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Monograph of the Central European Species of the Genus Scleroderma Pers.

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Introduction.

The present monograph on the Central European species of the genus *Scleroderma* Pers. is part of my special investigation of this specifically not numerous, but from a taxonomic point of view fairly complicated and thus also somewhat unclear genus, and at the same time it represents also part of the results of my monographic studies concerning the Czechoslovak gasteromycetes.

In view of the fact that a thorough monographic working of smaller units (e. g. families, genera and species) makes possible a far greater concentration on details, and thus also throws more light on some special questions, I started on the study of some species of the genus *Scleroderma* growing in Central Europe; in the present monograph I have tried to elucidate first of all the taxonomic position and division of some species, their synonyms, variability, biology, and their ecology, and especially to draw the taxonomic conclusions of their ecology. Last not least it was also the practical significance of some species of the genus *Scleroderma,* the poisonings caused by them, and the importance of the knowledge of Sclerodermata as a commercial commodity which made me deal in some detail with the group of the Central European Sclerodermata.

I studied the proof material deposited in the mycological herbarium of the National Museum, Prague, in the herbarium of the cryptogamological section of the Botanical Institute of the Charles University, Prague, further the material I collected in 1946—1949; at the same time I went also through the collection of exsiccata of Dr. J. V. Staněk. As it was impossible to obtain proof and comparative material also from museums abroad (the two largest herbaria, that of Hollós at Kecskemét and the mycological herbarium at Berlin-Dahlem, which contained a huge amount of comparative material of the *Gasteromycetes,* became victims of the war), it was necessary to desist from giving a list of the localities in the different countries and to restrict myself only to stating the general character. In view of the general and always abundant occurrence of the Central European species of the genus *Scleroderma* Pers. I do not even give — for reasons of space and clarity — their different Czechoslovak localities, which I have added only for less

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current species and forms. Where individual localities are given, they are only those from which I have seen proof specimens. To compile the diagnoses I used fresh material; for the observation of spores I used on the one hand ordinary distilled water and on the other hand a 10% solution of KOH, in which especially their sculpture becomes more distinct. In some cases I used oil immersion (cedar oil n/D = 1.515).

I have divided the paper into two parts: in the general part I have tried to give a historical survey of the investigation of the genus *Scleroderma* Pers., the morphology, biology and ecology and the practical importance of the genus *Scleroderma* Pers. The special part gives in addition to a survey of the Central European species, varieties and forms of the genus *Scleroderma* Pers. also their descriptions.

I am extremely grateful to Professor Karel Cejp, Administrator of the Mycological Section of the Botanical Institute of the Charles University for the interest he showed in this work and for his valuable advice, to Professor F. A. Novák for lending me the mycological herbaria and enabling me to study in the library, to Dr. Albert Pilát, Director of the Botanical Section of the National Museum for making accessible to me the mycological herbaria of the National Museum, Prague, and finally to MUDr. J. A. Herink for some valuable information.

Historical Survey of the Investigation of the Genus Scleroderma Pers.

Some Central European species of the genus *Scleroderma* Pers., though described under other names and included in quite different genera (mostly in the genera *Lycoperdon, Lycoperdastrum,* etc.), were clearly distinguished already by some early authors. In the following lines I try to give a chronological outline of our present knowledge of the Central European species of the genus *Scleroderma* Pers., beginning with the earliest authors.

In his paper "Botanicon Parisiense" published in 1727, Vaillant described briefly but comprehensively the present species *Scleroderma aurantium* (Vaill.) Pers. as "Lycoperdon aurantii coloris ad basin rugosum" (p. 123), and at the same time he gave the same species under the name of "Lycoperdon majus, globosum, squamosum" (p. 122). Just as clear are also his "Lycoperdon verrucosum, sphaericum, pediculo donatum" (p. 122) and "Lycoperdon cepae facie", described on p. 123 of the publication cited. Though Micheli (54) shortly after the publication of Vaillant's work divided Tournefort's collective genus *Lycoperdon* into several, mutually sufficiently differentiated genera, of which he designated

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by the name of "*Lycoperdastrum*" the present genus *Scleroderma* Pers., yet in the literature published at the beginning of the XIXth century we find the present species of the genus *Scleroderma* Pers. joined to the genus *Lycoperdon.* Micheli in his work "Nova plantarum genera" (1729) described the genus *Lycoperdastrum* in the following words: "*Lycoperdastrum* est plantae genus a *Lycoperdoide* diversum, cortice in nonnullis speciebus per verticem ordinate in plures radios instar coronae regiae, in aliis inordinate, dehiscente, qui tamen in omnibus eodem tempore a substantia divellitur. Hujusmodi substantia per cellulas non nitidas & tenaces, ut in *Lycoperdoide,* sed molles, & lanuginosas subdivisa est, ac distributa, cellulae vero eodem modo seminibus minutissimis in massam compactis, & filamentis pariter alligatis replentur. Eodem substantia, ubi semen jam maturum dimisit, in parvum glubulum contrahitur." (p. 219).

Among the ten species which he listed in his work he included "Lycoperdastrum cepae facie", further "Lycoperdastrum obscurum, altius radicatum, pulpa atro-purpurea, cute lacera, veluti punctata" and "Lycoperdastrum autumnale, flavescens, cortice tenuiori laevi, pulpa sordide purpurea", which corresponds to the present *Scleroderma verrucosum* (Vaill.) Pers. and its subsp. *bovista* (Fr.) m.

Linné's work "Species plantarum", of 1753, brought in addition to some descriptions, which it is difficult to identify reliably with some present species of fungi, also the good description of "Lycoperdon sphaeroidale basi rugosum stipitatum" (= "*Lycoperdon aurantium*") belonging indubitably to *Scleroderma aurantium* (Vaill.) Pers. A number of later authors (e. g. Schaeffer [1761], Sowerby [1799], Schumacher [1802], Bulliard [1809], Batsch [1789], Link [1795], Withering [1818] and Quélet [1886]) gave specific names belonging today to the genus *Scleroderma* Pers. in relation with the genus *Lycoperdon.*

The classical period of mycology, represented especially by the resounding names of Persoon, Albertini-Schweinitz and Fries, threw some more light on and partly brought also order into the taxonomic questions connected with the genus *Scleroderma* Pers., though Fries (24) himself still doubted the possibility of easy solution of the taxonomic position of the species of the the genus *Scleroderma* which — according to him — had been very negligently worked at that time. He laid the blame for this on the followers of Micheli, who brought rather confusion than elucidation into the species established and defined by him ("Michelius lynceus olim determinavit; laetior fuisset scientiae facies, nisi virum incomparabilem certatim deseruissent perhibiti emendatores").

It was no less a person than Persoon himself who in his work "Synopsis Methodica Fungorum", of 1801, not only laid the founda-

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tion for the building up of the present nomenclatoric system of the *Gasteromycetes,* but also described the genus *Scleroderma* and most of its Central European species in the present sense, to which he placed some species placed by the earlier authors either in the genus *Lycoperdon* or *Lycoperdastrum,* and made possible the later building up of the taxonomy of the genus *Scleroderma* on this basis. On the basis of the characteristic features of the peridie he formed also the generic name *Scleroderma* (*σκληρος* = hard, *δερμα* = cuticle, skin). Persoon (58) described the following species: *Scleroderma aurantium, Scleroderma citrinum, Scleroderma verrucosum, Scleroderma spadiceum,* and *Scleroderma cepa*; of these the first and the last two species are conspecific.

Albertini-Schweinitz (Conspectus fungorum, 1805) gave three species of the genus *Scleroderma* Pers., of which only the first two really belong to this genus. They are *Scleroderma citrinum* Pers. (= *Scleroderma aurantium* [Vail.] Pers.) and *Scleroderma spadiceum* Pers. (= *Scleroderma aurantium* [Vaill.] Pers. var. *spadiceum* [Pers.] Fr.). *Scleroderma cervinum* α (*granulatum*), which both authors described in the following words: "Aestate juniore extus pallet, jam tum granulosum; intus e dilute rubro purpurascit. Cortex dein magis magisque induratus spadiceus evadit: medulla e fusco nigricat. Vulgata species videtur in pinetis: non obstante enim loco subterraneo, mero casu efossa satis frequens invenitur", is according to our present knowledge a synonym of the species *Elaphomyces cervinus* (Pers.) Schroeter *).

Against the name of *Scleroderma aurantium* (Vaill.) Pers., which is today universally valid according to the rules of priority, Hornemann's (23) designation of *Scleroderma vulgare* maintained itself for a long time and was accepted by a number of later authors with Fries himself at their head. Fries (24) described also its variety characterised by the basal mycelian fascicle, which he designated as var. *macrorhizum* (in 1831 this variety was described by Wallroth as a separate species); further he listed Persoon's species *Scleroderma spadiceum* (= Schaeffer's *Lycoperdon spadiceum*), which, however, he took over as a variety of the species *Scleroderma vulgare.*

The considerable variability in shape and colour of some species was the reason why some authors described such variable specimens

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*) *Elaphomyces cervinus* (Pers.) Schröter hides itself under a whole number of specific names formed by different authors in the genus *Scleroderma* Pers. Among its synonyms we can include e. g. *Scleroderma cervinum* Pers., *Scleroderma cervinum* α (*granulatum*) Alb. & Schw., *Scleroderma cervinum* var. *scabrum* Pers., *Scleroderma vulgare* Horn. var. *cervinum* (Pers.) W. G. Smith, *Scleroderma vulgare* Horn. var. *laevigatum* (Fuck.) W. G. Smith.

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as new species or at least varieties (e. g. *Scleroderma squamosum* Chev., *Scleroderma vulgare* var. *aurantiacum* (Vaill.) W. G. Smith, *Scleroderma areolatum* Ehrenberg, *Scleroderma Bresadolae* Schulz., *Scleroderma Torrendii* Bres., etc.).

In 1841 was published in Sturm's „Deutschlands Flora III", Corda's description of a new hypogaeic fungus, which he called *Phlyctospora fusca.* The incomplete description (in Corda's original diagnosis is the remark: "Asci vel basidia nulla") was the reason for its later uncertain taxonomic position. Beck (7), who studied in detail specimens found later of this species in all stages of development, ascertained the origin of spores on the basidiae, and thus the confused taxonomic question was partly solved. But it was only Fischer (22) who definitely placed this fungus in the genus *Scleroderma* Pers.

The numerical and specific richness and considerable variability of some species of the genus *Scleroderma* Pers. was exposed by Saccardo's "Sylloge fungorum" (1888—1912), which brought the description of tens of species of the genus *Scleroderma* Pers. from all over the world. (Under the generic name of *Scleroderma* there appeared here unfortunately also species which have absolutely nothing in common with it, and which have to be placed as synonyms to *Mycenastrum corium* [Guers. ex D. C.] Desv.).

