UREDINALES FROM S.W. ASIA: III

THE RUST FUNGI OF TURKEY

D. M. HENDERSON

This account of the rust flora of Turkey is the result of work following three months in Turkey in May, June and July, 1960. Although search for rust fungi was my primary object, bryophytes and flowering plants were collected as well. The expedition was planned by J. D. A. Stainton and the numbers (S. & H. = Stainton & Henderson) form a single series for our collections of all groups. The location of collecting sites will be helped by reference to our itinerary published elsewhere (Coode, M., Turkish Itineraries, III. Notes R.B.G. Edinb. **25,** 165–169, 1963).

My chance to collect in Turkey in 1960 and the success of my visit are due to Mr. J. D. A. Stainton's generous invitation to accompany him and his tolerance of my preference for collecting *diseased* plants.

In this paper 211 species are listed, including previously published records. It seemed appropriate to include all the published records on the rust flora so that knowledge of the flora to date is summarized, although there is no doubt that many records require confirmation and inclusion of a species on the basis of records alone does not necessarily mean that I consider it well founded.

The problem of a suitable species-concept is difficult in the rust fungi. In agreement with Jørstad I am opposed to recognizing species simply on the basis of the specific distinction of the hosts and presumed host-specialization. That line of reasoning produces a myriad of species for which, at least so far, no coherent principles of grouping at higher taxonomic level have been suggested. Whenever I have good evidence that species are morphologically similar and occur on related hosts I have lumped them. Where the evidence is less certain, I have retained segregate species but indicated where I think they may belong. It is quite obvious that for example, the rusts of Compositae pose an extremely intricate problem which will require very intensive work and much more abundant material than is at hand at the moment for its complete resolution.

The records in the 19th century of rust fungi in Turkey were all derived from the collections of phanerogamic collectors such as Haussknecht and Bornmüller. These were worked out by Rabenhorst, Cooke and Magnus in the last and in the first few decades of the present century. In 1906 R. Maire collected a few fungi in south-eastern Turkey and published a short list. A few other papers by Sydow (1935) and records and descriptions of new species in Monographia Uredinearum appeared up to 1939. The major contributions of Bremer (then visiting professor at Ankara) and his collaborators appeared in 1947 and 1952. During the same period Petrak published a number of accounts based principally on collections by K. H. Rechinger and on a few by P. H. Davis. In 1958 Karel, the resident plant pathologist in Ankara included notes on pathogenically

important rusts in his survey of plant pathogenic fungi in Turkey. During the past fifteen years Dr. P. H. Davis has assiduously collected rusts for the Edinburgh Herbarium in the course of his expeditions and these have been listed in a series of papers (Henderson, 1957, 1959 and 1961). The list of references at the end of this paper includes, it is hoped, most papers having a bearing on the Turkish rust flora. In the main body of the text references to previously published records are given as numbers referring to a key list at the end of the paper.

I have made no attempt here to analyse the relationships of the Turkish rust flora; to anyone familiar with Tranzschel's summary (1939) of the rust flora of the U.S.S.R. it is obvious that, at present, our knowledge of the Turkish flora is still too incomplete to make any comparisons and analyses valid. Many alternation patterns could undoubtedly be worked out by more intensive observation in the field, for the existence of large areas of natural vegetation in Turkey means that the vegetational associations with their heteroecious rusts exist undisturbed. A constantly moving expedition such as ours in 1960 has the advantage that many areas are sampled but the disadvantage that there is little time to search for alternate hosts and to attempt to piece together life histories.

I am indebted to many colleagues for assistance with identification of host plants and to Miss H. Prentice for help with spore-measurements, indexing and preparation of microscopical mounts.

Aecidium euphorbiae Pers. Syn. Meth. Fungorum, 211 (1801).

On *Euphorbia herniariifolia* Willd.; Sivas: Gürün to Pinarbaşi, 2300 m. 19 June 1960. *S. & H.* 5678.

On *Euphorbia herniariifolia* var. *glaberrima* Halacsy; Sivas: Bey Dağ, 2400 m., 1 June 1960, *S. & H.* 5312.

On *Euphorbia macroclada* Boiss.; Sivas: Sivas, 1300 m., 21 May 1960, *S. & H.* 5094.

On *Euphorbia oblongifolia* C. Koch; Artvin: Şavval Tepe, 1800 m., 7 July 1960, *S. & H.* 6060.

On *Euphorbia virgata* Waldst. & Kit.; Gümüşane: Soganli Geçidi, 1200 m., 18 May 1960, *S. & H.* 5043.

All specimens with deformed dwarfed stems bearing spermogonia and aecidia.

In Eurasia, aecidia associated with deforming systemic mycelium may belong to at least seven major rust species:- aecidial stages of the, heteroecious species *Uromyces pisi*, *U. anthyllidis*, *U. dianthi* (=*caryophyllinus*), smooth-spored *Uromyces* of the *U. arenariae* type and the autoecious species, *U. proeminens* and *U. tuberculatus*. The endoforms e.g. *U. euphorbiae-silvaticae*, must also be considered, for without germinating the aecidiospores their resemblance to the aecidia of long cycle rusts is complete.

Of the four *Euphorbia* species listed above only *E. virgata* has been connected with heteroecious rusts. Treboux (1912) infected *Astragalus hypoglottis*, *A. creticus* and *A. sanguinolentus* with aecidiospores from *E. virgata*; the rust corresponds to a race of *U. pisi* often referred to as

U. punctatus which is widespread in the steppe regions of central and western Asia and occurs on *Astragalus* spp. in Turkey (Henderson, 1961).

Euphorbia cyparissias commonly serves as a host of *U. punctatus* in western Europe and is recorded as a host in Roumania (Savulescu, 1953) and the Ukraine (Tranzschel, 1939) but does not penetrate into Asia Minor.

There is evidence from experiments in western Europe that *E. virgata* may also serve as host for another race of *U. pisi*, *heimlerianus* on many species of *Vicia* with many records in U.S.S.R. but none in Turkey (see Guyot, 1957 for a summary of infection experiments with *E. virgata* and *E. cyparissias*). Furthermore, *E. virgata* is implicated with *E. cyparissias* and *E. seguieriana* as a host of the legume rusts of the *U. pisi* group usually placed under *U. genistae-tinctoriae* or *U. laburni*, with diplont hosts in the genera *Caragana*, *Colutea*, *Genista*, *Cytisus* and *Laburnum*. The rust is recorded on *Colutea* sp. in Turkey (Karel, 1958), in Iran on *Caragana* (Petrak, 1956) and *Colutea persica* (Petrak and Esfandiari, 1941) and on most of the diplont hosts in neighbouring U.S.S.R. (Tranzschel, 1939).

Finally in the *U. pisi* group the race *U. striatus*, predominantly on *Medicago* and *Trifolium*, has been shown to form aecidia on *Euphorbia virgata* (Treboux, 1912) as well as on *E. cyparissias* and *E. seguieriana*. Diplont stages are known from Turkey on *Medicago* (see under *U. pisi*).

Gucsevich (1952) lists *E. virgata* as an aecidial host of many races of *U. anthyllidis* in the Crimea but the connection remains unconfirmed.

Uromyces dianthi occurs on several genera of the *Caryophyllaceae* in Turkey (see below) but the aecidial state known to form on *Euphorbia seguieriana* is not recorded from western Asia. Gucsevich (1952) records it from the Crimea and Savulescu (1953) from Roumania. The aecidia of *Uromyces proeminens* occur on deformed shoots of *Euphorbias* but there is usually some evidence—the presence of uredospores or teliospores—that the fungus is autoecious. *U. proeminens* occurs in Turkey on *Euphorbia chamaesyce* (Maire, 1906), on several species of sect. *Chamaesyceae* in the U.S.S.R. (Tranzschel, 1939) and on *E. turcomanica* in Iran (Petrak, 1949).

No species of *Endophyllum* has been recorded from Turkey on *Euphorbia*. *Endophyllum euphorbiae-silvaticae* occurs in the Crimea (Gucsevich, 1952) and its host *E. amygdaloides* extends into northern Turkey.

The occurrence of aecidia on *Euphorbia macroclada* is of some interest. In Spain, Unamuno has described an autoecious species with smooth teliospores, *U. euphorbiae-nicaeensis*, on *Euphorbia nicaeensis*. *Euphorbia macroclada* is closely allied to and replaces *E. nicaeensis* in Asia Minor. It seems probable that the rusts are related. Bearing in mind the smooth teliospores of *U. euphorbiae-nicaeensis* the most probable teliospore hosts for the aecidial stage on *Euphorbia macroclada* are some of the Caryophyllaceae known to be hosts for uredospores and smooth teliospores. *U. arenariae* and *U. formosus* are possible dicaryont states which would fit the requirements although Tranzschel (1939) suggested that *U. arenariae* is correlated with *U. sublevis* rather than any completely smooth-spored species.

Aecidium haussknechtianum Hennings in Mitteil. Thur. Bot. Ver. **13,** 77 (1899).

Turkish record: *Berberis crataegina:* 45.

Aecidium leonticis Tranzschel in Acta Hort. Bot. Univ. Jurjevensis, **2,** 91 (1901).

Turkish record: *Leontice leontopetalum:* 40.

Aecidium ranunculacearum DC. Fl. Fr. **6,** 97 (1815).

On *Ranunculus kochii* Ledeb.; Sivas: Bey Dağ, Zara, 2700 m., 1 June 1960, *S. & H.* 5308.

Ranunculus kochii was heavily infected with aecidia on the Bey Dağ. It was growing in rocky clefts alongside a sward of close-grazed non-flowering grasses so its relation is probably to a diplont stage on *Gramineae* although none could be found at this site. *Ranunculus kochii* belongs to sect. *Ficaria* of *Ranunculus*. To the same section belongs *R. ficaria* which is a common host of *Uromyces poae* and it is most probable that this was the species on *R. kochii*. *A. ranunculucearum* occurs on *R. kochii* in U.S.S.R. (Tranzschel, 1939).

Aecidium scabiosae (Dozy & Molk.) Wint. in Rabenh. Kr. Fl. Deutsch. 1, (1) 264 (1884).

Turkish records: *Cephalaria syriaca:* 34.
Scabiosa palaestina: 45.
S. rotata: 45.

Aecidium scillae Fuckel, Fungi rhenani, 282 (1863).

On *Scilla sibirica* L. *sens. lat.*; Gümüşane: Soganli Geçidi, 1800 m., 18 May 1960, *S. & H.* 5047, spermogonia and aecidia only.

The *Scilla* was growing not far from *Festuca* sp. in *Rhododendron* scrub. Although no telia could be found on any host in the vicinity it seems most probable that the aecidia belong to a rust of the *Puccinia scillae-rubrae* type which Cruchet showed may alternate between *Scilla bifolia* and *Festuca rubra*, a pattern which has been confirmed by Gaumann (Gaumann, 1959).

Aecidium sp. aff. muscari Linhart in Hedwigia **22,** 22 (1883).

On *Muscari alpinum* Gay.; Sivas: Pinarbaşi to Gürün, 1700 m., 27 May 1960, *S. & H.* 5205.

Aecidia only, rather immersed, with a short white peridium, spermogonia absent, aecidiospores 10–14 μ in diameter, wall minutely verruculose.

On *Muscari armeniacum* Baker; Giresun: Aluçra, 1300 m., 19 May 1960, *S. & H.* 5067.

Aecidium muscari is based on a collection on *Muscari comosum* from Hungary and is claimed to be the aecidial stage of *Puccinia festucina* (perhaps=*P. sessilis* according to Cummins, 1956) on *Festuca ovina* (Tranzschel, 1939). However, Jørstad (1960) has pointed out that aecidia on *Muscari* may be a stage of a *Uromyces* on *Festuca*, *Uromyces turcomanicus*, which belongs to a group of species he places under *Uromyces fragilipes*. In so far as in my Turkish collection spermogonia are absent it fits descriptions of the aecidial stage of *U. turcomanicus* more closely.

The reputed aecidia of *P. festucina* are accompanied by spermogonia. The aecidiospore sizes do not appear to differentiate the species.

When these aecidia were collected in Turkey search was made for telia on other hosts but none was found. The collection from Aluçra was associated with *Festuca* but even there no telia was found.

Aecidia are known on *Muscari* from Italy eastwards to Caucasia and Iran. Observation and experiment are required to resolve the present confusion.

Caeoma saxifragae (Str.) Wint. in Rabenh. Kr. Fl. Deutsch. 4, **1** (1), 258 (1884).

Turkish record: *Saxifraga adenophora:* 4.

Magnus noted in his account of this fungus that willows were more or less absent from the district and that it seemed unlikely that this collection belonged to the heteroecious *Melampsora alpina* complex.

Caeoma sp.

On *Paeonia arietina* Anderson; Sivas: Yildiz Dağ, 2200 m., 5 June 1960, *S. & H.* 5356. Epiphyllous spermogonia and hypophyllous caeomoid aecidia.

Turkish record: *Paeonia arietina:* 40.

The finding of this *Caeoma* was interesting for undoubtedly it is the same as previously recorded from Tunçeli province (Henderson, 1959) whose telia host was unknown. The *Paeonia* on the Yildiz Dağ grew in rather degraded oak woodland with scattered plants of *Salix* and a few Poplars. In spite of a long search on fallen leaves of these trees even under *Paeonia* plants bearing aecidia, no telia could be found. In spite of this it seems quite probable that the caeoma belongs to a *Melampsora* on *Salicaceae* for the previous collection also occurred in a habitat associated with *Salix*.

Coleosporium tussilaginis (Pers.) Lév. in Orbigny, Dict. Univ. Hist. Nat. **12,** 786 (1849).

On *Campanula rapunculoides* L.; Rize: Ilica, in *Picea-Abies* forest, no pines, 1000 m., 19 July 1960, *S. & H.* 6283. Trabzon: Trabzon, 20 m., 27 June 1960, *S. & H.* 5868. Uredinia only.

On *Campanula lactiflora* MB.; Trabzon: Hemşikoy, 600 m., 24 July 1960, *S. & H.* 6318. Telia only.

On *Campanula ephesia* Boiss. Priene, leg. *Dennis*, May 1962.

On *Campanula lyrata* Lam. Troy, leg. *Dennis*, May 1962.

On *Inula heterolepis* Boiss.; Mugla: Köz Cakara Dağ, 150 m., 15 July 1962, *Khan, Prance & Ratcliffe*, 62.

On *Inula viscosa* (L.) Ait.; Hatay: Iskenderun, sea level, with *Pinus*, 13 June 1960, *S. & H.* 5504. Uredinia only.

On *Pedicularis comosa* L.; Trabzon: Hemşikoy, 600 m., 24 July 1960, *S. & H.* 6326. Uredinia and telia.

On *Petasites hybridus* (L.) Wett.; Artvin: Otingol, 2000 m., 3 July 1960, *S. & H.* 5985.

On *Rhinanthus minor* L.; Trabzon: Hemşikoy, 600 m., 24 July 1960, *S. & H.* 6324. Telia only.

On *Senecio orientalis* Willd.; Artvin: Artvin, 2000 m., 1 July 1960, *S. & H.* 5943.

Uredinia only, spores 26–34 × 20–22 μ. *Pinus sylvestris* was present in the vicinity.

On *Senecio platyphyllus* DC.; Artvin: Artvin, 2000 m., 1 July 1960, *S. & H.* 5943A. Uredinia only, spores 24–30 × 21–22 μ.

Turkish records: *Asteriscus aquaticus:* 45.
Campanula rapunculoides: 12A.
C. athoa: 45.
C. sp.: 2.
Chrysophthalmum dichotomum: 42.
Datisca cannabina: 42 (as *C. datiscae*).
Inula helenium: 40.
I. heterolepis: 1, 8, 24, 31, 40.
I. viscosa: 34.
Senecio vernalis: 17.

Coleosporium tussilaginis is here used to include all the races which have often been treated at specific rank, e.g. *C. senecionis*, *C. campanulae*.

I cannot distinguish on morphological grounds any of the Turkish collections I have examined. Material on *Asteriscus aquaticus* was described at varietal rank by Saccardo (1915) from Malta and then as *C. asteriscii-aquatici* by Sydow (1921) from Greece. The descriptions are all of uredospores only and come well within the limits of *C. tussilaginis*. I have not examined Turkish material on *Asteriscus*.

Outwith Turkey, *C. tussilaginis*, in the broad sense, parasitises such a range of hosts that to list them is pointless. Certainly the present list of hosts in Turkey is but a small proportion of the potential host range in that country.

No aecidial stage of any *Coleosporium* was found in 1960 although pines were searched in suitable sites, nor have aecidia been recorded. The collection on *Inula viscosa* was close to *Pinus halepensis* at Iskenderun but prolonged search failed to reveal aecidia. Alternation of the races on *Inula* with *Pinus halepensis* in France is listed by Viennot-Bourgin (1956). It seems, however, that independance of alternation is frequent in *Coleosporum* according to all the observations that have been made in north temperate floras.

Gymnosporangium clavariiforme (Pers.) DC. Dl. Fr. **2,** 217 (1805).

Turkish records: *Crataegus heterophylla:* 8.
C. monogyna: 4, 11, 46.

The following two records are of doubtful validity.

Gymnosporangium amelanchier Fischer on *Cotoneaster racemiflorum* (a native of China): 52. *Gymnosporangium juniperinum* on *Crataegus monogyna*: 24.

Gymnosporangium confusum Plowr. Monogr. Brit. Ured. & Ustilag. 232 (1889).

On *Juniperus oxycedrus* L.; Gümüşane: Soğanli Geçidi, 1200 m., 18 May 1960, *S. & H.* 5044.

Telia on small, fusoid swellings on the branches; telial masses purplish brown; teliospores of two main types, one fusoid 38–45 × 19–23 μ, with pale, thin, smooth, wall, the other broadly ellipsoid, rounded at apex, 35–40 × 27–30 μ, wall 2–3 μ thick, brown.

On *Crataegus oxyacantha* L.; Artvin: Artvin, 1000 m., 1 July 1960, *S. & H.* 5948. Trabzon: Trabzon, 20 m., 27 June 1960, *S. & H.* 5859.

Spermogonia and aecidia on branchlets, leaf veins and fruits. Lateral walls of peridial cells transversely striate.

On *Crataegus* sp.; Adana: 50 km. N. of Iskenderun, 1300 m., 14 July 1960, *S. & H.* 5573.

On *Mespilus germanica* L.; Trabzon: Trabzon, 20 m., 27 June 1960, *S. & H.* 5865. Erzurum: Tortum Göl, 1250 m., 9 July 1960, *S. & H.* 6121.

Turkish records: *Cotoneaster vulgaris:* 45, 46.
Crataegus orientalis: 42.
C. monogyna: 12A.
C. sp.: 12A, 42.
Cydonia oblonga: 12A.
Juniperus oxycedrus: 45, 46.
Mespilus germanica: 46 (as *G. clavariaeforme*).

There has been so much confusion and uncritical identification of Gymnosporangia that the published records must be regarded with suspicion. The records are listed here but with this reservation.

Gymnosporangium fuscum DC. Fl. Fr. **2,** 217 (1805).

Turkish records: *Pyrus communis:* 8, 12A, 46.
P. elaeagnifolia: 12A, 20.
P. malus: 12A (doubtful record).
Juniperus excelsa: 8.
J. nana: 12A, 46.

Gymnosporangium tremelloides Hartig, Lehrb. Baumkrankh. 55 (1882). (1901).

Turkish records: *Pyrus malus:* 45, 46.
Sorbus aria: 12A.

Hyalopsora polypodii (Pers.) Magn. in Ber. Deutsch Bot. Ges. **10,** 582 (1201). Turkish record: *Cystopteris fragilis:* 42.

Kuhneola uredinis (Link) Arth. in Res. Sci. Congr. Intern. Bot. Vienne, 342 (1905).

On *Rubus* sp.; Artvin: Artvin 2000 m., 1 July 1960, *S. & H.* 5927.

Uredinia only; small, scattered, pale yellow, aparaphysate; uredospores pyriform to broadly ellipsoid, 22–31 × 19–24 μ, wall thin, regularly verrucose.

Kuhneola uredinis is widely distributed in Western Europe and south to North Africa and occurs in North America. It appears to reach its eastern limit in Caucasia.

Melampsora allii-populina Kleb. in Zeitschr. Pfl.-krankh. **12,** 25 (1902).

Turkish record: *Populus nigra:* 12A, 46.

Melampsora epitea Thüm. in Mitth. Forstl. Versuchsw. Oesterr. **2,** 38 (1879).

On *Salix caprea* L.; Trabzon: Hemşikoy, 600 m., 24 July 1960, *S. & H.* 6315.

Uredinia only, 0·5 mm. diameter, hypophyllous, with capitate paraphyses, heads 15–22 μ diameter, uredospores 18–22 × 16–18 μ.
Trabzon: Maçka, 28 June 1960, *S. & H.* 5884. Uredinia only.

On *Salix bornmuelleri* Hausskn.; Malatya: Hekimhan, 1300 m., 8 June 1960, *S. & H.* 5407.

Uredinia only, paraphysate; uredospores uniformly verruculose, 25–28 × 18–21 μ.

On *Euonymus latifolius* Mill.; Sivas: Cicir near Gemerek, 1300 m., 22 May 1960, *S. & H.* 5123, spermogonia and caeomoid aecidia.

Turkish records: *Salix bornmuelleri:* 8 (as *M. salicina*).
S. sp. aff. triandra: 42.

These three collections can only be placed in species aggregates. In northern Europe *M. larici-caprearum* is frequent on *Salix caprea* but telia are usually formed in abundance even quite early in the season; only uredospores are present in my collection. Furthermore, *Larix* is lacking in Turkey. It seems most probable that the *S. caprea* collections belong to the *M. abieti-caprearum* section of the aggregate *M. epitea. Abies nordmanniana* is present in the area, although the caeoma stage has not been found in Turkey.

The correct placing of the rust on *S. bornmuelleri* is also in doubt. There are no previous accounts of a rust on this host other than Magnus' record. The presence of unconnected caeoma on *Paeonia* elsewhere in Turkey (see *Caeoma* sp.) makes it probable that there are several new alternation patterns to be discovered.

The caeoma on *Euonymus* from Cicir is presumably of the *M. euonymi-caprearum* affinity. Both *Populus* and *Salix* were present in the vicinity.

The host identity of the rust recorded from Antalya "on *Salix aff triandra*" is so doubtful that it is not possible from uredospores alone to place it more accurately. If indeed the host is *S. triandra*, the rust may well be *M. amygdalinae* which occurs in U.S.S.R. but has not been found in Turkey.

Melampsora euphorbiae (Schub.) Cast. Obs. Pl. Acotyl. **2,** 18 (1843).

On *Euphorbia cheiradenia* Boiss. & Hohen.; Malatya: Kangal to Hekimhan, 1300 m., 7 June 1960, *S. & H.* 5385; *ibid. S. & H.* 5371.

On *Euphorbia eriophora* Boiss.; Maraş: Maraş to Göksun, 1400 m., 15 June 1960, *S. & H.* 5591, uredinia and telia.

On *Euphorbia falcata* L.; Maraş: Maraş to Göksun, 1300 m., 14 June 1960, *S. & H.* 5572.

On *Euphorbia helioscopia* L.; Istanbul: Belgrad forest, 200 m., 12 May 1960, *S. & H.* 5001. Samsun: Samsun, 50 m., 15 May 1960, *S. & H.* 5021. Uredinia and telia.

On *Euphorbia macrocarpa* Boiss. & Buhse; Maraş: Berit Dağ, 1800 m., 16 June 1960, *S. & H.* 5616. Uredinia and telia.

On *Euphorbia macroclada* Boiss.; Malatya: Malatya to Maraş, 1400 m., 9 June 1960, *S. & H.* 5456. 'Armenia' 1865, *Calvert & Zohrab.*

On *Euphorbia oblongifolia* C. Koch; Trabzon: Hemşikoy, 600 m., 24 July 1960, *S. & H.* 6317.

On *Euphorbia peplus* L.; Samsun: Samsun, 50 m., 15 May 1960, *S. & H.* 5022, uredinia and telia.

On *Euphorbia stricta* L.; Istanbul: Belgrad forest, 200 m., 12 May 1960, *S. & H.* 5011.

Turkish records: *Euphorbia helioscopia:* 1, 45.
E. tinctoria: 20, 45, 42, 12A.
E. macrocarpa: 8.
E. nicaeensis: 24.
E. falcata: 12A.
E. peplus: 45.
E. kotschyana: 42.

Melampsora euphorbiae is here used in the broad sense and includes rusts on *Euphorbia* variously referred to as *M. euphorbiae-gerardianae* and *M. helioscopiae* in literature referring to Turkish records and also *M. gelmii*, *M. euphorbiae-dulcis* and M. *euphorbiae-cyparissiae*, to mention only a few of the most frequently used names. Although the extremes of the range of teliospore morphology are very different there appear to be no major breaks in the morphological series and the best course seems to be to regard all as belonging to one macrospecies.

More extensive data on variation within *M. euphorbiae* will be published shortly.

None of the collections bore caeomoid aecidia which seem to be rather rare in this species. The rust is native on a wide range of Euphorbias in Eurasia and North Africa and has been introduced into other geographical regions with its host species.

Melampsora hypericorum Wint. in Rabh. Krypt. Fl. Ed 2, **1** (1) 241 (1882).

On *Hypericum sp. aff. armenum* Jaub. & Spach; Rize: Rize to Ispir, 3000 m., 16 July 1960, *S. & H.* 6256.

On *Hypericum androsaemum* L.; Trabzon: Trabzon, 20 m., 27 June 1960, *S. & H.* 5867.

Caeomoid aecidia only, in both collections.

Turkish records: *Hypericum calycinum:* 42.
H. crispum: 45.

M. hypericorum is common on some species of *Hypericum* in Western Europe. Kuprevicz & Tranzschel (1957) record it on *Hypericum androsaemum*, *H. elegans* and *H. montbretii* in Caucasia.

Melampsora lini (Ehrenb.) Lév. in Ann. Sci. Nat. Ser. 3, **8,** 376 (1847).

On *Linum gallicum* L.; Trabzon: Trabzon, 20 m., 27 June 1960, *S. & H.* 5854. Uredinia only.

Turkish records: *Linum anatolicum:* 8.
L. cariense: 42.
L. catharticum: 42.
L. mucronatum: 40.
L. seljukorum: 42.
L. usitatissimum: 12A, 45, 46.

Karel (1958) speaks of serious losses due to heavy attacks by *M. lini* on cultivated flax. Susceptible varieties have fallen out of use as a result.

Melampsora populnea (Pers.) Karst. in Bidr. Kanned. Finl. Nat. Folk, **31,** 53 (1879).

Turkish record: *Populus alba:* 24.

Melampsora salicis-albae Kleb. in Pringsh. Jahrb. Wiss. Bot. **35,** 679 (1901).

Turkish record: *Salix alba:* 45, 46 (as *M. allii-salicina* Kleb.).

Melampsorella caryophyllacearum Schroet. in Hedwigia **13,** 85 (1874).

On *Abies nordmanniana* (Steven) Spach; Artvin: Artvin, 2000 m., 1 July 1960, *S. & H.* 5922.

Aecidia only, on the under surfaces of deformed leaves borne on roundish witches' brooms. The brooms are similar to those induced on *Abies alba* in northern Europe.

Turkish record: *Abies bornmuelleriana:* 12A, 46.

Melampsorella caryophyllacearum in its diplont stage is a parasite of a wide range of members of the *Caryophyllaceae* and in northern Europe it clearly often dispenses with alternation and perennates by uredinial overwintering. In northern Europe *Abies alba* is the frequent host although various introduced hosts have been recorded; *Abies sibirica* and *A. nordmanniana* are listed for U.S.S.R. (Tranzschel, 1939). No infection of caryophyllaceous hosts has been recorded in Turkey and none was found at the site of the Artvin collection. Karel (1958) recorded the aecidial state on *Abies bornmuelleriana* from Kastamonu but does not list any diplont host. Seven species of the *Alsineae* are listed by Tranzschel (1939) and a few are mentioned by Savulescu (1953) in Roumania.

Melampsorella symphyti Bubak in Centralbl. Bakt. II. **12,** 424 (1904).

On *Symphytum* sp.; Artvin: Magara yayla, Murgul, 2400 m., 6 July 1960, *S. & H.* 6042.

