the directrix d; consequently B_k is a double *principal point* of the complex $\{t'\}^9$.

The plane pencil which is the image of a ray in β_{122}, has one ray in the axial complex; hence the complex $\{t'\}^9$ contains the *ten fields* $[\beta_{klm}]$. It contains also the *ten bilinear congruences* with the directrices b_{kl}, p'_{mnr}.

Of the scroll $(t')^4$ representing a ray t_α, four rays rest on d; the complex $\{t'\}^9$ contains therefore the *field* $[t_\alpha]$, which has to be counted four times.

The quadratic cone associated to a singular ray s (§ 5), has two generatrices in common with the axial complex; hence the congruence (5,8) of the rays s belongs twice to $\{t'\}^9$.

Botany. — "*On the Calcifuge Plants of the Inland Dunes of the Island of Goeree*". By Dr. TH. WEEVERS. (Communicated by Prof. WENT).

(Communicated at the meeting of May 29, 1920).

The broom, Sarothamnus vulgaris Wimm, occurs in the island of Goeree within a sharply defined area. This fact first induced me to examine the flora of the grounds where the broom occurs and where it does not; afterwards I was led to study that flora in connection with the nature of the soil.

This research concerned especially the interior of the island, known as the "Oude Land van Diepenhorst", which is bounded by the Western-Dunes in the West and the Central- and Eastern-Dunes in the East, the latter bordering on the young Sea-dunes; the old center being for the rest surrounded by polders. LORIÉ [1]) had already looked upon this center as the old inland-dunes; the small calcium-content of the sandy soil, less than 0.07 % $CaCO_3$ [2]) lends support to this conception.

Yet these inland-dunes cannot be put on a par with the inland-dunes to be found north of the Meuse. From data derived from borings, performed [3]) with a view to the construction of a tramway and to the watersupply of the island, it appeared to me that under the layers of sand are always found bands of bog-, and clay-soil, whose upper edge lies 1 m. below A. P. (Amsterdam water-mark), the lower edge from 2 to 5 m. below it, approximately at the same level where these layers are found also in the other parts of the island of Goeree and Overflakkee and likewise in Zeeland. So the inland dunes of Goeree are overlying peat-, and clay-layers of the old "haff", as in Belgium, and not the old "Schoorwal". But the Goeree inland-dunes are poor in calcium unlike most of the Belgian dunes, which are calcium-rich. Consequently their flora bears a marked resemblance to that of the few calcium-poor districts found in Zeeland and in Belgium, and termed by MASSART [4]), in agreement with RUTOT [5]), the "dunes internes" and "sable à Cardium".

[1]) J. LORIÉ, Arch. du Musée Teyler. Vol. III. 1892.

[2]) Cf. JESWIET, Entwicklungsgeschichte der Flora der holländischen Dünen.

[3]) These data were procured through the kindness of Dr. J. T. STEENHUIS.

[4]) J. MASSART, Essai de geographie bot. des districts litt. et alluv. de la Belgique Recueil Inst. bot. L. Errera, T. VII. 1908.

[5]) A. RUTOT, Bulletin de la société de géologie, paleontologie et d'hydrologie 1906.

Still, the formation in Goeree differs from that assumed by MASSART; archeological findings below the layers of sand proved that they must have been deposited there later than ± 200 A. D. [1]), and probably they are an aeolian formation from more westerly and lixiviated older dunes, in the manner advocated by JESWIET (l.c.) with regard to the grounds north of the Meuse. It appears, indeed, that their calcium-content does not increase even down to a rather great depth (± 1 m.); and amounts in the Oude Land van Diepenhorst only to 0,018 % $CaCO_3$. I will not enlarge upon the matter, but will only add that the calcium-content in the Oude Land van Diepenhorst, is lowest (less than, 0,02 %) [2]); in the Western-, and the Central-dunes slightly higher (± 0,1 %), while towards the coast it rises to ± 1 %. Now, while the grounds of the inland-dunes consist entirely of sand, and possess a psammitic flora in the sense of Drude, the vegetation of the meadows in the Land van Diepenhorst is of quite a different nature from that of the "Meent"-meadows in the Western- and the Central-dunes. In the former we find everywhere Sarothamnus vulgaris and occasionally Erica tetralix and Calluna vulgaris; in the latter all three are absent. This difference cannot be referred to the meadows being fed down, or to more or less manuring by the grazing cattle, these factors being the same for either territory; so we may readily correlate this difference in flora with the greater or smaller calcium-content of the soil, since the broom as well as heather and erica are considered to be calcifuge.

