OBSERVATIONS ON N.W. EUROPEAN LIMESTONE GRASSLAND-VEGETATIONS I.

LIMESTONE GRASSLAND-VEGETATIONS IN THE CENTRAL PART OF THE FRENCH JURA, SOUTH OF CHAMPAGNÔLE (DEPT. JURA).

BY

J. H. WILLEMS

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SUMMARY

In June, 1969, the author studied a number of limestone grassland-vegetations in the French Jura Mountains, South of Champagnôle, on the methods of the French-Swiss School of phytosociology. These vegetations can be assigned to the alliance Mesobromion Br.-Bl. & Moor 1938, and belong to the:

A. PINGUICULA VULGARIS – BROMUS ERECTUS-VEGETATION.
B. EU-MESOBROMION OBERD. 1957.
Mesobrometum collinum (Scherr. 1925) Oberd. 1957.
1. *subass. typicum*
2. *hypericetosum subass. nov.*
a. Achillea millefolium–variant
b. Teucrium chamaedrys–variant

Special attention was paid to the cryptogams occuring in these associations. More than 40 taxa of bryophytes and lichens were met with. There proved to be a distinct correlation between the phanerogamic communities and the distribution of the cryptogams.

I. INTRODUCTION

In 1925 SCHERRER described an open plant community from moderately calcareous stations and named it, on Braun-Blanquet's oral suggestion, Meso-Brometum. Since that time this association has been the subject of numerous studies (i.a. KOCH 1931, SCHWICKERATH 1932, DIEMONT & VAN DE VEN 1953, WIEDMANN 1954, ZOLLER 1954 a, 1954 b, BORNKAMM 1960, GIGON 1968, BRAND 1970, SHIMWELL 1971 a, 1971 b). The limestone grassland-vegetations in question were also often included, with other associations, in local studies of all plant communities of a given area, (KAISER 1926, SCHLEUMER 1934, LIBBERT 1939, POTTIER-ALAPETITE 1943, SCHWICKERATH 1944, VON ROCHOW 1951, MÜLLER 1966). These vegetations are rich in cryptogams, notably bryophytes, locally also lichens, these were thoroughly taken into account by only a few investigators (TANSLEY 1939,

Braun-Blanquet & Tüxen 1952, Barkman 1953, Bornkamm 1960, Brand 1970, Shimwell 1971 a, 1971 b). The present paper reports the results of a study of a number of limestone grassland-vegetations from very diverse stations. Special attention was paid to bryophytes and lichens. The field work was carried out in June, 1969, in the central part of the French Jura Mountains, South of the town of Champagnôle (dépt. Jura). See fig. 1.

II. Methods

The vegetation relevés were made on the basis of the principles of the French-Swiss school of phytosociology (Braun-Blanquet 1964).

The cryptogams were only partly identified in the field. In each plot in open places, in grass tufts, and spread over the whole surface, a representative sample was collected and subsequently sorted to species and identified in the laboratory.

As a consequence it was impossible to assess the abundance and dominance of a considerable number of species. Therefore, in table II, which includes bryophytes and lichens, only their presence is marked by an X.

In the middle of every plot the pH was measured at a depth of ca. 5 cm by means of a pH-meter with color indicator solution (Hellige). These measurements are recorded at the top of the table of phanerogams (table I).

For topographical and toponymical purposes the topographic maps (scale 1 : 25 000) Champagnôle 1/2, 5/6, 7/8, and the Cartes Michelin 1 : 200 000 nos. 70 and 74 were used. The altitude of the sample plots was determined with the aid of these maps, and with an altimeter. The slope-angle was measured with a bank-indicator (Hilger & Watts). For extensive climatological, geological, and pedological data of the region the reader is referred to Pottier-Alapetite (1943).

III. The place in the system of vegetation classification

The vegetations described below must be assigned to the association described by Scherrer (1925) from the Limmat Valley in the Swiss Jura. Braun-Blanquet & Moor (1938) gave a detailed circumscription of it, called it Mesobrometum erecti typicum Scherrer 1925, and placed it in the suballiance Mesobromion Br.-Bl. & Moor 1938, alliance Bromion erecti (Br. – Bl. 1925 n.n.) 1936, order Brometalia erecti (W. Koch 1926 n.n.) Br.-Bl. 1936.

Knapp (1942) described from the central French Jura as the only association of the limestone grassland-vegetations the Koelerio – Gentianetum praealpino-jurassicum Knapp 1942. Our relevés differ so much in their constituent species from this association that they cannot be referred to it.

The Mesobromion Br.-Bl. & Moor 1938, originally treated as a suballiance, was raised to an alliance in 1957 by Oberdorfer. The plant communities described in the present paper are referable to the suballiance

Mesobromion grasslands from the central French Jura (J.H.Willems)

Table I

ASSOCIATION MESOBROMETUM COLLINUM (records 3–35): SUB-ASS. TYPICUM (records 3–14); SUB-ASS. HYPERICETOSUM (records 16–35): ACHILLEA MILLEFOLIUM-VARIANT (records 16–21), TEUCRIUM CHAMAEDRYS-VARIANT (records 22–35)

