ЗИМНЯЯ ЭКОЛОГИЯ

Павел Валерьевич
Квартальнов

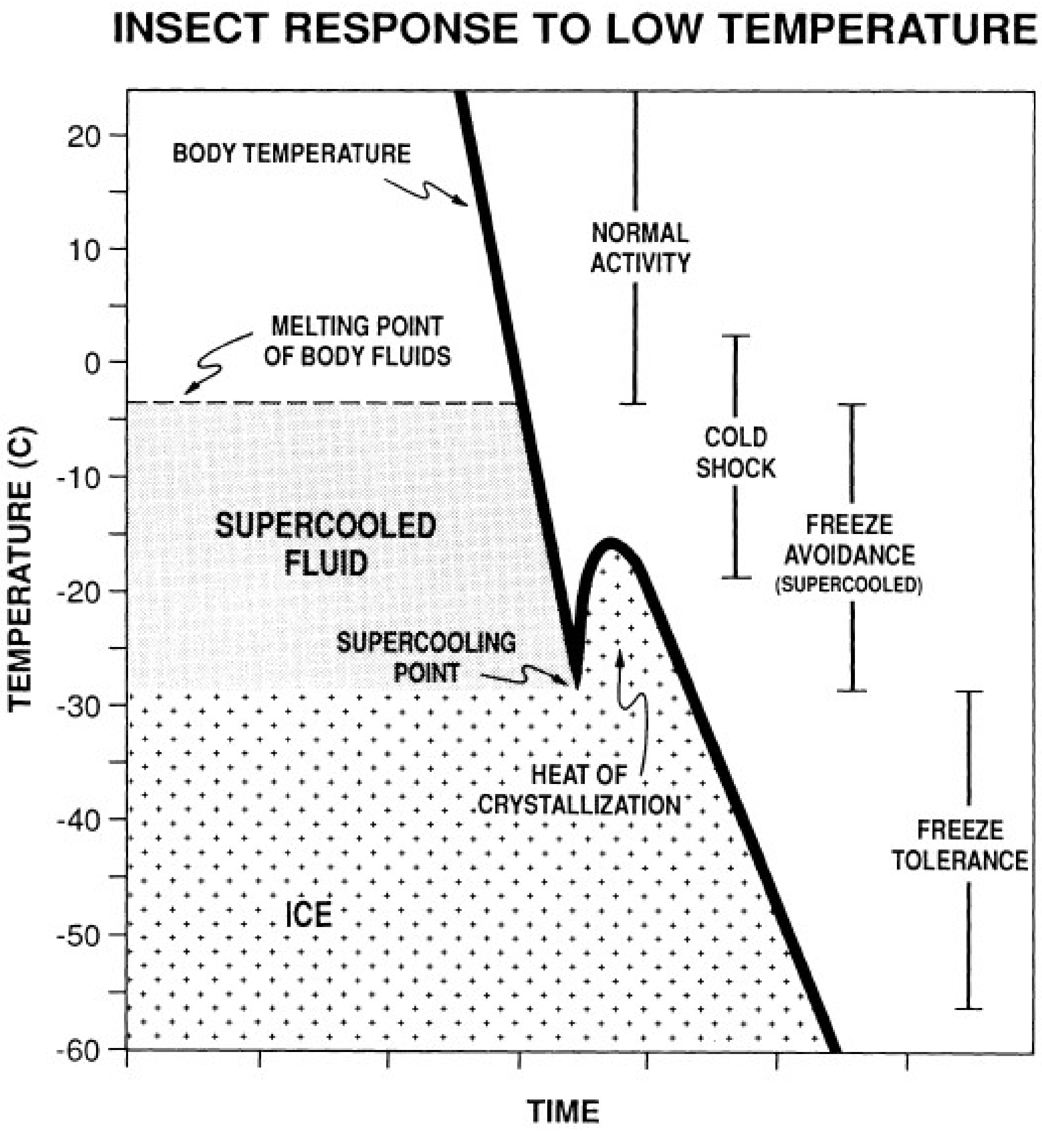


Figure 1. Responses of insects cooled to subzero temperatures. Insect body temperatures (heavy line) in relation to the melting point, the supercooling point, and the nucleation of ice in body fluids. Although the bars on the right convey general ranges of insect response to low temperatures, the top of the bar for the range of freeze tolerance and the bottom of the bar for freeze avoidance correspond to the supercooling point value illustrated in the center of the figure. However, a number of freeze-tolerant insects have supercooling points in the range of −8° to −10° C, whereas some freeze-susceptible species supercool extensively, to −60° C or below.

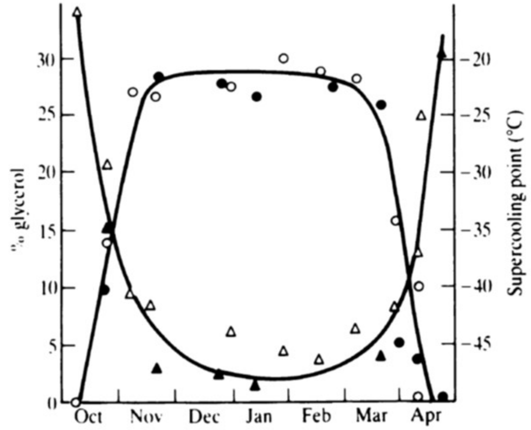


Fig. 4. Seasonal changes in glycerol content (% of fresh weight) and mean supercooling points of larvae of the moth Retinia (Petrova) resinella *in Estonia; filled symbols (●▲) are second instar larvae, open symbols (○△) are final instar larvae. (After Hansen, 1973[53].)*

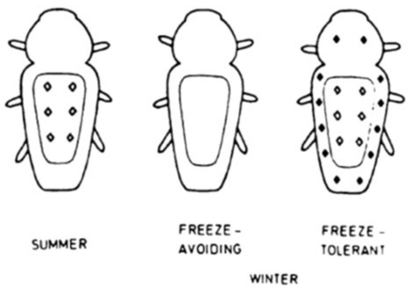


Fig. 6. Distribution of ice nucleating agents [INAs] in the body fluids of insects during summer and winter. Open symbols (◇) depict INAs within intracellular or gut compartments and filled symbols (◆) indicate haemolymph INAs. Freeze sensitive = freeze avoiding species. (After Zachariassen, 1980[55].)

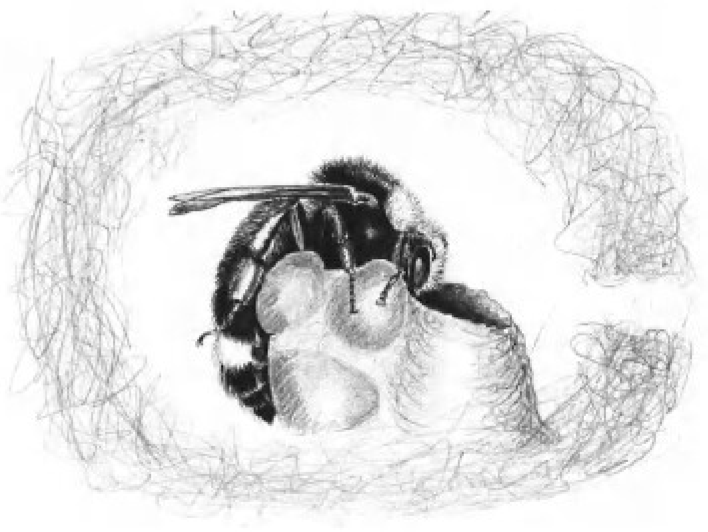
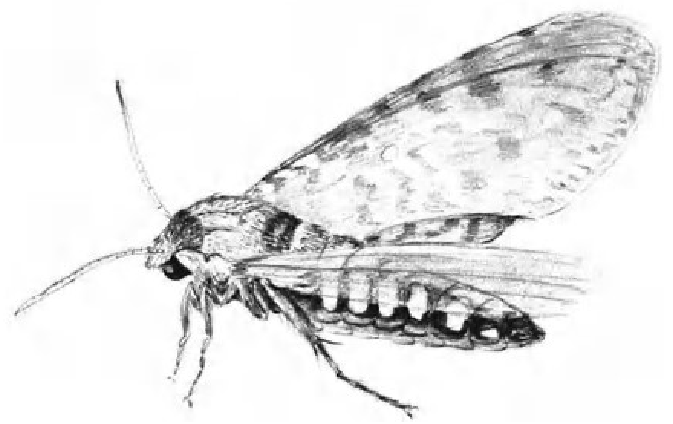


Fig. 6.16 The founding queen of *Bombus vosnesenskii* incubating her initial brood clump with pupae and new egg clumps. She is facing her honeypot, which she refills during intermittent foraging trips. Her elongated abdomen is pressed tightly upon the brood. (From photograph by B. Heinrich.)



