THE XEROTHERMIC LICHEN SPECIES CLADONIA MAGYARICA VAIN

A history of investigation

The typical form of Cladonia magyarica was first collected by J. BERNÁTSKY in the Danube island Csepel, in a sand soil, in 1901. The specimen collected by him is placed in the herbarium of the Hungarian National Museum, denominated Cladonia pyxidata var. neglecta, determined correctly by Ö. SZATALA during the revision of the herbarium in 1929. A datum still older is I. RICHTER's collection from 1885, containing a specimen of Cladonia magyarica f. pocilliformis from Pokorágy, in county Gömör. That lichen has got into the herbarium of the Institute of Plant Taxonomy of the Lóránt Eötvös University under the name of Cladonia pyxidata, revised similarly by Ö. SZATALA. These are, therefore, the oldest herbarial data concerning the forms of Cladonia magyarica. In the period between 1885, resp. 1901 and 1924, the typical form was found by a lot of botanists, among them also by Hungarian lichenologists of repute (GYELNIK, SÁNTHA, SZATALA, TIMKÓ), in the quicksand regions of the Great Hungarian Plain, and one of the variations was found even in Transdanubia, i. e. in the part of the country that lies between the Danube, the Drava and the western frontier, without being recognized by the collectors as a new species. On the labels of the most specimens in the herbaria the name Cladonia pyxidata var. neglecta is given.

At last in 1924, GY. TIMKÓ found some conspicuous specimens in the wood „Bugacz" near Kecskemét, and being unable to determine them he sent them to the excellent Finnish Cladoniaspecialist, E. VAINIO. VAINIO immediately recognized them being new plants, determining their taxonomic place betwen Cladonia pyxidata and Cladonia chlorophaea. In 1929, he described them as nova species, giving them the name of Cladonia magyarica. A variation similar to the variant named Cladonia pyxidata var. pocillum, the Cladonia magyarica var. pocilliformis, has been separated from TIMKÓ's material similarly by VAINIO, as well. The variant is regarded by I. PIŠÚT (1961 : 370) to be but of formal value and mentioned as a new combination by the name f. pocilliformis (VAIN.) PIŠÚT.

The original specimens of both forms are preserved in the botanical collection of the National Museum of Natural Sciences (Budapest) with E. VAINIO's autographic signature „Exemplum originale" and his autograph.

In 1930, V. GYELNIK (1930 : 22–23) published a detailed description of the lichen and the localities of occurrence of the type plants.

Both the exsiccatum and VAINIO's original diagnosis appeared in the publication of the Botanical Collection of the National Museum (Cent. VIII. Lichenes 75. No. 715) in 1930. In the same year J. ANDERS (1930 : 499–501), and in the next one H. SANDSTEDE (1931 : 410–411) dealt with Cladonia

magyarica. All the three authors gave also a good description of the plant mentioning, however, for want of a larger mass of matter for investigation, only the typical form and, sometimes, the f. pocilliformis.

The literature concerning Cladonia magyarica and the f. pocilliformis, published until 1931, has been summarized by H. SANDSTEDE (1931 : 411). There are mentioned there not only the occurrence in Hungary but also several other ones abroad. The latter ones, however, may be accepted but with some reservation.

Finally in 1961, I. PIŠÚT (Preslia, 33 : 369–374) treated of the relationship, occurrence, and distribution relations of Cladonia magyarica, in his monograph „Bemerkungen über Cladonia magyarica Vain., mit Berücksichtigung ihrer Verbreitung im Karpatenbereich", on the basis of a material resulting from several collections, first of all from the herbarium of the Botanical Collections of the National Museum of Natural Sciences in Budapest. In his monograph, the localities in Hungary are, anyway, indicated with several errata.

Morphology of the Cladonia magyarica VAIN

(a) External morphology

(1) Primary thallus

The Cladonia magyarica has two kinds of thalluses, consisting partly of squamae lying on the substratum and localized horizontally (thallus primarius), partly of podetia tanding vertically (thallus secundarius).

The lacings (laciniae) of the primary thallus are middlesized, flattened, narrowly lobed. The length of lacings is (3)–5–6–(10) mm, their breadth is (1)–2–3,1 mm. Their upper surface is greenish-grey, K + mildly yellowish, their lower side is white, showing no reaction with KOH. A young primary thallus is generally circular, the rims of the squamae located radiately being in touch; later on, anyhow, the thallus loses its circular shape and the sqamae become scattered.

The thallus squamae are stiff if dry, their white lower side turns outside forming an excellent reflective surface. In wet state, the lacing are flatly spread, lying loosely on the substratum and bulging, sometimes, a little.

The colour of the upper surface of squamae is brightly green, if young and wet, it is, however greyish-green, oil-green or oil brown, K + yellowish, if older and dry, and it is light brownish-red after the reagent being dried up. From the lower surface of squamae brown hypha bundles, rhizinae protrude assuring the adhesion to the loose substratum. They are as long as 2–3 mm.

(2) Podetia

The small podetia that are at first thin, and above a little broadened, are appearing in the young primary thallus. The full-developed podetia are similar to the funnels of the Cladonia pyxidata var. neglecta. Either they are simple, of a single chalice, or the chalices are rising storey-like from each other forming even triple floors like in case of the lichen species Cladonia verticillata. There may rise one sprout or around even more of them from the rims of chalices. The podetia grown in stories generally surpass the lenght of the lowest podetium. A fast growth, as a sign of regeneration, occurs first of all if the primary thallus and the lowest podetium are buried with sand mobilized by wind.

The encrustement of podetia is branny, a little furrowed in spots. Their colour is whitish-grey, humidly green.

From the sides of podetia and particulary from the rim of funnels several leaf-like squamae are rising, getting rolled round and thus showing their white lower surfaces outwards, having here and there rims with blackish rhizinae. The squamae are yellow with KOH, their taste is bitter showing that they contain fumarprotocetraric acid, like the podetia of the Cladonia pyxidata group with bitter taste generally do.

The sizes of podetia, computed as an average value of 150 measurings, are: their mean length is (10)–16–17–(22) mm (typical form), resp. (6)–9–(11) mm. (f. pocilliformis); their thickness is 2–4 mm; funnel diameter (3)–4–5–(8) mm (typical form), resp. (2)–3 mm (f. pocilliformis). On one occasion, at the f. verticillata, a 46 mm high funnel has been found.

The lacings of podetia are (1,5)–2–2–(5) mm long and (0,5)–1–1,5–(2) mm broad.

The abundantly foliose forms with long shoots and narrow funnels can be confounded with the forms of Cladonia degenerans f. phyllophora EHRH. It the single funnels have several squamae they resemble the form Cladonia chlorophaea f. pterygota.

(3) The *apothecia* are light brown if young and in wet state, and they are brown in an older state, rising from the rim of funnels and often filling in the whole interior of the funnel.

The spores are unicellular, colourless, elliptic, of a size of 12–14×3,5 microns, at one end a little sharpened, at their side mildly bulging.

(4) The *picnidia* occur at the funnels closely side by side, they are sitting if young, with short pedicles if well-developed and then they are similar to small, undeveloped apothecia, being nearly spherical, in ripe state with a round opening above. In fully developed state they are of a size of 0,2–0,5 mm. Sometimes they appear on secondary thallus squamae or in the middle of the funnels, as well. The picnoconidia are of the size of 7–9×1 microns almost spindle-like, mostly a little bent.

(b) Internal morphology

Ot the basis of anatomical investigations, in the cross-section of the primary thallus an external crustaceous layer is taking place, with a subjacent zone of gonidia, and a hypha tissue underneath in the thickest layer. The gonidia, are arranged in nearly spherical groups, touching one another with their rims, thus the layer of gonidia is not thoroughly contiguous, resp. of equal thickness. The hyphae running betwee the gonidia are of thinner walls, sucking up and conveying the assimilata. The hyphae of medulla are thicker, on their surface lichen-acid crystals may be observed consisting of fumarprotocetraric acid. In the hypha tissue, here, there are smaller and bigger cavities, gaps that make spongy the tissue of medulla. Thus the thallus is capable of sucking up quickly the minimal quantity of dew of precipitation and, consequently, of increasing quickly in volume. The absorption of moisture on the lower surface of the lacings of thallus, pressed closely to the substratum, can be carried out the more easily because the lacings haven't any lower crust, and the spongy white medulla layer is sticking immediately to the surface of sand (cf. Table III. Fig. 1., 2.).

The greyish coloration of the primary thallus is a consequence of a dense and mildly coloured hypha plexus in the upper crus above the layer of gonidia functioning as a lampscreen against an exaggerated insolation. In the moistened and swollen thallus lacings also the spongy substance of that layer is being filled with water and thus the transparent green colour of gonidia can be brightly effective through the wet layer that became loose and swollen.

The horn-shaped podetia are massive till the end, if young, and below in later time, too; then they get hollow about in the middle and from then they have two layers. The podetia, and therefore also the secondary thalluses, are covered by a crustaceous layer outside. Beneath that layer there comes a so-called external-medulla, then the layer of gonidia can be seen and there follows an internal medulla layer consisting of thicker hyphae. This layer is dense, as well, and forms a substance with small holes. Inside the funnel there isn't any internal crustaceous layer. The crustaceous substance and the gonidial substance are of a much looser pattern than the internal crustaceous substance. The layer of gonidia often dissolves in soredia and then it becomes completely loose. The soredia render service for the vegetative multiplication.

On the upper part of small funnels, flared out hornlike, the external and internal crusts are getting farther from each other. Gonidia are occurring only on the surface of the external layer, i. e. outside, the internal layer consisting of a hypha tissue. Between the medulla layer of the external layer and the hypha tissue of the internal layer, there may be observed some septa running along connected, in different heights, even transversally by thin cross-lamellae, consisting similarly of hypha tissues. Therefore, the upper horn-like part of podetia, consisting of two layers, has a definite internal structure that – according to the lichen species – determines the shape of podetia, making their substance hard and, in dry state, brittle and fragile. The orifice of the small funnels is not open but closed with a thin layer that is remitting Cladonia magyarica into the sub-section Thallostelides of the section Eucladonia subgenus Clausae (Cf. Table I. Fig. 5., and Table III. Fig. 4.).

The internal ventricles of podetia are particularly suitable, apart from carrying out the mechanical task, for storing the moisture absorbed by the spongy medulla substance and also introduced in form of vapour.

Physiological conditions[1]

For studying gonidia, we have made pure cultures, according to R. CHODAT's method. As culture fluid, DETMER/KNOPP's solution has been used. The standard solution was of the following composition:

H_2O	1000 g	KH_2PO_4	0,25 g
$Ca(NO_3)_2$	1 „	KCl	0,25 „
$Mg\ SO_4$	0,25 „	$FeCl_3$	1 drop from a solution of 1 percent.

In the first culture series we have used solutions of 1/1, 1/2 and 1/3 concentration from the standard solution aforesaid. A part of them has been applied as a fluid, another part as a solid culture medium with 2 percent agar-

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agar. A half part of the culture media and culture fluids was given with 2 percent glucose.

The culture media have been made as follows:

DETMER's standard solution was diluted with distilled water in the above-mentioned ratio, then we have given 2 percent agar-agar to it and the whole was boiled in an autoclave, in Erlenmeyer's test-tubes closed with wad-stoppers. The boiling culture medium, in a fluid state, was filtered through a cotton-wool filter and distribuer into eprouvettes, resp. smaller Erlenmeyer's test-tubes. The glucose in the quantity necessary to the culture medium has been given to the culture fluid after being boiled but before being filtered. The eprouvettes and Erlenmeyer's test-tubes ware sterilized, closed with wad-stoppers, in an autoclave, held 20 minutes long under a pressure of one atmosphere, about in 110–120 °C. We let the eprouvettes get cold in an inclined state, gettling so slanting culture medium surfaces.

