

Critical notes on some plant rusts—II*).

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1. Structure of the telium in *Nothoravenelia japonica*.

Nothoravenelia Diet. is a monotypic genus described by Dietel (1910) with *N. japonica* Diet. as type, parasitic on the leaves of *Securinega fluggeoides* in Japan. Only uredia and telia are known for the rust, the latter affording the diagnostic characters of the genus. Opportunity for examining the telial stage of the rust, in specimens deposited in the Royal Botanic Gardens, Kew, England, became available through the kindness of Dr. E. M. Wakefield.

In his descriptions of the telia of *Nothoravenelia*, Dietel made no mention of the subcuticular or subepidermal nature of the sori. A careful examination of the telial sorus indicates that the initials are at first subepidermal, organised within the substomal space, and after emerging out through the stoma form the sorus above the epidermis, similar to the condition present in *Olivea* Arth. The sori therefore appear superficial, without there being evidences of the rupture of the epidermis. A palisade layer of basal cells are at first differentiated in the sorus formed above the epidermis, being surrounded by paraphyses which are marginal and incurved. The basal cells abstrict off in basipetal succession two to three spores in chains. These are compactly united with one another both laterally and terminally to form a discoid pulvinate head. The telial head is separated from the basal cells by a single layer of thin-walled intercalary cells which are homologous with the spores in development.

As the telial heads mature, the upper two to three layers of cells become thick-walled, reddish-brown and with rich cell contents. In contrast, the lowermost tier of cells, which was referred above as intercalary cells, remain thin-walled and sterile. At maturity, there is a distinct cleavage furrow formed between the basal cells and the sterile intercalary cells which infact function as abstrictor cells. Consequently the entire telial head separates away carrying with it a fringe of the sterile intercalary cells at the base. The development of more than one telial head successively from the same sorus has been noticed, similar to those observed by Dietel also.

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In describing the generic characters Dietel states that the teliospores in *Nothoravenelia* are two-celled at the centre and those along the edge remaining one-celled. Present study however indicates that the teliospores are one-celled and produced in chains as in *Angiospora* where the teliospores were once mistaken for two-celled *Puccinia*-like spores.

2. Status of the genus *Dichlamys* Syd.

The genus *Dichlamys* was established by Sydow (1919) with *D. Trollipi* (Kalchbr. & Macow.) Syd. as type, occurring on *Zygo-phyllyum foetidum* in South Africa. The rust was first placed under *Uromyces* by Kalchbrenner (1882) and by Sydow H. and P. in Monographia Uredinearum II (1910). However in 1919, it was raised to the rank of a separate genus by H. Sydow, taking as distinguishing characters, the presence of *Uromyces*-like teliospores with coloured endospore and hyaline exospore which swells appreciably in water. As pycnia and aecia are unknown for the rust, the hygroscopic nature of the hyaline exospore alone is made use of in separating the genus from *Uromyces*. The genus has been recognised as valid by Dietel (1928) who cites a single species.

Specimens of *Dichlamys Trollipi* and *D. Harmsianus* (P. Henn) Doidge (= *Uromyces Harmsianus* (P. Henn) Doidge) became available through the kindness of Dr. E. M. Doidge. The uredia in both the species are subepidermal and erumpent, with globose to ellipsoid urediospores. The telia are also subepidermal, erumpent, and the teliospores are pedicellate, reddish-brown, one-celled, with a single apical germ pore as in *Uromyces*. The exospore is hyaline or light-brown and hygroscopic. In *D. Harmsianus*, the exospore swells considerably and finally bursts away.

Studies on several other rusts indicate that the characteristic swelling of the exospore is only a specific character and cannot be considered as having generic significance. Mundkur & Thirumalachar (1946) showed that in *Puccinia Alli-Cepulae* the exospore in the teliospore swells considerably in water. Similarly several other rusts have hygroscopic wall layer in the teliospore. Mention may be made of *Uropyxis Amorphae* where the exospore swells in water up to 15 μ and finally bursts away. It is true that among the smut genera, the genus *Kuntzeomyces* P. Henn. is distinguished by its hygroscopic outer wall layer. However, its 3-layered wall is an important distinguishing character separating it from *Cintractia*. Pycnial and aecial stages being so far unknown for *Dichlamys*, it seems advisable to treat it as a synonym of *Uromyces* as adopted by Doidge (1926) also.

3. On *Endophylloides portoricensis* Whetzel & Olive.

Endophylloides is a monotypic genus described by Whetzel and Olive (1917) on *Mikania cordifolia* in Porto Rico. The rust is well distributed in some of the Central American countries. Whetzel and Olive separated *Endophylloides* from *Endophyllum* in that, the latter is much more like an *Aecidium* with prominent peridial cells and pulverulent spore mass. In the aecioid telium of *Endophylloides* the peridium was stated to be wanting or atleast inconspicuous.

