

Botany. — *Polymorphism and Colour of the Calluna-flower.* By W. BEIJERINCK. (From the Nederlandsch Biologisch Station Wijster, Prov. Drenthe.) (Communicated by Prof. L. G. M. BAAS BECKING.)

(Communicated at the meeting of November 30, 1935).

The flowers of *Calluna* are placed terminally on leafy shoots of the first and second order on the main axis (Figures 1 and 2). In exceptional cases the flowers are placed on lateral axes of the third order; or the annual or main shoot itself terminates in a flower instead of terminating in a leafy short shoot or assimilation shoot, as happens normally¹).

The flowering twigs originate from the axil of a leaf and carry, in their simplest form, one pair of assimilating leaves, designated as prophylls, notwithstanding the fact that their external form is usually that of normal leaves.

The flowering twig further carries 4—12 bracts which crowd directly against the perianth (Figure 2). In this form it might appear that the flowering twigs are peduncles and that the inflorescence of *Calluna* should be called a raceme as is stated in many older and more recent botanical works. This is, however, not true, for *Calluna* only has a pseudo-inflorescence. The flowering twig does not always possess 2 ordinary leaves. It occurs repeatedly that flowers are placed terminally on a leafy shoot (Figure 1).

Plants showing this phenomenon regularly may be brought to the var. *terminalis* Johannes Jansen cum fa.

From the axes of one or more of the flowering-shoot-leaves, new leafy twigs, with or without terminal flower, often emerge. Both the variable number of leaves on the flowering twig and the occurrence of the subsidiary twigs mentioned above give support to the view that *Calluna* has no proper inflorescence. Morphologists of note, such as WYDLER (1860), DÖLL (1859) and WIGAND (1854) already have observed this behaviour. The Swedish botanist MALME (1908) dealt with this topic extensively. At most it appears warranted to speak of a "racemous arrangement" of the flowers because the monopodial arrangement is maintained, even after the formation of the flowers.

¹) Transition-forms in which indications of a reduced main vegetation-point were present (a small leaf-bud next to a quasi-terminal flower) also occurred.

Real terminal flowers at the main axis do not show such vegetative buds. The terminal flower is placed into the direction of the main axis, vertical, instead of ascending (or even pendulous) as in the normal, feebly zygomorphic flowers. The terminal flower in the first case is actinomorphic and sometimes more robust.

