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The Galls of Norway

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The Galls of Norway. By JAMES W. H. TRAIL, M.A., M.D.,
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(Read 8th March 1888.)

During two visits which I made to Norway—the first in 1878, to the fiords near Bergen, Trondhjem, and Christiania, and the second, in August 1887, to the upper part of Hardanger with the Scottish Alpine Botanical Club,—I collected such galls as I could discover, chiefly with a view of comparing them with the species that I had found in Scotland. On working them out I found a great general similarity to the Scotch species, though with minor differences; but I was still more interested to find that very little had been published that threw light upon the galls of Norway, and that my observations seemed to add considerably to previous records, slight though my collections were. In the hope that they may prove of some value as a contribution towards a knowledge of the geographical distribution of European galls, though no actual novelties have to be put on record, I have prepared an exhaustive account of the galls brought home by me, restricting the descriptions to those characters of diagnostic value. For each I have given the localities in which the specimens were found by me in Norway, the localities in Scotland, when Scotch, and the recorded distribution on the Continent of Europe.

For the sake of easy reference, the galls are arranged primarily in the order of the plants on which they occur (following the arrangement in use in English books); and where several galls were found on any host, *e.g.*, on *Tilia parvifolia*, they are arranged in the order of the relative rank of the gall-makers, beginning with the higher insects, and passing downwards to the mites. A list is added, in which the gall-makers are arranged in their relative rank, without reference to the host-plants.

In an Appendix a summary is given of all the information that I have been able to gain with reference to any previous records of galls or gall-makers in Norway.

Cerastium triviale, Link.—Pseudo-galls of an homopterous insect, *Trioxa Cerastii*, H. Loew, were of very frequent occurrence at Vik, Eide, and other places in Hardanger, in August 1887. They are produced by the irritation due to the con-

tinued attacks of the larvæ and pupæ, which may be found in multitudes living amid a whitish woolly secretion, between the inflated and imbricated leaves of the terminal buds. The pseudo-galls may reach the size of a large walnut, though frequently not exceeding that of a hazel-nut; but for a while they do not change colour from the normal green. The inflorescences are very often involved, and remain stunted and abortive. This gall has not been recorded as British; but there is a gall of very frequent occurrence on various species of *Cerastium* in Scotland that very much resembles its smaller forms. The Scotch gall is the work of an aphid (*Brachycolus Stellaris*, Hardy), which lives upon *Cerastium* sps. and *Stellaria Holostea* in early summer, and produces similar galls on *Holcus lanatus*, *Agrostis alba*, and other grasses in autumn. *Trioza Cerastii* has been recorded previously from Bohemia, Thuringia, Silesia, Bavaria, the Tyrol (where I have found its galls in the Brenner Pass), Lower Austria, and Åbo in Finland. I have also found it on the Rigi in Switzerland.

Tilia parvifolia, Ehrh.—All the galls about to be mentioned from this tree were found in the vicinity of Eide, on 13th August 1887. They all appear to be identical with galls already described from Central Europe, some of which also are found in Scotland; but from several of them the makers have not yet been reared, and they bear only provisional names.

1. A leaf bearing several of the unmistakable galls of *Hormomyia Reaumuriana*, F. Loew, was found by Professor Bower, and given by him to me. The galls are scattered in the leaf-blade, projecting like a cone both above and below, the lower cone being the more acute. When mature they open (to allow the larva to emerge) by a kind of lid on the upper surface. Though not known as Scotch, these galls are not rare in Central Europe.

2. On several trees the leaves and bracts bore numerous examples of the very inconspicuous blister-like galls of *Cecidomyia Frauenfeldi*, Kalt. From two to eight may be found on a leaf, scattered over the surface. When fresh they can hardly be detected, except on a close search, as they project very little above the general surface, and do not differ from it in colour. Their lower surface is rather the

more prominent, and bears a small central umbo. After a time they become far more conspicuous, owing to changing to a pale brown colour. The larva have not yet been reared from them.

3. Upward-rolled thickened leaf-margins that appear to be the galls of *Cecidomyia Tiliae* (Schranck), H. Loew; but I found them only on one tree, and in too withered a condition to permit of certainty, as there was no trace of the larvæ in them. Similar galls occur near Aberdeen.

4. On a twig I found two galls that agree well with some of the galls of *Sciara tiliicola*, Winnertz, that I possess from other localities. They are rounded, fleshy, but hard swellings, about 6 or 8 mm. in diameter, and situated near the tip of the twig. This gall occurs in Britain, and is common on the Continent.

5. *Ceratoneon extensum*, Bremi, or the "nail-galls" of limes. —These well-known galls are widely distributed in Europe, and are found in various parts of Scotland. Their peculiar form, like small nails or rifle-bullets projecting from the upper surface of the leaf, renders their recognition easy; they are the work of a gall-mite (*Phytoptus* sp.).

