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# THE USTILAGINALES OR SMUTS OF UTAH

BY

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## PREFACE

Since September, 1902, the writer has been collecting fungi in Utah. During that time collecting has been carried on in every county in Utah. Several consecutive summers were spent at Brighton, in Big Cottonwood Canyon, Salt Lake County. The summer of 1911 was spent with the late Dr. Rydberg, collecting in Grand and San Juan Counties. Spare time in other summers was used in exploring the fungus flora of Mt. Timpanogos, Utah County, with Aspen Grove, 6800 ft. alt., as a base.

Unless otherwise stated, all collections listed in this bulletin were made by the writer.

In the course of this study of the smuts of Utah, the writer received great encouragement and assistance from the late Dr. George P. Clinton. He has also received aid in the determination of smuts from Dr. George L. Zundel and Dr. W. W. Diehl; and of hosts, from Dr. Aven Nelson, Dr. Ivan Johnston, Dr. Paul C. Standley, Dr. Julian Steyermark, Dr. S. F. Blake, Mrs. Agnes Chase, and especially from the late Dr. P. A. Rydberg. The writer extends his thanks also to Dr. Flowers for the splendid illustrations.

A. O. GARRETT

## KEY TO THE FAMILIES

- Promycelium several-celled, producing lateral sporidia at the cross-walls  
..... *Ustilaginaceae*, p. 8
- Promycelium undivided by cross-walls, the sporidia in clusters at its apex  
..... *Tilletiaceae*, p. 13

## KEY TO THE GENERA

- Sori not permanently embedded in the tissues of the host
- Spores single
    - Sori dusty at maturity
      - Without false membrane of definite fungus cells.
        - Spore-mass concealed in the grain, the grain retaining its shape\* ..... *Tilletia*, p. 14
        - Spore-mass in the grain or other part of the plant; if in the grain, the latter is completely destroyed.....  
..... *Ustilago*, p. 9
      - With false membrane of definite fungus cells and a central columella ..... *Sphacelotheca*, p. 8
    - Sori agglutinated at maturity (rarely dusty)..... *Cintractia*, p. 8
  - Spores chiefly in pairs; sori in leaves..... *Schizonella*, p. 8
  - Spores in balls; sori dusty or granular
    - Spore-balls without a sterile cortex
      - Spore-balls loosely united and some completely separating at maturity..... *Sorosporium*, p. 8
      - Spore-balls completely united, rather permanent; spore-mass reddish-brown..... *Thecaphora*, p. 8
    - Spore-balls with a sterile cortex..... *Urocystis*, p. 14
- Sori permanently embedded in the tissues of the host
- Spores single in loose groups..... *Entyloma*, p. 13
  - Spores agglutinated into spore balls with sterile cortex.....  
..... *Doassansia*, p. 13

\*Our species so far as known occur only on *Triticum* and *Muhlenbergia*.

## USTILAGINACEÆ

1. *CINTRACTIA ARCTICA* Lagerh.

In leaves of *Carex nova* Bailey. **3380**. Aug. 8, 1927, just below Emerald Lake, Mt. Timpanogos, Wasatch Mts., Utah County. (Smut determined by Dr. G. P. Clinton and Dr. G. L. Zundel; host by Kenneth Mackenzie.)

2. *CINTRACTIA CARICIS* (Pers.) Magn.

Plate II, 12-14

*Uredo caricis* Pers.

In ovaries of *Carex elynoides* Holm. **3379**. Aug. 8, 1927, just below Emerald Lake, Mt. Timpanogos, Wasatch Mts., Utah Co.

In ovaries of *Carex Hoodii* Boott. Collected Aug. 18, 1933, by Dr. Bassett Maguire, Stillwater Basin, Head Bear River, Summit Co., 11000 ft. alt.

In ovaries of *Carex sp.* **416**. July 7, 1904, City Creek Canyon, Salt Lake Co. **285**. Aug. 15, 1903, City Creek Canyon, Salt Lake Co.

In ovaries of *Carex nigricans* C. A. Meyer. Listed in N. A. Flora **7:33**. 1906 as occurring in Utah on this host.

3. *SCHIZONELLA MELANOGRAMMA* (DC) Schroet.

Plate III, 17-19

In leaves of *Carex nebraskensis* Dewey. **639**. May 6, 1905, near Liberty Park, Salt Lake City.

In leaves of *Carex sp.* **289**. Aug. 15, 1903, near Lake Mary, Big Cottonwood Canyon, Salt Lake Co. **1002**. June 25, 1907, Red Butte Canyon, Salt Lake Co.

4. *SPHACELOTHECA REILIANA* (Kuhn) Clinton.

In inflorescence of *Sorghum vulgare* Pursh. La Verkin, Washington Co. Collected by Dr. J. Wm. Harrison.

5. *SOROSPORIUM SAPONARIAE* Rud.

Plate III, 13

In inflorescence of *Silene Menziesii* Hook. **956**. Aug. 26, 1906 Mt. Majestic, Big Cottonwood Canyon, Salt Lake Co. First collection of this smut in the United States. **3138**. July 22, 1925, Aspen Grove, Mt. Timpanogos, Wasatch Mts., Utah Co. **3524a**. Aug. 4, 1930, near Mirror Lake, Uinta Mts., Duchesne Co.

In inflorescence of *Stellaria Jamesiana* Torr. (*S. Curtisii* Rydb.) **2155**. July 8, 1911, La Sal Mts. near Gold Basin, San Juan Co. Also collected by Rulon Lewis on this host at Maple Flat near Provo, Utah Co., in June, 1927.

6. *THECAPHORA CALIFORNICA* (Hark.) Clinton.

Plate III, 16

In inflorescence of *Grindelia squarrosa* (Pursh) Dunal (?) Collected by Dr. Seville Flowers at Price, Carbon Co. This seems to be a new host for this species. Dr. W. W. Diehl has verified the determination of smut.

7. **THECAPHORA DEFORMANS** Dur. & Mont.

In pods of *Astragalus missouriensis* Nutt. N. A. Flora (7:42 1906) lists a collection from Utah on this host.

In pods of *Astragalus tenellus* Pursh. N. A. Flora (l. c.) lists a collection from Utah on this host.