	Number of the record	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
	Quadrat size (m²)	4	4	25	10	6	10	10	10	10	10	15	15	15	10	12	25	25	25	15	25	25	10	10	25	15	10	5	5	15	25	15	20	25	10	10
	Aspect	–	–	–	–	–	–	N	W	W	W	–	–	N	N	S	–	–	S-O	S-O	O	S-O	S	S	–	S	S	S	O	S	S	S	O	–	–	S
	Slope °	–	–	–	–	–	–	15	20	20	15	–	–	30	15	25	–	–	10	20	10	10	25	30	–	15	20	40	45	25	25	30	40	–	–	30
	Mowing (M) or grazing (B)	B	B	B	B	B	B	M	M	M	M	M	M	–	M	B	B	B	B	B	B	B	B	B	M	B	B	–	–	M	M	M	B	M	M	–
	Altitude	500	500	485	485	510	510	580	470	480	480	750	750	580	580	660	790	810	800	960	800	810	1020	1010	590	810	800	860	840	780	810	780	800	590	500	770
	pH of the A_1 horizon	7-7.5	7	7	7	7	7	5	7	7	7	7	7	7	5	7	6-7	7	5	6-7	5	5	7	7	5	7	7	7-8	7	7	7	5	7	5	6-7	7-8
	Cover %	90	90	80	80	100	100	100	100	100	100	100	100	100	100	95	100	95	100	100	100	100	80	80	100	80	100	90	95	100	100	100	90	100	90	90
	Species number	22	20	32	36	37	35	30	36	42	39	48	49	35	44	39	46	44	41	36	43	40	24	26	21	37	34	29	32	33	35	29	32	25	23	47
	Differential species of Pinguicula vulgaris-Bromus erectus community																																			
	Pinguicula vulgaris	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Parnassia palustris	+	1	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Carex hostiana	2	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Ranunculus repens	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Diff. species of sub-ass. typicum																																			
	Tetragonolobus maritimus	2	2	2	1	+	1	.	2	2	3	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Leontodon hispidus	1	.	1	1	1	1	1	.	.	.	1	1	.	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Listera ovata	.	.	.	+	.	+	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
	Carex panicea	.	.	.	1	.	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Tragopogon pratensis	.	.	.	.	.	.	.	1	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
A	Ophrys apifera	.	.	+	.	+	+	.	1	+	1	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
A	Gymnadenia conopsea	.	.	.	.	+	+	+	+	+	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
A	Ophrys insectifera	.	.	.	+	+	1	.	+	+	1	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
A	Platanthera chlorantha	.	.	.	.	+	+	.	+	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
V	Ophrys sphegodes	.	.	.	+	.	1	.	+	+	1	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
O	Centaurea scabiosa	.	.	.	.	.	.	.	.	1	.	1	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
B	Trifolium montanum	.	.	.	.	.	+	+	.	.	.	1	1	+	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Diff. species of Achillea millefolium variant																																			
B	Achillea millefolium	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	1	1	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	+
	Cirsium vulgare	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Alchemilla vulgaris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
A	Coeloglossum viride	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	+	+	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Anthoxanthum odoratum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2	1	1	1	2	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Bellis perennis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Luzula campestris	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	+	1	1	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Cynosurus cristatus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	1	2	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Veronica chamaedrys	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
	Botrychium lunaria	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
	Diff. species of Teucrium chamaedrys variant																																			
	Teucrium chamaedrys	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	1	1	.	+	1	1	+	.	.	1	+	+
	Vicia cracca	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	1	.	.	.	.	.	.	.	.	.	+	+	+	+	+	.	.	.	.
V	Sedum sexangulare	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	1	.	.	.	1	1	.	.	.	.	.
	Sedum acre	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	1	1	.	.	.	+	.	.	.	.	.
A	Agrimonia eupatoria	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+
O	Dianthus carthusianorum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.
	Diff. species of sub-ass. hypericetosum																																			
	Hypericum perforatum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	1	1	2	1	.	1	1	.	+	.	.	.	.	+	.	.	+
	Helictotrichon pratense	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	.	.	.	.	.	1	.	.	.	1	1	.	.	1
V	Galium mollugo	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	1	.	.	.	.	+	.	.	+	+	.	.	.	.	.
	Sesleria caerulea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	+	+	.	+	.	1	+	.	.	.	.	.	2	.	.	.
	Origanum vulgare	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	1	.	+	+	.	.	.	.	.
	Cerastium arvense	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	+	+	.	.	2	1	.	.	.	.	1	+	.	.	.	.	1	.	+
	Character species according to Braun-Blanquet & Moor 1938																																			
	Association character species																																			
A	Cirsium acaulon	+	+	2	1	1	2	.	1	1	1	+	+	1	1	1	+	.	1	+	1	1	.	+	+	1	1	1	1	1	+	.	.	+	.	1
A	Primula veris	.	.	.	.	.	.	.	.	+	1	2	2	.	1	1	1	1	1	+	2	2	.	.	+	.	1	1	2	.	1	1	+	.	.	2
A	Orchis ustulata	.	.	.	.	.	.	.	.	.	+	+	.	.	+	.	+	+	.	.	+	+	.	.	.	.	.	.	.	+	.	.	+	.	+	+
A	Gentiana germanica	.	.	.	.	.	.	.	.	.	+	1	1	.	.	+	.	.	.	.	.	.	.	+	1	+	.	.	.	.	.	.	+	.	.	+
A	Anacamptis pyramidalis	.	.	.	1	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	+