Concerning the history of the investigation of the genus *Scleroderma* Pers. from a floristic point of view we have, in addition to general communications by earlier authors, especially the larger systematic mycological works of basic importance published in Central Europe especially in the second half of the last century, which often give many data on the geographical distribution of the species in the different countries. In Germany we have e. g. the works of Winter (86) and Schröter (68), in Italy the study of Petri (59), in Rumania of Alexandri (2) and Popovici (60), etc. The representative exhaustive monograph of Hollós (36) gave a number of localities not only from Hungary but also from the territory of our country. From among the non-European works giving material for the study of the genus *Scleroderma* Pers. I draw attention especially to the epic publication of Coker & Couch (14) with data on the distribution of the genus *Scleroderma* Pers. in North America, further to Cunningham's work (19) with the same floristic orientation for Australia and New Zealand, and finally to the most recent and already classic work of Bottomley (10) which gives us an understanding of the geographical distribution of the *Gasteromycetes* in South Africa. Finally there are a number of smaller papers and contributions of a floristic character, in which

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we find also some minor details concerning the phytogeography of the genus *Scleroderma* Pers. in Central Europe.

It would be a mistake to believe that the present monograph is the final link in the long chain of investigations dealing with the genus *Scleroderma* Pers. In the whole effort of solving some taxonomic questions concerning especially the *Scleroderma* of Central Europe it is only an incentive for a more thorough working of this genus and a contribution to its future monographic investigation.

Morphology and Biology

A. Morphology of the Receptacle.

The genus *Scleroderma* Pers. forms spherical, mostly supraterranean, fleshy receptacles with a strong coriaceous peridie sharply differentiated from the gleba, irregularly tearing. The receptacle of some subterranean species carries at its base a tail-like fascicle of mycelian filaments, which especially in some species, subspecies and varieties is dense and richly ramified. The fleshy gleba is formed by irregulary spherical, undelimited spore-beds separated by sterile tissue, in which the spores form on the piriform basidiae.

From a morphological point of view the sculpture of the surface of these spores is very interesting, especially the more or less distinct reticulation which can be observed when shining them through (e. g. in a 10% solution of KOH). This reticulation, whose origin was discovered by Beck (7), is formed by the pressure of the adjoining hyphes (i. e. either ramifying sterile hyphes, or branches growing directly from the basidiae), growing round the young spores and leaving on them these traces fixed in some species and their forms until maturity. The involucrum of the hyphal cells surrounding the spore is visible only in very young spores, and it disappears soon; only in the species of the section *Phlyctospora* Corda is it visible also in mature spores in the form of an envelope of hyaline cells and it gives a characteristic determining feature.

B. Biological and Ecological Remarks.

Most of the Central European species of the genus *Scleroderma* Pers. grow in evident symbiotic relation with different trees; below I shall speak of the composition of their habitats. A very interesting form, different in its substratum from this way of life, is the evidently saprophytic *Scleroderma verrucosum* (Vaill.) Pers. subsp. *typicum* Šebek, var. *violascens* Herink in litt., growing on the one hand on very rotten stumps and on the other hand on strongly humic soil under leafy trees or in mixed growths, especially in parks, etc.

A characteristic habitat of the species *Scleroderma aurantium* (Vaill.) Pers. are dry coniferous (especially mountain) forests,

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where it grows in moss-cushions as well as on the naked soil without vegetation and only covered with dry needles, then the sunny edges of these forest associations, sandy forest paths, clearings bare or planted with young cultures, heaths, dry grassy hills, etc. On exposed sandy soils (in our country especially the sand dunes in the middle Elbe basin) it occurs in an interesting ecological form, differentiated from the type by the powerful and dense basal fascicle of broadly spread-out mycelian filaments, whose task it is to fix the receptacle in the loose and constantly (even though only insensibly) shifting environment. This var. *macrorhizum* Fr. occurs on our sand dunes, exclusively in mere sand; where on the slope of the dune already some initial vegetation has settled (e. g. *Corynephorus canescens, Koeleria glauca, Festuca ovina, Spergula vernalis,* later also *Calluna vulgaris,* among lichens especially *Cladonia rangiferina* etc.), we find mostly again the typical *Scleroderma aurantium* (Vaill.) Pers.

The humic soils of leafy forests (especially oak forests), on light sandy soils of mixed forests, on the edges of groves (especially in the meadow groves of the Elbe basin), under shrubs, at the roots of ancient oaks, in the grassy parts of leafy forests, on moist forest paths and on the grass-covered sides of forest-ditches, in avenues, etc. *Scleroderma verrucosum* (Vaill.) Pers. grows abundantly; together with it occurs often also its subspecies *bovista* (Fr.) Šebek, growing chiefly in gardens, on slopes and especially in the company of limetrees (especially in avenues of lime-trees). Often we find this subspecies also in sandy fields, especially where avenues of lime-trees or also isolated lime-trees are found in the vicinity. Especially *Scleroderma aurantium* var. *spadiceum* (Schaeff.) Fr. chooses also habitats similar to those of *Scleroderma verrucosum* (Vaill.) Pers. (i. e. leafy forests), but we find the former also in coniferous forests in association with the typical *Scleroderma aurantium* (Vaill.) Pers.

Survey of the Central European Species, Varieties and Forms of the Genus *Scleroderma* Pers.

I. Receptacle in maturity supraterranean or at least partly projecting from the soil, at the base with a ± developed bundle of mycelian filaments, irregularly tearing up at the apex. Spores spherical, bristly-spinose Section I, *Eu-Scleroderma* De Toni.

A. Receptacle spherical, reniform to tuberous or bulbous; the stipe-like basal part is lacking or is only quite small, receptacle ± light coloured, cracked into areolas and squamae.

1) Peridie strong, in fresh specimens moderately elastic, in dry specimens very hard, coriaceous, in a cut and when bruised turning pink to red, light yellowish brown to brownish, cracked especially at the apex into areolas, broad squamae and verrucae, at the base with a short fascicle of mycelian filaments. Spores (in KOH) reticulate . . . . . .

1) *Scleroderma aurantium* (Vaill.) Pers.

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a) Peridie whitish, whitish yellow to sand brown, finely granular or entirely smooth, at the base with a long, thick and firm fascicle of mycelian filaments . . . . . var. *macrorhizum* Fr.

2) Peridie thin, coriaceous, turning yellow in a cut, honey brown, dark brown, umber brown to reddish brown, cracked at the apex into tiny squamae and verrucae. Spores (in KOH) not reticulated . . . . var. *spadiceum* (Schaeff.) Fr.

B. Receptacle spherical, irregularly spherical, compressed to tuberous, often narrowing towards the base and passing into the sterile stipe-like part, or with a dense basal fascicle of mycelian filaments, ± dark coloured, smooth, covered with floccose squamae.

1) Peridie very thin, smooth, yellowish brown, darker at the apex, covered with fine, umber brown squamae . . . . . 2) *Scleroderma verrucosum* (Vaill.) Pers.

a) Receptacle often narrowing towards the base and passing into a sterile, ± long, flattened, smooth or grooved, stipe-like part. Spores (in KOH) not reticulated. It grows especially in leafy forests (especially of oak), on forest paths, under shrubs, etc. . . . . subsp. *typicum* Šebek

(Receptacle tiny, in a cut turning purple in youth, peridie in youth with pink to purple shades; it grows on rotten stumps or on humic soil in mixed forests, parks, etc.) . . . . var. *violascens* Herink in litt.

b) Receptacle at the base with a dense long fascicle interwoven from fine mycelian filaments. Spores (in KOH) reticulate. It grows in light soil in gardens, leafy forests (often together with subsp. *typicum* Šebek), but especially under lime-trees, in sandy fields, etc. . . . . subsp. *bovista* (Fr.) Šebek

(Basal fascicle of mycelian filaments grown together, long, strong, compact. In humic groves and leafy forests . . var. *fascirhizum* Šebek

II. Receptacle subterranean, in maturity sometimes projecting from the soil. Spores spherical, enveloped by hyaline cells . . . . . Section II. *Phlyctospora* Corda.

A. Receptacle spherical to tuberous, peridie strong, coriaceous, dark brown. Spores (in KOH) reticulate. Rare . . . . . 3) *Scleroderma fuscum* (Corda). E. Fischer.

Genus **Scleroderma** Pers. emend. Fries.

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Receptacle spherical, irregularly spherical, reniform or tuberous, in most species at the base with a fascicle of ramified, mycelian filaments, fleshy. — Peridium simple, coriaceous, ± strong, sharply differentiated from the gleby, mostly coloured light yellow, yellowish brown to umber brown, cracked especially at the apex into squamae, squamose areolas, verrucae, or quite smooth, tearing irregularly. — Gleba fleshy, with irregularly spherical, not delimited spore-beds, in youth white, later black with a purple tinge, vein-like interwoven with white fragments of sterile tissue; in maturity first in a mashy dark substance, later turning into the grayish green sporer, of strongly aromatic smell. — Basidia piriform to clavate, spores by 2—4 directly adnate or irregularly adnate with a short strigma to the basidie, globular, verrucose to bristly spinose, in some species enveloped by minute hyaline cells, blackish brown, lighter in KOH, with a ± visible reticulation in some specimens.

They grow in sandy forests, on the edge of forest paths, in clearings, an healths, in grassy parts of leafy (especially oak) forests, under shrubs, in avenues (especially of lime-trees), in sandy fields, etc., always abundant in the whole of Central Europe.

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Scleroderma citrinum Persoon, Syn. Meth. Fung., pg. 153, 1801. — Albertini et Schweinitz, Consp. fung., pg. 81, 1805. — Martius, Flora crypt. Erlang., pg. 383, 1817. —

Scleroderma squamosum Chevallier, Flore gén. des envir. de Paris, pg. 357, 1826. —

Scleroderma vulgare Hornemann, in Flora Danica, Tab. 1969, fig. 2, 1829. — Fries, Syst. Myc. III: pg. 46, 1829. — Berkeley, Engl. Flora V: pg. 305, 1863. — Vittadini, Mon. Lycoperd., pg. 61 (p.p.), 1843. — Krombholz, Schwämme VII: pg. 22, Tab. 60, Fig. 21—22, 1843. — Durieu, Flora d'Algérie, pg. 392, 1846. — Hussey, Illustr. of Brit. Fungi I, Tab. XVII, fig. 1, 1847. — Berkeley, Outlin. of Brit. Fungology, pg. 303, Tab. XV, fig. 4, 1860. — Cooke, Handb. of Brit. Fungi, pg. 374, No. 1090, fig. 116, 1871. — Winter, in Rabenhorst: Kryptogamen-Fl. Deutschlands I: pg. 887—888, Fig. 1—2 1884. — Trelease, The Morels and Puff-Balls of Madison, pg. 119, Tab. IX, fig. 6, 1888. — Schröter, Die Pilze Schles. I: pg. 704, 1889. — Massee, A mon. of the Brit. Gastrom., pg. 49, Tab. III, Fig. 45, 1889. — Saccardo, Sylloge fung. VII: pg. 134, No. 445, 1888. — Gillet, Champ. de France (Gasterom.), Tab. XV, 1892. — Massee, Brit. Fungus Fl. I: pg. 20—21, Tab. 35, fig. 4, 1892. — Fischer, in Engler-Prantl: Die natürl. Pflanzenfam. I/1: pg. 337, fig. 175 B, C, 1900. — Hollós, in Növénytani Közlem. I/2: pg. 60, Tab. 1—3, 1902. — Popovici, Fl. Crypt. Roum., pg. 43, 1903. — Boudier, Icones Mycol., Tab. 145, 1904—1907. — Smith W. G., Syn. of the Brit. Basidiom., pg. 479, No. 2086, Fig. 134 A—E, 1908. — Petri, Fl. Ital. Crypt. V: pg. 94, No. 4, Fig. 53—54, 1909. — Migula, Pilze III/2: pg. 763, No. 4174, Tab. 145, Fig. 1—2, 1912. — Michael, Führer f. Pilzfr. I: pg. 82, No. 82, 1918. — Velenovský, České houby, pg. 809, Tab. 150, Fig. 6. 1920. — Moffat, The fungi of the Chicago reg. II: pg. 22, Tab. XXV, Fig. 2, 1923. — Verwoerd, Afr. Lycop. en Nidul., pg. 18, 1925. — Clements & Shear, The Gen. of Fungi, Tab. 47, Fig. 11, 1931. —

