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## CHEMICAL AGENTS OF WARFARE<sup>1</sup>

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Chemicals as a means of defense in warfare were first used by the Spartans in 431-404 B.C. against the Athenians. Screening smokes were used in the War of 1812 and at the siege of Charleston in the Civil War. During the World War the first effective use was by the Germans using chlorine on the Ypres salient. The line was broken from three to five miles and had the Germans possessed full faith in their weapon they might have pushed whole armies through the gap and reached the Channel. The first efforts of the Allies were of protective measures and in less than thirty-four hours after the first attack improvised gas masks were at hand; after that the Allies turned their attention to making gases. Almost simultaneously with the introduction of the cloud attack came the use of lachrymators. Then Germany introduced another gas, phosgene, after this chloropicrin, then diphenylchlorarsine and finally mustard, the king of war gases. In the employment of mustard Germany violated one of the first principles of chemical warfare; it being unsound for any nation to introduce a new weapon until that nation is furnished with the means of protecting itself against the use by the enemy. All the other gases were well known, but Germany "was sure" that the Allies could not retaliate with mustard because they could not produce it in time, but they underestimated the ability and ingenuity of their enemies.

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# RUSTS OF TENNESSEE<sup>1</sup>

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So far as the writers are aware, no previous study of the rusts of Tennessee has been undertaken. Some years ago, Kauffman (1917) listed several species of fungi which he collected in the vicinity of Elkton, Sevier County, East Tennessee. His list includes several species of rusts, all of which the authors have since found.

Their collections now include 108 species, distributed in two families and twenty genera. Since most of these rusts have been taken within a radius of forty miles of Knoxville, it is assumed that further collections in other regions of the State will yield additional species.

Attention is directed to a few species the occurrence of which in Tennessee is of considerable interest. The collection of *Chrysomyxa aseris* Jackson represents the first record of this species in the eastern United States. Hitherto, this rust has been known only in western Montana to northern Oregon and northward. *Puccinia asterum* (Schw.) Kern is here reported for the first time on *Sericocarpus asteroides* (L.) BSP. On *Viola lovelliana* Brainerd, we have found *Uromyces andropogonis* Tracy. This is a new host for any species of rust. The aecial stage of *Uromyces hedysari-paniculata* (Schw.) Farl. has been taken in East Tennessee on *Desmodium rigidum* (Elli.) DC. This represents the first collection of aecia of this rust on this host. The rust *Cronartium comandrae* Pk. was found on the sassafras bush, *Buckleya distichophylla* (Nutt.) Torr. near Wolf Creek, Cocke County. Since the range of *Buckleya* is quite restricted, the occurrence of the rust is of particular interest. Two new species, *Aecidium* sp. and *Coleosporium* sp. are listed.

All the species reported are filed in the herbarium of the University of Tennessee. Duplicates of a majority are in the herbaria of H. S. Jackson, J. C. Arthur, and H. H. Whetzel. A number of the species have either been determined or confirmed by Jackson, Arthur, Whetzel, and Hedgcock.

## Melampsoraceae

1. *Cerotelium dicentrae* (Trel.) Mains & Aud. O, I on *Dicentra cucullata* Torr. A single collection from Great Smoky Mts., at 5000 ft., near the Tennessee-North Carolina line, in North Carolina. Not collected in Tennessee but should be found in this state.

<sup>1</sup>The publication of this paper at this time was made possible by the generosity of Dr. L. K. Hesler.

<sup>2</sup>Kauffman, C. H., 1917. Tennessee and Kentucky Fungi. *Mycologia* 9: 166-166.