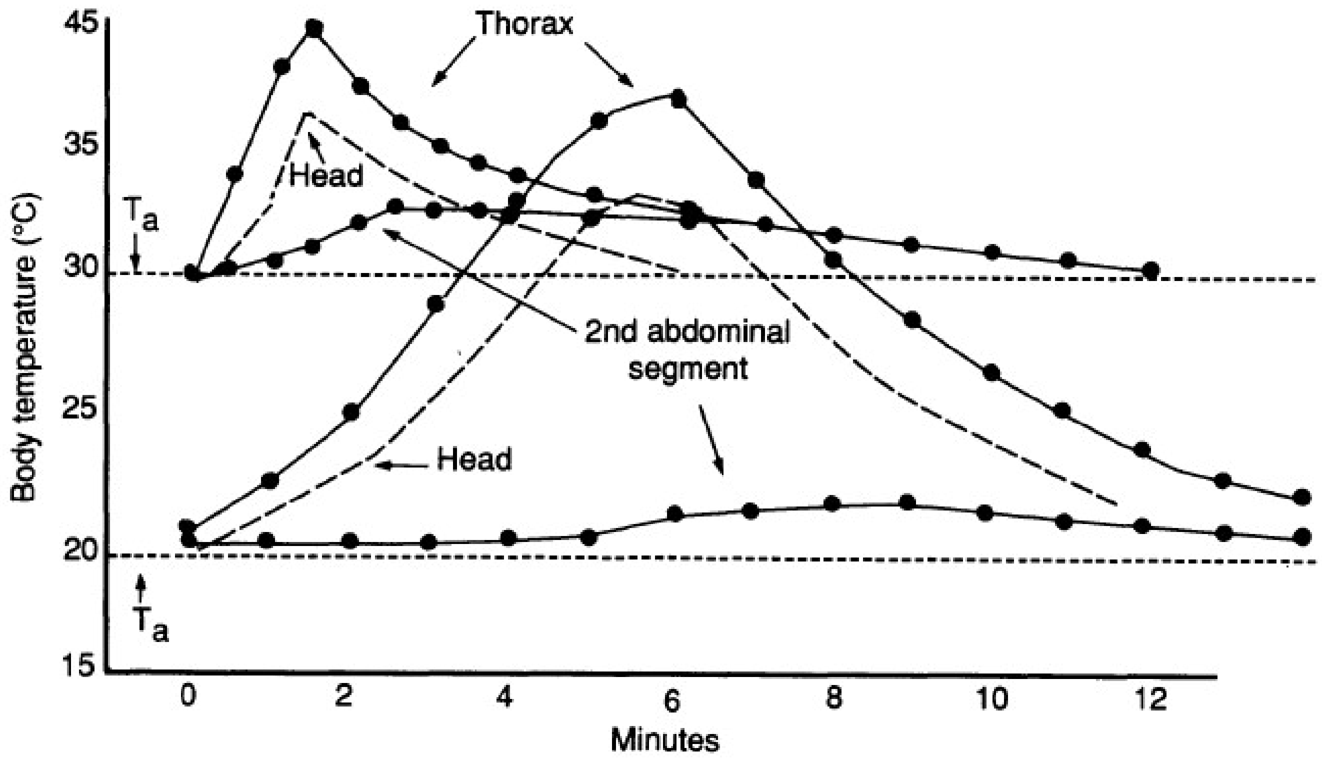


Fig. 1.7 Temperatures at different parts of the body during warm-up and subsequent cool-down in *Manduca sexta* at 30 °C *(top)* and 19.5 °C *(bottom)*. (T_{thx} and T_{abd} from Heinrich and Bartholomew, 1971; T_{hd} interpolated from data in Hegel and Casey, 1982.)

«Зимние мотыльки»

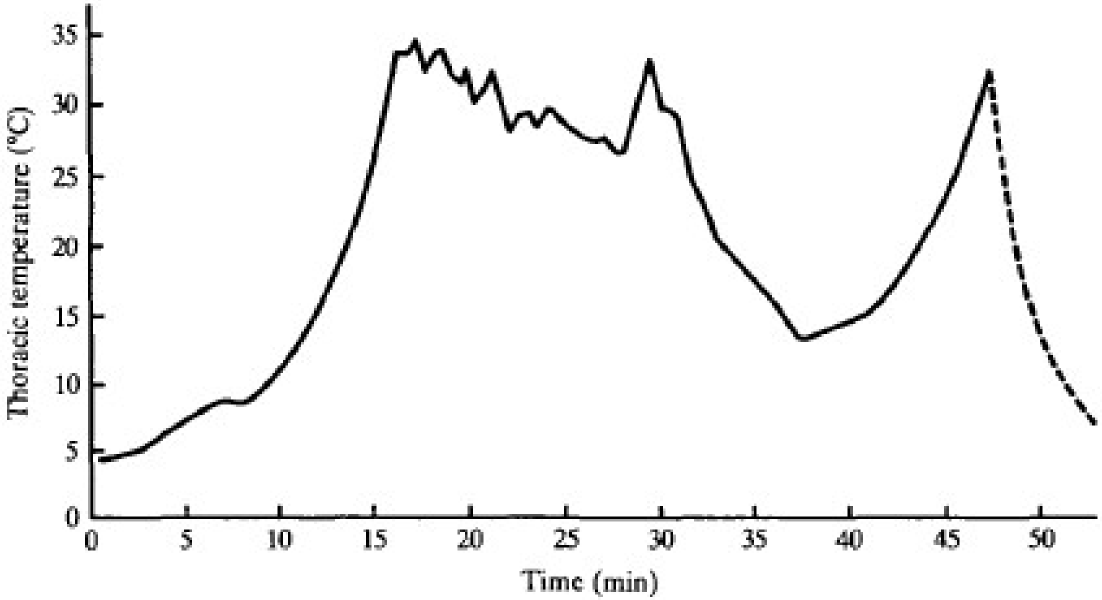
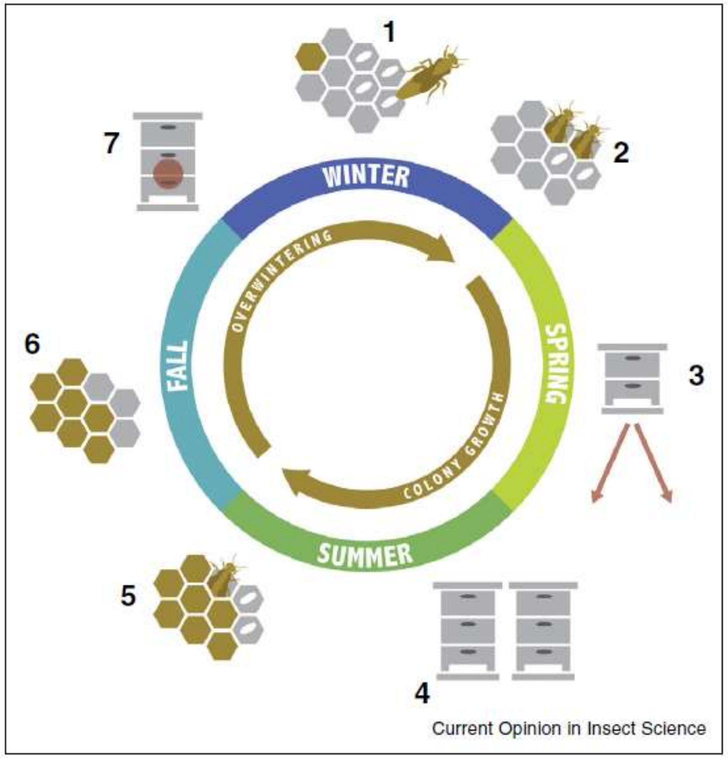


Fig. 7. Thoracic temperature of a tethered *Eupsilia morrisoni* (192 mg) at an ambient temperature (T_a) of 0°C. Dashed line indicates passive cool-down.



Honey bee colony life cycle. Hexagonal patterns represent cells in combs. Gray cells are empty, brown cells represent food stored (honey and/or pollen), and white eliptic figures in the cells represent eggs. Brood rearing starts in winter **(1)** and peaks in spring **(2)**. The rapid increase in worker population in spring results in swarming **(3)**. After swarming, both colonies rebuild their worker populations and forage to increase their food stores through summer **(4)**. Brood rearing decreases by the end of summer **(5)** and ceases in fall **(6)**, with the production of the winter bee cohort. In the winter, worker bees form a thermoregulating cluster (red circle inside the hive) with the decrease in ambient temperature **(7)**.
*Graphical design by Harland Patch and Nick Sloff, Penn State. HPG — After Snodgrass, 1925. Vitellogenin — Heli Hvukainen, used with permission.