Scleroderma vulgare Horn. *var. aurantiacum* (Vaill.) W. G. Smith, Syn. of the Brit. Basidiom., pg. 479, 1908. —

Exsiccata: Cooke, Fung. Brit., No. 417. — Fuckel, Fungi Rhenani exsiccati, No. 1253, 2485. — Jaczewski, Fungi Rossici exsiccati, No. 129. — Klotzsch-Rabenhorst, Herb. Myc., No. 174. — Herbarium Mac-Owanianum, No. 1454 (as *Melanogaster Owanianum* Kalchbr. (teste Massee)). — Oudemans, Fungi Néderl., No. 245. — Rabenhorst-Winter, Fungi europaei exsiccati, No. 243. — Roumeguère, Fungi Gall. exsiccati, No. 3830 (as *Scle-*

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roderma verrucosum Pers.). — Saccardo, Myc. Ven., No. 1412. — Sydow, Mycotheca Marchica, No. 107. — Thümen, Fungi Austriaci exsiccati, No. 334. — Thümen, Mycotheca universalis, No. 607 (as *Scleroderma bovista* Fr.). — Crypt. Exsicc. Mus. Vindobon., No. 1810. — Weese, Eumyc. selecti exsiccati, No. 513. —

Receptacle irregularly spherical, ovoid, tuberous to reniform, in large specimens always flattened at the apex, often narrowing towards the base and ciliate, at the base with a short fascicle of fine mycelian filaments densely penetrated by humus, supraterranean or partly plunged into the soil, tearing irregularly. — Peridium strong, in a cut and when bruised turning slightly pink to lilac red, coriaceous, in fresh specimens moderately elastic, in dry specimens very hard, light yellowish brown, dirty yellow, yellowish brown with lemon yellow, orange to vermilion red shades, brownish to brown, cracked especially at the apex into verrucae, irregular areolas and ± broad squamae. — Gleba white in youth, turning pink in a cut, later black (with a purple shade), interwoven with white veinlets in maturity turing first into a dark mashy substance, later into a poppy-seed gray to grayish green sporée, of strongly aromatic smell. — Spores spherical, blackish brown, spinose, 7—15 μ in ϕ; observed in KOH they appear yellowish brown, and a ± distinct reticulation can be observed on their surface.

Ecology: It grows from June to October, singly or in groups on the sandy edge of dry coniferous forests, on stony slopes and in parched clearings, in clay-pits, on dry grassy hills and in moss (especially in cushions of *Leucobryum glaucum*). Characteristic species of sandy monocultures of pine-woods in the middle Elbe basin (in Czechoslowakia), where it is often the only representative of their mycoflora in the hot summer months. On stony clearings it often forms groups of tens of specimens resembling by their colouring and shape perfectly their environment — light pebbles and clayey soil.

Geographical Distribution: Czechoslovakia: Velenovský (81). — France: Chevallier (39), Corbière (Champ. de la Manche), Vaillant (80), Bulliard (12), De Candolle (20), Gillet (28), Quélet (61). — Deutschland: Killermann (41), Winter (86), Schröter (68), Migula (53), Martius (47), further Fuckel, Klotsch-Rabenhorst, Rabenhorst-Winter (in collections of exsiccata). — Nieder-Österreich: Wernberg, VIII, 1936, leg. Dr. A. Pilát. — Thümen, Weese, Rabenhorst-Winter (in collections of exsiccata). — Magyarország: Hollós (34—38), Hazslinszky (32.).

Practical Utilisation: *Scleroderma aurantium* (Vaill.) Pers. is a fungus well-known in all countries and abundantly used as a substitute for truffle (*Tuber aestivum* Vitt. and *Tuber brumale*

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Vitt. var. *melanosporum* (Vitt.) E. Fischer). In our country it is a fungus universally gathered under different popular names, but mostly it is called "truffle". It is edible only in small quantities. The fungi have to be used either at once (fresh) or dried, but must not be stored for a longer time as — especially in the hot months — they succumb to toxic rotting.

Remarks: Hollós (36) identifies with this species also *Scleroderma flavidum* Ellis & Everh. described in the Journal of Mycology I: pg. 88, 1895, figured in typical specimens e. g. by Coker & Couch (14) (Tab. 87, 88 and 120, Fig. 2—3) and Bottomley (10) (Tab. XXX, Fig. 1—2, Tab. XXXI, Fig. 3), and published by the authors themselves under this name in the exsiccata collection North American Fungi, ser. 1698. *Scleroderma flavidum* Ellis & Everh. is certainly a good species, also considered as such especially by the most recent North American, South African and Australian authors (e. g. Coker & Couch (14), Verwoerd (82), Bottomley (10), Cunningham (19), growing in North America, South Africa, Australia and New Zealand.

The receptacles of the species *Scleroderma aurantium* (Vaill.) Pers. are attacked by *Xerocomus parasiticus* (Fr. ex Bull.) Quél., which occurs though sporadically yet in its localities always in masses. It is interesting that the specimens of *Scleroderma aurantium* (Vaill.) Pers. attacked by *Xerocomus parasiticus* show — in contradistinction to non-infected ones — a double type of spores (as far as the configuration of their surface is concerned): smooth and verrucous spores. Already Tulasne (77) and later also Patouillard (51) found these differences. Also Mattirolo (51) came to the same finding; he made the microscopic analysis of a number of specimens of *Scleroderma aurantium* (Vaill.) Pers. attacked by *Xerocomus parasiticus* (Fr. ex Bull.) Quél. and the pyrenomycetus *Hypomyces chrysospermus* Tul., and at the same time he ascertained the reduction of our *Scleroderma* spores leading — in the case of a strong arrack — even to "sterilité parasitaire" of some specimens. On the receptacles of *Scleroderma verrucosum* (Vaill.) Pers., *Scleroderma aurantium* (Veill.) Pers. and *Scleroderma aurantium* var. *spadiceum* (Schaeff.) Fr. he observed, on the other hand, the *Deuteromycetes Trichothecium roseum* Link and *Verticillium lateritium* Berk. (*Hyphomycetes, Moniliatae*) as saprophytes, and these had no ingluence on the formation of morphologically variable spores.

Variability: Fairly variable species with regard to size and shape of the receptacle. Younger specimens are always more dark-coloured (with shades from lemon yellow via orange to yellowish brown and sometimes almost rust-coloured); specimens from localities strongly exposed to the sun show always a lighter (to almost

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dirty white) colouring. *Scleroderma citrinum* Pers. and *Scleroderma vulgare* Horn. var. *aurantiacum* (Vaill.) W. G. Smith are synonyms, designating specimens within the limits of the colour variability mentioned above. *Scleroderma vulgare* Horn. var. *laevigatum* (Fuck.) W. G. Smith and *Scleroderma vulgare* Horn. var. *cervinum* (Pers.) W. G. Smith (to whose descriptions Smith (72) remarks "resembling *Elaphomyces granulatus,* of which species it is sometimes, without examination, placed in herbaria as a var. Fir woods. Probably a distinct species") are nothing but synonyms evident at first sight already from the descriptions, belonging to *Elaphomyces cervinus* (Pers.) Schröter.

Var. **macrorhizum** Fries.

Scleroderma vulgare var. *macrorhizum* Fries, Syst. Myc. III: pg. 47, 1829. — Saccardo, Sylloge fung. VII: pg. 135, 1888.
Scleroderma macrorhizon Wallroth, Fl. Crypt. Germ., No. 2283, 1831. —

Receptacle irregularly spherical to reniform, in large specimens flattened at the apex, larger than in the type, with a large, long, firm fascicle of mycelian filaments at the base, which are broadly spread out at the surface of the substratum, connecting among themselves and broadly grown together towards the base. — Peridium finely granular, ± cracked especially at the apex into fine squamae, or completely smooth, of whitish, whitish yellow to sand brown colouring, some specimens at the base whitish yellow to lemon yellow. — For the rest agreeing with the type.

Ecology: Characteristic variety of sandy and stony places in Central and Northern Europe, in our country characteristic for the bare sandy soils of the middle Elbe basin (Czechoslowakia). The receptacles grow in sheer sand, often almost below its surface, on the bare slopes of sand dunes free from all vegetation, strongly exposed to the sun. The firm and broadly spread out fascicle of mycelian filaments fixes the receptacle in the loose and shifting substratum.

Geograpical Distribution: Czechoslowakia: Písty (district Nymburk), sand dunes behind the village, VII.—IX. 1949, leg. S. Šebek (H. Myc. Šebek.) — Hradištko (distr. Nymburk), sandy edge of a pine-forest, VIII. 1949, leg. S. Šebek (H. Myc. Šebek). — Deutschland: Nordhausen, in stony gardens, leg. F. Wallroth (as *Scleroderma macrorhizon* Wallroth). — Sverige: Femsjö, in pure sand, leg. E. Fries (24). —

Remarks: Form well distinguishable from the typical *Scleroderma aurantium* (Vaill.) Pers., from which it is distinguished practically only the larger size of the receptacle, the strong basal fascicle of mycelian filaments, the finely granular to smooth, light-coloured

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peridie, and the different character of the habitat. The size and shape of the mycelian fascicle, with fulfills especially in this variety also an important mechanical function, is probably dependent on the nature of the substratum; Wallroth's specimens collected "ad terram glareosam tersam arearum hortensium" formed — in view of the pebbly ground-such a long and compact fascicle of mycelian filaments as we find in the species of the genus *Mitremyces*; our shifting sandy localities demand the formation of a more superficial and broadly fixing mycelian mechanism.

Var. **spadiceum** (Schaeff.) Fries.