6. *Erineum tiliaceum*, Persoon, originally described by Persoon as a fungus, but now known to be the work of gall-mites of the genus *Phytoptus*, was not uncommon in the form of patches, 4 to 10 mm. across, on the lower surface of the leaves. These are pale, or tend to become violet or purple, and have a velvety appearance, due to the numerous erect simple hairs that form the gall; between the hairs live the mites. This gall has been found in various places in Scotland, and it is recorded from Germany and from Austria.

7. On a single leaf that I brought from Eide, and which may belong to *T. grandifolia*, Ehrh., are several galls about the size of hemp-seed, in the axils of the chief veins. They are hard and rather prominent, but smooth, above; their lower surface is covered with a considerable tuft of rusty-brownish hairs, similar to, but much more abundant than the usual hairs in the axils of the chief veins. This gall also is the work of a species of *Phytoptus*. It is probably the *Erineum bifrons* of Le Pelletier de St Fargeau. I have specimens of this gall from Perthshire. It is recorded from Germany and from Austria.

8. *Legnon crispum*, Bremi.—In this gall the margins of the leaves are rolled into narrow warty tubes, in the interior of which live the mites (*Phytoptus* sp.) that produce them. The tubes are very irregular in width, but do not resemble any of the other mite-galls of the limes. They may be readily overlooked, being inconspicuous, as they seldom exceed 2 or 3 mm. in breadth, and 20 mm. in length. Examples are in my possession from Bonn, and from Salzburg in the Tyrol. I am not aware of the occurrence of this gall in Scotland.

Of the above galls on *T. parvifolia* some leaves bore Nos. 2, 6, and 8, and others bore 5, 7, and 8.

Geranium sanguineum, Linn.—In 1878 I brought home with me, from Hardanger, a single example of the mite-galls produced by *Phytoptus Geranii*, Thomas. The galls are involute leaf-segments, which become slightly thickened and fleshy, and form tubes in which the mites live. Usually a mass of the galls is clustered at the tip of a stem, where it is very conspicuous, some masses reaching the size of a large walnut. The galled leaves are often bright red or yellow. These galls are very frequent on the coast south of Aberdeen, and they have also been found at Allonby in Cumberland. On the Continent of Europe they are recorded from Thuringia, Austria, Croatia, and Switzerland (Lugano).

Acer Pseudo-Platanus, Linn.—In the town of Bergen, both in 1878 and in 1887, I observed the leaves of several trees almost covered with multitudes of the small red "nail-galls" known as *Ceratoneon vulgare*, Bremi, the work of gall-mites of the genus *Phytoptus*. Frequently a single leaf bears hundreds of these galls, usually crowded in patches as closely as they can be packed together. They are widely distributed over Europe, and are common in Britain.

Lotus corniculatus, Linn.—The well-known and common galls of *Cecidomyia Loti*, De Geer, were found upon this plant at Vik, on the Hardanger Fiord, last August. They consist of flower-buds much swollen and fleshy, which do not open, are almost always more or less deep purple-red in colour, and are very conspicuous. They are common in Britain, and are widely distributed throughout Europe.

Astragalus alpinus, Linn., was found on the way from Oiford to the Voringfos, last August, bearing numerous galls

of a midge (*Cecidomyia* ? *Onobrychidis*, Bremi), in the form of inflated, conduplicate, yellowish-green, rather fleshy, isolated leaflets, or terminal swellings on the young stems, made up of a mass of ill-formed young leaves of the bud, the whole mass being often about the size of a large pea. Often a number of leaflets are galled on each leaf. No midge-gall has been recorded previously from this species of *Astragalus*, so far as I can learn.

Vicia Cracca, Linn.—Masses of galls occur on the tips of the stems, reaching the size of a large hazel-nut. These galls consist of the pinnæ of the younger leaves, near the tips of the stems, all crowded into masses, the larger of which are sometimes as much as 30 mm. in diameter. Each leaflet is conduplicate, inflated, rather fleshy, and yellowish-green or dull yellow. Occasionally some of the separate leaflets of an otherwise healthy leaf are galled in this same way, but remain isolated. Each leaflet is tenanted by one or more larvæ of a midge, probably *Cecidomyia Viciæ*, Kieffer. Similar galls are common on *V. Cracca*, as well as on allied Leguminosæ, in Scotland; *C. Viciæ* has been recorded from *V. sepium* in Lorraine.

Prunus Padus, Linn.—In 1878 I found the leaves of this tree near Christiania much infested with the galls known as *Ceratoneon attenuatum*, Bremi, caused by mites (*Phytoptus*); and last August I met with the same galls even more plentifully in the Jordal valley, near the Buarbræ in Hardanger. They belong to the type of "nail-galls," standing erect on the upper surface of the leaf, to which they are fixed by a narrow base. Usually each leaf bears a considerable number of the galls scattered irregularly over it. They vary a good deal in form, some being spindle-shaped, others being turbinate or oval, and warty. They are dull-green, yellow, or red. In the Jordal the leaves very often bore the galls intermixed with large spots of the fungus *Polystigma fulvum*, Tul. The galls are abundant in Scotland, and are widely distributed throughout Europe.