For making pure cultures, we have used soil concoctions, as well. The sand was boiled with distilled water – calculating two parts of water to one part of sand – 10–15 minutes long, in a temperature between 90–100° C. After discharging the solution from the cooled and settled concontion, we have filtered it through a filtering paper and used that instead of DETMER's solution. The soil concoction was used also with agar-agar. 2 percent of agar-agar was applied in the soil-concoction, with glucose or without sugar.

The culture fluids and culture media used at the second series of experiments have been:

DETMER's solution of 2/1 concentration, without agar-agar, with 4 p. c. glucose,

DETMER's solution of 1/3 concentration, with 2 p. c. agar-agar, with 4 p. c. glucose,

A soil-concoction made of dry sand from the F. Kiss wood, with 2 p. c. agar-agar, 4 p. v. glucose,

DETMER's solution with JAAG's modification, without agar-agar, with 4 p. c. glucose.

The composition of DETMER's modified solution is:

H_2O	1000 g	KH_2PO_4	0,25 g
NH_4Cl	0,650 „	KCl	0,25 „
$CaCl_2$	0,675 „	Mg SO_4	0,24 „
$FeCl_3$ (1 p. c.)	1 drop.		

In the first series of experiments R. CHODAT's method of pure breeding was applied (CHODAT, 1913. p. 193).

A piece of the thallus squamae of Cladonia magyarica was rinsed clean with distilled water before being inoculated. Then it was squashed in a drop of distilled water, macerated with a lancet. Thus we have obtained a mass consisting of gonidia and hyphae. The inoculation took placewith a heated platinum needle. The needle was dipped into a waterdrop containing the hypha-gonidium mass and the materialsticked to the neddle was inoculated into the culture medium, resp. the culture fluid.

The substance inoculated in this way is not clean, as yet; besides gonidia and algae, also a lot ot bacteria, penicillia, hyphae have got into the culture medium. From the infecting organisms – particulary in a culture medium

sugared – the bacteria and penicillia are developing very fast and in a few days they oppress the gonidia propagated much more slowly. In some cultures, anyway, also the gonidia have produced discernible cultures. The necessary inoculations were performed from these cultures. Finally, after repeated inoculations, we have obtained pure cultures, without any bacteria and penicillia.

In the last series of culture, the inoculation took place with a micro-manipulator. We have striven for getting a pure culture from a single gonidium. For that purpose JANSE–PÉTERFI's micro-manipulator has prover the best. For its use we have applied the method recommended by JAAG (1929, pp. 19–22).

Some nice, well-developed thallus squamae of Cladonia magyarica were pured from the contaminations sticked to them and visible even macroscopically. Then they were held under running water for half an hour, and the foreign materials, supposedly sticked to the thallus squamae, incessantly, were washed away with a strong water-spout. After that, the thallus pieces were kept in distilled water sterilized – about ten minutes long – and washed in distilled water with a strong spout. The thallus squamae, rinsed clean in that way, were blotted, placed between elderpith pieces cut in a sterile way, and dried a little. Then, on a slide sterilized in flame, the upper surface of the thallus pieces was scraped somewhat with an annealed lancet. In that way we have obtained the result that the epiphytal algae that sticked to the surface and could not be removed by rinsing, have got into the scrape, as well. And even the upper crust was removed with this method from the layer of gonidia under it. At last, we have separated – similarly with a lancet – the green layer of gonidia from the lower colourless hypha layer. This operation with the moist thallus pieces can be carried out easily. The layer pieces that contained the separeted gonidia were cut up into very tiny pieces on another slide being similarly sterile. After dropping sterile water on them, we have covered the thallus pieces with a cover-plate and with a mild pressure on the plate we have separated the gonidia and hyphae. After removing the cover-plate, we have obtained water drops containing hypha pieces and free gonidia. We have introduced a small drop of that upon the lower side of the plate covering the wet chamber of the micro-manipulator. In this way we obtained the water drop containing gonidia like a hanging drop. On the right and left sides of the cover plate, beside the water drop with gonidia, we have placed sterile water drops. The drying up of the wet chamber was prevented by the help of a moist wadding. The wet chamber prepared like this was placed on the microscopic slide, and the manipulation was carried out with microscopic magnifications. The pipettes were made according to PÉTERFI's method.

We have sucked up a gonidium with a pipette sterilized in absolute alcohol and flame. For removing bacteria or foreign algacells that possibly sticked to it, we have rinsed the gonidium chosen, as well. Therefore, we blew out the content of pipette upon the clean, empty surface of the cover plate, sucking away the water from the gonidium again and again, taking care that the algal-cell itself doesn't get into the pipette. Repeating this operation three-four times, we have achieved the result that the selected gonidium cell was available for us clean, in a state suitable for inoculation.

With that procedure, which is much more laborious than the former one was, we could inoculate a single gonidium and investigate really the gonidia of Cladonia magyarica in the cultures obtaine by the help of it. An indisputable

advantage of the method is that, already at the first inoculation, we have obtained a pure culture undisturbed by the presence of penicillia or bacteria either in sugared or in sugarless culture media.

The cultures, obtained after the first series being inoculated, could be bred pure, inoculated three-four times again and again. The alga of the pure culture was a gonidium isolated from the lichen thallus originated from the „Csengele" wood. The alga cells nearly spherical, of a size changing between 8–18 μ. The cells had a big yellowish-green chromatophore (Code des Couleurs: jaune vert No. 276), filling up the cell completely. The surface of the chromatophore is smooth, appearing sometimes finely granular. With a gentian-blue staining, a nucleus of the size 1,5–2 μ of central site may be demonstrated.

The cell wall gives a violet cellulose reaction with chlorzinciodine. The cells contain a large quantity of oil, well-visible even without staining. As a result of a staining with Sudan III, the spread small oil drope run together into a bright orange drop. The oil content is large compare with the size of cell, filling up about one-third part of them.

In the cultures the cells form groups, as a consequence of the way of their division, resp. multiplication.

The gonidium algae have mostly multiplied in the cultures by forming autospores. The chromatophore of uniformly green colour became turbid in the cells fully developed, some granulation has appeared in it. Later on, this granulation became stronger, forming small, at first irregular clodes later transformed into regular spherules. These spherical autospores have more and more increased, filling up, at last, completely the interior of the sporangium cell. After being delivered, six-seven autospores have increased remaining together and forming thus mulberry-like bunches. These bunches are giving the cell groups appearing in the pure cultures. Whether the autospores had got into the open air by bursting the wall of the sporangium cell or by breaking up the whole cell, it could be observed that some autospores remained inside the cell-wall cover emptied. The two-three autospores left over again began forming new cell groups.

The autospores are of small regular spheric shape, with rather dark yellowish-green chromatophore, filling in the cell cavity completely. In older age, a nucleus can be demonstrated in them with gentian-blue staining.

When the autospores are reaching the size of normal gonidia and the state of their physiological maturity, they become even themselves autosporangia.

In pure gonidium cultures also a multiplication by isogametes can often be observed. We have studied the substance coming from the culture in distilled water. In five minutes after taking out the material, the uniformly green chromatophore became granular, decomposing first dimly but later well discernibly into several oval particles that, increassing and eventually crowded, have completely filled the interior of the mother cell. It the meantime, on the cell wall of the mother cell, in the form of a cap-like protrusion, the site of the future discharge has become visible. The gametes, incrassed and crowded, had carried aut a great pressure on the cell wall that quickly opened with a small round hole at the site of leaving mentioned above. Through the opening produced in this way the mass of gametes being still immobile in the cell was slowly pressed out, surrounded by a greenish jelly-like viscous substance. In the mass pressed out and placed spherically before the orifice of the mother cell

in some seconds the gametes got activated, began swarming, then separated from one another explosionlike and swam away. Sometimes two-three gametes got on with sticking together, coming apart only later, in some distance from the mother cell. On the membrane of the mother cell emptied the site of the opening is obvious.

In certain cases when the developing gametes can already be separated well without being pressed completely to one another for the time being, they begin to move already inside the mother cell. This movement lasts some seconds, sometimes however for some minutes, then the mother cell quickly opens and the exploding gametes are scattered with a fast swimming. Inside the empty cell wall some gametes are sometimes left behind. These are circulating in the empty mother cell for a long time – as long as a quarter or half an hour – at last, losing their flagella , they become round.

The gametes delivered are uniform, somewhat elongated. one of their ends being more pointed, the other one rounded off. Their size is 5–10×2–4 μ, they have on their pointed ends two flagella equally 6 μ long, with the help of which they are swimming with a lively, drilling motion being capable of a quick changing of direction. They often twirl round their own axis remaining in the same place and then, breaking off that motion, they are quickly swimming in a straight direction again. Sometimes they perform only the rotary motion described. The gametes swimming in straight direction may quickly come to a stop and begin turning round and round. That motion of theirs can last as long as 1–1 to 15–20 minutes. Their motion gets slower and slower, at last they cease to move, get rid of their flagella become round and, as independent cells, they begin to feed, grow, i. e. they begin to function as new cells.

At the round end of gametes, a chromatophore can be found having either the shape of a trough tight on the wall or being stretched along the wall. The chromatophore sometimes fills in the whole body of gametes. In the gametes there cannot be demonstrated any nucleus or stigma, even by being stained.

The isogametes may copulate in different ways. With their pointed and sometimes rounded ends or with their sides they adhere closely to each other, meanwhile turning round in the same place or advancing with a drilling motion. In some time their motion becomes slower, they flick more rarely with their flagellae, and finally they cease entirely to move.

The physiological behaviour of the gonidium alga bred in the first series of culture was as follows.

We have got the thalluses developed big from pure cultures in their most perfect form in DETMER's culture media of different concentrations. The colour of thalluses was a little lighter and their surface a little wetter, too, in the soil concoctions containing sugar. We have observed a development at an approximatley uniform pace in the soil concoctions containing glucose and in DETMER's culture media. The cultures were generally yellowish-green, granular, of a little surface with characteristic protrusions and dimples making wavy the surface of thalluses.

In several cultures there developed not the original godinium of Cladonia magyarica but an epiphyte alga in symbiosis with the lichen thallus on its rugous surface. This fact, as an experimentary mistake, was already mentioned by R. CHODAT (1913, p. 193), as well. In the greatest part of cultures, however, there was reall the gonidium alga that was bred.

In the second series of culture, made by the help of micro-manipulators,

we have used the gonidia of the Cladonia magyarica thalluses originating from the F. KISS wood and BILISICH wood beside Szeged–Âsotthalom. The inoculation was carried out with the method used in the Geneva school an followed by JAAG, too. As culture medium we have used a culture medium with glucose prepared with one-third of DETMER's agar-agar, sand soil with glucose from the F. KIS wood, 2/1 of DETMER's solution with glucose, and DETMER's modified solution with glucose.

The inoculated cultures were put into a culture case placed before a window giving a diffuse light and looking on the direction NNE. In the case a temperature of 16–18° C was assured.

The inoculation of cultures took place on February 21st. For a complete month there has not occured – according to cur macroscopic observation – any visible change. Between March 20th and 22nd some vaccines took place. At the bottom of a culture with DETMER's modified culture fluid and on the surface of more nutrient substrata some dots of 0,5 mm diameter have appeared. The thalluses continued developing gradually but very slowly. On June 19th the size of cultures was of a diameter of 5–7 mm.

From the cultures grown large enough, on April 19th and May 6th we made transmissions by inoculation to different culture media. Erlenmeyer's retorts containing the vaccines were kept partly in a diffuse, partly in a direct sunlight. With these series we have wished to investigate the to influence of the different culture media and of the luminous intensity. The cultures grown in DETMER's sugared culture medium from the F. KISS wood have shown round cultures with a size of 5 mm. That consisted of fine small clods showing in some places knobs, elswhere dimples. The knobs were placed as if their centre had developed alga groups along concentric circles starting from the same centre. The middle of culture was thicker, it protruded more than the peripheric part that seemed to be thinner. Its colour is yellowish-green (Code des Couleurs: Vert No. 302), of a somewhat wet surface without being bright. The gonidia dissolved in a sugared soil concoction from the BILISICH wood have given small thalluses of a less regular shape but of a much finer granulation, and therefore of a smoother surface. Their colour was more yellowish-green (Code des Couleurs: Vert No. 307), the surface wetter and brighter. Also the external picture of the thalluses grown in culture media non-sugared was similar to those described above, the small thalluses have however formed a smaller and thinner cover.