Scleroderma vulgare var. *spadiceum* (Schaeff.) Fries, Syst. Myc. III: pg. 49, 1829. — Saccardo, Sylloge fung. VII: pg. 136, 1888. — W. G. Smith, Syn. of the Brit. Basidiom., pg. 479, 1908. —

Lycoperdon spadiceum Schaeffer, Ic. et discriptio fungorum, Tab. 188, Fig. VII (p.p.), 1761 (not *Lycoperdon spadiceum* Pers.!). —

Lycoperdon cepae facie Vaillant, Bot. Paris., pg. 123, No. 13, Tab. XVI, Fig. 5—6, 1727. —

Lycoperdastrum cepae facie Micheli, Nova plant. genera, pg. 220, 1729. —

? *Tuber solidum* Withering, A bot. arrang. of Brit Plants IV: pg. 459, 1818. —

Scleroderma spadiceum Persoon, Syn. Meth. Fung., pg. 155, 1801. — Albertini et Schweinitz, Consp. fung., pg. 81, No. 230, 1805. — Martius, Fl. Crypt. Erlang., pg. 383 1817. —

Scleroderma cepa (Vaill.) Persoon, Syn. Meth. Fung., pg. 155, 1801. — Schweinitz, Syn. Fung. Carol., No. 348, 1822. — Greville, Scott. Crypt. Fl. II: Tab. 66, Fig. 1—4, 1823. — Hollós, in Növenytanyi Közlem. I/2: pg. 60, Tab. 4—6, 1902. — Hollós, Gasterom. Ungarns, pg. 130, Tab. 23, Fig. 3—7, 1904. — Bambeke, in Bull. Soc. Roy. de Botanique de Belg. XLIII: Fig. 4, 1906. — Petri, Fl. Ital. Crypt. V: Fig. 54, 1—55, 1909. — Fries Th., Sver. Gasterom., pg. 52, Fig. 38, 1922. — Verwoerd, Afr. Lycop. en Nidul., pg. 18, 1925. — Coker & Couch, Gasterom. of USA, pg. 167, Tab. 92—93, 120, Fig. 7, 1928. — Fischer, in Engler-Prantl: Die natür. Pflanzenfam. VII a: pg. 37, 1933. — Teng, Fungi of China, pg. 505, 1939. — Bottomley, Gasterom. of South Afr., pg. 536—537, Tab. XXVIII, Fig. 1, Tab. XXIX, Fig. 1, 1948. —

Scleroderma cepioides Gray, A nat. arrang. of Brit. Plants I: pg. 582, 1821. —

Scleroderma vulgare Horn. var. *cepa* (Pers.) W. G. Smith, Syn. of the Brit. Basiddiom., pg. 479, 1908. —

Receptacle spherical, somewhat depressed at the apex, often with a bulbously contracted base (without tuft of mycelian filaments) to piriform, supraterranean, tearing irregularly, smaller than in the type. — Peridium turning yellow in a cut, in dry specimens thin, coriaceous, honey brown, dark brown, umber brown to reddish brown, cracked at the apex into tiny squamae and verrucae. — Gleba in youth white, later brownish black (with carmine to purple shades) to rusty black, in maturity disintegrating into an olive gray sporée. — Spores globular, blackish brown, 8—15 μ in ⌀, shortly and finely

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spinose, observed in KOH they do not show any reticulation on the surface. For the rest it agrees with the typical *Scleroderma aurantium* (Vaill.) Pers.

Ecology: Variety growing singly or in groups, from June to October, mostly in leafy forests but also in coniferous forests (here often together with the typical *Scleroderma aurantium* (Vaill.) Pers. with which it is indubitably confused.

Geographical Distribution: Czechoslowakia: Chuchle, 1925, leg. B. Klika (together with *Scleroderma aurantium* (Vaill.) Pers.); Česká Bělá, VI. 1930, leg. Rejsek; Jirny, VI. 1932, leg. B. Klika (together with *Scleroderma verrucosum* (Vaill.) Pers. subsp. *bovista* (Fr.) Šebek; Mnichovice, 1914, leg. Dr. J. Velenovský. — Deutschland: Schaeffer (67), Martius (47). — France: Vaillant (79). — Magyarország: Hollós (35—36). —

Remarks: The size of the specimens I measureg varied between 1 and 3 cm. Hollós (36) gives the diameter of the receptacles as 1—5 cm., Bottomley (10) even 1—8 cm.! Also the size of the spores varies; according to Hollós (36) 9—10 μ, Bottomley (10) gives the measurements of the spores as 10.2—15.3 μ in ϕ. The principal features for distinguishing it from the typical *Scleroderma aurantium* (Vaill.) Pers. are the smaller, flattened spherical, often bulbous, dark brown receptacle with yellowing peridie cracked into tiny squamae, in the maturity brownish black colouring of the gleba, and the finely spinose, smaller spores without reticulate structure (in KOH). Among the synonyms of this variety we could perhaps place also *Lycoperdon irregulare* De Candolle, Flore Française VI: pg. 102, 1815, of which Fries (24), listing it among the doubtful species, writes: "Num ad hoc etiam *S. cepa* Schweinitz. Car. 348 sine descriptione, sed valde distinctum dictum, cum *S. cepa* Europ. procul dubio ad *S. vulgare referendum*" (pg. 151).

2. **Scleroderma verrucosum** (Vaill.) Pers.

Scleroderma verrucosum (Vaill.) Persoon, Syn. Meth. Fung., pg. 154, 1801. — Gray, A. nat. arrang. of Brit. Plants I: pg. 582, 1821. — Greville, Scott. Crypt. Fl. I: Tab. 48, 1823. — Chevallier, Flore gén. des envir. de Paris, pg. 358, 1826. — Fries, Syst. Myc. III: pg. 49, 1829. — Duby, in A. P. de Candolle: Bot. Gall., pg. 852, 1830. — Berkeley, Engl. Flora V: pg. 306, 1836. — Durieu, Flora d'Algérie, pg. 393, 1846. — Hussey, Illustr. of Brit. Fungi I: Tab. XVII, Fig. 2, 1847. — Berkeley, Outlin. of Brit. Fungology, pg. 303, 1860. — Cooke, Handb. of Brit. Fungi, pg. 375, No. 1092, 1871. — Winter, in Rabenhorst: Kryptogamen-Fl. Deutschl. I: pg. 889, 1884. — Quélet, Enchiridion Fung., pg. 243, 1886. — Saccardo, Sylloge fung. VII: pg. 136, No. 447, 1888. — Massee, A mon. of the Brit. Gastrom., pg. 50, fig. 47, 1889. — Schröter, Die Pilze Schles. I: pg. 704, 1889. — Sorokin, in Rev. Myc. 1890: pg. 14, No. 45, Tab. XXIV, Fig. 349, Tab. XXV, Fig. 355, 1890. — Massee, Brit. Fungus Fl. I: pg. 22, 1892. — Fischer, in Engler-Prantl: Die natür. Pflanzenfam. I/1: pg. 336, Fig. 175 A, 1900 and l. c. VII a:

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pg. 37, Fig. 26 A, 1933. — Hollós, in Növenytanyi Közlem. I/2: pg. 60, 1902. — Popovici, Fl. Crypt. Roum., pg. 43, 1903. — Hollós, Gasterom. Ungarns, pg. 131, Tab. XXIII, Fig. 21—29, 1904. — Smith W. G., Syn. of the Brit. Basidiom., pg. 479, No. 2087, 1908. — Petri, Fl. Ital. Crypt. V: pg. 97, Fig. 54/3, 1909. — Migula, Pilze III, 2. 2., pg. 764, No. 4175, 1912. — Lind, in Rostrup: Danish Fungi, pg. 403, 1913. — Velenovský, České houby, pg. 811, 1920. — Fries Th., Sver. Gasterom., pg. 54, Fig. 40, 1921. — Rea, Brit Basidiom., pg. 50, 1922. — Verwoerd, Afr. Lycoperd. en Nidul., pg. 18, 1925. — Killermann, Bayer, Gasterom., pg. 509, 1926. — Corbière, Champ. de la Manche, pg. 263, 1929. — Clements & Shear, The Gen. of Fungi, pg. 353, 1931. — Alexandri, Contrib. la cunoaşt. gasterom. Rom., pg. 66, Tab. XII, Fig. B (c—d), 1932. — Brandza & Solacolu, in Publ. Soc. Nat. Rom. No. 11, pg. 27, 1932. — Cunningham, Gasterom., pg. 119, 1944. — Vasilkov, Sjedobnyje i jadovityje griby SSSR, pg. 101, 1948. — Bottomley, Gasterom. of South Afr., pg. 537, Tab. XXVIII, Fig. 2, Tab. XXIX, Fig. 2, 1948. —

Lycoperdon verrucosum, sphaericum, pediculo donatum Vaillant, Bot. Paris., pg. 122, Tab. XVI, Fig. 7, 1727. — Bulliard, Champ. I: pg. 157, Tab. 24, 1809. — De Candolle, Fl. Fr. II: pg. 265, No. 715, 1805—1815. — Withering, A bot. arr. of Brit. Plants IV: pg. 451, 1818 (non Lycoperdon verrucosum, bruneum, induratum, scabrum Batsch, Elenchus fung., pg. 155, No. 33, 1789, quod *Lycogala epidendrum* Fr. est, nec *Lycoperdon verrucosum* etc. Ruppius, Fl. Jenensis etc., pg. 304, 1718, quod synonymum Lycoperdontis perlati Pers. est). —

Lycoperdastrum obscurum, altius radicatum, pulpa atropurpurea etc. Micheli, Nova plant. gen., pg. 219—220, No. 3—4, Tab. 99, Fig. 3, 1729. — Battarra, Fung. agri Arim. hist., pg. 64, Tab. 31, Fig. B, C, 1755. —

Lycoperdon defossum Batsch, Elench. fung. III: pg. 125, Tab. XLII, fig. 229, 1789 (non *Lycoperdon defossum* Vitt., Mon. Lycop., pg. 33, 1843). — Sowerby, Col. Fig. of Engl. Fungi, Tab. 311, 1799. —

Lycoperdon dispar Batsch, Elench. fung. III: pg. 147, 1789. —

Lycoperdon pedunculatum Link, Dissert. bot. II, 1795. —

Scleroderma areolatum Ehrenberg, Sylvae Mycol. Berol., XV: pg. 27, 1818. —

Scleroderma pandanaceum F. v. Muell. ex Berk. Journ. Linn. Soc. XIII: pg. 171, 1872. —

Scleroderma Bresadolae Schulzer, in Hedwigia XXIII: pg. 163, No. 11, 1884. — Saccardo, Sylloge fung. VII: pg. 140, No. 463, 1888. —

Scleroderma Torrendii Bresadola, Mycetes Lusit. Novi, pg. 132, 1902. — Bresadola, Revista De Sci. Nat. do Coll. de S. Fiel. Lisboa, 1902. —

Exsiccata: Desmazières, Cryptogam. Franc., ser. I, No. 467. — Fuckel, Fungi Rhenani exsiccati, No. 1254. — Jaczewski, Fungi Rossici exsiccati, No. 128. — Oudemans, Fungi Néderl., No. 120. — Rabenhorst-Winter, Fungi europaei exsiccati, No. 3141. — Lundell & Nannfeldt, Fungi exsicc. suecici, praesertim upsalienses, No. 948 (as *Scl. aurantium* Pers.). — Rathay, Flora exsiccata Austro-Hungarica, No. 1559. — Romeguère, Fungi Gall. exsiccati, No. 3829 (as *Scleroderma geaster* Vitt. var. *arenarium*). — Săvulescu, Herb. mycol. romanicum, Fasc. X. No. 497. — Sydow, Mycotheca germanica, No. 1059. — Sydow, Mycotheca Marchica, No. 315 (as *Lycoperdon aestivale* Bon.), No. 451. — Thümen, Mycotheca universalis, No. 608 (as *Scleroderma polyrhizon* Lév. = *Scleroderma geaster* Fr.). —

Receptacle supraterranean, irregularly spherical to depressed, often narrowing towards the base and passing into the sterile, ± long, flattened, stipe-like, smooth or lacunous part, at the base with

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a short fascicle of mycelian filaments, irregularly opening at the apex. — Peridium very thin, elastic, smooth, ochrous yellow, yellowish brown to pastry brown, always darker towards the apex, covered at the surface with minute and fine, umber brown, floccose squamae, always more densely floccose at the apex. — Gleba in youth white, at the time of maturity breaking down into a grayish brown sporée. — Spores spherical, dark brown, fairly densely bristly spinose, 10—16.5 μ in ϕ, observed in KOH they are lighter and do not show a reticulation on their surface; only the individual spines can be more distinctly distinguished.