	Alliance character species																																			
V	Bromus erectus	+	+	1	1	2	3	3	2	2	2	2	2	2	3	2	2	2	2	1	3	3	1	2	1	2	2	2	3	2	2	4	2	1	2	2
V	Potentilla tabernaemontani	+	1	2	1	2	2	2	1	.	2	.	.	2	2	+	+	1	1	1	1	1	2	2	1	2	1	.	+	1	1	.	1	1	1	1
V	Hippocrepis comosa	1	+	.	2	2	1	.	.	.	.	2	1	+	.	.	2	1	2	1	1	.	1	1	.	1	2	.	.	2	1	+	+	.	.	1
V	Scabiosa columbaria	+	+	+	+	1	1	1	.	1	1	1	2	1	1	.	.	+	.	1	.	.	.	+	.	2	2	.	.	.	.	.	.	.	.	1
V	Orchis morio	.	.	+	1	+	.	.	.	r	.	.	.	.	+	1	+	+	+	1	+	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.
V	Helianthemum nummularium	.	.	.	.	.	.	2	.	.	.	.	2	.	1	.	1	1	2	3	.	.	1	2	.	2	2	.	.	.	.	2	.	.	.	2
V	Globularia elongata	.	.	.	1	.	.	.	.	.	.	+	1	+	+	.	.	.	.	.	.	.	.	.	.	1	.	.	.	+	+	.	.	1	.	.
V	Anemone pulsatilla	.	.	.	.	.	.	.	.	.	.	+	1	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2	.
	Order character species																																			
O	Brachypodium pinnatum	.	.	1	2	2	2	1	2	4	3	2	2	1	2	+	.	+	1	2	2	1	.	1	3	1	1	2	1	3	3	2	1	3	.	2
O	Ranunculus bulbosus	.	.	+	+	+	+	.	2	2	2	1	2	+	2	1	1	+	1	.	1	2	+	2	.	1	1	1	2	1	1	1	1	.	1	2
O	Sanguisorba minor	.	.	.	+	.	.	1	+	2	2	2	1	2	2	1	2	1	2	2	2	2	1	2	.	1	2	2	2	1	1	1	2	.	.	1
O	Anthyllis vulneraria	.	.	+	.	+	1	.	+	.	1	+	1	+	1	.	+	+	2	3	.	1	2	2	.	2	+	1	+	1	1	+	1	.	3	.
O	Plantago media	.	.	2	2	2	2	.	2	2	2	.	1	.	1	2	2	2	2	2	1	1	.	.	.	1	1	.	1	.	1	.	1	.	1	2
O	Euphorbia cyparissias	.	.	1	.	.	.	1	2	1	1	1	2	1	2	+	2	1	2	2	2	2	1	1	2	1	2	2	.	.	.	.	1	2	2	+
O	Carlina vulgaris	.	.	+	+	+	+	.	.	+	1	+	+	+	+	.	.	.	.	.	.	.	.	.	+	+	+	.	.	1	.	.	.	.	.	+
O	Salvia pratensis	.	.	+	.	1	.	.	+	1	1	1	1	.	.	.	.	+	.	.	.	.	.	.	.	.	.	2	1	1	1	1	.	.	.	1
O	Asperula cynanchica	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	.	.	+	.	.	.	.	.	+	.	.	+	+	+	+	.	+	.	+
O	Stachys officinalis	.	.	.	.	.	.	3	+	.	.	1	+	1	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1	.	.
O	Onobrychis viciifolia	.	.	.	.	.	.	.	.	.	.	2	1	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
O	Prunella grandiflora	.	.	.	.	.	+	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
O	Koeleria cristata	1	+	1	+	1	2	1	.	.	.	+	+	+	1	.	.	.	.	1	.	.	1	1	.	1	+	.	+	.	.	.	.	.	1	.
	Companions																																			
B	Briza media	1	2	1	2	1	1	1	1	+	1	1	+	+	1	1	1	2	2	2	2	1	1	1	+	1	1	2	1	1	1	.	2	r	3	2
B	Carex flacca	+	+	2	2	1	1	1	1	2	1	2	2	2	2	1	1	1	2	1	2	2	.	.	2	1	1	1	2	1	2	1	2	2	.	1
B	Lotus corniculatus	2	1	1	1	1	1	1	2	2	1	2	2	+	+	+	+	1	1	1	2	2	1	.	.	1	+	2	2	2	1	1	1	.	.	1
B	Thymus pulegioides	.	.	+	+	2	2	.	+	.	.	+	+	+	1	+	.	2	2	3	1	.	3	2	1	2	1	.	+	1	1	2	+	1	2	1
B	Linum catharticum	1	.	1	+	+	1	.	.	1	+	1	1	+	+	+	.	.	+	.	1	+	+	.	.	1	+	+	.	+	1	+	1	.	.	1
B	Hieracium pilosella	.	.	.	.	.	.	.	.	.	.	1	1	.	2	1	2	1	2	1	2	1	1	2	.	2	2	2	+	1	.	+	1	.	2	2
B	Plantago lanceolata	.	.	.	.	.	.	.	1	+	+	.	1	1	1	1	2	2	1	1	1	1	1	.	.	1	1	+	.	.	.	.	.	.	+	1
B	Chrysanthemum leucanthemum	.	.	+	+	+	1	.	.	+	+	+	.	+	1	2	.	1	1	.	1	.	.	.	.	.	.	.	+	.	+	+	+	.	+	.
B	Festuca rubra s.l.	1	.	+	.	.	.	+	+	1	1	+	1	1	1	1	2	.	.	1	2	2	.	.	.	1	.	.	1	1	2	.	+	1	2	+
B	Galium verum	.	.	.	.	.	.	1	.	.	.	+	.	.	.	.	2	.	1	.	.	1	.	.	1	.	.	.	.	.	.	1	.	1	2	.
B	Daucus carota	.	.	.	.	.	.	.	.	2	.	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	.	1
	Companions																																			
	Polygala comosa	1	1	1	1	1	1	1	1	+	1	1	1	.	+	+	+	1	1	1	+	2	.	1	+	2	2	1	.	.	1	+	1	1	+	1
	Carex caryophyllea	.	.	+	+	+	1	.	2	1	1	+	1	.	.	.	1	1	1	+	1	1	1	1	.	+	+	1	1	1	+	.	1	.	1	+
	Ononis repens	1	2	+	+	2	1	1	1	1	1	1	.	.	1	2	1	1	.	.	1	1	1	.	.	.	.	.	.	1	+	.	.	.	1	1
	Trifolium pratense	1	.	1	.	1	1	1	.	+	+	+	1	+	1	2	1	+	+	1	+	1	.	.	.	.	.	+	.	1	2	1	.	.	.	+
	Trifolium repens	.	.	1	1	1	.	.	1	1	1	.	1	+	.	1	+	1	1	.	1	+	.	.	.	.	+	2	1	.	.	.	1	.	.	1
	Galium pumilum	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	+	.	+	1	.	1	.	+	.	.	1	+	+	.	.	1	.	+	.	.
	Genista tinctoria	1	2	1	1	2	1	.	.	.	1	2	2	2	1	1	1	2	.	.	.	.	.	.	2	.	1	.	.	.	.	.	.	2	.	1
	Orobanche elatior	.	+	+	+	.	.	.	r	r	+	+	+	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	r	.	+	+	+
	Juniperus communis	.	+	1	+	+	.	1	.	+	+	.	.	.	+	.	+	+	.	.	.	+	.	1	+	.	.	.	.	.	.	.	.	1	.	.
	Rhinanthus alectorolophus	1	.	.	.	1	1	+	2	.	r	1	1	.	1	.	+	1	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	1
	Genistella sagittalis	.	.	.	.	.	.	.	.	1	.	.	2	.	1	.	1	2	.	3	+	.	.	1	1	2	2	.	.	.	.	.	.	.	.	.
	Viola hirta	.	.	.	.	.	.	1	.	.	.	+	+	1	1	.	+	.	.	1	+	.	.	.	1	1	+	.	1	.	.	.	.	1	.	+
	Dactylis glomerata	.	.	.	.	.	.	.	.	1	.	.	.	.	.	+	1	1	.	+	+	.	.	.	.	.	.	.	.	+	.	1	+	.	.	1
	Campanula rotundifolia	.	.	.	.	.	.	.	1	1	+	.	.	+	.	.	.	.	2	.	.	.	.	.	.	.	+	+	.	.	.	.	+	+	+	.
	Taraxacum officinale	.	.	.	1	.	.	.	2	1	2	.	.	.	.	.	1	.	.	.	+	2	.	.	+	.	.	.	.	+	.	.	.	.	.	+
	Ranunculus acris	.	.	.	.	1	.	.	.	.	.	.	.	.	.	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.
	Orchis militaris	.	.	.	+	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	1	.	+	.	.	1
	Poa pratensis	.	.	+	.	+	1	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	+	.	.	+	+	.	.	.	+
	Gentiana lutea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	2	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
	Calluna vulgaris	.	.	.	.	.	.	2	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.
	Knautia arvensis	.	.	.	.	.	.	1	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	+	1	.	.	.
	Succisa pratensis	.	+	.	+	.	1	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
	Cynanchum vincetoxicum	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.
	Crataegus monogyna	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.
	Prunus spinosa	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	1	.	.	.	.	.	.	+	.	.	.	.	.	.	.

