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Orthocaulis binsteadii (Kaalaas) Buch — a new liverwort for Central Europe — *Orthocaulis binsteadii* (Kaalaas) Buch — nowy dla flory Europy Środkowej gatunek wątrobowca

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During the field work of 1959 I found in the Tatry Mts. the rare subarctic liverwort — *Orthocaulis binsteadii* (= *Barbilophozia binsteadii* Loeske = *Lophozia binsteadii* Evans). The locality of this species lies just below the top of the Ornak-peak, on a rather steep slope facing west, at an altitude of 1850 m. above sea level. In that place rather extensive carpets of *Sphagnum nemoreum* are formed. These carpets having the shape of long, slightly arched strips, are overgrown with masses of small liverworts which proved to belong to the northern *Orthocaulis binsteadii*. The great number of such *Sphagnum*-cushions are situated parallel one to another, the distance between them reaching about 1/4 m. In these *Sphagnum* cushions and in depressions between them, various plants of the *Trifidi-Distichetum* community are growing (see plant lists below!). The locality of *Orthocaulis binsteadii* lies therefore in the alpine vegetation belt where *Trifidi-Distichetum* is a climax association.

The following plants are found in that locality:

A. *Sphagnum* cushions:		
The basic community:	*Sphagnum nemoreum*	4.5
	Polytrichum strictum	2.2
	Vaccinium myrtillus	2.2
	Juncus trifidus	2.2
	Oreochloa disticha	+
	Festuca supina	+
On and between *Sphagnum* plants:	*Orthocaulis binsteadii*	4.5
	Orthocaulis kunzeanus	1.1
	Lophozia silvicola	+
B. In depressions between *Sphagnum* cushions:		
	Cetraria islandica	4.4
	Cladonia rangiferina	1.1
	Vaccinium myrtillus	1.1
	Cladonia silvatica	+

The basic parts of *Sphagnum* cushions are often destroyed by winds and the dead *Sphagnum* plants are overgrown by various lichens chiefly *Icmadophila ericetorum* and *Cladonia bellidiflora*. The plants of *Orthocaulis binsteadii* from Tatry Mts. are pictured on fig. 1 and 2.

The described locality of *Orthocaulis binsteadii* is the only locality of that species in the Central European Mountains. It has, as yet, not been reported neither from the Alps nor from the Carpathians. It is rather common in the Scandinavian Mountains (in the lower alpine and subalpine belts — Arnell 1956, Mårtensson 1955/6), and widely distributed in North America (chiefly in Canada: Frye & Clark 1937—1947, Persson 1952, 1957) and North Asia (tundra zone: Smirnowa 1959, Soczawa 1930, Wassiliew 1956, Zenkowa 1953, Sawicz-Ljubickaja 1936, and — rare — in the mountains of the Far East of the USSR — Gorodkow 1935). In spite of such wide distribution in the North it has so far not been reported from mountains of lower latitudes. It seems therefore very probable that *Orthocaulis binsteadii* is genetically a northern (subarctic) species, and its locality in the Tatry Mts. is of the glacial age. It should be pointed out that this interesting hepatic grows in the Tatry Mts. in the same conditions which are characteristic for its occurence in the North — there are tundra-like communities on — or between — *Sphagnum* or other bog mosses. The distribution of this plant is shown on fig. 3.

The plants from the Tatry Mts. are quite typical. They have been worked out biometrically and then a comparison with Scandinavian and type material (type material was published in Schiffner's Hepaticae Europeae exsiccatae No. 433) was made according to the method of J. Jentys-Szaferowa (1948, 1959) [1] The results of such comparison are shown on the diagram (Fig. 4).

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[1] Short outline of the method: the required material are the arithmetical means of some characteristic features of a leaf (or other organ). For instance Jentys-Szaferowa (l. c.) used in her *Betula* studies 16 characters involving the length of petiole, number of nerves in a leaf etc.

One of the specimens must be chosen for a type and then we compare other samples with that type. This is done by dividing the means of the compared specimen (m) by the corresponding means of our type (m_t). The type in my present work consists of 50 leaves of *Orthocaulis atlanticus* from various localities in Scandinavia, Great Britain and Tatry Mts.