Ecology: It grows in August-September, singly or colletively on light humic soil of leafy forests (especially in oak forests), at the edge of groves, in sandy soil of mixed forests, on clay sides of forest ditches, on moist forest paths in the grass, in avenues, etc. In our country a characteristic species of oak forests and of meadow groves in the Elbe basin (in Czechoslowakia), where it often grows in great numbers on humic soil mixed with leaves, especially under shrubs, in the grass, at the roots of old oak-trees, etc.

Geographical Distribution: Very wide-spread species in the whole of Europe, North America, Africa, Australia and New Zealand: Czechoslowakia: Velenovský (81) — Deutschland: Winter (86), Schröter (68), Migula (53), Killermann (41), Ehrenberg (21), further Fuckel, Rabenhorst-Winter, Sydow, Thümen (in collections of exsiccata). — France: Chevalier (39), De Candolle (20), Quélet (61), Corbière (Champ. de la Manche), Vaillant (79), Bulliard (12), further Desmazières (in an exsiccata collection). — Nieder-Österreich: Hadersfeld, leg. Rathay (Flora exsiccata Austro-hungarica, No. 1599). — Seitenstetten, 1924 (h. NMP No. 482698). — Schulzer (96), further Rabenhorst-Winter (in an exsiccata collection). — Magyarország: Hollós (35—36). —

Practical Utilisation: *Scleroderma verrucosum* (Vaill.) Pers. and its subsp. *bovista* (Fr.) Šebek, growing mostly under lime-trees, are gathered here and there in Czechoslowakia and used in sauces, soups, etc. For its use the same applies as for the other species of the genus *Scleroderma.*

Remarks: The size of the receptacle varies — according to the different authors — between 1 and 8 cm.: Saccardo (66) gives the width of the receptacle as 4—6 cm., Schröter (68) as 5—8 cm., Velenovský (81) as 3—5 cm., Bottomley (10) as 1—8 cm. In measuring tens of specimens I found an average size between 2 and 4 cm., but I found also abnormally large specimens (of up to 15 cm. in ϕ). The presence (or size) of the sterile stipe-like base depends on the nature of the substratum (as Hollós (36) rightly remarked).

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Heavy soils prevent the formation of or perfect "stipe", which in specimens from such localities is short (some specimens even lack it completely), so that we often find only spherical or irregularly spherical receptacles without sterile basal part, resembling rather dark-coloured specimens of *Scleroderma aurantium* (Vaill.) Pers. or still more its var. *spadiceum* (Schaeff.) Fr. On lighter leaf soils or sandy soils it forms a broad stipe, 1.5—7 cm. long. This species differs from *Scleroderma aurantium* (Vaill.) Pers. mainly by the smaller size, the thinner, elastic, darker coloured peridie covered with fine, umber brown squamae, and the stipe-like basal part. Velenovský (81) gives its description under the name of *Scleroderma vulgaris* Horn. (pg. 809). Schröter (68) placed to it erroneously as synonym *Scleroderma citrinum* Pers., which belongs to *Scleroderma aurantium* (Vaill.) Pers. Similarly also Hollós (36) included erroneously *Lycoperdon spadiceum* Schaeffer (= *Scleroderma aurantium* (Vaill.) *Pers.* var. *spadiceum* (Schaeff.) Fr.) among its synonyms. "Fungus globosus, gilvus, squamis fuscis variegatus, polyrhizos Boccone", placed by Hollós (64) on the one hand to this species, and on the other hand simultaneously as synonym to *Scleroderma aurantium* (Vaill.) Pers., belongs rather to its subsp. *bovista* (Fr.) šebek. — The specimens deposited in the herbarium of the National Museum, Prague, and designated by Velenovský as *Scleroderma stipitatum* Vel., belong indubitably to *Scleroderma verrucosum* (Vaill.) Pers.

Variability: Very widely distributed species, considerably variable in size and colouring as demonstrated by Saccardo (66), who listed a number of its shape and colour varieties from localities scattered almost all over the world. The variability of this species demands a separate detailed investigation, on which I am working at present. In view of this I give below the descriptions of the Central European subspecies, varieties and forms so far established.

Scleroderma verrucosum (Vaill.) Pers. falls into several morphologically and ecologically defined subspecies, of which subsp. *typicum* šebek and subsp. *bovista* (Fr.) šebek are the most widespread ones in Central Europe. To them come still several morphological and colour varities of a lower taxonomic value, given below.

2 a. **Scleroderma verrucosum** (Vaill.) subsp. **typicum** šebek
(= *Scleroderma verrucosum* sensu auct.)

Hanc subspeciem (*Scleroderma verrucosum* (Vaill.) Pers. subsp. *typicum* šebek) omnes exemplares typici *Sclerodermatis verrucosi* sensu europearum, africanorum et ex plurima parte etiam americanorum auctorum, ad terram humosam nemorum (precipue in quercetis fructicosis) habitantes, repraesentant.

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I designate as subsp. *typicum* Šebek all typical small specimens of *Scleroderma verrucosum* (Vaill.) Pers. with a sterile stipe-like base, agreeing with the description given above, growing mostly in leafy (especially oak) forests. To this subspecies belongs *Scleroderma verrucosum* (Vaill.) Pers. in the sense of the European, African and American authors.

Its characteristic colour variety is especially the purple var. *violascens* Herink in litt. whose description follows below.

Var. **violascens** Herink in litt.

Forma carposomate minori, peridio immaturo, roseo, violaceo vel rubescente, dissecto violascente, ad basim pallido, colore pallide subluteo-albo, serius hoc modo colorato peridio fusco umbraceis squamulis tecto ab *Scl. verrucoso* (Vaill.) Pers. distincta. Habitat ad terram humosam vel ad truncos putridos in nemoribus et hortis publicis.

Receptacle of smaller size, peridium in youth with pink, purple or reddish shades, turning purple in a cut in youth, paler (pale yellowish to whitish) towards the base of the receptacle, later on this background umber brown areolate.

Ecology: It grows on old, very rotten stumps or on strongly humic soil (thus evidently purely saprophytic, scarcely with any symbiotic relations) under leafy trees or in a mixed growth, especially in parks, etc.

Geographical Distribution: Czechoslowakia: Vyklantice (distr. Pacov), in grass under oaks and ash-trees, VIII. 1942, leg. Dr. J. Herink (Herb. Myc. J. A. Herink No. 597/42 in h. NMP). — Turnov, VIII. 1944, leg. Dr. J. Herink (Herb. Myc. J. A. Herink, No. 858/44). — Praha-Stromovka, on humic soil, IX. 1944, leg. Dr. J. Herink (Herb. Myc. J. A. Herink, No. 1117/44). —

Remarks: In working this monograph I had in the herbarium of the National Museum, Prague, one item (No. 597/42) at my disposal, designated as "*Scleroderma verrucosum* f. *roseo-inhalata* Herink", which contained two minute dry receptacles, whose dark brown peridie showed only red shades. Even by microscopical analysis I could not determine any more details in the receptacles of this form, unknown to me, as they were too young and had immature and badly developed spores. More detailed data on this form were given to me by its finder, Dr. J. Herink, who writes (in litt.): "Its receptacles are small, very dark brown, but in youth pinkish purple, at the base straw-yellow. Peridie in a cut beautifully purple. This form is scarcely a symbiont; it seems to be an explicit saprophyte. A typical *Scleroderma* smell is lacking in young receptacles."

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To the colour forms belonging to *Scleroderma verrucosum* (Vaill.) Pers. subsp. *typicum* Šebek, represented especially by the characteristic var. *violascens* Herink, we may count perhaps also (so far without designation and taxonomic placement) those very characteristic specimens which Herink (in litt.) describes as "large pieces with a relatively very thin, saturated pinkish purple peridie, almost without areolation or only with very tiny areolas." Unfortunately I have not seen either fresh specimens or exsiccata.

2 b. **Scleroderma verrucosum** (Vaill.) Pers. subsp. **bovista** (Fr.) n. comb.

Scleroderma bovista Fries, Syst. Myc. III: pg. 48, 1829. — Berkeley, Engl. Flora V: pg. 306, 1836. — Durieu, Flora d'Algérie, pg. 393, 1846. — Berkeley, Outlin. of Brit. Fungology, pg. 303, 1860. — Cooke, Handb. of Brit. Fung., pg. 375, No. 1091, 1871. — Hazslinsky, Mag. hasgomb. pg. 23, 1875. — Karsten, Myc. Fenn. III: pg. 363, 1871—76. — Winter, in Rabenhorst: Kryptogamen-Fl. Deutschl. I: pg. 889, 1884. — Quélet, Enchiridion fung., pg. 243, 1886. — Saccardo, Sylloge fung. VII: pg. 135, No. 446, 1888. — Massee, A mon. of the Brit. Gastrom., pg. 51, Fig. 36, 1889. — Schröter, Die Pilze Schles. I: pg. 705, 1889. — Massee, Brit. Fung. Flora I: pg. 22, 1892. — Fischer, in Engler-Prantl: Die natür. Pflanzenfam. I/1: pg. 337, 1900 et l. c. VII a: pg. 37, Fig. 25, 1933. — Hollós, in Növenytanyi Közlem. I/2: pg. 60, Tab. 7—9, 1902. — Hollós, Die Gasterom. Ungarns, pg. 132, 178, Tab. XXIII, Fig. 16—20, 1904. — Smith W. G., Syn. of the Brit. Basidiom., pg. 479, No. 2088, 1908. — Petri, Fl. Ital. Crypt. V: pg. 96, Fig. 54/2, 1909. — Migula, Pilze III: 2. 2., pg. 764, No. 4176, 1912. — Lind, in Rostrup: Danish Fungi, pg. 403, 1913. — Velenovský, České houby, pg. 811, Tab. 150, Fig. 7, 1920. — Fries Th., Sver. Gasterom., pg. 54, Fig. 39, 1922. — Rea, Brit Basidiom., pg. 49, 1922. — Killermann, Bayer. Gasterom. pg. 150, 1926. — Coker & Couch, Gasterom. of USA, pg. 163—164, Tab. 89, Tab. 90, Tab. 120, Fig. 4, 1928. — Alexandri, Contrib. la cunoaşt. gasterom. Rom., pg. 67—68, Tab. XII, Fig. A (a—b), 1932. — Teng. Fungi of China, pg. 505, 1939. — Cunningham, Gasterom., pg. 117, 1944. — Bottomley, Gasterom. of South Africa, pg. 54, 1948. —

? Fungus globosus, gilvus, squamis fuscis variegatus, polyrhizos Boccone, Museo di Pis. e di esper., Tab. 305, Fig. 1—2, 1697. —

Lycoperdastrum autumnale, flavescens, cortice tenuiori, laevi, pulpa sordide purpurea Micheli, Nova plant. genera, pg. 220, Tab. 99, Fig. 2, 1729. —

Scleroderma texense Berkeley, in Lond. Journ. of Botany IV: pg. 308, 1845. —

Scleroderma columnare Lloyd, in Myc. Notes 63: pg. 759, 1918. —

Exsiccata: Săvulescu, Herb. mycol. romanicum. — Shear C. L., Pathogogical and mycological collections, edited by United States Department of Agriculture, No. 60862 (as *Scleroderma aurantium* (Vaill.) Pers.).