Systemic uredinia only.

Abies nordmanniana, a possible aecidial host, grew in the vicinity.

Milesina feurichii (Magnus) Magnus in Ber. Deutsch Bot. Ges. **27,** 325 (1909).

On *Asplenium septentrionale* L.; Artvin: Otingol, 1500 m., 4 July 1960, *S. & H.* 6020.

Uredinia only; mostly on petioles, uredospores ellipsoid, 30–34 × 12–15μ, wall sparsely echinulate, 1·5μ thick, without visible pores.

Milesina feurichii is confined to *Asplenium septentrionale* and is known on this host from western Europe to the U.S.S.R. Although teliospores have been found, the aecidial host is unknown but is presumably a species of *Abies*.

Abies nordmanniana a possible host, was present at the locality in Turkey.

Milesina kriegeriana Magnus in Ber. Deutsch Bot. Ges. **27,** 325 (1909).

On *Dryopteris dilatata* (Hoffm.) A. Gray; Artvin: Artvin, 2000 m., 1 July 1960, in *Abies nordmanniana* forest, *S. & H.* 5925.

Uredinia only, uredospores 30–35 × 18–22 μ, wall echinulate.

Milesina vogesiaca Syd. in Ann. Mycol. **8,** 491 (1910).

On *Polystichum aculeatum* (L.) Roth; Artvin: Artvin, 2000 m., 1 July 1960, in *Abies nordmanniana* forest, *S. & H.* 5923.

Uredospores oblong-ellipsoid, 34–40 × 18–25 μ, wall thin, hyaline, smooth. Teliospores present, intra-epidermal, hyaline.

Milesina vogesiaca occurs in both the New and Old World. The aecidia are unknown but doubtless will be discovered on some species of *Abies*.

A. nordmanniana was closely associated with the rusted plants in Turkey but no infection could be found. Experience with other *Milesina* species makes it clear, however, that most populations are non-alternating, often with scanty productions of teliospores.

Miyagia pseudosphaeria (Mont.) Jørst. in Nytt Mag. Bot. **9,** 78 (1962).

On *Sonchus oleraceus* L.; Rize: Ikizdere to Ispir, 2000 m., 15 July 1960, *S. & H.* 6231. Uredinoid aecidia and uredinia present.

Trabzon: Trabzon, 20 m., 27 June 1960, *S. & H.* 5871, uredinia only.

Not previously recorded from Turkey, although it is widely distributed in Eurasia. The aecidia occur on swollen purplish spots whereas the uredinia are scattered, unassociated with discolouration of the host tissues.

Peridermium pini (Pers.) Lév. in Mem. Soc. Linn. Paris, **4,** 212 (1826).

Turkish record: *Pinus sylvestris:* 45, 46.

Karel does not indicate whether this is a non-alternating aecidial race or a heteroecious type belonging to *Cronartium flaccidum*.

Phragmidium circumvallatum Magnus in Ber. Deutsch Bot. Ges. **12,** 84 (1894).

On *Geum heterocarpum* Boiss.; Sivas: Gürün to Pinarbaşi, 1700 m., 19 June 1960, *S. & H.* 5726.

Caeomoid aecidia only, on the basal leaves.

Turkish record: *Geum heterocarpum:* 4 and 8 (as *Caeoma circumvallatum*).

Phragmidium circumvallatum follows the distribution of its principal

host, *G. heterocarpum*, from Spain through North Africa to Asia Minor and south-western U.S.S.R. (Tranzschel, 1939). It occurs on the allied species *G. kokanicum* in northern Iran where Jørstad (1960) has suggested it may also occur on *Potentilla poteriifolia*.

Phragidium fragariae (DC.) Rabh. Herb. Myc. 1987 (1855).

On *Potentilla sterilis* (L.) Garcke; Trabzon: Maçka, 230 m., 28 June 1960, *S. & H.* 5882, uredinia and telia.

Turkish record: *Potentilla micrantha:* 8.

Phragidium fragariae is a common species through Europe and western Asia. In host range it is limited to Section *Fragariastrum* of *Potentilla*.

Phragmidium kamtschatkae (Anders.) Arth. & Cumm. in Mycologia, **25,** 401 (1933).

On *Rosa foetida* Herrm.; Sivas: Gürün, 1400 m., 28 May 1960, *S. & H.* 5218.

Cicir, nr. Gemerek, 1300 m., 22 May 1960, *S. & H.* 5125.

Telia on systemically infected and deformed lateral shoots; teliospores slightly angular, 36–42 × 20–23 μ, rough at apex, pedicel short, deciduous.

Turkish record: *Rosa sulphurea* 12A (as *Teloconia rosae*).

P. kamtschatkae has an interesting distribution embracing almost all temperate central Asia (extending into Europe in east Finland) south to the Caucasia and central Turkey. In the east it occurs south to northern Pakistan.

Of the sections of the genus *Rosa*, sects. *Cinnamomeae* and *Pimpinellifolii* are susceptible. Both *R. sulphurea* and *R. foetida* belong to the latter and in the U.S.S.R. *R. pimpinellifolia* and *R. xanthina* of the same section are attacked (Tranzschel, 1939).

The systematic position of this species has been cause for discussion. Comparison with two-celled species of *Phragmidium* such as *P. biloculare* from north America suggests that Arthur & Cummins' decision to place it in *Phragmidium* is correct. However, the taxonomy of this group would stand critical revision. The teliospore walls of the two-celled species are thin and *P. kamtschatkae* does not show the characteristic laminated wall which is characteristic of most *Phragmidia*.

Phragmidium mucronatum (Pers.) Schlecht. Fl. Berol. **2,** 156 (1824).

On *Rosa canina* L. sens. lat.; Trabzon: Trabzon, 20 m., 27 June 1960, *S. & H.* 5857.

Uredinia only; uredospores with small pores (less than 4 μ in diameter).

On *Rosa canina* L. sens. lat.; Sivas: Zara to Suşehri, 1100 m., 23 June 1960, *S. & H.* 5753.

Uredinia and telia; uredospores with small indistinct pores.

Turkish records: *Rosa pulverulenta:* 24.
R. sp.: 12A, 46.

Phragmidium potentillae (Pers.) Karst. in Bidr. Kanned. Finl. Nat. Folk, **31,** 49 (1879).

On *Potentilla hirta* L.; Malatya: Hekimhan, 1300 m., 8 June/1960, *S. & H.* 5406.

Uredinia and telia; teliospores 4–6 celled, 62–74 × 26–28 μ, pointed at apex, wall obscurely warted, pedicel up to 150 μ long, persistent.

Turkish records: *Potentilla hirta:* 1, 8.
P. sp.: 45.

Phragmidium potentillae is widespread in the north temperate regions of both the Old and New Worlds.

Phragmidium sanguisorbae subsp. **mediterranea** Hendersonin Notes R.B.G. Edinb. **22,** 600 (1958).

On *Poterium sanguisorba* L. s.l.; Sivas: Gürün, 1400 m., 28 May 1960, *S. & H.* 5240.

Uredinia and telia. Teliospores 68–80 × 26–30 μ, stipe 40–51 μ long.

The following collections of uredinia only cannot be identified subspecifically:

On *Poterium sanguisorba* L. s.l.; Erzurum: Tortum Göl, 1250 m., 9 July 1960, *S. & H.* 6110. Trabzon: Trabzon, 20 m., 27 June 1960, *S. & H.* 5872; Maçka, 250 m., 28 June 1960, *S. & H.* 5890.

Phragmidium tuberculatum Müller in Ber. Deutsch Bot. Ges. **3,** 391 (1885).

Turkish records: *Rosa glutinosa:* 42.
R. sp.: 12A, 24, 41, 42, 45, 46.

Phragmidium violaceum (Schultz) Wint. in Hedwigia **19,** 54 (1880).

On *Rubus fruticosus* L. agg.; Trabzon: Trabzon, 20 m., 27 June 1960, *S. & H.* 5852. Hatay: Iskenderun, sea level, 13 June 1960, *S. & H.* 5512.

Uredinia only, uredospores mostly 25–23 μ, thick-walled with prominent echinulae 3μ apart.

Turkish records: *Rubus tomentosus:* 20.
R. sp.: 12A, 24, 45, 46.

The two most frequent Phragmidia on the *Rubus fruticosus* complex in Europe, *P. bulbosum* and *P. violaceum*, do not extend very far eastwards in Asia. In the U.S.S.R. they penetrate little further than the Caspian and in Persia *P. violaceum* occurs in the Elburz Mountains (Petrak, 1949 and 1953). Eastwards, in West Pakistan, the *Phragmidia* on *Rubus* are quite distinct from the western Eurasiatic group (Ahmad, 1956).

Pileolaria terebinthi (DC.) Cast. Observ. Pl. Acotyl. **1,** 22 (1842).

On *Pistacia palaestina* Boiss.; Hatay: Iskenderun, sea level, 13 June 1960, *S. & H.* 5506. Spermogonia and uredinoid aecidia.

Konya: Konya to Antalya, 600 m., 28 July 1960, *S. & H.* 6338.

Spermogonia and uredinoid aecidia; aecidia up to 2 mm. in diameter, hypophyllous, dark brown, aecidiospores similar to uredospores; uredinia

small, hypophyllous, scattered, uredospores subgloboid to ellipsoid, 24–30 × 21–24 μ, wall finely verrucose.

Turkish records: *Pistacia terebinthus:* 1, 3, 12A, 20, 24, 46.
P. lentiscus: 12A, 46.
P. mutica (=*P. atlantica* var. *latifolia*)*:* 5, 22.
P. vera: 12A.

Puccinia acetosae Körn. on Hedwigia, **15,** 184 (1876).

On *Rumex acetosella* L.; Rize: Ikizdere to Ispir, 2000 m., 15 July 1960, *S. & H.* 6234. Uredinia only, uredospores 28–34 × 26–28 μ, with two supra-equatorial pores, wall distinctly echinulate. Sivas: Şebinkarahisar to Giresun, 1700 m., 24 June 1960, *S. & H.* 5800. Uredinia only.

On *Rumex acetosa* L.; Trabzon: Hemşikoy, 600 m., 24 July 1960, *S. & H.* 6321.

Uredinia small, scattered, light reddish brown, uredospores broadly ellipsoid, 26–30 × 22–24 μ, wall distinctly echinulate with two supra-equatorial pores. Telia similar to uredinia but dark brown; teliospores ellipsoid-clavoid, 35–40 × 18–20 μ, apex 2–4 μ thick, wall 1·5–2 μ thick, distantly verrucose, pore of upper cell apical of lower cell superior, pedicel usually shortly deciduous, rarely up to 20 μ long.

Turkish records: *Rumex tuberosus:* 5.
R. tmoleus: 12A.
R. acetosella: 40 (as *P. pachyphloea*).

Puccinia acetosae is restricted in host range to species of *Rumex* subgenus *Acetosa* and *Acetosella*. Both *R. tuberosus* and *R. tmoleus* belong in that affinity. The collections on *R. acetosella* and *R. acetosa* differ considerably in morphology of the telia. On *R. acetosa* telia are small and scattered whereas on *R. acetosella* they are much larger and long-covered by the surrounding epidermis. Jørstad (1958) has drawn attention to the fact that telia are rare on both *R. acetosella* and *R. acetosa* and that they occur chiefly in the southern part of the distribution range.

Puccinia achilleae Cooke in Grevillea **9,** 13 (1880).

Syn.: *Puccinia santolinae* Magnus in Hedwigia **39,** 97 (1909).

On *Achillea santolina* L.; Konya: Ankara to Konya, 600 m., 28 July 1960, *S. & H.* 6335.

Uredospores sparse, soon replaced by teliospores. Telia on leaves and especially on stems, black, erumpent, pulvinate, 1–2 mm. in diameter often confluent up to 5 mm. Uredospores 30–32 × 26–30 μ, wall sparsely echinulate with two equatorial pores each covered by a large, smooth cap; teliospores broadly ellipsoid, constricted medianly, 38–46 × 24–27 μ, cells equal in size, pore of upper cell subapical, pore of lower cell median, wall everywhere closely and finely verrucose, 2 μ thick; pedicel persistent, up to 120 μ long.

On *Achillea santolina* L.; Sivas: Gürün, 1400 m., 28 May 1960, *S. & H.* 5242.

Petrak (1947) discussed the *Achillea* rusts at some length and concluded that *P. achilleae* Cooke and *P. santolinae* Magnus were doubtfully distinct:

I have examined both the holotype of Cooke's fungus from M. Boriter (Herb. K.) and an isotype of *P. santolinae* (Bornmüller, Iter aegyptiacum no. 11137) and agree with him, but would go further and unite the two. It is true that uredospores are not present on the holotype of *P. achilleae*, but sparse uredospore production is a common feature of many Composite rusts of this region—for example many collections of *P. calcitrapae* lack them entirely. Nor do I think the differences in teliospore ornamentation and spore wall colour sufficient to separate them. Under oil immersion the warts on the walls of *P. achilleae* are slightly more prominent than those on *P. santolinae* but the range is well within that encountered in many rust species. Several other writers (Rayss, 1951; Viennot-Bourgin, 1958) have considered the same problem. All recognise the similarity of the two species but fail to unite them. Viennot-Bourgin, in particular, examined a number of collections of what he called *P. santolinae* on various species of *Achillea*. The present known distribution of *P. achilleae* including *P. santolinae*, with the source of the records in brackets, is as follows:

On *Achillea santolina*, Egypt (2), Palestine (39), Iran (9, 15, 26), U.S.S.R. (Tranzschel, 1939), India (Watts Padwick, 1945).

On *A. talgonica*, Iran (15).

On *A. vermicularis*, Iran (23), Turkey (31).

On *A. falcata*, Lebanon (37).

On *A. allepica*, Lebanon (37), Israel (53).

On *A. tenuifolia* (= *A. albicaulis*), Iran (Cooke in Grevillea, **9,** 13, 1880).

Puccinia allii Rud. in Linnaea, **4,** 392 (1829).

On *Allium* sp.; Antalya: Antalya, 29 July 1960, *S. & H.* 6341.

Telia only, foliicolous, with columnar brown paraphyses; teliospores clavoid or oblong, rather angular, 50–68 × 20–24 μ, wall smooth, thickened at apex.

Turkish records: *Allium ampeloprasum:* 12A.
A. myrianthum: 31.
A. sp.: 24.

Puccinia andropogonis-hirta Beltran in Mem. R. Soc. Esp. Hist. Nat. **50,** 252 (1921).

The record of *Puccinia cesatii* (in Bremer *et al.*, 1952) on *Hyparrhenia hirta* should probably be referred to *P. andropogonis-hirta*. Unfortunately no description of the rust was given by Bremer and his associates so it is impossible to be certain of this, but the host relations of the fungi as worked out by Cummins (1953) suggest it.

Puccinia ankarensis Bremer & Petrak in Sydowia **1,** 249 (1947).

Turkish record: *Lactuca? viminea: loc. cit.*

This species was described from the region of Ankara. It is reputedly an opsis-form with systemic aecidia according to the original description.

Puccinia antirrhini Diet. & Holw. in Hedwigia **36,** 298 (1897).

Turkish record: *Antirrhinum majus:* 12A, 46.

Puccinia aphanicondra Lindroth in Acta Soc. Fauna Fl. Fenn. **22,** 86 (1902).

On *Ligusticum alatum* M.B.; Trabzon: Hemşikoy, 600 m., 24 July 1960, *S. & H.* 6319.

Uredospores sparse, mixed in telia, subgloboid, 32·5 × 27·5 μ, wall echinulate, up to 5·5 μ thick at apex, with two equatorial pores. Telia up to 1 mm. diam. black; teliospores ellipsoid slightly constricted at septum, 32–45 × 20–25 μ, wall 4·5 μ thick, irregularly thickened, undulate in profile, upper pore apical, lower pore subequatorial, pedicel very short.

Turkish record: *Ligusticum alatum:* 5.

Puccinia aphanicondra is known from only a few collections in Caucasia and Turkey. Only uredinia and telia have been found. It is undoubtedly close to *P. petroselini* a brachyform, but as Lindroth pointed out in his original description the warts on the teliospores are more conspicuous on *P. aphanicondra* than in *P. petroselini.* Comparison of the latest collection with those of *P. petroselini* from scattered localities in Europe confirms this distinction; but this is not great and more extensive collections might well bridge the gap between the species.

Puccinia arabidis Henderson in Notes R.B.G. Edinb. **23,** 72 (1959).

Turkish record: *Arabis graellsiiformis:* 40.

Puccinia arenariae (Schum.) Wint. in Hedwigia **19,** 38 (1880).

On *Sagina* sp.; Rize: Iliça, 1000 m., 19 July 1960, *S. & H.* 6286.

Teliospores 28–38 × 11–16 μ, apex 3·5–6 μ thick.

On *Stellaria* sp.; Rize: Iliça, 1000 m., 19 July 1960, *S. & H.* 6287.

Teliospores 33–46 × 12–17 μ, apex 3–7 μ thick.

Turkish record: *Alsine* sp.: 4.

Puccinia aristidae Tracy in Jour. Myc. **7,** 281 (1893).

Turkish record: *Aristida plumosa:* 10.

Puccinia aristidae is sparsely recorded from S.W. Asia. The aecidial hosts so far as known are species of *Heliotropium* and *Tournefortia.*

Puccinia aristolochiae (DC.) Wint. Krypt. Fl. Ed 2, **1,** 201 (1882).

On *Aristolochia maurorum* L.; Sivas: Gürün, 1400 m., 29 May 1960, *S. & H.* 5263; Sivas to Kayseri, 1400 m., 23 May 1960, *S. & H.* 5112.

Spermogonia and aecidia on a deforming, systemic mycelium.

Turkish records: *Aristolochia maurorum:* 8.
A. pallida: 4.

Puccinia asphodeli Moug. in Duby, Bot. Gall. **2,** 891 (1830).

On *Asphodelus microcarpus* Viv.; Antalya: Antalya, 29 July 1960, *S. & H.* 6342.

Telia only, on withered leaves, teliospores subgloboid to broadly ellipsoid, not constricted, 56–68 × 44–52 μ, wall distinctly bistratose, the inner wall brown, 2–3 μ thick, the outer hyaline or tinged brown, 4–8 μ

thick, both without obvious pores, outer wall slightly and irregularly roughened, pedicel very short.

On *Asphodelus microcarpus* Viv.; Antalya: Perge, 4 May 1962, *R. W. G. Dennis*, telia on old leaves.

Turkish record: *Asphodelus microcarpus:* 1, 12A, 20.

The teliospores of *P. asphodeli* have a remarkable structure; the outer wall is thick and hyaline and contrasts sharply with the relatively thin inner brown wall. There are no signs of pores in the walls, an unusual feature for thick-walled spores and the mode of germination is totally unknown. The species occurs frequently in the Mediterranean region.

Puccinia ballotae Henderson in Notes R.B.G. Edinb. **23,** 74 (1959).

Turkish record: *Ballota saxatilis:* 40.

Puccinia balsamitae (Str.) Röhl. Deutsch. Fl. Ed 2, **3** (3), 133 (1813).

Turkish record: *Tanacetum balsamita:* 40 (mistakenly as *P. hieracii*).

Puccinia betonicae DC. Fl. Fr. **6,** 61 (1815).

On *Stachys grandiflora* (Willd.) Benth.; Rize: Rize to Ispir, 3000 m., 16 July 1960, *S. & H.* 6259.

Leaves systemically infected, small and paler. Telia only.

Stachys grandiflora appears to be a new host for this rust which is usually on *Stachys betonica.* However, the two hosts are quite closely related and are similar in growth habit.

Puccinia bistortae DC. Fl. **5,** 61 (1815).

Turkish record: *Polygonum* (sect. *Persicaria*?) sp.: 31.

Puccinia bithynica Magnus in Bull. Herb. Boiss. Ser. 3, **3,** 579 (1903).

On *Salvia multicaulis* Vahl; Maraş: Berit Dağ, Elbistan, 16 June 1960, *S. & H.* 5603.

Uredospores mixed in telia, subgloboid, finely echinulate, 26–30 × 22–30 μ, with 6–8 scattered pores, each with a large hyaline cap. Teliospores oblong, mostly 45–55 × 23–30 μ, wall smooth, 6–8 μ thick at apex, pedicel stout, persistent, up to 120 μ long; a few unicellular teliospores and pale leptospores present.

Gümüşane: Soganli Geçidi, 950 m., 18 May 1960, *S. & H.* 5042.

Telia only; teliospores 40–46 × 25–28 μ.

On *Salvia cryptantha* Montbr. & Auch.; Nevşehir: Göreme to Ürgüp, 1300 m., 24 May 1960, *S. & H.* 5130.

Telia only, with dark-coloured resting spores and hyaline leptospores, leptospores narrowly ellipsoid, 46–58 × 18–23 μ, apex pointed, 8–10 μ thick, wall tinted yellow-brown, pedicel up to 100 μ long, persistent, resting teliospores broadly ellipsoidal, 46–53 × 22–27 μ, wall smooth, dark brown, 2–2·5 μ thick and up to 10 μ at apex.

Turkish records: *Salvia grandiflora:* 4, 31.
S. acetabulosa: 31.

The rusts of *Salvia* have been reviewed recently by Baxter (1955) who lists as hosts of *P. bithynica* seven species of *Salvia* from southern Europe, North Africa and Turkey. To this list *S. multicaulis* and *S. cryptantha* are additional host plants. Magnus' type is a collection made by Bornmüller on *S. grandiflora* from Bithynia.

Puccinia buharica Jacz. in Hedwigia, **39,** 131 (1900).

On *Zoegea leptaurea* L.; Maraş: 10 km. south of Maraş, 1400 m., 10 June 1960, *S. & H.* 5497.

Uredospores and teliospores mixed in the same sorus; uredospores subgloboid 20–24 × 20–22 μ with three equatorial pores; teliospores broadly ellipsoid to subgloboid 30–38 × 22–27 μ, wall finely verruculose, dark brown up to 3 μ thick.

P. buharica has been recorded from the limited area of Tadzhikistan, Turkmenia and Iran on *Z. crinita* and *Z. leptaurea.* It undoubtedly belongs to the *Puccinia calcitrapae* affinity but the almost globose teliospores quite unconstricted at the septum seem to distinguish it adequately.

Puccinia bulbocastani Fuck. Symb. Myc. 52 (1869).

On *Bunium bourgaei* (Boiss.) Freyn & Sint.; Gümüşane: Soganli Geçidi, 1800 m., 18 May 1960, *S. & H.* 5045.

Spermogonia and aecidia on deformed leaves.

Turkish record: *Bunium chaerophylloides:* 52.

Puccinia bulbocastani belongs to the group of species with reticulately ornamented teliospore walls parasitic upon *Umbelliferae.* Of this group *P. pimpinellae* is the commonest example in the area. *P. bulbocastani* differs from most in lacking uredospores. The 1960 collection is placed in this species chiefly because the aecidial infection is partially systemic as in *P. bulbocastani.* Other aecidia occur on the nearly related genus *Carum,* those of *P. bistortae sensu lato* and *P. stipae-sibiricae* (Tranzschel, 1939), but the aecidial mycelium of both is more or less localised.

Puccinia bupleuri Rud. in Linnaea, **4,** 514 (1829).

On *Bupleurum lancifolium* Hornem.; Sivas: Sivas to Kayseri, 1400 m., 23 May 1960, *S. & H.* 5115. Aecidia only.

Turkish records: *Bupleurum commutatum:* 4.
B. croceum: 41.
B. falcatum: 11.
B. heldreichii: 20.
B. nodiflorum: 20.
B. subovatum: 45.

Puccinia calcitrapae DC. Fl. Fr., **2,** 221 (1805).

Puccinia acroptili Syd. Monogr. Uredinearum, **1,** 4 (1902).
Puccinia bardanae Corda, Icon. Fung. **4,** 17 (1840).
Puccinia carduorum Jacky, Zeit. Pfl.-Krankh. **9,** 288 (1899).
Puccinia carlinae Jacky, Zeit., Pfl.-Krankh. **9,** 59 (1899).
Puccinia carthami Corda, Icon. Fung. **4,** 15 (1840).

Puccinia centaureae DC. Fl. Fr. **5,** 59 (1815).
Puccinia cousiniae Syd. Monogr. Uredinearum, **1,** 62 (1902).
Puccinia echinopsis DC. Fl. Fr. **5,** 59 (1815).
Puccinia schirajewskii Tranzschel, Myc. Rossica **3-4,** 109–110 (1911).

For ease of reference this aggregate is listed under host genera.

ACROPTILON

Turkish record: *Acroptilon picris:* 8, 20 45 (as *P. acroptili*) 42 (as *P. calcitrapae*) 12A (as *P. jaceae*).

Puccinia acroptili Syd. is based on collections on *Acroptilon picris* from Kurdistan and Persia (Sydow, 1904). According to Tranzschel (1939) the rust is widespread on this host in U.S.S.R. and he regarded *P. acroptili* as a synonym of *P. centaureae* (=*P. calcitrapae*). I have examined specimens from Iran (Bornmüller, Iter Persico-turcicum no. 4372, probably an isotype) and agree with Tranzschel's opinion and accordingly place it with *Puccinia calcitrapae.*

ARCTIUM

Turkish record: 'Lappa': 45 (as *P. bardanae*).

CARDUUS

On *Carduus nutans* L.; Maraş: Berit Dağ, Elbistan, 1600 m., 16 June 1960, *S. & H.* 5615.

Uredospores mixed in telia, 24–26 × 22–26 μ, with three equatorial pores, wall delicately echinulate in upper half. Teliospores 31–34 × 25–28 μ, wall delicately echinulate.

Turkish records: *Carduus armenus:* 5.
C. nutans (as *C. armenus*): 5.
C. olympicus: 42.

CARLINA

Turkish records: *Carlina corymbosa:* 42.
C. oligocephala: 2 (as *P. carlinae*).

CARTHAMUS

Turkish record: *Carthamus tinctorius:* 34, 46.

There seems little doubt that the rust usually referred to as *P. carthami* belongs in *P. calcitrapae*; it is a brachyform, and morphologically it matches typical *P. calcitrapae* very well. An interesting feature of the life history of the rust on *Carthamus* is the extensive infection and production of sori on the underground parts of the host plant.

CENTAUREA

On *Centaurea pulchella* Ledeb.; Sivas: Sivas, 1200 m., 6 June 1960, *S. & H.* 5363. Uredinia and telia only.

On *Centaurea carduiformis* DC.; Sivas: Sivas to Zara, 1200 m., 23 June 1960, *S. & H.* 5791.

Uredinia sparse, replaced by telia; uredospores 23–26 × 21–22 μ, with three equatorial pores; teliospores 34–38 × 24–26 μ, upper pore subapical, lower pore median or superior, wall 2–3 μ thick.

On *Centaurea iberica* Trev.; Sivas: Zara to Suşehri, 1200 m., 23 June 1960, *S. & H.* 5770.

Uredospores mixed in telia, teliospore wall 1–1·5 μ thick.

Trabzon: 30 km. west of Trabzon, 20 m., 27 June 1960, *S. & H.* 5851.

Uredinia only, uredospores 22–24 × 21–24 μ, with three equatorial pores.

On *Centaurea polypodifolia* DC.; Sivas: Sivas to Zara, 1200 m., 23 June 1960, *S. & H.* 5786.

Telia replacing uredinia; uredospores 28–30 × 24–28 μ, wall sparsely echinulate, with large smooth patches and three equatorial pores; teliospores 34–42 × 24–27 μ.

On *Centaurea* sp. (sect. *Cyanus*).; Maraş: Göksun to Elbistan, 1400 m., 15 June 1960, *S. & H.* 5590.

Telia black, with a few uredospores intermixed; uredospores subgloboid with three equatorial pores; teliospores broadly ellipsoid, wall delicately verrucose, pore of upper cell apical, of lower equatorial.

Turkish records: *Centaurea cariensis:* 4.
C. ensiformis: 41.
C. iberica: 42.
C. lydia: 1.
C. sessilis: 5.
C. solstitialis: 45.
C. squarrosa: 41.
C. virgata: 40.