In pods of *Lathyrus utahensis* Jones. **981a**. Sept. 13, 1906, Parley's Canyon, Salt Lake Co.

In pods of *Vicia oregana* Nutt. **1021**. July 25, 1907, City Creek Canyon, Salt Lake Co.

In ovaries of *Vicia trifida* Dietr. **4141**. July 7, 1904, City Creek Canyon, Salt Lake Co.

8. **THECAPHORA TRAILLII** Cooke.

Plate III, 14-15

In inflorescence of *Cirsium Eatoni* (A. Gray) Robinson (*Carduus leiocephalus* [D. C. Eaton] Heller.) **834**. Aug. 14, 1905, Big Cottonwood Canyon, Salt Lake Co.

9. **USTILAGO AVENAE** (Pers.) Jens.

In inflorescence of *Avena sativa* L. **3464**. Aug. 7, 1908, Wasatch Co. Common throughout the state wherever oats is cultivated.

10. **USTILAGO BROMIVORA** (Tul.) Fisch. de Waldh.

Plate II, 9-11

In ovaries of *Bromus hordeaceus* L. **210**. June 10, 1903, Salt Lake City. Distributed in Fungi Columb. (No. 1995)

In ovaries of *Bromus marginatus* Nees. **1161**. Aug. 28, 1908, Red Butte Canyon, Salt Lake Co.

In ovaries of *Bromus polyanthus* Scribn. **836a**. Aug. 15, 1905, Big Cottonwood Canyon, Salt Lake Co.

In ovaries of *Bromus tectorum* L. **2503**. June 2, 1919, Salt Lake City, **2986a**. Aug 10, 1921, Manti, San Pete Co.

11. **USTILAGO BULLATA** Berk.

In spikelets of *Agropyron spicatum* (Pursh) Scribn. & Smith. **3571**. June 25, 1938, Lindsay's Garden, Salt Lake City. The cluster of host plants from which this specimen was collected was surrounded for some distance with plants of *Elymus glaucus* Buckl., the leaves and spikelets of many of which were smutted with *U. striaeformis* (Westend) Niessl. It was in this immediate locality that No **3332**, *U. striaeformis*, was collected.

Fraser and Scott referred to a "Smut of Western Rye Grass" (*Agropyron pauciflorum*) in *Phytopathology* **16**. 473-477. July, 1926. They conclude that the smut is *Ustilago bromivora*, and give the average measurements of one hundred of the smut spores on *Agropyron pauciflorum* as 9.23 mu, while the same number of spores of the smut from *A. Richardsoni* averaged 9.26 mu. In December, 1931, the West Virginia Bulletin, page 43, refers the smut to *Ustilago bullata* Berk. *Ustilago bullata* Berkley was described in 1855.

Under date of February 18, 1932, Dr. Zundel writes as follows: "All of the smuts that you have collected on *Agropyrum* species are now placed as *Ustilago bullata*." This would include my No. 322, determined by Dr. Clinton as *U. macrospora* Desmaz, and No. 3076, determined as *U. striaeformis* (Westend) Niessl., both on *Agropyron pauciflorum* (Schwein.) Hitchc. (*A. tenerum* Vasey).

The following is McAlpine's description of *Ustilago bullata* as given by Fischer\*:

"Sori produced in the inflorescence and destroying it, at first enclosed in a greyish or leaden-colored membrane which is soon ruptured, exposing the dark-brown to black compact mass of spores, sometimes only attacking a portion of the spikelets. Spores globose to subglobose or ellipsoid, olive-brown, densely warted, 8-11 mu in diam. or 10-12 x 7-8 mu, occasionally reaching a length of 14 mu."

Now, my Nos. 322 and 3076 were both found on stem and leaves, and none in the inflorescence. Is this of any diagnostic importance?

Later, George W. Fischer proposes that *Ustilago Agropyri* Clinton, *U. bullata* Berkeley, *U. bromivora* (Tul.) Fisch. von Waldh., *U. bromivora macrospora* Farl. and *U. Lorentziana* Thüm. be all united as one composite species under the oldest of the above names, *U. bullata*. Fischer proposes the following description for the composite species:

"Sori in the spikelets, bullate, sometimes entirely involving the glumes, but more often only partially so, at first enclosed by a greyish membrane (the host epidermis) of varying strength according to host, but which sooner or later ruptures, exposing the powdery dark-brown to purple-black or black sporemass; spores rather thick-walled, mostly globose to subglobose, but often, especially in agglutinated or not fully mature specimens, tending to be irregular or polyhedral, usually dark brown or olive-brown, with an epispore varying from very minutely echinulate-verrucose to rather coarsely verrucose, 5-14 mu in diameter, more often 7-9 mu. not including the occasional elongate and irregular spores nearly always present. Germination of the indirect type, resulting in 1-3 promycelia, which are 1-3 celled, and bearing ellipsoid to oblong sporidia at tips and often below cross-walls."

Now, as previously remarked, my *Agropyron* smuts, with the exception of No. 3571, were all in the leaves, and not in the spikelets. Should we broaden the above description a little by adding, after spikelets, "or in the leaves"? If so, would not the composite species become even more composite?

## 12. USTILAGO CRUS-GALLI Tracy & Earle

### Plate I, 17-18

In stems and leaves of *Echinochloa Crus-galli* (L.) Beauv. (*Panicum Crus-galli* L.) **616**. Sept. 16, 1904, Salt Lake City.  
Salt Lake City is the type locality for this smut.

## 13. USTILAGO GAYOPHYTI Hark.

In ovaries of *Gayophytum caesium* Nutt. **857**. Aug. 22, 1906, Big Cottonwood Canyon, Salt Lake Co.

In ovaries of *Gayophytum intermedium* Rydb. **501**. Aug. 27, 1904, Big Cottonwood Canyon, Salt Lake Co.

In ovaries of *Gayophytum ramosissimum* T. & G. A collection from Utah on this host is mentioned in N. A. Flora **7:21** 1906.

\*Mycologia 29. 408-425. 1937.