Also: (5) Sieglingia decumbens 1; (7) Quercus robur +; (9) Equisetum arvense 1; (11) Pimpinella saxifraga +, Medicago lupulina +, Senecio erucifolius 1; (12) Equisetum arvense r, Medicago lupulina 1; (14) Festuca pratensis 1, Berberis vulgaris +; (18) Festuca pratensis 2; (22) Arabis hirsuta +; (25) Berberis vulgaris +; (28) Cornus sanguinea 1; (32) Carex digitata +.

Bryophytes and Lichens of Mesobromion grasslands from the central French Jura. (J.H. Willems) **Table II**

Number of the record:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Cover %	10	5	5	10	5	10	20	5	10	10	30	30	25	35	5	25	60	50	30	30	50	40	40	40	30	35	10	10	35	40	40	40	25	25	10
Species number	2	2	4	4	3	4	7	3	3	3	7	7	4	13	1	10	14	10	8	3	8	9	8	4	11	7	5	6	11	9	10	16	5	9	3
Cratoneuron commutatum (Hedw.) Rot.	X	X	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Tortella densa (Lor. et Mol.) Crundw. et Nyh.	X	X	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	X	·	·	·	·	·	·	·	·	·	·
Calliergonella cuspidata (Hedw.) Loesk.	·	·	X	X	X	X	X	·	·	·	·	·	·	X	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Campylium chrysophyllum (Brid.) J.Lange	·	·	X	·	X	X	X	·	·	·	·	·	·	X	·	·	·	X	·	·	·	·	·	·	·	·	·	X	·	·	·	X	·	X	X
Ctenidium molluscum (Hedw.) Mitt.	·	·	X	X	·	·	·	X	X	X	X	X	X	X	·	X	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	X
Rhytidiadelphus triquetrus (Hedw.) Warnst.	·	·	·	·	·	·	·	·	·	·	X	X	X	X	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Pseudoscleropodium purum (Hedw.) Fleisch	·	·	·	·	·	·	X	X	X	X	X	X	X	X	X	X	·	·	X	·	X	·	·	X	·	·	·	·	·	·	·	X	X	·	·
Thuidium recognitum (Hedw.) B.S.G. ssp. philibertii (Limpr.) Dix.	·	·	·	·	·	·	·	·	·	·	X	X	·	·	·	X	X	·	·	X	X	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Rhytidium rugosum (Hedw.) Kindb.	·	·	·	·	·	·	·	·	·	·	X	X	·	X	·	X	·	X	X	·	·	·	·	·	X	X	·	·	X	X	X	X	·	X	·
Abietinella abietina (Hedw.) Fleisch.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	X	X	X	X	X	X	X	X	X	·	·	·	·	X	X	X	X	X	X	·
Cladonia furcata (Huds.) Schrad. var. subrangiformis (Sandst) Hennipm.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	X	X	X	·	X	X	X	X	X	X	·	·	X	X	X	X	X	X	·
Hypnum cupressiforme (Hedw.) var. lacunosum Brid.	·	·	·	·	·	X	·	·	·	·	·	·	·	X	·	X	X	X	X	X	X	X	X	X	X	X	X	·	·	·	X	X	X	X	·
Fissidens cristatus Mitt. var. mucronatus (Limpr.) Waldh.	·	·	·	·	·	·	X	·	·	·	·	·	·	·	·	·	·	·	X	·	X	·	·	·	·	·	X	·	·	·	·	X	X	X	·
Tortella tortuosa (Hedw.) Schimp.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	X	·	·	·	X	X	·	X	·	·	X	X	X	X	X	·	·	X
Cladonia pyxidata (L.) Hoffm. var. chlorophaea Flörke.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	X	X	·	X	X	·	·	X	X	X	X	·	·	·
Pleurochaete squarrosa (Brid.) Lindb.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	X	X	·	·	X	X	X	·	·	·	·
Ditrichum flexicaule (Schwaegr.) Hamp.	·	·	·	X	X	X	·	·	·	·	·	·	·	·	·	·	X	·	·	·	·	X	X	·	X	X	·	·	·	·	·	X	·	X	·
Tortella inclinata (Hedw.) Limpr.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	X	X	X	·	·	·	·	·	X	X	X	·	·	·	·
Cladonia rangiformis Hoffm.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	X	X	·	·	·	·	·	X	·	·	·
Cladonia furcata (Huds.) Schrad. var. furcata	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	X	X	X	·	·	·	·
Bryum sp.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	X	·	X	·	·	X	X	·	·	·	·	·	·	·	·	·	·	·	·
Dicranum bonjeanii De Not.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	X	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	X	·
Weisia sp.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	X	·	·	·	·	·	X	·
Weisia microstoma (Hedw.) C.Müll.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	X	·	X	·	·	·	·	·	·	·	·	X	·	·	·	·	·	·	·
Eurhynchium swartzii (Turn.) Hobk.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	X	·	·	·	·	·	·	·	·	·	X	·	X	·	X	·	·	·	·
Brachythecium velutinum (Hedw.) B.S.G.	·	·	·	·	·	·	·	·	·	·	·	·	·	X	·	·	·	·	·	·	·	·	·	·	·	·	·	·	X	X	·	·	·	·	·
Fissidens adiantoides Hedw.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	X	·	·	X	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Cephalozia connivens (Dicks.) Spruce	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	X	·	·	·	·	·	·	·	·	·	X	·	·	·
Cladonia verticillata (Hoffm.) Schaer.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	X	·	·	·	·	·	·	·	X	·	·	·	·	·	·	·	·	·	·
Fissidens taxifolius Hedw.	·	·	X	X	·	·	·	X	X	X	·	·	·	·	·	·	X	·	·	·	·	·	·	·	·	·	X	X	·	·	·	·	·	·	·
Dicranum scoparium Hedw.	·	·	·	·	·	·	·	·	·	·	·	X	·	X	·	·	·	X	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Entodon orthocarpus (Brid.) Lindb.	·	·	·	·	·	·	·	·	·	·	X	X	·	·	·	X	X	·	·	·	·	·	·	·	·	·	·	·	·	·	·	X	·	·	·
Hylocomium splendens (Hedw.) B.S.G.	·	·	·	·	·	·	X	·	·	·	·	·	X	X	·	X	·	·	·	·	·	·	·	·	·	·	·	X	·	·	·	X	·	·	·
Brachythecium glareosum (Spruc.) B.S.G.	·	·	·	·	·	·	X	·	·	·	·	·	·	X	·	X	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	X	·	·	·
Campylium cf. polygamum (B.S.G.) C.Jens.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	X	·	·	·	·	·	·	·	·
Cladonia foliacea (Huds.) Willd. var. alcicornis (Lightf) Schaer.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	X	·	·	·	·	·	·	·	·	·	·
Pottia lanceolata (Hedw.) C.Müll.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	X	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Frullania dilatata (L.) Dum.	·	·	·	·	·	·	·	·	·	·	·	·	·	X	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Bryum cf. pseudotriquetrum (Hedw.) Schwaegr.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	X	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Fissidens sp.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	X	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Homalothecium sericeum (Hedw.) B.S.G.	·	·	·	·	·	·	·	·	·	·	·	·	·	X	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Calypogeia fissa (L.) Raddi	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	X	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Pellia epiphylla (L.) Corda	·	·	·	·	·	·	X	·	·	·	·	·	·	·	·	·	X	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Peltigera canina Willd. var. rufescens Mudd.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	X	·	·	·	·	·	·
Mnium affine Schwaegr.	·	·	·	·	·	·	·	·	·	·	X	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Ceratodon purpureus (Hedw.) Brid.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	X	·	·	·