Description: Carposomate subgloboso, obovato vel tuberiforme, ad basim fasciculum densum fibris mycelialis compositum ferente. Peridio tenui, elastico, glabro, pallide fusco, rubro-fusco vel obscure umbraceo-fusco, fuscis squamulis tenuiter floccoso. Gleba primum candida, serius purpureo-nigra, tempore maturitatis in

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pulverem sporiferum olivaceo-fusci coloris discedente. Sporis globosis, atrofuscis, aculeate echinulatis, 10—14.5 μ in diam. —

Receptacle irregularly spherical, ovoid to tuberous, with an often uneven, rugged surface, at the base with a dense fascicle composed of ± fine mycelian filaments, supraterranean or partly plunged into the soil, tearing irregularly. — Peridium thin, soft, in fresh specimens elastic, in dry ones brittle, smooth, light yellow, pastry-brown to grayish brown, sometimes with reddish shades, darker at the apex covered areolately with tiny umber brown squamae. — Gleba in yout white, later black with a purple shade, at the time of maturity disintegrating into a grayish brown to olive brown sporée. — Spores globular, dark brown, spinose, 10—14.5 μ in ϕ, submerged in KOH they show on their surface a ± distinct reticulation.

Ecology: It grows from June to September, singly or in groups, in light, rather sandy soil, often in lime-tree avenues, in gardens, on slopes and in sandy fields. In often occurs also in the same habitats as *Scleroderma verrucosum* (Vaill.) subsp. *typicum* Šebek, i. e. in leafy forests, under shrubs etc.

Practical Utilisation: *Scleroderma verrucosum* (Vaill.) Pers. subsp. *bovista* (Fr.) Šebek is gathered under different popular names and is used together with the other current European species of the genus *Scleroderma* Pers. as admixture to some seasoned foods (e. g. sauces, etc.).

Geographical Distribution: Czechoslowakia: Velenovský (81). —.Deutschland: Winter (86), Schröter (68), Migula (53), Killermann (41). — France: Quélet (61). — Magyarország: Hazslinzsky (32), Hollós (35—36).

Remarks: *Scleroderma verrucosum* (Vaill.) Pers. subsp. *bovista* (Fr.) Šebek is considered an independent species by most of the authors mentioned; the comparative study of fresh material belonging to subsp. *typicum* Šebek as well as to subsp. *bovista* (Fr.) Šebek convinced me — on the basis of the number of preceding habitual characters — of the very close affinity between these two subspecies, on the basis of which I place the former independent species *Scleroderma bovista* Fr. as characteristic subspecies to *Scleroderma verrucosum* (Vaill.) Pers. From this typical *Scleroderma verrucosum* (Vaill.) Pers. it is distinguished especially by the larger receptacle, the elastic, in dry specimens brittle peridie, the long, dense basal fascicle of mycelian filaments, and the distinct reticulation on the surface of the spores (in KOH). — Size, length and density of the basal fascicle of mycelian filaments are again dependent on the texture of the substratum. In lighter, loose and more sandy soils (e. g. under lima-trees, in fields) a richer and

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longer basal fascicle develops than in specimens growing in more settled soils.

Scleroderma texense Berk. is placed by Bottomley (10) by mistake at the same time also to *Gyrophragmium Delilei* Mont. (*Gasteromycetes, Secotiaceae*).

To the subsp. *bovista* (Fr.) Šebek belong also the small receptacles deposited in the herbarium of the National Museum in Prague, and designated by Velenovský as *Scleroderma pustulatum* Vel.

A separate variety of *Scleroderma verrucosum* (Vaill.) Pers., subsp. *bovista* (Fr.) Šebek with a compact fascicle of mycelian filaments forms.

Var. **fascirhizum** Šebek.

Varietas carposomate forma, magnitudine et colore subspeciei *bovistae* (Fr.) Šebek, sed longo, denso et lacunoso fasce basali, fibris mycelialis late concretis ramosisque composito, ab ea disticta. — Habitat ad terram humidam nemorum Bohemiae, cum subspecie antecedente.

Receptacle of the same shape, size and colouring as in the subsp. *bovista* (Fr.) Šebek, from which it is distinguished by the long, strong and compact basal fascicle of broad mycelian filaments grown together. It does not differ microscopically.

Geographical Distribution: Czechoslowakia: Roblín, in a leafy grove, X-1925, leg. B. Klika (h. NMP No. 486362, designated as *Scleroderma bovista* var.). — Chuchle, 1923, leg. B. Klika (h. NMP No. 486703). — Střelice near Brno, clearing with young growth, VII-1948, leg. Fr. Valkoun (coll. mycol. Dr. V. J. Staněk). —

Ecology: This variety grows in humic groves and leafy forests. It will certainly be found more frequently, as it is probably confused with the subsp. *bovista* (Fr.) Šebek, from which it is distinguished by the dense, broadly ramified fascicle of grown-together mycelian filaments at the base of the receptacle.

3. **Scleroderma fuscum** (Corda) E. Fischer.

Scleroderma fuscum (Corda) E. Fischer, in Engler-Prantl: Die natür. Pflanzenfam. I/1: pg. 336, Fig. 175 D, 1900 and l. c. VII a: pg. 36, Fig. 26 D, 1933. — Bucholtz, Hypog. Russl., pg. 173, Tab. I, Fig. 25, Tab. V, Fig. 12—14, 1902. — Petri, Flora Ital. Crypt. V: pg. 99, 1909. — Migula, Pilze III. 2. 2.: pg. 764, No. 4177, 1912. —

Phlyctospora fusca Corda, in Sturm: Deutschl. Flora II: pg. 51, Tab. 16, Fig. 1—5, 1841. — Corda, Anleit. zum St. der Mykol., pg. 95, Tab. C, 37, Fig. 4—6, 1842. — Corda, Icones fung. V: pg. 23, 1842. — Tulasne, Fungi hypogaei, pg. 98—99, 1862. — Winter, in Rabenhorst: Kryptogamen-Fl. Deutschl. I: pg. 885, 1884. — Saccardo, Sylloge fung., VII: pg. 179, No. 589, 1888; IX: pg. 281, 1891. — Mattirolo, in Accad. reale delle

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sci. di Torino LIII: pg. 364, 1903. — Hollós, Die Gasterom. Ungarns, pg. 26, 1904. — Mattirolo, in Extr. do Bol. Soc. Brot. XXII: pg. 17, 1906. — Hollós, Magyar. föld. gomb., pg. 106, Tab. III, Fig. 24—25, Tab. V, Fig. 22, 1911. —

Receptacle small, spherical to tuberous, subterranean or partly above the soil. — Peridium strong, turning carmine red when bruised, coriaceous, smooth, dark brown. — Gleba white in youth, turning black in maturing, finally brownish black. — Spores globular, dark brown, 9—12 μ in ϕ, enveloped by irregularly angular hyaline cells, 4—5 μ high, so that the total diameter of the spores is 14—18 μ; observed in KOH they are lighter and a reticulation appears on their surface.

Ecology: It grows singly and in groups, usually beneath the surface, in coniferous forests and on stony places rarely.

Geographical Distribution: Species occurring rarely in France, Portugal, Czechoslowakia, Austria and Hungary. — Czechoslowakia: Praha, in the surrounding coniferous forests, beneath the surface, rare, leg. A. C. J. Corda. — Reichenau, VI-1889, leg.? — Mirovice, 1909, leg. Borovský (h, NMP). — Corda (16) remarks that Dr. Welwitsch found this species in Moravia. France: Departement Nivernais, leg. Tulasne. — Nieder-Österreich: Between the villages of Payerbach and Schlöglmühl, in stony places, VIII-1886, leg. Wöhrl. — Nagelberg (distr. Schrems), IX-1895, leg. E. Wanck. —

Remarks: Corda (16) characterised the receptacles of the genus *Phlyctospora* as follows: "Peridium simplex, coriaceum, intus carnosum dein cellulosum. Cellulae farctae irregulares. Sporae aggregatae, compositae, decolorantes, substantia immersae; episporio celluloso hyalino; nucleo globoso colorato, firmo. Asci vel basidia nulla."

The lack of asci and basidia can be explained only by the maturity of the specimens which Corda examined microscopically; their gleba was in an advanced stage of development so that it was no longer possible to ascertain their basidia. In consequence also the systematic position of this species was very uncertain, and soon it was placed as insufficiently known species to the family *Hymenogastraceae* Vitt. (e. g. Tulasne (78), Winter (86), Saccardo (66) and Hollós (37)), later — on the basis of detailed anatomical and ontogenetical investigations of some authors — already in the family *Sclerodermataceae* (e. g. Hollós (36)) or also directly in the genus *Scleroderma* Pers. (cf. Beck (7), Rabinowitsch (62), Fischer (22), etc.). It was especially Beck (7) who studied this species with regard to the development of the receptacle and on the basis of a rich material in all stages of development, in which he ascertained basidia, he placed the genus *Phlyctospora* Corda in the affinity of the genus *Melanogaster* Corda.

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Rabinowitsch (62) was convinced of its belonging to the genus *Scleroderma* Pers., but only Fischer (22) placed the species *Phlyctospora fusca* Corda finally in the genus *Scleroderma* Pers. as *Scleroderma fuscum* (Corda) E. Fischer.

By a concatenation of various circumstances I got hold of the very specimens in which Dr. Beck made his observations, so that I was able to confirm reliably in the same material the whole development of the gleba and the formation of the spores, bearing out his report. I had the opportunity or observe the interesting structure of the spores also in the Bohemian specimens from Mirovice (from the herbarium of the National Museum, Prague).

Tulasne (78) gives the size of the spores as 12.8—16 μ, Beck (7) as 14—17 μ, Hollós (38) as 10—18 μ. The size of the spores (from Beck's specimens), which I measured, varied between 14 and 18 μ.

Species dubiae et incertae sedis.

A few species imperfectly described in the literature can be counted to the genus *Scleroderma* Pers. In view of the fact that these species cannot be accurately identified (because of the insufficient description and the lack of proof specimens) I place them (for the sake of completeness of this monograph) in the following group of doubtful and insufficiently known species.

Scleroderma chrysosporum Opiz.

Scleroderma chrysosporum Opiz is an insufficiently described fungus unknown to me, which presumably represents an typical specimen of the species *Scleroderma verrucosum* (Vaill.) Pers. For the sake of completeness I give its original description by Opiz.

„Rundlich, fast stiellos, klein bräunlich, gefeldert, warzig. Warzen eckig, dunkelbraun. Flocken goldgelb mit gleichfarbigen Sporen. Bei Kamenic (28. Aug. 1854 Kalmus).

Saccardo (66), who placed it among the doubtful species, remarked: "Hab. in Bohemia orientali."

Pompholyx sapidum Corda.

Original description by Corda (16): "*Pompholyx sapidum*: tuberiforme, rotundatum, basi subplicatum; peridio albo, dein fuscescente glabro; substantia alba, dein violaceo-nigricans; sporis fuscis verrucosis.