14. **USTILAGO HIERONYMI** Schroet.**Plate I, 11-13**

In inflorescence of *Bouteloua curtipendula* (Michx.) Torr. (*B. racemosa* Lag.). N. A. Flora **7**:13 1906 lists a collection from Utah on this grass.

In inflorescence of *Bouteloua gracilis* (H. B. K.) Lag. (*B. oligostachya* (Nutt.) Torr. **2233**. Aug 14, 1911, Montezuma Canyon, near Monticello, San Juan Co.

15. **USTILAGO HORDEI** (Pers.) Kellerm.

In inflorescence of *Hordeum vulgare* L. **3235**. July 14, 1926, field near Provo, Utah Co.

16. **USTILAGO HYPODYTES** (Schlecht.) Fries

In internodes of *Distichlis stricta* (Torr.) Rydb. (*D. spicata stricta* Scribn.) **2272**. Aug. 24, 1914, Salt Lake City. **2514**. July 18, 1919, Price, Carbon Co.

In internodes of *Elymus condensatus* Presl. Collected by Dr. Wyatt W. Jones, September, 1918, near Murray, Salt Lake Co.

In internodes of *Hilaria Jamesii* (Torr.) Benth. **2508**. July 18, 1919, Price, Carbon Co. First known collection on this host. (Host determined by Mrs. Chase; smut by Dr. Clinton).

In *Oryzopsis hymenoides* (Roem. & Schult.) Ricker (*Eriocoma cuspidata* Nutt.) **2059**. July 31, 1909, Fish Creek Canyon, western Sevier Co. In inflorescence. **2514**. July 18, 1919, Price, Carbon Co. **2143**. July 1, 1911, Moab, Grand Co. **2178**. July 22, 1911, San Juan Co. **2224**. Aug. 3, 1911, near Edwin Natural Bridge, San Juan Co.

In leaves and inflorescence of *Sitanion hystrix* (Nutt.) J. G. Smith (*S. californicum* J. G. Smith). **2009**. June 19, 1909, Salt Lake City. Grif-fith referred to this unusual form in Bull. Torr. Club **31**:87 1895.

In internodes of *Stipa* sp. A collection from Utah on this host is listed in N. A. Flora **7**:5. 1906.

17. **USTILAGO LEVIS** (Kellerm. & Sw.) Magn.**Plate II, 1-4**

In inflorescence of *Avena sativa* L. **243**. July 15, 1903, Salt Lake City. **2052**. July 29, 1909, Clear Creek Canyon, western Sevier Co. Co-extensive with the cultivation of oats.

18. **USTILAGO LONGISSIMA** (Sow.) Tul.**Plate I, 8-10**

In leaves of *Glyceria striata* (Lam.) Hitchc. (*G. nervata* Trin.; *Panicularia nervata* (Willd.) Kuntze). **615**. Sept. 15, 1904, Salt Lake City.

19. **USTILAGO LORENTZIANA** Thüm.**Plate I, 19-21**

In ovaries of *Hordeum jubatum* L. **392**. June 20, 1904, Salt Lake City. **2011**. June 22, 1909, Salt Lake City. **2620a**. July 21, 1919, Castle Dale, Emery Co. **2750**. Aug. 20, 1920, Lewiston, Cache Co.

In ovaries of *Hordeum jubatum caespitosum* (Scribn.) Hitchc. (*H. caespitosum* Scribn.) **2015c**. June 15, 1909, Salt Lake City.

In ovaries of *Hordeum nodosum* L. **165**. Oct. 12, 1902, Salt Lake City. **3545**. Aug. 5, 1933, near Gogorza, Summit Co.

In ovaries of *Hordeum pusillum* Nutt. **485**. Aug. 18, 1904, Salt Lake City.

In inflorescence of *Sitanion Hystrix* (Nutt.) J. G. Smith (*S. californicum* J. G. Smith). **2592**. June 12, 1920, Salt Lake City.

#### 20. USTILAGO MACROSPORA Desmaz.

##### Plate II, 5-6

In leaves of *Agropyron sp.* **322**. Aug. 26, 1903, Salt Lake Co. This is the smut now referred to *Ustilago bullata* Berk. (q. v.)

In leaves of *Elymus canadensis* L. **3218**. June 14, 1926. Collected by James Kartchner at Provo, Utah Co.

In leaves of *Elymus canadensis robustus* (Scrib. & Smith) Mackenz. & Bush (*E. robustus* Scrib. & Smith) **257**. Aug. 3, 1903, Salt Lake City.

#### 21. USTILAGO MARGINALIS (Lk.) Niessl.

##### Plate II, 7-8

In leaves of *Polygonum bistortoides* Pursh (*Bistorta bistortoides* (Pursh) Small). **3388**. Aug. 8, 1927, near Emerald Lake, Mt. Timpanogos, Wasatch Mts., Utah Co.

#### 22. USTILAGO MULFORDIANA Ell. & Ev.

##### Plate I, 14-16

In inflorescence of *Festuca octoflora* Walt. **666**. June 14, 1905, Salt Lake City.

#### 23. USTILAGO NUDA (Jens.) Kellerm. & Swingle.

In inflorescence of *Hordeum sp. cult.* Coextensive with the cultivation of barley. Included in Dr. Wyatt W. Jones' list of Economic Fungi of Utah as occurring in Salt Lake Co.

#### 24. USTILAGO STRIAEFORMIS (Westend.) Niessl.

##### Plate I, 1-5

In leaves of *Agropyron pauciflorum* (Schwein.) Hitchc. (*A. tenerum* Vasey). **3076**. Nov. 8, 1922, Salt Lake City. This collection has been referred to *Ustilago bullata* Berk. (q. v.)

In leaves of *Agrostis exarata* Trin.? **3539**. June 20, 1933, near Gogorza, Summit Co. The host was in vegetative condition only. Mrs. Chase and Mr. Swallen think the host may be as given above, which would be a new host for this smut. Dr. W. W. Diehl determined the smut.

In leaves of *Elymus canadensis* L. **2767**. Sept. 4, 1920, near Salt Lake City.

In leaves of *Elymus canadensis robustus* (Scribn. & Smith) Mackenz. & Bush (*E. robustus* Scrib. & Smith). **890**. June 23, 1906, Parley's Canyon, Salt Lake Co.