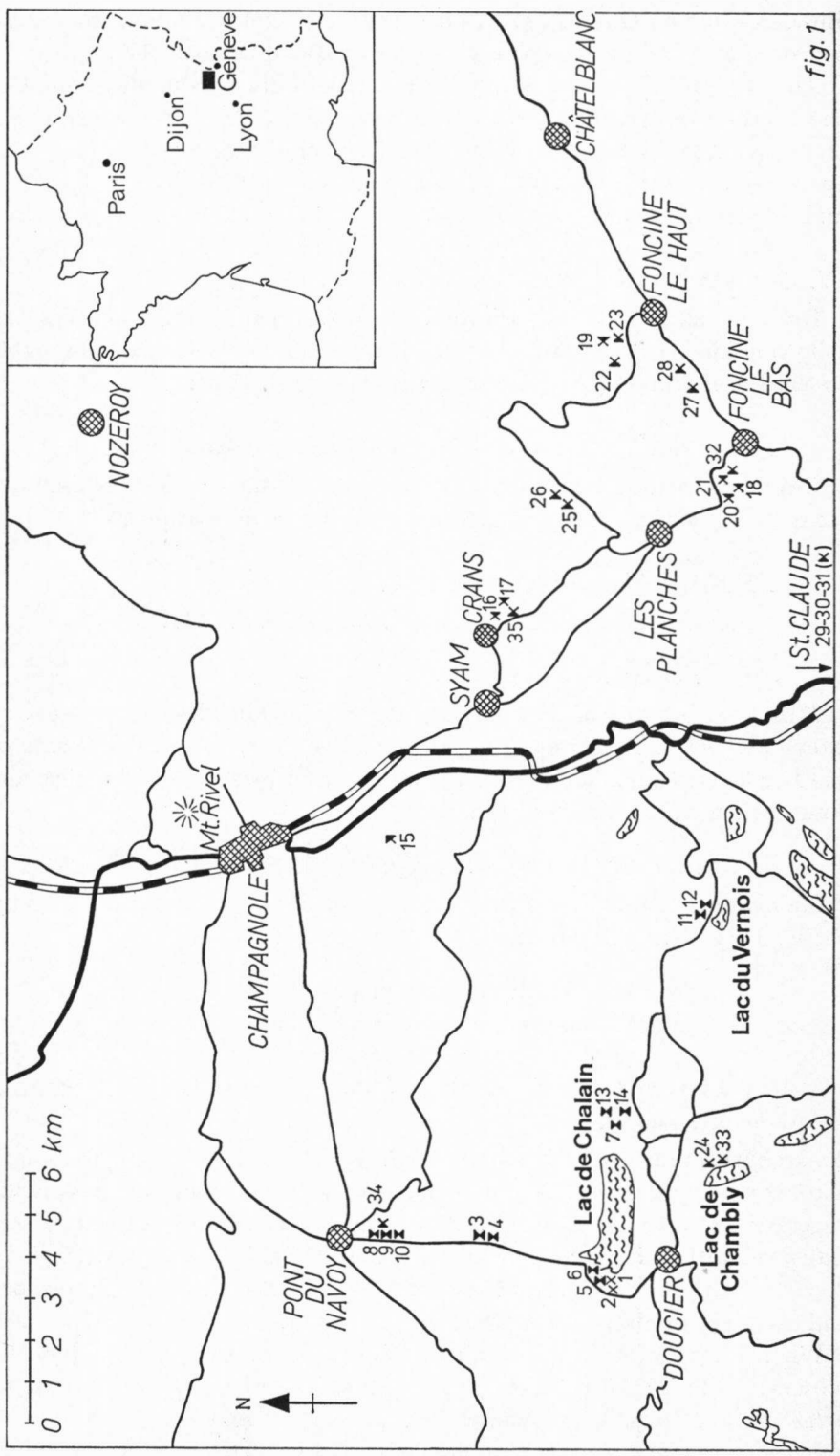
Paris
Dijon
Lyon
Genève
NOZEROY
Mt.Rivel
CHAMPAGNOLE
PONT DU NAVOY
DOUCIER
SYAM
CRANS
LES PLANCHES
St.CLAUDE
29-30-31 (x)
CHÂTELBLANC
FONCINE LE HAUT
FONCINE LE BAS
Lac de Chalain
Lac du Vernois
Lac de Chambly
0 1 2 3 4 5 6 km
N

fig. 1

Eu-Mesobromion Oberd. 1957 and, except the relevés 1 and 2, to the association Mesobrometum collinum (Scherrer 1925) Oberd. 1957.

The letters before the species names in tabel I gives a qualification after the Prodromus der Pflanzengesellschaften, Fasz. 5, Verband des Bromion erecti (BRAUN-BLANQUET & MOOR 1938) and means: A = character species of the association, V = idem of the alliance, 0 = idem of the order, and B = companions.