Some of the collections, notably that on *Centaurea carduiformis*, approach *Puccinia persica* which differs from *P. calcitrapae* only in the greater thickness of the teliospore wall and which has been recorded on a number of species of *Centaurea* and *Phaeopappus*. The type host of *P. persica* is *C. carduiformis*. Viennot-Bourgin (1958) based a new species *P. ourmiahensis* on a collection on *Centaurea solstitialis* from Iran. This species is described as having many scattered pores in the uredspores; if that is so it represents a type different from all others common on the *Compositae*; otherwise the thick-walled teliospores suggest that it is nothing other than *P. persica*.

Viennot-Bourgin (1958) has also described *P. centaurea-virgatae* on *Centaurea virgata* from Iran. He differentiated it from '*P. centaureae*' by its larger teliospore pedicels and by apical thickening of the teliospore wall. The Turkish material I have seen on *C. virgata* does not match his descriptions but agrees with *P. calcitrapae*. Tranzschel (1939) records only *P. jaceae* (=*P. hieracii*) on *C. virgata* in U.S.S.R. and indeed several of the published records might be found to belong in *P. hieracii* if sufficient attention were paid to the pores of the uredospores.

The collection on a plant of *Centaurea* sect. *Cyanus* of a *P. calcitrapae* rust is interesting. Systemic rusts with two equatorial pores in the uredo-

spore of the *P. montana—P. cyani* type, are more usually found on these hosts. The collection on *Centaurea ensiformis* which was previously placed in *P. cyani* (Henderson, 1959) has been re-examined and a few uredospores found. The pores are three and equatorial, in *P. cyani* they are only two in number. Only species of sect. *Cyanus* are with certainty known as hosts of *P. cyani*.

CIRSIUM

Turkish records: *Cirsium leucopus:* 20.
C. pisidium (as *P. centaureae-asperae* Cast.): 24.

According to recent accounts (Guyot, 1951) *Puccinia centaureae-asperae* Cast. differs from *P. calcitrapae* in certain features, notably thicker teliospore wall and rather more persistent pedicels. As its relation to *P. calcitrapae* is undeniable and its distinction in doubt it seems best to regard it as a synonym until material can be examined.

COUSINIA

Turkish record: *Cousinia umbrosa:* 10 (as *P. cousiniae* Syd.).

ECHINOPS

Turkish records: *Echinops heldreichii:* 42.
E. ritro: 45.
E. sp. aff. *viscosus:* 40.

Collections of rusts of the *P. calcitrapae* type have often been named *P. echinopsis* DC. but they differ in no respect from typical *P. calcitrapae*. The relation with *P. pulvinata*, also on *Echinops*, is discussed under that species.

PHAEOPAPPUS

Turkish records: *Phaeopappus salignus:* 41.
P. kotschyi var. *persica* (as '*Centaurea cheirolopha*'): 31.
P. carthamoides: 31.

It should be noted that *P. phaeopappi* Maire was later found to be on the host *Staehelina lobelii* and not on *Phaeopappus kotschyi*.

SERRATULA

On *Serratula cerinthifolia* Sibth. & Sm.; Maraş: Maraş to Göksun, 1300 m., 14 June 1960, *S. & H.* 5520.

Telia only; teliospores 32–38 × 22–24 μ, wall delicately verruculose, pedicel short, pore of upper cell apical, of lower superior or median. No systemic deforming mycelium present.

P. schirajewskii Tranz. was based on a collection on *Serratula heterophylla*. Isotype material (Tranzschel & Sereb., Mycotheca Russia, 109) shows that it has the characteristically finely verrucose teliospores with short pedicels and subgloboid to ellipsoid uredospores with three equatorial pores of *P. calcitrapae*. P. *heterophyllae* Cooke on the same host has a systemic host-deforming mycelium and uredospores with large conspicuous pore caps and agrees completely with *P. punctiformis*.

Puccinia calthae Link in L. Sp. Pl. Ed 4, **6** (2), 79 (1825).

On *Caltha polypetala* Hochst.; Sivas: Zara to Suşehri, 1200 m., 23 June 1960, *S. & H.* 5774.

Uredinia and telia, teliospore wall smooth.

Puccinia calthae has not been recorded from Turkey before. On *Caltha polypetala* it occurs in neighbouring districts of U.S.S.R. (Tranzschel, 1939). *P. calthicola* with finely echinulate spores, occurs in the Balkans (Savulescu, 1953) and in northern and eastern U.S.S.R. (Tranzschel, 1939) but does not appear to penetrate so far south as *P. calthae.*

Puccinia campanulae Carm. ex Berk. in Smith, Engl. Fl. **5,** (2), 365 (1836).

On *Campanula tridentata* Schreb.; Sivas: Şebinkarahisar to Giresun, 1400 m., 24 June 1960, *S. & H.* 5820.

Telia hypophyllous, pulvinate, long-covered by the host epidermis. Teliospores oblong, constricted, 19–23 × 40–50 μ, wall smooth, up to 10 μ thick at apex, pedicel up to 25 μ long.

Gaumann & Jaag (1935) investigated the microcyclic rusts on *Campanula* and described several microspecies discriminated by small differences in teliospore size. The Turkish collection has rather large spores compared with some of their races. Throughout its wide range in the north temperate region *P. campanulae* is rather rare—Tranzschel (1939) does not record it from U.S.S.R.

Puccinia cancellata Sacc. & Roum. in Rev. Mycol. **1881,** 26 (1881).

On *Juncus acutus* L.; Hatay: Iskenderun, sea level, 13 June 1960, *S. & H.* 5498.

Uredinia only, forming large brown patches on the stems; uredospores, ellipsoid, 24–30 × 20–23 μ, wall 2–3 μ thick with two equatorial pores.

An aecidial host of *P. cancellata* is unknown, but it will most probably be found to be a member of the *Compositae*, in conformity with the pattern of its allies *P. cyrnaea* and *P. litoralis.*

Puccinia cardui-pycnocephali Syd. Monographia Uredinearum **1,** 34 (1902).

Syn.: *P. galatica* Syd. in Monographia Uredinearum, **1,** 34 (1902).

On *Carduus pycnocephalus*; Sivas: Şebinkarahisar to Giresun, 1400 m., 24 June 1960, *S. & H.* 5809.

Telia only; teliospores oblong-ellipsoid, slightly constricted, 36–42 × 24–28 μ, wall 2–3 μ thick, finely verrucose, pore of upper cell superior, of lower cell median. Pedicel persistent, usually about 25–30 μ long.

Hatay: Iskenderun, 23 April 1957, *Davis & Hedge* (D.26989). Teliospores 36–41 × 25–28 μ.

Gaziantep: Gaziantep, 13 May 1957, *Davis & Hedge* (D.28075).

Uredinia only; uredospores subgloboid, 24–28 × 22–26 μ with three equatorial pores.

Turkish record: *Carduus pycnocephalus* var. *albidus:* 1 (as *Puccinia galatica* Sydow (*loc. cit.*))
C. pycnocephalus: 1 (as *P. carduorum*), 8 (as *P. hieracii*).

Puccinia cardui-pycnocephali clearly belongs to the *P. calcitrapae* group of rusts occurring on members of the *Compositae*. It differs however, from the main *P. calcitrapae* complex in the long and persistent pedicels of the teliospore and the consistently large teliospores. This tendency towards large teliospores with persistent pedicels is represented in other affinities, for example *P. pulvinata* on *Echinops* a member of the *P. calcitrapae* group and *P. kurdistani*, a member of the *P. hieracii* alliance. With this tendency there also seems to be one of suppression of uredospore production and it is generally presumed that the development is connected with arid habitats.

Puccinia galatica was described from Turkey on *Carduus pycnocephalus* var. *albidus* by the Sydows. It has the persistent pedicel and longer spores of *P. cardui-pycnocephali* but was described as having a thicker teliospore wall (3 μ) than *P. cardui-pycnocephali* or "*P. carduorum*". *P. persica* is another extremely thick-walled member of the group occurring on various species of *Centaurea*. The Sydows themselves (Monographia, **1,** 852) reduced *P. galatica* to synonymy under *P. cardui-pycnocephali.*

Puccinia caricina DC. Fl. Fr. **5,** 60 (1815).

On *Carex hordeistichos* Vill.; Sivas: Suşehri to Şebinkarahisar, 1400 m., 24 June 1960, *S. & H.* 5812.

Uredinia only, spores subgloboid, 24–30 × 22–27 μ, wall finely echinulate with three equatorial pores.

On *Carex silvatica* Huds.; Rize: Pazar, 10 m., 29 June 1960, *S. & H.* 5903. Uredinia only.

Turkish record: *C. hirta:* 4.

Puccinia carniolica Voss in Oest. Bot. Zeit. **35,** 420 (1885).

Turkish record: *Peucedanum chrysanthum:* 8.

P. carniolica is closely allied to *P. libani* (*q.v.*). Magnus (1891) mentions that the collection on *P. chrysanthum* had small numbers of aecidia in groups—the only character differentiating *P. carniolica* from *P. libani. P. libani* appears to be quite common from Turkey eastwards, whereas *P. carniolica* has more often been recorded from the western Mediterranean extending into northern Italy, Austria and Hungary.

Puccinia cesatii Schroet. in Cohn, Beitr. Biol. **3,** 70 (1879).

On *Bothriochloa ischaemum* (L.) Keng; Erzerum: Tortum Göl, 1100 m., 9 July 1960, *S. & H.* 6090.

Sori entirely amphisporic; amphispores globoid, 26–30 μ in diameter, wall finely verrucose, 2·5–3·5 μ thick, with four equatorial pores, pedicels hyaline, 55–70 μ long.

Hatay: Iskenderun, sea level, 13 June 1960, *S. & H.* 5810; *ibidem*, 5505.

Uredinia only, spores broadly ellipsoid to subgloboid, 26–28 × 20–22 μ with 4–5 equatorial or slightly scattered pores.

Turkish record: *Bothriochloa ischaemum:* 20.

Puccinia cesatii produces normal teliospores as well as amphispores and in his revision of rusts on the *Andropogoneae* Cummins (1953) notes

that amphispores have not been seen in extra-European collections and are more common in northern collections. The rust occurs on *Bothriochloa* from France and Austria eastwards to Northern India; on other host genera it extends to Australia. The record of *P. cesatii* on *Hyparrhenia hirta* (Bremer *et al.*, 1952) probably refers to *P. andropogonis-hirta* Beltran.

Puccinia chamaedryos Ces. in Klotsch, Herb. Myc. **1,** no. 1991 (1854).

On *Teucrium chamaedrys* L.; Trabzon: Trabzon 20 m., 27 June 1960, *S. & H.* 5864.

Abundant leptosporic, hypophyllous telia in circinate groups; teliospores 46–50 × 16–19 μ, fusoid with apical thickening, wall pale yellowish brown, stipe up to 80 μ long, basidia 4-spored.

Turkish record: *Teucrium chamaedrys:* 4, 10 (on '*T. canum*'), 24 (as *P. annularis*).

Throughout its range *T. chamaedrys* is host for two distinct rusts of the *P. annularis* group; one type very close to *P. annularis* which Guyot and Massenot (1952) segregate as *P. chamaedryos* Ces. and the other a dark-spored type referable to *P. polii* Guyot. *P. chamaedryos* has slightly longer teliospores (40–49 μ) compared with *P. annularis sensu stricto* (37–40 μ) according to their examination of European collections.

The Turkish collections on *T. chamaedrys* agrees with their definition of *P. chamaedryos* and is so named, although with the reservation that a better course may be to regard all the races they recognize at specific rank as part of a large rather variable species, *P. annularis.*

Puccinia circaeae Pers. Syn. Meth. Fung. 228 (1801).

On *Circaea* sp.; Trabzon: Iliça, 2200 m., 21 July 1960, *S. & H.* 6306.

Teliospores 26–34 × 10–14 μ, wall smooth, pedicels persistent.

Puccinia cnici Mart. Prodr. Fl. Mosq. Ed **2,** 227 (1817).

On *Cirsium acarna* (L.) Moench; Konya: Konya to Antalya, 600 m., 28 July 1960, *S. & H.* 6339.

Çorum: Çorum, 600 m., 26 July 1960, *S. & H.* 6332.

Uredinia soon replaced by telia, uredospores 24–28 × 22–24 μ with 3 equatorial pores with large swollen caps; teliospores 35–41 × 26–28 μ wall finely verruculose, pore of upper cell apical, of lower superior.

On *Cirsium* sp. aff. *lappaceum*; Maraş: 10 km. south of Maraş, 1400 m., 10 June 1960, *S. & H.* 5496.

Uredospores and teliospores in the same sorus; uredospores 30–44 × 26–32 μ with 3–4 equatorial pores each with an inflated hyaline cap; teliospores oblong-ellipsoid 46–52 × 26–37 μ, pedicels occasionally persistent.

On *Cirsium vulgare* (Savi) Airy-Shaw; Erzerum: Yusufeli to Erzerum, 1200 m., 9 July 1960, *S. & H.* 6085.

Uredinia only; uredospores with 3 equatorial caps and very large hyaline caps.

Turkish records: *Cirsium anatolicum:* 12A (as *P. cirsii—eriophori*).
C. (*Pycnomon*) *acarna:* 20, 22, 42, 45 (as *acarnae*).
C. lappaceum var. *microcephalum:* 42.

Puccinia cnici is an autoecious species with spermogonia and aecidioid aecidia. Aecidia have never been found on *Cirsium acarna* but they are not necessarily found on other hosts of *P. cnici*, particularly if collections are made late in the season. Suggestions that the *P. acarna* rust often differentiated as *P. acarnae* is a brachycyclic species seem to have no evidence to support them.

Puccinia cnici-oleracei Pers. ex Desm., Cat. Pl. Omis. 24 (1823).

On *Aster amellus* L.; Erzerum: 48 km. north of Erzurum, 1600 m., 9 July 1960, *S. & H.* 6136.

Telia only. 42–54 × 18–20 μ, apex 6–10 μ thick.

On *Cirsium hypoleucum* DC.; Artvin: Artvin, 1800 m., 4 July 1960, *S. & H.* 6015.

Telia only, hypophyllous; teliospores 42–50 × 21–24 μ, wall smooth 5–10 μ thick at apex, pedicel up to 30 μ long.

Puccinia cnici-oleracei is a widespread micro-form on many genera of the *Compositae*—the various races have often been recognized at specific rank according to the host genus parasitised e.g. *P. asteris* (*Aster*) *P. andersoni* (*Cirsium*), *P. millefolii* (*Achillea*). It has not been recorded in Turkey previously but must be expected to be found on many more hosts. *Aster amellus* is a host for the species in Central Europe but has not been noted from S.W. Asia.

Puccinia conclusa Thüm. in Jour. Sci. Math. Phys. Nat. Lisboa, **24,** 10 (1878).

Turkish record: *Cyperus* sp.: 45 (as *P. romagnoliana*).

Puccinia conii Fuck. in Jahrb. Nass. Ver. Nat. **24-25,** 53 (1869).

Turkish record: *Conium maculatum:* 34.

Puccinia convolvuli Cast Obs. Pl. Acotyl. **1,** 16 (1843).

On *Convolvulus* sp. aff. *arvensis* L.; Rize: Hopa to Borçka, 300 m., 30 June 1960, *S. & H.* 5909. Spermogonia and aecidia only.

Turkish record: *Calystegia sepium:* 45.

Puccinia coronata Corda, Icones Fungorum, **1,** 6 (1837).

SPERMOGONIA AND AECIDIA

On *Frangula alnus* Miller; Trabzon: Maçka, 250 m., 28 June 1960, *S. & H.* 5881.

On *Rhamnus palaestina* Boiss.; Nevşehir: Göreme to Ürgüp, 1300 m., 24 May 1960, *S. & H.* 3132b.

On *Rhamnus* sp.; Nevşehir: Göreme to Ürgüp, 1300 m., 24 May 1960, *S. & H.* 5136.

Turkish records: *Avena sativa:* 12A, 46.
A. sterilis: 12A.
Lolium perenne: 20.

DIPLONT STAGES

On *Avena fatua* L.; Trabzon: Trabzon, 20 m., 27 July 1960, *S. & H.* 5878. Uredinia only.

On *Avena sativa* L.; Trabzon: Trabzon, 20 m., 27 July 1960, *S. & H.* 5866. Uredinia and telia.

On *Bromus tomentosus* Trin.; Erzurum: Tortum Göl, 1250 m., 9 July 1960, *S. & H.* 6115. Uredinia and telia.

On *Polypogon monspeliensis* (L.) Desf.; Hatay: Iskenderun, 13 June 1960, *S. & H.* 5499. Uredinia only.

Turkish record: *Rhamnus oleoides* subsp. *tauricola:* 42.

Puccinia crepidicola Syd. in Oest. Bot. Zeitschr. **51,** 17 (1901).

Turkish record: *Crepis alpina:* 31, 34.

Puccinia crepidis Schroet. in Cohn, Krypt. Fl. Schles. **1,** 319 (1887).

On *Crepis sancta* (L.) Babcock; Sivas: Gürün, 1400 m., 28 May 1960, *S. & H.* 5239. Systemic mycelium bearing aecidia and scattered uredinia.

On *Crepis hierosolymitana* Boiss.; Trabzon: 30 km. west of Trabzon, 20 m., 27 June 1960, *S. & H.* 5870.

Uredinia only, uredospores 20–24 × 20–22 μ with three equatorial pores. The rust of *C. hierosolymitana* is placed here tentatively. Many rusts have been described on *Crepis* but most cannot be discriminated by uredospores alone. *C. hierosolymitana* is closely related to *C. montana* so may be a host of the 'microspecies' *P. crepidis-montanae* Magn.

On *Crepis foetida* L.; Erzurum: Tortum Göl, 1250 m., 9 July 1960, *S. & H.* 6127.

Puccinia crucianellae Desm. in Ann. Sci. Nat. Sér. 3, **8,** 12 (1847).

Turkish records: *Crucianella macrostachya:* 40.
C. syriaca: 22.

This species is usually regarded as a hemi-form distinct from *P. punctata* which occurs on other genera of the Rubiaceae. They are doubtfully distinct morphologically.

Puccinia cynodontis Lacroix in Desm. Fl. Crypt. **3,** 653 (1859).

On *Adonis flammea* L. and *Cynodon dactylon* (L.) Pers.; Sivas: Sivas to Kayseri, 1400 m., 23 May 1960, *S. & H.* 5111.

Spermogonia and aecidia on *Adonis*; uredinia on *Cynodon.* Uredinia with some teliospores; uredospores subgloboid, 22–25 μ in diameter, wall finely verruculose 1·5–2 μ thick with three equatorial pores. Teliospores mostly 44 × 24 μ, conic at apex, wall smooth, pedicel persistent, up to 55 μ long.

On *Adonis aestivalis* L.; Gümüşane: Kelkit, 1600 m., 18 May 1960, *S. & H.* 5048. Spermogonia and aecidia.

Turkish records: *Cynodon dactylon:* 12A, 20, 42, 45.
Mercurialis annua: 12A (as *Aecidium marci*).

The relation between aecidia on *Adonis flammea* and the stages on *Cynodon* was quite obvious in the field. *Adonis flammea* is a host in U.S.S.R. *P. cynodontis* is very widespread and is plurivorous in its aecidial stage which occurs on hosts in the genera *Plantago*, *Adonis*, *Delphinium*, *Mercurialis*, *Viola* and *Veronica*.

Puccinia dioicae Magnus in Amtl. Ber. 50 Versamml. D. Naturf. Arzte Munchen, 199 (1877).

On *Taraxacum* sp.; Sivas: Zara to Sivas, 1500 m., growing with *Carex diluta* L., 3 June 1960, *S. & H.* 5338.

Spermogonia and aecidia only; peridial cells with outer wall markedly thicker than the inner.

Ibidem, 1300 m., growing with *Carex ovalis* group, *S. & H.* 5088.

Infection of *Taraxacum* was quite heavy in shallow water in brackish marshes near Sivas but no telia could be found on sedges even after an hour or two's search. *Carex diluta* is a likely host for *P. dioicae* as it is a close ally of the *C. flava* group on which *P. dioicae* occurs elsewhere.

Puccinia drabae Rud. in Linnaea **4,** 115 (1829).

Turkish records: *Draba cappadocica:* 8.
D. aizoides: 8.

Puccinia eremuri Kom. in Script. Bot. Hort. Univ. Petropol., **1895,** 30 (1895).

On *Eremurus* sp.; Sivas: Gürün to Pinarbaşi, 2300 m., 19 June 1960, *S. & H.* 5673.

Telia only, large and erumpent; teliospores broadly ellipsoid, 30–34 × 18–22 μ, wall with long, thin, often wavy or irregular ridges, pedicels very short and deciduous.

From accounts of the rust floras of U.S.S.R. and other parts of S.W. Asia it is quite obvious that *P. eremuri* occurs on a large number of species of *Eremurus* in this area. The large dark sori are so conspicuous that they are not missed even by the most cursory glance in the field.

Puccinia eryngii DC. in Lam. Encycl. Meth. **8,** 249 (1808).

On *Eryngium campestre* L.; Çorum: Çorum, 600 m., 26 July 1960, *S. & H.* 6334.

Uredospores mixed with teliospores, ovoid 28–30 × 25–28 μ, wall echinulate, 3–4 μ thick, with three equatorial pores, teliospores 37–44 × 22–26 μ, wall minutely reticulate, pore apical in upper, basal in lower cell, pedicels up to 50 μ long, persistent.

Aydin: Aydin, 600 m., 29 July 1960, *S. & H.* 6345.

Turkish records: *Eryngiumcampestre:* 4, 10, 12A.
E. noeanum: 8 (as *P. pimpinellae*).

Puccinia eryngii is an auteu-form similar to *P. pimpinellae* in having reticulately ornamented spores. It can be differentiated by the uredospore pores; three pores in *P. eryngii*, two in *P. pimpinellae*.

It is widely distributed in western Asia and the Mediterranean region

Puccinia expansa Link in L. Sp. Pl. Ed 4, **6** (2) 75 (1825).

On *Senecio orientalis* Willd.; Sivas: Bey Dağ, 2000 m., 2 June 1960, *S. & H.* 5277: Gürün to Pinarbaşi, 2300 m., 19 June 1960, *S. & H.* 5674.

Rize: Rize to Ispir, 3000 m., 19 July 1960, *S. & H.* 6261.

Telia only in all collections, hypophyllous, 1 mm. in diameter, thickly scattered on pale spots. Teliospores pulverulent, oblong-ellipsoid to broadly ellipsoid, 27–40 × 22–26 μ, wall smooth, 2–4 μ thick, pore of upper cell apical with a hyaline papilla, pore of lower cell superior; pedicel short, deciduous.

Puccinia falcariae Fuck. Symb. Mycol. 52 (1869).

Turkish record: *Falcaria rivini:* 45.

Puccinia frankeniae Link, Observ. Ord. Plant **2,** 30 (1816).

On *Frankenia hirsuta* L.; Mugla: Turgud, 14 July 1960, *Khan, Prance & Ratcliffe* 54.

Uredinia only, brown, pulvinate, uredospores globose, wall very closely and finely verruculose, with three (four) equatorial pores.

Puccinia frankeniae occurs on various species of *Frankenia* from the Canaries and Madeira eastwards to south-western Russia and W. Pakistan. It is regarded as an auteu-form but everywhere uredinia predominate and aecidia are very seldom found.

Puccinia gentianae (Str.) Rohl. Deutschl. Fl. Ed 2, **3,** 131 (1813).

Turkish records: *Gentiana cruciata:* 5.
G. gelida: 20.

Puccinia gladioli Cast. Obs. Pl. Acotyl. **2,** 17 (1842).

Turkish record: *Gladiolus atroviolaceus:* 45, 46.

Puccinia graellsiae Henderson in Notes R.B.G. Edinb. **22,** 195 (1957).

Turkish record: *Graellsia saxifragifolia:* 41.

Puccinia graminis Pers. Syn. Meth. Fungorum, 228 (1801).

On *Berberis* sp.; Gümüşane: Torul, 950 m., 17 May 1960, *S. & H.* 5033. Spermogonia and aecidia.

On *Bromus biebersteinii* R. & S.; Rize: Rize to Ispir, 1500 m., 16 July 1960, *S. & H.* 6249.

Uredosori long, confluent; uredospores with four equatorial pores, telia elongate on leaves.

On *Hordeum bulbosum* L.; Maraş: Maraş to Göksun, 1300 m., 14 June 1960, *S. & H.* 5571.

Uredinia and sparse telia; uredospores 24–28 × 16–18 μ with four equatorial pores.

On *Lolium persicum* Boiss. & Hohen.; Maraş: Göksun, 1700 m., 21 July 1952, *Davis, Dodds & Çetik* (D.20197).

On *Poa nemoralis* L.; Rize: Ikizdere to Ispir, 2000 m., 15 July 1960, *S. & H.* 6236.

Old telia only, upper leaves of collection with uredinia of *P. poae-nemoralis*.

Turkish records: *Agropyron repens:* 12A.
Avena barbata: 12A.
A. sterilis: 12A.
Berberis crataegina: 20, 42.
Elymus caput-medusae: 12A.
Hordeum sativum: 46.
Melica cretica: 24 (as *P. poculiformis*).
Triticum sativum: 46.

The recorded hosts of *P. graminis* certainly do not represent its full host range in Turkey. Karel (1958) notes that epidemics occur irregularly and that in some seasons it is very damaging on wheat especially in coastal districts.

Puccinia gundeliae Cooke in Grevillea **9,** 14 (1880).

On *Gundelia tournefortii* L.; Maras: Göksun to Elbistan, 1400 m., 15 June 1960, *S. & H.* 5584.

Uredospores preceding teliospores in some sori. Uredopores subgloboid, 24–30 × 22–25 μ, wall distantly echinulate with 2 (3) supra-equatorial pores. Telia hypophyllous, black, 1–1·5 mm. diameter, teliospores oblong-ellipsoid, 34–38 × 20–24 μ, wall very delicately echinulate, 2–3 μ thick, pore of upper cell median or apical of lower cell median.

Turkish record: *Gundelia tournefortii:* 55.

P. gundeliae is doubtfully distinct from *P. hieracii*. It occurs in south-western U.S.S.R. and Iran. It is presumably a brachy-form but aecidia have not been described.

Puccinia harioti Lagerh. in Tromso Mus. Aarsheft **16,** 135 (1894).

On *Stachys lavandulifolia* Vahl; Trabzon: between Erzurum and Bayburt, on mobile screes, 1500 m., July 1960, *S. & H.* 6168.

Turkish records: *Stachys setifera:* 6.
S. spectabilis: 6.

Spermogonia and aecidia only, on the deformed leaves, mostly hypophyllous but a few epiphyllous, the infected leaves stand upright and are narrower than normal and all infected rosettes are sterile. Aecidia tubular, up to 1 mm. long, peridial cells quadrate in longitudinal section, quadrate-hexagonal in plan, 24–40 × 26–32 μ in plan, 18–20 μ thick, a downward projection of the outer wall of each peridial cell overlaps the cell beneath, outer wall smooth, inner minutely verrucose; aecidiospores subglobose, 22–24 × 20–22 μ, with orange contents, wall hyaline, closely and finely verruculose.

Sivas: Gürün to Pinarbaşi, 2300 m., 19 June 1960, *S. & H.* 5679; Zara to Suşehri, 1200 m., 23 June 1960, *S. & H.* 5768.

This species is widespread on many species of *Stachys* in south-western Asia where it has occurred on *S. inflata*, *S. laxa* and *S. setifera* in Iran (Petrak, 1949 and Jørstad 1960), on *S. viscosa* (Tranzschel, 1939) and in Antilebanon on *S. nivea* (Sydow, 1935) and *S. mira* (Petrak, Myc. Gen. 945).

Puccinia heldreichiana Diet. in Hedwigia, **28,** 184 (1889).

(*P. barbeyi* (Roum.) Magnus in Bot. Zeit. **41,** 115 (1883) III's not described).

Turkish record: *Asphodelus microcarpus:* 42.

P. heldreichiana is readily distinguished in the teliospore stage from *P. asphodeli* which occurs on the same host species. The teliospores of *P. asphodeli* have remarkably thick, bistratose walls, the outer hyaline, whereas no obvious lamination of the walls can be seen in *P. heldreichiana.*

Puccinia helianthi Schwein. Syn. Fung. Carol. 73 (1822).

Turkish record: *Helianthus annuus:* 12A, 46.

Puccinia heterophylla Cooke in Grevillea **9,** 14 (1880).