In leaves of *Elymus glaucus* Buckl. **959**. July 17, 1906, Parley's Canyon, Salt Lake Co. **3332**. July 10, 1927, Lindsay's Garden Park, Salt Lake City. Host determined by Mrs. Agnes Chase. This collection was interesting "on account of the severe head infection of the smut."

In leaves of *Sitanion Hanseni* (Scrib.) J. G. Smith. June 19, 1909, East of Mt. Olivet Cemetery, Salt Lake City.

In leaves of *Phleum pratense* L. A collection from Utah on this host is recorded in N. A. Flora 7:19. 1906.

This smut seems to be quite variable, both as to size of spores and surface markings. For instance, the spores of my 2007, 3118, and 3128a "under low power do not appear to be echinulate but under oil immersion the characteristic spores of this species show up in good shape."

25. **USTILAGO TRITICI** (Pers.) Rostr.

Plate I, 6-7

In inflorescence of *Triticum aestivum* L. (*T. vulgare* Vill.) **2583**. July 19, 1919, Castle Dale, Emery Co. **2692a**. July 18, 1920, Cedar City, Iron Co. **2510**. July 18, 1919, Price, Carbon Co. Coextensive with the cultivation of wheat.

26. **USTILAGO ZEAE** (Beckm.) Ung.

In inflorescence, leaves and stalks of *Zea Mays* L. **531**. Sept. 10, 1904, Salt Lake City.

Coextensive with the cultivation of corn.

### TILLETIACEÆ

27. **ENTYLOMA ARNICALA** Ell. & Ev.

In leaves of *Arnica arcana* A. Nels. **3396b**. Aug. 8, 1927, Mt. Timpanogos, Wasatch Mts., Utah Co.

In leaves of *Arnica mollis* Hook. **3561**. August 28, 1937, Duchesne Co. Host determined by Dr. S. F. Blake.

In leaves of *Arnica Parryi* Gray. Collected by Dr. G. D. Darker, July 29, 1936 at Brighton, Big Cottonwood Canyon, Salt Lake Co.

28. **ENTYLOMA COMPOSITARUM** Farl.

Plate IV, 4-5

In leaves of *Erigeron Coulteri* Porter. **953**. August 27, 1906, Big Cottonwood Canyon, Salt Lake Co.

In leaves of *Viguiera multiflora* (Nutt.) Blake. (*Gymnolomia multiflora* Benth. & Hook.) Collected by Dr. G. D. Darker, Aug. 11, 1936, at Brighton, Big Cottonwood Canyon, Salt Lake Co.

29. **ENTYLOMA CRASTOPHILUM** Sacc.

Plate IV, 8-9

In leaves of *Catabrosa aquatica* (L.) Beauv. (*Glyceria aquatica* Presl.) **611a**. Sept. 1, 1904, Red Butte Canyon, Salt Lake Co.

In leaves of *Muhlenbergia asperifolia* (Nees & Mey.) Parodi (*Sporobolus asperifolius* Nees.) **4852**. Aug. 18, 1904, Liberty Park, Salt Lake City.

30. **ENTYLOMA SEROTINUM** Schroet.

Plate IV, 6-7

In leaves of *Lappula floribunda* (Lehm.) Greene **3423**. Aug. 19, 1927, Mt. Timpanogos, Wasatch Mts., Utah Co.

31. **DOASSANSIA ALISMATIS** (Nees) Cornu.

Plate IV, 1-3

In leaves of *Alisma Geyeri* Torr. **3541**. June 23, 1933, Dry Lake, Cache Co.

32. *TILLETIA ASPERIFOLIA* Ell. & Ev.

## Plate II, 15

In ovaries of *Muhlenbergia asperifolia* (Nees & Mey.) Parodi. (*Sporobolus asperifolius* Nees). **486a**. Aug. 18, 1904, Salt Lake City **2145**. July 1, 1911, Moab, Grand Co.

33. *TILLETIA FOETENS* (B. & C.) Trel.

In ovaries of *Triticum aestivum* L. (*T. vulgare* Vill.). Collected Apr. 1, 1924, by Miss Clara Anderson at Murray, Salt Lake Co. **2740**. Aug. 13, 1920, Oak City, Millard Co.

34. *TILLETIA TRITICI* (Bjerk.) Wint.

In ovaries of *Triticum aestivum* L. (*T. vulgare* Vill.) **633a**. Salt Lake City.

35. *UROCYSTIS AGROPYRI* (Preuss.) Schroet.

## Plate III, 7-10

In leaves and inflorescence of *Agropyron pauciflorum* (Schwein.) Hitchc. (*A. tenerum* Vasey). **934**. Aug. 15, 1906, near Lake Mary, Big Cottonwood Canyon, Salt Lake Co.

In leaves of *Agropyron Smithii* Rydb. **3384**. Aug. 17, 1938, near Salem Pond, Salem, Utah Co., Utah.

In leaves of *Elymus canadensis* L. **3219**. June 14, 1926. Collected by James Kartchner, Provo, Utah Co.

In leaves and stems of *Elymus glaucus* Buckl. **3551**. June 28, 1935, Lindsay's Garden Park, Salt Lake City.

In leaves of *Festuca Kingii* Cassidy (*F. confinis* Vasey). **3364**. July 28, 1927, hills near Aspen Grove, Mt. Timpanogos, Wasatch Mts., Utah Co.

36. *UROCYSTIS ANEMONES* (Pers.) Wint.

In leaves and stems of *Ranunculus adoneus* A. Gray (*R. stenobolus* Rydb.) **500**. Aug. 27, 1904, Big Cottonwood Canyon, Salt Lake Co. **3386**. Aug. 8, 1927, Mt. Timpanogos, Utah Co.

In leaves and stems of *Ranunculus Eschscholtzii* Schlecht. **305**. Aug. 13, 1903, Lake Martha, Big Cottonwood Canyon, Salt Lake Co.

In leaves and stems of *Ranunculus Jovis* A. Nels. (*R. digitatus* Hook.) **710**. July 3, 1905, head of South Fork, Big Cottonwood Canyon, Salt Lake Co.

In leaves and stems of *Trautvetteria grandis* Nutt. **2238**. Aug. 17, 1911, Abajo Mts., San Juan Co.