2. *Chrysomyxa weirii* Jackson. III on *Picea rubra* (DuRoi) Dietr., Great Smoky Mts., Sevier County, at 5200 ft.
3. *Coleosporium* sp. II on *Lysimachis quadrifolia* L. (A new species; to be described by Jackson.)
4. *Coleosporium campanulae* (Pers.) Lev. II, III on *Campanula americana* L.
5. *Coleosporium carneum* (Bosc.) Jackson. II, III on *Veronum albissimum* Nutt.
6. *Coleosporium elephantopodis* (Schw.) Thüm. O, I on *Pinus rigida* Mill. II, III on *Elephantopus carolinianus* Willd.
7. *Coleosporium inconspicuum* (Long) Hedg. and Long. II on *Coriopsis major* Walt.
8. *Coleosporium ipomoeae* (Schw.) Burr. II on *Ipomoea hederacea* Jacq.
9. *Coleosporium solidaginis* (Schw.) Thüm. O, I on *Pinus echinata* Mill., *P. rigida* Mill., *P. virginiana* Mill. II, III on *Aster ericoides* L., *Solidago altissima* L., *S. glomerata* Michx., *S. juncea* Ait., *S. latifolia* L.
10. *Coleosporium terebinthinaceae* (Schw.) Arthur. II, III on *Parthenium integrifolium* L., *Silphium compositum* Michx.
11. *Cronartium comandrae* Pk. II, III on *Buckleya distichophylla* (Nutt.) Torr.
12. *Cronartium quercus* (Brod.) Schroet. O, I on *Pinus echinata* Mill., *P. pungens* Lamb., *P. rigida* Mill., *P. virginiana* Mill. II, III on *Quercus marilandica* Muench.
13. *Gallowaya pinicola* Arthur. III on *Pinus virginiana* Mill.
14. *Melampsora abietis-capraearum* Tubeuf (*M. humboldtiana* Speg.). II, III on *Salix nigra* Marsh.
15. *Melampsoropsis roanensis* Arthur. II, III on *Rhododendron punctatum* Andr.
16. *Milesia polypodophila* (Bell) Faull. II on *Polypodium virginianum* L.
17. *Pucciniastrum agrimoniae* (Schw.) Tranz. II on *Agrimonia* sp.
18. *Pucciniastrum hydrangeae* (B. and C.) Arthur. O, I on *Tsuga canadensis* (L.) Carr. II, III on *Hydrangea arborescens* L.
19. *Pucciniastrum pustulatum* (Pers.) Diet. II on *Epilobium coloratum* Muhl.
20. *Pucciniastrum pyrolae* (Pers.) Schroet. II on *Chimaphila maculata* (L.) Pursh.
21. *Uredinopsis macrosperma* (Cke.) Magn. II, III on *Pteris aquilina* L.

## Pucciniaceae

22. *Aecidium* sp. O, I on *Lithospermum tuberosum* Rugel. (A new species; to be described by Arthur.)
23. *Frommea duchesneae* Arthur. II, III on *Duchesnea indica* (Andr.) Focke.
24. *Frommea obtusa* (Strauss) Arthur. II, III on *Potentilla canadensis* L.
25. *Gymnoconia interstitialis* (Schlect.) Lagerh. O, I III on *Rubus canadensis* L., *R. villosus* Ait.
26. *Gymnosporangium germinale* (Schw.) Kern. O, I on *Crataegus* sp. III on *Juniperus virginiana* L.
27. *Gymnosporangium globosum* Farl. O, I on *Crataegus berberifolia* T. & G.
28. *Gymnosporangium juniperi-virginianae* Schw. O, I on *Pyrus malus* L. III on *Juniperus virginiana* L.
29. *Gymnosporangium nidus-avis* Thaxter. III on *Juniperus virginiana* L.
30. *Kuehneola uredinis* (Link) Arthur. O, II, III on *Rubus canadensis* L.
31. *Kuukelia nitens* (Schw.) Arthur. I, III on *Rubus*, sp.
32. *Phragmidium rosae-aeugerae* Diet. II, III on *Rosa arifera* Michx.
33. *Puccinia aletridis* B. & C. II, III on *Aletris furiosa* L.
34. *Puccinia ambigua* (A. & S.) Lagerh. I, III on *Gutierrezia purpurea* L.