Spiræa Ulmaria, Linn.—On this plant I found at Eide, in 1878, galls of the midge *Cecidomyia Ulmaricæ*, Bremi. They are scattered in the substance of the leaves, are about the size of small shot, and are turbinate in form, the rounded end projecting from the upper surface, and the conical end

below the leaf-blade. They are very common in Britain and throughout Central Europe.

Geum urbanum, Linn.—Near the Buarbræ, in Hardanger, at about 1500 feet above the sea, I found numerous leaves bearing an abundant coating of *Erineum gei*, Fries, originally regarded as a fungus. It is the work of mites (*Phytoptus*), and consists of patches of silky or woolly hairs, on either surface of the leaf, but far more frequently on the lower. Occasionally they are bounded by the veins, but more often they thin out round their edges. The reverse surface of the leaf, opposite each patch, is wrinkled and discoloured, becoming yellowish or dull red. The hairs are usually white, but show a tendency to become violet or rusty brown. Often the leafstalks and stems also are affected. This gall is not known as British, but has been recorded from Sweden (on *G. rivale*), Thuringia, Austria, Switzerland, and France.

Sedum Rhodiola, Linn.—Galls formed by a *Phytoptus* were common in Hardanger last August, in the Simodal, near Eide, and on the way to Vossevangen, on the leaves and inflorescences of this *Sedum*. They are apt to form crowded masses, which deform greatly the organs attacked; all the young leaves, or the flowers at the tip of a stem, may be so distorted that the individual parts are scarcely distinguishable. Where they occur singly on the leaves they are usually about 1 to 4 mm. in length, and rather less in breadth. Each consists of a circular ridge of hypertrophied cellular tissue, with an irregular warty or fissured edge, bent inwards so as to leave only a narrow opening into the space within the ridge. Into this space project small outgrowths from the epiderm of the leaf, and between these the mites may be found. The galls are yellowish green, or violet passing into purple. Specimens were sent to me in 1881, by Dr Buchanan White, from Ben Blabhein, in the island of Skye. The gall was originally described by Dr F. Loew from specimens collected in Lower Austria.

Epilobium angustifolium, Linn.—Last August I found upon this plant, in the Simodal in Hardanger, the pseudo-galls of one of the *Psyllidæ*. They consist of the leaf-margin folded abruptly backwards, and flattened against the lower surface, so as to leave only a narrow space, in which were larvæ of the insect. The tissue of the gall

becomes slightly thickened and fleshy, and either yellowish green or reddish yellow, passing into purple on the surface most exposed to light. The reduplicated margin does not exceed 2 mm. in breadth, but it varies much in length, though usually between 25 and 60 mm. As a rule, most of the leaves on a stem are more or less galled. It was, of course, impossible to identify the gall-maker from the larvæ alone, and the only mention that I can find of a Psyllid as living on *Epilobium* is the enumeration by Mr J. Scott, in a list of "Food Plants of the species of Psyllidæ found in Great Britain" (*Ent. M. Mag.*, xix. p. 14), of *Aphalara nebulosa*, Zett., as living on *E. angustifolium*, but without any indication of his grounds for the statement, or of the habits of the insect, whether gall-making or otherwise.

Lonicera Xylosteum, Linn.—On this honeysuckle, in September 1878, I found, near Christiania, numerous examples of deformities produced by a *Phytoptus* on the leaves. These pseudo-galls consist of irregular wavy folds of the margins, and of scattered patches on any part of the surface of the leaf, which is thereby caused to assume a crumpled appearance, evidently due to the irritation produced by the suction of the mites, inducing hypertrophy of the diseased spots, the lateral expansion of which is restrained by the healthy portions around them. The mites live in the folds thus formed, which open on the upper surface of the leaf. This gall has been recorded from various parts of Germany, Lower Austria, the Tyrol, and Switzerland. I am not aware of the occurrence of galls on *L. Xylosteum* in Britain; but I have found at Cawdor, near Forres, a mite-gall on *L. Periclymenum*, which is regarded by Dr Thomas as the work of the same species of mite, the difference in form being attributed to the stage of development and the position of the leaves in the bud when the mites begin operations. In the latter plant the galled portion is a furrow nearly parallel to the edge of the leaf, and separated from it by a border of healthy tissue from 1 to 5 mm. broad. The furrow opens on the upper surface of the leaf, as in *L. Xylosteum*; but the appearance of the affected leaves is markedly distinct in the two plants. The galls on *L. Periclymenum* have been found near Gothenburg, in Sweden.

Galium verum, Linn.—Near Vik, in Hardanger, last

August, I picked up a stem of this Bedstraw, the leaves of which were almost all rolled by a *Phytoptus* lengthwise to form narrow tubes, in which the mites live. The deformity is very inconspicuous. It is of frequent occurrence in Scotland, and has been recorded from many localities in Germany and the Tyrol.