Sections through young as well as mature telia of *Endophylloides portoricensis* from several exsiccati material indicated the organisation of the sorus as in *Aecidium*, with the peridial cells lining the sorus in early stages. As the telium matures, the aecioid teliospores are abstricted off in basipetal succession, differentiating off alternately the fertile spores and the sterile intercalary cells. Unlike as in *Endophyllum*, the spores do not get separated, but become united into a compact columnar telium formed by the coalescence of the teliospore chains. Mature teliospores germinate away at the apex and the developing telial column protrudes considerably above the level of the epidermis of the host.

While the peridial cells are formed lining the young sorus, in mature telia they are found as thin evanescent cells borne on the telial column. In their disposition they resemble the telial columns of *Gambleola cornuta* Masee (Thirumalachar 1947) where they form the outermost layer of the spore tendril and do not line the margin of the sorus. Since in the mature telia of *Endophylloides portoricensis* there is space separating the margin of the sorus and the telial column, it is possible to overlook the presence of the peridial cells. Consequently *Endophylloides* is separated from *Endophyllum* not by the lack of peridia or their inconspicuous nature as stated by Whetzel and Olive, but by the occurrence of columnar telia formed the lateral and terminal coalescence of the spore chains.

4. On *Mimema Holwayi* Jackson.

The rust genus *Mimema* was founded by Jackson (1931) to accomodate a rust on *Cassia versicolor* collected by Holway in Bolivia, South America. In his description of the genus Jackson states that *Mimema* closely parallels *Hamaspora* Koern., but with the difference, that it parasitised a member of the *Leguminosae* instead of *Rosaceae*. For the benefit of those who failed to recognise genera merely based on host groups, he also proposed the alternate name *Hamaspora Holwayi*.

A careful restudy of authentic specimens deposited in the Arthur-Herbarium, has shown characteristic differences distinguish-

shing *Mimema* from *Hamaspora*. The uredia in *Mimema Holwayi* which is the only species so far known, are subepidermal, erumpent and paraphysate. But the paraphyses arise on the sides of the mouth, developing on a hyphoid base as in species *Cerotelium*. In contrast, the paraphyses in *Hamaspora* species are similar to those found in *Phragmidium*.

The teliospores of *Hamaspora* are spindle-shaped and thread-like in contrast to the more cylindrical spores of *Mimema* which show greater resemblance to those of *Sorataea Amiciae* Syd. In the latter rust, occasionally three-celled teliospores have been found (Thirumalachar & Cummins 1948) which emphasises further its close relationship with *Mimema*. Jackson also pointed out this feature and stated that the uredia of *Mimema Holwayi* and *Sorataea Amiciae* (= *Allopuccinia diluta* Jackson) are also closely similar. However a careful study of the uredia of *Sorataea Amiciae* by the writer has revealed that its sorus is formed as in *Olivea*. The uredial initials are at first grouped in the substomal space and after emerging out of the stoma form the sorus above the epidermis, thus appearing superficial. Further, the sorus is covered with a basket of paraphyses which are marginal and incurved. This is in contrast to the condition prevailing in *Mimema Holwayi* which resembles that of *Cerotelium* species. A careful scrutiny of the photomicrograph of the uredium given by Jackson as belonging to *Allopuccinia diluta* (= *Sorataea Amiciae*) appears to be that of *Mimema Holwayi*.

5. On *Sarcorhopalum* Rabenh.

Sarcorhopalum was described as a rust genus by Rabenhorst as far back as 1851 on the fronds of *Aspidium curvifolia* collected in the Nilgiri Hills, South India. *S. tubaeforme* Rabenh. was designated as the type. The fungus was stated to produce 4—6 mm. long outgrowths on the fronds intermixed with paraphyses and appearing like *Cronartium*. Since the writer had occasion to visit Nilgiri Hills, opportunity was taken to collect the same fungus in several localities. From recent literature however it is evident that Rabenhorst was mistaking the antler-like outgrowths produced by *Taphrina* species for the spore tendril of *Cronartium*-like rust. An earlier collection in 1939 made by Dr. M. O. P. Iyengar in the same locality and sent to Dr. Mix has been identified by the latter (1949) as *Taphrina cornu-cervi* Giesenhagen. Mix further records the notes on the herbarium sheets of this species in Patouillard's Herbarium now housed at the Farlow Herbarium. One is labelled „Herbarium Stendel“ Pl. Indiae Orientalis (M. Nilgiri), Ed. R. F. Hohenacker 901, *Roestelia tubaeformis* Rabenh. n. sp. in *Aspidio curvifolio* Kze. in Montibus Nilgiri. The second, *Taphrina tubiforme*

Lagerh. New Caledonia and *T. tubiforme* Lagerh. Tahiti, Herb. Pancher. Mix who examined these specimens reports that the antler-like outgrowths are characteristic. It appears that the name *Taphrina tubiforme* was not validly published by Lagerheim.