Turkish record: *Serratula cerinthifolia:* 31, 40.

Massenot (1958) has discussed the relations of the rusts on *Serratula* but without comparing them with species attacking other genera of the *Compositae.* It seems very probable that *P. heterophylla* cannot be separated morphologically from *P. punctiformis* on *Cirsium.*

Puccinia heucherae (Schwein.) Diet var. *saxifragae* (Schlecht.) Savile in Canad. J. Bot. **32,** 400 (1954).

Turkish record: *Saxifraga sibirica:* 41.

Puccinia hieracii Mart. Prodr. Fl. Mosq. Ed **2,** 227 (1817).

Puccinia cichorii Kickx, Fl. Crypt. Flandres, **2,** 65 (1867).
Puccinia jaceae Otth in Mitth. Naturf. Ges. Bern, **1865,** 173 (1866).
Puccinia picridis Hazl. in Math. Term. Kozlem, **14,** 152 (1877).
Puccinia taraxaci Plowr. Monogr. Ured. Ustilag. 186 (1889).

Puccinia hieracii is a complex species composed of a number of probably host-specialized races on a considerable range of genera of the *Compositae.* They all have two supra-equatorial pores in the uredospores and the teliospores are not especially thickened at the apex. *P. hieracii* differs from *P. calcitrapae* only in the number of pores in the uredospores.

The Turkish representatives are here arranged according to host genera.

CENTAUREA

On *Centaurea iberica* Trev.; Çorum: Çorum, 600 m., 26 July 1960, *S. & H.* 6333.

Uredinia hypophyllous; uredospores 28–29 × 22–24 μ, wall sparsely echinulate with two (rarely three) supra-equatorial pores; telia hypophyllous, replacing uredinia or separate from them; teliospores 32–40 × 22–26 μ, upper pore superior, lower median, wall delicately verrucose.

On *Centaurea virgata* Lam.; Konya: Ankara to Konya, 600 m., 28 July 1960, *S. & H.* 6337.

Uredospores 30–32 × 26–28 μ; teliospores 38–45 × 26–28 μ.

On *Centaurea nigrescens* Willd.; Trabzon: Maçka, 250 m., 28 June 1960, *S. & H.* 5887. Uredinia only.

On *Centaurea solstitialis* L.; Malatya: Malatya to Maraş, 1400 m., 9 June 1960, *S. & H.* 5461.

Uredospores sparse, 27–30 × 20–26 μ; teliospores 36–40 × 20–26 μ.

Turkish record: *Centaurea iberica:* 8.

CICHORIUM

Turkish records: *Cichorium intybus:* 12A (as *P. cichorii*) and 24 (as *P. prenanthis*).
C. divaricatum: 20 (as *P. endiviae*).

CHONDRILLA

On *Chondrilla juncea* L.; Malatya: Hekimhan, 1300 m., 8 June 1960, *S. & H.* 5440.

Uredinia only, uredospores with two supra-equatorial pores.

Turkish record: *Chondrilla juncea:* 12A, 42.

This is the rust usually referred to as *P. chondrillina* (Bub.) Syd. Jørstad (1962) has placed collections from the Balearic Islands in *P. hieracii* var. *chlorocrepidis* because of the intermediate position of the uredospore pores; between the equatorial position of *P. hieracii* var. *piloselloidearum* and the fully supra-equatorial in var. *hieracii*. The Turkish collection seems to be quite typical of var. *hieracii* in this respect.

HIERACIUM

On *Hieracium* sp.; Trabzon: Bayburt to Of, 2400 m., 11 July 1960, *S. & H.* 6176.

Uredinia and telia; uredospores 27–33 × 21–23 μ with two supra-equatorial pores; teliospores 30–37 × 19–22 μ, pedicel 8–20 μ long.

Rize: Rize to Ispir, 3000 m., 16 July 1960, *S. & H.* 6267. Uredinia only.

Turkish records: *Hieracium crinitum:* 20.
H. lanceolatum: 8.
H. odontophyllum: 8.
H. pannosum: 42.
H. procerum: 4.

PICRIS

Turkish record: *Picris pauciflora:* 8 (as *P. picridis*).

STIZOLOPHUS

Turkish record: *Stizolophus coronopifolius:* 8 (as *P. hieracii*) and in Sydow, Monographia Uredinearum **1,** 158 as *P. stizolophi.*

The position of this rust is uncertain until it is re-collected and examined. It seems to belong to the *P. calcitrapae-P. hieracii* affinity but neither Magnus nor the Sydows described uredospore pores.

TARAXACUM

On *Taraxacum crepidiforme* DC.; Rize: Rize to Ispir, 3000 m., 16 July 1960, *S. & H.* 6278.

Uredinia only, uredospores 26–30 × 22–26 μ, with two supra-equatorial pores.

On *Taraxacum* sp.; Rize: Rize to Ispir, 3000 m., 16 July 1960, *S. & H.* 6254.

Turkish records: *Taraxacum officinale:* 4.
T. serotinum: 8.

These records are placed here with some doubt. Some of the collections which were placed in *P. hieracii* have been transferred to *P. kurdistani*, others perhaps belong to *P. variabilis* which differs from *P. hieracii* in possessing peridiate aecidia. *P. taraxaci-serotini* Picb. (in Prace Morav. Prirod. Spol. **4** (9) 493, 1927) was described for a rust on *Taraxacum serotinum* in Czechoslovakia. The record on this host from Turkey may refer to the same fungus. From descriptions, *P. taraxaci-serotini* seems to be a later name for *P. kurdistani* Cooke. *Puccinia taraxaci-bithynici* Maire may belong there also.

Puccinia hordei Otth in Mitth. Naturf. Ges. Bern, **1870,** 114 (1871).

Turkish records: *Ornithogalum eigii:* 40.
Hordeum sativum: 4, 12A, 46 (as *P. simplex*).

Puccinia hysterium (Str.) Rohl. Deutsch. Fl. Ed 2, **3** (3), 131 (1813).

On *Tragopogon buphthalmoides* (DC.) Boiss.; Sivas: Gürün to Pinarbaşi, 1700 m., 19 June 1960, *S. & H.* 5720, systemic aecidia and spermogonia only.

On *Tragopogon latifolius* Boiss.; Sivas: Sivas, 1300 m., 30 May 1960, *S. & H.* 5266.

Spermogonia and aecidia on systemically infected leaves; telia sparse, scattered; teliospore ovoid not constricted, 28–34 × 20–24 μ, wall verrucose, 2–2·5 μ thick, pedicel short.

Turkish record: *Tragopogon latifolium:* 12A.

P. hysterium occurs on many species of *Tragopogon* in the Near East. Jørstad mentions it on *T. buphthalmoides* and it is recorded from Lebanon (7) on the closely allied *T. palaestinus.*

Puccinia imperatae Poir. in Bull. Mens. Nat. Alpes-Maritimes **20,** 105 (1913).

Turkish record: *Imperata cylindrica:* 45.

Puccinia iridis Rabh. Deut. Krypt.-Fl. **1,** 23 (1844).

On *Iris* sp. (sect. *Iris*); Erzurum: Tortum Göl, 1250 m., 9 July 1960, *S. & H.* 6128.

Uredinia only; uredospores broadly ellipsoid to subgloboid, 30–34 × 22–26 μ, wall 2 μ thick with three equatorial pores.

Jørstad and Roll-Hansen (1949) investigated a number of collections of *P. iridis* and divided them roughly into three groups. The Turkish collection falls in their large-spored group which is usually independent of host alternation.

Puccinia jasmini DC. Fl. Fr. **2,** 219 (1805).

On *Jasminum fruticans* L.; Maraş: Maraş to Göksun, 1300 m., 14 June 1960, *S. & H.* 5523.

Telia only, teliospores oblong ellipsoid, 41–47 × 20–25 μ, wall smooth, up to 10 μ thick, pedicels up to 80 μ long, persistent.

Sivas: Şebinkarahisar to Giresun, 1400 m., 24 June 1960, *S. & H.* 5807.

Nevşehir: Göreme to Ürgüp, 1300 m., 24 May 1960, *S. & H.* 5133.

Turkish record: *Jasminum fruticans:* 1, 4, 11, 12A, 46.

P. jasmini is circum-mediterranean in distribution following the distribution of its chief host *J. fruticans* and occurs also in the Canary Islands on *J. odoratissimum.* Although uredospores were described for one collection from Turkey (Bremer *et al.*, 1947) none can be found in the three collections made in 1960.

Puccinia kurdistani Cooke in Grevillea **4,** 116 (1876).

Syn.: *P. decipiens* Massee in Kew Bull., **1899,** 164 (1899).
P. taraxaci-bithynici Maire in Bull. Soc. Sci. Nancy **1906,** 17.

On *Taraxacum montanum* C. A. Mey.; Sivas: Gürün to Sivas, 1400 m., 20 June 1960, *S. & H.* 5743.

Uredinia only, large and very dark brown; uredospores 27–29 × 24–26 μ with two supra-equatorial pores.

Hakari: Zab gorge, 2 Aug. 1954, *Davis & Polunin* (D.23818). Listed as *P. hieracii* (Henderson, 1960).

On *Taraxacum megalorhizon* (Forsk.) Hand.-Mazz.; Kars: Ardahan to Haçuvan, 1700 m., 20 Aug. 1957, *Davis & Hedge* (D.32597).

Uredinia and telia; teliospores 36–40 × 20–23 μ, sori dark brown. This collection was previously listed as *P. hieracii* (Henderson, 1959).

On *Taraxacum* sp.; Rize: Rize to Ispir, 3000 m., 16 July 1960, *S. & H.* 6254.

Uredinia scattered, spores 28–30 × 26–29 μ, wall echinulate but smooth in patches, with two supra-equatorial pores; teliospores 30–34 × 23–26 μ, pores lateral in upper and lower cells.

On *Taraxacum* sp.; Bursa: Bursa, 2300 m., 13 Aug. 1947, *Davis* 14051 (previously listed as *P. hieracii*, Henderson, 1960).

Turkish records: *Taraxacum montanum* (=*glaucum*) holotype of *P. kurdistani* from Turkey (*loc. cit.*).
T. bithynicum: Maire in Bull. Soc. Sci. Nancy (1906) —holotype of *P. taraxaci-bithynici.*
T. kok-saghyz: 3 (as *P. decipiens*).

Cooke described *Puccinia kurdistani* on *Taraxacum glaucum* (= *montanum* C. A. Mey) from "Kurdistan" in a paper headed "Indian fungi". The holotype in Kew herbarium bears only teliospores 38–43 × 26–32 μ with finely verruculose wall, 2–2·5 μ thick. Cooke's measurements (50 × 25 μ) are clearly incorrect. Sydow (Ann. Mycol. **20,** 54, 1922) examined this material also and concluded that *P. kurdistani* and *P. decipiens* were identical. *Puccinia decipiens* was described by

Massee, on *Taraxacum montanum* from Kerman, S. Persia. The holotype in Kew herbarium bears sori of mixed teliospores and uredospores. The uredospores are subgloboid, 28–30 × 27–30 μ finely echinulate with two supra-equatorial pores; the teliospores are 37–40 × 28–30 μ, the wall finely verruculose, 2–2·5 μ thick. Massee's description gives the telio spores as 50–55 × 28–30 μ—as wildly incorrect as Cooke's description of his fungus. The Sydows (Monographia Uredinearum, 1), presumably on the basis of the Haussknecht collections on *Taraxacum canescens* which they list give slightly more accurate measurements. In spite of this confusion there is little doubt that they are conspecific and the earliest name for them is *P. kurdistani* Cooke. The discrimination of this fungus from the *P. hieracii* aggregate is more difficult. Indeed, without knowledge of aecidial stages it is impossible to say whether *P. kurdistani* belongs with the brachycyclic *P. hieracii* group or the macrocyclic *P. variabilis*. So far as is known, there are no possible heteroecious species to which it might be related. However, from *P. hieracii* on *Taraxacum*, often referred to as *P. taraxaci* Plowr., and from *P. variabilis* the collections assigned to *P. kurdistani* certainly differ in the larger teliospores (32–40 × 20–23 μ as against 25–30 × 18–22 μ) and the larger size and darker colour of both the uredosori and telia. The Sydows suggested that the wall of the teliospore of *P. decipiens* is thicker (3 μ) than *P. taraxaci* ("tenui") but this distinction does not hold for the collections I have examined, the walls of both are mostly 2–2·5 μ thick.

Complete separation of *P. kurdistani* from the whole *P. hieracii* aggregate is probably impossible for within *P. hieracii* there is considerable variation in soral size, colour and teliospore size. It is interesting to note that large teliospore races of *P. hieracii* on *Leontodon* have been found in Iceland (Jørstad, 1951) and Central Europe (Rytz, 1927). The relation between *P. kurdistani* and *P. hieracii* may be similar.

Puccinia lapsanae Fuck. in Jahrb. Nass. Ver. Nat. **15,** 13 (1860).

On *Lapsana ramosissima* Boiss.; Rize: Ikizdere to Ispir, 2000 m., 15 July 1960, *S. & H.* 6232.

Uredinia only; uredospores subgloboid to ellipsoid, 24–26 × 20–22 μ, wall sparsely echinulate, with two equatorial pores.

Ilica, 1000 m., 19 July 1960, *S. & H.* 6284. Uredinia only.

Giresun: Şebinkarahisar to Giresun, 2100 m., 25 June 1960, *S. & H.* 5835. Uredinia only.

Sivas: Sivas to Suşehri, 1200 m., 23 June 1960, *S. & H.* 5773. Uredinia only.

Istanbul: Belgrad forest, 200 m., 12 May 1960, *S. & H.* 5002. Aecidia, uredinia and telia.

On *Lapsana grandiflora* MB.; Rize: Ikizdere to Ispir, 2000 m., 15 July 1960, *S. & H.* 6218. Uredinia and telia.

Turkish record: *L. intermedia:* 12A.

Puccinia libani Magnus in Verh. Zool.-Bot. Ges. Wien **1,** 442 (1900).

On *Prangos lophoptera* Boiss.; Sivas: Gürün to Pinarbaşi, 1700 m., 19 June 1960, *S. & H.* 5700. Spermogonia, aecidia and telia.

On *Ferulago* sp.; Giresun: Şebinkarahisar, 1300 m., 19 May 1960, *S. & H.* 5074.

On *Prangos* sp.; Sivas: Pinarbaşi to Gürün, 1700 m., 27 May 1960, *S. & H.* 5201.

Spermogonia, aecidia and telia. Aecidia in groups of twenty to thirty accompanied by telia. Teliospores clavoid, 60–75 × 20–25 μ, wall smooth, up to 10 μ thick at apex, pedicels firm, brownish, up to 25 μ long.

Turkish records: *Peucedanum pisidicum:* 40.
Prangos ferulacea: 40.
P. lophoptera: 40.
P. uechtritzii: 40 and Lindroth (1902).

Puccinia libani is closely allied to *P. carniolica* with which it may eventually have to be merged. The only difference seems to lie in the number of aecidia in each group. In *P. carniolica* there are usually less than six whereas in *P. libani* they number twenty to thirty. *P. carniolica* occurs on species of *Peucedanum*, whereas *P. libani* occurs most frequently on species of *Prangos*. The collection on *Peucedanum pisidicum* reported in a previous paper (Henderson, 1959) bridges the gap between the species for although on *Peucedanum* it has many aecidia in a group.

Puccinia liliacearum Duby, Bot. Gall. 891 (1830).

Turkish record: *Ornithogalum* sp.: 40.

Puccinia littoralis Rostr. in Thüm. Myc. Univ. 327 (1876).

Turkish records: *Cichorium intybus:* 31.
Juncus sp. aff. *J. gerardii:* 12A.

Puccinia lojkoiana Thüm. in Oest. Bot. Zeitschr. **26,** 183 (1876).

On *Hyacinthella lineata* (Steud.) Chourd; Sivas: Gürün to Pinarbaşi, 1200 m., 19 June 1960, *S. & H.* 5669. Telia only.

Turkish record: *Ornithogalum nutans:* Sydow Monographia Uredinearum, **1,** 897, on '*O. prasandrum*'.

Hyacinthella is a new host genus for this very distinctive rust. Hitherto it has been collected on species of *Ornithogalum* and *Muscari* over a considerable geographical range from the Canary Islands (Jørstad, 1958) to Central Europe, the Balkans, Crimea and Iran. It does not occur in N. Africa (Guyot, 1952).

Puccinia major (Diet.) Diet. in Mitth. Thur. Bot. Ver. **6,** 46 (1894).

On *Crepis paludosa* (L.) Moench; Rize: Iliça, 2200 m., 21 July 1960, *S. & H.* 6295. Aecidia only.

Gümüşane: Zigana Pass, 1500 m., 17 May 1960, *S. & H.* 5037. Aecidia only.

Puccinia malvacearum Bert. ex Mont. in Gay Hist. Fis. Polit. Chile, **8,** 43 (1852).

Turkish records: *Alcea aptera:* 1, 12A.
Althaea rosea: 12A, 46.
Malva silvestris: 1, 8, 12A.
M. erecta: 4.
Malvella sherardiana: 45 (as *P. sherardiana*).

Puccinia martianoffiana Thüm. in Bull. Soc. Imp. Nat. Mosc. **1877,** 138 (1877).

Turkish record: *Paeonia mascula:* 41.

Puccinia melanographa Petrak in Ann. K.K. Naturh. Mus. Wien, **5.,** 417 (1939).

Turkish record: *Lactuca orientalis:* 10.

Puccinia menthae Pers. Syn. Meth. Fung. 227 (1801).

On *Calamintha grandiflora* (L.) Moench; Rize: Iliça, 1000 m., 19 July 1960, *S. & H.* 6288.

Uredinia only; uredospores 20–30 × 16–22 μ, wall thin with 2–3 indistinct pores.

Rize: Pazar, 10 m., 29 June 1960, *S. & H.* 5899. Uredinia only.

On *Calamintha vulgare* L.; Trabzon: Trabzon, 20 m., 27 June 1960, *S. & H.* 5863. Uredinia only.

On *Mentha longifolia* (L.) Huds.; Sivas: Zara to Suşehri, 1300 m., 23 June 1960, *S. & H.* 5760.

Uredinia abundant, uredospores 22–26 × 22–23 μ, wall delicately echinulate, with two equatorial pores. Telia sparse, teliospores 28–30 × 22–24 μ, wall delicately verrucose.

On *Origanum vulgare* L.; Trabzon: Trabzon, 20 m., 27 June 1960, *S. & H.* 5874. Uredinia only.

On *Nepeta*? sp.; Giresun: Şebinkarahisar, 1300 m., 19 May 1960, *S. & H.* 5075. Systemic spermogonia and aecidia on distorted shoots.

Turkish records: *Calamintha alpina:* 42.
C. origanifolia: 42.
Mentha aquatica: 42.
M. longifolia: 42.
M. silvestris: 20.
Micromeria fruticosa
subsp. *brachycalyx:* 42.
Origanum onites: 1.
Satureia hortensis: 41.
S. spicigera: 41.

Puccinia mertensiae Peck in Bot. Gaz. **6,** 227 (1881).

Turkish records: *Omphalodes luciliae:* 42.
O. cilicica: 42.

Puccinia mesneriana Thüm. in Flora, **60,** 175 (1877).

Turkish record: *Rhamnus oleoides:* 40.

Puccinia montana Fuckel, Symb. Mycol. Nachtr. **2,** 14 (1873).

On *Centaurea axillaris* Willd.; Gümüşane: Soganli Geçidi, 1800 m., 18 May 1960, *S. & H.* 5046.

Spermogonia and uredinoid aecidia on systemically infected shoots; aecidiospores 28–32 × 26–30 μ, with two equatorial pores.

Turkish record: *Centaurea cana:* 8.

Puccinia montana occurs on *Centaurea axillaris* in Caucasia (Tranzschel, 1939) and Lebanon (Rayss, 1946) and on *C. napulifera*, *C. pseudophyrygia*, *C. thaiszii* and *C. axillaris* (=*C. triumfettii*) in Roumania (Savulescu, 1953). It appears impossible to distinguish *P. montana* from *P. cyani* without teliospores. The teliospores of *P. montana* are coarsely warted whereas those, of *P. cyani* are finely verrucose.

Puccinia nigrescens Kirchn. in Lotos, **6,** 182 (1856).

On *Salvia amasiaca* Fr. & Bornm.; Rize: Ikizdere to Ispir, 2000 m., 15 July 1960, *S. & H.* 6233.

Telia hypophyllous, rather thickly scattered, black; teliospores broadly ellipsoid, constricted at median septum, 36–40 × 22–28 μ, apex 4–6 μ thick, pore of upper cell apical, of lower superior, both with conspicuous hyaline caps, wall smooth, pedicels hyaline, mostly deciduous, a few up to 30 μ long.

Turkish records: *Salvia amasiaca:* 34.
S. verticillata: 24 (as *P. obtusa*).
S. sp.: 31.

This rust is well known on *S. verticillata* (the type host) in Europe and S.W. Asia and has also been recorded on another close relative, *S. judaica* from Israel (Sydow, 1935).

Puccinia notobasidis Fragoso in Broteria, **22,** 52 (1926).

On *Notobasis syriaca* (L.) Coss.; Mardin: Kiziltepe, 600 m., 26 May 1957, *Davis & Hedge* (D.28643).

Turkish record: *Notobasis syriaca:* 34.

Puccinia obscura Schroet. apud Pass. in N. Giorn. Bot. Ital. **9,** 256 (1877).

On *Luzula forsteri* (Sm.) DC.; Rize: Pazar, 10 m., 29 June 1960, *S. & H.* 5900. Uredinia only. Rize: Hopa to Borçka, 300 m., 30 June 1960, *S. & H.* 5911.

Teliospores 34–50 × 14–20 μ; uredospores, 22–30 × 21–25 μ with two supra-equatorial pores.

Puccinia opopanacis Cesati in Bull. Club Alp. Ital. **1873,** 150 (1873).

On *Opopanax orientalis* Boiss.; Malatya: Malatya to Maraş, 1400 m., 6 June 1960, *S. & H.* 5464.

Telia with a few scattered uredospores with two equatorial pores.

On *Silaus carvifolia*? C. A. Mey.; Sivas: Şebinkarahisar, 1400 m., 24 June 1960, *S. & H.* 5821.

Uredinia hypophyllous on leaf segments; uredospores ovoid to subgloboid, 34–38 × 24–27 μ, wall sparsely echinulate with two, rarely three, equatorial pores. Teliospores replacing uredospores, 36–39 × 22–26 μ, wall undulate, pore of upper cell apical to equatorial of lower cell superior, some large, echinulate, thick-walled uredospores are present with the teliospores.

Turkish record: *Opopanax hispidum* (= *O. orientale* Boiss.): 34.

The collection on *Silaus carvifolia* is placed here tentatively; the host identification is not certain as the plant was sterile. The collection undoubtedly belongs to the *P. opoponacis—P. phymatospora* group characterized by undulate-walled teliospores. It agrees perfectly with the collection on the type host, *O. orientalis*. In Lindroth's (1902) account of umbelliferous rusts the uredospores are described as having three equatorial pores. There are mostly two pores in our collections but a few of the larger spores have three pores. No aecidial state is known for *P. opoponacis*; uredospores occur but only in small numbers in the telia.

Puccinia pachyphloea Syd. Monographia Uredinearum, **1,** 581 (1903).

On *Rumex tuberosus* L. subsp. *horizontalis* (C. Koch) Rech. f.; Erzurum: Iliça to Tercan, 1900 m., 10 July 1957, *Davis & Hedge* (D.30910).

Telia only, on stems and on leaves; teliospores mostly 34–40 × 21–25 μ, wall 3–3·5 μ thick, coarsely verrucose, a few imperfectly formed unicellular spores present.

P. pachyphloea was incorrectly recorded on *Rumex acetosella* in Turkey (Henderson, 1959). At that time I had not seen any other material of *P. pachyphloea* and placed too great reliance on thickness of the teliospore wall as a differential character. Thickening of spore walls seems to occur in many rusts in S.W. Asia and is probably correlated with the arid conditions of the region. The rust on *R. acetosella* I regard as a somewhat thick-walled type of *Puccinia acetosae*. *Puccinia biformis* from the western Mediterranean belongs to the same affinity but the spore apex is described as papillate.

Puccinia persica Wettst. in Hedwigia, **26,** 115 (1887).

Turkish records: *Centaurea behen:* 10.
C. myriocephala: 34.
C. persica: 45.

These records are kept distinct under *P. persica* but there is some doubt as to whether this species is separable from *P. calcitrapae*. The only difference lies in the thicker teliospore wall of *P. persica* but intermediates occur.

Puccinia phaeopappi Maire in Bull. Soc. Myc. Fr. **21,** 137 (1905).

On *Stœhelina lobelii*; Mersin distr. Karasali: Gulek boğaz, 31 Aug. 1949, *Davis* 16473.

Uredospores mixed in telia, 32·5–37·5 × 25–32 μ, echinulate, with two rather large equatorial pores. Telia hypophyllous, dark brown, 1 mm. in diameter; teliospores 45–55 × 27–35 μ, constricted at septum, upper pore apical, lower pore superior, wall not specially thickened at the apex, verrucose throughout, pedicel persistent, up to 55 μ long.

This species was described on *Phaeopappus kotschyi* from Cilicia (Maire, 1905) but Maire later corrected the host identification to *Staehelina apiculata*. The rust seems to be unknown, hitherto, except from the type collection. The two equatorial pores of the uredospores point to relation with the *P. hieracii* group but the verrucosity of the teliospore wall is more prominent than is usual in that affinity. The species is presumably a brachy-form but there is no information on this point.

Puccinia phlomidis Thuem. in Bull. Soc. Nat. Moscow, **1878,** 216 (1878).

On *Phlomis armeniaca* Willd.; Sivas: Sivas, 1300 m., 21 May 1960, *S. & H.* 5092; Maraş: Nurihak Dağ, 2800 m., 17 June 1960, *S. & H.* 5642. Both with systemic infections bearing spermogonia and aecidia only.

Turkish records: *Phlomis brevilabris:* 8 (as *Aecidium phlomidis*).
P. capitata: 40 (as *Aecidium phlomidis*).
P. nissolii: 4.
P. armeniaca: 12A, 45.

Puccinia phlomidis is an opsis-form with systemic aecidial mycelium, telia follow later in the season on the same leaves. The deformed host leaves are paler and yellowish; plants bearing aecidia are therefore conspicuous and aecidial tend to be more frequent than telial collections.

In addition to many species of *Phlomis* in S.W. Asia, *P. phlomidis* has been recorded on the genera *Eremostachys* (Rayss, 1951) *Stachyopsis* (Tranzschel, 1939) and with some doubt, as only aecidia were present, on *Lamium* (Jørstad, 1952) and *Leonurus* and *Lagochilus* (Tranzschel, 1939).

Puccinia phragmitis (Schum.) Körn. in Hedwigia, **15,** 179 (1876).

Turkish record: *Rumex* sp.: 45.

Puccinia physospermi Pass. in Rabh. Fungi Eur. 1969 (1875).

Turkish record: *Cnidium* sp. aff. *C. orientale:* 42.

Puccinia pimpinellae (Str.) Rohl. Deutsch. Fl. Ed 2, **3** (3), 131 (1813).

On *Pimpinella rhodantha* Boiss.; Trabzon: Hemşikoy, 600 m., 24 July 1960, *S. & H.* 6322.

Telia only; teliospores broadly ellipsoid, constricted at septum, 36–40 × 21–23 μ, wall 2–3 μ thick with reticulate ornamentation, reticula 2 μ across, pore of upper cell subapical, of lower median, pedicel short, deciduous.

On *Pimpinella peregrina* L.; Trabzon: Trabzon, 20 m., 27 June 1960, *S. & H.* 5873.

Teliospores 28–32 × 20–22 μ.

On *Scaligeria rotundifolia* (MB.) Boiss.; Gümüşane: *Sintenis* Iter Orientale, 19 July, 1894, no. 7267. Uredina and telia.

Turkish records: *Pimpinella corymbosa:* 40.
P. cretica: 1, 42.
P. kotschyana: 40.
P. pseudotragium: 8.
P. tragium: 40, 45.
Scaligeria rotundifolia: 4.