Then we introduce the obtained values in a system of coordinates: one horizontal line with numbers $0 — + \infty$ and another vertical one beginning at point 1 (one) of the preceding line. The first line comprises values of ratios m/m_t and the second is a type line ($m_t/m_t = 1$). On the left we write the characters and mark with points the values of m/m_t in our system for each character. Then we join these points and thus we obtain the line of shape of our exemplar in comparison with the (chosen) type.

A detailed discussion of this method can be found in the papers of J. Jentys-Szaferowa cited above. Moreover, the author of the present paper is preparing a publication containing the discussion about the application of this method to bryology.

In my diagram the values of the left side of the horizontal line have been changed from $0 — + 1$ to $+\infty — +1$ by using reciprocals of m/m_t. The lines of shape thus obtained are completely symmetrical.

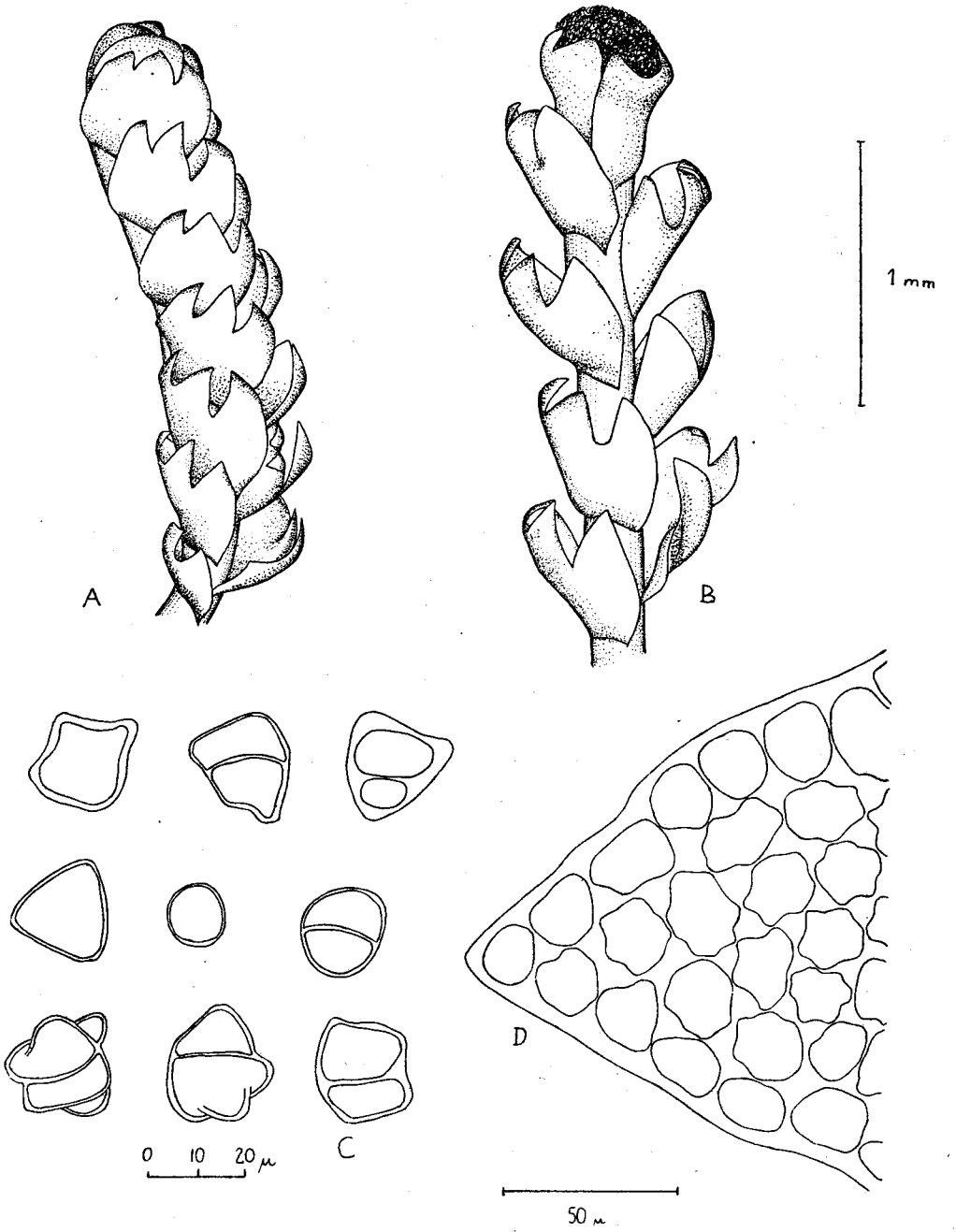

Fig. 1. *Orthocaulis binsteadii* (Kaalaas) Buch. A — Sterile plant, B — Plant with gemmae, C — Various gemmae, D — Cells of a leaf lobe. Original. All drawn after plants from Tatry Mts.