The granulation of the thalluses developed in solid culture media and visible to the naked eye supposedly is a cell group fragmentated from a mother cell each.

The gonidia haven't reveal any difference in direct and diffuse lights as there wasn't given any difference by DETMER's sugared solution and a sugared soil concoction. The want of sugar has, however, retarded the development strongly.

The results of the macroscopic investigations of cultures are:

(1) The presence of glucose is accelerating the development; without glucose, however the intensity of development is decreasing.

(2) The use of a direct or diffuse sunlight is giving no difference at gonidia coming from the same plant and locality and inoculated into the same culture medium.

(3) The intensity of development of the gonidia grown in the same soil concoction and DETMER's culture medium is identical.

(4) The gonidium algae originating from two different localities have shown a granulation of different colour and different fineness in culture media of different composition.

(5) The gonidia are developing in a culture fluid with greater intensity than in a solid culture medium. That is connected – in all probability – with the physical condition of the medium. In a solid culture medium the shape of cultures is regular.

(6) The introductions made of bred are developing faster than the primary cultures originating from a lichen thallus. It is demonstrated by this fact that the gonidium alga – after some generation – is accommodating itself well to the artificial conditions.

The results of the microscopic investigatons have been:

(1) The alga cells developed in the cultures are spheric or somewhat oval, their size being 6–8×10–14 μ, their wall thickness 0,8 μ.

(2) The chromatophore of the algae is of central site, of lobate edge, of yellowish-green (Code des Couleurs: Vert No. 306) colour.

(3) The alga cells are containing a great lot of oil stained well by Sudan III.

(4) The pyrenoid that shows also a weak starch reaction may hardly be seen in the cells grown in a medium sugared; it is, however, to be demonstrated easily in the cells developed in a culture medium without sugar.

(5) The alga cells are mononuclear.

(6) The gonidia are multiplying with autospores or gametes.

The gonidium alga of lichens belonging to the genus Cladonia is classified by R. CHODAT into the genus Cystococcus and bescribed by the name of Cystococcus Cladoniae CHOD. Similar observations have been made by O. JAAG and F. ELVING, as well.

The gonidium alga of Cladonia magyarica is differring from that of CODAT's plant both „in situ" and in the cultures, too. Therefore, for making a distinction, we have specified the gonidium alga of Cladonia magyarica by the name of Cystococcus cladoniae magyaricae.

Its description is as follows:

The cells are approximatively spheric or somewhat oval, their size being 6–8×10–14 and the thickness ot their walls, 0,8–0,9 μ; they take place in irregular cell clusters. In the algal cells there is generally one colour body, rarely there are two or three of them, being of laced edge and taking place in the middle of the cell. In each of the coloured bodies there can be found a pyrenoid. The multiplication is happenning by autospores and isogametes.

Cellulae algarum approximative globosae seu modice ovatae, cum magnitudine 6–8×10–14 μ. Crassitudo membranae cellularum 0,8–0,9 μ. Cellulae in acervis deformatis se ponuntur. In cellulis algarum unum, rarior duo seu tria chromatophora inveniuntur. Chromatophora – cum pyrenoidis singularis – in medio cellularum ponuntur. Multiplicatio cum autosporis isogametisque accidit.

Material production of Cladonia magyarica

Our investigations the material production of Cladonia magyarica. For that purpose we have investigated ten lichen plants covering a soil surface of 1 sq. dm each.

The collected matter was first pured macroscopically from the pedicles of the mosses, from the podetia of other lichens, from the mouldy foliage-leaves and other vegetable particles, animal excrements, carrions of perished insects, etc. Then we have removed the grains of sand sticked to the rhizinae on the surface of a metal sieve with the water spout from the water-mains of high pressure applied two times for ten minutes. The matter pured in this way was dried in an exsiccator in 120° C for 24 hours. After drying, we have messured it again and, computing an average of the result of measurements we have got the mean value of the material production for one sq. dm. Finally, having heated the lichen patterns, we have burned their organic matter. Extracting the residual weight of ashes from the weight of the dried matter, we have got the value of the organic matter production for a surface of one sq. dm.

For establishing the total organic product appearing on the sand surface together with the lichen thalluses, we have weighed the foreign matter collected with the single samples, as well. The sum of the weights of the dried lichen matter and of the foreign organic matter is giving the value of the total material production for one sq. dm on the locality of Cladonia magyarica. From these values – multiplied by ten – the quantity of the material production for one sq. m. can be established easily.

The results are summarized in the following table:

MATERIAL PRODUCTION OF CLADONIA MAGYARICA

Number of samples	Weight of the total production	Weight of the purified lichen material		Quantity of the removed water	Weight of the ash remained after being heated	The organic-matter content of the lichen mass investigated
		before drying	after drying			
	for one sq, dm in grammes					
1.	22,300	10,100	9,350	0,650	1,820	7,530
2.	14,150	7,850	6,920	0,930	1,555	5,365
3.	14,730	9,320	8,150	1,170	1,605	6,550
4.	17,900	8,480	7,150	1,330	1,835	5,315
5.	17,150	7,130	6,100	1,030	1,035	5,065
6.	23,950	11,350	10,540	1,810	1,210	9,330
7.	16,940	7,590	6,510	1,080	1,550	4,960
8.	16,610	10,910	9,600	1,310	1,610	7,990
9.	11,770	8,920	7,710	1,210	1,680	6,030
10.	16,100	8,200	7,350	0,950	1,420	5,930
In average	17,160	8,980	7,930	1,147	1,932	6,406

Investigation of the antibiotic activity of Cladonia magyarica[2]

The air-dried lichen body was finely ground and extracted (1 g/10 ml n-butanol, ethylether and chloroform at 20° C for 12 hours. The extracts solvent in each case) with distilled water at 4° C and 20° C, acetone, ethanol, were filtered and the antibiotic activity was controlled by agar-diffusion cup-test. The culture medium was a bouillon of 3% agar content, supplemented with 1% saccharose, set partly for pH 6,5, partly pH 7,5. The media were inoculated with the suspension of test microorganismus, then cups were punched out and 0,1 ml solutions were introduced into each cup of 8 mm in diameter and 3 mm in height.

As test-microorganisms the following bacteria and fungi were used: Bacillus cereus var. mycoides, Staphylococcus aureus WALKER, Escherichia coli O 111, Serratia marcescens, Candida albicans, Hansenula anomala, Aspergillus niger, Syncepahalastrum racemosum.

According to the results, Cladonia magyarica contains antimicrobial agents inhibiting selectively the multiplication of the two Gram-positive bacteria. The results are summarized in the Table. The figures in the Table show the radius of the zones of inhibition, the sign „+" marks partial inhibition and the sign „–" means inactivity.

ACTIVITY OF THE EXTRACTS OF CLADONIA MAGYARICA VAIN. AGAINST GRAM-POSITIVE BACTERIA:

Bacteria	Distilled water of				Ethyl-ether		Acetone		Ethanol		N-butanol		Chloro-form	
	4° C		20° C											
pH	6,5	7,5	6,5	7,5	6,5	7,5	6,5	7,5	6,5	7,5	6,5	7,5	6,5	7,5
Bacillus cereus var. mycoides	—	—	+	+	6	4	6	4	7	6	6	3	4	2
Staphylococcus aureus WALKER	—	—	—	—	4	2	3	+	4	2	3	+	3	+

The active substances are well extractable in organic solvents applied.

The antibacterial compounds were separated by thin-layer chromatography. The dried lichen material was extracted with ten-fold quantity of ethanol (w/v) under reflux for half an hour. Silica gel 6 (nach STAHL, MERCK) was used in an amount of 10 mg/cm² as adsorbent, and a benzen-ethanol (10:1) mixture as solvent system. From the extract, 0,1 ml was applied to the origin. The running distance was 12 cm. The chromatograms were developed biologically by covering the dried plates with bouillon agar of pH 7, then inoculated with Bacillus cereus var. mycoides, incubated in wet chamber at 30° C for 20 hours and checked for zones of inhibition.

With this method two active compounds could be detected: very possibly atranorin ($C_{18}H_{18}O_8$) (Rf = 0,8) and protocetraric acid ($C_{62}H_{50}O_{35}$) (Rf = 0,53).

[2] By Lajos FERENCZY

In connection with the investigation of the chemical and morphological character the lichen, T. AHTI (1966:388) is writing as follows: „This species contains atranorin besides fumarprotocetraric acid, but morphologically it closely resembles C. pyxidata and Cl. pocillum. Its status has been in doubt but after a thorough analysis PIŠÚT (1961) came to the conclusion that it is an independent species rather than, for instance, a chemical strain of Cl. pyxidata. The writer accepts this opinion, admitting that some specimens are difficult to distinguish from Cl. pyxidata on a morphological basis alone."

Ecological conditions

Cladonia magyarica prefers the depressions of sand surfaces where the soil is relatively the wettest even it the period of a great aridity. As a result of a prolonged drought and heat in Spring and Summer and of warm winds, the lichen thalluses are withering, becoming fragile. They break to pieces under the steps of animals and people, are pulverized. The temperature maxima fall on the months July–August. These maxima are in the habitats of Cladonia magyarica – according to the generally corresponding data of several researchers – as follows:

Year	Area	Temperature	Exposition	Name of researcher
1934	Szeged—Szatymaz	55—60° C	S	L. BAKONYI
1937	Nagykőrös, sandhill „Strázsadomb"	55° C	on the surface of soil	Z. HARGITAI
1961	Csengele wood	62—66° C	„	L. GALLÉ
1961	Csengele wood	62—62°	below a sand layer of 1 mm	L. GALLÉ
1965	Ásotthalom, „Emlékerdő" wood	56° C	S. E.	L. GALLÉ

Cladonia magyarica tolerates well, besides a high temperature, also the strong fall in temperature in winter characterizing the lowland conditions of the Hungarian steppe. The long and cold winters were often weathered out by our plants in that way, as the drop in temperature reached not rarely –25, –27° C, approaching even – 30° C. The lichen thalluses have preserved below the snow, or even without being covered by any snow, their fresh green colour. Their thallus and podetialsquamae have not rolled up as they did during the summer heat. To be sure, they have stiffened from the frost; thit stiffness, however, has not increased their fragility. On the thallus squamae and podetia we have not observed any demages or fissures caused by frost.

The tolerance of this high temperature interval, corresponding to 80–90° C, is due first of all to the fact that in the lichen thallus there are not formed real tissues, as yet, and the hypha network, on the other hand, is assuring an exaltion. In the apothecia the asci and in those the spores are defended by

paraphyses being close to one another, and the coloured, somewhat knobby hypha-ends of paraphyses are forming a real light-shade ensuring a defence against the scorching sunlight, as well.

The gonidia-algae themselves are not too sensitive organisms, either. That is shown by the fact that the algae survive in the arctic region on the surface of snow similarly as in the thermal waters.

Our lichen finds the optimal contitions necessary for ite development in the wetter and periods of Spring and Autumn, resp. in a less warm early Summer. In the spring months (April–May), in four weecks, the young podetia developing from the thallus are achieving a size of 2–3 mm. During the great aridity there don't appear any new young podetia. Then the lichen does not grow, either. The optimum of growth falls, therefore, on the spring months. In the summer months, because of the insolation, the high temperature, the withering caused by the great loss of water and, last but not least, as a consequence of the aeolian, moreover the zoogene and anthropogene effects, the lichen is sufferring much and in the woods visited strongly in the Great Hungarian Plain there are scarcely to be found any healthy substances and healthy thalluses.

Concerning the water preservation, Cladonia magyarica is, anyhow, making use also of the capacity of water preservation of moss plants occurring together with it (Syntrichia ruralis var. arenicola, Pleurochaete squarrosa, Ceratodon purpureus, etc.). Together with the mosses, the leaves falling on the soil surface, the stem formulae, the thallus is forming a left-like texture that, like a sponge, is resorbing in itself vapour, dew and other preceipitation of liquid state. Owing to that, in wet, foggy weather, in dewy mornings, the lichen thalluses become soft; after sunset, however, they grow dry, become fragile.

