ANNALES HISTORICO-NATURALES MUSEI NATIONALIS HUNGARICI
Tomus 66. Budapest 1974.

Trochiscia (Chlorophyta) Red Snow from Swedish Lapland

By E. Kol, Budapest

Abstract – *Trochiscia* red snow is a rare kryoseston discoloration. Until now the mass occurrence of *Trochiscia americana* Kol in North America and that of *Trochiscia rubra* Kol in Norway were found to cause red snow. In the snow-field of Swedish Lapland *Trochiscia americana* var. *lapponica* var. n. caused red snow. – 24 figures.

Red snow is the most frequent kryoseston discoloration. It is a well known natural phenomenon in the higher mountains of both the northern and the southern hemisphere and even in the Antarctic. Instances, however, when two red snows are caused by one and the same algal species, or identical assemblies of microorganisms are seldom found. From scientific view, therefore, it is of great impotance to collect samples from each red snow, because generally in each occasion a new algal species or a new assembly of algae is found in them. In this paper too, an entirelly new *Trochiscia* red snow found in the Swedisn Lappland will be reported on.

Red snow is a frequent natural phenomenon in the Scandinavian mountains. The snow vegetation of Norway has been dealt with by a number of authors: Bohlin (1893, 1895), Boldt (1888), Borge (1899), Lagerheim (1883, 1894), Nordstedt (1978), Skuja (1964, Ström (1923, 1926), Wille (1879, 1903), Wittrock (1883), Kol (1963). Red snow caused by immense masses of *Chlamydomonas nivalis* (Bau.) Wille (Kol 1968) has become known from numerous points in Norway.

Kol (1963: 156) reports on three cases of red kryoseston discoloration from the vicinity of Finse, Norway which were caused by the mass occurrence of various microorganisms. The red snow of Hardangerjökelen was caused almost without exception by *Chlamydomonas nivalis* (Bau.), Wille, tough *Scotiella nivalis* (Shuttlew.) Fritsch and in a negligible quantity other microorganisms also occurred there. In the rose-coloured snow of the other snow-field *Trochiscia rubra* Kol (= *Trochiscia cryophila* var. *rubra* Kol) dominated, and besides this species *Chlamydomonas nivalis* (Bau.) Wille and also other microorganisms played an important role. In the red snow of the third snow-field approximately 85 percent of the microorganisms was represented by *Chlamydomonas sanguinea* Lagerh.

Collection – Norddalsfjeld Mt. over Ketterjaure Lake, Swedish Lappland, north latitude 68,5 N, circa 750 m, brick-red snow, circa on 3 m² surface. 10. August 1973 leg. Á. Berczik. Also here I wish to express my best thanks to Dr. Á. Berczik for the most valuable snow sample collected for me.

Microorganisms in *Trochiscia americana* var. *lapponica* var. n. red snow

The bulk of the brick-red snow collected in Norddalsfjeld mountains of Swedish Lappland consisted of *Trochiscia americana* var. *lapponica* var. n. (Figs. 2—9). Table shows that in the red snow eight algae and two kryofungus species were living. From among the algal species five were kryobionts and two kryoxens: *Gloeocapsa ralfsii* (Bohl.) Lemm. and *Stigonema* sp.