Fig. 2. Six leaves of *Orthocaulis binsteadii*. Original, drawn after plants from Tatry Mts.

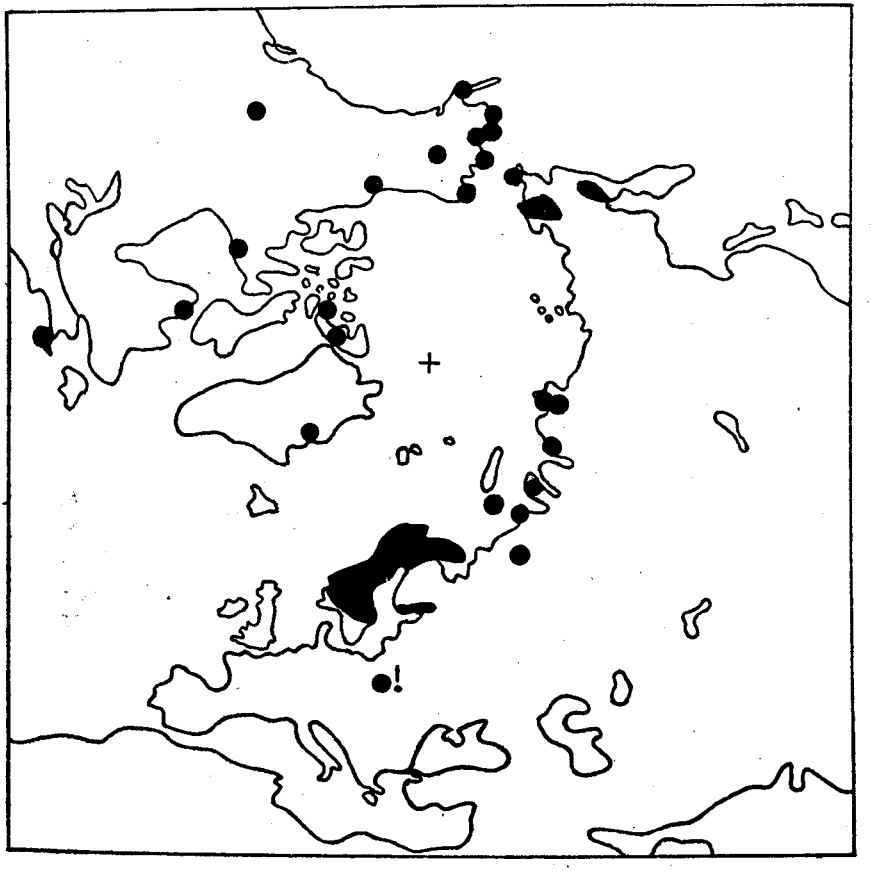

Fig. 3. Distribution of *Orthocaulis binsteadii*. The new locality in the Tatry Mts. marked with an !. Original.

Orthocaulis binsteadii is often said to be difficult to separate from nearly related species of *Orthocaulis* (i. e. *O. floerkeii*, *O. gracilis* and, especially, *O. atlanticus* — Arnell 1956). The biometrical method gives us the points for easier (and more exact) determination. From the diagramm (Fig. 4) we