Giesenhagen described the same fungus under the name *Taphrina cornu-cervi* Giesenhagen in 1892, from material collected in Nepal (India) and Ceylon. Everthough Rabenhorst mistook the fungus for a rust, the name *Sarcorhopalum tubiforme* was validly published. It is of interest to note that neither Clements & Shear (1931) nor Mix (1949) took notice of the genus and do not include it even under synonymy. The specific epithet '*tubiforme*' has definite priority over Giesenhagen's species *T. cornu-cervi*. Though not validly published, Lagerheim has rightly used the specific name *Taphrina tubiforme*. *T. cornu-cervi* should be treated as a synonym of *T. tubiforme* (Rabenh.) Lagerh.

6. On the identity of two rusts on *Toddalia aculeata*. Pers.

In an earlier paper by the writer (1942), two rust species on *Toddalia aculeata* var. *gracilis* and var. *floribunda* were placed under *Didymopsora* as *D. Toddaliae* and *D. macrospora* respectively. The two differed as regards the sizes of pycnia and the urediospores and teliospores. Both the rusts were described as brachy forms, with intraepidermal pycnia and subepidermal uredia and telia. The teliospores were hyaline, two-celled, produced in catenations to form short ephemeral spore columns. The two rust species were placed under *Didymopsora* tentatively taking into account the development of short ephemeral telial columns composed of two-celled, hyaline, apparently sessile *Puccinia*-like teliospores. In ascribing the two rust species, to *Didymopsora*, the following differences were also recorded in the paper which are quoted here; (a) The pycnia are amphigenous and intraepidermal in the *Toddalia* rust, where as they are reported to be subepidermal in all the species of *Didymopsora* so far recorded. (b) The teliospores (in *D. Toddaliae*) rupture the epidermis and on account of close adpression are exerted out in short columns. The basal spore is borne on a basal cell, which however is not present in the mature spore at the top. (c) The basal spores (teliospores of *D. macrospora*) have pedicels measuring up to 15—51 μ . Spores scaped from young telium retain their pedicels and can be mistaken for pedicellate teliospores. But all the mature teliospores are sessile, hyaline or pale yellow and very much constricted at the septa.

From the above account given in the earlier paper (1942) it was of interest to derive the sessile condition of the teliospore from the initial pedicellate nature. Fresh telial material of both *D. Toddaliae*

and *D. macrospora* which became available recently, enabled further studies. The teliospores produced from the base of the sorus are pedicellate and new spores are developed, they are pushed upwards. They present the same appearance as *Uromyces alpinus* (= *Schroeteria alpinus*) whose teliospores were misconstrued to be sessile, till M a i n s (1934) demonstrated the pedicels. As the teliospores mature, the pedicels appear to soften and deliquesce away. Consequently in the mature spore, the remnants of the pedicels are almost absent, presenting a sessile appearance. Since the teliospores at the time of their formation are pedicellate, they are distinctly separate from those of *Didymopsora*. The gelatinization of the pedicels to present a pseudo-sessile appearance in the *Toddalia* rust is reminiscent of *Coleopuccinia* and *Gymnosporangium*. The two rust species belong to an undescribed genus and the writer proposes the name *Didymopsorella* for their accomodation.

Didymopsorella Thirumalachar gen. nov.

Pycnia intraepidermal, applanate. Aecia uredinoid, subepidermal; aeciospores resembling the urediospores. Uredia subepidermal, urediospores pedicellate. Telia subepidermal, erumpent, producing short ephemeral columns, without peridia; teliospores two-celled, produced in succession, adhering lateally to one another, spore mass emerging out in semipermanent columns, hyaline, pedicellate at first, and later sessile due to deliquescence of pedicels; mature spores germinating without rest period; promycelium external and four-celled.

Type species: *Didymopsorella Toddaliae* (Petch) Thirumalachar on *Toddalia aculeata* var. *gracilis*. (Syn. *Uredo Toddaliae* Petch, *Didymopsora Toddaliae* Thirum. & Mundkur.).

Pycnia intraepidermalia, applanata. Aecia uredinoidea, apara-physata. Uredia subepidermalia, erumpentia; uredosporae pedicellatae. Telia subepidermalia, in breviusculis columellis erumpentia; teliosporae bicellulares, paulatim oriundae, lateraliter inter se cohaerentes et in catenis subpermanentibus emergentes, hyalinae, primum pedicellatae, demum pedicellis deliquescentibus sessiles, in maturitate promycelio externo, 4-cellulari germinantes.

Species typica *Didymopsorella Toddaliae* (Petch) Thirumalachar.

The rust on *Toddalia aculeata* var. *floribunda* is transferred under *Didymopsorella* as *D. macrospora* (Mundkur & Thirum.) comb. nov. A single rusted leaf of *Eugenia jambolana* collected in Nandi Hills revealed it to be a species of *Didymopsorella*.⁸ Spore measure-

ments indicated that it was distinct from both *D. Toddaliae* and *D. macrospora*. On account of the paucity of the material, the specific diagnosis of this rust is deferred.

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