IV. THE PLANT COMMUNITIES

On the basis of the distribution of phanerogamic plant species the following kinds of vegetation can be distinguished in table I, all assignable to the Mesobromion (Br.-Bl. & Moor 1938) Oberd. 1949:

A. PINGUICULA VULGARIS – BROMUS ERECTUS-VEGETATION.

Only met with in depressions on the banks of the Lac de Chalain. Contains species typical of dry as well as of wet calcareous stations.

B. EU-MESOBROMION OBERD. 1957.

Mesobrometum collinum (Scherr. 1925) Oberd. 1957.

1. *subass. typicum.*

This type occurs chiefly on the plateaus and hillsides facing West or North and is principally used for mowing. However, some areas North of the Lac de Chalain and on its banks were grazed by sheep, but their plant cover belonged to this subassociation.

2. *hypericetosum subass. nov.*

Mainly on South-, South-East-, and East-facing slopes, usually grazed by cattle. This subassociation can be further divided into an

a. Achillea millefolium-variant
b. Teucrium chamaedrys-variant

A. VEGETATION OF PINGUICULA VULGARIS AND BROMUS ERECTUS (relevés 1 and 2).

An area with much relief on the Western bank of the Lac de Chalain near Martigny supports in the depressions a type of limestone grassland-vegetation of an unusual composition. The subsoil consists of calcareous, loamy material of fluvio-glacial origin. The whole area is extensively grazed by sheep. It is situated several tens of meters from the lake shore and about 10 m above the water level; see fig. 1.

When the vegetation was studied, these depressions were dry, but the presence of such species as *Pinguicula vulgaris*, *Carex hostiana*, *Parnassia palustris*, and *Cratoneuron commutatum* indicates clearly that they must be sometimes wet or moist, with a strongly fluctuating groundwater table.

PLATE 1

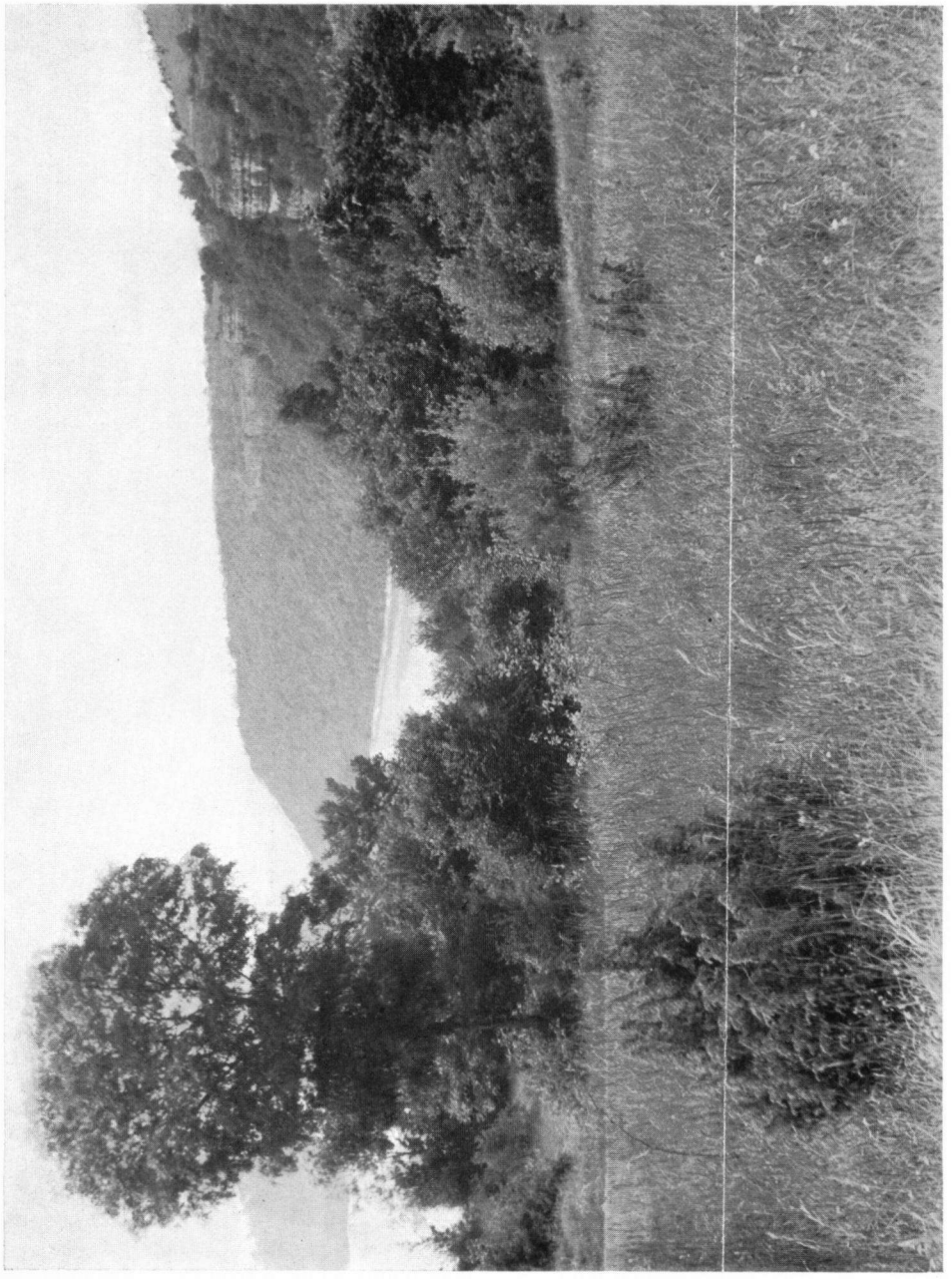

Fig. 2. Limestone grasslands on the plateau between Lac de Chambly and Songeson S.W. of Champagnôle. These are neither mown nor pastured; but sometimes under the vegetation traces of fires were found. In the grasslands seedlings of *Juniperus communis* and *Rosa canina*; at the edge *Corylus avellana*, *Crataegus monogyna*, *Salix sp.*, and *Fraxinus excelsior*. From this place are relevés 24 and 33.