G. boreale, Linn.—Last August I found numerous plants between Eide and Graven, affected with a diseased condition approaching that described by Dr F. Loew (*Verh. Zool. Bot. Ges. Wien*, xxxvii. pp. 25–27), from Lower Austria. The leaves towards the tips of the affected stems bear rather stiff hairs, sometimes in streaks, sometimes covering their surface and extending along the internodes between the whorls. The leaves, especially when seriously attacked, remain stunted, and show a tendency to curve upwards along the sides; and they may be found occasionally forming a scarcely complete tube. The hairs vary a good deal in length (the longest being about 7 mm.), and in colour they vary from hyaline to pale rusty brown, or dull violet. Last October I met with the same deformity on *Galium boreale* beside the Dee, a few miles from Aberdeen. It has been recorded from Siberia also.

Valeriana officinalis, Linn.—A single leaf picked up last year at Odde, in Hardanger, was distorted to form a pseudo-gall. The midrib in the middle of the leaf, and three or four of the middle segments, are twisted and thickened, so as to surround a space in which were some white larvæ of a *Cecidomyia*. The galled portion of the leaf is yellowish green, changing through dull red to brown. Galls similar to this occur in Aberdeenshire and Kincardineshire; but I know of no record of their occurrence elsewhere.

Achillea Millefolium, Linn.—Galls of a nematoid worm (*Tylenchus Millefolii*, F. Loew), were found by me last August, at Odde, on a plant of the Yarrow. They were first described by Dr Loew in 1873 (*Verh. Zool. Bot. Ges. Wien*, xxiv. pp. 18–24), from near Vienna. They especially affect the base leaves of stunted plants in dry situations, and are very inconspicuous, except when they twist the leaves, the appearance of which then indicates the presence of the galls. The latter are oval, or irregularly rounded fleshy swellings, sometimes on the midrib, sometimes on the large

veins in the segments. They seldom exceed 4 mm. in length. On section they are found to enclose a narrow irregular cavity, filled with the minute worms. I have found these galls in the Brenner Pass in the Tyrol, in very fine condition, as many as twenty occurring on a leaf, two or three sometimes on a single segment. I have looked for them in Scotland without success; but Mr Cameron told me that he had found them in the neighbourhood of Glasgow.

A. Ptarmica, Linn.—In 1878 I found, near Bergen, and near Christiania, the galls of a midge (*Hormomyia Ptarmicæ*, Vall.) on Sneezewort Yarrow. They are inflorescences, which, in consequence of the suction of the gall-makers, become swollen, but remain abortive, and are covered with a coating of pale woolly hairs. A section of the galled flower-head shows numerous larvæ of the gall-midge. These galls are common in Scotland, and have been recorded from all the countries of Central Europe. On the Norwegian examples there also occurred small ovate galls in the axils of the upper stem-leaves. They are nearly smooth, and are purple in colour; but from observations on these galls, in Scotland, where also they are associated with the galled inflorescences, I believe that they are the work of the same midge, the woolly coating being produced only in the inflorescences, from the organs situated there.

Hieracium murorum, Linn.—Near the Buarbræ glacier, in Hardanger, last August, I gathered several leaves of a *Hieracium*, which appears to be this species, bearing galls of *Cecidomyia Hieracii*, F. Loew (= *C. sanguinea*, Bremi, named from the galls alone). The galls are mere low blisters in the leaf-blade, slightly convex on the lower surface, but almost flat above; yet they are very conspicuous, since each is situated in a dull red-purple spot, which is surrounded by a border of reddish yellow. Seldom does a gall stand quite alone; far more often from three to ten are grouped so close that the coloured spots touch or partially coalesce to form an irregular line, sometimes near the midrib, sometimes near the margin. Each spot is from 4 to 6 mm. across. When full-fed the larvæ burrow underground to become pupæ. These galls have been recorded from Austria, Germany, and France.

H. corymbosum, Fries.—In the Simodal, in Hardanger, last August, I picked up two or three galls of *Aulax Hieracii*,

Bouché. They are rounded or oval swellings of the stems, most often situated at the point where the branches of the inflorescence arise; there they may be the size of a large hazel-nut. Less often they involve the base of the individual capitula, but are smaller in this situation. The surface is like that of the stem. A section shows that the gall consists of cellular pithy tissue surrounding numerous oval spaces, each of which has a more compact wall around it. In each cavity lives a larva. The galls of this insect are common in Scotland—on *H. corymbosum* and *H. sylvaticum*; and they have been recorded from various localities in Central Europe—on *H. murorum*, *H. umbellatum*, &c.

Campanula rotundifolia, Linn.—At Odde, in Hardanger, last autumn, the ovaries of this plant were not seldom swollen, forming the galls of a weevil, *Gymnetron Campanulæ*, Gyll. One side of the ovary is almost always more deformed than the other, and this, together with their larger size, renders them fairly conspicuous among the healthy seed vessels. This gall is common in the north-east of Scotland, and it has also been recorded from several localities on the Continent of Europe.

Veronica Chamædrys, Linn.—The only Norwegian specimen that I possess of the very common mite-gall known as *Caly-cophthora Veronicæ*, Kirchner, is from Christiania, where I picked it up in 1878. The ovate terminal bud, about the size of a large pea, with its pinkish-grey colour, due to its coating of woolly hairs, is one of the most easily detected and identified among mite-galls. The makers (*Phytopus* sp.) live between the imbricated leaves of the bud, and frequently one finds along with them the larvæ of a midge (*Cec. Veronicæ*, Bremi), which was formerly regarded as the gall-maker, but is only an inquiline. This gall is very common in Scotland, and has been recorded from many places in Germany, Austria, and Switzerland.