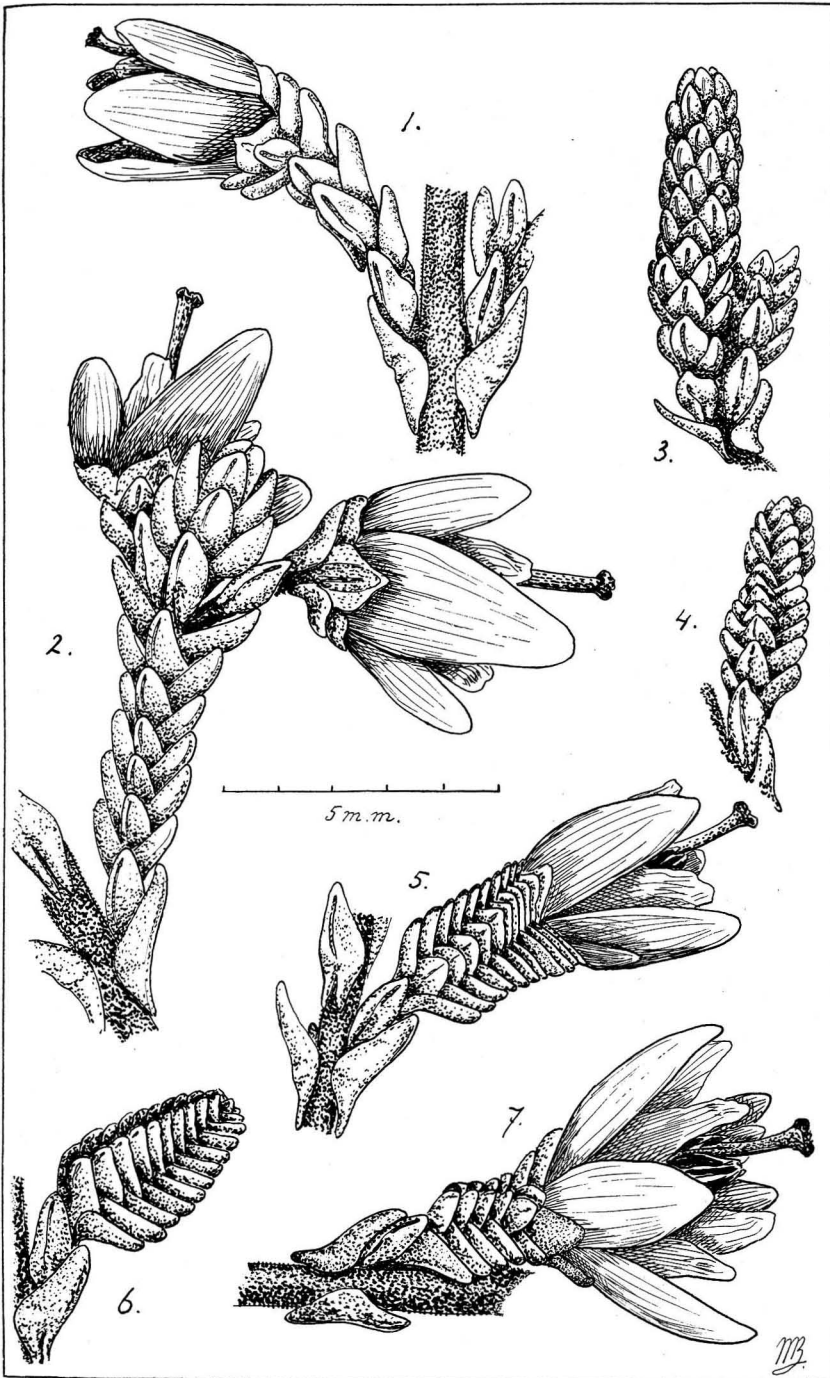


Fig. 1. Terminal flower of *Calluna* on a leafy twig of the first order on the main axis.
 Fig. 2. Flowers on bifoliate twigs of the second order, originating from the axil of leaves of the short shoot.
 Fig. 3 and 4. Bract-masses. Bracts placed in spirals.
 Fig. 5 and 6. Broader bract-masses, decussate.
 Fig. 7. Multibracteata with pentamerous perianth.