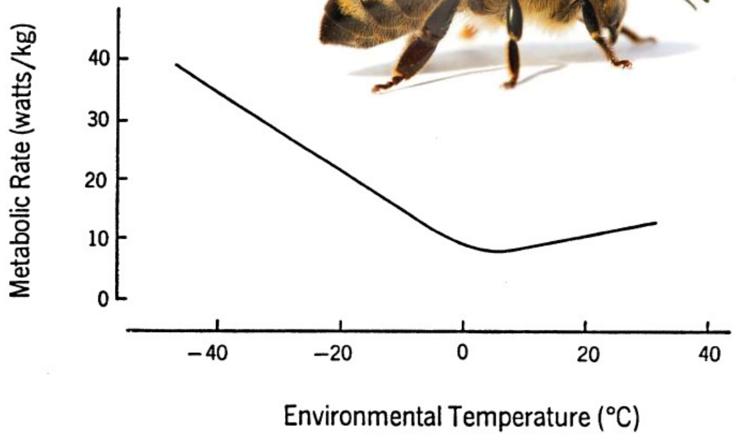
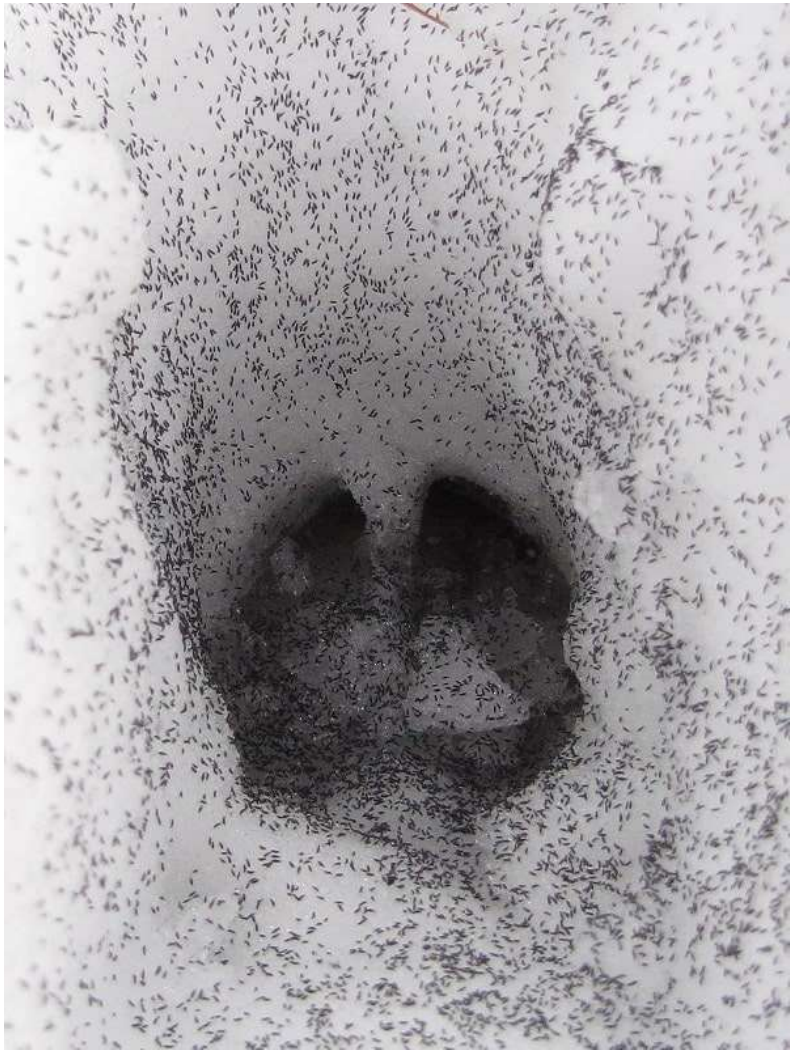


Figure 1. Relation of metabolic rate (oxygen consumption) to environmental temperature in honey bee colonies. The curve shown is a composite of two best-fit lines, for data points (not shown) below and above 0° C.

Fig. 14. A small, winter-open brook in mixed forest near Oslo. Several winter active Chironomidae hatched here. Photo: S. Hågvar.

Fig. 9. A calm, overcast and partly foggy winter day in mid-South Norway. Such stable weather conditions are favoured by *Chionea araneoides* for migration on snow. Photo: S. Hågvar.

Fig. 1A–B: Air spaces that are created along protruding vegetation allow arthropods to migrate between the subnivean and supranivean environments. A – channels through the snow along lower spruce branches and B – along a birch stem. Photo: S. Hågvar.



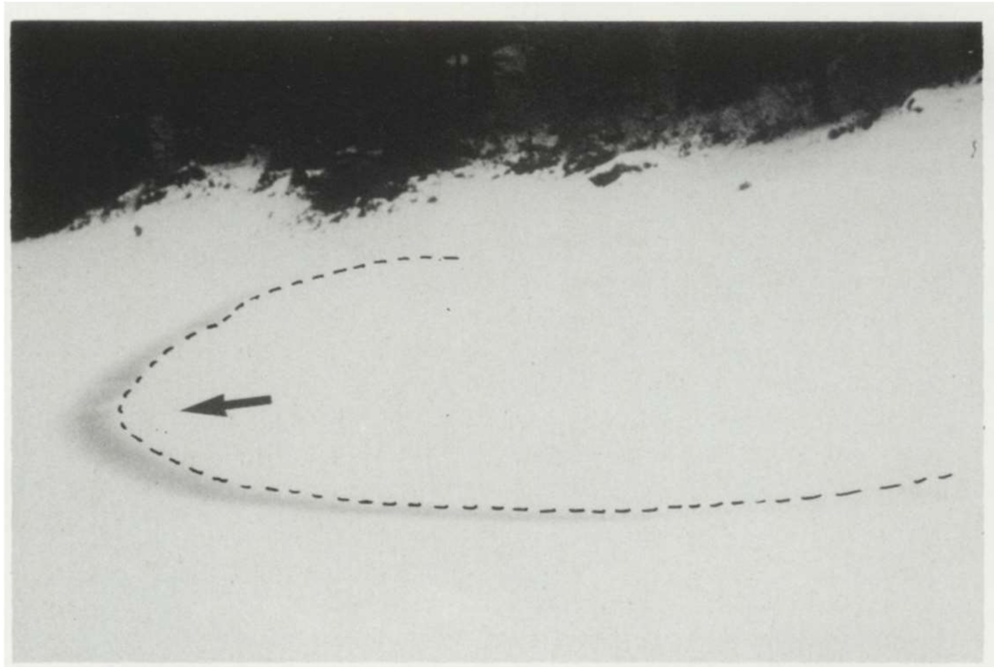


Fig. 12. Several species of winter gnats (Trichoceridae) can be encountered on snow in Fennoscandia. This is the large species *Trichocera regelationis*. Photo: S. Hågvar.

Fig. 13. Several species of Heleomyzidae regularly occur on snow. Most common of them is *Scoliocentra nigrinervis*. Photo: S. Hågvar.

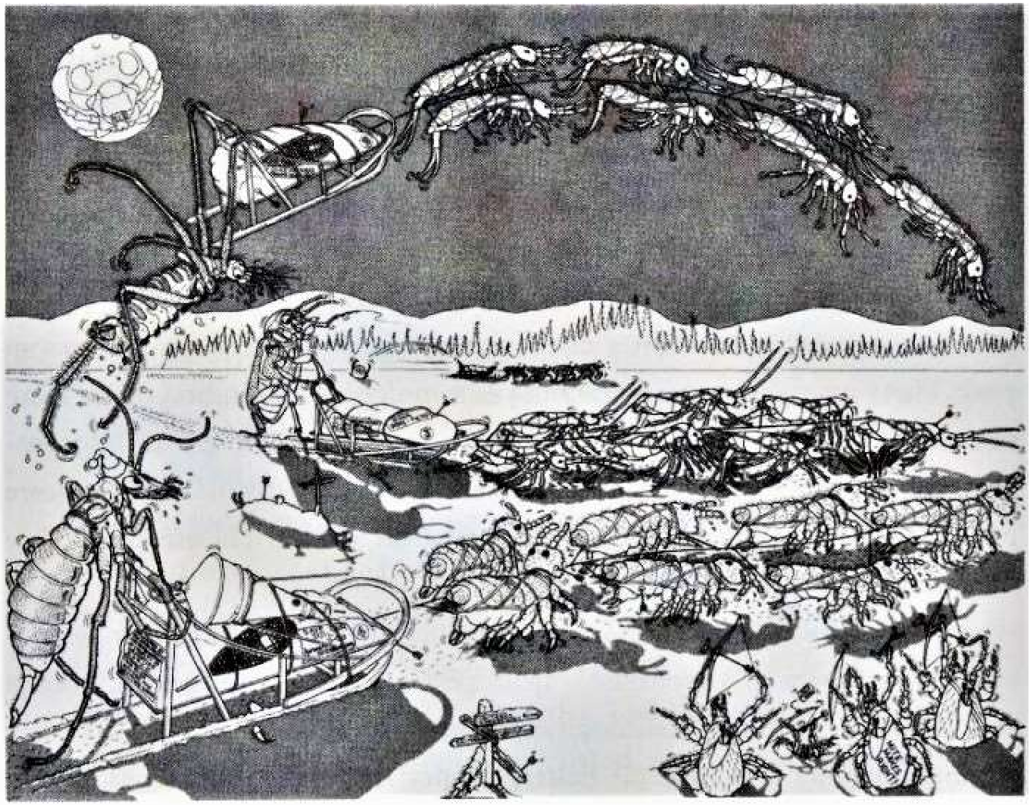


Fig. 2. A female of *Chionea araneoides* walking on snow.

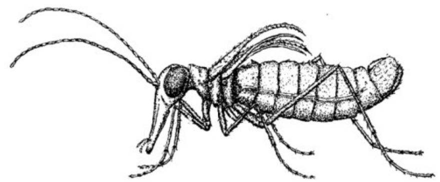
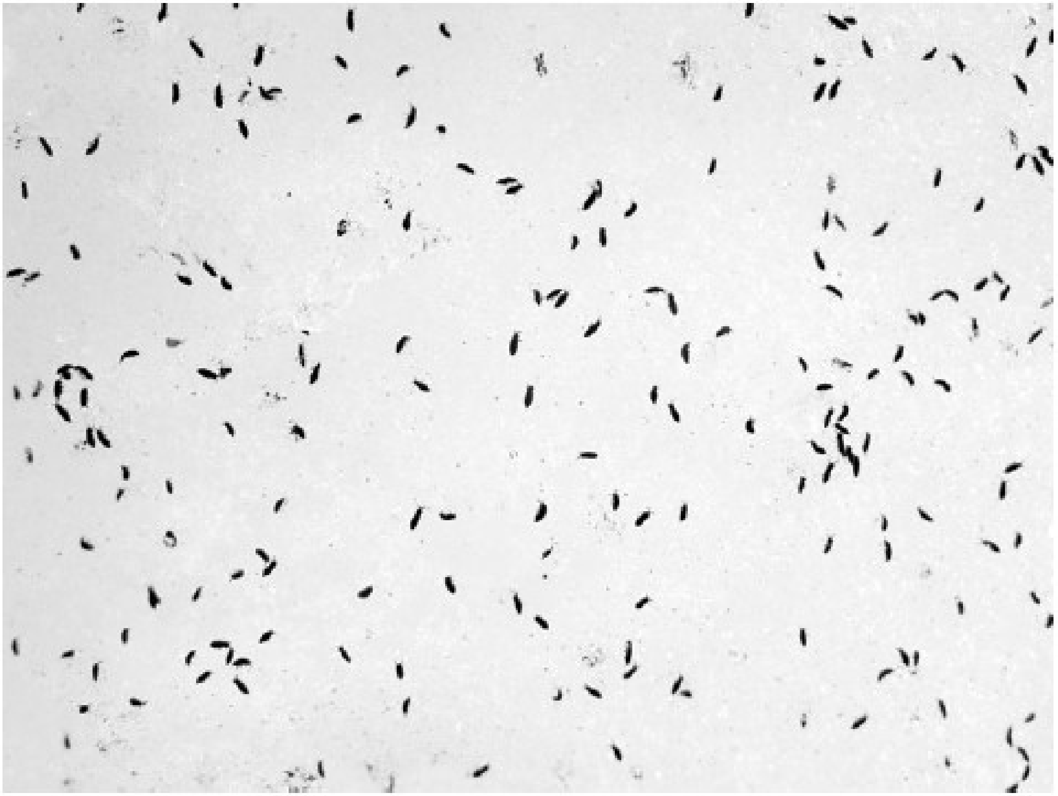


FIG. 1. *Boreus hyemalis*, ♂.