Nepeta Glechoma, Benth.—I have a specimen, gathered near Trondhjem in 1878, which bears several galls of a midge (*Cec. bursaria*, Bremi) on the leaves. They are placed, usually in groups of two or three together, on the upper surface, on which they stand erect. They resemble rifle bullets in form, and are 3 or 4 mm. in height. Their surface is covered with hairs. When mature they break away

from the leaves, carrying a portion of the tissue with them, so that the situation of each is then marked by a round hole through the leaf. I have this gall from Perthshire, and have seen it common in England. It has been recorded from France, Germany, and Austria.

Populus tremula, Linn.—I have a leaf of this tree, picked near Christiania in 1878, which bears the gall known as *Heliazeus Populi*, Kirchner, the work of a mite (*Phytopus* sp.). It is always situated on the base of the upper surface of the lamina, just where the petiole joins it, and is probably a distortion of the leaf-glands that normally occupy this situation. The galls are rounded warty outgrowths, 1 to 2 mm. high by 1 to 3 mm. broad, and are usually red or yellow. They are rather common in the north-east of Scotland, and I have thus been able to examine the development in fresh specimens. When full grown they are of firm texture, and inclose small irregular cavities, tenanted by the mites. At first each consists of two swellings (the glands), one on each side of the midrib, which are soft and fleshy. These soon overlap, until at last the two look like a single gall. The galls have been recorded from numerous localities in Germany and Austria.

Salix Caprea, Linn.—1. I have examples, gathered near Christiania, of galled petioles, swollen for the greater part of their length to more than twice the natural thickness, but otherwise little changed externally. On section each is found to enclose a cavity occupied by a larva of a sawfly, probably *Euura venusta*, Zaddach. I have found similar galls in Glen Gairn, in Aberdeenshire; and Mr Cameron records them from near Glasgow. *E. venusta* was described from German examples.

2. Galls of a midge (*Cec. Capreae*, Winn.) were gathered by me in 1878 near Christiania, and in 1887, at Odde, in Hardanger. They are about the size of small shot, and are woody in texture, rounded, but rather more conical below (where there is a small hole formed when the gall is mature), and yellowish in colour. They are scattered irregularly over the leaf, the conical part below, and the rounded part above the general surface. Each is occupied by a single larva. These galls are plentiful in Scotland, and they have also been recorded from France, Germany, and Austria.

3. Bushes of this willow near Christiania also bore very numerous examples of the galls named *Cephaloneon umbrinum*, Bremi (the work of *Phytoptus* sp.), scattered irregularly over the upper surface of the leaves. They are dull reddish or brown "nail-galls," irregularly rounded in form, attached by a narrow neck to the leaf. Each opens on the lower surface of the leaf, but the opening is nearly closed by a dense tuft of grey woolly hairs. The galls vary from 1 to 2 mm. in diameter. I have these galls from Aberdeenshire, and they are recorded from Vienna.

S. ? phylicifolia (Linn.), Sm.—I have what seems to be a branch of this species of willow from the Simodal, in Hardanger, bearing on the leaves several galls, which agree very closely in their structure with those of *Nematus ischnocerus*, Thoms. They are almost always in pairs, one on each side of the midrib. They are about 12 mm. long by 4 mm. broad, with the sides parallel and the ends rounded; they do not project at all below the leaf, but are prominent above. The upper surface is dark green or purplish red, and the lower surface resembles that of the leaf. Each gall is tenanted by the larva of a sawfly, probably *N. ischnocerus*, Thomson. I have found galls that I cannot distinguish from this in Braemar, Aberdeenshire, on *S. phylicifolia*, *S. nigricans*, and *S. arbuscula*, and on *S. lapponum*. In the same locality were galls similar in form, but of rather smaller size. Mr Cameron (*Brit. Hymenopt.*, ii. pp. 196–197) says that the only localities he knows for *N. ischnocerus* in Britain are Braemar, Rannoch, and New Galloway; and he names as its food-plants *S. purpurea* and *S. laurina*. It was first recorded from Sweden.

S. nigricans, Sm.—On this willow near Vik, and in the Simodal, last August, I found a profusion of galls on the leaves, in the form of globular bodies about the size of peas, attached to the lower surface of the leaves, and scarcely showing at all on the upper surface. They are smooth, shining, and yellowish green, sometimes with red patches where exposed to the sunshine. The central cavity in each is at first rather small, but is rapidly enlarged as the sawfly larva within eats away the substance of the walls; and when the larva is full fed the gall is little more than a shell. These galls are so entirely similar to those of *N.*

Salicis-cinereæ, Retz., on various species of smooth-leaved willow, and that sawfly is so widespread, that the galls from Hardanger probably belong to this species.