Puccinia pimpinellae occurs on a wide range of species of *Pimpinella* in Eurasia and its occurrence on *Scaligeria rotundifolia* supports the close association of the two host genera.

On *Scaligeria rotundifolia* it occurs in Turkey and U.S.S.R. (Tranzschel, 1939).

A closely allied species, *P. pulvillulata*, was described by Lindroth for a rust of this affinity on *Pimpinella cappadocica* and *P. olivieri*. The species is maintained here until its status can be reassessed.

Puccinia platypoda Sydow in Ann. Myc. **11,** 54 (1913).

On *Atraphaxis billardieri* Jaub. & Spach; Artvin: Artvin to Yusufeli, 1800 m., 8 July 1960, *S. & H.* 6069.

Aecidia in small groups. Telia conspicuous; teliospores 50–56 × 25–28 μ, wall smooth, with apical pore in upper and superior pore in lower cells, stipes hyaline, 50–100 × 30–36 μ, swelling when moistened and pushing teliospores up out of the sorus.

This rather remarkable opsis-form was described by Sydow from a collection from Tortum Göl on '*Artraphaxis* sp.' The 1960 collection comes from very near the type locality so it is highly probable that the type was also on *A. billardieri*. There are no other records of the species in Turkey but it is recorded on *A. pungens* and *A. pyrifolia* in U.S.S.R. (Tranzschel, 1939) and on *A. frutescens* and *A. caucasica* in Kazakstan (Nevodovsky, 1956).

The genus *Atraphaxis* is predominantly west-central Asiatic in distribution but one species extends to Greece. The very remarkable swollen pedicels of the teliospores seem to function as those of many species of *Phragmidium*.

Puccinia plicata Kom. in Script. Bot. Hort. Univ. Petropol. **4,** 28 (1895).

On *Prangos* sp.; Maraş: Nurihak Dağ, 2400 m., 17 June 1960, *S. & H.* 5655.

Telia only, borne on a systemic mycelium; teliospores 28–32 × 22–25 μ, wall irregularly thickened and undulate in outline, pore of upper cell apical, pore of lower superior or equatorial, pedicel short.

Turkish record: *Prangos denticulata:* 12A.

Puccinia plicata is a micro-form and is undoubtedly closely allied to several other micro-forms with similar undulate walls. There are several species with similar teliospores of which only uredinia and telia are known, for example, *P. opoponacis*, *P. agasyllidis* and *P. rugulosa*, but no corresponding brachy- or auteu-forms appear to have been described.

Puccinia poae-nemoralis Otth in Mitth. Naturh. Ges. Bern, **1870,** 113 (1871).

Syn.: *Uredo anthoxanthina* Bub. in Ann. Myc. **3,** 223 (1905).

On *Berberis* sp.; Sivas: Zara to Sivas, 1300 m., 20 May 1960, *S. & H.* 5090. Spermogonia and aecidia.

On *Poa annua* L.; Rize: Iliça, 1000 m., 19 July 1960, *S. & H.* 6282. Uredinia only.

On *Poa nemoralis* L.; Artvin: Artvin, 2000 m., 1 July 1960, *S. & H.* 5946. Uredinia only; Otingol, 1800 m., 4 July 1960, *S. & H.* 6002. Uredinia only.

Rize: Ikizdere to Ispir, 2000 m., 15 July 1960, *S. & H.* 6227.

Trabzon: Trabzon, 250 m., 28 June 1960, *S. & H.* 5880. Uredinia only.

Giresun: Şebinkarahisar to Giresun, 2100 m., 25 June 1960, *S. & H.* 5840. Uredinia only. Sivas: Zara to Suşehri, 1200 m., 23 June 1960, *S. & H.* 5772.

Uredinia only, with capitate paraphyses constricted below the head; uredospores 24–27 × 22–24 μ with 8–9 scattered pores.

On *Anthoxanthina odoratum* L.; Rize: Rize to Ispir, 3000 m., 16 July 1960, *S. & H.* 6272.

Uredinia only with thick-walled clavate paraphyses; uredospores 26–28 × 22–24 μ with 7–8 scattered pores.

Puccinia poae-nemoralis is a widespread species for the most part independent of alternation. The aecidial stage (*Aecidium graveolens* Shuttl.) is partially systemic on the *Berberis* host. Unfortunately, in the one locality where aecidia were found, no telia could be found on neighbouring grass hosts to indicate the pattern of alternation. All the 1960 collections on grass hosts lack telia; the most common situation for this species. In this respect it differs from *Puccinia poarum* which also occurs commonly on species of *Poa*, in which telia are usually present. The distinctive uredo paraphyses with constricted capitate heads adequately distinguish it from other grass rusts. The hosts listed must present but a very incomplete account of the species in Turkey for many more hosts are recorded from neighbouring regions of U.S.S.R. (Tranzschel, 1939).

Puccinia poarum Niels in Bot. Tidsskr. **2,** 34 (1877).

On *Poa pratensis* L.; Trabzon: Hemşikoy, 600 m., 24 July 1960, *S. & H.* 6314.

Abundant epiphyllous telia, scanty uredinia; teliospores 38–56 × 16–22 μ thickened at apex, aparaphysate. Uredinia aparaphysate; spores subgloboid to broadly ellipsoid, 20–24 × 18–20 μ, wall thin, finely echinulate with scattered indistinct pores.

On *Petasites hybridus* (L.) Wett.; Artvin: Otingol, 2000 m., spermogonia and aecidia only, 3 July 1960, *S. & H.* 5987.

Turkish record: *Tussilago farfara:* 45.

Puccinia poarum is usually obligatorily heteroecious between *Tussilago* and various species of *Poa* in northern Europe. In central Europe a complex of species alternating between *Compositae* and grasses and sedges has been investigated by various workers since Ludi (1918) confirmed that *Aecidium petasites* Syd. was part of the life cycle of a grass rust. The grass rusts of this complex seem to me not to differ essentially from *P. poarum* and I would place them under that name. It is not possible to be sure of the relations of the Turkish collections on *Petasites hybridus*—no telia could be found—for they may belong to the group of sedge rusts e.g. *P. petasites-pendulae*. The race alternating with *Poa* has been recorded as *P. petasiti-pulchellae* on three species of *Petasites* from Roumania (Savulescu, 1953).

Puccinia podospermi DC. Fl. Fr. Ed 3, **2,** 595 (1805).

On *Scorzonera armeniaca* Boiss.; Malatya: Hekimhan, 1300 m., 8 June 1960, *S. & H.* 5422.

Telia only, including a few uredospores; uredospores ellipsoid, 22–26 × 19–22 μ, wall distantly echinulate, with two supra-equatorial pores. Teliospores broadly ellipsoid, not medianly constricted, 33–36 × 28–32 μ, wall 3–4 μ thick, conspicuously verrucose, pore of upper cell apical of lower equatorial.

This is a new host record for this rust. It is also interesting in that as *S. armeniaca* is a member of sect. *Podospermum* it supports Jørstad's (1961) finding that *P. podospermi* is restricted to this section of the host genus.

On *Scorzonera armeniaca* Boiss.; Nevşehir: Göreme to Ürgüp, 1300 m., 24 May 1960, *S. & H.* 5131.

Aecidia absent. Uredospores mixed with teliospores, subglobose, 26–30 × 21–25 μ with two equatorial pores, walls sparsely echinulate, teliospores 33–36 × 22–30 μ, wall finely verrucose or quite smooth, 3–4 μ thick, upper pore apical, lower pore median.

It is difficult to be certain without information on the aecidial stage to which species this collection belongs. The fine verrucosity of the teliospore wall suggests *P. hieracii* or *P. jackyana.* In typical *P. hieracii* the uredospore pores are clearly supra-equatorial, so it seem incorrect to place collections with equatorial pores under that name. The teliospore wall in our collection is rather thick for *P. jackyana* and approaches *P. meshedensis* Petrak in this respect. But it must be borne in mind that spore wall thickness may not be a suitable taxonomic character on which to place emphasis for rusts in this area. There are many cases of thick-walled equivalents of northern species in the arid regions and this may be a developmental response to dry conditions. The systematic position of the host in sect. *Podospermi* also supports the placing in *P. podospermi.*

On *Scorzonera jacquinianum* (Koch) Boiss.; Giresun: Aluçra, 1300 m., 19 May 1960, *S. & H.* 5069.

Systemic deforming mycelium bearing aecidia and spermogonia only. This collection is placed here because of the host identity. As Jørstad (1961) has shown, *P. podospermi* occurs on *Scorzonera* sect. *Podospermum* which includes *S. jacquinianum*, *S. laciniata* and *S. calcitrapifolia* throughout south Europe, North Africa to Central Asia. The other species, *P. jackyana*, with a host-deforming aecidial stage does not occur on hosts of this affinity. Two collections from Turkey cannot be accurately placed.

(1) On *Scorzonera parviflora* Jacq.; Sivas: Pinarbaşi, 1300 m., 25 May 1960, *S. & H.* 5157. Systemic mycelium bearing spermogonia and aecidia only.

This may be the same fungus recorded by Tranzschel (1939) on this host and by Nevodovsky (1956) from Kazakstan. Certainly Nevodovsky's illustration of teliospores are of the *P. podospermi* type. Jørstad (1961) suggests relation to *P. meshedensis* Petrak.

(2) On *Scorzonera* sp. aff. *sericea* recorded in Henderson (1959).

Only systemic spermogonia and aecidia were present; there is no information on rusts on this host.

Puccinia polygoni-amphibii Pers. Syn. Meth. Fung., 227 (1801).

On *Polygonum convolvulus* L.; Trabzon: Trabzon, 20 m., 27 June 1960, *S. & H.* 5869.

Uredinia only; uredospores 20–28 × 17–20 μ, wall echinulate with two supra-equatorial pores.

Turkish record: *Polygonum* sp.: 42, 12A.

Nothing is known of the biology of this rust in Turkey. There were many species of *Geranium* in the vicinity but no aecidia could be found.

Puccinia prenanthis Kunze apud Schub. in Fiv. Fl. Dresd. **2,** 250 (1823).

Syn.: *Puccinia mulgedii* P. & H. Sydow, Monogr. Ured. **1,** 123 (1902).
Puccinia mulgedii-cacaliifolia Kuschke, in Monit. Jard. Bot. Tiflis, **11,** 90 (1915).

On *Lactuca* (*Mulgedium*) *cacaliifolium* MB.; Artvin: Artvin, 2000 m., 1 July 1960, *S. & H.* 5924.

Epiphyllous spermogonia and aecidia and hypophyllous uredinia on the aecidial pustules. Uredospores subgloboid, 28–32 × 27–30 μ, wall 2·5–3 μ thick, with two to three equatorial pores with large, diffuse hyaline caps; pedicels rather persistent, up to 30 μ long.

Puccinia pulverulenta Grev. Fl. Edin. 228 (1824).

Turkish record: *Epilobium hirsutum:* 20, 45.

Puccinia pulvillulata Lindroth in Meddel. Stockh. Hogskol. Bot. Inst. **4,** 7 (1901).

Turkish records: *Pimpinella cappadocica:* 10.
P. tragium: 31.

The status of this species is uncertain, no material is available to me but it will probably be merged with *P. pimpinellae* when an adequate range of specimens is studied.

Puccinia pulvinata Rabh. in Hedwigia, **10,** 20 (1871).

P. jurineae Cooke in Grevillea, **9,** 14 (1880).

ECHINOPS

On *Echinops viscosus* DC.; Konya: Konya to Antalya, 600 m., 28 July 1960, *S. & H.* 6340.

Uredinia; uredospores subgloboid 32–40 × 32–34 μ with three or four, more or less equatorial pores. Teliospores sparse and mixed in uredinia, 48–56 × 30–34 μ.

Turkish records: *Echinops heldreichii:* 4.
E. sp.: 1, 22, 45.

JURINEA

On *Jurinea depressa* C. A. Mey. var. *pinnatisecta* Boiss.; Sivas: Şebinkarahisar to Giresun, 2300 m., 24 June 1960, *S. & H.* 5823.

Uredinia only. Uredospores 22–26 × 22–24 μ, with 3 (4) equatorial pores.

On *Jurinea pontica* Hausskn. & Freyn.; Sivas: Kayseri to Sivas, 1200 m., 1934, *E. K. Balls* 1444.

Telia only; teliospores mostly 54 × 26 μ, wall 2μ thick, pedicel up to 30 μ long.

Turkish record: *Jurinea depressa:* 4.

I have included the fungus often known as *P. jurineae* Cooke in *P. pulvinata* Rabh. This is no new concept for Rabenhorst himself in the original description of *P. pulvinata* lists a var. *jurineae* with the only differentiating notes "in *Jurinea cataonica*". *P. pulvinata* is allied to *P. calcitrapae* (including *P. echinopsis*) but differs in a tendency to have larger spores with longer, more persistent pedicels. The relation between *P. pulvinata* and *P. calcitrapae* is therefore similar to that between *P. kurdistani* and *P. hieracii.*

Puccinia punctata Link in Mag. Ges. Naturf. Fr. Berlin, **7,** 30 (1815).

On *Galium coronatum* Sibth. & Sm.; Sivas: Sivas to Kayseri, 1400 m., 23 May 1960, *S. & H.* 5098.

Aecidia hypophyllous. Uredinia sparse; uredospores 24–32 × 21–24 μ, wall sparsely echinulate with two equatorial pores. Teliospores 38–43 × 20–22 μ, apex 7–8 μ thick, wall smooth, stipe up to 50 μ long.

Maraş: Nurihak Dağ, 2000 m., 17 June 1960, *S. & H.* 5645, spermogonia and aecidia only.

On *Galium incanum* Sibth. & Sm.; Sivas: Gürün to Sivas, 1400 m., 20 June 1960, *S. & H.* 5731. Old aecidia, sparse uredinia and telia; Gürün, 1400 m., 29 May 1960, *S. & H.* 5262. Aecidia, uredinia and telia.

On *Galium punctatum* Sibth. & Sm.; Sivas: Gürün, 1400 m., 28 May 1960, *S. & H.* 5238. Aecidia, uredinia and telia.

On *Galium scabrifolium* (Boiss.) Hausskn.; Malatya: Kangal to Hekimhan, 1300 m., 7 June 1960, *S. & H.* 5395. Sparse aecidia, uredinia and telia.

On *Galium subvelutinum* subsp. *leiophyllum* (Boiss.) Ehrendf.; Maraş: Nurihak Dağ, 1800 m., 17 June 1960, *S. & H.* 5657. Abundant aecidia, sparse uredinia and telia.

Turkish records: *Galium coronatum:* 40.
Asperula breviflora: 40.

Puccinia punctata is very widespread in the Northern Hemisphere and is complex in its host relations and life cycle (for an account of this in Europe see Gaumann, 1959).

All the 1960 Turkish collections are clearly eu-forms. The telia are often very abundant on the basal parts of perennial hosts. From these, infection with basidiospores must take place either in late autumn on resting buds or at a very early stage of growth in spring, for the developing shoots are often heavily infected before they have reached a few centimetres in length.

Puccinia punctiformis (Str.) Rohling, Deutsch. Fl. Ed 2, **3** (3), 132 (1813).

On *Cirsium arvense* (L.) Scop.; Rize: Rize to Ispir, 1500 m., 16 July 1960, *S. & H.* 6246. Systemic infection of host; sori bearing mixed uredo and teliospores.

Giresun: Suşehri, 1300 m., 19 May 1960, *S. & H.* 5072.

Spermogonia and uredinoid aecidia, spores subgloboid, 26–30 × 24–28 μ, with three or four equatorial pores.

Puccinia purpurea Cooke in Grevillea, **5,** 15 (1876).

Turkish record: *Andropogon halepensis:* 45.

Puccinia pygmaea Eriks. in Bot. Centralbl. **64,** 381 (1895).

On *Calamagrostis littorea* (Schrad.) DC.; Malatya: Malatya to Maraş, 1600 m., 9 June 1960, *S. & H.* 5457.

Uredinia only, with capitate paraphyses, 18–23 μ long; uredospores 26–32 × 20–26 μ with 8–9 scattered pores.

P. pygmaea does not appear to have been found in S.W. Asia. Tranzschel (1931) produced aecidia on *Berberis vulgaris* with a rust on *Calamagrostis* but in Western Europe *P. pygmaea* is quite independent of host alternation and telia are usually sparse.

Puccinia recondita Rob. ex Desm. in Bull. Soc. Bot. Fr. **4,** 798 (1857).

Syn.: *P. rubigo-vera* Wint. in Rabh. Krypt. Fl. Ed 2, **1,** 217 (1882).
P. dispersa Eriks. & Henn. in Ber. Deut. Bot. Ger. **12,** 315 (1894).
P. bromina Eriks. in Ann. Sci. Nat. Bot. Ser. 8, **9,** 271 (1899).
P. holcina Eriks. in Ann. Sci. Nat. Bot. Ser. 8, **9,** 274 (1899).
P. hordei-murini Buchw. in Ann. Myc. **41,** 308 (1943).
P. triticina Ericks. in Ann. Sci. Nat. Bot. Ser. 8, **9,** 270 (1899).

On *Clematis orientalis* L.; Nevşehir: Göreme to Ürgüp, 1300 m., 24 May 1960, *S. & H.* 5134. Growing with *Agropyron* (*S. & H.* 5135) bearing telia. Aecidia abundant on discoloured leaf spots.

On *Agropyron* sp. (sterile); Nevşehir: Göreme to Ürgüp, 1300 m., 24 May 1960, *S. & H.* 5135.

Telia only, the host growing under plants of *Clematis orientalis* bearing aecidia.

On *Agropyron divaricatum* Boiss. & Bal.; Sivas: Gürün to Pinarbaşi, 1700 m., 19 June 1960, *S. & H.* 5696.

Uredinia only, aparaphysate, uredospores 24–31 × 22–26 μ, with 8–10 indistinct pores.

On *Alopecurus arundinacea* Poir.; Sivas: Sivas, 1200 m., 6 June 1960, *S. & H.* 5365. Uredospores 20–30 × 18–26 μ; telia sparse.

On *Bromus arvensis* L.; Maraş: near Göksun, 1600 m., 15 June 1960, *S. & H.* 5541.

Telia only; teliospores 42–52 μ, long lower cell 15–20 μ broad, upper cell 16–22 μ broad.

Erzurum: 48 km. north of Erzurum, 1600 m., July 1960, *S. & H.* 6135.

Uredinia abundant; telia sparse, aparaphysate; teliospores clavate or oblong 30–42 × 18–21 μ, apex up to 4 μ thick, ratio-length of spore: breadth of lower cell = 2·5.

On *Bromus intermedius* Guss.; Antalya: Antalya, 600 m., 29 July 1960, *S. & H.* 6344. Telia only.

On *Bromus madritensis* L.; Nevşehir: Göreme to Ürgüp, 1300 m., 24 May 1960, *S. & H.* 5138.

Uredospores 23–28 × 22–27 μ with 8–10 scattered pores. Teliospores sparse 38–50 × 14–22 μ.

On *Bromus mollis* L.; Rize: near Ikizdere, 2300 m., 16 July 1960, *S. & H.* 6245. Uredinia only.

Istanbul: Belgrad forest, 2000 m., 12 May 1960, *S. & H.* 5005. Uredinia only.

On *Bromus sterilis* L.; Giresun: Şebinkarahisar to Giresun, 2100 m., 25 June 1960, *S. & H.* 5838. Uredinia only.

Maraş: Maraş to Göksun, 1300 m., 14 June 1960, *S. & H.* 5568. Telia only; teliospores 50–65 μ long, upper cell 16–20 μ broad, lower cell 12–16 μ broad; Maraş to Göksun, 1300 m., 14 June 1960, *S. & H.* 5524. Telia only.

Trabzon: Maçka, 250 m., 28 June 1960, *S. & H.* 5888. Uredinia and telia; teliospores 38–46 μ long, upper cell 16–22 μ, lower cell 15–18 μ broad.

On *Bromus tectorum* L.; Sivas: Sivas, 1200 m., 22 May 1960, *S. & H.* 5127. Abundant uredinia and telia.

On *Eremopyrum cristatum* Willk. & Lange; Erzurum: between Yusufeli and Erzurum, 1600 m., July 1960, *S. & H.* 6142.

Uredosori on the upper leaves about 2 mm. long, orange, aparaphysate; uredospores subglobose, 21–24 × 19–21 μ, wall finely echinulate, less than 0·5 μ thick with very indistinct scattered pores; telia on the lower leaves, subepidermal with a few, brown, thick-walled, cylindrical paraphyses at the margin only; teliospores oblong, scarcely constricted, the apex truncate especially in the shorter spores, 40–56 × 14–20 μ, wall smooth, brown at the apex which is up to 3-4 μ thick but otherwise hyaline, pore in upper cell apical in lower not differentiated in the thin wall; pedicel short, hyaline.

On *Holcus lanatus* L.; Rize: Ikizdere to Ispir, 2000 m., 13 July 1960, *S. & H.* 6229. Uredinia only.

Trabzon: Trabzon, 20 m., 27 June 1960, *S. & H.* 5875. Uredinia and telia; Maçka, 250 m., 28 June 1960, *S. & H.* 5879.

On *Hordeum murinum* L.; Sivas: Suşehri to Şebinkarahisar, 1400 m., 24 June 1960, *S. & H.* 5813. Uredinia only; uredospores 25–32 × 21–25 μ, with 9–10 indistinct pores.

On *Triticum aestivum* L.; Maraş: Maraş to Göksun, 1300 m., 14 June 1960, *S. & H.* 5517. Uredinia and sparse telia.

Turkish records: *Aegilops ovata:* 37 (as *P. aegilopsis*).
Agropyron repens: 12A (as *P. persistens*).
A. taurum: 11 (as *P. agropyri*).
Anchusa angustissima: 8.
Bromus tectorum: 12A (as *P. symphyti-bromorum*).
Clematis cirrhosa: 45 (as *P. agropyri*).
Holcus setiglumis: 45 (as *P. holcina*).
Moltkia coerulea: 40 (as *Aecidium asperiifolia*).
Nonnea macrocarpa: 8.

Secale cereale: 12A, 46 (as *P. dispersa*).
Triticum sativum: 12A, 42, 46 (as *P. triticina*).

Puccinia recondita is a widespread species with many races exhibiting complex alternation. The few collections and records can give little indication of the true wealth of data waiting to be discovered relating to this group in Turkey and S.W. Asia in general.

The relation between the rusts on *Clematis orientalis* and *Agropyron* was sufficiently clear in the field to be certain about. This race has often been equated with the North American *P. agropyri*. Tranzschel (1939) includes *Clematis orientalis* as a host as well as nine other species of *Clematis* in U.S.S.R. The relation of the rusts on *Clematis* and *Agropyron* has been repeatedly confirmed experimentally in western Europe and Treboux (1912) produced infection on *Agropyron repens* from aecidia on *Clematis pseudoflammula*. No direct experimental work or field observations suggest the grass hosts of the aecidia on *Nonnea macrocarpa* and *Anchusa angustissima*. They are most probably *Bromus* races but the *Anchusa* might also be related to the dicaryon stages on *Secale*—a race often referred to as *P. dispersa*.

The rusts on *Bromus* are complex. Many experiments have confirmed the relation with boraginaceous aecidial hosts but in Palestine, for example, Rayss (1951) places many in *P. madritensis* and remarks on frequent field association with aecidia on *Clematis cirrhosa*, and the record on this host in Turkey may therefore refer to a *Bromus* race or to one on *Agropyron*.

A rust recorded on *Gaudinia fragilis* by Magnus as *P. rubigo-vera* is in this account placed in *P. schismi* (*q.v.*).

Puccinia rhagadioli Syd. Monographia Uredinearum **1,** 139 (1902).

On *Garhadiolus hedypnois* (F. & M.) Jaub. & Spach; Malatya: Malatya to Maraş, 1600 m., 9 June 1960, *S. & H.* 5484.

Uredospores mixed with teliospores, 23–35 × 20–23 μ, with three equatorial pores, teliospores broadly ellipsoid, 34–40 × 23–27 μ, wall finely verruculose, blackish-brown, 3–4 μ thick, upper pore sub-apical, lower pore median.

Turkish records: *Garhadiolus hedypnois:* 40.
Rhagadiolus stellatus: 5.

Puccinia rhagadioli stands in relation to *P. calcitrapae* as *P. jackyana* to *P. hieracii*; *P. rhagadioli* and *P. jackyana* are auteu-forms with systemic aecidial mycelium; the other two are brachy-forms causing little or no host distortion. This recurrence of the same spectrum of rust species on genus after genus of the *Compositae* provides many interesting questions on biology and speciation of these fungi. If uredospore pores are stressed then *P. rhagadioli*, with three equatorial pores, is most closely related to *P. calcitrapae*. If pore number is disregarded and the habit of the aecidial stage stressed, it resembles *P. crepidis* and *P. jackyana*, both with two, more or less equatorial, pores. If the full morphological range of dicaryon spores of *P. calcitrapae* is considered it may be difficult to distinguish the present collection with certainty but the dark rather thick teliospore wall appears to do so. Without material of aecidia the correct placing

must remain in some doubt. No other rust has been recorded on *Gar-hadiolus*, but on various species of the genus, *P. rhagadioli* is known from the western Mediterranean and North Africa (Guyot, 1952) eastwards to Azerbaidjan (Tranzschel, 1939) and Iran.

Puccinia saniculae Grev. Flora Edin., 431 (1824).

On *Sanicula europaea* L.; Trabzon: Pazar, 29 June 1960, *S. & H.* 5904. Uredinia only.

In addition to its wide distribution in western Europe, *P. saniculae* occurs in U.S.S.R. west of the Altai (Tranzschel, 1939) and in Northern India (Vasudeva, 1960). However as its host hardly extends into the drier parts of S.W. Asia there are no records from Iran, Syria, Lebanon or Israel and there have been no previous records from Turkey.

Puccinia saxifragae Schlecht. Fl. Berol. **2,** 134 (1824).

On *Saxifraga cernua* L.; Rize: Rize to Ispir, 3000 m., 16 July 1960, *S. & H.* 6271.

Teliospores 28–42 × 14–17 μ, apex 5–6 μ thick, wall delicately longitudinally striate, pore of lower cell superior.

Turkish record: *Saxifraga sibirica:* 20, 45.

Puccinia schismi Bub. in Ann. K.K. Naturh. Hofmus. Wien, **28,** 193 (1914).

On *Vulpia myuros* (L.) Gmel.; Trabzon: Trabzon, 20 m., 27 June 1960, *S. & H.* 5855.

Telia only; teliospores 44–55 × 20–22 μ.

Trabzon: Maçka, 250 m., 28 June 1960, *S. & H.* 5894.

Telia only; teliospores oblong, rather angular, 50–68 × 18–22 μ, lateral wall 1·5 μ thick.

On *Lophochloa phleoides* (Vill.) Reichb.; Trabzon: Trabzon, 20 m., 27 June 1960, *S. & H.* 5860. Uredinia and telia.

On *Lolium multiflorum* Lam.; Sivas: Zara to Suşehri, 1200 m., 23 June 1960, *S. & H.* 5771.

Uredinia only, sori pale yellow, uredospores 22–26 × 20–23 μ, with 8–10 scattered pores.

On *Lolium temulentum*; Maraş: Maraş to Göksun, 1300 m., 16 June 1960, *S. & H.* 5560.

Uredinia and telia; teliospores rather angular, 62–74 × 17–22 μ, lateral wall 2–3 μ thick.

Turkish records: *Gaudinia fragilis:* 1 (as *P. rubigo-vera*).
Lolium temulentum: 1 (as *P. rubigo-vera*).

The collections which I have examined on *Vulpia* and *Lophochloa* certainly belong to *P. schismi.* The rust on *Lolium multiflorum* on which telia are absent is more doubtfully placed here. Without examining the material the position of the "records" is doubtful; the species is only discriminated with difficulty even with abundant material.

P. schismi is of the *P. recondita* type but with aecidia on *Allium*, according to recent observations and experiments (for summary see Jørstad, 1958)

and it is widely distributed in the Mediterranean region. The only morphological differential between *P. schismi* and *P. recondita* is slight; the lateral wall of the teliospore of *P. schismi* is thicker than the corresponding wall in *P. recondita*. From the few collections examined this seems to hold reasonably well.