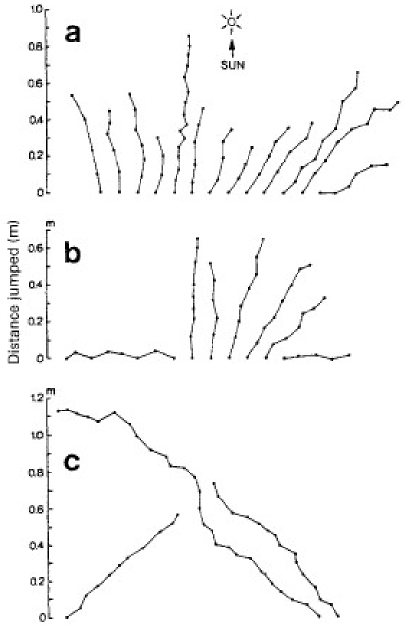


Fig. 9.1. Directional movements on Norwegian snow of individual *Hypogastrura socialis* (Hypogastruridae). Examples from three different populations (a,b,c). Dots indicate starting points for each jump. The animals moved towards the sun. Reproduced from Hågvar (1995) by kind permission of the author and the Finnish Zoological and Botanical Publishing Board.

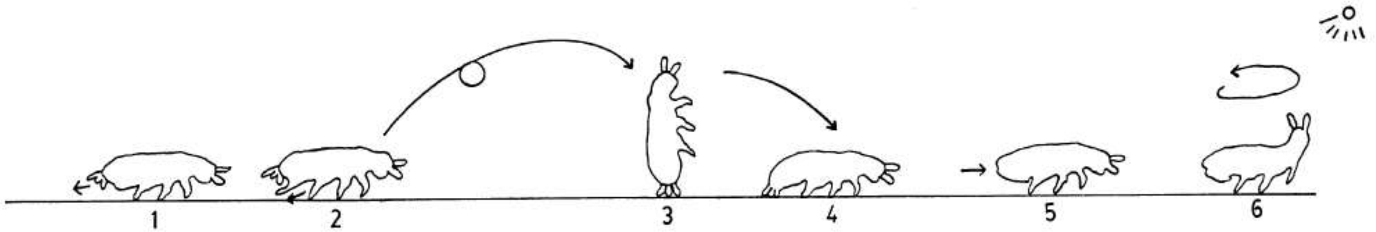
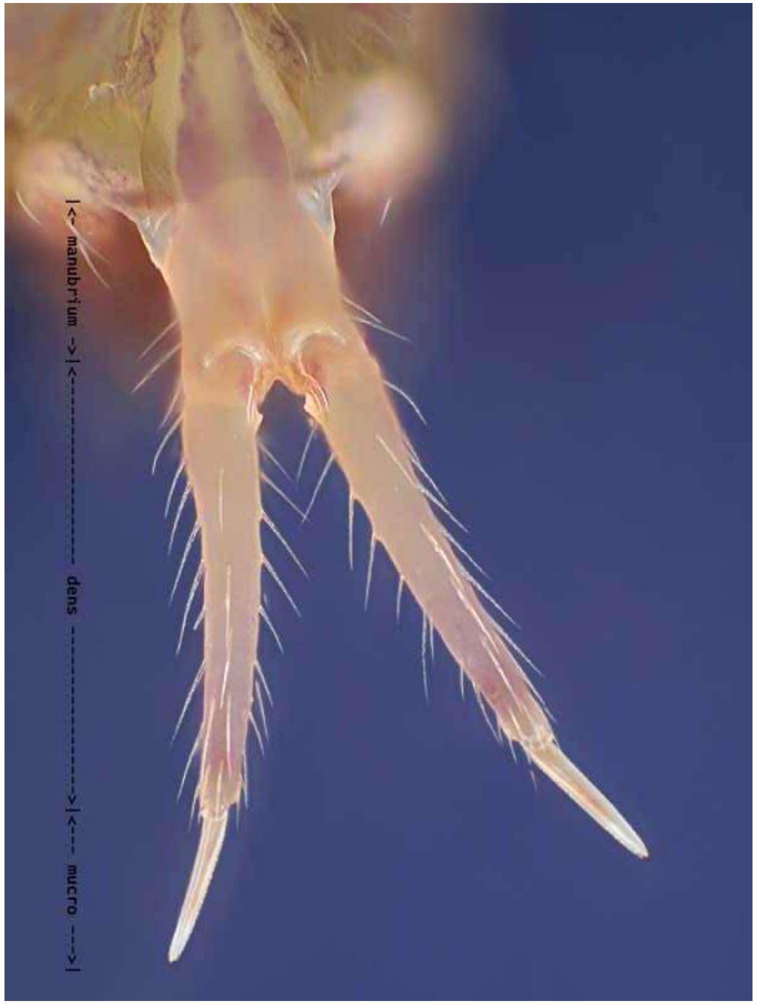


Fig. 4. Six phases during one jump in the springtail *Hypogastrura socialis*. 1. The animal contracts its body and extends the anal sacks. 2. The furca is released and the animal jumps. 3. Anal sacks "glue" the animal to the snow at landing and stop rotation. 4. The animal bends forward and grips the snow. 5. The anal sacks are withdrawn. 6. The animal rotates horizontally on the spot and positions itself for another jump at a certain angle relative to the sun. From Hågvar (2000).

ЦИКЛОМОРФОЗ



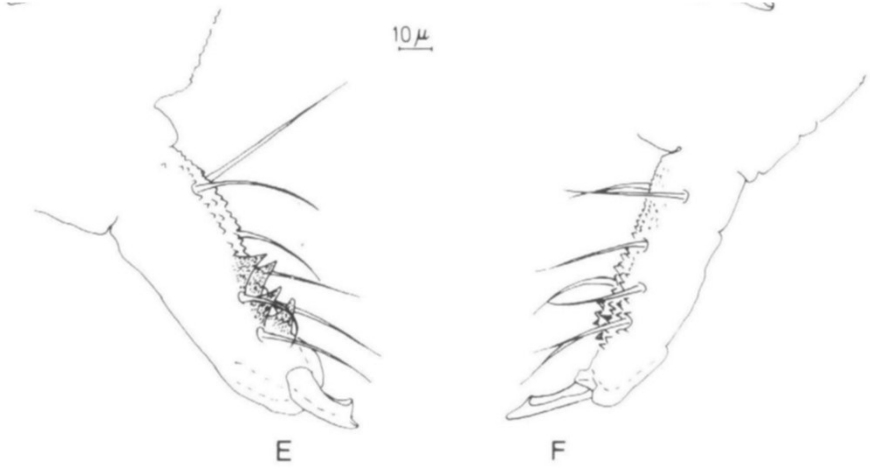


Fig. 2. Furca of *Hypogastrura socialis* during ecdysis, showing change from winter to summer form.