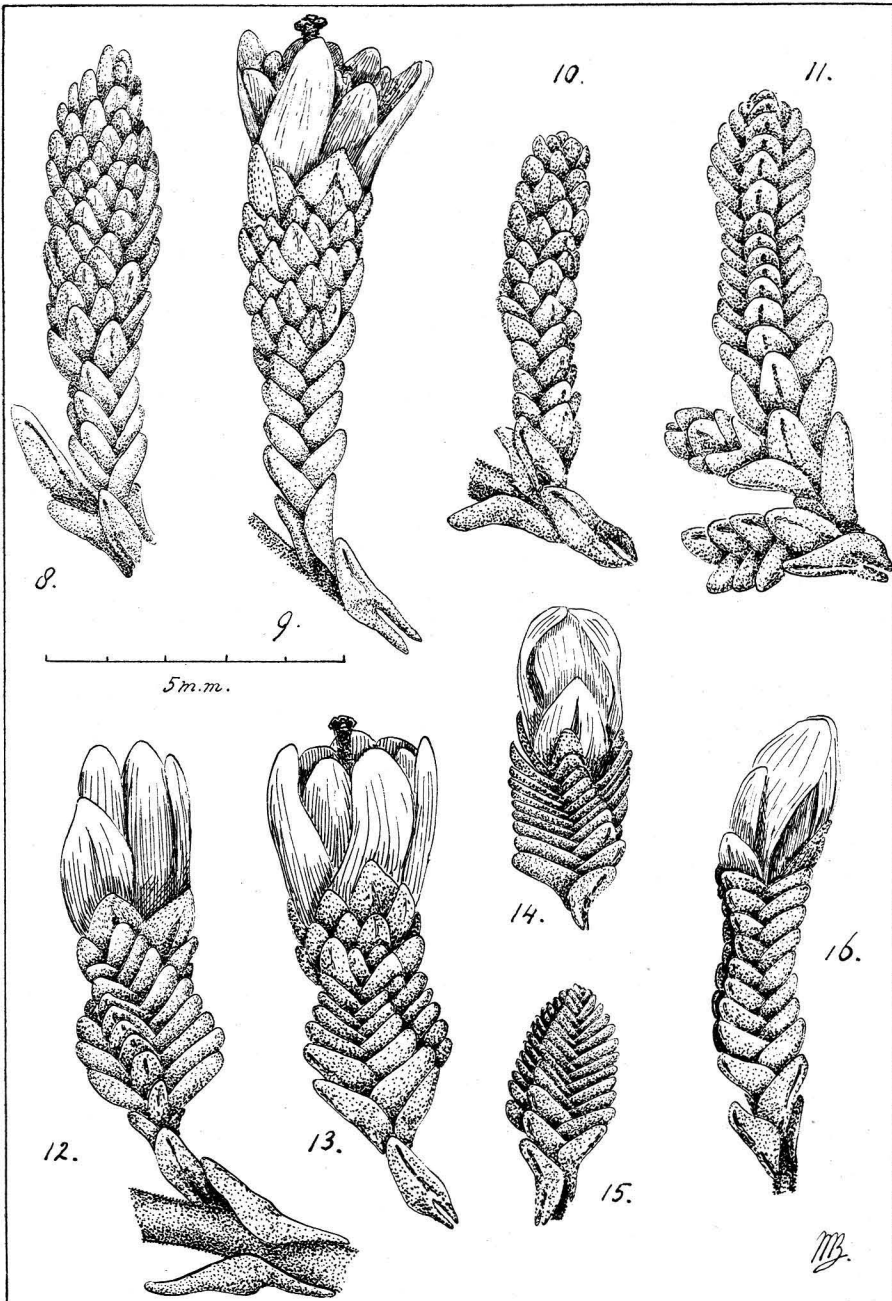


Fig. 8—16. Different types of flowers and bract-masses in the var. multibracteata.

Apart from the variability of the number of leaves at the flowering twig certain forms show more than twelve bracts. Almost specific organs are formed in this way, — so-called bract-masses —, which consist of mutually

addressed, usually ciliate bracts, still showing all transitions between stem-leaves and the coloured calyx.

The form of these bract-masses is variable, which is shown in plates I and II. Their number varies between 12 and 68, and perhaps more.

All these forms should be considered as belonging to the variety *multibracteata* Johannes Jansen cum fa.

The number of bracts in one mass varies somewhat at the same plant, but usually every multibracteate plant has its own preponderant type of bract-mass, whether stunted (Figure 14, 15), shorter or broader (Figure 5, 6), or longer and looser (Figure 16). The bracts may appear in spirals (Figure 3, 4, 8, 9, 10, 12, 13), or strictly decussate (Figure 5, 6, 11, 16), flowering or sterile (Figure 3, 4, 10), with pentamerous or hexamerous flowers (Figure 7), flowers with intercalated sepals or bracts (Figure 5, 12, 13, 14, 16), and with erect flowers (Figure 5, 7).

Most remarkable among these forms are: *torta* Johannes Jansen cum subfa., *deflorata* Johannes Jansen cum subfa. and *pentamera* Johannes Jansen cum subfa.