P. schismi has not been previously recorded from Turkey, but from neighbouring countries it has been listed under various synonyms. As *P. fragosoi* from Cyprus (18), Israel (53), and Iran (10), and U.S.S.R. (Tranzschel, 1939) as *P. laguri-chamaemoly* from Israel (39) and as *P. loliicola* in Iran (15) and Israel (39). Aecidia occur on various species of *Allium* on the western Mediterranean but it is surprising that so far they have not been found in the east where there is certainly not a scarcity of species of the host genus. A rust which may be of the *P. schismi* type, *P. triseti*, is known on species of *Trisetum* in Palestine (13) and Iran (43) but on this host races are also known which alternate, at least in western Europe, with *Sedum*.

Puccinia sempervivi (A. & S.) Jørstad in Skr. N. Videnskap. Akad. Oslo, 1, **1933,** 9, 151 (1934).

Syn.: *Endophyllum sempervivi* de Bary in Ann. Sci. Nat. Bot. IV, **20,** 86 (1863).

On *Sempervivum* sp. aff. *minus*; Artvin: Magara yayla, Şavval Tepe, 2000 m., 7 July 1960, *S. & H.* 6047.

On *Sempervivum globiferum* agg.; Sivas: Pinarbaşi, 2300 m., 26 May 1960, *S. & H.* 5183.

P. sempervivi is an endo-form; teliospores are morphologically like aecidiospores and are borne in aecidial structures. The rust seems to follow the genus *Sempervivum* throughout its range and there is no knowledge of specialised races within the species. Infected leaves are usually elongate and more erect and so stand out from the usual neatly arranged rosettes of uninfected leaves.

Puccinia serpylli Lindr. in Acta Soc. Fauna Flora Fennica, **26,** 10 (1904).

On *Thymus* sp.; Sivas: Gürün, 1400 m., 29 May 1960, *S. & H.* 5263.

Telia only, hypophyllous on leaves, teliospores with thickened apex.

Turkish record: *Thymus kotschyanus:* 40.

This microcyclic species is rare throughout its range which extends from Finland to Iran; only four previous collections are known.

Puccinia sessilis Schneid. ex Schroet. in Abh. Schles. Ges. Vaterl. Cult. Nat. Abt. **1869-72,** 19 (1870).

Turkish record: *Phalaris arundinacea:* 42.

Puccinia sileris Voss in Verh. Zool.-Bot. Ges. Wien, **26,** 120 (1876).

Turkish record: *Siler trilobum:* 8.

Puccinia smyrnii Biv.-Bernh. Manip. Pl. Sicil. (1816).

Turkish records: *Lecokia cretica:* 31.
Smyrnium olusatrum: 31.
S. connatum: 31, 34.

Puccinia sorghi Schwein. in Trans. Amer. Phil. Soc. **2,** (4) 295 (1895).

Turkish record: *Zea mays:* 46.

Puccinia stapfiana Petrak in Ann. Naturh. Hofmus. Wien, **52,** 307 (1941).

Turkish record: *Phlomis armeniaca:* 40.

Puccinia striiformis West. in Bull. Roy. Acad. Belg. **21,** 235 (1854).

Syn.: *P. glumarum* Eriks. & Henn. in Zeitschr. Pfl-krankh. **4,** 197 (1894).

On *Aegilops triuncialis* L.; Sivas: Zara to Suşehri, 1200 m., 23 June 1960, *S. & H.* 5780.

Uredinia only, pale, arrayed in rows, uredospores 26–30 × 22–26 μ with 10 scattered pores.

On *Aegilops ligustica* Coss.; Maraş: Göksun to Elbistan, 1400 m., 15 June 1960, *S. & H.* 5592. Uredinia only.

On *Aegilops speltoidea* Tausch.; Malatya: Hekimhan, 1300 m., 8 June 1960, *S. & H.* 5403. Uredinia and sparse telia.

On *Hordeum bulbosum* L.; Malatya: Hekimhan, 1300 m., 8 June 1960, *S. & H.* 5439. Uredinia only.

On *Taeniatherum crinitum* (Schreb.) Nevski; Sivas: Gürün to Sivas, 1400 m., 20 June 1960, *S. & H.* 5734. Uredinia and sparse telia.

On *Triticum aestivum* L.; Sivas: Zara to Suşehri, 1200 m., 23 June 1960, *S. & H.* 5782. Malatya: Hekimhan, 1300 m., 8 June 1960, *S. & H.* 5438. Uredinia and sparse telia.

Turkish records: *Aegilops cylindrica:* 12A (as *P. glumarum*).
A. ovata: 12A (as *P. glumarum*).
Bromus madritensis: 45 (as *P. glumarum*).
Hordeum bulbosum: 45 (as *P. glumarum*).
H. murinum: 12A (as *P. glumarum*).
H. sativum: 46 (as *P. glumarum*).
Secale cereale: 4, 12A, 46 (as *P. glumarum*).
Triticum sativum: 46 (as *P. glumarum*).

Puccinia tanaceti DC. Fl. Fr. **2,** 222 (1805).

On *Tanacetum myriophyllum* (C. A. Mey.) Willd.; Artvin: Artvin to Yusufeli, 1800 m., 8 July 1960, *S. & H.* 6077.

Uredospores mixed in telia, sparsely echinulate, with three equatorial pores; teliospores, 46–50 × 22–26 μ, wall verrucose especially towards apex, pedicels 60–100 μ long, persistent.

Turkish records: *Tanacetum praeteritum* subsp. *massicyticum:* 42.
Artemisia fragrans: 20.

This rust species is encumbered with many synonyms amongst which the commonest are *P. absinthii*, *P. proximella*, and *P. seriata*. Fahrendorff's paper (1941) on the rusts on *Artemisia* is an extreme example of discrimination of rust species on little other than presumed host specificity. The excellent paper on this group by Tranzschel (1934) has been overlooked by many workers; Fahrendorff does not refer to it.

Puccinia bashmica described by Petrak (1939) on *Chrysanthemum* (*Tanacetum*) *myriophyllum* from Iran seems completely synonymous with *P. tanaceti*.

Puccinia thesii Duby, Bot. Gall. **2,** 889 (1830).

Turkish records: *Thesium divaricatum:* 24.
T. micranthum: 40.

Puccinia trabutii Roum. & Sacc. in Michelia, **2,** 307 (1880).

On *Lepidium pumilum* Boiss. & Bal.; Sivas: Zara to Sivas, 20 May 1960, *S. & H.* 5087.

Spermogonia and aecidia in dense hypophyllous clusters.

Turkish records: *Lepidium draba:* 12A (as *P. isiacae*).
Myagrum perfoliatum: 12A (as *P. isiacae*).
Phragmites communis: 45.

Puccinia trabutii is restricted to the genus *Phragmites* in the dicaryotic phase but the aecidia have been found and experimentally confirmed on many dicotyledonous hosts, especially in the family *Cruciferae* (summary in Gaumann, 1959). The collection on *Lepidium pumilum* was made at the side of a marsh where *Phalaris* was growing. The marshes and lakes in the Sivas region of Turkey would be a good site for more extensive studies of the biology of this rust.

Puccinia vincae Berk. in Smith, Engl. Flora, **5** (2) 364 (1836).

On *Vinca herbacea* Waldst. & Kit.; Gümüşane: Soganli Geçidi, 1200 m., 18 May 1960, *S. & H.* 5041; Giresun: Aluçra, 1300 m., 19 May 1960, *S. & H.* 5078.

Spermogonia, uredinoid aecidia and telia on deformed upright stems. Aecidiospores 34–40 × 20–22 μ, with four equatorial pores, teliospores 38–42 × 22–26 μ, wall reticulately ornamented.

Turkish records: *Vinca herbacea:* 42, 12A and 46 (as *P. anatolica*).
V. major: 45, 46.
V. pubescens: 8.

The relation of this rust to *Puccinia anatolica* has been discussed previously (Henderson, 1961). There seems little doubt that *P. anatolica* represents secondary infection. I did not see any collections in midsummer in Turkey in 1960 to add any more evidence on this point.

Puccinia violae DC. Fl. Fr. **6,** 62 (1815).

On *Viola* sp.; Rize: Hopa to Borçka, 300 m., 30 June 1960, *S. & H.* 5912.

Uredinia with teliospores replacing uredospores; uredospores 26–28 × 19–22 μ, wall distantly echinulate with two equatorial pores. Teliospores 24–30 × 18–22 μ wall sparsely verruculose, pore of upper cell apical of lower superior.

On *Viola* sp.; Artvin: Artvin, 2000 m., 1 July 1960, *S. & H.* 5945. Spermogonia and aecidia only.

Turkish records: *Viola kitaibeliana:* 45.
V. olympica: 4 (as *P. aegra*).
V. sylvatica: 8, 20.

Puccinia wolgensis Navashin in Uebers. Leist. Bot. Russland 146, **1892,** (1894).

On *Stipa szovitsiana* Trin. & Hohen.; Sivas: Gürün to Sivas, 1400 m., 20 June 1960, *S. & H.* 5733.

Telia only, up to 1 cm. long, elongate, erumpent and epiphyllous, brown, teliospores subgloboid to broadly ellipsoid, 50–72 × 34–44 μ, wall 8–10 μ thick, dark brown, minutely and irregularly verrucose, pores not visible, stipe up to 50 μ long.

On *Stipa* sp.; Sivas: Gürün to Pinarbaşi, 1700 m., 19 June 1960, *S. & H.* 5699. Telia only.

Puccinia wolgensis is new to Asia Minor. Uredinia appear to be sparsely produced although Nevodovski (1956) describes them from Kazakstan. The thick-walled, rather round-celled teliospores are so distinctive that Tranzschel's suggestion (1939) that P. *wolgensis* is correlated with the microform *P. gageae* with similar teliospores, is almost certainly correct although the connection has not been experimentally confirmed. *P. wolgensis* occurs on *Stipa pennata*, *S. lessingiana*, *S. orientalis*, *S. hohenackeriana* and *S. szovitsiana* in U.S.S.R. (Tranzschel and Nevodovski) and in Syria on *S. barbata* (Sydow, 1935).

Puccinia ziziphorae Syd. Mon. Ured. **1,** 304 (1902).

Turkish record: *Ziziphora clinopodioides:* 37, 42.

Pucciniastrum agrimoniae (Diet.) Tranzschel in Script. Bot. Hort. Univ. Petropol. **4,** 301 (1895).

On *Agrimonia eupatoria* L.; Trabzon: Hemşikoy, 600 m., 24 July 1960, *S. & H.* 6313.

Uredinia only; uredospores 14–22 × 12–14 μ, sparsely echinulate.

Turkish record: *Agrimonia* sp.: 34.

The aecidial stage of this rust is unknown but presumably it would occur on *Abies*. Teliospores are rarely produced. The rust occurs on several species of *Agrimonia* in U.S.S.R. (Tranzschel, 1939).

Pucciniastrum brachybotrydis (Tranzschel) Henderson.[1]

On *Omphalodes cappadocica* (Willd.) DC.; Rize: Pazar, 10 m., 29 June 1960, *S. & H.* 5906.

Uredinia only, on orange-brown spots, 5 mm. in diameter; uredospores broadly ellipsoid to subgloboid, 20–22 × 16–18 μ, wall thin, hyaline, without evident pores, echinulations 2–2·5 μ apart, contents faintly yellowish. Apex of peridial cells not specially ornamented.

No member of the *Pucciniastreae* has been recorded on the genus *Omphalodes*. However, the boraginaceous genera, *Brachybotrys*, *Brunnera*, *Myosotis* and *Trigonotis* are hosts of *P. brachybotrydis* according to

[1]**Pucciniastrum brachybotrydis** (Tranzschel) Henderson **comb. nov.** Basionym: *Thekopsora brachybotrydis* Tranzschel in Ann. Myc. **5,** 551 (1907).

Hiratsuka (1958). This rust extends from Western Siberia (Altai) to Manchuria and Japan. The nearest station to eastern Turkey is in the Altai where it occurs on *Brunnera sibirica*. I have not had an opportunity of examining other material but the fungus from Turkey matches figures of uredospores and descriptions of Russian collections given by Kuprevicz and Tranzschel (1957). The transfer to *Pucciniastrum* is made since the distinction of subepidermal (*Pucciniastrum*) *versus* intra-epidermal (*Thekopsora*) teliospores is not considered a sufficient distinction for delimitation of genera in the *Pucciniastreae*.

Pucciniastrum circaeae (Wint.) Speg. in Sacc. Syll. Fung. **7,** 763 (1888).

On *Circaea alpina* L.; Rize: Iliça, 1600 m., with *Picea orientalis* and *Abies nordmanniana*, 21 July 1960, *S. & H.* 6297.

Uredinia only, uredospores ellipsoid-ovoid, 18–24 × 12–14 μ, wall with echinulations 1·5–2·5 μ apart.

P. circaeae is widespread throughout the temperate and boreal parts of the Old World. Telia are scarce and aecidia have been seen only as the results of experimental infections of *Abies alba* in Switzerland.

Pucciniastrum pyrolae Diet. ex Arth. North Amer. Fl. **7,** 108 (1907).

On *Pyrola media* Sw.; Artvin: Mağara Yayla, Şavval Tepe, 2400 m., 6 July 1960, *S. & H.* 6043.

Hypophyllous uredinia only; uredospores mostly 30 × 15 μ.

Throughout its range, telia of *P. pyrolae* are very scarce and the aecidial stage is unknown although it may be expected to occur on species of *Abies*. *A. nordmanniana* is present in the forests at Artvin but no rust was found on it.

Trachyspora intrusa (Grev.) Arth. Manual of Rusts, 97 (1934).

On *Alchemilla vulgaris* L. agg.; Sivas: Yildiz Dağ, 1800 m., 4 June 1960, *S. & H.* 5347 (II only); Şebinkarahisar to Giresun, 1400 m., 14 June 1960, *S. & H.* 5815 (II & III). Rize: Iliça, 2200 m., 21 July 1960, *S. & H.* 6300. Uredospores subgloboid, thin-walled, 20–26 × 18–23 μ. Trabzon: Hemşikoy, 600 m., 24 July 1960, *S. & H.* 6325 and 6323. Uredinia and telia; teliospores 27–30 × 26–28 μ, wall coarsely and irregularly tuberculate. Artvin: Otingol, 2000 m., 3 July 1960, *S. & H.* 5976 (II & III).

Turkish records: *Alchemilla vulgaris:* 8.
A. acutiloba: 4, 20.

Trachyspora intrusa is widespread in the northern hemisphere and occurs in Iran (Petrak, 1949), W. Pakistan (Ahmad, 1956), and on many segregates of *Alchemilla vulgaris* in U.S.S.R. (Tranzschel, 1939). Unfortunately the segregates *A. vulgaris* have not been elucidated for the Turkish flora so only the aggregate host name can be used here.

Tranzschelia pruni-spinosae (Pers.) Diet. in Ann. Mycol. **20,** 31 (1922).

Turkish records: *Amygdalus communis:* 12A, 46.
A. orientalis: 46.

Anemone coronaria: 12A.
Prunus armeniaca: 12A, 46.
P. domestica: 12A, 46.
P. persica: 12A, 46.

It is almost certain that many if not all of these records refer to *Tranzschelia discolor* (Fuck.) Tranz. & Litv. which is the species commonly found on cultivated *Rosaceae* and *Anemone coronaria.*

Uredo festucae DC. Fl. Fr. **5,** 82 (1815).

On *Festuca rubra* L.; Giresun: Şebinkarahisar to Giresun, 2100 m., 25 June 1960, *S. & H.* 5834. Uredinia only.

This isolated uredo collection is placed under *U. festucae* as it may belong to any one of a few rust species. In N.W. Europe, *P. festucae* and *Uromyces dactylidis* both occur on *Festuca rubra* and of these it seems most probable that *U. festucae* is an isolated uredo stage of *Puccinia festucae.*

Uredo quercus Duby, Bot. Gall. **2,** 893 (1830).

On *Quercus coccifera* L.; Hatay: Iskenderun, sea level, 13 June 1960, *S. & H.* 5511.

Uredinia only; uredospores oblong-ellipsoid to subgloboid, 21–26 × 12–21 μ, wall finely echinulate.

Uredo quercus occurs scattered in the western Mediterranean area on several species of oak, but has not been recorded from the eastern Mediterranean although it occurs in eastern U.S.S.R. (Tranzschel, 1939). *Q. coccifera* appears to be a new host for it. Throughout its range in Europe only uredospores have been found except for one collection from south-eastern France noted by Viennot-Bourgin (1956, p. 225 as a footnote).

Uromyces acantholimonis Syd. in Ann. Mycol. **4,** 28 (1906).

Turkish records: *Acantholimon acerosum:* 40, 42.
A. echinus: 42.
A. kotschyi: 10.
A. sp.: 12A.

The species of *Uromyces* on members of the *Plumbaginaceae* are only doubtfully distinct and often intergrade one with another. *Uromyces acantholimonis* stands between *U. limonii* and *U. armeriae* in morphology and these two are themselves not always very distinct. However, with only limited material at hand a revision of the group would be premature.

The greatest development of the genus *Acantholimon* is in S.W. Asia and within this area infection is known in Iran, Turkey and U.S.S.R.

Uromyces acetosae Schroet. in Rabh. Fungi Eur. 2080 (1876).

Turkish record: *Rumex acetoselloides* (=*R. acetosella*): 12A.

Uromyces aecidiiformis (Str.) Rees in Amer. J. Bot. **4,** 369 (1917).

Turkish record: *Fritillaria pontica:* 4, 17 (as *U. erythronii*).

Uromyces anthyllidis (Grev.) Schroeter in Hedwigia, **14,** 162 (1875).

ANAGYRIS

On *Anagyris foetida* Perge, leg. *Dennis*, May 1962. Uredinia only.

Turkish record: *Anagyris foetida:* 45.

CICER

Turkish record: *Cicer arietinum:* 12A, 45, 46 (as *U. ciceris-arietini*).

HYMENOCARPUS

Turkish record: *Hymenocarpus circinnatus:* 1.

LOTUS

On *Lotus* sp. aff. *palustris*. Priene, Anatolia leg. *Dennis*, May 1962. Telia

On *Lotus* sp.; Erzurum: Tortum Göl, 1250 m., 9 July 1960, *S. & H.* 6122. Uredinia only; uredospores subgloboid 22–24 × 20–22 μ, with 3–4 scattered pores.

ONONIS

Turkish record: *Ononis spinosa:* 45 (as *U. ononidis*).

PHYSANTHYLLIS

Turkish record: *Physanthyllis tetraphylla:* 1.

TRIGONELLA

On *Trigonella* sp.; Trabzon: 2 miles south of Trabzon, 100 m., 16 May 1960, *S. & H.* 5024. Uredinia and telia.

Turkish records: *Trigonella astriotes:* 40.
T. foenum-graecum: 45, 46.
T. monantha: 40.
T. radiata: 40.

Uromyces appendiculatus (Pers.) Unger, Einfl. Bodens, 216 (1836).

Turkish record: *Phaseolus vulgaris:* 12A, 46.

Uromyces argaeus Maire in Bull. Soc. Sci. Nancy, **1906,** 16 (1906).

Turkish record: *Rumex tuberosus:* Maire, *loc. cit.*

This species was described from a collection made on the Erciyas Dağ in 1904 and has not been re-collected. According to the original description it differs from *U. rumicis* by its verruculose papillate teliospores and from *U. acetosae* by its faintly echinulate uredospores and the scattered arrangement of the verrucae on the teliospores. It clearly requires further collection and study. *Puccinia pachyphloea* also occurs on *R. tuberosus* in Turkey and *P. biformis* Lagerh. occurs on the same host species in the western mediterranean region (Guyot & Malencon, 1957).

Uromyces behenis (DC.) Unger, Einfl. Bodens, 216 (1836).

On *Silene* sp.; Rize: Rize to Ispir, 3000 m., 16 July 1960, *S. & H.* 6257. Aecidia only, hypophyllous, aecidiospores faintly verrucose.

Turkish record: *Silene* sp.: 12A.

The identification of solitary aecidia on *Silene* is doubtful, *U. behenis*

is an autoecious species with aecidia. Aecidia on *Silene* have often been accredited to *Puccinia behenis* although the relation between the two has never been confirmed experimentally. Tranzschel (1939) suggested that *P. behenis* is a heteroecious species with an aecidial state unproved but possibly forming on *Bupleurum*.

Uromyces betae (Pers.) Tul. in Ann. Sci. Nat. Bot. 4, **2,** 89 (1854).

Turkish record: *Beta vulgaris:* 12A, 45, 46.

Uromyces bornmulleri Magn. in Verh. Ges. Deutsch. Naturf. Arzte, **61,** 151 (1893).

Turkish record: *Bongardia chrysocoma:* 40.

Uromyces dactylidis Otth in Mitth. Naturf. Ges. Bern., **1861,** 85 (1861).

On *Poa bulbosa* var. *vivipara* Koel.; Nevşehir: Göreme to Ürgüp, 1300 m., 24 May 1960, *S. & H.* 5137. Telia only.

Sivas: Sivas, 1200 m., 22 May 1960, *S. & H.* 5128. Uredinia and telia abundant; growing beside aecidia on *Ranunculus oxyspermus*.

On *Ranunculus oxyspermus* MB. var. *phyrygius* (Boiss.) Davis; Giresun: Aluçra, 1300 m., 19 May 1960, *S. & H.* 5165. Growing with *Poa bulbosa* var. *vivipara*. Spermogonia and aecidia only.

Turkish records: *Ranunculus* (*Ficaria*) *grandiflorus:* 45.
Poa bulbosa: 1.

Uromyces dactylidis is used here in the broad sense to include many races of grass *Uromyces* alternating with Ranunculaceous hosts. The best known alternate with species of *Festuca*, *Poa* and *Dactylis* but undoubtedly other graminicolous connections await discovery. Cummins (1956) includes *Uromyces adelphicus* Syd. described on *Milium trichopodium* from Syria, *U. atropidis* Tranz. on *Glyceria distans* and *U. triseti* Katajev in U.S.S.R. within the compass of *U. dactylidis*. On the basis of my field observations there seems little doubt that in Turkey the race on *R. oxyspermus* alternates with *Poa bulbosa*. The hosts are quite frequently associated and the alternation has every appearance of being obligatory. This, of course, agrees with observations elsewhere that *U. dactylidis* tends to be obligatorily heteroecious.

Ranunculus oxyspermus is closely allied to *R. illyricus* which was suspected of being a host of a race on *Festuca ovina* in U.S.S.R. (Treboux, 1912). Aecidia have been recorded on *R. oxyspermus* from Roumania (Savulescu, 1953), from Syria (Magnus, 1899) and from Tashkent (Tranzschel, 1939) but no mention was made of possible grass hosts.

The rust on *R. kochii* recorded under *Aecidium ranunculacearum* may well belong here but its relation to *U. dactylidis* has never been proved. There must be similar doubt about the relationship of the aecidium recorded on *Ranunculus* (*Ficaria*) *grandiflorus* by Bremer *et al.* (1952).

Uromyces dianthi Niessliu Verh. Naturf. Ber. Brünn, **10,** 162 (1872).

On Malatya: Hekimhan to Malatya, 1400 m., 8 June 1960, *S. & H.* 5449.

Uredinia only, uredospores ellipsoid with four equatorial pores.

Turkish records: *Buffonia virgata:* 20.
Dianthus barbatus: 45, 46.

The aecidia of *U. dianthi* occur on Euphorbias in which infection is systemic. Aecidia of *U. pisi* and other rusts also occur on *Euphorbia* and cannot be distinguished from the caryophyllaceous rust in that state. All the aecidial states known in Turkey are treated as *Aecidium euphorbiae* and it is possible that some of the collections in fact belong to *U. dianthi.*

Uromyces fallens (Arth.) Barth. Handb. N. Amer. Uredinales, 61 (1928).

Turkish records: *Trifolium caudatum:* 4.
T. repens: 4.
T. sp.: 12A.

There are undoubtedly many other suitable hosts for *Uromyces fallens* in Turkey. *T. alexandrinum*, *T. campestre*, *T. carmeli*, *T. clypeatum*, *T. formosum* and *T. spumosum* have all been recorded as hosts in south-western Asia. Some of these records are doubtful for there has been much confusion of the *Trifolium* rusts and without details of the spore stages present it is impossible to be certain as to what is meant by '*U. trifolii*'.

Uromyces formosus Syd. in Ann. Mycol. **6,** 527 (1908).

Turkish record: *Dianthus libanotis:* 52.

Uromyces geranii (DC.) Lév. in Ann. Sci. Nat. ser 3, **8,** 371 (1847).

On *Geranium ibericum* Cav. subsp. *ibericum*; Rize: Rize to Ispir, 3000 m., 16 July 1960, *S. & H.* 6277.

On *Geranium ibericum* Cav. subsp. *jubatum* (Hand.-Mazz.) Davis; Rize: Iliça, 2200 m., 21 July 1960, *S. & H.* 6296.

Both collections with spermogonia and aecidia only; aecidia hypophyllous and on thickened distorted petioles, peridia fragmentary, outer and inner walls of equal thickness.

On *Geranium pusillum* Burm. f.; Giresun: Şebinkarahisar to Giresun, 2100 m., 25 June 1960, *S. & H.* 5837. Uredinia only.

On *Geranium psilostemon* Ledeb.; Rize: in alpine meadow between Ikizdere and Ispir, 2000 m., July 1960, *S. & H.* 6225.

Uredospores subglobose to broadly ellipsoid, 27–31 × 21–24 μ, wall finely and distantly echinulate, echinulae hyaline, up to 1·6 μ long 1·5 μ thick, with one equatorial pore. Teliospores ellipsoid, with a very prominent apical papilla over the pore, 33–43 × 20–23 μ, wall smooth.

On *Geranium pyrenaicum* Burm. f.; Rize: in alpine meadows between Ikizdere and Ispir, 2000 m., July 1960, *S. & H.* 6224.

Infection on this host was much sparser than on *Geranium psilostemon* in the same place and only uredinia were present.

Turkish record: *Geranium pyrenaicum:* 4 (as *U. kabatianus*).

Of the four well-recognised rusts parasitizing *Geranium* only *Uromyces geranii* is known from Turkey although suitable hosts for the others are undoubtedly present. *Puccinia morthieri* and *P. leveillei* are microforms

whose presence is recorded on several species of *Geranium* in U.S.S.R. (Tranzschel, 1939). *P. leveillei* also extends into Chitral and Northern Pakistan (Jørstad, 1952). *P. geranii-tuberosi*, a microform described by Petrak (1953) from Iran, belongs to the same affinity.

Uromyces geranii is very widely distributed in the north temperate region of the Old World and also reaches western North America.

Uromyces glycyrrhizae (Rabh.) Magnus in Ber. Deutsch Bot. Ges. **8,** 383 (1890).

On *Glycyrrhiza glabra* L.; Malatya: Hekimhan, 1300 m., 8 June 1960, *S. & H.* 5419.

Uredinoid aecidia systemic on the leaves, covering the undersurfaces; aecidiospores 27–30 × 22–24 μ, wall delicately echinulate with two equatorial pores. (Teliospores smooth, 17–32 × 15–25 μ with an apical hyaline papilla, Guyot, 1957).

Turkish records: *Glycyrrhiza glabra:* 12A.
G. glandulifera: 8.
G. violacea: 22 (as *U. appendiculata*).
G. sp.: 12A.

Uromyces glycyrrhizae is confined to species of *Glycyrrhiza* and occurs in the Old World from southern Spain and North Africa to western China and in the New World in western North America. The record from Turkey on *Lathyrus tukhtensis* (Henderson, 1959) should be transferred to *U. viciae-fabae*. The perennation of this species was studied many years ago in North America by Olive (1913) who concluded that the rust perennates by mycelium in the host and that haploid and dicaryotic hyphae occur mixed in the host, but there is still doubt as to the interpretation of the sori present. Olive favoured the view that uredinoid aecidia are absent and that the sori are true uredosori. Guyot (1957) accepts this interpretation. Arthur (1934) and Savulescu (1953) regard them as uredinoid aecidia. Certainly, in nature, the resemblance to *Puccinia obtegens* is striking; unfortunately no material was fixed for detailed examination. Only the systemic phase was found. Infected plants are conspicuous by reason of their paler colour and more erect, slightly narrower leaves.

Uromyces gypsophilae Cooke in Grevillea, **9,** 14 (1880).