37. *UROCYSTIS CARCINODES* (Berk. & Curt.) Fisch. de Waldh.

## Plate III, 3-4

In leaves and stems of *Actaea arguta* Nutt. (*A. eburnea* Rydb.) **276**. Aug. 13, 1903, Big Cottonwood Canyon, Salt Lake Co.

In leaves and stems of *Actaea viridiflora* Greene. **3279**. Aug. 1, 1926, Mt. Timpanogos, Wasatch Mts., Utah Co.

In leaves and stems of *Clematis pseudoalpina* (Kuntze) A. Nels. (*Atragene pseudoalpina* (Kuntze) Rydb.) **820**. Aug. 10, 1905, Big Cottonwood Canyon, Salt Lake Co. **3463**. Aug. 2, 1928, Mt. Timpanogos, Wasatch Mts., Utah Co.

38. *UROCYSTIS FLOWERSII* Garrett

Plate III, 11-12

In leaves of *Zigadensus elegans* Pursh (*Anticlea elegans* [Pursh] Rydb.). Collected by Dr. Seville Flowers, Aug. 8, 1925, Timpanogos Cirque, Mt. Timpanogos, Wasatch Mts., Utah Co. Type collection. Known only from the type locality.

39. *UROCYSTIS HEUCHERAE* Garrett

Plate III, 5

In leaves of *Heuchera parvifolia* Nutt. **3378**. Aug. 8, 1927, along trail just below Emerald Lake, Mt. Timpanogos, Wasatch Mts., Utah Co. Type collection. Known only from the type locality.

40. *UROCYSTIS LITHOPHRAGMAE* Garrett

In leaves of *Tellima bulbifera* (Rydb.) A. Nels. (*Lithophragma bulbifera* Rydb.). **741**. July 10, 1905, head of Little Cottonwood Canyon, Salt Lake Co. Type collection. Known only from the type locality.

41. *UROCYSTIS SOROSPORIODES* Korn.

Plate III, 1-2

In leaves and stems of *Aconitum columbianum* Nutt. Listed in N. A. Flora **7**:56. 1906 as occurring in Utah on this host.

In leaves and stems of *Aquilegia coerulea albiflora* A. Gray (*A. leptocera* Nutt.) **284**. Aug. 15, 1903, Big Cottonwood Canyon, Salt Lake City.

In leaves and stems of *Aquilegia flavescens* S. Wats. **284a**. Aug. 15, 1903, Big Cottonwood Canyon, Salt Lake Co.

In leaves of *Thalictrum Fendleri* Engelm. **2157**. July 8, 1911, La Sal Mts. near Gold Basin, San Juan Co. **3182**. Aug. 18, 1925, Mt. Timpanogos above Aspen Grove, Wasatch Mts., Utah Co.

In stems and leaves of *Thalictrum sparsiflorum* Turcz. **793**. July 29, 1905, Big Cottonwood Canyon, Salt Lake Co. **799**. Aug. 3, 1903, Little Snake Canyon, Wasatch Co.

42. *UROCYSTIS VIOLAE* (Sow.) Fisch. de Waldh.

Plate III, 6

In leaves of *Viola adunca* J. E. Smith (*V. longipes* Nutt.) **767**. July 22, 1905, Brighton, Big Cottonwood Canyon, Salt Lake Co.

In leaves of *Viola purpurea venosa* (Wats) Brainerd. May 8, 1932, Mill Creek Canyon, Wasatch Mts., Salt Lake Co. **1078**. May 16, 1908, City Creek Canyon, Wasatch Mts., Salt Lake Co.

## PLATE I

- 1-5. *Ustilago striaeformis* on *Elymus glaucus*.  
1. Sori on stem and leaf sheath  $\times 1$ ; 2. Infected spike  $\times 1$ ; 3. Stem sori  $\times 5$ ; 4-5. Spores  $\times 1200$ .
- 6-7. *Ustilago tritici* on *Triticum aestivum*.  
6. Infected heads  $\times 5$ ; 7. Spores  $\times 1200$ .
- 8-10. *Ustilago longissima* on *Glyceria nervata*.  
8. Leaf sori  $\times 1$ ; 9. Sorus enlarged  $\times 5$ ; 10. Spores  $\times 1200$ .
- 11-13. *Ustilago Hieronymi* on *Bouteloua gracilis*.  
11. Sori on leaves  $\times 1$  and  $\times 2$ ; 12. A single sorus  $\times 10$ ; 13. Spores  $\times 1200$ .
- 14-16. *Ustilago Mulfordiana* on *Festuca octoflora*.  
14. Unaffected and affected plants  $\times 1$ ; 15. Soral mass in floret  $\times 10$ ; 16. Spores  $\times 1200$ .
- 17-18. *Ustilago Crus-galli* on *Echinochloa Crus-galli*.  
17. Affected spike  $\times 1$ ; 18. Spores  $\times 1200$ .
- 19-21. *Ustilago Lorentziana* on *Hordeum jubatum*.  
19. Infected heads  $\times 1$ ; 20. Single infected floret  $\times 10$ ; 21. Spores  $\times 1200$ .
- 22-23. *Ustilago hypodytes* on *Oryzopsis hymenoides*.  
22. Infection on the internodes  $\times 1$ ; 23. Spores  $\times 1200$ .