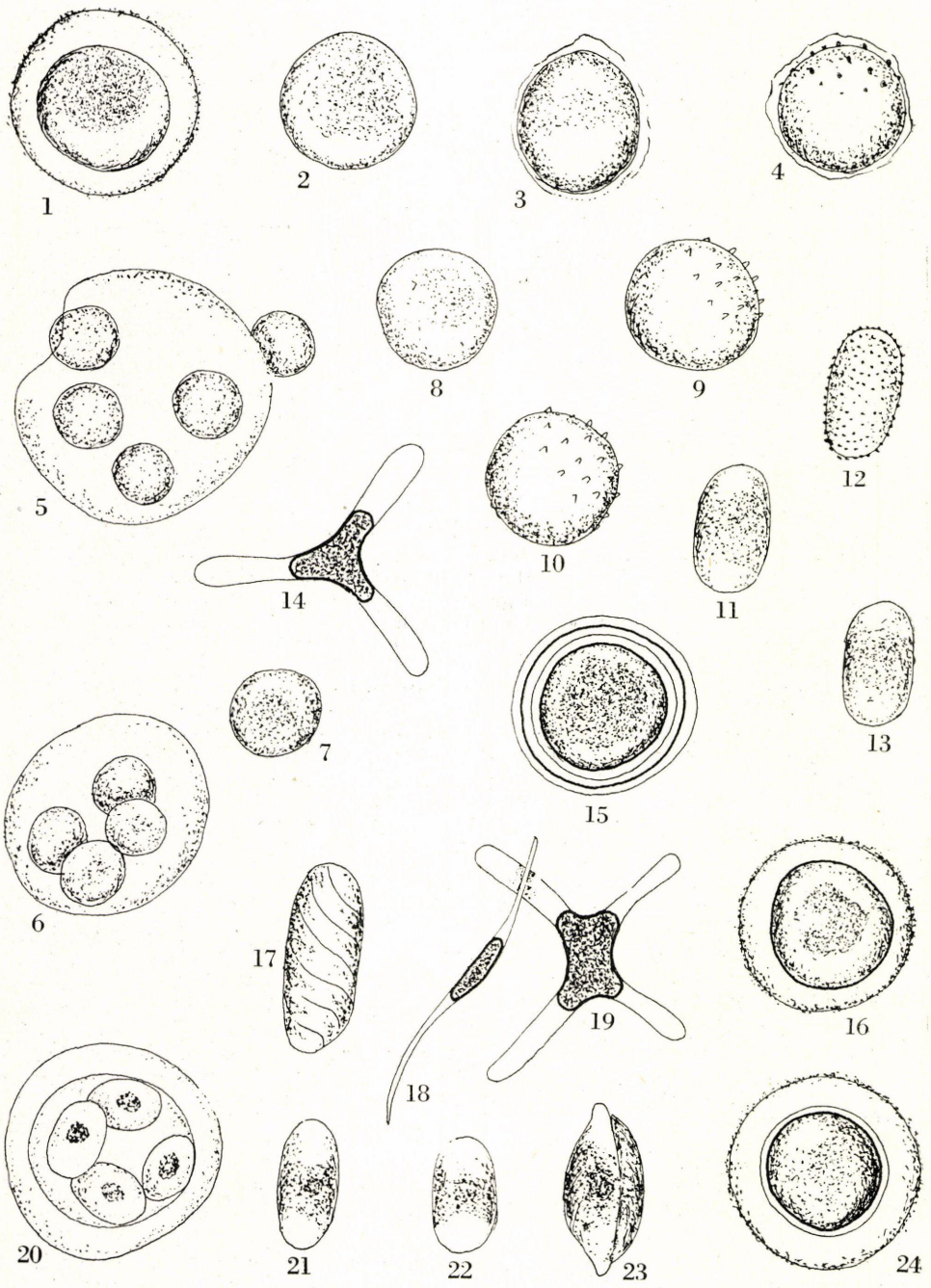

Fig. 1. *Chlamydomonas sanguinea* LAGERH. with gelatinous sheath (x 500). Figs. 2 – 10. *Trochiscia americana* var. *lapponica* var. n. (x 1000): 2 = older cell with smooth cell-wall, 3 = cell with irregularly thickened wall, 4 = cell with warted cell-wall, 5 = cell-division, the wall of the mother cell is gelatinized, 6 = cell-division, 7 = very young daughter cell,

90 percent of the red snow vegetation was represented by *Trochiscia americana* var. *lapponica* var. n., and 10 per cent of it by *Chlamydomonas sanguinea* LAGERH. (Figs. 1, 15, 16, 24), *Cryocystis granulosa* KOL (Figs. 11—13), *Scotiella norvegica* KOL Fig. 17), *Scotiella nivalis* (SHUTTLEW.) FRITSCH. (Figs. 21—23), *Gloeocapsa ralfsii* (BOHL.) LEMM. (Fig. 20), *Stigonema* sp., *Chionaster bicornis* KOL (Fig. 18), *Chionaster nivalis* (BOHL.) WILLE (Fig. 19). Besides microorganisms there were also fragments of plant origin and fungus spores present in the snow sample. It is an interesting feature of kryoseston discoloration that black snow is mingled to the brick-red snow.