Added to this array should be varieties in leaf- and flower-colour, as well as the different growth-forms and early- or late flowering forms. The latter bear flowers until November and January.

The multibracteate group of *Calluna* is linked by many transitions to the usual form, with 4—12 bracts. Multibracteate is called a form with more than 12 bracts. In the variety *multibracteata* there occur repeatedly sepaloid or coloured bracts which also may be considered as not fully developed intercalated sepals. Five completely developed sepals occur sometimes, two of which are decussate. Similar irregularities also occur outside the multibracteate group. A pentamerous perianth, supernumerary sepals or (and) petals, a reduced number of stamens, polystyly or monstrous stamens or styles are often observed. An excessive number of stamens has not been observed. Reduction of the number to 2 or 3 has been met with. Closed flowers without stamens have been seen rather frequently. At closer observation these "bud-flowers" usually show a duplication of the calyx or rather, the corolla has been substituted by the "chaffy" sepals. Petals and stamens are lacking while the ovary and style may be either normal or monstrous (Figures 25, 26, 27).

Plants with suchlike closed flowers belong to the var. *diplocalyx* Johannes Jansen cum fa., which is actually the transition to the group var. *polysepala* Johannes Jansen cum fa.

Diplocalyx may show sometimes a slight opening of the flowers and also flowers from which the style extrudes by means of the stigma. Such flowers are fertile and form normal fruit. Variations on this theme are formed by plants possessing a double calyx, a corolla and stamens; plants with double calyx and stamens; one tetramerous calyx, ovary and style (Figure 28). The latter was met only once. The varieties and forms

mentioned above are all kept in culture in the experimental garden of the Biological Station.

The variety *polysepala* is also polymorphic, as for instance a trimerous to polymerous calyx with a normal sexual apparatus, or only a normal, reduced or compound style. Further forms without pistils, stamen and corolla. These flowers consist entirely of chaffy sepals and may be very compact or hard.

Further distinction within this group is made between spherical, bud-shaped or open flowers (Figure 17, 18, 19, 20), consisting of decussate (Figure 20, 21) or spirally placed sepals. Several colour-varieties occur within this group. A multibracteate form which was also polysepalous, was found once¹). Closed-flowered forms may belong to the variety *diplocalyx* Johannes Jansen cum fa. and *polysepala* but also to the variety *clistanthes* Johannes Jansen cum fa. In the latter form the contents of the flowers are normal (Figure 37), but like the variety *diplocalyx* the flowers are not always entirely closed, but somewhat opened (Figure 29). Among the latter there are plants which show a copious and prolonged flowering.

Apart from certain colour-varieties and growth-forms the 4 varieties mentioned above are most frequently occurring in this country (e.g. in the surroundings of Nijmegen, Mook, Wijchen, Wageningen and in N-SW Drenthe). The distribution of these forms was studied in a part of the Drenthe-heather during summer and autumn of 1935. The field was examined at the end of- and after the main flowering season. In this season the varieties are conspicuous, because the flowers keep their colour much longer (*polysepala*, *diplocalyx* and *clistanthes*), they may flower much later (*multibracteata*, *diplocalyx*), they may not flower at all (*multibracteata*).

Visiting the field in the months September to December, one will find several abnormal forms per Hectare.

On about 200 Hectares were found:

85	plants	of	the	variety	<i>multibracteata</i> ,
91	"	"	"	"	<i>diplocalyx</i> ,
49	"	"	"	"	<i>polysepala</i> ,
24	"	"	"	"	<i>clistanthes</i> .

The distribution is by no means regular, the varieties seem to be massed at certain points. Respectively 7 and 10 plants of the variety *diplocalyx* were found on an area of a few hundred square metres.

Multibracteata has also been found in groups.

To the rarer forms of *Calluna* belong the strictly female variety *gynodioica* nov. var. ²).