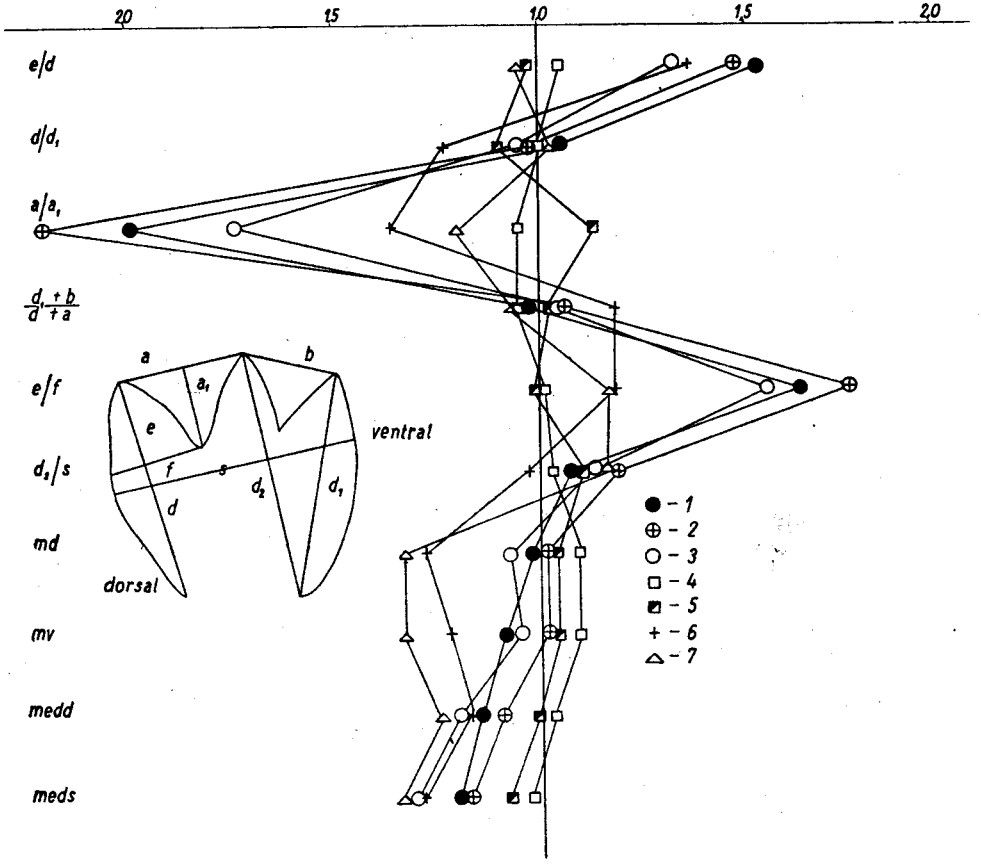

Fig. 4. Diagram showing the lines of shape of various species of genus *Orthocaulis* in comparison with *O. atlanticus* (the vertical, straight line), md = length of marginal cells in the dorsal lobe, mv = the same in the ventral lobe, medd = length of cells in leaf middle, meds = breadth of cells in leaf middle. Other marks are explained on the leaf outline (left). Original
1 — *O. binsteadii* — Tatry, 2 — *O. binsteadii* — type, 3 — *O. binsteadii* — Norway, 4 — *O. atlanticus* — G. Britain, 5 — *O. atlanticus* — Tatry, 6 — *O. floerkeii* — Tatry, 7 — *O. gracilis* — Tatry

can see that *O. binsteadii* can be separated from all related taxa on the basis of its leaf shape and especially:

1. by the shape of leaf lobes (e/f), and
2. by the shape of leaf sinuses (a/a_1).

Ad 1. It is evident from that diagram that *Orthocaulis binsteadii* differs from all the other species in question by its narrow and long leaf lobes. The

value of the e/f relation (see fig. 4 and table 1) is in this species distinctly higher than in any other form.

Ad 2. Also the leaf sinuses are narrow and deep and the value of the a/a_1 relation is here much lower than elsewhere.

Moreover, it can be separated from *O. floerkeii* on the basis of the symmetry of leaves: the dorsal lobe in *O. binsteadii* (and in other discussed species) is the longest and the ventral one — the shortest. On the contrary, in *O. floerkeii* the ventral lobe is the longest and the dorsal lobe the shortest. This is the reason that the values of d/d_1 and $\frac{d_1 + b}{d + a}$ relations are quite different (see table 1). (*O. binsteadii* can, of course, be also separated from *O. floerkeii* on the basis of a total lack of amphigastria).

From *O. gracilis* it can be separated on the basis of the *greater* (!) marginal cells in leaf lobes (Schuster's statement, 1955, that *O. binsteadii* posseses small, 16—19 μ, cells as in *O. gracilis* is not correct. The type specimen of *O. binsteadii* has even very large cells approaching in size those of *O. atlanticus* — see diagram, fig. 4).

From the majority of forms of *O. atlanticus* it can be distinguished on the basis of the relative length of the dorsal leaf lobe (ratio e/d).

The relationships of that group of the genus *Orthocaulis* will be discussed later in a separate paper on the basis of more extensive material.