Betula alba, Linn.—1. *Erineum betulinum*, Schum., was common on the lower surfaces of the leaves near Trondhjem and Christiania in 1878, and near Eide in 1887. This *Erineum* sometimes forms small spots along the midrib and the larger veins, sometimes isolated patches of densely crowded hairs scattered on the lower (rarely the upper) surface of the leaf, and sometimes it occupies almost the whole of the surface. The hairs are at first nearly white, but become rusty brown. The mites live between them. *E. betulinum* is very common in Scotland, and is recorded from France, Germany, and Austria.

2. In the same localities as the last-mentioned gall I also found another gall formed by a species of *Phytoptus*, but of markedly distinct structure. The latter galls resemble hard little warts in the tissue of the leaves, as many as fifty or sixty occasionally existing in a single leaf, but they very seldom coalesce. Though scarcely reaching 1 mm. in diameter, they project on both surfaces of the leaf-blade, especially in the dried leaves, as their hard texture prevents shrinkage. Each surrounds a relatively large cavity, which opens by a narrow outlet below, protected by a small tuft of hairs. The mites live in the cavity of the gall. I have found the galls very frequently in Scotland; they occur also in England, and have been recorded from many places in Germany and Austria.

Alnus incana (Linn.), D.C.—This alder in Hardanger seems to take the place filled by *A. glutinosa* in Scotland. I have found on it two kinds of mite-galls (*Phytoptus* sps.).

1. *Erineum alnigenum*, Lk., described by Link as a fungus under the name *Phyllerium alnigenum*, was of frequent occurrence near Christiania, and near Eide in Hardanger. It is far more frequent on the lower than on the upper surface of the leaf, and assumes the form either of well-defined spots of hairs, or patches diffused irregularly along the midrib and larger veins. At first the hairs are pale, but the spot becomes rusty brown, approaching a russet brown, surrounded by a narrow pale border. The hairs are slender, bent, and blunt. This gall has been recorded from Saxony, from the

neighbourhood of Vienna, and from the Tyrol. On *Alnus glutinosa* an *Erineum*, very similar in appearance to the above, is very common in Scotland, and also occurs in Saxony and near Vienna, but the hairs in it are different from those of *E. alnigenum*. It is known as *E. alneum*, Persoon.

2. Another mite-gall is frequently met with on the leaves of *A. incana*, along with the *Erineum*, very often even on the same leaves. It is known by the name *Cephaloneon pustulatum*, Bremi, and belongs to the "nail-gall" type. Often a leaf bears upwards of a hundred of the galls on its upper surface, some scattered singly, others crowded into groups as closely as they can stand. They are irregularly oval, rough, and red, or yellowish-red; and do not exceed 2 mm. in diameter. Each communicates with the lower surface of the leaf by a narrow hole, which is surrounded with a warty lip. This gall occurs on *A. incana* in Switzerland, in Germany, and in Austria. It is even more common in the same countries on *Alnus glutinosa*, upon which tree it is also very plentiful in many localities in Scotland.

Juniperus communis, Linn.—At Oiford in Hardanger, last August, I found galls of a midge (*Hormomyia juniperina*, Linn.) on juniper twigs. They resemble green cones at the tips of the smaller twigs, and are ovate, about 6 mm. long by 4 broad, and externally consist of three broad scale-like needles, which surround three smaller needles, between which is the cavity occupied by the larva. This gall is plentiful in Scotland, and has been recorded from France and Germany; and the midge is also stated in Siebke's *Enumeratio* to occur on the Dovrefield mountains.

*List of Makers of Galls found by me in Norway in
1878 and 1887.*

COLEOPTERA.

Gymnetron Campanulæ, Gyll., galled ovaries of *C. rotundifolia*.

HYMENOPTERA.

Though I did not rear the makers, I venture to refer the galls to the undermentioned insects, as they agree entirely with galls of these species from other localities.

- Euura venusta*, Zadd., . . . galled petioles of *Salix Caprea*.
Nematus ischnocerus, Thoms., galls on leaves of *S. ? phyllicifolia*.
N. Salicis-cinereæ, Retz., . . . pea-galls on leaves of *S. nigricans*.
Aulax Hieracii, Bouché, . . . stem-galls of *Hieracium corymbosum*.

HEMIPTERA.

- Trioza Cerastii*, H. Loew, . . . galled branches of *Cerastium triviale*.
Aphalara sp.? folded leaf-margins of *Epilobium angustifolium*.

DIPTERA.

- Sciara tilicola*, H. Loew, . . . twig of *Tilia parvifolia*.
Hormomyia Reaumuriana, F. Loew, . . . leaf of *Tilia parvifolia*.
H. Ptarmicæ, Vall, flower-heads of *Achillea Ptarmica*.
H. juniperina, Linn., on twigs of *Juniperus communis*.
Cecidomyia Frauenfeldi, Kalt., . . . leaves of *Tilia parvifolia*.
C. ? Tiliæ, Schrck., leaves of *Tilia parvifolia*.
C. Loti, De Geer, flower-buds of *Lotus corniculatus*.
C. Viciæ, Kief., leaflets of *Vicia Cracca*.
C. ? Onobrychidis, Bremi, . . . leaflets of *Astragalus alpinus*.
C. Ulmaricæ, Bremi, leaves of *Spiræa Ulmaria*.
C. sp.? leaf of *Valeriana officinalis*.
C. Hieracii, F. Loew, leaves of *Hieracium ? murorum*.
C. bursaria, Bremi, leaves of *Nepeta Glechoma*.
C. Capreæ, Winn., leaves of *Salix Caprea*.