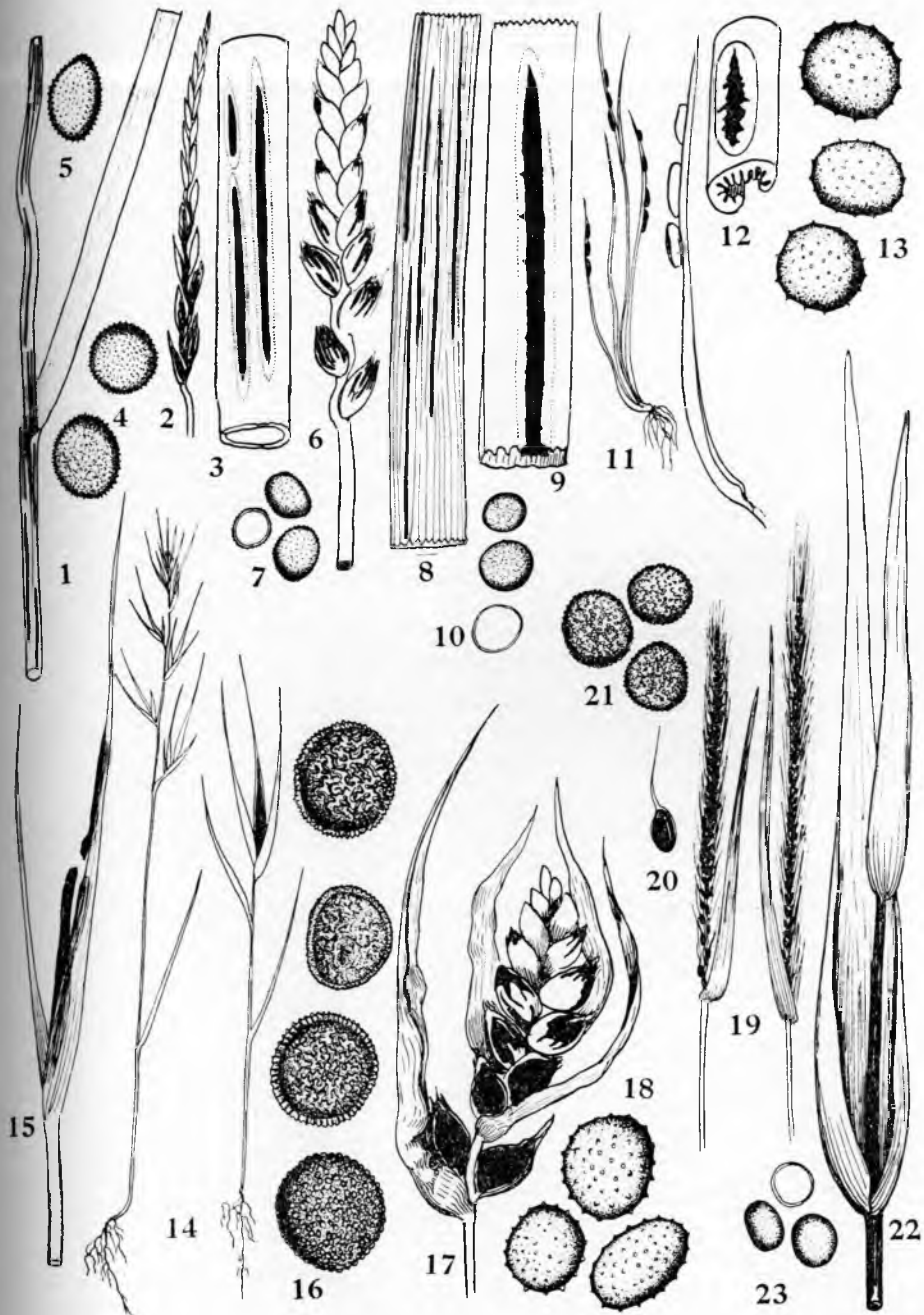


PLATE I

## PLATE II

- 1-4. *Ustilago levis* on *Avena sativa*.  
1. Infected panicle  $\times 1$ ; 2. Outer glume showing pustulate sori  $\times 10$ ; 3. Older sori on glumes  $\times 10$ ; 4. Spores  $\times 1200$ .
- 5-6. *Ustilago macrospora* on *Elymus canadensis*.  
5. Sori on leaf  $\times 1$ ; 6. Spores  $\times 1200$ .
- 7-8. *Ustilago marginalis* on *Polygonum bistortoides*.  
7. Marginal sori on leaf  $\times 1$ ; 8. Spores  $\times 1200$ .
- 9-11. *Ustilago bromivora* on *Bromus tectorum*.  
9. Infected panicle  $\times 1$ ; 10. Spore masses in florets  $\times 10$ ; 11. Spores  $\times 1200$ .
- 12-14. *Cintractia Caricis* on *Carex elynoides*.  
12. Normal and affected spikes  $\times 1$ ; 13. Spore mass on central columella  $\times 5$ ; 14. Spores  $\times 1200$ .
15. *Tilletia asperifolia*. Spores from *Muhlenbergia asperifolia*  $\times 1200$ .