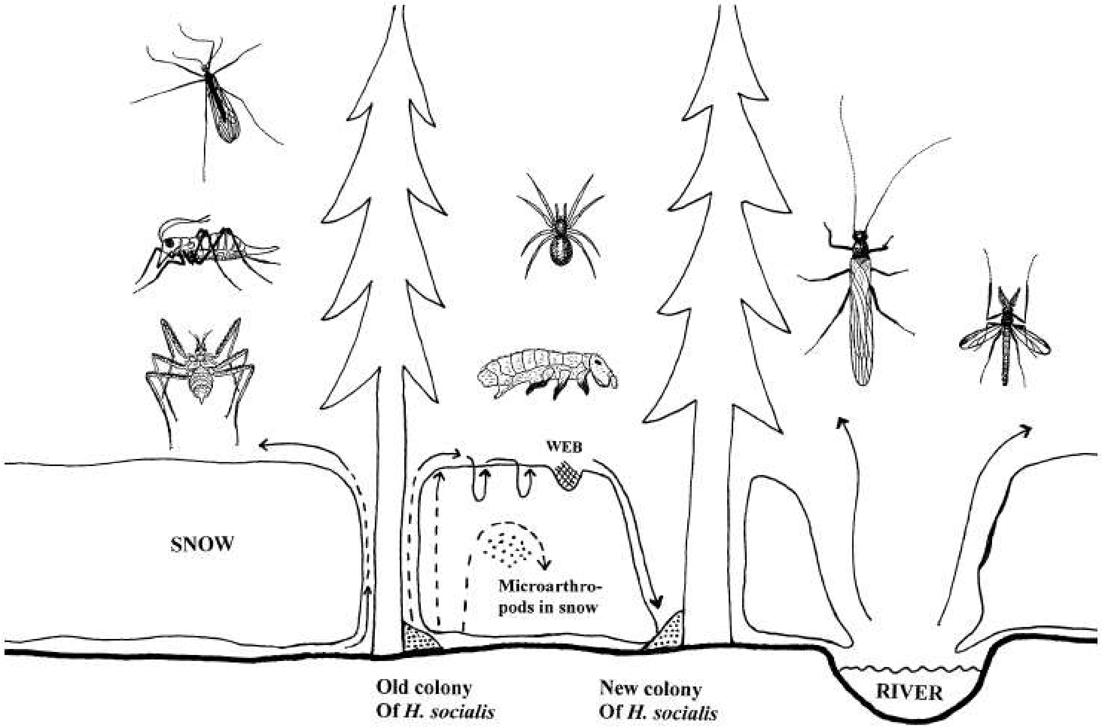


Fig. 20. Schematic illustration of how some arthropods use snow as a substrate. To the left and from the top: *Trichocera* (Diptera), *Boreus* (Mecoptera), and *Chionea* (Diptera) climb to the snow surface during mild weather and retract to the subnivean environment in cold weather. In the middle: Several microarthropods stay within the snow pack, but the springtail *Hypogastrura socialis* enters the snow surface and performs mass migrations in mild, sunny weather. At low temperatures, they retract vertically into the snow layers, waiting for another mild day. New colonies are formed near the end of the winter. The spider *Bolephthyphantes index* catches springtails in webs on the snow. To the right: Certain species of Plecoptera and Chironomidae hatch from open rivers and brooks in winter and are active on snow.

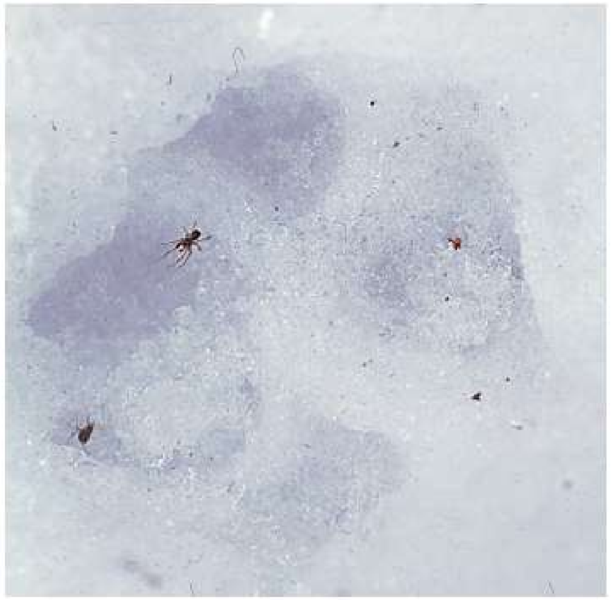
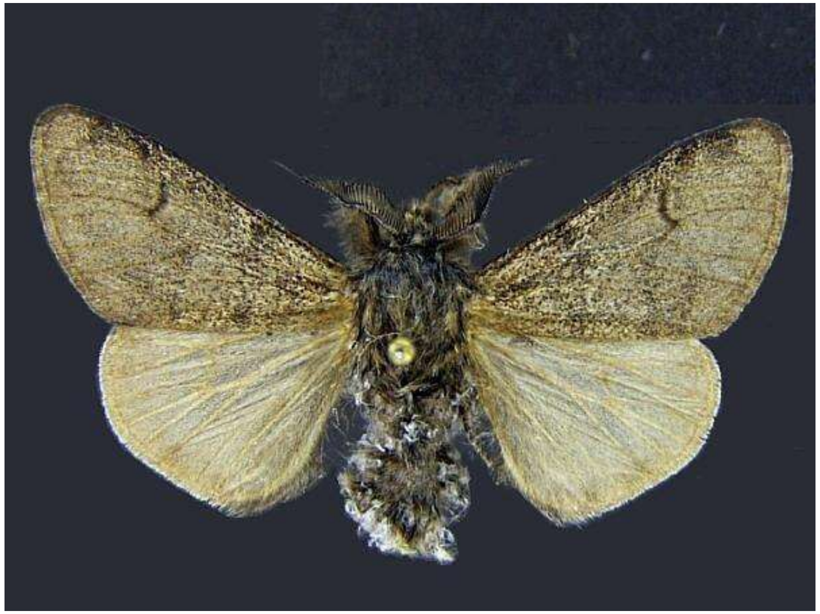
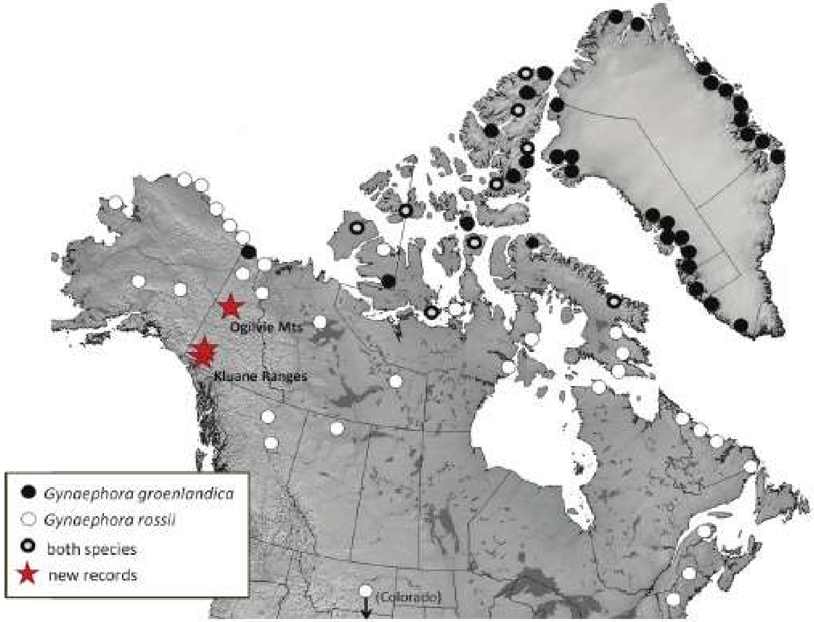


Fig. 19. A pair of *Bolephthyphantes index* sitting in a web constructed over a footprint of a fox. Migrating springtails are caught in the web. Photo: G. Hågvar.

ДИАПАУЗА

Gynaephora groenlandica





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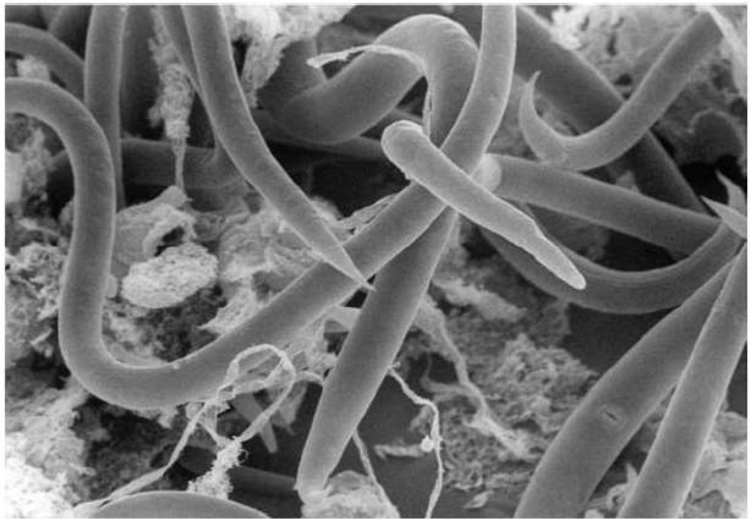


Fig. 1. Scanning electron micrograph of an Antarctic nematode (Panagrolaimus davidi)*, which survives intracellular freezing.*[5] *The worms are about 1 mm in length and the width of the largest is 39 μm.*