Mit knolliger, gerundeter, am Grunde gefalteter, weisser, später braunwerdender glatter Peridie; weisser, später schwarz violetter Substanz und braunen warzigen Sporen. Diese neue Gattung und Art

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wohnt in Wäldern in lockerer, fetter, humusreicher Erde, und findet sich selten im böhmischen Mittelgebirge und am Erzgebirge. Auch um Carlsbad kommt sie vor, und wird daselbst als „weisse Trüffel" gesammelt und gespeist.

Remarks: In the characterisation of his monotypical genus *Pompholyx* Corda (18) remarked: "Asci vel basidia nulla. Sporae simplices, venarum parenchymate irregulariter immersae, sphaerico tetraedricae; episporio simplici, verrucoso, basi hilo maximo instructo." The lack of any mother cells in the gleba of the genus *Pompholyx* Corda can be explained by the maturity of the specimens on the basis of which Corda can be explained by the maturity of the specimens on the basis of which Corda established this new genus; their gleba was thus in the highest stage of development, so that the basidia had already disintegrated, and could not be ascertained in this stage.

Jaczewski (40), who found *Pompholyx sapidum* Corda in the neighbourhood of Smolensk (SSSR) and made on it detailed ontogenetic obersvations, ascertained in lit also piriform basidia arranged in the gleba in the same way as in the genus *Scleroderma* Pers., on which develop spherical, dark, verrucous spores, 12.5 μ in diam. In view of the arrangement of the basidia in the gleba, entirely different from that in the family *Hymenogastraceae,* where the hymenium with the basidia covers the walls of the hollow channel-shaped chambers, he denied the possibility of placing it taxonomically in the family *Hymenogastraceae,* as done e. g. by Winter (86), and placed it together with the genera *Scleroderma* Pers., *Phlyctospora* Corda, *Melanogaster* Corda and *Polysaccum* Alb. et Schw. in the family *Sclerodermataceae.*

As the whole habitus and the microscopic details agree with those in the genus *Scleroderma* Pers. one can agree with Velenovský (81) that *Pompholyx sapidum* Corda is only a "doubtful genus and species and representing indubitably only the ordinary *Scleroderma vulgare*" (pg. 811).

The Synonyms of Genus Scleroderma Pers. relating to other Genera.

Scleroderma arrhizum Pers., Syn. Meth. Fung., pg. 152, 1801 = *Pisolithus tinctorium* (Mich. ex Pers.) Coker & Couch.

Scleroderma Beccarii (Pass.) De Toni, in Saccardo: Sylloge fung. VII: pg. 142, No. 472, 1888 =*Mycenastrum corium* (Guers. ex D. C.) Desv.

Scleroderma callostoma Pers., in Journ. of Bot. II: pg. 15, 1841 = *Callostoma lutescens* (Schw.) Burnap.

Scleroderma carcinomale (L.) Pers., Syn. Meth. Fung., pg. 153, 1801 =*Podaxis pistillaris* (L. ex Pers.) Morse.

Scleroderma cervinum Pers., Syn. Meth. Fung., pg. 153, 1801 = *Elaphomyces cervinus* (Pers.) Schröter.

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Scleroderma cervinum α *granulatum* Alb. et Schw., Consp. fung., pg. 81, 1805 = *Elaphomyces cervinus* (Pers.) Schröter.

Scleroderma chilense (Mont.) De Toni, in Saccardo, Sylloge fung. VII: pg. 139, No. 462, 1888 = *Mycenastrum corium* (Guers. ex D. C.) Desv.

Scleroderma corium (Guers.) Grav., in Duby, Bot. Gallicum II: pg. 892, 1830 = *Mycenastrum corium* (Guers. ex D. C.) Desv.

Scleroderma corium (Guers.) Grav. var. *Kara-Kumianum* Sorokin in Saccardo, Sylloge fung. VII: No. 474 et IX: No. 1147, 1888 = *Mycenastrum corium* (Guers. ex D. C.) Desv.

Scleroderma fragile (Lév.) De Toni, in Saccardo, Sylloge fung. VII: pg. 140, No. 464, 1888 = *Mycenastrum corium* (Guers. ex D. C.) Desv.

Scleroderma Geaster Fr. var. *socotrana* Henning, in Bull. de l'Herb. Boiss. I (No. 3): pg. 100, 1893 = *Mycenastrum corium* (Guers. ex D. C.) Desv.

Scleroderma herculaneum Pers., Syn. Meth. Fung., pg. 151, 1801 = *Pisolithus tinctorius* (Mich. ex Pers.) Coker & Couch.

Scleroderma leptodermeum (Dur. et Mont.) De Toni, in Saccardo: Sylloge fung. VII: pg. 141, 1888 = *Mycenastrum corium* (Guers. ex D. C.) Desv.

Scleroderma olivaceum (Cooke et Mass.) De Toni, in Saccardo: Sylloge fung., VII: pg. 142, 1888 = *Mycenastrum corium* (Guers. ex D. C.) Desv.

Scleroderma ? perforatum Schulz. = *Reticularia umbrina* Pers.

Scleroderma phaeotrichum (Berk.) De Toni, in Saccardo: Sylloge fung. VII: pg. 139, No. 461, 1888 = *Mycenastrum corium* (Guers. ex D. C.) Desv.

Scleroderma pistillare (L.) Pers., Syn. Meth. Fung., pg. 150, 1801 = *Podaxis pistillaris* (L. ex Pers.) Morse.

Scleroderma radicatum (Dur.) De Toni, in Saccardo: Sylloge fung. VII: pg. 141, No. 470, 1888 = *Mycenastrum corium* (Guers. ex D. C.) Desv.

Scleroderma spinulosum (Peck) De Toni, in Saccardo: Sylloge fung. VII: pg. 141, Nr. 469, 1888 = *Mycenastrum corium* (Guers. ex D. C.) Desv.

Scleroderma strobilinum Kalchbr. ex Thümen, Grevillea IV: pg. 74, 1875 = *Phellorina strobilina* Kalchbr.

Scleroderma tinctorium (Mich.) Pers., Syn. Meth. Fung., pg. 152, 1801 = *Pisolithus tinctorius* (Mich. ex Pers.) Coker & Couch.

Scleroderma tuberosum Sprengel, Syst. IV: pg. 520 = *Atsraeus hygrometricus* (Pers.) Morgan.

Scleroderma umbrinum Cooke & Mass., Grevillea XIX: pg. 45, 1890 = *Pisolithus tinctorius* (Mich. ex Pers.) Coker & Couch.

Scleroderma vulgare Horn. var. *cervinum* (Pers.) W. G. Smith, Syn. of the Brit. Basidiom., pg. 479, 1908 = *Elaphomyces cervinus* (Pers.) Schröter.

Scleroderma vulgare Horn. var. *laevigatum* (Fuck.) W. G. Smith, Syn. of the Brit. Basidiom., pg. 479, 1908 = *Elaphomyces cervinus* (Pers.) Schröter.

The List of Names and Synonyms of the Central European Species of the Genus Scleroderma Pers.

Actigea Rafinesque = *Scleroderma* Pers.

areolatum, Ehrenberg = *Scleroderma verrucosum* (Vaill.) Pers.

arrhizum Pers., *Scleroderma* = *Pisolithus tinctorius* (Mich. ex Pers) Coker & Couch.

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aurantiacum (Vaill.) W. G. Smith, var. *Sclerodermatis aurantii* (Vaill.) Pers. = *Scleroderma aurantium* (Vaill.) Pers.

aurantii coloris Vaill., *Lycoperdon* = *Scleroderma aurantium* (Vaill.) Pers.

aurantium (Vaill.) *Pers., Scleroderma.*

autumnale Mich., *Lycoperdastrum* = *Scleroderma verrucosum* (Vaill.) Pers. subsp. *bovista* (Fr.) Šebek.

Beccarii (Pass.) De Toni, *Scleroderma* = *Mycenastrum corium* (Guers. ex D. C.) Desv.

Bovista Fr., *Scleroderma* = *Scleroderma verrucosum* (Vaill.) Pers. subsp. *bovista* (Fr.) Šebek.

bovista (Fr.) Šebek, subsp. *Sclerodermatis verrucosi* (Vaill.) Pers.

Bresadolae Schulzer, *Scleroderma* = *Scleroderma verrucosum* (Vaill.) Pers.

Callostoma Pers., *Scleroderma* = *Callostoma lutescens* (Schw.) Burnap.

carcinomale (L.) Pers., *Scleroderma* = *Podaxis pistillaris* (L. ex Pers.) Morse.

cepa (Vaill.) Pers., *Scleroderma* = *Scleroderma aurantium* (Vaill.) Pers. var. *spadiceum* (Schaeff.) Fr.

cepa (Pers.) W. G. Smith, var. *Sclerodermatis aurantii* (Vaill.) Pers. = *Scleroderma aurantium* (Vaill.) Pers. var. *spadiceum* (Schaeff.) Fr.

cepae facie Mich., *Lycoperdastrum* = *Scleroderma aurantium* (Vaill.) Pers. var. *spadiceum* (Schaeff.) Fr.

cepae facie Vaill. *Lycoperdon* =*Scleroderma aurantium* (Vaill.) Pers. var. *spadiceum* (Schaeff.) Fr.

cepioides Gray, *Scleroderma* = *Scleroderma aurantium* (Vaill.) Pers. var. *spadiceum* (Schaeff.) Fr.

cervinum Pers., *Scleroderma* = *Elaphomyces cervinus* (Pers.) Schröter.

cervinum (Pers.) W. G. Smith, var. *Sclerodermatis aurantii* (Vaill.) Pers. = *Elaphomyces cervinus* (Pers.) Schröter.

citrinum Pers., *Scleroderma* = *Scleroderma aurantium* (Vaill.) Pers.

columnare Lloyd, *Scleroderma* = *Scleroderma verrucosum* (Vaill.) Pers. subsp. *bovista* (Fr.) Šebek.

corium (Guers.) Grav., *Scleroderma* = *Mycenastrum corium* (Guers. ex D. C.) Desv.

defossum Batsch, *Lycoperdon* = *Scleroderma verrucosum* (Vaill.) Pers.

dispar Batsch, *Lycoperdon* = *Scleroderma verrucosum* (Vail.) Pers.

fascirhizum Šebek, var. *Sclerodermatis verrucosi* (Vaill.) Pers. subsp. *bovistae* (Fr.) Šebek.

fragile (Lév.) De Toni, *Scleroderma* = *Mycenastrum corium* (Guers. ex D. C.) Desv.

fusca Corda, *Phlyctospora* = *Scleroderma fuscum* (Corda) E. Fischer.

fuscum (Corda) E. Fischer, *Scleroderma.*

globosus Bocc., Fungus = ? *Scleroderma verrucosum* (Vaill.) Pers. subsp. *bovista* (Fr.) Šebek.

granulatum Alb. et Schw., var. *Sclerodermatis cervini* Pers. = *Elaphomyces cervinus* (Pers.) Schröter.

herculaneum Pers., *Scleroderma* = *Pisolithus tinctorius* (Mich. ex Pers.) Coker & Couch.

chilense (Mont.) De Toni, *Scleroderma* = *Mycenastrum corium* (Guers. ex D. C.) Desv.

chrysosporum Opiz, *Scleroderma* = species mihi ignota.

irregulare D. C., *Lycoperdon* = species dubia, forsan *Sclerodermati* proxima.