The problem of calcifuge and calcicole plants is an intricate one and not by far solved; consequently it has given rise to an extensive literature, of which only the principal points can be dealt with in the present paper. In our case, however, there is the advantage, that some factors, which in other cases are of vital importance, may be readily eliminated here. This refers especially to the physical factors, such as structure of the soil, size of the grains and in this connection the aqueousness of the soil, and the sensitivity to the sun's rays.

Researches by THURMAN [3]), and afterwards by GR. KRAUS [4]) have pointed out the great significance of these factors, especially for

[1]) I feel greatly indebted to Prof. HOLWERDA for imparting to me the age of the objects found.

[2]) Our method of determining Ca was the same as that used by JESWIET (l.c.). We confined ourselves to determining only the content of the Ca-compounds that could easily be attacked, i.e. of those which are of interest for plant-food.

[3]) THURMAN, Essai de phytostatique appliqué à la chaîne du Jura. 1849.

[4]) GR. KRAUS, Boden und Klima auf kleinstem Raum. 1911.

mountainous regions. They afford an explanation why a plant shuns calcium in one place and tolerates it in another; a sort of rivalry between allied species may also come into play here, as NÄGELI has demonstrated with the familiar instance of Achillea atrata and Achillea moschata.

In Goeree, however, none of these factors exist. The soil of both territories is sand, the grains being approximately of the same size, and the humus-content is low; in the sunlight the temperature does not differ materially in corresponding places; yet the drier grounds of the Land van Diepenhorst contain the plants under consideration, those of the Western-, and Central-dunes do not. Nor can the concentration of the groundwater be the conclusive factor [1]), although generally speaking GOLA's classification, which lays special stress upon the contrasting characters of the colloidal and crystalloidal constituents of the soil, has many advantages. The xerophytic broom grows on the dry grounds of the Land van Diepenhorst; on the other hand it shuns the dry, as well as the moister sandy grounds of the Central dunes. In the former the concentration of the groundwater might be somewhat higher, and more stable on account of the slightly increased calcium-content, in the latter this is decidedly not the case, but both are pergeloid in GOLA's classification. Nevertheless it is obvious that the edaphic factors exert some influence here.

The plant is capable of taking up considerable quanta even from a soil that contains very little calcium, thus the calcifuge Castanea vesca has on diluvial soil (calcium-content ± 0.3 %) 45 % calcium in the ashes of the leaves, in those of the wood as much as 73 %.

The calcium-content of calcifuge plants is, however, mostly very low as may be demonstrated in a simple way with MOLISCH's [2]) reaction; formation of the double-salt Gaylussite by means of a 10 % Na_2CO_3-solution.

Calcifuge plants of the peat-moor, such as Drosera spec., Orchis maculata, Narthecium ossifragum, Gentiana pneumonanthe, Pinguicula vulgaris, Molinia coerulea, Sphagnum spec. then yield a very faint reaction, Sarothamnus vulgaris likewise. From quantitative determinations I gathered that the ash-content of this latter plant amounted to ± 16 % of the dry weight, the calcium-content of the ashes ± 3.5 %, that is 0.5 ‰ of the dry weight. We see, then, that, though the ash-content of a plant and also the amount of calcium in the ash varies largely with the nature of the soil on which it

[1]) G. GOLA. Saggi di una teoria osmotica del edafismo. Ann. di Bot. VIII 1918.

[2]) H. MOLISCH, Beiträge zur Mikrochemie der Pflanze. Ber. d. Bot. Ges. 1916.

grows [1]), this constitutes a striking contrast with the Trifolium pratense occurring in the Central dunes, which has a calcium-content of 2.5 % of the dry weight, i.e. 50 times the value found for Sarothamnus. Next I wish to call attention to the fact that in many cases $CaCO_3$ exerts a noxious influence on the calcifuge plants, e.g. the Castanea vesca. This is a familiar fact with respect to peat-moor plants, to such mycotrophes as Calluna and Erica, and is perhaps owing to the influence of calcium-salts on the mycorrhiza. Since our knowledge of the entire metabolism of these mycotrophes is still insufficient, I prefer to leave it out of consideration here and will discuss the deleterious effect on Sarothamnus [2]). Experiments by MASSART (l.c.) undertaken at Coxyde showed the noxiousness of the calcium-rich soil of the recent dunes to this plant, but the nature of the bad effect could not be well made out. For Sphagnum spec. the case is better. Experiments by PAUL [3]) evidenced that solutions of as little as 0.01—0.03 % $CaCO_3$ are deleterious to these plants, which are much less sensitive to $CaSO_4$-solutions. In that case it can hardly be supposed that the noxious influence of the Ca-ions, as such, play the principal part. [4])

This leads us gradatim to consideration of the reaction of the nutrient-medium, which in the latter two cases differs with an addition of $CaCO_3$ or of $CaSO_4$.