Comparative data of the microorganisms found in the red snow

Microorganism	Norddalsfjeld Mt. Swedish Lappland	Environs of Finse Norway
Algae		
Chlorophytae		
Chlamydomonas nivalis (BAU.) WILLE	+	+
Chlamydomonas sanguinea LAGERH.	+	+
Cryocystis (Chodatella) granulosa KOL	+	
Mesotaenium berggrenii (WITTR.) LAGERH.		+
Scotiella nivalis (SHUTTLEW.) FRITSCH	+	+
Scotiella norvegica KOL		+
Raphidonema nivale LAGERH.	+	+
Trochiscia americana var. lapponica var. n.	+	
Trochiscia rubra KOL (*Trochiscia cryophila* var. *rubra* KOL)		+
Cyanophyta		
Gloeocapsa ralfsii (HARV.) LEMM.	+	
Stigonema sp.	+	
Fungi		
Chionaster bicornis KOL	+	+
Chionaster nivalis (BOHL.) WILLE	+	+
Chytridium chlamydococcii A. BR.		+

Table shows that in the brick-red snow of Swedish Lappland many such microorganisms occurred that were also found in the red snow in the environs of Finse (KOL 1963). *Trochiscia* species seldom occur in such quantities that would cause discoloration of snow. In the literature, there is mention made, to my knowledge, only of two cases of *Trochiscia* kryoseston discoloration. In more than one snow-field of the Rocky Mountains, North America, the *Trochiscia americana* (KOL 1968), and in the snow-fields at Finse, Norway the *Trochiscia rubra* KOL (KOL 1963, 1968) caused red snow.

8 = greater daughter cell with thin cell-wall, 9 = cell with cell-wall decorated with small spines and warts, 10 = cell with spined cell-wall. Figs. 11 – 13. *Cryocystis granulosa* KOL (x 1000) in different stages of development. – Fig. 14. *Chionaster nivalis* (BOHLIN) WILLE – Figs. 15 – 16, 24. *Chlamydomonas sanguinea* LAGERH. (x 500); various resting stages: 14 = with layered cell-wall, 15 = with thick cell-wall, 24 = with gelatinous sheath. – Fig. 17. *Scotiella norvegica* KOL (x 1000). – Fig. 18. *Chionaster bicornis* KOL (x 1000). – Fig. 19. *Chionaster nivalis* (BOHL.) WILLE (x 1000). – Fig. 20. *Gloeocapsa ralfsii* (BOHL.) LEMM. (x 1000). – Figs. 21 – 23. *Scotiella novalis* (SHUTTLEW.) FRITSCH. (x 1000) in different stages of development.

The *Trochiscia* red snow reported here is the third one the alga of which is known. It follows from the aboves that the three red snows were caused by different *Trochiscia* species each. It is characteristic, that nearly every algal species found in the snow samples was in an early stage of development, and only a few completely developed forms and small numbers of species in the resting stage occurred.

Chlamydomonas sanguinea LAGERH. (Figs. 1, 15, 16, 24)

Spherical, bright-red cells, 32—40 μ in diameter, with thin (Fig. 1) or thick layered cell-wall (Figs. 15—16) occasionally with gelatinous sheath (Fig. 24). Only a few nonmotile forms were found.

The species was described first by LAGERHEIM from the red snow of Pichincha volcano, South America. Since then it has been found in more than one places in Europe. It was found to cauese red snow in the Alps (KOL 1968), in the High Tatra (KOL 1969), and near Finse, Norway (KOL 1963). It is one of the rare kryobiontic algal species that cause kryoseston discoloration in both the southern and the northern hemisphere.

Cryocystis granulosa KOL Figs. 11—13)
(= *Chodatella granulosa* KOL)

Oval or ovoid cells, 10—15 μ wide and 15—27 μ long, with cell-wall ornamented with warts, were found in various stages of development in the snow sample. The species is abundant in the North American Rocky Mountains and in the snowfled of Grönland.

Scotiella nivalis (SHUTTLEW) FRITSCH (Figs. 21—23)

One of the most frequent kryobionts is bipolar. It is very frequent in the snowfields of both the northern and the southern hemisphere.

The specimens of each species found in the snow sample originating from Swedish Lappland were in various stages of development. The spherical young and oval cells had various sizes and were numerous. There were only a few individuals with cell-wall ornamented with ribs.