PLATE 2

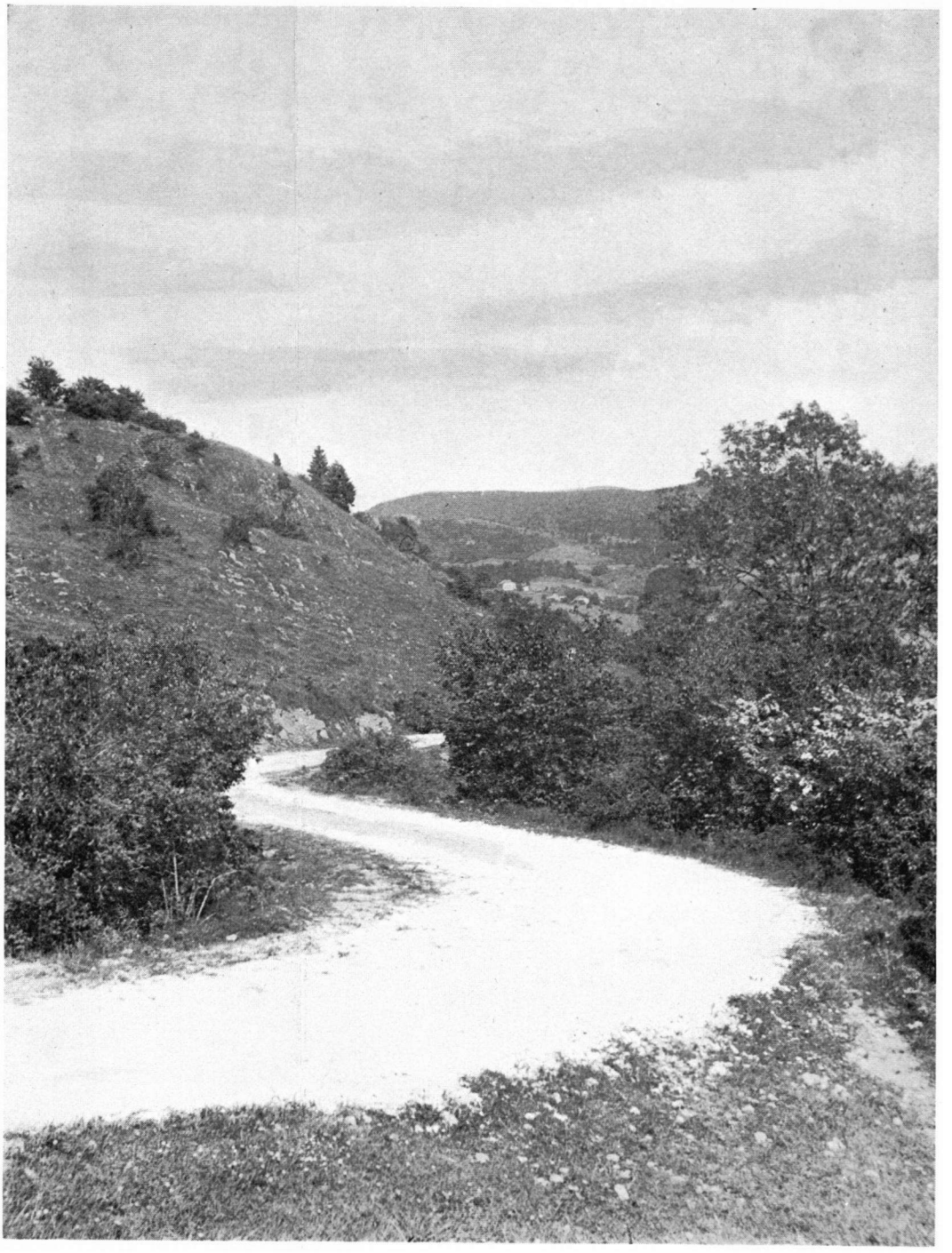

Fig. 3. Limestone grassland-vegetations on a S. facing hillside near Chez Rutillet, between Foncine-le-Haut and Foncine-le-Bas, S.E. of Champagnôle. Extensive grazing by cattle. The thickets consist mainly of *Corylus avellana*, *Crataegus monogyna*, *Fraxinus exelsior*, and *Rosa canina*. Site of relevés 19, 22 and 23.

The presence of *Bromus erectus*, *Cirsium acaulon*, *Hippocrepis comosa*, *Potentilla tabernaemontani*, *Scabiosa columbaria*, *Koeleria gracilis*, *Leontodon hispidus*, etc., compels us to assign the vegetation to the Bromion erecti. It may be transitional to the Caricion davallianae Klika 1934. It also shows some affinity to the Pinguiculo vulgarae – Cratoneuretum Oberd. 1957, alliance Cratoneurion commutati W. Koch 1928 (OBERDORFER 1957).

There is also much resemblance to the subassociation of *Parnassia palustris* of the so called "frische Subassoziations-Gruppe des Gentiano – Koelerietum boreoatlanticum Knapp 1942" distinguished by BORNKAMM (1960) in the vicinity of Göttingen (Central Germany). The most striking difference is the number of species per relevé, in the relevés of Bornkamm on the average (4 relevés) 48 species, not over 57 and not less than 43, in our relevés from the Jura 23 and 22 species of phanerogams and cryptogams, respectively. It should be kept in mind that the plots of Bornkamm measured 9 m², ours only 4 m².

Pinguicula vulgaris, *Carex hostiana*, *Ranunculus repens*, *Tetragonolobus maritimus*, *Koeleria gracilis*, *Hippocrepis comosa*, and *Genista tinctoria* occur in both relevés in the Jura but are absent from Bornkamm's. This is also true for the mosses *Cratoneurum commutatum* and *Tortella densa*. Species common to both localities are, i. a.: *Parnassia palustris*, *Leontodon hispidus*, *Scabiosa columbaria*, *Bromus erectus*, *Linum catharticum*, *Briza media*, *Carex flacca*, *Lotus corniculatus*, and *Trifolium pratense*.

From an area between the Würmsee and the Ammersee in Bavaria S. W. of Munich WIEDMANN (1954) described a transitional type as Schoeno – Brometum; this also resembles to some degree our relevés 1 and 2 from the Jura. Wiedmann published a comprehensive table of 5 relevés containing a total of 52 species of higher plants. Ten of these also occur in our relevés from the Jura, i.a., *Parnassia palustris*, *Pinguicula vulgaris*, *Bromus erectus*, *Hippocrepis comosa*, and *Scabiosa columbaria*.

In an article on the flora and vegetation of the Central Jura TRONCHET (1955) reported the occurence of *Pinguicula vulgaris*, but not from such stations as the one under discussion. POTTIER-ALAPETITE (1943) described the presence of *Parnassia palustris* in the Central Jura in an association of *Plantago serpentina* and *Tetragonolobus siliquosus* (= *T. maritimus*) belonging to the Mesobromion. In this association, and also in the subassociation described by Pottier-Alapetite without *Plantago serpentina* and *Blackstonia perfoliata*, *Parnassia palustris* occurs together with *Tetragonolobus maritimus*. The Plantagini – Tetragonolobetum described by Pottier-Alapetite differs so much, in terms of their overall number, from our vegetation of *Pinguicula vulgaris* and *Bromus erectus* to be classed in the same association.