¹) By Mr. JOH. JANSEN at Malden (Gld.).

²) The female plant with closed flowers, mentioned by ASCHERSON (1901), probably belongs to the variety *diplocalyx*.

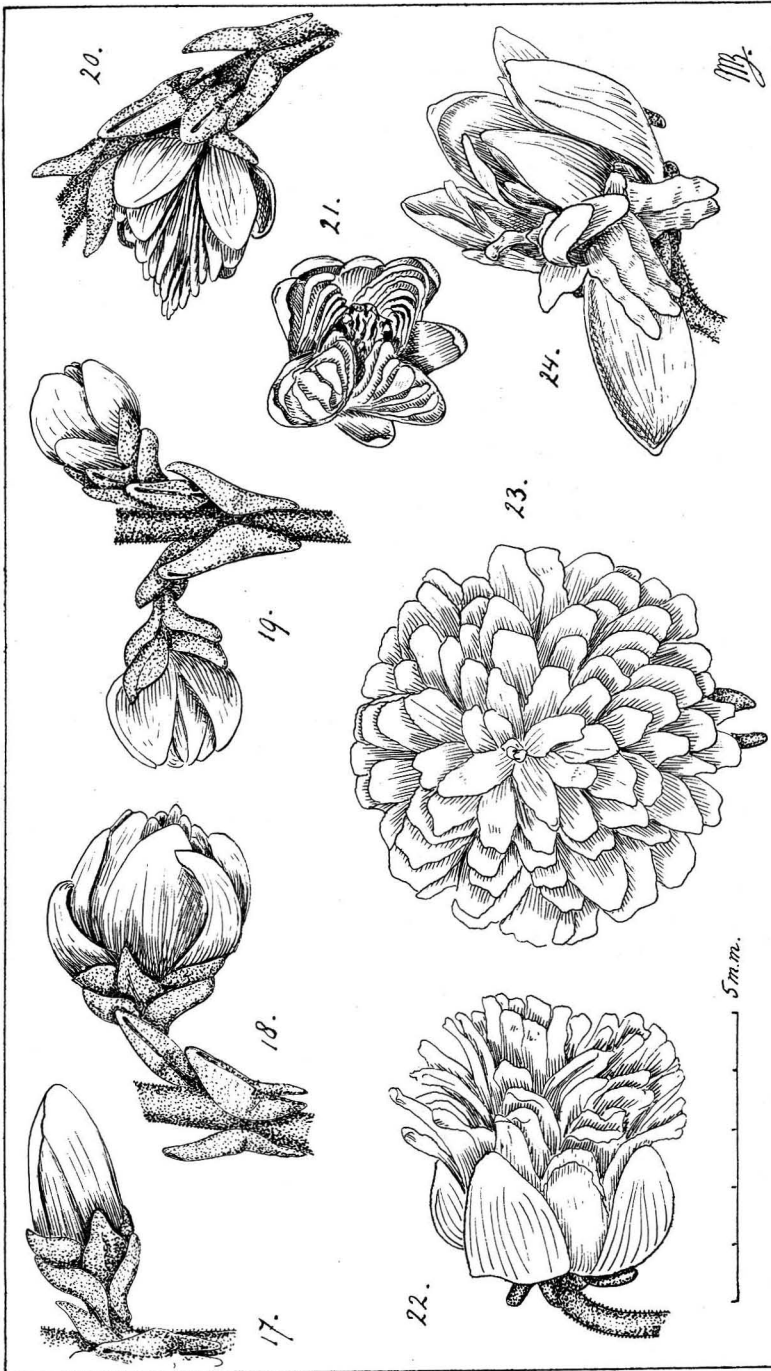
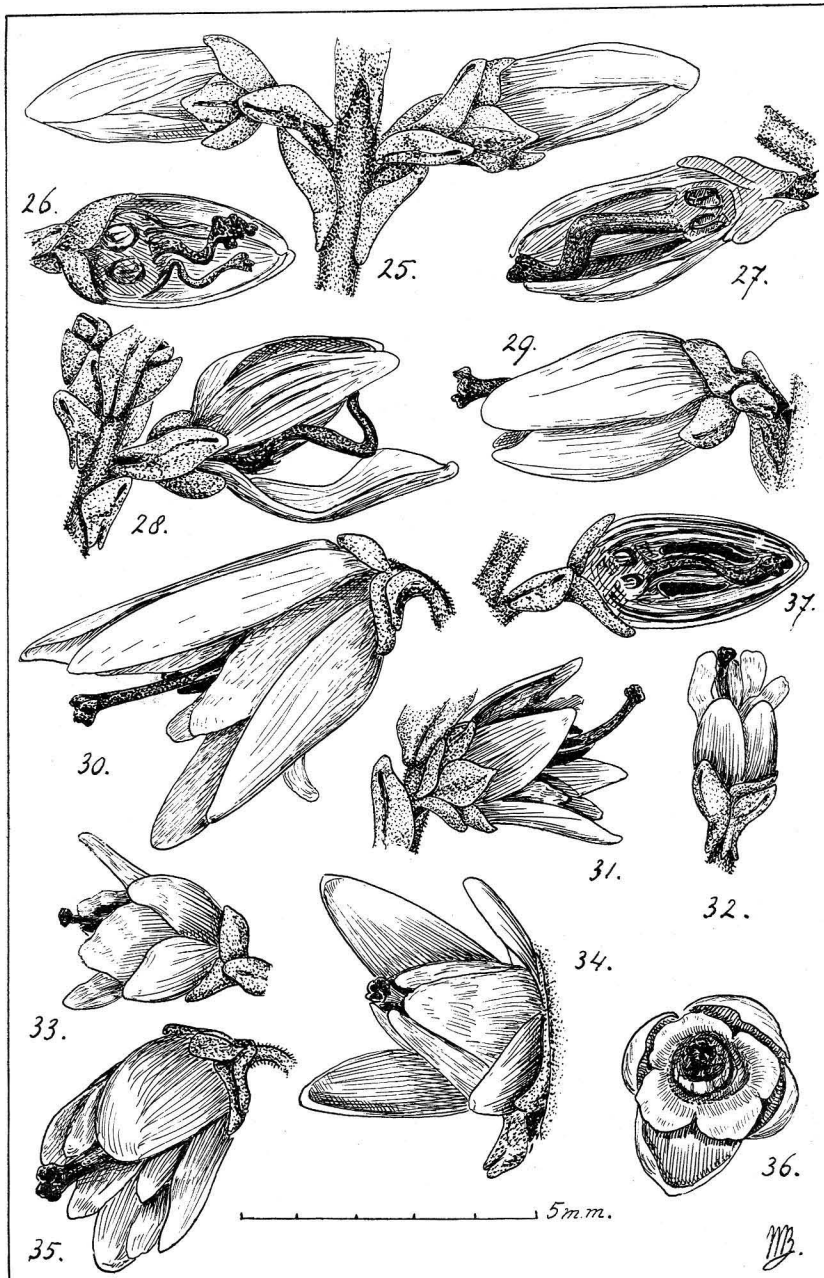