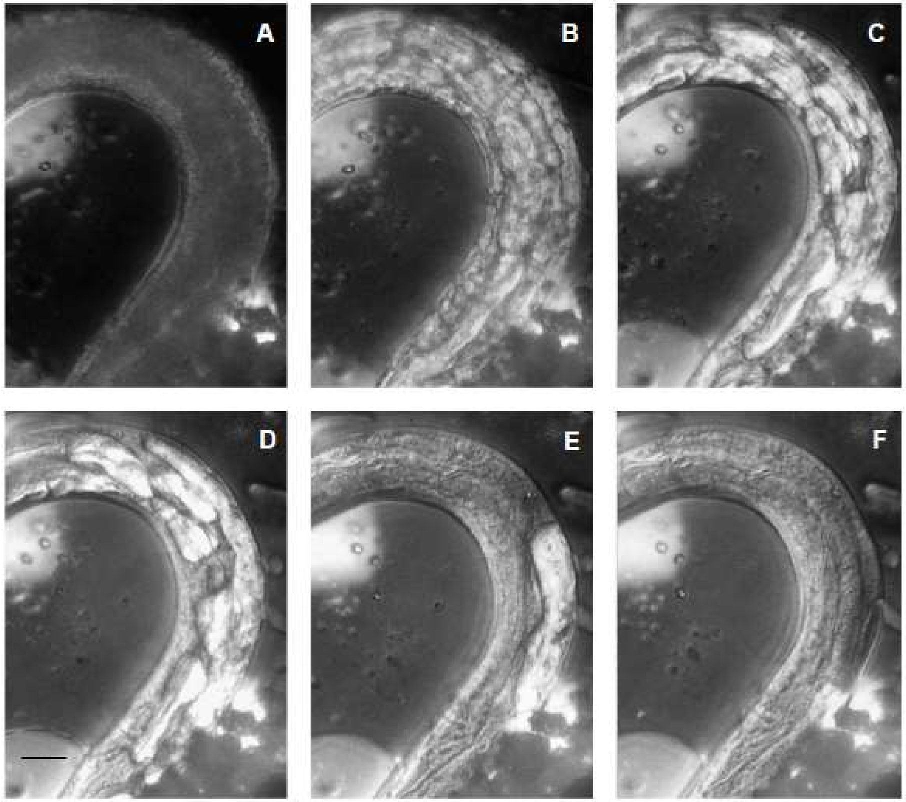
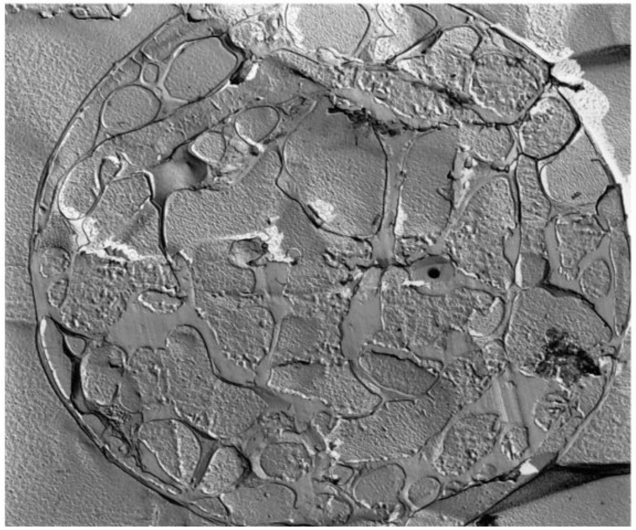
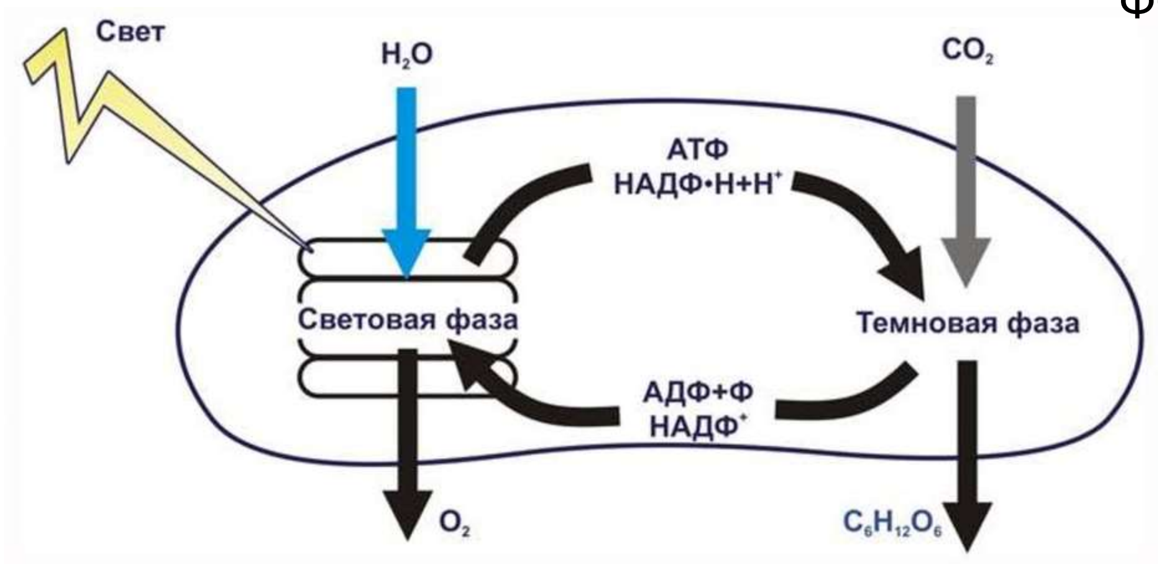


Fig. 2. Melting of ice in *P. davidi* (B–F) after freezing to −20 °C (A) on a cold stage mounted on a Zeiss Axiophot photomicroscope. The photographs were taken using a microflash and differential interference contrast optics. Ice melting can be seen in all parts of the body. Scale bar, 20 μm.

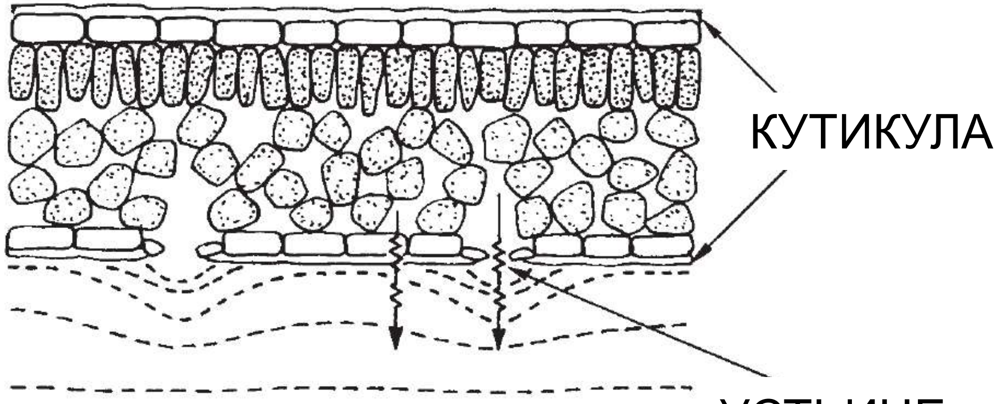


ФОТОСИНТЕЗ



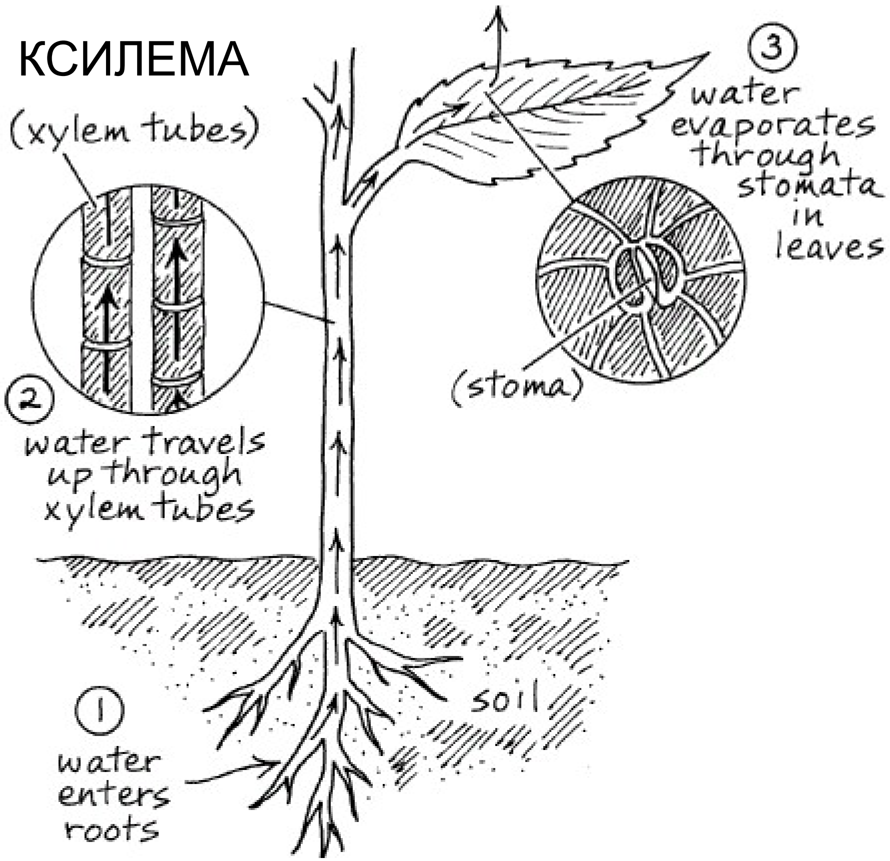
Свет
H_2O
CO_2
АТФ
НАДФ•Н+Н⁺
Световая фаза
Темновая фаза
АДФ+Ф
НАДФ⁺
O_2
$C_6H_{12}O_6$