As mentioned above, the lichen thalluses are often tread underfoot, diddled out of their accustomed site, knocked down by pasturing animals and people working in the forest. In that case the podetia that are normally in a vertical site are getting on the surface of sand into a horizontal position and often even upside down. In the thallus has still enough water reserve or if it becomes wet so the podetia begin to proliferate. There appear on them not only new secondary squamae but also small secondary and tertiary funnels growing upwards (Cf. Table I. Fig. 8., 9., and Cf. PIŠÚT 1961:371, Fig. d.)

It was interesting to observere how Cladonia magyarica is defending itself against wind and against being covered by the quicksand. The wind often fills in the depressions occupied by Cladoniae with sand, decaying leaves, vegetable debris. First the primary thallus is getting under sand then often even the podetia themselwes. At any rate, as soon as a buried thallus like that can get some moisture, there grow upwards new thallus squamae at the end of podetia, there are sprouting new, young podetia. In that way the plant is striving to get over the sand. If, however, it cannot get any precipitation in due time then the lichen thalluses perish. If, on the other hand, it can get some precipitation and a regeneration occurs then only the thallus pieces and podetia are decaying that have remained under the surface of sand. They increase in both cases the humus content of the sand soil.

The regenerating podetia like these can, however, be befallen by a further disaster, as well. In that case the regenerating processe is anew beginning, and fantastic shapes may be produced.

P. MAGYAR is exposing in his monograph „The sand vegetation like a guide for the sand afforestation" (1933:281–313, Hungarian) that an old endeavour of our acting foresters is to look for soil-marking plants from whose presence a conclusion may be drawn, even without investigating the soil, concerning the quality of ground and so indirectly also concerning the kind of trees with which the area may be planted.

Well, Cladonia magyarica belongs to the good soil-marking plants locked for. According to the soil investigation of GY. BODROGKÖZY in the wood at Felső-Ásotthalom, in one of the localities of Cladonia magyarica, the sand soil is containing, besides 7,90–7,95 pH value, 3,76 p. c. of $CaCO_3$, 1,05 p. c. of humus. The humus content is gradually decreasing in a greater depth. A similar pH value was obtained, on the basis of colorimetric local pH measurements, by L. BAKONYI, as well, establingshing (6,5)–7,0–7,5 pH values in the BILISICH wood, as well on the sand soil of the F. KISS wood and „Honvéd" wood. The lichen is, therefore, of a mildly basophilous. The water-realizing of soil in the water column originating from the same level (of 0–20 cm) was 221 mm in five hours.

The sand soils occupied by Cladonia magyarica are, as a rule, light brown or yellowish brown, their grain size being 0,02–0,2 mm.

Cenological conditions

Cladonia magyarica is one of the character species of the synusium Cladonia foliacea – Cladonia magyarica that is creating the moss-level of the different sand plant-associations in the Pannonian flora area.

The associations characteristic of the quicksand and containing Cladonia magyarica, as well, are:

(1) Festucetum vaginatae (RAP.) SOÓ.

a) arrabonicum: County Zala, Nagykanizsa–Sormás (T. PÓCS).

b) danubiale: County Pest, Szentendre (J. ZSOLT). – Rákoskeresztúr (T. PÓCS). – Nagykőrös (Z. HARGITAI). – Pócsmegyer (I. KÁRPÁTI). – Vácrátót (I. KÁRPÁTI and Mrs. I. KÁRPÁTI). – County Csongrád, Ásotthalom, wood „Emlékerdő" (GY. BODROGKÖZY). – In the same area (L. GALLÉ). – Csengele wood (L. GALLÉ). – „Honvéd" wood, FERENC KISS wood (L. BAKONYI).

(2) Festucetum vaginatae – Corynephoretum danubiale SOÓ. County Pest, Nagykőrös (Z. HARGITAI). County Tolna, Mezőföld (Á. BOROS).

(3) Astragalo-Festucetum sulcatae danubiale SOÓ. County Pest, Nagykőrös, in woods „Nagyerdő" and „Pálfája" (Z. HARGITAI). – Rákoskeresztúr (T. PÓCS.)

a) Poa angustfolia Typ. County Csongrád, Ásotthalom wood, Dugonics wood, Átokháza wood, Pálinkás wood (GY. BODROGKÖZY).

The synthetic list of Cladonia foliacea-Cladonia magyarica synusium is as follows:

Form of	Name	D (Dominancy)	K (Constancy)
Cl	Cladonia foliacea	1–5	V
Cl	Cl. magyarica	1–4	V
Cl	Cl. rangiformis	1–2	III
Cl	Cl. furcata	1–2	III
Cl	Cl. subrangiformis	+ – 1	II
Pa	Parmelia pokornyi	+ – 2	IV
Pa	P. vagans	+ – 1	II
Co	Collema pulposum	+ – 1	II
Pl	Lecidea (Psora) decipiens	+	I
Cl	Cladonia cornutoradiata	+	I
Cl	Cl. chlorophaea	+	I
Cl	Cl. coniocraea	+	I
Ce	Cornicularia aculeata	+	I
Br	Syntrichia ruralis v. arenicola	+ – 1	I
Br	Pleurochaete squarrosa	+ – 1	I
Br	Ceratodon purpureus	+ – 3	I
Br	Barbula convoluta	1–3	II
Br	Bryum argenteum	1	II
Br	Encalypta vulgaris	+ – 1	I

The assoctations enumerated and the synusium occuring in them are the modest plant associations of the Hungarian sand steppes first of all of the sand-hills in the region between the rivers Danube and Tisza that are forming the plant assoctations of the drym barren sand soil in large areas. The closing of the pedunculate plants is changing in high degree: in places lying deeper it may be as much as 80–90 p. c., on the hill-sides exposed to wind and sun, however, they are hardly covering 10–20 p. c. of the soil. In the latter cases, a synusium consisting of lichens and mosses is coming into domination. It is therefore that this synusium is considered by several foreign authors (TH. MÜLLER 1951; O. KLEMENT, 1955) as an independent association under the name Cladonietum endiviaefoliae.

As interpreted by R. SOÓ's Hungarian plant-sociological school, however, this association is to be regarded as synusium.

Taxonomical Part

Together with the typical form of Cladonia magyarica, often even in identical localities, there occur some very characteristic forms that may be recognized easily and are differing conspicously from the another. In the course of an investigation of several hundreds of herbary specimens and of several thousands of living exemplars, I have observed a lot of forms from those having but hardly laced podetia till those laced bunch-likely and superabundantly, till the funnels proliferating simply and manifoldly, on the basas

of wich some collectors had classified the Cladonia magyarica forms into other Cladonia species (e. g. Cladonia pyxidata f. neglecta).

During our investigations we have carried out the separation of these forms, distinguishing six well-separable forms and apart from them one teratologic case.

The identity of the fungus and alga components has been considered as a common mark characteristic of the whole species, being able to be decided by reason of the construction, shape and size of the spores and gonidia. There were regarded as a common mark also the internal construction of the primary thallus and of the podetia, as well the reactions of the thallus and podetia to KOH, $CaOCl_2$ and paraphenilendiamine.

We have regarded as a mark of form also the external shape of the thallus, the form of its position on the substratum, the colour of thallus, the external construction of podetia, being simple or composed, the degree of their being laced, the location of lacings, the differences concerning the crustation of podetia. Moreover, we have distinguished the sterile and fructificativous forme that are always differing from each other. Already I. PIŠÚT (1961:370) had distinguished an irregular form in connection with the regeneration. That is showing so great differences that, if not found in the thallus of Cladonia magyarica, we should not believe it to belong to this species.

Taking into consideration the differences mentioned above, we have prepared the clue of variations and forms of the species Cladonia magyarica, in English (a) and in Latin (b) languages:

(a)

Clue of variations and forms of the species Cladonia magyarica VAIN

1 a The podetia are assurgent..... 2
b The podetia are procumbent, from their sides new small funnels are germinating ..... **8. ter. setigerus**
2 a The podetia are simple 3
b The podetia are proliferating repeatedly, in storeys **5. f. verticillata n. f.**
3 a The plants are sterile, without apothecia..... 4
b The plant are producing abundantly. The podetia have a lot of apothecia, in young age light brown later on dark brown ones ..... **6. f. carpophora n. f.**
4 a The funnel is bunch-like foliose. Typical form. **1. var. magyarica**
b The funnel is foliose not bunch-like 5
5 a On the edge of the funnel there are sitting tiny shoots **3. f. prolifera n. f.**
b The edge of the funnel is not germinating 6
6 a The primary thallus is well developed, spherical, pressed strongly to the substratum, in the middle it is brownish, towards the edges it is lighter, growing generally on moss grass. The podetium is short, trumpet-like, with a narrow orifice **6. f. pocilliformis (VAIN.) PIŠÚT**
b The primary thallus is weakly developed, the podetium is oblong-cylindrical, widening out moderately, sparcely. ..... It is rather verrucous, rimous ..... **7. f. truncata n. f.**

c The primary thallus and podetium are as before but the podetium is abundantly, bushily squamulose ..... **2. f. squamulosissima n. f.**

(b)

Clavis variationum et formarum speciei Cladoniae magyaricae VAIN.

1 a Podetia assurgentia 2
b Podetia procumbentia. Ex latere podetiorum nova, parva podetia secundaria progerminant ..... **8. ter. setigerus**
2 a Podetia simplicia 3
b Podetia compluria, super se prolifera ..... **5. f. verticillata n. f. m.**
3 a Plantae steriles sunt, sine apotheciis 4
b Podetia abunde frugifera, multis, initio clare-fuscescentis, mox obscure-fuscescentis apotheciis ..... **4. f. carpophora n. f. m.**
4 a Scyphus podetiorum superne dense squamuloso-frondosus **1. var. magyarica**
b Scyphus podetiorum haud squamuloso-frondosus 5
5 a Ex margine scyphorum complures, maiores-minoresve proles excrescuntur ..... **3. f. prolifera n. f. m.**
b Margines scyphorum haud germinantes 6
6 a Thallus primarius bene evolutus, ad substratum valde adnatus, medio fuscescens, ad margine clarior, vulgo in superficie muscorum frondosorum crescens. Potedia brevia, pocilliformia, cum foraminibus angustis ..... **3. f. pocilliformis (VAIN.) PIŠÚT**
b Thallus primarius tenuiter evolutus, partim adsurgens, ad substratum haud adpressus. Podetia oblongo-cylindrica, leniter lata, haud foliosa, magis rimosa vel verrucosa ..... **7. f. truncata n. f. m.**
c Thallus primarius et podetium ut prius. Tota superficies podetiorum dense et hirsute laciniata ..... **2. f. squamulosissima n. f. m.**

(c) Description of variations and forms

1. var. magyarica

The typical form. The podetia are above funnel-like, simple, often more or less squamous, crustaceous, whitish grey, soredeous. With KOH they are showing a brightly or weakly yellow staining, with P (paraphenylendiamine) red, they are (10)–16–17–(22) mm long and 2–4 mm thick. The funnel has a diameter of (3)–4–5–(8) mm, it is above densely, bunch-like foliaceous. The squamae are (1,5)–2–3–(5) mm long and (0,5)–1–1,5–(2) mm broad, with branching lacings.

Typus. Podetia scyphifera, simplica, saepe demum plus minusve squamosa, albido-glaucescentia, sorediis destituta. Cum KOH + sat bene aut leviter lutestentia, cum P + rubra, (10)–16–17–(22) mm longa et 2–4 mm crassa. Scyphus podetiorum (3)–4–5–(8) mm in diametrum, superne dense squamuloso frondosus. Squamae (1,5)–2–3–(5) mm longae et (0,5)–1–1,5–(2) mm latae, laciniatae.

Occurrence: It is frequent in the sand soils of the Plain, in the clearings of sand-strengthening woods.