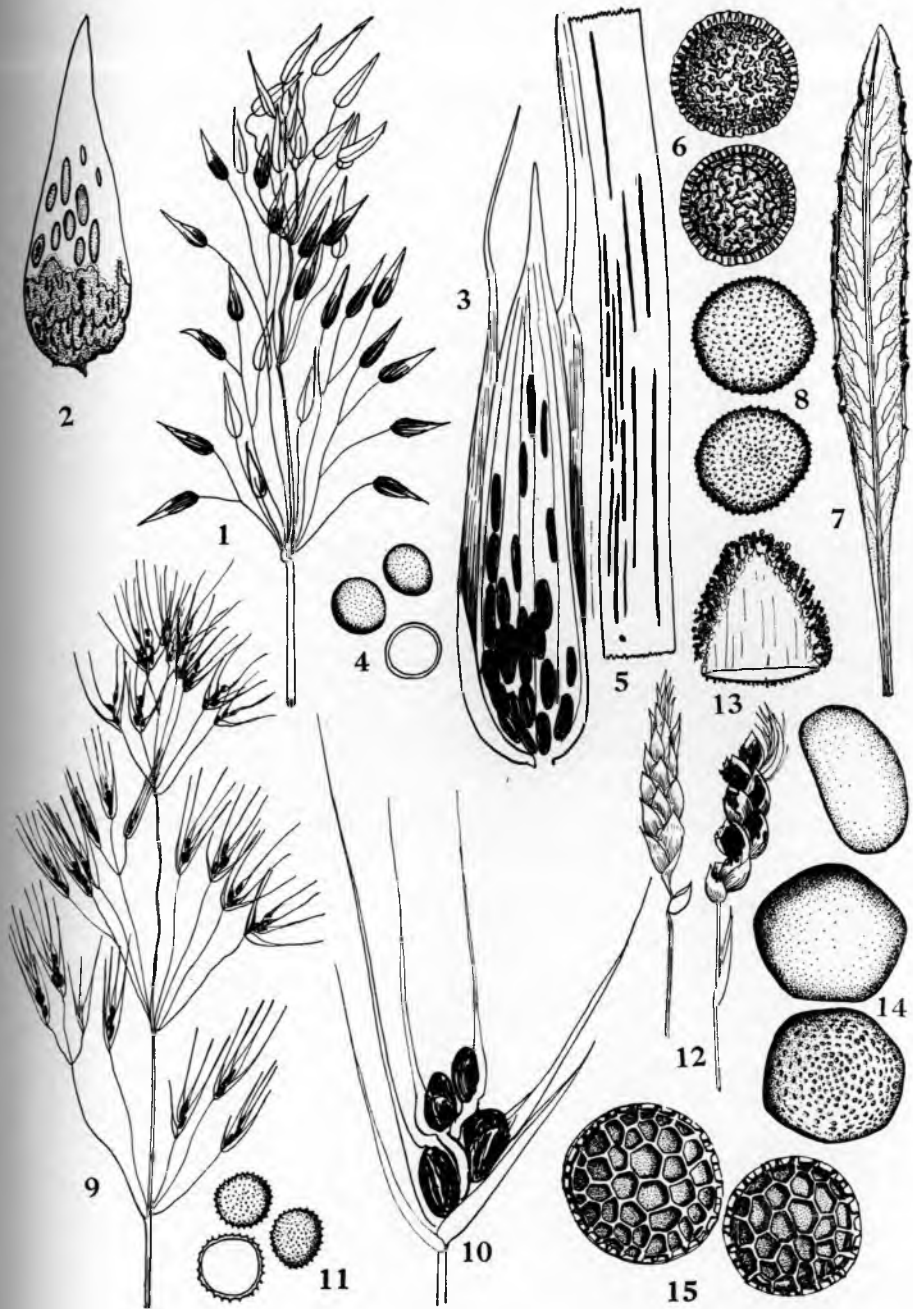


PLATE II

## PLATE III

- 1-2. *Urocystis sorosporoides* on *Aquilegia coerulea albiflora*.  
1. Sori on petiole and leaf  $\times 1$ ; 2. Spore balls  $\times 600$ .
- 3-4. *Urocystis carcinodes* on *Clematis pseudoalpina*.  
3. Sori in petioles  $\times 1$ ; 4. Spore balls  $\times 600$ .
5. *Urocystis heucherae*. Spore balls from *Heuchera parvifolia*  $\times 600$
6. *Urocystis violae*. Spore balls from *Viola purpurea venosa*  $\times 600$
- 7-10. *Urocystis Agropyri*. 7. Sori on stems and leaves of *Elymus glaucus*  $\times 1$ ; 8. Sori on leaf  $\times 5$ ; 9. Sori on leaf of *Agropyron sp.*  $\times 1$ ; 10. Spore balls  $\times 600$ .
- 11-12. *Urocystis Flowersii* on *Zigadenus elegans*. 11. Sori on leaf  $\times 1$ ; 12. Spore balls  $\times 600$ .
13. *Sorosporium Saponariae*. Spore balls from *Silene Menziesii*  $\times 600$ .
- 14-15. *Thecaphora Trailii*. Spore balls  $\times 600$ ; 15. Separate spores  $\times 1200$ . From inflorescence of *Cirsium Eatoni*.
16. *Thecaphora californica*. Spore balls from inflorescence of *Grindelia squarrosa* (?)  $\times 600$ .
- 17-19. *Schizonella melanogramma* on *Carex nebraskensis*.  
17. Sori in leaf  $\times 1$ ; 18. Agglutinated spore mass  $\times 100$ ; 19. Spores  $\times 1200$ .