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Kara-Kumianum Sorokin, var. *Sclerodermatis corii* (Guers.) Grav. = *Mycenastrum corium* (Guers. ex D. C.) Desv.
laevigatum (Fuck.) W. G. Smith, var. *Sclerodermatis aurantii* (Vaill.) Pers. = *Elaphomyces cervinus* (Pers.) Schröter.
leptodermeum (Dur. et Mont.) De Toni, *Scleroderma* = *Mycenastrum corium* (Guers. ex D. C.) Desv.
Lycoperdastrum Mich. = *Scleroderma* Pers.
macrorhizon Wallr., *Scleroderma* = *Scleroderma aurantium* (Vaill.) Pers. var. *macrorhizum* Fr.
macrorhizum Fr., var. *Sclerodermatis vulgare* Fr. = *Scleroderma aurantium* (Vaill.) Pers. var. *macrorhizum* Fr.
majus Vaill., *Lypoperdon* = *Scleroderma aurantium* (Vaill.) Pers.
Nepotatus Lloyd = *Scleroderma* Pers.
obscurum Mich., *Lycoperdastrum* = *Scleroderma verrucosum* (Vaill.) Pers.
olivaceum (Cooke et Mass.) De Toni, *Scleroderma* = *Mycenastrum corium* (Guers. ex D. C.) Desv.
pandanaceum F. v. Muell., *Scleroderma* = *Scleroderma verrucosum* (Vaill.) Pers.
pedunculatum Link, *Lycoperdon* = *Scleroderma verrucosum* (Vaill.) Pers.
phaeotrichum (Berk.) De Toni, *Scleroderma* = *Mycenastrum corium* (Guers. ex D. C.) Desv.
Phlyctospora Corda = *Scleroderma* Pers.
pistillare (L.) Pers., *Scleroderma* = *Podaxis pistillaris* (L. ex Pers.) Morse.
Pompholyx Corda = ? *Scleroderma* Pers.
pulpa subcoerulea Bocc., Fungus = *Scleroderma verrucosum* (Vaill.) Pers. subsp. *bovista* (Fr.) Šebek.
radicatum (Dur.) De Toni, *Scleroderma* = *Mycenastrum corium* (Guers. ex D. C.) Desv.
sapidum Corda, *Pompholyx* = ? *Scleroderma* sp.
scabrum Pers., var. *Sclerodermatis cervini* Pers. = *Elaphomyces variegatus* Vitt.
Sclerangium Lév. = *Scleroderma* Pers.
socotrana Henning, var. *Sclerodermatis geastri* Fr. = *Mycenastrum corium* (Guers. ex D. C.) Desv.
spadiceum Schaeff., *Lycoperdon* = *Scleroderma aurantium* (Vaill.) Pers. var. *spadiceum* (Schaeff.) Fr.
spadiceum Pers., *Scleroderma* = *Scleroderma aurantium* (Vaill.) Pers. var. *spadiceum* (Schaeff.) Fr.
spadiceum (Schaeff.) Fr., var. *Sclerodermatis aurantii* (Vaill.) Pers.
spinulosum (Peck.) De Toni, *Scleroderma* = *Mycenastrum corium* (Guers. ex D. C.) Desv.
solidum With., Tuber = ? *Scleroderma aurantium* (Vaill.) Pers. var. *spadiceum* (Schaeff.) Fr.
squamosum Chev., *Scleroderma* = *Scleroderma aurantium* (Vaill.) Pers.
Stella Massee = *Scleroderma* Pers.
Sterrebeckia Link. = *Scleroderma* Pers.
strobilinum Kalchbr. ex Thüm., *Scleroderma* = *Phellorina strobilina* Kalchbr.
tessulatum Schum., *Lycoperdon* = *Scleroderma aurantium* (Vaill.) Pers.
texense Berk., *Scleroderma* = *Scleroderma verrucosum* (Vaill.) Pers. subsp. *bovista* (Fr.) Šebek.

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tinctorium (Mich.) Pers., *Scleroderma* = *Pisolithus tinctorius* (Mich. ex Pers.) Coker & Couch.
Torrendii Bres., *Scleroderma* = *Astraeus hygrometricus* (Pers.) Morgan.
tuberosum Spreng., *Scleroderma*.
Torendii Bres., *Scleroderma* = *Scleroderma verrucosum* (Vaill.) Pers.
tuberosum Spreng., *Scleroderma* = *Astraeus hygrometricus* (Pers.) Morgan.
umbrinum Cooke & Mass., *Scleroderma* = *Pisolithus tinctorius* (Mich. ex Pers.) Coker & Couch.
verrucosum Vaill., *Lycoperdon* = *Scleroderma verrucosum* (Vaill.) Pers.
verrucosum (Vaill.) Bull., *Lycoperdon* = *Scleroderma verrucosum* (Vaill.) Pers.
verrucosum (Vaill.) Pers., *Scleroderma*.
violascens Herink in litt., var. *Sclerodermatis verrucosi* (Vaill.) Pers. subsp. *typici* Šebek.
vulgare Fr., *Scleroderma* = *Scleroderma aurantium* (Vaill.) Pers.

Souhrn.

Předložená práce o středoevropských druzích rodu *Scleroderma* je výsledkem autorova dvouletého speciálního studia tohoto druhově sice nepočetného, ale s hlediska systematického dosti složitého a tím i poněkud nejasného rodu, Autor prostudoval dokladové exempláře, uložené v mykologickém herbáři Nár. Musea v Praze a v herbáři kryptogamologického odd. botanického ústavu univ. Karlovy v Praze, dále pak materiál, který sám nashromáždil v letech 1946—49. Vzhledem ke všeobecnému a vesměs hojnému rozšíření středoevropských druhů r. *Scleroderma* neuvádí autor — z důvodů úspory a přehlednosti práce — ani jejich jednotlivá naleziště, která jsou připojena pouze k druhům a formám méně běžným a omezuje se toliko na údaje rázu všeobecného.

Práce je rozdělena na dvě části: v části všeobecné podává autor především historický přehled dosavadních poznatků o středoevropských druzích r. *Scleroderma*, z nichž některé byly známy již Vaillantovi (1727). — Vaillant je zařadil do kollektivního rodu *Lycoperdon*. Od tohoto rodu je zanedlouho po něm oddělil Micheli (1729), který označil rod *Scleroderma* (v dnešním smyslu) jménem *Lycoperdastrum*. Přes to však celá řada pozdějších autorů uvádí druhová jména, patřící dnes k rodu *Scleroderma*, ve vztahu k r. *Lycoperdon*. Klasická doba mykologie, s jejímž rozkvětem jsou spjata jména Persoon, Albertini-Schweinitz a Fries, přinesla více světla a částečně i pořádku do systematických otázek, spojených s rodem *Scleroderma*. Persoon první ve svém díle „Synopsis Methodica Fungorum" z r. 1801 popsal rod *Scleroderma* a většinu jeho středoevropských druhů v dnešním smyslu. Jméno *Scleroderma aurantium*, stanovené Persoonem, které je dnes platné podle pravidel priority, nahražuje Fries zcela neprávem pozdějším Hornemannovým jménem *Scleroderma vulgare*. Fries (1829) popisuje také jeho var. *macrorhizum* a přejímá Persoonův druh *Scleroderma spadiceum* jako varetu druhu *Scleroderma vulgare*. Značná tvarová i barevná proměnlivost některých druhů byla příčinou, že mnozí autoři popisovali takové variabilní exempláře jako nové druhy nebo alespoň odrůdy. Na variabilitu některých druhů rodu *Scleroderma* (zvláště druhu *Scleroderma verrucosum* (Vaill.) Pers.) poukazuje Saccardo (1888), který uvádí řadu tvarových a barevných variet z lokalit, roztroušených téměř po celém světě.

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V dalších kapitolách zmiňuje se autor stručně o morfologii plodnoce r. *Scleroderma*, zvláště o vzniku výtrusů a jejich struktury, která jmenovitě u některých druhů je velmi charakteristická a je i dobrým určovacím znakem. V kapitole o biologii a ekologii druhů rodu *Scleroderma* poukazuje na velmi zajímavou odrůdu druhu *Scleroderma verrucosum* (Vaill.) Pers., var. *violascens* Herink, rostoucí zřejmě saprofyticky na ztrouchnivělých pařezech a lišící se tak od běžného symbiotického způsobu života ostatních druhů r. *Scleroderma;* v dalším probírá pak charakter stanoviště, na nichž se jednotlivé druhy vyskytují. *Scleroderma aurantium* (Vaill.) Pers. roste v suchých jehličnatých lesích (zvláště v borových monokulturách), na jejich písčitých okrajích, na vyprahlých pahorcích, vřesovištích, písečných přesypech (s charakteristickou *Scleroderma aurantium* var. *macrorhizum* Fr.) a pod. Na humosních půdách listnatých lesů (zvláště v dubových lesich), na písčité půdě smíšených lesů, pod keři, v travnatých částech listnatých lesů, na vlhkých lesních cestách, v stromořadích a pod. roste hojně *Scleroderma verrucosum* (Vaill.) Pers.; spolu s tímto druhem vyskytuje se zhusta také jeho subsp. *bovista* (Fr.) Šebek, rostoucí především v zahradách, na stráních, v písčitých polích a jmenovitě v lipových stromořadích.

Všeobecnou část uzavírá přehled středoevropských druhů, variet a forem r. *Scleroderma*, rozdělující je do dvou sekcí: Sekce I. *Eu-Scleroderma* De Toni — je charakterisována v dospělosti nadzemními nebo alespoň částečně ze země vyčnívajícími, nepravidelně na temeni se trhajícími plodnicemi, na basi s více či méně vyvinutým svazkem myceliových vláken. Výtrusy kulovité, ježatě ostnité. — Sekce II. *Phlyctospora* Corda: plodnice podzemní, v dospělosti někdy ze země vyčnívající. Výtrusy kulovité, hyalinními buňkami obalené.

Část speciální přináší popisy 3 středoevropských druhů, 4 variet a forem r. *Scleroderma*; *Scleroderma bovista* Fr. považuje autor za význačnou subspecii druhu *Scleroderma verrucosum* (Vaill.) Pers., a popisuje 2 nové variety (var. *violascens* Herink, patřící k druhu *Scleroderma verrucosum* (Vaill.) Pers. subsp. *typicum* Šebek a var. *fascirhizum* Šebek, patřící ke *Scleroderma verrucosum* (Vaill.) Pers. subsp. *bovista* (Fr.) Šebek) a 1 novou subspecii (*Scleroderma verrucosum* (Vaill.) Pers. subsp. *typicum* Šebek), jíž označuje všechny typické malé exempláře druhu *Scleroderma verrucosum* (Vaill.) Pers. se sterilní třeňovitou basí, ve smyslu evropských, afrických a většiny amerických autorů.

Práci uzavírá seznam synonym r. *Scleroderma* Pers., vztahujících se na houby jiných rodů, dále seznam jmen a synonym středoevropských druhů r. *Scleroderma* Pers. a soupis použité literatury.

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Zeitschrift/Journal: Sydowia

Jahr/Year: 1953

Band/Volume: 7

Autor(en)/Author(s): Sebek Svatopluk

Artikel/Article: Monograph of the Central European Species of the Genus Scleroderma Pers. 158-190