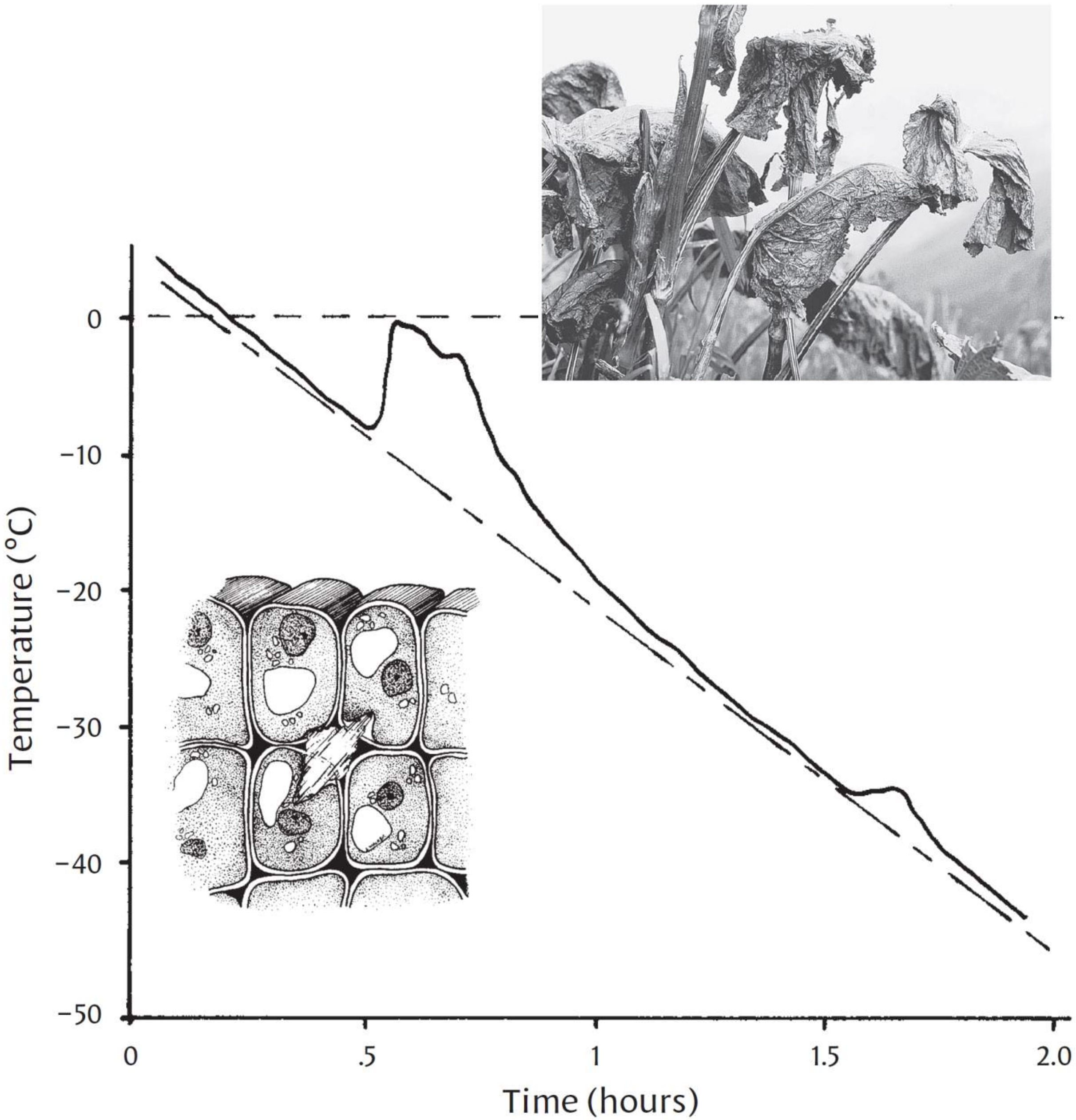
[C] MIROSLAV VAIDIĆ for OPENPHOTO.NET CC:Attribution-ShareAlike



Lower boundary layer illustrating vapor concentration contours

(open)





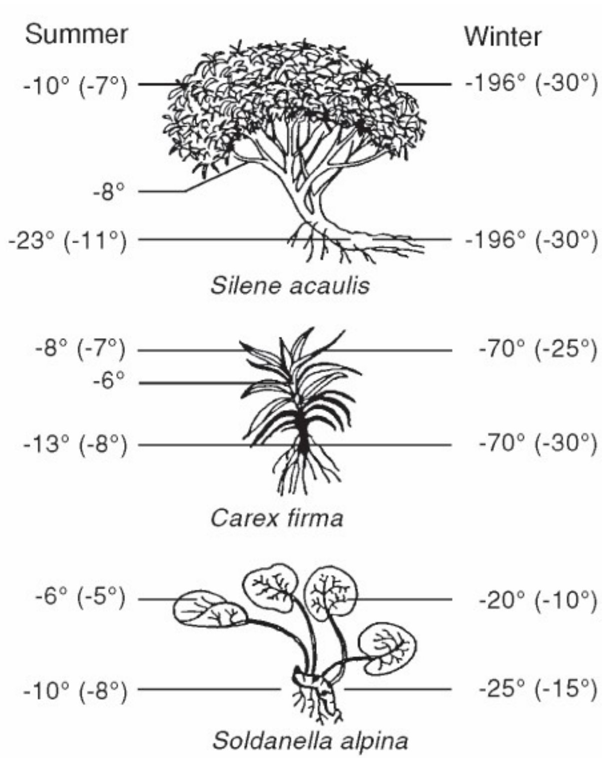
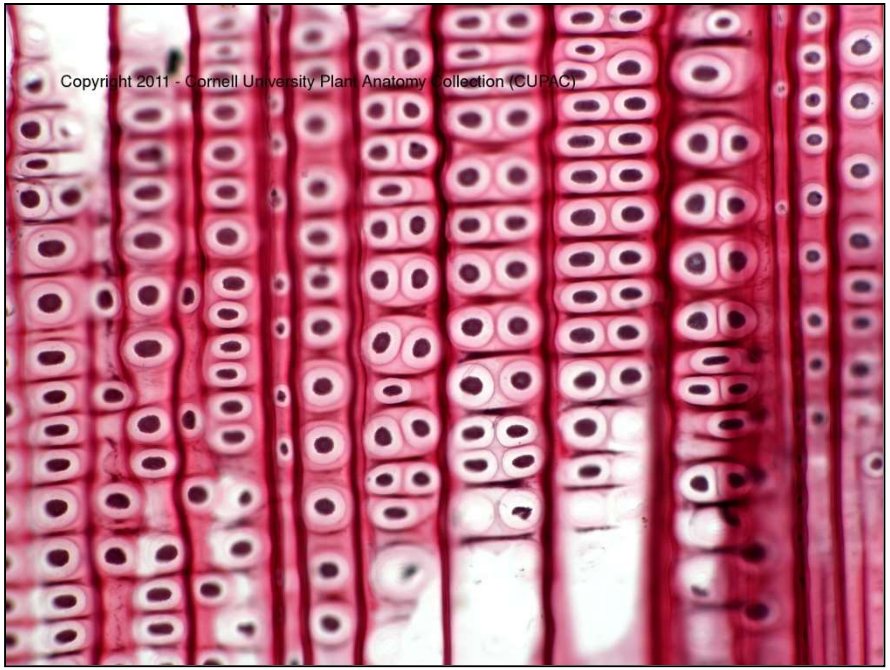


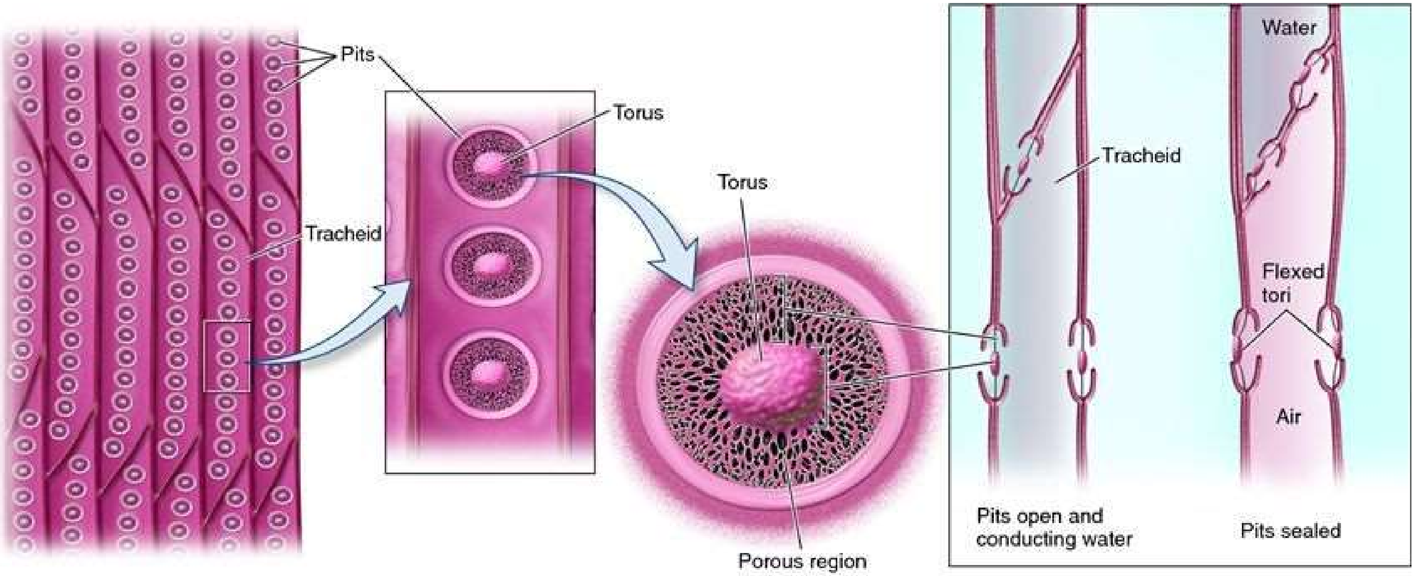
Fig. 5.9. Freezing resistance of the alpine snowbed species *Soldanella alpina* – a species of southern European distribution, in comparison to species commonly overwintering at more exposed (snow-deprived) habitats. The arctic-alpine *Silene acaulis* often grows on wind-swept ridges, *Carex firma* holds an intermediate position with respect to snow cover. *Numbers* indicate maximum frost resistance, and in *brackets*, resistance after 3 to 5 days of warm temperature pretreatment, indicating the potential reduction of resistance during warm spells. (Larcher 1980)

Как ночь бессонную зима напоминает,
И лица жёлтые, несвежие глаза,
И солнца луч природу обольщает,
Как незаслуженный и лучезарный взгляд.