The writer is deeply indebted to Dr. S. Arnell (Bromma, Sweden) for testing the Tatry plants and to Mrs. Prof. Dr. J. Jentys-Szaferowa (Cracow, Poland) who taught him the biometrical methods.

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Tabela 1

Mean values of some leaf characters

No.	Species name	Locality	Arithmetical means of									
			e/d	d/d_1	a/a_1	$\frac{d_1 + b}{d + a}$	e/f	d_2/s	md	mv	medd	meds
1.	*O. binsteadii*	Norway	0,317±0,006	1,107±0,012	1,915±0,004	0,847±0,012	0,887±0,012	0,994±0,009	20,4±0,25	20,3±0,36	22,3±0,23	19,6±0,28
2.	*O. binsteadii*	type	0,358±0,008	1,120±0,011	1,510±0,051	0,849±0,010	1,000±0,017	1,042±0,011	22,1±0,33	21,8±0,19	24,4±0,36	21,8±0,25
3.	*O. binsteadii*	Tatry	0,371±0,008	1,190±0,014	1,660±0,040	0,806±0,017	0,965±0,021	0,936±0,004	21,1±0,27	19,7±0,31	23,1±0,31	21,7±0,31
4.	*O. atlanticus*	G. Britain	0,256±0,006	1,147±0,014	3,145±0,081	0,786±0,011	0,577±0,012	0,917±0,009	23,9±0,31	23,5±0,31	27,8±0,32	24,5±0,29
5.	*O. atlanticus*	Tatry	0,237±0,008	1,033±0,014	2,930±0,114	0,842±0,012	0,571±0,015	0,962±0,012	22,6±0,34	22,3±0,31	26,3±0,38	23,8±0,37
6.	*O. gracilis*	Tatry	0,237±0,003	1,196±0,011	2,750±0,090	0,789±0,009	0,668±0,015	1,011±0,010	16,6±0,24	16,4±0,19	21,5±0,29	19,4±0,26
7.	*O. floerkeii*	Tatry	0,324±0,014	0,932±0,009	2,430±0,080	0,965±0,012	0,675±0,020	0,848±0,009	17,2±0,21	17,7±0,30	22,4±0,30	19,7±0,26

List of species treated:

1. *Orthocaulis binsteadii*, Norway, Sør-Trøndelag, Oppdal, Nonshø, 1050 m. 12. VII. 1907, leg. I. Hagen, det. B. Kaalaas. — 2. *Orthocaulis binsteadii*, Norwegen, Gudbrandsdalen, in einem Hochgebirgssumpfe auf dem Bottberg bei Holaker im Lesje, ca. 1100 m, 12. VIII. 1907, leg. B. Kaalaas. Schiffner „Hepaticae europeae exsiccatae" nr. 433, Orig. Ex.! — 3. *Orthocaulis binsteadii*, Tatry Zachodnie, on and between *Sphagnum nemoreum* in the west slope of Ornak-peak, 1850 m, 7. IX. 1959, leg. J. Szweykowski (teste S. Arnell in litt.). — 4. *Orthocaulis atlanticus*, England, S. W. Yorkshire Hebden Bridge, an Blöcken, Mauern und Felsen, Sept. 1912, leg. D. A. Jones, det. V. Schiffner; Schiffner „Hepaticae europeae exsiccatae" nr 1391. — 5. *Orthocaulis atlanticus*, Tatry Wysokie, valley of Zmarzły Staw pod Kościelcem-lake, on soil between granite boulders by tourist path, 1710 m, 24. VI. 1954. leg. Jerzy Szweykowski (teste S. Arnell in litt.). — 6. *Orthocaulis gracilis*, Tatry Zachodnie, in a oligotrophic swampy place in the valley Dolina Kondratowa near the basis of Łopata Mt., 24. VIII. 1956, leg. J. Szweykowski. — 7. *Orthocaulis floerkeii*, Tatry Zachodnie, on granitic rocks by a stream in the valley Dolina Jarząbcza, 1480 m, 18. VIII. 1956, leg. J. Szweykowski.

The arithmetical means are based on measurings of 50 leaves from 50 various stems in each sample.

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STRESZCZENIE

Autor opisuje tatrzańskie stanowisko *Orthocaulis binsteadii*, wątrobowca rozpowszechnionego w obszarze arktycznym i subarktycznym, a nie znanego dotychczas z gór niższych szerokości geograficznych, oraz podaje biometryczną charakterystykę materiału polskiego.

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