When 150 grms of dry sandy soil was shaken up with 50 c.c. of distilled water and the fluid was filtered off after 24 hrs., the filtrate presented, in the case of the sandy soil of the sea-dunes (calcium-content 2 or 3 %) a distinct alkaline reaction with lacmoid-, and rosolic acid solution, also a weaker alkaline reaction in the case of the soil of the Central- and the western dunes (calcium-content 0,1—1,0 %). On the contrary the reaction was neutral or faintly acid in samples of sand from the "Oude Land van Diepenhorst" (calcium-content 0,01—0,02 %), where Sarothammus, Calluna and Erica occur. Would it then be possible perhaps to find a clue to the problem in this direction? PAUL (l.c.) carried out an inquiry into the occurrence of Sphagnum in the peat-moors of Bavaria, which also pointed in this direction; some cases of plant-diseases did so too [5]). At any

[1]) In weak specimens of the calcifuge Castanea vesca, grown on a soil richer in calcium, a higher calcium-content is found than in the healthy specimens of a calcium-poor soil.

[2]) Influence of the calcium-richer soil on the root-tubercles, in other words on the N-intake is not likely. On the calcium-richer soil the other Papilionacea, also have tubercles; likewise there is N-manuring by the grazing cattle in both cases.

[3]) PAUL, Mitt. kgf. bayr. Moorkulturanstalt, 1908.

[4]) The mostly calcifuge lupin is sensitive to $CaSO_4$.

[5]) e. g. the oat-disease of the "Veenkolonie" and the Hooghalen-disease of rye.

rate it is evident that a difference in reaction of the groundwater yields quite another nutrient medium; by more calcium the decomposing effect of the acids is abolished. As is obvious, it is the roots that undergo the deleterious influence of additional calcium, which is proved by the fact that the Castanea vesca, when grafted upon the oak, also thrives in calcium-richer soils.

However, although this influence of the reaction of the groundwater is of great moment, it cannot be the only causative factor. This is supported by the cases in which two kinds of soil exhibit a similar reaction, and nevertheless possess distinctly differing vegetation with identical physical factors but non-identical calcium-content. Cases in point are the inland-dunes, such as the Central-dunes of Goeree on the one side and the sea-dunes on the other. In Goeree Orchis morio, Scleranthus perennis and others shun the seadunes (calcium-content from 2 to 3 %). They are however indigenous to the Central-dunes (calcium-content 0,1—1 %). It is also supported by the fact that lupin, which is mostly calcifuge, undergoes the noxious influence of $CaSO_4$-manure. In conclusion I, therefore, point to the antagonism of the bivalent Ca-ions and the univalent Potassium-, and Sodium-ions. Zoological researches by LOEB [1]) and afterwards botanical experiments by VAN OSTERHOUT [2]) (e.g. with plantroots) have shown that the salts of the univalent as well as those of the bivalent metals, taken separately, have a toxic effect, which, however, is neutralised by a definite concentration of the others.

Their effect on the permeability of the protoplasm is such that in Na-salts the permeability increases till death approaches; that in Ca-salts alone it first decreases in order to increase again after a certain minimum has been reached, till ultimately death sets in also, and permeability is constant, exosmosis complete [3]). On the other hand solutions of Na-, and Ca-salts in a certain ratio (e.g. 95,24 NaCl and 4,76 $CaCl_2$) in experiments with Laminaria [4]) do not affect the normal permeability at all, and render normal growth possible, which led VAN OSTERHOUT (l.c.) to hypothetical speculations about the action on the protoplasm, which cannot be gone into here.

It is a fact, however, that excess of either salt (in casu Ca) can

[1]) LOEB, Am. Journ. Physiology. Vol. 3. 1900.

[2]) W. J. v. OSTERHOUT, Jahrb. f. Wiss. Botanik Bd. XLVI, 1908, On the importance of physiologically balanced solutions for plants. Botan. Gazette 44. 1907.

[3]) TH. WEEVERS, Betrachtungen und Untersuchungen über die Nekrobiose und die letale Chloroformeinwirkung. Rec. des trav. bot. néerl. Vol. IX. 1912.