On *Saponaria*; Konya: Ankara to Konya, 600 m., 28 July 1960, *S. & H.* 6336.

Telia only; teliospores 19–21 × 17–19 μ, wall 2μ thick with scattered warts 2–2·5 μ apart, pore apical with a hyaline papilla, pedicel short.

On *Saponaria*; Sivas: Zara to Suşehri, 1200 m., 23 June 1960, *S. & H.* 5781.

Telia only, containing a few uredospores. Uredospores 23–25 × 21–22 μ, with three equatorial pores. Teliospores subgloboid, 20–22 × 16–20 μ, wall very dark, conspicuously verrucose.

Turkish records: *Gypsophila anatolica:* 20.
G. ruscifolia: 34.
Saponaria orientalis: 40.
Vaccaria pyramidata: 12A, 45.

Uromyces heliotropii Sredinsky in Issatschenko, Parasit. Pilze Gouv. Chernon. 229 (1896).

On *Heliotropium europaeum* L.; Aydin: Aydin, 600 m., 29 July 1960, *S. & H.* 6345.

Uredinia only. Uredospores ellipsoid to subgloboid, wall sparsely echinulate with two equatorial pores.

Turkish records: *Heliotropium europaeum:* 12A, 45.
H. ellipticum: 45.
H. villosum: 24.
H. sp.: 21 (as *Aecidium heliotropii*).

The life history of this species is still uncertain. For long the teliospores were known only from the type description but they have since been described from Israel on *H. rotundifolium* (Rayss, 1937) and from Kazakstan (Nevodovski, 1956) on *H. lasiocarpum*. The aecidial stages on *Heliotropium* are partially understood. Aecidia associated with uredinia on *Heliotropium* in France were identified by Hariot as *Aecidium heliotropii-europaei*. In S.W. Asia however, aecidia on *Heliotropium* may well belong to heteroecious *Puccinia aristidae* on *Aristida* whose relations were confirmed experimentally by Tranzschel. This *Aristida* aecidium corresponds to *Aecidium caspicum* Jacz.

Uromyces laevis Koernicke in Hedwigia, **16,** 38 (1877).

On *Euphorbia macroclada* Boiss.; Sivas: Gürün, 1400 m., 28 May 1960, *S. & H.* 5237.

Telia only, densely covering the undersurfaces of the leaves; teliospores ellipsoid, 26–31 × 22–25 μ, wall smooth, up to 2 μ thick, with an apical pore with a small hyaline cap, pedicel short.

The discovery of *U. laevis* on *Euphorbia macroclada* is of some interest. It has hitherto been found only on *E. seguieriana*. However, the only other smooth teliospored, autoecious rust is an auteuform described by Unamuno (1937) from Spain on *Euphorbia nicaeensis* as *U. euphorbiae-nicaeensis*. The host species involved, *E. nicaeensis* and *E. macroclada* are extremely closely related; the latter replaces the former in the eastern Mediterranean. The evidence is thus strong for correlation between the two rusts. *Euphorbia seguieriana*, another host in the same taxonomic affinity, occurs within the distribution area of both hosts and is also infected with *U. laevis*.

It seems also very probable as Tranzschel (1939) pointed out that some of the smooth-spored *Uromyces* on *Caryophyllaceae* (e.g. *U. arenariae*, *U. formosus*) can form their aecidia on Euphorbias and are correlated with *U. laevis* and *U. euphorbiae-nicaeensis*. Aecidia possibly of this group on *Euphorbia macroclada* are known from Turkey (see under *Aecidium euphorbiae*).

Uromyces lapponicus Lagerh. in Bot. Notiser, **1890,** 274 (1890).

On *Astragalus pinetorum* Boiss.; Sivas: Gürün to Pinarbaşi, 2300 m., 19 June 1960, *S. & H.* 5676.

On *Astragalus* sp. (sect. *Dasyphyllum*); Sivas: Gürün to Pinarbaşi, 1700 m., 19 June 1960, *S. & H.* 5724.

Both collections with spermogonia and aecidia on a systemic mycelium.

Uromyces lapponicus occurs in montane and arctic regions of the northern hemisphere on many species of the genera *Astragalus* and *Oxytropis*. In western Asia it is recorded from Russia on many species of *Astragalus*, *Oxytropis* and *Phaca* (Tranzschel, 1939), from west Pakistan on unnamed species of *Oxytropis* and *Astragalus*, from Iraqi Kurdistan on *Astragalus rugosus* (Picbauer, 1932) and from N. Persia on *A. chrysanthus* (Jørstad, 1959). A rust from N. Persia described by P. & H. Sydow as *Uromyces persicus* on *Astragalus remotijugus* is usually considered synonymous with *U. lapponicus*. The type description of *U. persicus* describes the spores as 23–35 × 21–28 μ with darker wall and a pronounced apical papilla whereas the teliospores of *U. lapponicus* are said to be 21–30 × 20–24 μ with brownish walls and an indistinct papilla. Lack of teliospores in the Turkish collection prohibits assessment of these criteria. The biology of the life history of the fungus in Turkey gave every sign of being the same as the northern European infections seen on *Astragalus alpinus* in Scandinavia in 1961. The aecidium-bearing mycelium is plainly systemic. The association of the aecidial and telial stages in Europe still rests solely on association of the two in the field; it has never been confirmed experimentally.

Uromyces lazistanicus Petrak in Ann. Naturh. Mus. Wien, **52,** 308 (1941).

Turkish record: *Orobus roseus:* 10.

The rust on this host is known only from the type description. It seems possible that it is nothing but a race of *U. viciae-fabae* but unfortunately Petrak did not describe the pores of the uredospores which would have assisted in assessing relationships.

Uromyces limonii (DC.) Lév. in Dict. d'Hist. Nat. Art. Uredinées, 19 (1840).

On *Limonium gmelinii* (Willd.) Ktze.; Sivas: Zara to Sivas, 1300 m., 20 May 1960, *S. & H.* 5089. Spermogonia and aecidia only.

Turkish records: *Limonium* (*Statice*) *sinuatum:* 12A.
L. pycnantha: 20 (as *U. limonii* var. *statices-pycnanthae* Maire).
L. sp.: 34.

Several taxa have been proposed for rusts on *Limonium* and *Acantholimon* in S.W. Asia but it seems doubtful if more than one species would be recognized after thorough revision. On *Statice* (*Limonium*) *pycnantha* Maire (1906) described a variety *statices-pycnanthes* with globular teliospores and telia distinguished from uredinia only with difficulty. Material of this collection has not been examined. Another collection on the same host species and from the same province as Maire's (Nigde) did not show those *differentiae* (Henderson, 1959). The validity of the variety is in doubt. For a rust on *Limonium* (*Statice*) *sinuatum* Rayss (1937) described *U. savulescui* said to differ from *U. limonii* by the crustose texture of the telia and by the more elongate teliospores. Rust on this host has been recorded in Turkey (Bremer *et al.*, 1947) but the material on which the record was based has not been seen. Guyot (1951) considered that Rayss' fungus was doubtfully distinct from *U. limonii*.

U. limonii is widespread on species of *Limonium* in central and southern Europe and North Africa, extending south-eastwards in Iran and eastwards into central Asia. *U. staticae-sinensis* from China belongs to the same affinity.

Uromyces lineolatus (Desm.) Schroet. in Hedwigia, **15,** 108, (1876).

On *Scirpus maritimus* L.; Hatay: Iskenderun, in brackish seaside marshes, 13 June 1960, *S. & H.* 5500.

Uredinia only; uredospores elliptic-ovoid, 26–31 × 16–20 μ, with three equatorial pores.

No aecidium of this rust was found at Iskenderun, but the lack of teliospores suggested that perhaps the population there was non-alternating. Throughout its wide range in N. America, Western Europe and S.W. Asia *U. lineolatus* is known to have many aecidial hosts in very diverse host families; *Apium*, *Daucus*, *Glaux*, *Hippuris*, *Oenanthe*, *Pastinaca* and *Sium*.

Uromyces muscari (Duby) Lév. in Ann. Sci. Nat. ser 3, **8,** 371 (1847).

On *Bellevalia albana* Woronow; Sivas: Sivas, 1300 m., 30 May 1960, *S. & H.* 5265.

Telia only, erumpent, forming large chocolate brown spots; teliospores ovoid-subgloboid, angular, 22–26 × 14–20 μ, wall thin, smooth, pedicel short.

On *Bellevalia* sp.; Sivas: Sivas, 1300 m., 21 May 1960, *S. & H.* 5093. Telia only.

On *Muscari* sp.; Giresun: Aluçra, 1300 m., 19 May 1960, *S. & H.* Telia only.

Turkish records: *Bellevalia ciliata:* 17.
Leopoldia sp.: 40.
Muscari comosum: 40.
M. sp.: 12A.
Urginea maritima: 45.

In the broad sense in which it is used here *Uromyces muscari* includes *U. scillarum*. It parasitizes a wide range of genera of the Liliaceae including, *Muscari*, *Bellevalia*, *Leopoldia*, *Scilla*, *Endymion*, *Hyacinthus* and *Urginea*. Uredospores are rare in this species and usually totally absent as in all the Turkish collections examined. At various times collections of aecidia on *Muscari* and *Scilla* have been associated with the life cycle of *U. muscari* but in fact there is no experimental proof of the association. The aecidia are probably part of the life cycle of graminicolous rusts. This point is more fully discussed under *Aecidium muscari*.

Uromyces nerviphilus (Grogn.) Hots. Publ. Puget Sound Biol. Sta. **4,** 368 (1925).

Syn.: *Uromyces flectens* Lagh. in Sv. Bot. Tidskr. **3,** 36 (1909).

On *Trifolium repens* L.; Trabzon: Trabzon, 20 m., 27 June 1960, *S. & H.* 5850D.

Telia only, hypophyllous on leaves and on petioles. Not previously recorded in Turkey where the host is confined, so far as is known, to the provinces of the north coast. Outwith Turkey, the rust follows *Trifolium repens* throughout its range (Gugot, 1957) and in south-western Asia has been recorded on *Trifolium resupinatum* (Esfandiari, 1948) and on *T. tumens* in Azerbaidjan (Tranzschel, 1939).

Uromyces petitmenginii Maire in Bull. Soc. Myc. Fr. **46,** 230 (1930).

On *Minuartia meyeri* (Boiss.) Bornm.; Malatya: Doganşehir, 1600 m., 9 June 1960, *S. & H.* 5470.

Uredospores mixed with teliospores, subgloboid 17–23 × 22–25 μ, with 2 (3) equatorial pores with prominent hyaline caps; teliospores black in mass, pulverulent, subgloboid, 22–25 × 19–25 μ, wall 2 μ thick, faintly tuberculate with low, distant warts.

The only account of *U. petitmenginii* is Maire's original description of a collection from Greece.

It is quite obvious that there is a complex of *Uromyces* species on *Caryophyllaceae* in S.W. Asia and south and eastern Europe which will require many more collections for proper elucidation. On *Caryophyllaceae* some at least of them seem to be microforms paralleling the many microforms on *Euphorbia*; the two groups deriving originally from full cycle rusts of the *U. dianthi* type.

The collection from Turkey on *M. meyeri* agrees quite well with Maire's description and figures except that the teliospore wall is said to be thicker in his account. Support for identifying our collection with Maire's fungus comes also from the taxonomy of the hosts. Maire's species was on *Minuartia globosa* which is a very close relative of *M. meyeri*; both belong to Series *Montana* of Section *Minuartia* (McNeill, 1963).

Uromyces pisi (DC.) Otth in Mitth. Naturf. Ges., Bern, **1863,** 87 (1863).

Under this name are treated many races of leguminous rusts which are often treated at specific rank e.g. *U. striatus*, *U. laburni* (*U. genistae-tinctoriae*), *U. pisi* s. str., *U. punctatus*. Their morphological similarity is generally recognized. Their aecidial hosts so far as they have been investigated are all members of the genus *Euphorbia*. Within the aggregate there is considerable variation in the type of ornamentation of the teliospore wall, particularly the degree of ordering of the ornamentations to form longitudinal lines.

The *U. pisi* aggregate is undoubtedly close to *U. anthyllidis* another wide-ranging aggregate of leguminous rusts, again with species of *Euphorbia* as aecidial hosts. The discrimination of the two is not always easy. The races within the aggregate are here arranged alphabetically according to host genus.

ARGYROLOBIUM

Uromyces striatus Schroeter in Abh. Schles. Ges. Vaterl. Cult. Nat. Abth. **1869-72,** 10 (1870).

Turkish record: *Argyrolobium calycinum:* 8.

The rust on *Argyrolobium calycinum* has seldom been recorded. Magnus'

original description (1891) is of uredospores only so its attribution to the segregate species *U. striatus* is somewhat doubtful. Tranzschel (1939) added two records from U.S.S.R. but was doubtful of their taxonomic position and had not examined the material. It should be noted that Doidge has described *Uromyces argyrolobii* on *Argyrolobium amplexicaule* from Natal (Doidge, 1932). The description suggests a race of *U. pisi*.

Argyrolobium calycinum is of rather limited distribution in S.W. Asia.

ASTRAGALUS

Uromyces punctatus Schroet. in Abh. Schles. Ges. Vaterl. Cult. Nat. Abth. **1869-72,** 10 (1870).

Turkish record: *Astragalus* (subg. *Tragacantha*): 42.

This race infects a large number of species in the genera *Astragalus* and *Oxytropis* and is widely distributed in Eurasia from western Europe to the Altai. It also occurs in western North America. Alternation with *Euphorbia virgata* and *E. cyparissias* was demonstrated in Russia (Treboux, 1912). Only one record for Turkey reflects the meagreness of the mycological exploration of the country—not a lack of hosts—of which there must be several hundred in the *Leguminosae*.

COLUTEA

Uromyces laburni (DC.) Otth in Mitt. Naturf. Ges. Bern, **1863,** 87 (1863).

Uromyces genistae-tinctoriae (Pers.) Wint. in Hedwigia, **19,** 36 (1880).

Turkish record: *Colutea* sp.: 45, 46.

This race attacks a wide range of genera including *Caragana*, *Colutea*, *Cytisus*, *Genista* and *Laburnum*. *Euphorbia cyparissias*, *E. seguieriana* and *E. virgata* are known aecidial hosts; only the last-named has been found with aecidia in Turkey (see under *Aecidium euphorbiae*).

GALEGA

Uromyces galegae (Opiz) Sacc. in Mem. R. Acad. Padova, **24,** 13 (1874).

Turkish record: *Galega officinalis:* 40.

This race of the *U. pisi* group is little known. No experiments have been carried out on its host specialization in the dicaryont stage and its aecidial host is unknown although it is presumably a species of *Euphorbia*.

The area of distribution of *U. galegae* extends from southern France through northern Italy, and the Balkans to Caucasia (Guyot, 1957).

MEDICAGO

Uromyces striatus Schroet. in Abh. Schles. Ges. Vaterl. Cult. Nat. Abth., **1869-72,** 11 (1870).

On *Medicago sativa* L.; Sivas: Sivas to Zara, 1200 m., 23 June 1960, *S. & H.* 5785 and 5787. Uredinia and telia; uredospores with three equatorial pores, teliospores with striate surface ornamentation.

On *Medicago* sp.; Sivas: Zara to Sivas, 1500 m., 3 June 1960, *S. & H.* 5333. Uredinia only; uredospores with three or four equatorial pores.

Turkish records: *Medicago sativa:* 12A, 45, 46.
M. sp.: 4, 45.

The rusts of *Medicago*, like most leguminous *Uromyces*, have been much confused and the correct placing of published records cannot be determined. *Medicago* is usually considered to be susceptible to two species of *Uromyces*, *U. anthyllidis* and *U. pisi*, both being interpreted in the broad sense. The distinction between these two species taken over their whole host range is not always easy but on *Medicago* they are quite distinct. The race of *U. anthyllidis* on *Medicago* has usually been referred to in the past as *U. magnusii* Kleb. It has not been recorded from Turkey but no doubt occurs there, for it is known from Israel (on *M. blancheanus*, *M. galilea*, Rayss, 1951), Iran (on *M. rigidula*, Jørstad, 1960), Syria (on *M. rigidula*, Sydow, 1935), the Crimea and Caucasus (on *M. minima*, Tranzschel, 1939). It should be noted that the question of the identity of *U. magnusii* Kleb. and *U. medicaginis* Trotter and *U. heimi* Mayor & Viennot Bourgin, has not been settled (see Guyot, 1957, p. 107). Nothing is known of the aecidial hosts of these rusts of the *U. anthyllidis* group on *Medicago*. They presumably may have aecidia on *Euphorbia* species. It is clear however that alternation is not obligatory. The name *U. striatus* Schroet. has been applied to the *U. pisi* race on *Medicago* and *Trifolium* which has very distinctly longitudinally striate ornamentation on the surface of the teliospores. Within W. Asia, *U. pisi* is known on *Medicago denticulata* (Caucasia, Tranzschel, 1939), *M. falcata*, *M. sativa*, *M. lupulina*, *M. tianshanica* and *M, caerulea* (Kazakstan, Nevodovski, 1956), *M. lupulina* (Caucasia and Georgia, Tranzschel, 1939), *M. notata* (Israel, Rayss, 1937), *M. sativa* (Iran, Khabiri, 1952, Lebanon, Rayss, 1946, and Israel, Rayss, 1951), and many localities in U.S.S.R. (Tranzschel, 1939), *M. tuberculata* (Israel, Rayss, 1937) and on *Trifolium arvense* from Caucasia and *T. aureum* from Ukraine (Tranzschel, 1939). "*Uromyces striatus*" is very widely distributed throughout the world whenever suitable hosts occur (C.M.I. Map 342).

Alternation of the rust on *Medicago* belonging to the *U. pisi* group was investigated by Treboux (1912). Aecidiospores from aecidia on *Euphorbia virgata* and *E. seguieruana* (=*E. gerardiana*) infected *Medicago falcata*, *lupulina* and *sativa* and later (1912, p. 562) *M. minima* and *M. murex* were successfully inoculated from *Euphorbia virgata.*

ONOBRYCHIS

Uromyces onobrychidis Bubak in S.B. K. Bohem. Ges. Wiss. II, **46,** 7 (1902).

Turkish records: *Onobrychis cappadocica:* 40.
O. hypargyrea: 45.
O. viciifolia: 12A, 46.
O. sp.: 42.

The race on *Onobrychis* is widespread throughout temperate Eurasia on many species of the genus. The only experimental work on aecidial hosts has been recorded by Guyot (1957) who obtained transmission from *Euphorbia cyparissias* to *Onobrychis sativa.* Turkey is outwith the range of *E. cyparissias* but some other *Euphorbia* probably acts as aecidial host there. This race certainly perennates by uredospores without the intervention of aecidia—a situation which is indeed frequent in many races of the *U. pisi* complex.

VICIA

Uromyces pisi (DC.) Otth *sensu stricto.*

Turkish record: *Vicia angustifolia:* 4.

U. pisi in the strict sense attacks species of *Lathyrus*, *Pisum* and *Vicia* and is recorded on species of all three in U.S.S.R. (Tranzschel, 1939) and on *Pisum sativum* in Cyprus (Nattrass, 1737) and Israel (Rayss, 1951) *Euphorbia cyparissias* and *E. esula* are the only confirmed aecidial hosts of this race. Only the latter occurs in Turkey.

Uromyces polygoni-avicularis (Pers.) Karst. in Bidr. Kanned Finl. Nat. Folk. **4,** 12 (1879).

On *Polygonum cognatum* Meisn.; Sivas: Gürün, 1400 m., 28 May 1960, *S. & H.* 5219. Uredinia only. Pinarbaşi to Gürün, 1700 m., 27 May 1962, *S. & H.* 5197. Aecidia. Malatya: Hekimham, 1300 m., 8 June 1960, *S. & H.* 5444. Uredinia and telia. Gümüşane: Kelkit, 1600 m., 18 May 1960, *S. & H.* 5049. Aecidia.

On *Polygonum* sp. aff. *bellardi* All.; Trabzon: Trabzon, 20 m., 27 June 1960, *S. & H.* 5862.

Uredinia only; uredospores subgloboid, finely and closely verruculose with (2) 3–4 more or less equatorial pores.

Turkish records: *Polygonum aviculare:* 40.
P. cognatum: 40. 42, 37, 4, 8, 24.
P. bellardi: 40.

Uromyces polygoni-avicularis is an exceedingly common rust on *Polygonum cognatum* in Turkey and infection is usually very heavy. Outwith Turkey the rust is very widely distributed in the Northern Hemisphere particularly on *Polygonum* sect. *Avicularia* and has been recorded in S.W. Asia on *P. aviculare*, *P. bellardi*, *P. alpestre*, *P. tubulosum* (Iran, Viennot-Bourgin, 1958) and on *P. equisetiforme*, *P. acerosum* and *P. biaristatum* in southern U.S.S.R. (Tranzschel, 1939).

Guyot's (1938) differentiation of a variety *polygoni-alpestris* based apparently on one or two published accounts of collections from the Near East seems to be ill-founded. His variety is predominantly teliosporic, but in Turkey aecidia are quite common. It seems much more probable that in early spring the telia are the result of autumn infection of seedling host plants whereas the aecidia result from infection from overwintered teliospores. Certainly this point would bear investigation, but recognition of varieties is not justified.

Uromyces proeminens (DC.) Lév. in Ann. Sci. Nat. ser. 3, **8,** 371 (1847).

Turkish records: *Euphorbia chamaesyce:* 20.

Uromyces proeminens is restricted to Euphorbias of section *Anisophyllum* in Eurasia. The aecidial stage is systemic; the dicaryont infection localised. *Euphorbia* rusts of this group are probably correlated with heteroecious leguminous rusts of the *U. anthyllidis* types and with microforms on Euphorbias of the *U. tinctoriicola*, *U. winteri* group. The teliospores of all are rather similar morphologically.

Uromyces rumicis (Schum.) Wint. in Hedwigia, **19,** 37 (1880).

On *Rumex pulcher* L.; Trabzon: Trabzon, 20 m., 27 June 1960, *S. & H.* 5877.

Uredinia and telia; uredospores 25–29 × 18–21 μ, with two supra-equatorial pores, wall smooth, apex with a prominent hyaline papilla.

Turkish records: *Rumex obtusifolius:* 4.
R. patientia: 42.

Uromyces rumicis is a common rust of all three hosts cited above throughout its area of distribution in Eurasia. It is obviously independent of host alternation at most sites but the connection with an aecidial stage on *Ranunculus ficaria* has been elucidated by Gaumann (1931).

Another species of *Uromyces* on *Rumex*, *U. argaeus*, has been described from Erciyas Dağ, Turkey. The host was *Rumex tuberosus* and Maire described the teliospores as verrucose and papillate at the apex. The discrimination of the various rusts of *Rumex* and *Polygonum* is dealt with under *Uromyces polygoni-avicularis*.

Uromyces salsolae Reich. in Verh. Zool. Bot. Ges. Wien, **27,** 842 (1877).

Turkish records: *Noaea spinosissima:* 45.
Petrosimonia brachiata: 40, 42.

Uromyces scutellatus (Pers.) Lév. in Ann. Sci. Nat. Ser. 3, **8,** 371 (1847).

On *Euphorbia virgata* W. & K.; Gümüşane: Soganli Geçidi, 1200 m., 18 May 1960, *S. & H.* 5043.

Infected stems short and barren with leaves only 1–1·5 cm. long and 0·5 cm. broad. Spermogonia and telia only; uredospores present in telia, broadly ellipsoid or subgloboid, yellow, 24–26 × 22–24 μ, wall echinulate, 1–2 μ thick with four irregularly placed pores; teliospores subgloboid or ellipsoid, 26–30 × 23–26 μ, wall brown, 2·5–3 μ thick, with coarse warts often longitudinally elongate and occasionally fused to form striae.

Turkish records: *Euphorbia oblongata:* 17.
E. macroclada: 22.

Uromyces scutellatus is widely distributed in Eurasia on many species of *Euphorbia*. It has been recorded on *Euphorbia virgata* in U.S.S.R. (Tranzschel, 1939) Roumania (Savulescu, 1953) and Iran (Jørstad, 1960).

Uromyces sommerfeltii Hyl. Jørst. & Nannf. in Opera Bot. Upsal. **1,** 19 (1953).

On *Solidago virgaurea* L.; Artvin: Otingol, 1500 m., 4 July 1960, *S. & H.* 6019.

Telia only, blackish-brown in small circinate groups; teliospores obovoid 24–30 × 18–20 μ, wall smooth, up to 8 μ thick at apex.

Uromyces sommerfeltii occurs throughout the north temperate region. Tranzschel (1939) records it from Caucasia. In Eastern U.S.S.R. and North America *U. rudbeckii* also infects *Solidago* but may be distinguished by the light brown colour of the telia.

Uromyces sublevis Tranzschel in Ann. Mycol. **8,** 29 (1910).

Turkish record: *Euphorbia macroclada:* Tranzschel, *loc. cit.*

Uromyces sublevis also occurs on *E. petrophila*, *E. glareosa*, *E. nicaeensis*, and *E. seguieriana*, in eastern Europe and the U.S.S.R.

Uromyces thapsi (Opiz) Bub. in Fungi Bohemici, 96 (1906).

Turkish records: *Verbascum splendidum:* 42.
V. sp.: 34.

Uromyces tinctoriicola Magnus in Verh. Zool.-Bot. Ges. Wien, **46,** 429 (1896).

Turkish record: *Euphorbia seguieriana:* Tranzschel, 1910; 8, (as *U. excavatus*).

The Magnus record is placed here with some doubt for according to Tranzschel (1910) *U. levis* and *U. cristulatus* also infect this host. *U. tinctoriicola* was described from Persian Kurdistan and in south-western Asia is known on *Euphorbia macroclada* and *E. hohenackeri* and in neighbouring regions of U.S.S.R. on *E. glareosa* and *E. seguieriana* (Tranzschel, 1939).

Uromyces trifolii-repentis Liro in Acta Soc. Fauna Fl. Fenn. **29** (6), 15 1906).

On *Trifolium hybridum* L.; Istanbul: Belgrad Forest, 200 m., 12 May 1960, *S. & H.* 5004. Spermogonia, aecidia, uredinia and sparse telia.

On *Trifolium repens* L.; Artvin: Murgul, Magara yayla, 3000 m., 7 July 1960, *S. & H.* 6044. Aecidia only.

Turkish records: *Trifolium physodes:* 42.
T. repens: 12A, 46.

The principle host of *U. trifolii-repentis* is *Trifolium repens* which it follows throughout its range from western Europe and North Africa to Central Asia north to Siberia and south to Pakistan (Ahmad, 1956). It has been introduced to Japan, Australia and New Zealand. This is the same distribution as the microcyclic *U. nerviphilus* on the same host. The two can only be distinguished by the presence of spermogonia, aecidia and especially of uredinia in *U. trifolii-repentis*. *Uromyces fallens* may be distinguished from *U. trifolii-repentis* by the presence of three or four pores in the uredospore wall as against two, rarely more, in the latter.

In south-western Asia *Trifolium fragiferum* is also attacked (Iran, Jørstad, 1960; Israel, Rayss, 1951) and may be expected to be found so in Turkey, as in Europe it is a frequent host. The production of aecidia varies according to host and according to Kobel's work (1920) the species exists in several races. Aecidia are common on *T. repens*, rare on *T. hybridum* and probably unknown on *T. fragiferum*.

Uromyces valerianae (DC.) Lév. in Ann. Sci. Nat. ser. 3, **8,** 371 (1847).

On *Valeriana alliariifolia* Vahl; Giresun: Şebinkarahisar to Giresun, 1800 m., 25 June 1960, *S. & H.* 5842.

Spermogonia, aecidia and uredinia. Uredospores sparsely echinulate with two equatorial or sub-equatorial pores.

Turkish record: *Valeriana alliariifolia:* 20.

U. valerianae is eurasiatic in distribution except for an isolated station in S. Africa. Within its main centre of distribution it does not extend into the more arid regions—the host genus is typically mesophytic. This holds for its distribution in S.W. Asia where it is known on *V. alliariifolia* only in northern Turkey and Caucasia. It is known on several species of *Valeriana* in U.S.S.R. (Tranzschel, 1939).

Uromyces vesicatorius (Bubak) Nattrass. A first List of Cyprus fungi. Nicosia, 10 (1937).