Fig. 17—21. Different flower-types of var. polysepala.
 Fig. 22—23. Flower-type of the var. polypetala.
 Fig. 24. Flower of var. plena, artificially opened.

Five specimens of this type have been found in the above-mentioned area. Any vestige of anthers was lacking; the flowers were not opened entirely, but possessed a normal perianth and pistil (Figure 35, 36).



- Fig. 25—27. Flower-types of var. *diplocalyx*.
 Fig. 28. Flower, reduced to tetramerous calyx and gynaecium.
 Fig. 29 and 31. Flower-types of var. *clistanthes*.
 Fig. 30 and 31. Flowers respectively of large- and small-flowered form.
 Fig. 32 and 33. Flower-types of var. *brachysepala*.
 Fig. 34. Flowers with opened calyx and almost closed corolla.
 Fig. 35 and 36. Flower-types of var. *gynodioica*.

The English heathers have yielded the beautiful variety *polypetala* (Figure 22, 23), which has been in culture for quite a while, but as far as I am aware is not known for our country.

In this group more or less pubescent plants and plants with markedly divergent flower-colours are known (see below). Simultaneous reduplication of calyx and corolla was found once¹). For this variety I suggest the preliminary name *plena* (Figure 24). From the other forms brief mention is made of var. *brachysepala* Johannes Jansen cum fa., in which the sepals are shorter as, or at most as long as the petals. The sepals appear relatively broad (Figure 33). Only a few specimens of this type were found; a similar form with chiefly closed little flowers occurs more frequently (Figure 32). Normal flowers may occur on such plants, however. Culture will show whether their characteristics are constant. The constancy of large- and small-flowered forms (Figure 30, 31) has to be tested in the same way.

The four commoner varieties appear constant on vegetative propagation (cuttings).

Finally a form should be mentioned in which the calyx opens, but in which the corolla remains partially closed (Figure 34). This form was found only once.

In dealing with the different colour-varieties in *Calluna* it must be mentioned that the flowers are often of different colours or shades. An accurate determination of the colour is therefore difficult and only approximative determination is possible. The observations reported are the average of the results obtained by 3 persons. The numbers are taken from the wellknown: "Code des couleurs" by KLINCKSIECK and VALETTE (1908).

A number of selected plants shows the following colours: 21 — 0.546 — 546 — 553B — 556 — 561/556 — 561 — 562 — 566 — 0.571 — 571/572 — 572 — 578C — 582 — 587 — 0591 — 591/592 — 0596 — 596 — 597 — 582 and white, in total 22 different shades and colours. The most representative colours for the Drenthe area are:

- 546 lavender,
- 556 deep purple-lavender,
- 566 purple-lavender,
- 571 light purple-lavender,
- 582 dark purple,
- and white.

Purely pink shades are rare, for instance: 21 var. *polypetala* from England (Mrs. HAMILTON hort. of MAXWELL and BEALE, Dorset²).

In polychromatic flowers the calyx may be of a deeper or lighter

¹) By the misses N. and A. KRIJTHE, near Hijken (Dr.).

²) This form is aberrant both in form and colour of the flower. Locality: Mount Maughan (Yorkshire).

shade than the corolla and may remain so. Metachromatic flowers occur frequently¹).

Flowers of lighter shades increase in colour on ageing or vice versa (and change from lavender to reddish).

Amphichromatic flowers were mentioned for *Calluna vulgaris* for the first time by LINDMAN.

In three instances such plants were found by us; one specimen showed a strictly white flowering shoot on a plant with purple-lavender flowers. In two cases dark-lavender shoots were found on light-lavender flowering plants. In one of the latter cases dark flowers occurred between the light ones at places, while sectorial colouring of single flowers was observed on the same plant.

I wish to express my sincere thanks to the misses Ir. N. KRIJTHE and A. KRIJTHE, to Mr. JOH. JANSEN and to my wife for much assistance during the many field-excursions.

Wijster (Drenthe), 18 Oct. 1935.

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¹) LINDMAN (1907) introduced the terms poly-, hetero-, meta- and amphichromatic.

Botany. — *The opening of the flower-buds of Calluna vulgaris* (L.) Salisb.
By W. BEIJERINCK. (Communicated by Prof. L. G. M. BAAS BECKING).

(Communicated at the meeting of November 30, 1935).

The main flowering-season of the Scotch heather in August coincided this year in our country with a prolonged period of drought. Many *Calluna* plants showed a remarkable development of the flower-buds in so far as the plants were covered at the end of August with almost exclusively closed, but entirely mature buds of about the same size.