[4]) W. J. v. OSTERHOUT, Antagonism and Permeability. Science Vol. XLV. 1917.

be toxic, as e.g. was shown by VAN OSTERHOUT's soil-experiments. Addition of $CaCl_2$-solutions to the otherwise fairly favourable soil was injurious to the cultivated plants; addition of KCl-solutions was not. VAN OSTERHOUT interprets this by pointing out that through the addition of Calcium the relation of the two metals departs more and more from the optimal whereas it approximates the optimal relation through the addition of Potassium.

Reverting to our broom we see that relative to the soil of the Land van Diepenhorst the calcium-content of the soil of the Central-dunes rises from 0.015 % to 0.90%, i.e. ± 60 times the original value. On the contrary there is no appreciable total increment of the potassium-, and the sodium-salt-content: in the Central-dunes this was 0.08 %, in the Land van Diepenhorst 0.06 %.

The relation in the Western and Central-dunes has been largely modified, so that the equilibrium for the true calcifuge plants, such as Sarothamnus, has been disturbed. The view is favoured by the fact that calcifuge-plants, such as Castanea vesca, can be cultivated in calcium-rich soil, provided the soil is of itself potassium-rich [1]), or potassium is added to it, SCHIMPER [2]) maintained that calcium inhibited the absorption of ironsalts, and that addition of ironsalt-solution to calcium-rich soil removed the excited chlorosis. By others, among whom SIDORINE [3]), this was however refuted and ascribed to the alkalinity of the nutrient solution that had been used.

For Magnesium LOEW [4]) asserted that a certain ratio of Ca and Mg is required for a satisfactory development, which, however, has been negatived by Russian and American writers [5]) on the science of manuring.

With the method for soil-examination adopted by me I found in both soils only traces of magnesium; I, therefore, refrain from giving my opinion about this question, which may be solved through subsequent experiments, which I purpose to perform with the Sarothamnus by cultivating it on calcium-richer soil to which various salts will be added. This however is a time-consuming undertaking; for the time being experiments with water-cultures of buck-wheat were indicative of the great importance of the antagonism of the salts of univalent and bivalent metals in the problem of calcifuge plants.

1) ARNOLD ENGLER, Ber. Schweizer. bot. Ges. 1901.
2) SCHIMPER, Pflanzengeographie. 1908.
3) SIDORIN. Ergebn. Landw. Stat. Moskou 1916..
4) LOEW. Bull. Agric. Coll. Tokyo 1902. Die Lehre vom Kalkfactor. Berlin 1914.
5) A. DOJARENKO Journ. f. experim. Landwirtschaft 1903, F. A. WATT Journ. agr. research 1916.

Physiology. — *"On the Pharmacological Action of Isoamylhydrocuprein (eukupin) and Isoctyl hydrocuprein (vuzin)"* By Prof. R. MAGNUS and U. G. BIJLSMA.

(Communicated at the meeting of April 23, 1920).

Of late years especially three compounds out of a series of hydrocuprein-derivatives, which had been examined by MORGENROTH and his pupils on their antiseptic action in vitro and in vivo, have been applied in therapeutics. These researchers had namely discovered that the alkylated hydrocuprein-derivatives were strong antiseptics every member of this series having a specific affinity for certain micro-organisms.

Thus ethylhydrocuprein counteracted especially pneumococci; isoamylhydrocuprein antagonized diphteria bacilli, bacilli of malignant edema and pyogenous cocci; isoctyl hydrocuprein neutralized the effect of bacilli of malignant edema and pyogenous cocci still more than isoamylhydrocuprein did (in vitro; in vivo they showed little difference). These three substances were given the commercial names, respectively of optochin, eukupin and vuzin.

As most commonly happens with the products of chemo-terapeutic researches, also these three substances were applied to patients or to men under suspicion of being infected, before pharmacological examination had sufficiently established their effects upon the mammal. Indeed, with respect to optochin inquiries were made later on, but hardly anything was effected in this direction for eukupin and vuzin. In order to meet this deficiency as far as possible, we have examined pharmacologically the double-hydrochloric acid salts of the latter two substances, which were put at our disposal through the kindness of Prof. MORGENROTH (Berlin). Before long these experiments will be published [1]) in extenso in another place; for the present we are able to give a concise report of our results, in which eukupin and vuzin stand for the double hydrochloric acid salts.

1. The pharmacological action of eukupin and vuzin (in the cases examined) agrees for the most part with that of quinine.

2. Eukupinae bihydrochloridum is soluble in distilled water to

1) For the bibliography we refer also to this detailed publication.