Turkish record: *Leontice leontopetalum:* 12A.

Uromyces viciae-craccae Const. in Ann. Mycol. **2,** 251 (1904).

Turkish record: *Vicia gregaria:* 42.

Uromyces viciae-fabae (Pers.) Schroet. in Hedwigia, **14,** 161 (1875).

On *Vicia crocea* (Desf.) Fedtsch.; Trabzon: Maçka, 250 m., 28 June 1960, *S. & H.* 5886.

Hypophyllous aecidia in groups of six to eight and epiphyllous uredinia; uredospores echinulate with usually three equatorial pores.

On *Vicia hirsuta* (L.) S. F. Gray; Trabzon: Trabzon, 20 m., 27 June 1960, *S. & H.* 5856.

Uredinia only; uredospores 22 × 19 μ, wall delicately echinulate with three to four equatorial pores.

On *Vicia sepium* L.; Rize: Ikizdere to Ispir, 2000 m., 15 July 1960, *S. & H.* 6235.

Uredinia only.

Turkish records: *Lathyrus tukhtensis:* 40 (in error as *Uromyces glycyrrhizae*).
Lens esculenta: 12A, 45, 46.
Vicia faba: 1, 12A, 45, 46.
V. sativa: 12A.
V. sp.: 42.
Pisum sativum: 45.

U. viciae-fabae is widespread on wild and cultivated hosts throughout the north temperate region. In S.W. Asia its occurrence on many species of *Lathyrus*, *Lens*, *Pisum* and *Vicia* (including *Ervum* and *Orobus*) is recorded. Confusion with *U. ervi* is possible. That species occurs chiefly on section *Ervum* of *Vicia* (e.g. *V. hirsuta*, *V. tetrasperma*) but *V. sativa* (sect. *Vicia*) is also susceptible. My collection from Trabzon on *Vicia hirsuta* is certainly *U. viciae-fabae* in that uredinia are dominant (scarce in *U. ervi*) and that three to four pores (usually two or three in *U. ervi*) are present. The collection on *V. crocea* could be *U. ervi*, uredinia were very scanty and the aecidia were at different stages of maturity rather suggestive of the repeating aecidia which are a feature of that species. It appears that this is the first record of a rust on *Vicia crocea.*

Uromyces wartoensis Petrak in Ann. Naturh. Mus. Wien, **52,** 309 (1941).

Turkish record: *Astragalus wartoensis:* 10.

This species is known only from the type collection; on further knowledge it may well prove to be a race of *U. pisi.*

Uromyces winteri Wettst. in Sitz-Ber. K. Akad. Wiss. Wien, **98,** 353 (1890).

Turkish record: *Euphorbia falcata:* 24—from the type locality, the only Turkish record.

Key to literature containing records of rusts in Turkey

1. Magnus (1907)
2. ,, (1909)
3. ,, (1894)
4. ,, (1903)
5. ,, (1896)
6. ,, (1899)
8. ,, (1891)
9. Petrak (1939)
10. ,, (1941)
11. Bubak (1914)
12A. Bremer *et al.* (1947)
15. Viennot-Bourgin (1958)
17. Fritsch (1890)
20. Maire (1906)
22. Rabenhorst (1871)
23. Petrak & Esfandiari (1941)
24. Wettstein (1889)
26. Petrak (1949)
31. ,, (1953)
34. ,, (1956)
37. Rayss (1946)
39. ,, (1951)
40. Henderson (1959)
41. ,, (1957)
42. ,, (1961)
45. Bremer *et al.* (1952)
46. Karel (1958)
52. Picbauer (1932)
53. Rayss (1937)
55. Jørstad (1959)

INDEX TO HOSTS—

Host species	Rust species
Abies bornmuelleriana	*Melampsorella caryophyllacearum*
— *nordmannia*	— —
Acantholimon acerosum	*Uromyces acantholimonis*
— *echinus*	— —
— *kotschyi*	— —
— sp.	— —
Achillea allepica	*Puccinia achilleae*
— *falcata*	— —
— *santolina*	— —
— *talgonica*	— —
— *tenuifolia*	— —
— *vermicularis*	— —
Acroptilon picris	— *calcitrapae*
Adonis aestivalis	— *cynodontis*
— *flammea*	— —
Aegilops cylindrica	— *striiformis*
— *ligustica*	— —
— *ovata*	— *recondita*
— —	— *striiformis*
— *speltoidea*	— —
— *triuncialis*	— —
Agrimonia eupatoria	*Pucciniastrum agrimoniae*
— sp.	— —
Agropyron divaricatum	*Puccinia recondita*
— *repens*	— *graminis*
— —	— *recondita*
— *taurum*	— —
— sp.	— —

Host species	Rust species
Alcea aptera	*Puccinia malvacearum*
Alchemilla acutiloba	*Trachyspora intrusa*
— *vulgaris*	— —
Allium ampeloprasum	*Puccinia allii*
— *myrianthum*	— —
— sp.	— —
Alopecurus arundinacea	*Puccinia recondita*
Alsine sp.	— *arenariae*
Althea rosea	— *malvacearum*
Amygdalus communis	*Tranzschelia pruni-spinosae*
— *orientalis*	— —
Anagyris foetida	*Uromyces anthyllidis*
Anchusa angustissima	*Puccinia recondita*
Andropogon halepensis	— *purpurea*
Anemone coronaria	*Tranzschelia pruni-spinosae*
Anthoxanthum odoratum	*Puccinia poae-nemoralis*
Antirrhinum majus	— *antirrhini*
Arabis graellsiiformis	— *arabidis*
Arctium lappa	— *calcitrapae*
Argyrolobium calycinum	*Uromyces pisi*
Aristida plumosa	*Puccinia aristidae*
Aristolochia maurorum	— *aristolochiae*
— *pallida*	— —
Artemisia fragrans	— *tanaceti*
Asperula breviflora	— *punctata*
Asphodelus microcarpus	— *asphodeli*
— —	— *heldreichiana*
Asplenium septentrionale	*Milesina feurichii*
Aster amellus	*Puccinia cnici-oleracei*
Astericus aquaticus	*Coleosporium tussilaginis*
Astragalus pinetorum	*Uromyces lapponicus*
— *wartoensis*	— *wartoensis*
— sp. (sect. *Dasyphyllum*)	— *lapponicus*
— sp. (subg. *Tragacantha*)	— *pisi*
Atraphaxis billardieri	*Puccinia platypoda*
Avena barbata	— *graminis*
— *fatua*	— *coronata*
— *sativa*	— —
— *sterilis*	— —
— —	— *graminis*
Ballota saxatilis	— *ballotae*
Bellevalia albana	*Uromyces muscari*
— *ciliata*	— —
— sp.	— —
Berberis crataegina	*Aecidium haussknechtianum*
— —	*Puccinia graminis*
— sp.	— —
— —	— *poae-nemoralis*
Beta vulgaris	*Uromyces betae*
Bongardia chrysocoma	— *bornmulleri*
Bothriochloa ischaemum	*Puccinia cesati*
Bromus arvensis	— *recondita*
— *biebersteinii*	— *graminis*
— *intermedius*	— *recondita*
— *madritensis*	— —
— —	— *striiformis*
— *mollis*	— *recondita*
— *sterilis*	— —
— *tectorum*	— —
— *tomentosus*	— *coronata*
Buffonia virgata	*Uromyces dianthi*
Bunium bourgaei	*Puccinia bulbocastani*
— *chaerophylloides*	— —
Bupleurum commutatum	— *bupleuri*
— *croceum*	— —
— *falcatum*	— —

Host species	Rust species
— *heldreichii*	*Puccinia bupleuri*
— *lancifolium*	— —
— *nodiflorum*	— —
— *subovatum*	— —
Calamagrostis littorea	*Puccinia pygmaea*
Calamintha alpina	— *menthae*
— *grandiflora*	— —
— *origanifolia*	— —
— *vulgare*	— —
Caltha polypetala	— *calthae*
Campanula athoa	*Coleosporium tussilaginis*
— *ephesia*	— —
— *lactiflora*	— —
— *lyrata*	— —
— *rapunculoides*	— —
— *tridentata*	*Puccinia campanulae*
— sp.	*Coleosporium tussilaginis*
Carduus armenus	*Puccinia calcitrapae*
— *nutans*	— —
— *olympicus*	— —
— *pycnocephalus*	— *cardui-pycnocephali*
— — var. *albidus*	— —
Carex hirta	— *caricina*
— *hordeiticho*	— —
— *sylvatica*	— —
Carlina corymbosa	— *calcitrapae*
— *oligocephala*	— —
Carthamus tinctorius	— —
Centaurea axillaris	— *montana*
— *behen*	— *persica*
— *cana*	— *montana*
— *carduiformis*	— *calcitrapae*
— *cariensis*	— —
— *ensiformis*	— —
— *iberica*	— —
— —	— *hieracii*
— *lydia*	— *calcitrapae*
— *myriocephala*	— *persica*
— *nigrescens*	— *hieracii*
— *persica*	— *persica*
— *polypodifolia*	— *calcitrapae*
— *pulchella*	— —
— *sessilis*	— —
— *solstitialis*	— —
— —	— *hieracii*
— *squarrosa*	— *calcitrapae*
— *virgata*	— —
— —	— *hieracii*
— sp. (sect. *Cyanus*)	— *calcitrapae*
Cephalaria syriaca	*Aecidium scabiosae*
Chondrilla juncea	*Puccinia hieracii*
Chrysophthalmum dichotomum	*Coleosporium tussilaginis*
Cicer arietinum	*Uromyces anthyllidis*
Cichorium divaricatum	*Puccinia hieracii*
— *intybus*	— —
— —	— *littoralis*
Circaea alpina	*Pucciniastrum circaeae*
— sp.	*Puccinia circaeae*
Cirsium acarna	— *cnici*
— *anatolicum*	— —
— *arvense*	— *punctiformis*
— *hypoleucum*	— *cnici-oleracei*
— *lappaceum* var. *microcephalum*	— *cnici*
— *leucopus*	— *calcitrapae*
— *pisidium*	— —
— *vulgare*	— *cnici*
— sp. aff. *lappaceum*	— —
Clematis cirrhosa	— *recondita*
— *orientalis*	— —

Host species	Rust species
Cnidium sp. aff. *orientale*	*Puccinia physospermi*
Colutea sp.	*Uromyces* sp.
Conium maculatum	*Puccinia conii*
Convolvulus sp. aff. *arvensis*	— *convolvuli*
Cotoneaster racemiflorum	*Gymnosporangium amelanchier*
— *vulgaris*	— *confusum*
Cousinia umbrosa	*Puccinia calcitrapae*
Crataegus heterophylla	*Gymnosporangium clavariiforme*
— *monogyna*	— —
— —	— *confusum*
— —	— *juniperinum*
— *orientalis*	— *confusum*
— *oxyacantha*	— —
— sp.	— —
Crepis alpina	*Puccinia crepidicola*
— *foetida*	— *crepidis*
— *hierosolymitana*	— —
— *paludosa*	— *major*
— *sancta*	— *crepidis*
Crucianella macrostachya	— *crucianellae*
— *syriaca*	— —
Cydonia oblonga	*Gymnosporangium confusum*
Cynodon dactylon	*Puccinia cynodontis*
Cyperus sp.	— *conclusa*
Cystopteris fragilis	*Hyalopsora polypodii*
Datisca cannabina	*Coleosporium tussilaginis*
Dianthus barbatus	*Uromyces dianthi*
— *libanotis*	— *formosus*
Draba aizoides	*Puccinia drabae*
— *cappadocica*	— —
Dryopteris dilatata	*Milesina kriegeriana*
Echinops heldreichii	*Puccinia calcitrapae*
— —	— *pulvinata*
— *ritro*	— *calcitrapae*
— *viscosus*	— *pulvinata*
— sp. aff. *viscosus*	— *calcitrapae*
— sp.	— *pulvinata*
Elymus caput-medusae	*Puccinia graminis*
Epilobium hirsutum	— *pulverulenta*
Eremopyrum cristatum	— *recondita*
Eremurus sp.	— *eremuri*
Eryngium campestre	— *eryngii*
— *noeanum*	— —
Euonymus latifolius	*Melampsora epitea*
Euphorbia chamaesyce	*Uromyces proeminens*
— *cheiradenia*	*Melampsora euphorbiae*
— *eriophora*	— —
— *falcata*	— —
— —	*Uromyces winteri*
— *helioscopia*	*Melampsora euphorbiae*
— *herniariifolia*	*Aecidium euphorbiae*
— — var. *glaberrima*	— —
— *kotschyana*	*Melampsora euphorbiae*
— *macroclada*	*Aecidium euphorbiae*
— —	*Melampsora euphorbiae*
— —	*Uromyces laevis*
— —	— *scutellatus*
— —	— *sublevis*
— *nicaeensis*	*Melampsora euphorbiae*
— *oblongata*	*Uromyces scutellatus*
— *oblongifolia*	*Aecidium euphorbiae*
— —	*Melampsora enphorbiae*
— *peplus*	— —
— *seguieriana*	*Uromyces tinctoriicola*
— *stricta*	*Melampsora euphorbiae*
— *tinctoria*	— —
— *virgata*	*Aecidium* —

Host species	Rust species
Falcaria rivini	*Puccinia falcariae*
Ferulago sp.	— *libani*
Festuca rubra	*Uredo festucae*
Frangula alnus	*Puccinia coronata*
Frankenia hirsuta	*Puccinia frankeniae*
Fritillaria pontica	*Uromyces aecidiiformis*
Galega officinalis	— *pisi*
Galium coronatum	*Puccinia punctata*
— *incanum*	— —
— *punctatum*	— —
— *scabrifolium*	— —
— *subvelutinum* subsp. *leiophyllum*	— —
Garhadiolus hedypnois	— *rhagadioli*
Gaudinia fragilis	— *schismi*
Gentiana cruciata	— *gentianae*
— *gelida*	— —
Geranium ibericum	*Uromyces geranii*
— *psilostemon*	— —
— *pusillum*	— —
— *pyrenaicum*	— —
Geum heterocarpum	*Phragmidium circumvallatum*
Gladiolus atroviolaceus	*Puccinia gladioli*
Glycyrrhiza glabra	*Uromyces glycyrrhiza*
— *glandulifera*	— —
— *violacea*	— —
— sp.	— —
Graellsia saxifragifolia	*Puccinia graellsiae*
Gundelia tournefortii	— *gundeliae*
Gypsophila anatolica	*Uromyces gypsophilae*
— *ruscifolia*	— —
Helianthus annuus	*Puccinia helianthi*
Heliotropium ellipticum	*Uromyces heliotropii*
— *europaeum*	— —
— *villosum*	— —
— sp.	— —
Hieracium crinitum	*Puccinia hieracii*
— *lanceolatum*	— —
— *odontophyllum*	— —
— *pannosum*	— —
— *procerum*	— —
— sp.	— —
Holcus lanatus	— *recondita*
— *setiglumis*	— —
Hordeum bulbosum	— *graminis*
— —	— *striiformis*
— *lanatus*	— *recondita*
— *murinum*	— —
— —	— *striiformis*
— *sativum*	— *graminis*
— —	— *hordei*
— —	— *striiformis*
Hyacinthella lineata	— *lojkoiana*
Hymenocarpus circinnatus	*Uromyces anthyllidis*
Hypericum androsaemum	*Melampsora hypericorum*
— *calycinum*	— —
— *crispum*	— —
— sp. aff. *armenum*	— —
Hyparrhenia hirta	*Puccinia andropogonis-hirta*
Imperata cylindrica	— *imperatae*
Inula helenium	*Coleosporium tussilaginis*
— *heterolepis*	— —
— *viscosa*	— —
Iris sp. (Sect. *Iris*)	*Puccinia iridis*
Jasminum fruticans	— *jasmini*
Juncus acutus	— *cancellata*
— sp. aff. *J. gerardii*	— *littoralis*
Juniperus excelsa	*Gymnosporangium fuscum*
— *nana*	— —
— *oxycedrus*	— *confusum*

Host species	Rust species
Jurinea depressa	*Puccinia pulvinata*
— *pontica*	— —
Lactuca cacaliifolium	*Puccinia prenanthis*
— *orientalis*	— *melanographa*
— *viminea*	— *ankarensis*
Lapsana grandiflora	— *lapsanae*
— *ramossisima*	— —
Lathyrus tukhtensis	*Uromyces viciae-fabae*
Lecokia cretica	*Puccinia smyrnii*
Lens esculenta	*Uromyces viciae-fabae*
Leontice leontopetalum	*Aecidium leonticis*
— —	*Uromyces vesicatorius*
Leopoldia sp.	— *muscari*
Lepidium draba	*Puccinia trabutii*
Ligusticum alatum	— *aphanicondra*
Limonium gmelinii	*Uromyces limonii*
— *pycnantha*	— —
— *sinuatum*	— —
— sp.	— —
Linum anatolicum	*Melampsora lini*
— *cariense*	— —
— *catharticum*	— —
— *gallicum*	— —
— *mucronatum*	— —
— *seljukorum*	— —
— *usitatissimum*	— —
Lolium multiflorum	*Puccinia schismi*
— *perenne*	— *coronata*
— *persicum*	— *graminis*
— *temulentum*	— *schismi*
Lophochloa phleoides	— —
Lotus sp. aff. *palustris*	*Uromyces anthyllidis*
— —	— —
Luzula forsteri	*Puccinia obscura*
Malva erecta	— *malvacearum*
— *silvestris*	— —
Malvella sherardiana	*Puccinia malvacearum*
Medicago sativa	*Uromyces pisi*
— sp.	— —
Melica cretica	*Puccinia graminis*
Mentha aquatica	— *menthae*
— *longifolia*	— —
— *silvestris*	— —
Mespilus germanica	*Gymnosporangium confusum*
Mercurialis annua	*Puccinia cynodontis*
Micromeria fruticosa subsp. *brachycalyx*	— *menthae*
Minuartia meyeri	*Uromyces petitmenginii*
Moltkia coerulea	*Puccinia recondita*
Muscari alpinum	*Aecidium* sp. aff. *muscari*
— *armeniacium*	— —— —
— *comosum*	*Uromyces muscari*
— sp.	— —
Myagrum perfoliatum	*Puccinia trabutii*
Nepeta sp.	— *menthae*
Noaea spinosissima	*Uromyces salsolae*
Nonnea macrocarpa	*Puccinia recondita*
Notobasis syriaca	— *notobasidis*
Omphalodes cappadocica	*Pucciniastrum brachybotrydis*
— *cilicica*	*Puccinia mertensiae*
— *luciliae*	— —
Onobrychis cappadocica	*Uromyces pisi*
— *hypargyrea*	— —
— *viciifolia*	— —
— sp.	— —
Ononis spinosa	— *anthyllidis*
Opopanax hispidum	*Puccinia opopanacis*
— *orientalis*	— —
Ornithogalum eigii	— *hordei*
— *nutans*	— *lojkoiana*

Host species	Rust species
Ornithogalum sp.	*Puccinia liliacearum*
Origanum onites	— *menthae*
— *vulgare*	— —
Orobus roseus	*Uromyces lazistanicus*
Paeonia arietina	*Caeoma* sp.
— *mascula*	*Puccinia martianoffiana*
Pedicularis comosa	*Coleosporium tussilaginis*
Petasites hybridus	— —
— —	*Puccinia poarum*
Petrosimonia brachiata	*Uromyces salsolae*
Peucedanum chrysanthum	*Puccinia carniolica*
— *pisidicum*	— *libani*
Phaeopappus carthamoides	— *calcitrapae*
— *kotschyi* var. *persica*	— —
— *salignus*	— —
Phalaris arundinacea	— *sessilis*
Phaseolus vulgaris	*Uromyces appendiculatus*
Phlomis armeniaca	*Puccinia phlomidis*
— —	— *stapfiana*
— *brevilabris*	— *phlomidis*
— *capitata*	— —
— *nissolii*	— —
Phragmites communis	— *trabutii*
Physanthyllis tetraphylla	*Uromyces anthyllidis*
Picris pauciflora	*Puccinia hieracii*
Pimpinella cappadocica	— *pulvillulata*
— *corymbosa*	— *pimpinellae*
— *cretica*	— —
— *kotschyana*	— —
— *peregrina*	— —
— *pseudotragium*	— —
— *rhodantha*	— —
— *tragium*	— —
— —	— *pulvillulata*
Pinus sylvestris	*Peridermium pini*
Pistacia lentiscus	*Pileolaria terebinthi*
— *mutica*	— —
— *palaestrina*	— —
— *terebinthus*	— —
— *vera*	— —
Pisum sativum	*Uromyces viciae-fabae*
Poa annua	*Puccinia poae-nemoralis*
— *bulbosa*	*Uromyces dactylidis*
— — var. *vivipara*	— —
— *nemoralis*	*Puccinia graminis*
— —	— *poae-nemoralis*
— *pratensis*	— *poarum*
Polygonum aviculare	*Uromyces polygoni-avicularis*
— *bellardi*	— —
— *cognatum*	— —
— *convolvulus*	*Puccinia polygoni-amphibii*
— sp. aff. *bellardi*	*Uromyces polygoni-avicularis*
— sp. (sect. *Persicaria*)	*Puccinia bistortae*
— sp.	— *polygoni-amphibii*
— *mounpeliensis*	— *coronata*
Polystichum aculeatum	*Milesina vogesiaca*
Populus alba	*Melampsora populnea*
— *nigra*	— *allii-populina*
Potentilla hirta	*Phragmidium hirta*
— *macrantha*	— *fragariae*
— *sterilis*	— —
— sp.	— *potentillae*
Poterium sanguisorba	— *sangiisorbae* subsp. *mediterranea*
Prangos denticulata	*Puccinia plicata*
— *euchtritzii*	— *libani*
— *ferulacea*	— —
— *lophoptera*	— —
— sp.	— —
— sp.	— *plicata*

Host species	Rust species
Prunus armeniaca	*Tranzschelia pruni-spinosae*
— *domestica*	— —
Prunus persica	*Tranzschelia pruni-spinosae*
Pyrola media	*Pucciniastrum pyrolae*
Pyrus communis	*Gymnosporangium fuscum*
— *elaeagnifolia*	— —
— *malus*	— —
— —	— *tremelloides*
Quercus coccifera	*Uredo quercus*
Ranunculus grandiflorus	*Uromyces dactylidis*
— *kochii*	*Aecidium ranunculacearum*
— *oxyspermus* var. *phrygius*	*Uromyces dactylidis*
Rhagadiolus stellatus	*Puccinia rhagadioli*
Rhamnus oleoides	— *mesneriana*
— — subsp. *tauricola*	— *coronata*
— *palaestina*	— —
— sp.	— —
Rhinanthus minor	*Coleosporium tussilaginis*
Rosa canina	*Phragmidium mucronatum*
— *foetida*	— *kamtschatkae*
— *glutinosa*	— *tuberculatum*
— *pulverulenta*	— *mucronatum*
— *sulphurea*	— *kamtschatkae*
— sp.	— *mucronatum*
— sp.	— *tuberculatum*
Rubus fruticosus	— *violaceum*
— *tomentosus*	— —
— sp.	*Kuhneola uredinis*
— sp.	*Phragmidium violaceum*
Rumex acetosa	*Puccinia acetosae*
— *acetosella*	— —
— *acetoselloides*	*Uromyces acetosae*
— *obtusifolius*	— *rumicus*
— *patentia*	— —
— *pulcher*	— —
— *tmoleus*	*Puccinia acetosae*
— *tuberosus*	— —
— —	*Uromyces argaeus*
— *tuberosus* subsp. *horizontalis*	*Puccinia pachyphloea*
— sp.	— *phragmites*
Sagina sp.	— *arenariae*
Salix alba	*Melampsora salicis-albae*
— *bornmuelleri*	— *epitea*
— *caprea*	— —
— sp. aff. *triandra*	— —
Salvia acetabulosa	*Puccinia bithynica*
— *amasiaca*	— *nigrescens*
— *cryptantha*	— *bithynica*
— *grandiflora*	— —
— *multicaulis*	— —
— *verticillata*	— *nigrescens*
— sp.	— —
Sanicula europaea	— *saniculae*
Saponaria orientalis	*Uromyces gypsophilae*
— sp.	— —
Satureia hortensis	*Puccinia menthae*
— *spicigera*	— —
Saxifraga adenophora	*Caeoma saxifragae*
— *cernua*	*Puccinia saxifragae*
— *sibirica*	— *heucherae*
— —	— *saxifragae*
Scirpus maritimus	*Uromyces lineolatus*
Scilla sibirica	*Aecidium scillae*
Scabiosa palaestina	— *scabiosae*
— *rotata*	— —
Scaligeria rotundifolia	*Puccinia pimpinellae*
Scorzonera armeniaca	— *podospermi*
— *jacquinianum*	— —

Host species	Rust species
Secale cereale	*Puccinia recondita*
— —	— *striiformis*
Sempervivum globiferum	— *sempervivi*
— sp. aff. *minus*	— —
Senecio orientalis	*Coleosporium tussilaginis*
Senecio orientalis	*Puccinia expansa*
— *platyphyllus*	*Coleosporium tussilaginis*
— *vernalis*	— —
Serratula cerinthifolia	*Puccinia calcitrapae*
— —	— *heterophylla*
Silaus carvifolia	— *opopanacis*
Siler trilobum	— *sileris*
Silene sp.	*Uromyces behenis*
Smyrnium connatum	*Puccinia smyrnii*
— *olusatrum*	— —
Solidago virgaurea	*Uromyces sommerfeltii*
Sonchus oleraceus	*Miyagia pseudosphaeria*
Sorbus aria	*Gymnosporangium tremelloides*
Stachys grandiflora	*Puccinia betonicae*
— *lavandulifolia*	— *harioti*
— *spectabilis*	— —
Staehelina lobelii	— *phaeopappi*
Stellaria sp.	— *arenariae*
Stipa szovitsiana	— *wolgensis*
— sp.	— —
Stizolophus coronopifolius	— *hieracii*
Symphytum sp.	*Melampsorella symphyti*
Taeniatherum crinitum	*Puccinia striiformis*
Tanacetum balsamita	— *balsamitae*
— *myriophyllum*	— *tanaceti*
— *praeteritum* subsp. *massicyticum*	— —
Taraxacum bithynicum	— *kurdistani*
— *crepidiforme*	— *hieracii*
— *kok-saghyz*	— *kurdistani*
— *megalorhizon*	— —
— *montanum*	— —
— *officinale*	— *hieracii*
— *serotinum*	— —
— sp.	— *dioicae*
Taraxacum sp.	*Puccinia hieracii*
— sp.	— *kurdistani*
Teucrium chamaedrys	— *chamaedrys*
Thesium divaricatum	— *thesii*
— *micranthum*	— —
Thymus kotschyanus	— *serpylli*
— sp.	— —
Tragopogon latifolius	— *hysterium*
Trifolium caudatum	*Uromyces fallens*
— *hybridum*	— *trifolii-repentis*
— *repens*	— *fallens*
— —	— *nerviphilus*
— —	— *trifolii-repentis*
— sp.	— *fallens*
Trigonella astriotes	— *anthyllidis*
— *foenum-graecum*	— —
— *radiata*	— —
— sp.	— —
Triticum aestivum	*Puccinia recondita*
— —	— *striiformis*
— *sativum*	— *graminis*
— —	— *recondita*
— —	— *striiformis*
Tussilago farfara	— *poarum*
Urginea maritima	*Uromyces muscari*

Host species	Rust species
Vaccaria pyramidata	— *gypsophilae*
Valeriana alliariifolia	— *valerianae*
Verbascum splendidum	— *thapsi*
— sp.	— —
Vicia angustifolia	— *pisi*
— *faba*	— *viciae-fabae*
— *gregaria*	— *viciae-craccae*
— *hirsuta*	— *viciae-fabae*
— *sativa*	*Uromyces viciae-fabae*
— *sepium*	— —
— sp.	— —
Vinca herbacea	*Puccinia vincae*
— *major*	— —
— *pubescens*	— —
Viola kitaibeliana	— *violae*
— *olympica*	— —
— *sylvatica*	— —
— sp.	— —
Vulpia myuros	— *schismi*
Zea mays	— *sorghi*
Zizophora clinopodioides	— *zizophorae*
Zoegea leptaurea	— *buharica*

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