Среди пытающихся распуститься,
Средь почек обреченных он блуждал.
Сочувствие к обманутым растеньям
Надулось в нём, как парус, возросло…

Константин Вагинов «Южная зима»

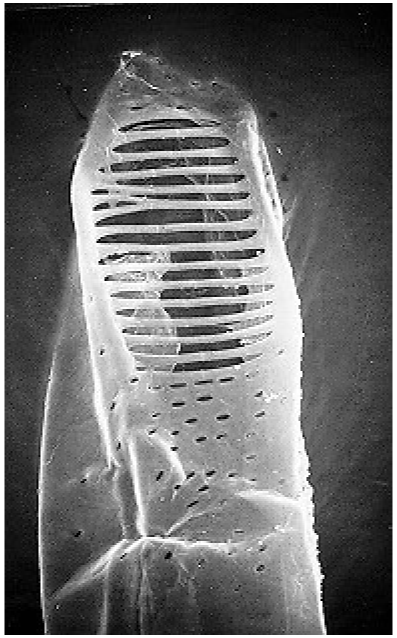


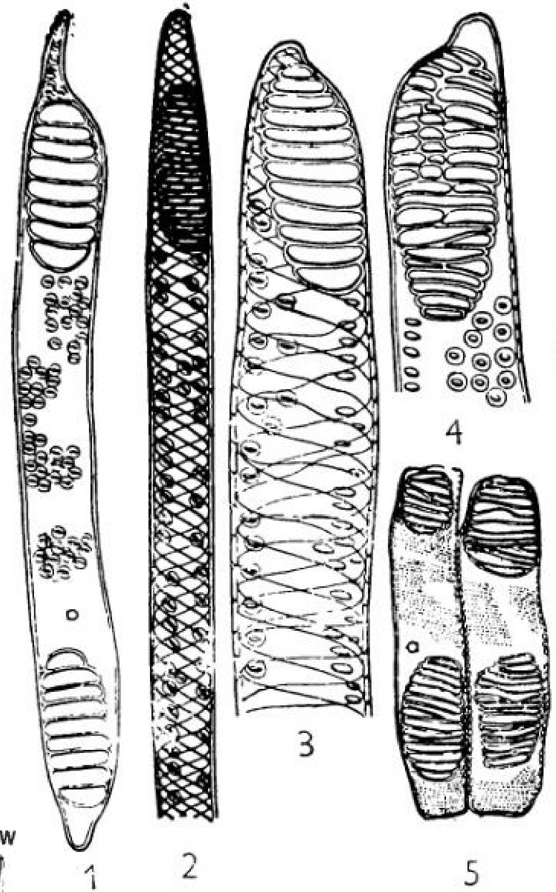


(a) Columns of tracheids showing cell walls

(b) Tracheid pits containing tori

(c) Tracheid with open pits (left side) and tracheid with sealed pits (right side)

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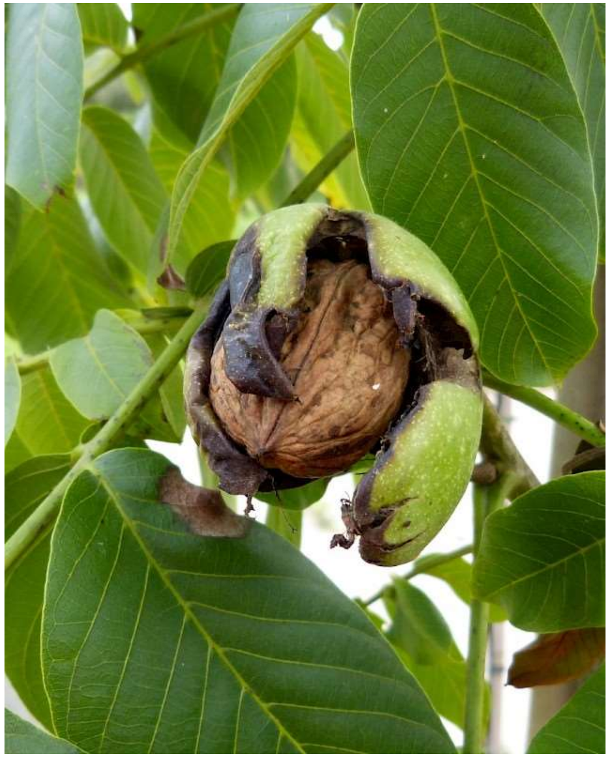

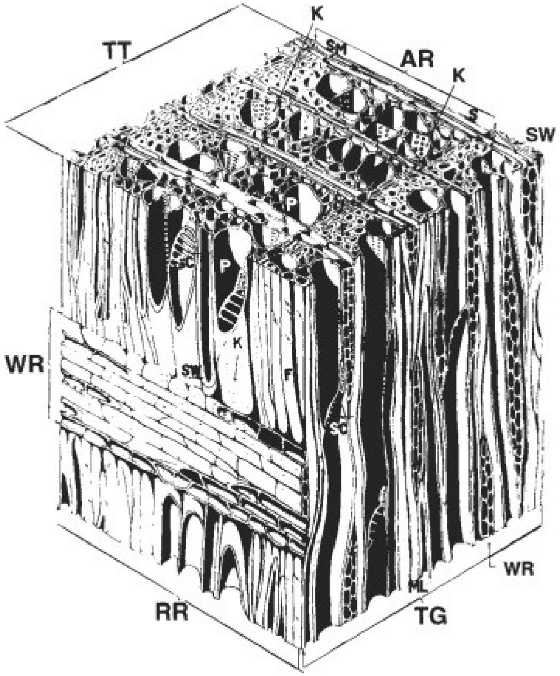
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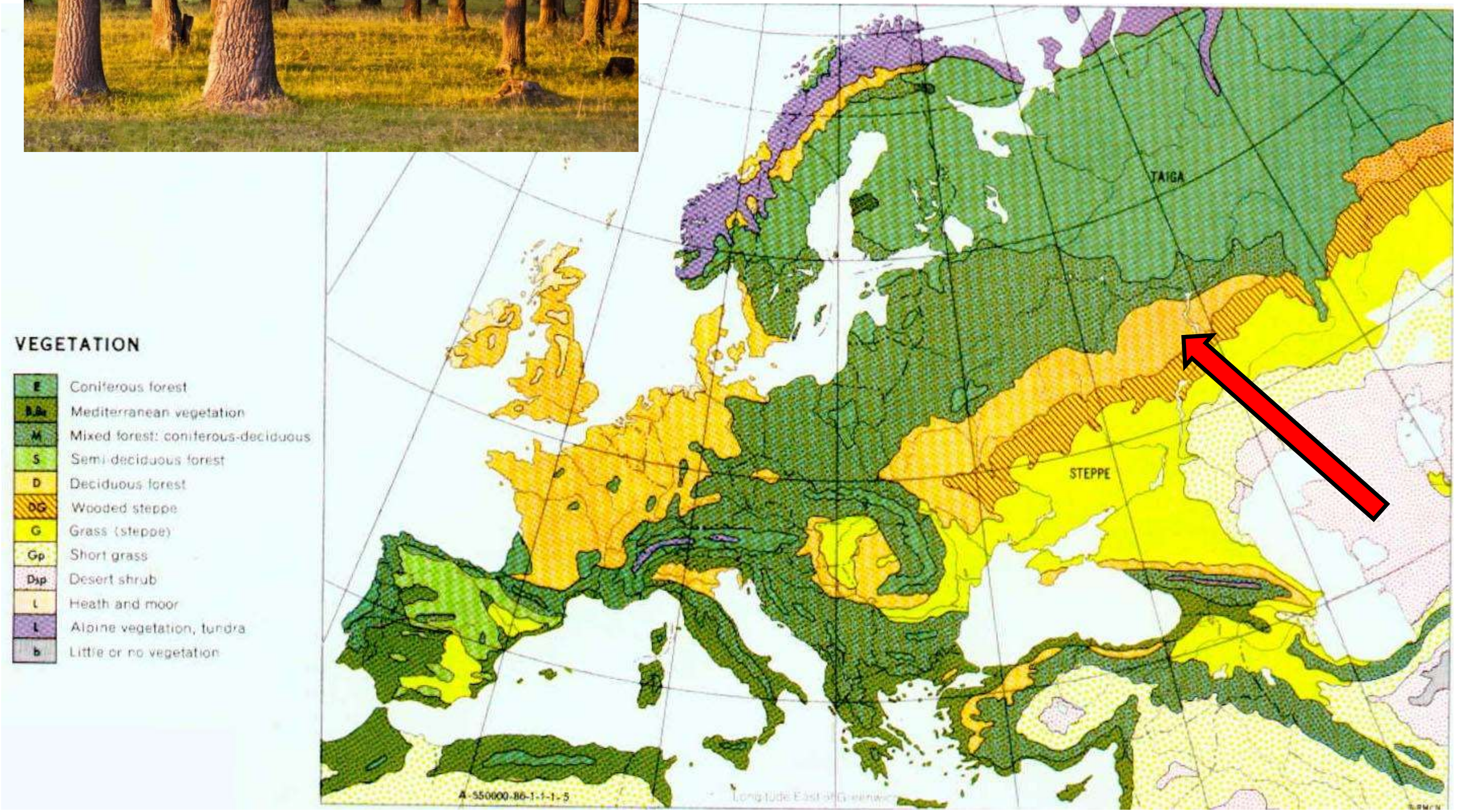
VEGETATION
Coniferous forest
Mediterranean vegetation
Mixed forest: coniferous-deciduous
Semi-deciduous forest
Deciduous forest
Wooded steppe
Grass (steppe)
Short grass
Desert shrub
Heath and moor
Alpine vegetation, tundra
Little or no vegetation
TAIGA
STEPPE