2. f. squamulosissima Gallé

The podetia are abundantly, bushily foliaceous. The edge of squamae is only less or hardly lash-like.

Tota superficies podetiorum dense et hirsuta frondosa. Margines squamarum haud vel leviter rhizinatae.

Occurrence: Together with the type, very sporadically.

3. f. prolifera Gallé

From the edge of podetia smaller of bigger shoots are springing.

Ex marginibus scyphorum complures minores-maioresve proles excrescuntur. Proles vulgo sine apotheciis.

Occurrence: Mixed with the type, it is rather frequent.

4. f. carpophora Gallé

Frugiferous form. The apothecia are light brown in young age, later on they are dark brown; they are solitary and sit on the edge of funnels or confluent occluding the orifices of the vigorous proliferating funnels.

Forma frugifera. Apothecia initio clare-fuscescentia, mox obscure-fuscescentia, solitaria, ad margines podetiorum adnata, vel confluentia et foramen scyphorum robustiorum proliferorumque claudunt.

Occurrence: It is growing in the same localities like the type.

5. f. verticillata Gallé

The podetia are proliferating threefold or multifold, in streys. The secondary funnels are originating from the edge of middle of podetia. The plant is similar to Cladonia verticillata.

Podetia ter, seu compluria super se prolifera. Scyphi secundarii vel ex margine, vel ex medio podetiorum excrescentes, ad podetia Cladoniae verticillatae similes.

Occurrence: Together with the type, sporadically.

6. f. pocilliformis (VAIN.) PIŠÚT

E. VAINIO apud V. GYELNIK: MBL XXIX. 1930 : 22–23, – I. PIŠÚT: Preslia 3, 1961 : 370.

Occurrence: On the surface of moss grasses, in rather shady places, in localities of the Plain mentioned at the type, and the lower regions of the Hungarian Middle Mountains. Hygrophytic variation.

7. f. truncata Gallé

The primary thallus is evanescent or weakly developed, partly rising erect, non-depressed. The podetia are oblong-cylindrical, mildly broadened, hardly foliaceous, rather verrucosus-rimous, somewhat shorter than the podetia of the typical plant: they are 10–16–(17) mm long, 0,5–2 mm broad. Diameter of funnels 3–6 mm.

Thallus primarius tenuiter evolutus, partim adsurgens, non adpressus. Podetia oblongo-cylindrica, leniter lata, haud foliosa, modice squamulosa,

magis verrucosa vel rimosa, aliquantum minores quam podetia plantae typicae, longitudine 10–16–(17) mm, crassitudine 0,5–2 mm. Latitudo scyphorum 3–6 mm in diam.

Occurrence: Together with the typical plant it is rather frequent.

8. ter. setigerus

From the sides of the lying podetia there germinate newer, tiny funnels of irregular shape.

Ex latere podetiorum procumbentium podetia secundaria progerminant. Podetia secundaria parva et irregularia sunt.

Occurrence: Mixed with the typical form, very scarcely.

Distribution of Cladonia magyarica VAIN.

In Hungary seven flora regions of four territories meet one another that belong to the Middle-European flora area. The phytogeographic classification of the area – on the basis of R. SOÓ (1964 : 97) – is a follows:

A) Pannonicum
- I. Matricum
  - 1. Tokajense
  - * 2. Tornense
  - * 3. Borsodense
  - 4. Agriense
  - 5. Neogradense
- II. Bakonyicum
  - 1. Visegradense
  - * 2. Pilisense
  - * 3. Vesprimense
  - 4. Balatonicum
- III. Praenoricum
  - 1. Laitaicum
  - 2. Castriferreicum
  - 3. Petovicum
- IV. Eupannonicum
  - * 1. Arrabonicum
  - * 2. Colocense
  - * 3. Praematricum
  - * 4. Crisicum
  - 5. Nyirségense
  - 6. Samicum
  - 7. Titelicum

B) Illyricum
- V. Praeillyricum
  - 1. Saladiense
  - * 2. Somogyicum
  - * 3. Kaposense
  - * 4. Sopianicum

C) Noricum
- VI. Noricum
  - 1. Ceticum
  - 2. Stiriacum

D) Carpaticum
- VII. Carpaticum
  - 1. Cassovicum

The lichens that belogn to the form circle of Cladonia magyarica occur in the flora area discussed in the flora regions marked by an asterisk (*). The occurrences are indicated also in the annexed map and inserted into the detailed enumeration. This composition is carried out on the basis of literary data, specimens in herbaria and our own collections. In the enumeration we have given separately the Hungarian data and – for the sake of completeness – those from outside Europe, separately at the typical form and the units under the species. In the extra-European group we have put a mark of interrogation (?) in front of the occurrences and definitions considered to be uncertain. We are regarding as questionable first of all the data that mention the High Tatra,

the territory of Oberrheimkreis, the wood at Berchtesgaden, the Spitzbergen, Abbazia, Macedonia, the West-Indian Isles, the United States of America, Africa (Algeria), as well, among the localities of Cladonia magyarica, and mainly of the Cl. magyarica f. pocilliformis. In this respect I am agreeing with the opinion of I. PIŠÚT who wrote (1961 : 372): „Bisher ist Cl. magyarica mit sicherheit nur aus dem Gebiete der pannonischen Flora in Ungarn und der Südslowakei bekannt, die anderen Literaturangaben kann man mit Recht bezweifeln."

The capital letters in front of the Hungarian occurrences are marking the flora territories, the Roman numerals – according to the plant-geographical classification of R. SOÓ – the flora areas, the Arabic numerals, however, the flora regions.

For a better perspicuity. we are publishing, shortened, the names of the investigated herbaria and collectors. The meanings of te abbreviations are:

Hb. Bak.	= The herbarium of László BAKONYI
Hb. Boros	= Dr. Á. BOROS: Plantae Hungariae Exsiccatae
Hb. Bodr.	= Herbarium Dr. BODROGKÖZY
Hb. Degen	= Dr. Á. DEGEN: Plantae Hungariae Exsiccatae
Hb. Fóriss	= F. FÓRISS: Lichenotheca Hungarica
Hb. Fö.	= Herbarium of the Plain Committee of the Hungarian Geographic Society
Hb. Gallé	= Dr. L. GALLÉ: Lichenes Hungariae
Hb. Gyeln.	= Ex herbario Lichenum Hungarici V. GYELNIK
Hb. Kárp.	= Herbarium Dris I. KÁRPÁTI: Flora Hungarica
Hb. Mus. Nat. Bp.	= Herbarium Musei Nationalis Hungarici Budapest
Hb. Mus. Szeged	= Herbarium Musei de Móra Ferenc nominati Szegediensis
Hb. Sántha	= Dr. L. SÁNTHA: Lichenes Hungarici Exsiccati
Hb. Szat.	= Ö. SZATALA: Lichenes rengi Hungarici exsiccati
Hb. Timár	= Herbarium Dris L. TIMÁR. – Flora Hungarica
Hb. Univ. Bp.	= Herbarium Reg. Scient. Universitatis Hungariae, Budapest
Hb. Univ. Debr.	= Herbarium Instituti Botanici Universitatis Debreciniensis
Hb. Univ. Szeged	= Herbarium Instituti Botanici Universitatis Szegediensis.

The material collected in the same time, by the same collector from the same locality but being to be found more herbaria will be mentioned only on one occasion, in the herbarium in which the first specimens can be found.

Cladonia magyarica Vain var. magyarica

Syn.: Cl. magyarica Vain.

Litt.: Schedae ad „Floram Hung. Exsicc." Cent. VIII. 1927 : 8. – Ö. SZATALA, M. B. L. 1929 : 74. – V. GYELNIK, M. B. L. 1930 : 22–23. – J. ANDERS, Archiv f. Protistenkunde, 71, 1930 : 499–501. – H. SANDSTEDE, Rabenhorst's Krypt. Fl. IV/2. 1931 : 410–411. – G. LETTAU, Flechten aus Mitteleuropa, X(57): 28. – V. J. GRUMMANN, Fedd, Rep. Sp. Nov. 61, 1958: 180.

– I. PIŠÚT, Preslia, 1961: 369–374. – I. PIŠÚT – L. OPOLD, Biológia, 1963: 530–532. – K. BERTSCH: Flechtenf. v. Südwestdeutschl., 1964: 35. – VERSEGHY KL.: Typenverzeichnis. 1964: 46. – T. AHTI, Ann. Bot. Fenn. 3, 1966: 388.

Exsicc.: Sectio Bot. Musei Nat. Hung. Bpest.: Flora Hung. Exsicc. Cent. VIII. Lichenes 75. No. 715. (1927.) – Vězda: Lich. Sel. Exs. Fasc. IV. No. 86. (1961.)

Typus: Holotypus (13 365) et Paratypus (13 354, 13 356, 13 357) in Hb. Mus. Nat. Bp.

Fig.: ANDERS, Archiv f. Protistenkunde, 1. c., Taf. 21. Fig. 2a, b, c. – SANDSTEDE, Rabh. Krypt. Fl., 1. c. Taf. XXX. Abb. 9. – PIŠÚT, Preslia, (1. c. Fig. c). – PIŠÚT – OPOLD, Biológia, 1. c. Obr. 1./c.

Habitationes extra territorium Hungariae et Bohemiae
Europa:

(?) Herb. Boissier, Genf, leg. SUGES, 1862. – (?) Rötler Schloss (Oberrheimkreis), Herb. A. BRAUN, Bot. Mus. Berlin. – (?) Berchtesgaden, Wald bei Kühreint, leg. SCHOENAU.

Bohemia:

In planitie „Podunajská nížina, Štúrovo, Čenkovský les, Loco deserto „Lang puszta", 110 m. s. m. solo arenoso. – Praedium „Čenkovský major", 110 m. s. m., ad arenam mobilem. (PIŠÚT, 1958). – Čenkovský les, prope viam publicam inter praedium „Čenkovský les" et „Jursky Chlm", in Populeto ad arenam mobilem. (PIŠÚT, 1960). – Pr. opp. Nitra, Zobor: Pleška, 440 m., Žibrica 540 et 575 m., Pohranice: Cerovec, 260 m., Horné Krškany: Tobola, 210 m., Nitra: Kalvária, 210 m. (PIŠÚT et OPOLD, 1962).

Habitationes in territorio Hungariae:

A–IV/1. – Comit. Győr.: Bőny, Gönyű, Mórichida pr. p. Ferencháza, Nagyszentjános. Solo arenario. (POLGÁR S.) – Schiegstätte, ad tumulum arenae. 1926. ZÓLYOMI B. (Hb. Mus. Nat. Bp.)

Comit. Veszprém: Fenyőfő. Solo arenario. POLGÁR S.

A–IV/3. – Comit. Bács-Kiskun: Bócsa, tumuli arenae. 120 m. 1951. BOROS Á. (Hb. Boros). – Pr. opp. Kiskunfélegyháza, Jakabszállás, in silva „Kisasszony erdeje". Ad arenam juniperosam. 120 m. 1936. BOROS Á. (Hb. Boros). – Pr. opp. Kecskemét, in tumulo arenae „Bugac puszta", solo arenoso. 1902. FILARSZKY et KÜMMERLE. (Hb. Mus. Nat. Bp.) – Pr. opp. Kecskemét, in silva „Bugaci nagyerdő", in tumulo arenae. 120 m. s. m. 1924. TIMKÓ GY. (Hb. Mus. Nat. Bp.) – Pr. opp. Kecskemét, in silva „Nagy Nyír", 120 m. Solo arenario. 1916. SZATALA O. (Hb. Mus. Nat. Bp.) – Ibidem, 120 m. 1916. DEGEN Á. (Hb. Mus. Nat. Bp.) – Pr. opp. Kecskemét, in silva „Monostori erdő", in tumulo arenae, 120 m. 1914. TIMKÓ GY. (Hb. Mus. Nat. Bp.) – Pr. p. Izsák, in silva „Ágasegyházi erdő", solo arenario. 120 m. 1922. TIMKÓ GY. (Hb. Mus. Nat. Bp., Hb. Univ. Bp., HB. Fö. Bp.) – Pr. opp. Kecskemét, in silva „Bugaci Nagyerdő", in tumulo arenae, 100 m. 1934. BOROS Á. (Hb. Boros). – Pr. opp. Kecs-

kemét, ibidem 120 m. 1960. FÓRISS F. (Hb. Fóriss). – Ibidem, 1934. BAKONYI L. (Hb. Bakonyi). – Pr. opp. Kecskemét, in silva „Bibicháti erdő", solo arenario. 1965. 120 m. GALLÉ L. (Hb. Gallé).