35. *Puccinia andropogonis* Schw. O. I on *Pentstemon canescens* Britton  
*Chelone Lyoni* Pursh., *Gerardia* sp. II, III on *Andropogon scoparius* Michx.  
*A. ternarius* Michx., *A. virginicus* L., *Erianthus* sp.
36. *Puccinia anemones-virginianae* Schw. III on *Anemone virginiana* L.  
(Lam.) Gray.
37. *Puccinia angustataoides* R. E. Stone. III on *Rynchospora corniculata* L.
38. *Puccinia anomala* Rostr. II, III on *Hordeum vulgare* L.
39. *Puccinia antirrhini* Diet. & Hol. II on *Antirrhinum majus* L.
40. *Puccinia asperifolii* (Pers.) Wetts. II, III on *Secale cereale* L.
41. *Puccinia asteris* Duby. III on *Aster ericoides* L., *A. paniculatus* Lam.
42. *Puccinia asterum* (Schw.) Kern. O, I on *Aster acuminatus* Michx.  
*A. lateriflorus* (L.) Britton, *Erigeron annuus* (L.) Pers., *Sericocarpus*  
*asteroides* (L.) BSP., *Solidago patula* Muhl. II on *Carex mirabilis* Dewey.
43. *Puccinia atropuncta* Pk. & Clinton. II, III on *Veratrum viride* Ait.
44. *Puccinia circaeae* Pers. III on *Circaea intermedia* Ehrh., *C. latifolia* L.
45. *Puccinia cirsii* Lasch. II on *Cirsium discolor* (Muhl.) Spreng.
46. *Puccinia claytoniata* (Schw.) Pk. O, I on *Claytonia virginica* L.
47. *Puccinia clematidis* (DC.) Lagerh. O, I on *Actaea alba* (L.) Mill.  
*Cimicifuga racemosa* (L.) Nutt., *Clematis virginiana* (L.) Mill. II, III on  
*Triticum vulgare* Vill.
48. *Puccinia conoclinii* Szym. II, III on *Eupatorium coelestinum* L.
49. *Puccinia convolvuli* (Pers.) Cast. I, II on *Convolvulus sepium* L.
50. *Puccinia coronata* Cda. II, III on *Avena sativum* L., *Dactylis glom-*  
*erata* L., *Holcus lanatus* L., *Lolium* sp., *Paspalum setaceum* Michx.
51. *Puccinia cyani* (Schleich.) Pass. III on *Centaurea cyanus* L.
52. *Puccinia cyperi* Arthur. II, III on *Cyperus strigosus* L., *C. refractus*  
Englm.
53. *Puccinia eatoniae* Arthur. II, III on *Sphenophyllis pallens* (Spreng.)  
Scribner.
54. *Puccinia eleocharidis* Arthur. O, I on *Eupatorium aromaticum* L.  
*E. falcatum* Michx., *E. purpureum* L., *E. rotundifolium* L.
55. *Puccinia ellisiana* Thüm. II, III on *Andropogon virginicus* L.
56. *Puccinia emaculata* Schw. II on *Panicum commutatum* Schultes.
57. *Puccinia epiphylla* (L.) Wettst. II on *Poa pratensis* L.
58. *Puccinia fraseri* Arthur. II, III on *Hieracium venosum* L.
59. *Puccinia gentianae* (Strauss) Link. III on *Gentiana villosa* L.
60. *Puccinia graminis* Pers. II, III on *Phleum pratense* L., *Poa trivialis* L.
61. *Puccinia grossulariae* (Schum.) Lagerh. I on *Ribes rotundifolium* Michx.
62. *Puccinia helianthi-mollis* (Schw.) Jackson. I, II, III on *Helianthus*  
*divaricatus* L.
63. *Puccinia heucherae* (Schw.) Diet. III on *Mitella diphylla* L., *Tuarella*  
*cordifolia* L.
64. *Puccinia hibisciata* (Schw.) Kellerm. II on *Muhlenbergia Schreb.*  
J. F. Gmel.
65. *Puccinia hieracii* (Schum.) H. Mart. II on *Pyrrhopyppus carolinianus*  
(Walt.) DC., *Taraxacum officinale* Weber.
66. *Puccinia impatientis* (Schw.) Arthur. I on *Impatiens* sp. II, III on  
*Elymus virginicus* L.
67. *Puccinia lateripes* Berk. & Rav. III on *Ruellia strepens* L.
68. *Puccinia maculosa* Schw. III on *Krigia amplexicaulis* Nutt.
69. *Puccinia malvacearum* Bertero. III on *Althaea rosea* Gav.
70. *Puccinia marilandica* Lindr. II, III on *Sanicula canadensis* L., *S.*  
*marylandica* L.
71. *Puccinia menthae* Pers. II, III on *Blephilia hirsuta* (Pursh) Benth.  
*Mentha arvensis* L. var. *canadensis* (L.) Briq., *Monarda* sp., *Pycnanthemum*  
*pycnanthemoides* (Leavenw.) Fernald.
