (G. S. Kulkarni; Sept. 1916.)

Ovaricolous but not all ovaries in a raceme attacked; male flowers not smuted; ovaries slightly enlarged, sori deep brown, covered by a thick leathery membrane of host tissue. Spores released by a tear at the apex of the membrane, pulverulent, deep Hessian Brown (Ridgway), irregularly subglobose and slightly angled with a thick epispora; with fine, blunt, short spines, but no pits; diameter from 9 to 15 μ with a mean of 12.4 μ .

On *Polytoca barbata* Stapf at Gosenhatti, Belgaum District. Collected by G. S. Kulkarni on 2 September 1916. Type specimens in the *Herbarium Cryptogamae Indiae Orientalis*, New Delhi, and the Imperial Mycological Institute, Kew.

XXV. (1) Collected by G. S. Kulkarni on *Polytoca barbata* Stapf at Gosenhatti, Belgaum District, on 2 September 1916. *Type*.

Diameter (μ)	9	10	11	12	13	14	15	
Frequency (n)	3	3	39	71	57	28	5	=206
	Mean = 12.4 μ .							

XXV. (2) Collected by G. S. Kulkarni on *Polytoca barbata* Stapf on the Charodi Farm on 30 October 1916.

Diameter (μ)	10	11	12	13	14	15	
Frequency (n)	3	23	65	84	18	7	=200
	Mean = 12.6 μ .						

This smut differs from *Ustilago Coicis* Brefeld in possessing spores that are distinctly larger and have a thicker deeper brown epispore, which displays no prominent pits.

SUMMARY

This paper records the results of a critical re-investigation of forty-four collections of Indian smuts in the *Herbarium Cryptogamae Indiae Orientalis* of the Imperial Agricultural Research Institute at New Delhi. Most of the hosts have been re-identified and the smuts themselves compared with fragments of the type collections. The forty-four collections have grouped themselves into twenty-five species, of which seven are proposed as new and five appear as new combinations. The type collection of the exotic *Ustilago spermoidea* Berk., received from Peradeniya, Ceylon, was found to belong to the genus *Sphacelotheca*, and the species is therefore transferred to that genus. Further work with the rest of the collections is in progress.

[Since I wrote in the introductory remarks that 109 smuts had been recorded for India, one more smut, *Cintractia disciformis* Liro, has come under my notice. Though the smut was collected by Duthie in 1884, it was described only in 1935 by Liro as a new species in the Finnish Journal, *Annales Botanici Societatis Zoologicae-Botanicae Fennicae Vanamo*, VI, 6, 1935.]

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