Comit. Csongrád. – Pr. p. Szeged–Csengele. In Robinetis. Solo arenaceo. 98 m. s. m. 1913. LÁNYI B. (Hb. Mus. Szeged). – Pr. opp. Szeged, circum praediis „Szeged-Alsó tanyák", in silva „Alsó-Ásotthalmi erdő", ad arenam mobilem. 1934. BAKONYI L. (Hb. Bakonyi). – Ibidem, ad arenam mobilem. 114 m. 1939. GYŐRFFY I. (Hb. Mus. Nat. Bp.) – Pr. p. Csengele, in silva „Csengelei erdő", ad arenam mobilem. 98 m. BAKONYI L. (Hb. Bakonyi). – Ibidem, solo arenario in ass. Corynephoreto Fest. vaginatae. 98 m. GALLÉ L. (Hb. Gallé). – Pr. opp. Szeged, in silva „Honvéderdő", ad arenam mobilem. 1934. BAKONYI L. (Hb. Bakonyi). – Pr. p. Szeged–Ásotthalom, in silvis „Pillich-erdő" et „Kiss Ferenc erdeje". Ad arenam mobilem. 1934. BAKONYI L. (Hb. Bakonyi). – Pr. p. Csengele, in silva „Csengelei erdő", solo arenoso, sub Robiniis. 98 m. 1930. ANTOS K. (Hb. Univ. Szeged). – Pr. p. Szeged–Ásotthalom, in silva „Ásotthalmi erdő". Solo arenario. 114 m. 1942. FÓRISS F. (Hb. Fóriss). – In silva „Szeged–Honvéderdő". In solo Robineti. 70 m. 1941. TIMÁR L. (Hb. Gallé). – Pr. p. Pusztamérges. Pálfy erdő. In solo arenario Robineti. 1950. TIMÁR L. (Hb. Gallé). – Pr. p. Sövényháza, in silvis. Solum arenosum. 80 m. TIMÁR L. (Hb. Gallé). – Pr. p. Ásotthalom, in silva „Ásotthalmi erdő", ad terram arenosam. 114 m. 1958. et 1968. GALLÉ L. (Hb. Gallé). – Pr. p. Pusztamérges, in silva „Honvéderdő", ad terram arenosam. 70 m. GALLÉ L. (Hb. Gallé). – Pr. p. Felgyő, ad ripam canalis „Vidre-ér". Solo arenoso. 1956. GALLÉ L. (Hb. Gallé). – Pr. pagum ÁSOTTHALOM, in silva reservata „Emlékerdő", in ass. Salicetum rosmarinifoliae. 114 m. 1955. BODROGKÖZY GY. (Hb. Bodr.) – Ibidem. Solo arenario. 114 m. 1965 et 1966. GALLÉ L. (Hb. Gallé). – Pr. p. Ásotthalom, in silva „Kiss Ferenc erdeje". 114 m. Solo arenario. 1958. GALLÉ L. (Hb. Gallé).

Comit. Pest.: Pr. p. Monor, in silva „Monori erdő", 150 m. In arenosis. 1913. DEGEN Á. (Hb. Mus. Nat. Bpest). – Ibidem. 150 m. 1913 et 1914. TIMKÓ GY. (Hb. Mus. Nat. Bp.). – Alsóhernád in Monor. 1907. 150 m. MÁGÓCSY–DIETZ S. (Hb. Mus. Nat. Bp.) – Ibidem, in arenosis. 130 m. 1915. SZATALA Ö. (Hb. Mus. Nat. Bp.) – Ibidem, in silva „Örkényi erdő", 120 m. 1915. TIMKÓ GY. (Hb. Mus. Nat. Bp.) – In silva „Pótharaszti erdő", Solo arenario. 120 m. 1925. GYELNIK V. (Hb. Mus. Bp.) – Ibidem, Pusztapótharaszt, in silva „Nyárfás erdő" nominata 130 m. 1936. BOROS Á. (Hb. Boros). – Pr. opp. Nagykőrös, in silvis „Nagyerdő" et „Csókáserdő", in ass. Fest. vaginatae danubiale. 1942. HARGITAI Z. – Ibidem, „Nagyerdő", „Csókáserdő", „Pálfája" in Fest. sulcatae danubiale. 1942. HARGITAI Z. Ibidem, „Nagyerdő", „Csókáserdő", „Strázsadomb", in Fest. corynephoretum. 1942. HARGITAI Z. In Hb. Harg. – Pr. pagum Rákoskeresztúr, in silva „Akadémia erdő", in Fest. vaginatae. 1954. PÓCS T. (Hb. Pócs).

B–V/2. – Comit. Tolna, pr. p. Kistápé, in silva „Nagyerdő". In coll. arenosis. 140 m. 1952. BOROS Á. (Hb. Boros).

f. pocilliformis (Vain.) Piš.

Syn.: Cl. magyarica var. pocilliformis Vain.

Litt.: V. GYELNIK, M. B. L. 1930: 22–23. – SANDSTEDE, H. Rabenhorst's Krypt. Fl. IV/2. 1931: 411. – PIŠÚT, I. Preslia, 1961: 370. – VERSEGHY Kl. Typen-Verzeichnis. 1964: 46.

Exsicc.: Sectio Bot. Mus. Nat. Hung. Bpest. Flora Hung. Exsicc. No. 514. Typus: Holotypus (13 368) et Paratypus (13 374) in Hb. Mus. Nat. Bp.

Habitationes extra territorium Hungariae et Bohemiae
Africa:

(?) Auf Löss hinter Mustapha, Albier. Mernex.

Asia:

(?) Hispaniola, Civ. Haiti, Massiv de La Selle, 1400 m., Plantae Indiae Occid., Nr. 7 648., leg. E. EKMANN.

Europa:

Herb. BOISSIER, Genf, 1881, Coteau d'Escery. – (?) Rosseggthal, leg. LINDAU, Bot. Mus. Berlin. – (?) Mazedonien, Schar-Dagh, leg. FLEISCHER. – (?) Abbazia, an Steinen oberhalb der Osteria, Frau Dr. WEISSBUHN. – (?) Gudhem, Westergotland, leg. E. P. VRANG. – (?) Austria Inferior. In monte Scheiblingstein sp. Seehof. 1905. leg. J. B. KÜMMERLE.

Bohemia:

Montium „Magas-Tátra, in valle „Furcota-völgy", in superficie saxa granitica, ad terram. 1600 m., 1912. leg.: TIMKÓ GY. (Hb. Muss. Nat. Bp.) – Comit. Gömör. Pr. p. Pokorágy. 1885. Leg. RICHTER. Hb. Univ. Bp. – Comit. Barcs. Pr. p. Vihnye in silva. 1913. leg. FUCKÓ. Hb. Univ. Debr. – Malé Karpaty: Dobrá voda-Malé skaly, ca 400 m. Kalkboden an sonnigen Abhängen, 1959. leg. PIŠÚT. – Juhoslovenský kras: Zádielska dolina, ca 400 m., Sonnige Kalkfelsen, 1957. leg. PIŠÚT. – Kolíňany: Ad cacuminem „Koliňanký vrch", 310 m., 1962. (PIŠÚT et OPOLD).

Habitationes in territorio Hungariae:

A–I/2. – Comit. Abaúj-Torna: Jósvafő, sub rad. montis „Farkaslyuk" Substr. saxa calcarea. 250 m. 1954. FÓRISS F. (Hb. Fóriss).

A–I/3. – Comit. Borsod: Bükk, pr. p. Ómassa, in Nagymező-reservatum. – Substr.: saxa gejziritica. 196 m. 1954. FÓRISS F. (Hb. Fóriss).

A–II/2. – Comit. Pest: In muscos ad truncum Quercus roboris supra vallem „Farkasvölgy", ca 400 m. 1910. leg. GY. TIMKÓ. Hb. Mus. Bp. – Ad saxa calcarea inter muscos. Monte „Nagykopaszhegy", ca 350 m. Pr. p. Piliscsaba. 1913. TIMKÓ GY. (Hb. Mus. Bp.) – Pr. p. Pilisborosjenő, in cac. montis Nagykevély. Substr.: Terra musc. calcarea. Ca 330 m. 1911. FÓRISS F. (Hb. Fóriss. No. 1168). – Pr. p. Nagykovácsi, in monte Kopasztető. Substr.: Terra muscosa. 400 m. 1912. FÓRISS F. (Hb. Fóriss. No. 1367). Ibidem, in silva „Kopaszerdő". Substr.: terra muscosa calcarea. 350 m. 1912. FÓRISS F. (Hb. Fóriss. No. 1353 et 1367).

Comit. Fejér: In collibus arenosis „Homok-tisztás" pr. Mór. 280 m. 1935 BOROS Á. (Hb. Boros).

Comit. Zala: Tihany, in cac. montis Akasztóhegy. Substr.: saxa calcarea 760 m. 1954. FÓRISS F. (Hb. Fóriss).

A–IV/1. Comit. Győr: In territorio campi bombardici. In deserta arenosa. 1926. ZÓLYOMI B. (Hb. Mus. Bp.) – Pr. p. Bács, Bőny, Győrszentiván, Likós, in silva „Hecsei-erdő" nominata. Valdefrequens, gregarie. Solo arenario. 1941. POLGÁR S. (Hb. Mus. Nat. Bp.)

Comit. Veszprém: Pr. p. Fenyőfő. 1941. POLGÁR S. (Hb. Mus. Nat. Bp.)

A–IV/2. – Comit. Pest: Pr. opp. Budapest, in „Feketefej", ad saxa calcarea inter muscos. – 380 m. 1912. TIMKÓ GY. (Hb. Mus. Bp.)

A–IV/3. – Comit. Bács-Kiskun: Pr. p. Izsák, inter tumulos arenae silvis „Ágasegyházi-erdő", ad terram arenosam muscosam. 120 m. 1922. TIMKÓ GY. (Hb. Mus. Bp.) – In regione urbis Kecskemét, in silva „Bugaci Nagy-erdő". In muscos, loco tumuloso arenae. 120 m. 1914. TIMKÓ GY. (Hb. Mus. Bp.) – Pr. p. Alpár, in tumulo arenae in silva „Szikra-erdő". 105 m. 1915. TIMKÓ GY. (Hb. Mus. Nat. Bp.) – Ibidem, 1965. GALLÉ L. (Hb. Gallé). – In arenosis „Kisasszony-erdeje", praedii Kiskunfélegyházai Jakabszállás, versus Bugac. 180 m. 1936. BOROS Á. (Hb. Boros). – Ibidem, 120 m. Substr.: solo arenoso. 1960. FÓRISS F. (Hb. Fóriss).

Comit. Csongrád: Pr. p. Dorozsma, Nagyszék, supra muscos in Festuceto. 90 m. 1929. GALLÉ L. (Hb. Mus. Bp.) – Pr. p. Ásotthalom, in silva „Ásotthalmi-erdő." Substr.: terra arg. in Pinetis. 118 m. 1936. FÓRISS F. (Hb. Fóriss). – Ibidem, in silva „Dugonics-erdő", in Festuceto vaginatae. 114 m. 1955. BODROGKÖZY GY. (Hb. Bodr.). – Ibidem, in silva reservata „Emlékerdő". 114 m. 1956. BODROGKÖZY GY. (Hb. Bodr.) – Ibided, in silva „Ásotthalmi-erdő", ad terram arenosam. 114 m. 1958. GALLÉ L. (Hb. Gallé et Hb. Mus. Szeged). – Pr. p. Pusztamérges, in silva „Honvéderdő", ad arenam mobilem. 70 m. 1959. GALLÉ L. (Hb. Gallé). – Pr. p. Csengele, in silva „Csengelei-erdő" ad terram arenosam in Pineto nigrae, supra muscos. 110 m. 1961. GALLÉ L. (Hb. Gallé). – Pr. p. Ásotthalom, in silva reservata „Emlék-erdő", ad terram arenosam. 114 m. 1965. GALLÉ L. (Hb. Gallé).