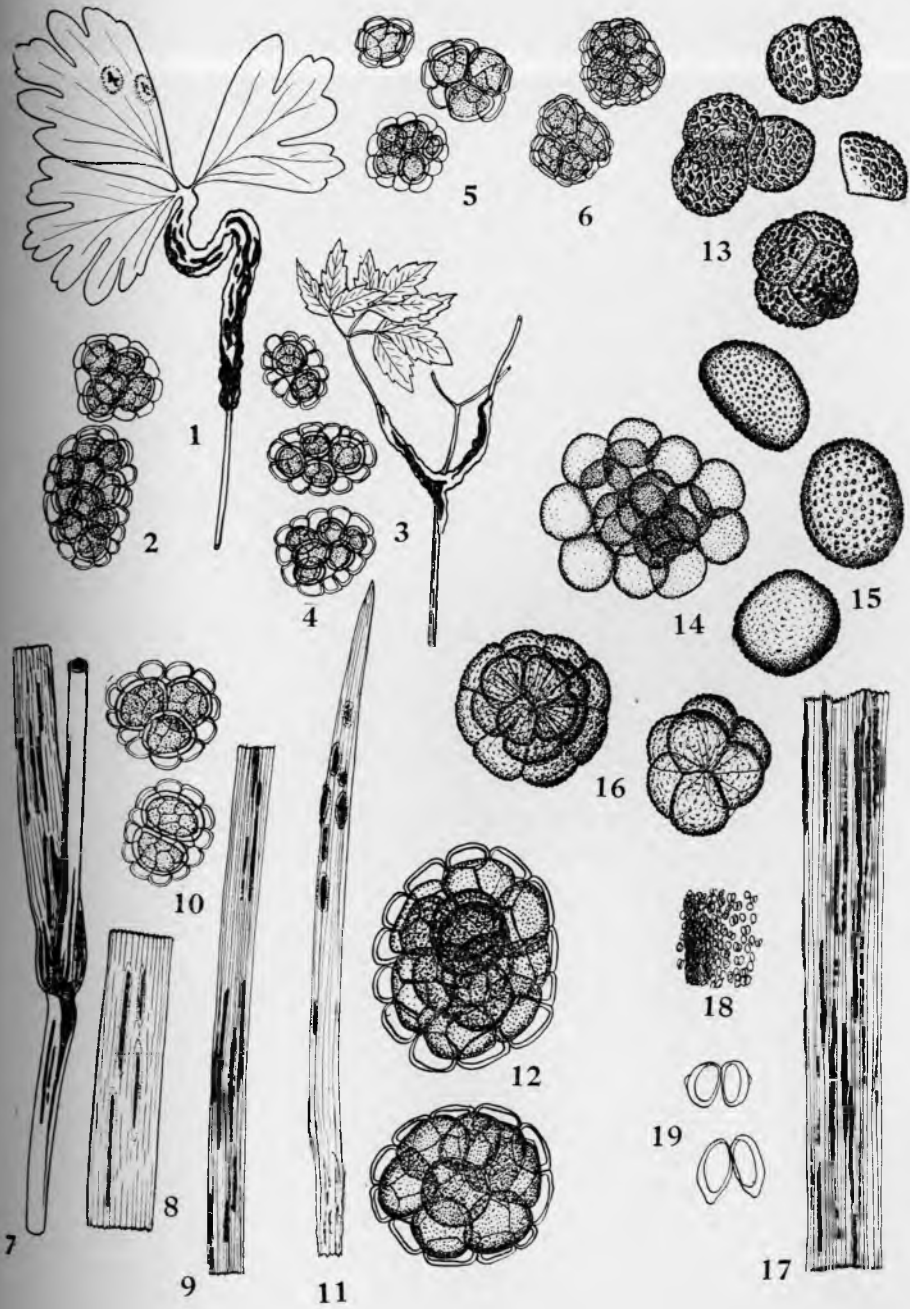


PLATE III

## PLATE IV

1-3. *Doassansia Alismatis* on *Alisma Geyeri*.

1. Sori in leaf  $\times 1$ ; 2. A spore ball with outer sheath of sterile cells  $\times 50$ ; 3. Spores  $\times 1200$ .

4-5. *Entyloma Compositarum* on *Erigeron Coulteri*.

4. Spore mass in leaf  $\times 1$ ; 5. Spores seen through the epidermis  $\times 600$ .

6-7. *Entyloma serotinum* on *Lappula floribunda*.

6. Spore mass in leaf  $\times 1$ ; 7. Spores within the cells  $\times 600$ .

8-9. *Entyloma crastophilum* on *Muhlenbergia asperifolia*.

8. Spore masses in leaves  $\times 1$ ; 9. Spore masses seen through the epidermis  $\times 600$ .

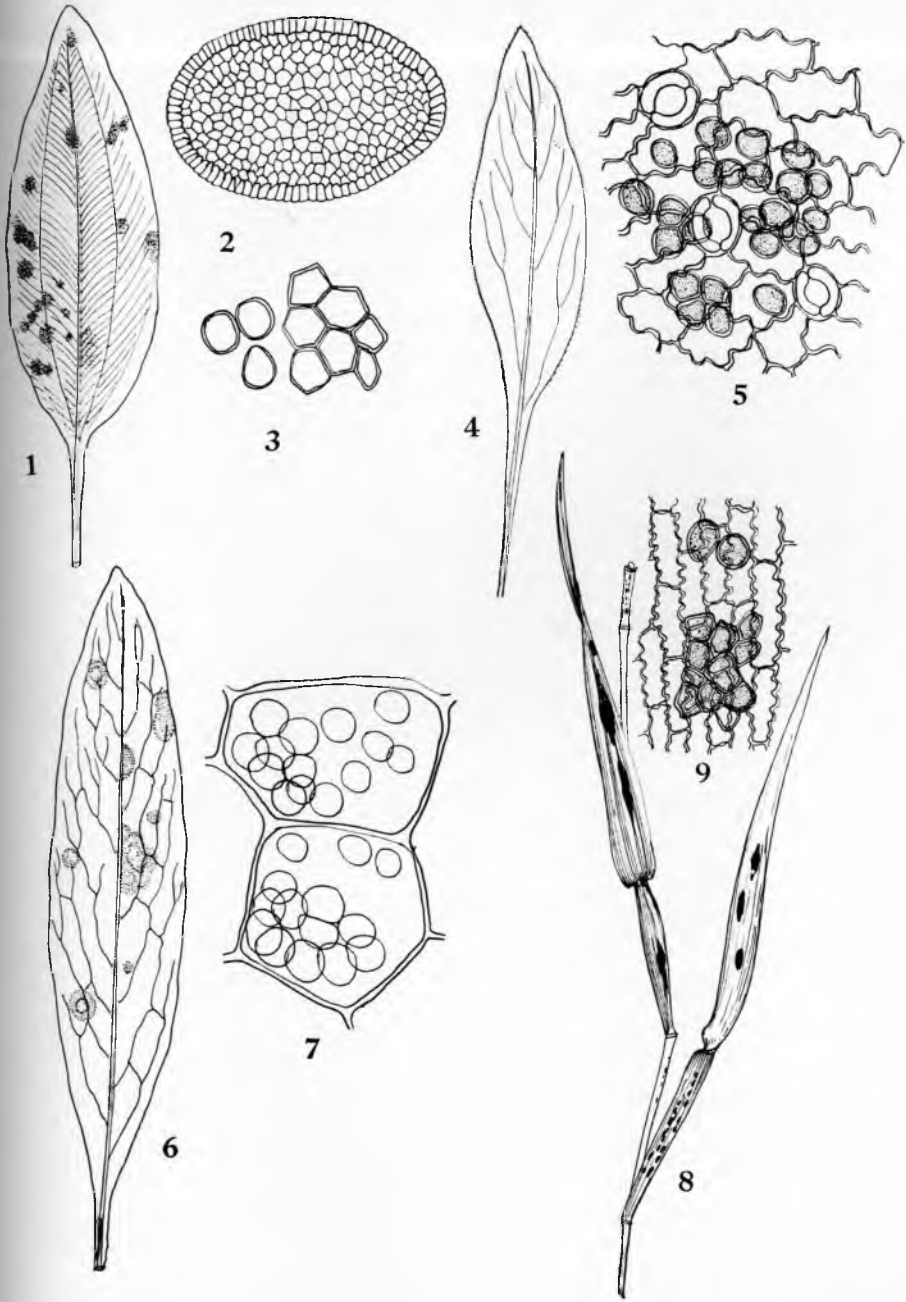


PLATE IV

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