72. *Puccinia nolitangeris* Cda. II on *Impatiens pallida* Nutt.
73. *Puccinia obliqua* B. & C. III on *Gonolobus* sp.
74. *Puccinia orbicula* (Pk. & Clinton) Kuntze. O, II, III on *Prenanthes*  
*serpentaria* Pursh.
75. *Puccinia oxalidis* (Lév.) Diet. & Ellis. II on *Oxalis bowiei* Herb.
76. *Puccinia pimpinellae* (Strauss) H. Mart. II, III on *Chaerophyllum*  
*tainturieri* Hook., *Osmorrhiza* sp.
77. *Puccinia podophylli* Schw. O, I, III on *Podophyllum peltatum* L.
78. *Puccinia polygoni-amphibii* Pers. II on *Polygonum acre* H.B.K., *P.*  
*convolvulus* L., *P. pennsylvanicum* L.
79. *Puccinia sambuci* (Schw.) Arthur. O, I on *Sambucus canadensis* L.  
II on unnamed sedge.
80. *Puccinia smilicis* Schw. II, III on *Smilax glauca* Walt., *S. hispida*  
Muhl.
81. *Puccinia sorghi* Schw. II, III on *Zea Mays* L.
82. *Puccinia tenuis* (Schw.) Burrill. O, I, III on *Eupatorium urticae-*  
*folium* Reichard, *E. purpureum* L.
83. *Puccinia verbesinae* Schw. O, I, II, III on *Actinomeris alternifolia*  
(L.) DC., *Verbesina occidentalis* (L.) Walt.
84. *Puccinia vernoniae* Schw. III on *Vernonia* sp.
85. *Puccinia violae* (Schum.) DC. O, I on *Viola hastata* Michx., *V. sca-*  
*bruscula* Schwein. II, III on *Viola canadensis* L., *V. hastata* Michx., *V.*  
*papilionacea* Pursh., *V. scabruscula* Schwein.
86. *Puccinia virgata* E. & E. III on *Sorghastrum nutans* (L.) Nash.
87. *Puccinia windsorae* Schw. II, III on *Tridens flaxus* (L.) Hitchcock.
88. *Puccinia xanthii* Schw. III on *Xanthium canadense* Mill.
89. *Tranzschelia punctata* (Pers.) Arthur. O, I on *Anemone quinque-*  
*folia* L. III on *Prunus* sp.
90. *Uromyces andropogonis* Tracy. O, I on *Viola Lovelliana* Brainerd,  
*V. papilionacea* Pursh. II, III on *Andropogon ternarius* Michx., *A. virgin-*  
*icus* L.
91. *Uromyces appendiculatus* (Pers.) Fr. II, III on *Phaseolus* sp., *Stro-*  
*phostyles helvola* (L.) Britt., *Vigna sinensis* (L.) Endl.
92. *Uromyces caladii* (Schw.) Farl. O, I, II, III on *Arisaema dracontium*  
(L.) Schott., *A. triphyllum* (L.) Schott.
93. *Uromyces carophyllinus* (Schrank) Wint. II on *Dianthus* sp.
94. *Uromyces dactylidis* Otth. II on *Dactylis glomerata* L.
95. *Uromyces fallens* (Desmaz.) Kern. II, III on *Trifolium pratense* L.
96. *Uromyces hedysari-paniculati* (Schw.) Farl. O, I on *Desmodium*  
*rigidum* (Eil.) DC. II, III on *Desmodium canadense* (L.) DC., *D. Dillenii*  
Farl., *D. obtusum* (Muhl.) DC.
97. *Uromyces houstoniatus* (Schw.) J. Sheldon. O, I on *Houstonia pur-*  
*purea* L.
98. *Uromyces howei* Pk. III on *Asclepias syriaca* L.
99. *Uromyces hyperici-frondosi* (Schw.) Arthur. III on *Hypericum muti-*  
*lum* L.
100. *Uromyces junci-effusi* Syd. II, III on *Juncus effusus* L.
101. *Uromyces lespedezae-procumbentis* (Schw.) M. A. Curtis. O, I, II,  
III on *Lespedeza frutescens* (L.) Britt., *L. hurta* (L.) Hornem., *L. intermedia*  
(S. Wats.) Britt., *L. procumbens* Michx.
102. *Uromyces medicaginis* Pass. II on *Medicago sativa* L.
103. *Uromyces polygoni* (Pers.) Arthur. O, I on *Polygonum* sp.
104. *Uromyces proeminens* (DC.) Pass. II, III on *Euphorbia dentata*  
Michx., *E. Preslii* Guss.
105. *Uromyces rynchosporae* Ellis. II on *Rynchospora glomerata* (L.)  
Vahl.
106. *Uromyces rudbeckiae* Arthur & Holway. III on *Rudbeckia laciniata*  
L.
107. *Uromyces silphii* (Burrill) Arthur. II, III on *Juncus dichotomus*  
Ell., *J. tenuis* Willd.
108. *Uromyces spermacoces* (Schw.) M. A. Curtis. III on *Diodia teres*  
Walt.