Comit. Pest: Csepel. Ad arenam. 1901. BERNÁTSKY J. (Hb. Mus. Bp.) – Ad insulam „Csepelsziget". In arenosis ad pagum Szilágyitelep. 1909. KÜMMERLE J. B. et SUZÁK J. (Hb. Mus. Bp.) – Ibidem, ad tumulos „Felsőbuckák". Ad arenam mobilem. 110 m. 1911. MOESZ G. (Hb. Mus. Bp.) – Pr. p. Sükösd. Ad terram. 1912. GREINICH F. (Hb. Mus. Bp.) – In arenosis insulae Csepel, pr. p. Szilágyitelep, 1915. DÉGEN Á. (Hb. Dégen). – Pr. p. Csepel, in territorio tumulis arenae „Felsőbuckák", supra tumulos muscosas. 120 m. 1924. TIMKÓ GY. (Hb. Mus. Bp.) – In collibus arenosis „Nyárfás-erdő", praedii Pusztapótharaszt. 130 m. 1936. BOROS Á. (Hb. Boros). – Pr. p. Csévharaszt, in silva „Pótharaszti-erdő", in silva Junipereto-Populetum. 1958. KÁRPÁTI I. (Hb. Kárp.) – In collibus arenosis „Öregbucka" pr. p. Szabadszállás. 120 m. 1951. BOROS Á. (Hb. Boros).

A–IV/4. – Comit. Hajdú: Hortobágy, in deserto „Árkuspuszta". In Artemisio-Festucetum pseudovinae typ. muscosa. 86 m. 1960. BODROGKÖZY GY. (Hb. Bodr.)

B–V/3. – Comit. Somogy: Pr. p. Balaton-Alsólelle. Ad terram muscosam pr. stationem. 110 m. 1913. SÁNTHA L. (Hb. Univ. Bp.)

B–V/4. Comit. Baranya: Pr. opp. Pécs. Montium Mecsek. Pr. viam „Irma-út", apud quiete „Lenkei-pihenő". Substr.: terra. 300 m. 1955. FÓRISS F. (Hb. Fóriss. No 26 378.)

f. truncata GALLÉ n. f.

Typus: In herb. Mus. Szeged.

Fig.: I. PIŠÚT–L. OPOLD, Biológia (Bratislava), l. c. p. 531. Obr. 1/b. Habitationes: Europa, Bohemia: Comit. Gömör. Pr. p. Szalóc: in campo edito „Pelsőci-fennsík". Subst.: saxa calcarea, 680 m. 1940. FÓRISS F. (Hb. Fóriss).

Hungaria:

A–IV/3. – Comit. Bács-Kiskun: In silvis Nagy-Nyír, pr. opp. Kecskemét. 120 m. 1916. SZATALA Ö. (Hb. Mus. Bp.) – In tumulo arenae in regione opp. Kecskemét, in silva „Bugaci Nagy-erdő". 120 m. 1914. TIMKÓ GY. (Hb. Mus. Bp.) – In coll. arenosis „Bugaci-Nagyerdő" praedii Bugac, pr. opp. Kecskemét. 100 m. 1934 – BOROS Á. (Hb. Boros). – In Junipereto arenoso „Kisasszony erdeje", praedii „Kiskunfélegyházi Jakabszállás", versus Bugac. 120 m. 1936. BOROS Á. (Hb. Boros). – Ibidem, 1960. FÓRISS F. (Hb. Fóriss). – In collibus arenosis „Debeák" pr. opp. Kiskunhalas. 140 m. 1959. BOROS Á. (Hb. Boros). – In coll. arenosis „Bodoglári-erdő", pr. opp. Kiskunhalas. 130 m. 1959. BOROS Á. (Hb. Boros). – In coll. arenosis Lakitelek. 130 m. 1965. GALLÉ L. (Hb. Gallé et Hb. Mus. Szeged). – Pr. opp. Kecskemét, in silva „Bibicháti-erdő", ad arenam mobilem. 120 m. 1965. GALLÉ L. (Hb. Gallé).

Comit. Csongrád: Pr. p. Szeged–Királyhalom. In silva „Alsó Ásotthalmi-edrő". Solo arenoso. 114 m. 1912. LÁNYI B. (Hb. Mus. Szeged). – Pr. p. Szeged–Várostanya. In silva „Ásotthalmi-erdő". Substr.: terra arg. in Pinetis. 118 m. 1936. FÓRISS F. (Hb. Fóriss. No 16 728 et 16 719). – Pr. p. Szeged–Pusztamérges. In solo arenoso in silva „Pálfy-erdeje". 110 m. 1950. TIMÁR L. (Hb. Gallé). – Pr. p. Sövényháza. Solum arenosum in ass. Robinietum pseudacaciae. 80 m. 1951. TIMÁR L. (Hb. Gallé). – Pr. p. Ásotthalom, in silva reservata „Emlékerdő", ad terram arenosam. 114 m. 1965. GALLÉ L. (Hb. Gallé). – Ibidem. 1960. GALLÉ L. (Hb. Gallé et Hb. Mus. Szeged). – Pr. p. Pusztamérges, in silva „Honvéderdő", ad terram arenosam. 79 m. 1958. GALLÉ L. (Hb. Gallé). – Pr. p. Csengele, in silva „Csengelei-erdő", ad terram arenosam in ass. Festucatum vaginatae. 110 m. 1961. GALLÉ L. (Hb. Gallé). – Pr. p. Ásotthalom, in silva „Ásotthalmi-erdő", in ass. Festucetum vaginatae. 114 m. BODROGKÖZY GY. (Hb. Bodr.) – Ibidem, in silva reservata „Emlékerdő", ad terram arenosam in ass. Festucetum vaginatae, 114 m. 1955. GALLÉ L. (Hb. Gallé et Hb. Mus. Szeged).

Comit. Pest: In collibus arenosis insulae „Csepel", pr. p. Soroksár. 110 m. 1904. DÉGEN Á. (Hb. Mus. Bp.) – Pr. p. Monor, in arenosis umbrosis sylvae „Monori-erdő". 150 m. 1913. DÉGEN Á. (Hb. Mus. Bp.) – In arenosis „Pótharasztja", pr. p. Monor. 150 m. 1907. DÉGEN Á. (Hb. Mus. Bp.) – In arenosis insulae „Csepel-sziget", pr. p. „Szilágyi-telep". 110 m. 1925. DÉGEN Á. (Hb. Mus. Bp.) – Pr. p. Vasad, in silva „Pótharaszti-erdő". Solo arenario. 120 m. 1925. GYELNIK V. (Herb. Mus. Bp.) – In collibus arenosis „Nyárfás-erdő", praedii Pusztapótharaszt. 130 m. 1936. BOROS Á. (Hb. Boros). – Pócsmegyer,

in pascuis. Ass.: Festucetum vaginatae, 1955. KÁRPÁTI I. (Hb. Kárpáti). – Pr. p. Csévharaszt, in silvis „Pótharaszti-erdő", in Festucetum vaginatae populetosum. 120 m. 1958. KÁRPÁTI I. (Hb. Kárp.) – Ibidem. In Junipereto-Populetum 120 m. 1958. KÁRPÁTI I. (Hb. Kárp.) – In collibus arenosis „Kisbócsa", pr. Bócsa. 120 m. 1951. BOROS Á. (Hb. Boros).

B–V/2. – Comit. Tolna: In collibus arenosis ad silvam „Nagyerdő", pr. p. Kistápé. 140 m. 1952. BOROS Á. (Hb. Boros).

f. prolifera GALLÉ n. f.

Typus: In herb. Mus. Szeged.
Fig.: I. PIŠÚT – L. OPOLD, Biológia (Bratislava), l. c. p. 531. Obr.: 1/a.

Habitationes: Europa, Hungaria:

A–I/3. Comit. Borsod: Montium Bükk. Répáshuta, in monte Balla völgy. Substr.: saxa calcarea muscosa. 370 m. 1930. FÓRISS F. (Hb. Fóriss.)

A–IV/3. Comit. Bács-Kiskun: In Junipereto arenoso „Kisasszony-erdeje". praedii Kiskunfélegyházai Jakabszállás, versus Bugac. 120 m. 1936. BOROS Á. (Hb. Boros). – Ibidem, FÓRISS F. 1960. (Hb. Fóriss). – In collibus „Bodoglári-erdő" pr. opp. Kiskunhalas. 130 m. 1959. BOROS Á. (Hb. Boros). – In collibus arenosis „Debeák", pr. p. Kiskunhalas. 140 m. 1959. BOROS Á. (Hb. Boros). – Pr. p. Alsóbugac, in silva „Bugaci Nagyerdő". Substr.: solo arenoso. Alt. 120 m. 1960. FÓRISS F. (Hb. Fóriss).

Comit. Csongrád: Szeged–Ásotthalom. Ad terram arenosam in silvis „Ásotthalmi-erdő". Substr.: terra arg. in Pinetis. 118 m. 1936. FÓRISS F. (Hb. Fóriss). – Ásotthalom, in silvis „Ásotthalmi-erdő" et „Dugonics-erdő", in Salicetum rosmarinifoliae resp. in Festucetum vaginatae. 114 m. 1955. BODROGKÖZY GY. (Hb. Bodr.) – Pr. p. Ásotthalom, in silva „Ásotthalmi-erdő", ad terram arenosam. 114 m. 1958. GALLÉ L. (Hb. Gallé). – Pr. p. Pusztamérges, in silva „Honvéderdő", ad terram arenosam. 78 m. 1958. GALLÉ L. (Hb. Gallé). – Pr. p. Csengele, in silva „Csengelei-erdő", ad terram arenosam in ass. Festucetum vaginatae. 110 m. 1961. GALLÉ L. (Hb. Gallé).

Comit. Pest: in collibus arenosis „Nyárfás-erdő" praedii Pusztapótharaszt. 130 m. BOROS Á. (Hb. Boros).

f. verticillata GALLÉ n. f.

Typus: In herb. Mus. Szeged.

Habitationes extra territorium Hungariae
Europa, Austria:

Flora des Gesenkes. M. Schönberg. 1931. F. SCHENK. (Hb. Univ. Debr.)

Habitationes in territorio Hungariae:

A–I/3. – Comit. Borsod: Montium Bükk, Répáshuta, in valle Balla-völgy (Tokaj). Substr.: saxa calc. muscosa. 370 m. 1930. FÓRISS F. (Hb. Fóriss).

A–IV/3. – Comit. Bács-Kiskun: In coll. arenosis in silva „Bugaci Nagyerdő", in regione oppidi Kecskemét. 120 m. 1914. TIMKÓ GY. (Hb. Mus. Bp.) – Pr. opp. Kecskemét, ad terram arenosam in silvis „Nagy Nyir". 120 m. 1916. SZA-

TALA Ö. (Hb. Szat. No 2 074). – Sub frutice Juniperus in silva „Bugaci Nagy erdő", in tumulis arenae. 120 m. 1924. TIMKÓ GY. (Hb. Mus. Bp. et Hb. Univ. Szeged). – Pr. p. Jakabszállás, in silva „Kisasszony-erdeje". Substr.: solo arenoso. 130 m. 1960. FÓRISS F. (Hb. Fóriss).