Scotiella norvegica KOL (Fig. 17)

Spindle shaped cells, 15 μ wide by 40 μ long, with spirally decurrent ribs. In the sample only a few specimen were found. This algal species was first described by KOL (1968) from the red snow near Finse.

Trochiscia americana var. **lapplandica** var. n. (Figs. 2—10)

Proximum adest ad *Trochiscia americana* KOL sed differt ab eo: 1. coloris cellularum, 2. ornamentation cellularum, 3. dimensione cellularum.

Habit. in nivibus rubris Swedish Lapland.

D e s c r i p t i o n — Spherical cells, 10—20 μ in diameter. The cell-walls of the young cells are thin and smooth (Figs. 2, 7, 8), those of the older ones become thickened (Fig. 2), first undulated (Fig. 3) later decorated with small, sparsely loca-

ted warts finally with spines. The thick, older cell-wall is brownish (Figs. 4, 9, 10). The cells contain much rose-coloured oil, hardly any starch. Pyrenoid was not visible in the cells.

Reproduction takes place by autospore formation. The daughter individuals with thin, smooth cell-wall escape by means of the gelatinization of the cell-wall of the mother cell (Figs. 5,6). This microorganism bears resemblance most to the *Trochiscia americana* KOL species. It differs from it, however, on the basis of the following features: 1. the cell is light brick-red. 2. the wall of the cell is ornamented with warts. 3. it is smaller.

KOL (1968) found the *Trochiscia americana* KOL species to occur in several places of the North American Rocky Mountains, from where she had described it first.

References

BOHLIN, K. (1893): Snöalger fram Pite Lappmark. – *Bot. Notiser*, p. 42 – 46.

BOHLIN, K. (1895): Über Schneealgen aus Pite Lappmark. – *Bot. Cbl.*, **64:** 42 – 45.

BOLDT, R. (1888): Om förekomsten af röd snö i finska Lappmarken. – *Bot. Notiser.*, p. 233 – 234.

BORGE, O. (1911): Die Süsswasseralgenflora Spitzbergens. – *Videnskaps. Skr. I. Nath., Naturw. Kl.*, **110** 5 – 39.

KOL, E. (1957): Über die Verbreitung der schnee- und eisbewohnenden Mikroorganismen in Europe I. – *Arch. f. Hydrobiol.*, **52:** 574 – 582.

KOL, E. (1963): On the red snow of Finse (Norway). – *Ann. Hist.-nat. Mus. Nat. Hung.*, **55:** 155 – 160.

KOL, E. (1968): Kryobiologie und Limnologie des Schnees und Eises, I. Kryovegetation. – *Die Binnengewässer*, **24:** 1 – 216.

KOL, E. (1969): Chlamydomonas sanguinea Lagerh. in the High Tatra. – *Ann. Hist.-nat Mus. Nat. Hung.*, **61:** 141 – 145.

LAGERHEIM, G. (1883): Bidrag till kännedom on snöfloran i Lules Lappmark. – *Bot. Notiser*, p. 230 – 235.

SKUJA, H. (1964): Grundzüge der Algenflora und Algenvegetation der Fjeldgegend um Abisko in Schwedisch Lappland. – *Nova Acta Regiae Soc. Sc. Upsaliensis*, Ser. IV., **18:** 1 – 465.

SRTÖM, M. K. (1923): Snow Algae from the Sarek Mountains. – *Naturw. Unters. d. Sarekgeb.*, **35:** 522 – 524.

SRTÖH, M. K. (1926): Norwegian Mountains Algae. – *Skr. Norske Vid. Akad.* p. 1 – 263.

WILLE, N. (1903): Algologische Notizen IX – XIV. – *Nyt magazin for Naturvidenskab.*, **41:** 88 – 189.

WITTROCK, V. B. (1883): On snöns och isens flora särskildt i de arktiska trakterna. – A. E. NORDENSKIÖLD: *Studier och forsk. föranledda af mina resor i Höga Norden.*, p. 65 – 124.

Author's address: Dr. E. KOL

Botanical Department of the
Hungarian Natural History Museum
H – 1146 Budapest, Vajdahunyadvár
Hungary