ACARIDA.

All the mite-galls belong to the genus *Phytoptus*, distinguished from other mites by the long slender body, and the possession of only four legs. The species are so much alike that it is scarcely possible to distinguish between them, save by the differences in the galls produced by them; but fortunately the galls are readily distinguished from one another, even where two or more species occur on the same leaf. Before the true nature of the galls was detected many of them received names, without reference to the makers; and these names are still retained for convenience of reference, and are given in brackets below. They fall naturally into well-marked divisions, *e.g.*, "nail-galls" (*Ceratoneon* and *Cephaloneon*), scattered over the upper surface of the leaves;

hairy patches (*Erineum*), on either surface, though usually below, originally regarded as imperfect fungi; tubes formed of involute leaf-segments, with or without the growth of hairs; galled buds (*Calycophthora*, &c.), often covered with a thick coat of hairs; folds in leaves or margins closely rolled into narrow tubes (*Legnon*); and other forms for which special names have not been suggested, and that need not be more fully discussed.

(<i>Erineum tiliaceum</i> , Pers.), .	} all on leaves of <i>Tilia parvifolia</i> .
(<i>Ceratoneon extensum</i> , Bremi), .	
(<i>Legnon crispum</i> , Bremi), .	
(? <i>Erineum bifrons</i> , Le Pell.), .	leaf of <i>Tilia ?grandifolia</i> .
(<i>Ceratoneon vulgare</i> , Bremi), .	leaves of <i>Acer Pseudo-platanus</i> .
<i>Phytoptus Geranii</i> , Thomas, .	rolled leaf-segments of <i>Geranium sanguineum</i> .
(<i>Ceratoneon attenuatum</i> , Bremi),	leaves of <i>Prunus Padus</i> .
(<i>Erineum Gei</i> , Fries), . . .	<i>Geum urbanum</i> .
Warty galls of <i>Phytoptus</i> , . . .	<i>Sedum Rhodiola</i> .
Rollled leaves,	<i>Galium verum</i> .
Hair-growths and curvature of	leaves of <i>Galium boreale</i> .
Leaf-crumpling (<i>Legnon</i>), . .	<i>Lonicera Xylosteum</i> .
(<i>Calycophthora Veronicae</i> , Kirchner.)	bud-galls of <i>Veronica Chamædrys</i> .
(<i>Heliazeus Populi</i> , Kirchner), .	gland-gall at base of leaf-blade of <i>Populus Tremula</i> .
(<i>Cephaloneon umbrinum</i> , Bremi),	leaves of <i>Salix Caprea</i> .
(<i>Erineum betulinum</i> , Schum.),	leaves of <i>Betula alba</i> .
Warty galls,	leaves of <i>Betula alba</i> .
(<i>Erineum alnigenum</i> , Link), .	leaves of <i>Alnus incana</i> .
(<i>Cephaloneon pustulatum</i> , Bremi.)	leaves of <i>Alnus incana</i> .

NEMATOIDEA.

- (*Tylenchus Millefolii*, F. Loew), leaves of *Achillea Millefolium*.

With a view to render this paper of greater value, I have sought out previous records about the galls and gall-makers of Norway, but only to find that but little has been put on record concerning the one or the other. Indeed, the only works in which I have succeeded in finding information are—

1. A paper of two pages by Steenstrup in *Forhandlingars ved de skandinaviske Naturforskere's syvende Møde i Christiania*, 12-18 July 1856, pp. 189-190, entitled *Om de paa skandinaviske Traaer og andre Planter forekommende Traeemider (Phytoptus, Duj.)*. (On the Tree-mites occurring on the Scandinavian Trees and other Plants.)
2. *Enumeratio Insectorum Norvegorum*, by H. Siebke, begun in 1874, and still going on under the editorship of J. Sparre Schneider.
3. *Byggaalen (Tylenchus Hordei, n. sp.)*, by W. M. Schøyen (*Christiania Videnskabs-Selskabs Forhandling*, 1885, No. 22, pp. 1-16, pl. i.).