Comit. Csongrád: Pr. p. Szeged–Csengele, in Robineto. 1913. 98 m. LÁNYI B. (Hb. Mus. Szeged). – Pr. p. Ásotthalom, in silva „Dugonics-erdő", in ass. Festucetum vaginatae. 114 m. 1935. BODROGKÖZY GY. (Hb. Bodr.) – Pr. p. Ásotthalom, in silva „Ásotthalmi-erdő", ad terram arenosam. 114. m. 1958. GALLÉ L. (Hb. Gallé). – Pr. p. Pusztamérges. In silva „Honvéderdő", ad terram arenosam, 78 m. 1958. GALLÉ L. (Hb. Gallé). – Pr. p. Csengele, in silva „Csengelei-erdő", ad terram arenosam in Festuceto vaginatae. 110 m. 1961. GALLÉ L. (Hb. Gallé). – Pr. p. Ásotthalom, in silva reservata „Emlékerdő", ad terram arenosam. 114 m. 1965. GALLÉ L. (Hb. Gallé).

f. squamulosissima GALLÉ n. f.

Typus: In herb. Mus. Szeged.

Habitationes in territorio Hungariae:

A–I/3. – Comit. Borsod: Montium Bükk, Répáshuta, in valle „Balla-völgy" (Tokaj) Substr.: saxa calcarea muscosa. 370 m. 1930. FÓRISS F. (Hb. Fóriss No. 7 849.)

A–IV/3. – Comit. Csongrád: Ásotthalom, in silva „Ásotthalmi erdő", ad terram arenosam. 114 m. 1955. GALLÉ L. (Hb. Gallé). – Pr. p. Ásotthalom, in silva „Szakiskola erdeje", prope Junipereto virginianae. 114 m. 1955. BODROGKÖZY GY. (Hb. Bodr.) – Pr. p. Pusztamérges, in silva „Honvéderdő", ad terram arenosam. 78 m. 1958. GALLÉ L. (Hb. Gallé).

f. carpophora GALLÉ n. f.

Typus: In herb. Mus. Szeged.

Habitationes in territorio Hungariae:

A–IV/3. – Comit. Bács-Kiskun: In collibus arenosis sylvae „Szikra-erdő", supr. p. Alpár. 105 m. 1915. TIMKÓ GY. (Hb. Mus. Bp.) – Pr. opp. Kecskemét, in deserto arenario „Bugac-puszta". 1902. 120 m. FILARSZKY et KÜMMERLE. (Hb. Mus. Bp.) – Pr. opp. Kiskunhalas, in collibus arenosis „Debeák". 140 m. 1959. BOROS Á. (Hb. Boros). – In silvis „Nagy Nyir", pr. opp. Kecskemét, ad terram arenosam. 120 m. 1916. SZATALA Ö. (Hb. Szat.)

Comit. Csongrád: Pr. pagum Csengele. In Robineto. 98 m. 1913. LÁNYI B. (Hb. Mus. Szeged). – Pr. p. Ásotthalom, in praediis „Szegedi Alsótanyák", in silvis ad arenam mobilem. 114 m. 1935. GYŐRFFY I. (Hb. Mus. Bp.) – Ibidem, in silva „Ásotthalmi erdő", in Fest. vaginatae. 114 m. 1955. BODROGKÖZY GY. (Hb. Bodr.) – Pr. p. Csengele, in silva „Csengelei erdő", ad terram arenosam. 98 m. 1961. GALLÉ L. (Hb. Gallé). – Pr. p. Ásotthalom, in silva reservata „Emlékerdő", solo arenario. 114 m. 1966. GALLÉ L. (Hb. Gallé et Hb. Mus. Szeged).

Comit. Pest: In arenosis umbrosis sylvae „Monori erdő", pr. Monor. 150 m. 1913. DÉGEN Á. (Hb. Mus. Bp.)

ter. setigerus

Typus: In herb. Mus. Szeged.
Fig.: I. PIŠÚT, Preslia, l. c. p. 371.

Habitationes in territorio Hungariae:

A–IV/3. – Comit. Bács-Kiskun: Pr. p. Jakabszállás, in silva „Kisasszonyerdeje" nominata. Substr.: solo arenoso. 120 m. 1960. FÓRISS F. (Hb. Fóriss).

Comit. Csongrád: Pr. p. Ásotthalom, in silva „Ásotthalmi erdő", 114 m. 1934. BAKONYI L. (Hb. Bakonyi). – Pr. p. Pusztamérges, in silva „Honvéderdő", solo arenoso. 78 m. 1934. BAKONYI L. (Hb. Bak.) – Pr. p. Csengele, in silva „Csengelei erdő", ad terram arenosam. 98 m. 1934. BAKONYI L. (Hb. Bak.) – Pr. p. Ásotthalom, in silva „Ásotthalmi erdő". Terra arg. in Pinetis. 114 m. 1936. FÓRISS F. (Hb. Fóriss). – Pr. p. Pusztamérges, in silva „Honvéderdő", solo arenoso. 78 m. 1958. GALLÉ L. (Hb. Gallé). – Ibidem, in solo Robineti. 78 m. 1941. TIMÁR L. (Hb. Gallé. – Pr. p. Csengele, in silva „Csengelei erdő", ad terram arenosam. 110 m. 1961. GALLÉ L. (Hb. Gallé).

Summary

(1) The Cladonia magyarica VAIN. is a characteristic, soilmarking lichen species of the sand areas of the Pannonian flora region, a xerothermic and photophilous plant, tolerating high (62–66° C) temperature and a withering of the highest degree, too. One of its variations, the f. pocilliformis (VAIN.) PIŠÚT is groving on the surface of moss grasses. This form is a hygrophilous variation occurring also in mountainous woods, on a substratum on lime content.

(2) It is highly xerophytic owing to the spongy internal construction of the primary thallus and of the podetia. In the medulla and in the interior of podetia the retention and maximal utilization of huidity is assured by small vapour-chambers formed from hypha texture.

(3) The double-walled, funnel-like shape of podetia is assured by the holding septa running between the two layers.

(4) We have succeeded in breeding purely and determining the gonidia of the lichen. The alga species living in symbiosis with the fungus of Cladonia magyarica proved to be Cystococcus cladoniae magyaricae.

(5) The lichen is containing two characteristic agents: atranorin and fumarprotocetraric acid. As to their antibiotic activity, both of them have a bactericide effect on Gram-positive bacteria.

(6) The Cladonia magyarica is one of the character species of the synusium Cladonia foliacea – Cladonia magyarica forming the moss level of Festucetum vaginatae (RAP.) SOÓ, Festucetum vaginatae-Corynephoretum danubiale SOÓ, Astragalo-Festucetum sulcatae danubiale SOÓ. It occurs in the associations Junipereto-populetum, Artemisio-Festucetum pseudovinae, Festucetum vaginatae danubiale a) salicetosum rosmarinifoliae (MAGYAR) SOÓ and b) stipetosum capillatae (MAGYAR) SOÓ as well.

(7) Inside the species Cladonia magyarica as typical form there may be distinguished six well-separable forms and one teratological form. Thesen forms – except the f. pocilliformis – are present in the same localities, too.

(8) The area of the distribution of the lichen is the Pannonian flora region. Outside Hungary and the southernmost territories of Czechoslovakia, the data mentioned in the literature concerning its localities are uncertain.

László Gallé

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Explication of Tables

Table I

1. Cladonia magyarica f. verticillata
2. Cladonia pyxidata var. pocillum
3. Cladonia magyarica f. prolifera
4. Cladonia magyarica f. squamulosissima
5. Cladonia magyarica var. magyarica
6.—7. Cladonia magyarica f. carpophora
8.—9. Cladonia magyarica ter. setigerus

Table II

1.—2.Young Pinus nigra stand in the Csengele wood and in the Honvéd wood.
3. Cladonia pyxidata var. pocillum
4. Cladonia magyarica f. truncata
5.—6. Cladonia magyarica f. pocilliformis

Table III

1. Cross section of the Cladonia magyarica thallus
2. Cross section of the margin of the Cladonia magyarica thallus
3. The regeneration of Cladonia magyarica thallus from the rim of podetia cowered by sand
4. Longitudinal section of the podetium of Cladonia magyarica
5. Rhizina of Cladonia magyarica, connecting two adjacent thallus squamae
6., 8. Gonidia of Cladonia magyarica in different magnification
7. Drawing of Cystococcus cladoniae magyaricae in tronger magnification

A CLADONIA MAGYARICA VAIN. XEROTHERM ZUZMÓFAJRÓL

A Cladonia magyarica tőalakját 1901-ben BERNÁTSKY J., a zuzmó alakköréhez tartozó f. pocilliformis (VAIN.) PIŠÚT formát pedig még előbb, 1885-ben RICHTER I. gyűjtötte. Az új fajt azonban egyikük sem ismerte fel. Később, 1924-ben, TIMKÓ GY. a Kecskemét melletti „Bugaczi-erdő"-ben talált több feltűnő példányt, amelyeket E. VAINIO Cladonia magyarica néven új fajként írt le. Az új zuzmófaj diagnózisát 1930-ban GYELNIK V. (1930: 22—23) közölte. A rendkívül érdekes zuzmófajjal J. ANDERS (1930:499—501), H. SANDSTEDE (1931:410—411), I. PIŠÚT (1961:369—374) és I. PIŠÚT—L. OPOLD (1963:530—532), végül pedig T. AHTI (1966:380—389) foglalkoztak behatóbban. Az említett szerzők elsősorban a zuzmó morfológiai, rendszertani, florisztikai és növényföldrajzi viszonyait tanulmányozták.

A szegedi Tudományegyetem Növénytani Intézeteiben, illetőleg a szegedi Móra Ferenc Múzeumban BAKONYI L. (1934: élettani viszonyok, szaporodásbiológia, szimbionták kitenyésztése), FERENCZY L. (1963: antibiotikus aktivitás) és GALLÉ L. (1959—1968: ökológia, cönológiai viszonyok, szervesanyagprodukció, taxonómia, elterjedés) foglalkoztak a mésztartalmú kötött homoktalajnak ezzel a talajjelző növényével.

A vizsgálatok eredményei a következők:

A Cladonia magyarica széles ökológiai spektrumú bokros-zuzmó, amely —30 C° és 66 C° közötti hőmérséklet ingadozást is elvisel.

A gombakomponens fejlődése glukózzal dúsított DETMER-féle táptalajon a leggyorsabb.

A JANSE—PÉTERFI-féle mikromanipulátorral izolált gonidiumokat sikerült tápoldatban tisztára tenyészteni. A zuzmótelepben a gombakomponenssel együttélő alga: Cystococcus cladoniae magyaricae fajnak bizonyult. Sejtjei gömbölydedek, 6—8×10—14 μ nagyságúak, egy (ritkán két vagy három) csipkés szélű zöld színtestet tartalmaznak. Szaporodásuk autospórákkal és izogamétákkal történik.

A telep és a podéciumok antibakteriális, szelektív hatóanyagokat tartalmaznak, amelyek Gram-pozitív baktériumok szaporodását gátolják. Ezek az atranorin ($C_{18}H_{18}O_8$) és a fumárprotocetrársav ($C_{62}H_{50}O_{35}$). Mindkét anyag erősen apoláros, vízben rosszul oldódó vegyület.

A Cladonia magyarica a futóhomokra jellemző asszociációkban előforduló Cladonia foliacea-Cladonia magyarica szinúzium tagja s ebben a társulásban D:4, K:5 értékekkel fordul elő.

A zuzmó szervesanyag termelése a területegységre eső összes szerves anyagproduktum 37,0—37,5%-a.

A Cladonia magyarica alakköréhez a var. magyarica -n, mint tőalakon kívül 6 jól elkülöníthető forma (f. pocilliformis, n. f. truncata, n. f. prolifera, n. f. verticillata, n. f. squamulosissima, n. f. carpophora) és 1 teratológiai alak (ter. setigerus) tartozik. Leírásukat az angol és a latin szöveg, habitusképeiket az I—III. tábla tartalmazza.

A zuzmófaj és alakjai a Kárpátmedence magyarországi és szlovákiai homoktalajain fordulnak elő. (Vö. az angol szövegnél közölt térképvázlattal.) Az irodalomban más európai és Európán kívüli lelőhelyekről közölt adatok bizonytalanok.

Gallé László