Taking these in the above order, the first is known to me only by a summary in one of the valuable papers by Professor Thomas of Ohrdruf. In Steenstrup's paper he says, with regard to galls of *Phytoptus* on Scandinavian plants, "the peculiar hairy outgrowths which they (the mites) produce on the leaves of *alders*, *birches*, *limes*, *elms*, *beeches*, *walnut*, species of *maple*, *sloe*, *plum* trees escaped from cultivation, *willows*, *hazel* bushes, *wild thyme*, *bedstraw*, &c.," are, as regards form and situation, characteristic for each species. He distinguishes between the chief types of mite-galls, *e.g.*, pouches, rolled leaves, hairy growths, &c.; but does not enter into details with respect to the special forms of galls on any particular species of plant, so that it is uncertain which of the forms of mite-galls he alludes to in the case of such plants as bear more than one. He says also, with regard to their origin, "the patches of hairs, *e.g.*, on the beech leaves, which have been taken for fungi, and described under the genus *Phyllerium*, and the elegant folding of the leaves of the hornbeam, have the same origin" as the other mite-galls.

In Siebke's *Enumeratio* there is no mention of the galls made by any of the insects; but I find the following species enumerated as Norwegian, and as they are known to be gall-makers in other countries, we cannot doubt that they are so in Norway also. I have added the notes in brackets to each:—

COLEOPTERA.

- Ceuthorrhynchus sulcicollis*, Gyll., on flowers of *Erysimum hieracifolium*, at Christiania (galls roots of various species of *Brassica*).
- C. contractus*, Marsham, on flowers at Christiania (reared from galls on roots of *Brassica Sinapistrum*, in Britain).
- Gymnetron Linariæ*, Panzer, at Christiania (galls roots of *Linaria vulgaris*).
- G. noctis*, Herbst., on flowers of *Linaria vulgaris*, at Christiania and at Drammen (larva lives in slightly deformed ovaries of *Linaria vulgaris*).

HYMENOPTERA.

- Nematus Salicis-cinereæ*, Retz (sub nom. *N. cinereæ*, De Geer), at Christiania and at Tromsø (produces pea-galls on willows, see above).
- N. gallicola*, Westw. (sub nom. *N. Vallisnieri*, Hart.), at Christiania (produces oblong galls in the leaves of various willows, projecting from both surfaces).
- N. Salicis-pentandræ*, Retz. (sub nom. *N. pentandræ*, De Geer), at Christiania (produces woody swellings on the twigs of various willows, especially on *S. pentandra*).
- N. dolichurus*, Thomson, taken at Fokstuen, in Dovre (probably makes galls on one or more of the alpine willows).

HEMIPTERA.

- Livia juncorum*, Latr., on various flowers, especially on Compositæ, at Christiania (galls young shoots of *Juncus communis*).
- Schizoneura Ulmi*, Linn., on *Ulmus campestris*, near Christiania (causes the leaves to become fleshy, and to form wide tubes, in which the Aphides live).
- Tetraneura Ulmi*, De Geer, on leaves of *Ulmus campestris*, near Christiania (the galls are oval bodies, about 12 by 6 mm., rising from the upper surface of the leaf, to which they are attached by a narrow pedicle; the Aphides live in the large central cavity).
- Pemphigus bursarius*, Linn., on *Populus pyramidalis*, near Christiania (produces flask-shaped galls, about 12 mm. in height, on the petioles; an opening at the upper end leads into the cavity occupied by the Aphides).

DIPTERA.

Trypeta solstitialis, Linn. (sub nom. *Tephritis solstitialis*), at Christiania and Eidsvold. (I have reared this fly from galled flower-heads of *Centaurea nigra*, gathered near Aberdeen; it is said by Kaltenbach to gall *Carduus nutans*, *C. crispus*, *C. acanthoides*, *Cnicus lanceolatus*, *Centaurea Scabiosa*, *C. Jacea*, and *C. montana*.)

Lauxania cenea, Fallen, at Christiania, and in several other localities. (This fly is said by Winnertz to gall the ovaries of the *Viola arvensis* and of *V. tricolor*; but I have not found confirmation of this statement by any other author; and I have never found galled ovaries on these plants, though the fly is not scarce in the vicinity of Aberdeen.)

Hormomyia juniperina, Linn. (sub nom. *Lasioptera juniperina*), at Nystuen and at Kongsvold (galls *juniper* buds, see above).

Herr Schøyen gives an account of a disease called *Krok*, which he observed in 1885, to be prevalent in the district of Lom, where it had been observed as early as 1849 by Moe and Norman. He traced the cause to the formation of very numerous small galls on the roots. In these he found a profusion of Nematoid worms, both sexes of which were mature, so that he was able to determine that they belonged to a previously undescribed species, which he named *Tylenchus Hordei*. The galls of this species have also been detected on barley at Pajala in the north of Sweden, and at Karasjok in Norwegian Finmark. Herr Schøyen compares the galls with those found by Dr Warming on *Elymus arenarius* on the coast of Zealand in Denmark, and by myself on the same plant near Aberdeen, and comes to the conclusion that all are the work of the same species of *Tylenchus*. His description and figures quite support this conclusion.

[Note. —Since the above has been put in type I have observed in the *Botanisches Centralblatt* (vol. xxxiv. p. 18) a short notice of a work by Herr J. Brunchorst, entitled *De vigtigste Plantesygdomme*, published in Bergen last year. It is said in the notice that the work is a popular account of diseases of plants, and that in the last part of it the hurtful gall-growths are described. Not having seen the book, I do not know in how far it adds to the above records.]