B. EU-MESOBROMION OBERD. 1957.

The relevés were made in grassland used for mowing or pasture or without any present antropogenic influence. The differences in the pH values only

weakly reflect the differences in the soil from one place to another. The relevés differ also in the direction of exposition and in the slope.

POTTIER-ALAPETITE (1943), in her study of the vegetation of the central-French Jura, described plant communities belonging to the Eu-Mesobromion. The present author failed to find any of her communities in the course of his work South of Champagnôle. Only her subassociation Mesobrometum seselietosum shows much resemblance to the Mesobrometum collinum typicum described below (relevés 3–14).

In the central Jura the limestone grassland-vegetations are mown as well as pastured, which suggests comparison with MÜLLER's data (1966). On the basis of their floristic composition this author divided the 'basiphile Magerrasen' on the Spitzberg near Tübingen (South-West Germany) into two associations. This subdivision tallies with the use by man; the mown Mesobromion grasslands belong to the Onobrychi (viciaefoliae) – Brometum (Scherrer 1925) Th. Müller 1966, the pastured Mesobromion grasslands to the Gentiano – Koelerietum Knapp 1942.

Species regarded as characteristic of and differentiating for the mown Onobrichi-Brometum, e.g. *Bromus erectus*, *Anthyllis vulneraria*, *Primula veris*, *Ophrys insectifera*, *Orchis militaris*, *Dactylis glomerata*, *Galium mollugo*, and *Rhinanthus alectorolophus*, occur in the central French Jura in mown as well as in pastured grasslands; see table I. This is also true for taxa confined for the pastured grasslands on the Spitzberg, e.g. *Cirsium acaulon*, *Gentianella germanica*, and *Ononis repens*. In the Jura only a few characteristic and differential species of the Onobrychi-Brometum on the Spitzberg are confined to mown Mesobromion grasslands or show a notable preference for them, e.g. *Onobrychis viciifolia*, *Centaurea scabiosa*, *Trifolium montanum*, *Gymnadenia conopsea*, and *Tragopogon pratensis*. This seems to indicate that the subdivision of the mown and pastured grasslands on the Spitzberg near Tübingen, based on their floristic composition, as given by MÜLLER (1966), is not valid for the area of the present publication.

1. *Mesobrometum collinum (Scherr. 1925) Oberd. 1957. subass. typicum.* (relevés 3–14).

Relevés 3–6, from vegetations extensively grazed by sheep, are situated on fluvio-glacial deposits near Marigny and on the N.W. shore of the Lac de Chalain, all in level areas; see figure 1. Relevés 7–14, on the other hand, are, with a few exceptions, from vegetations sloping from 15–30°, facing mostly N. or W., and regularly subject to mowing; see figure 4. They are not on fluvio-glacial deposits, but on hillsides with soils derived from the underlaying Jurassic limestone. In spite of these differences in biotic and abiotic milieu factors the floristic composition induces us to assign them all to one and the same subassociation.

With two exceptions (relevés 7 and 14) the pH is about 7. The phanerogamic cover percentage is, except for relevés 3 and 4, always 100. Relevé 15 is

notably intermediate between the Mesobrometum collinum typicum and the next type:

2. *Mesobrometum collinum (Scherr. 1925) Oberd. 1957. subass. nov. hypericetosum.* (relevés 16–35).

This community, too, is pastured as well as mown and occurs on plateaus and also on hillsides facing South, South-East or East; see figure 4. It is found at higher altitude than the preceding subassociation. In the A_1-layer the pH fluctuates between 5 and 7–8. The phanerogamic cover percentage is at least 80. The differential species are: *Hypericum perforatum, Helictotrichon pratensis, Galium mollugo, Sesleria caerulea, Origanum vulgare,* and *Cerastium arvense.* Two variants can be distinguished.

a. Achillea millefolium variant. (relevés 16–21).

This is grazed by cattle and occurs on plateaus and faintly sloping hillsides (less than 20°). It occurs between 790 and 960 m, on the average at 830 m. Furthermore it is characterized by the presence of a number of species preferring some degree of treatment with manure and higher soil moisture. This lead to definite relations with the Arrhenatherion elatioris Br.-Bl. 1925. The differential species are: *Achillea millefolium, Cirsium vulgare, Alchemilla vulgaris, Coeloglossum viride, Veronica chamaedrys, Botrichium lunaria, Luzula campestris, Cynosurus cristatus, Anthoxanthum odoratum,* and *Bellis perennis.* Several characteristic taxa of the order

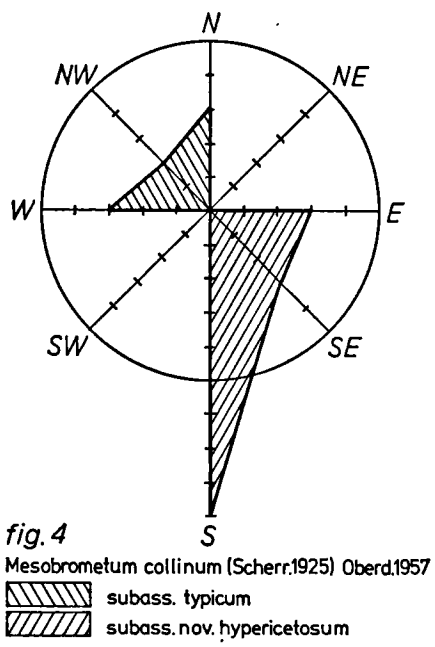

Fig. 4. Direction of exposure of the two subassociations in which relevés were made.

Brometalia, such as *Carlina vulgaris*, *Salvia pratensis*, *Asperula cynanchica*, *Stachys officinalis*, *Onobrychis viciifolia*, and *Koeleria cristata* are almost absent. The same is true for some characteristic taxa of the alliance Mesobromion, e.g. *Globularia elongata* and *Anemone pulsatilla*, and of the association Mesobrometum, e.g. *Gentianella germanica*.

It should be noted that *Orchis morio* and *Orchis ustulata* have a higher presence in this variant than in the other communities. Another orchid, *Coeloglossum viride*, is quite confined to this variant, with a high presence. This may be largely dependent on the altitude at which the variant occurs and agrees with TRONCHET's statement (1955) that *Coeloglossum viride* prefers 'prairies des plateaux supérieurs et prairies culminales' in the Jura. This was also supposed to hold for *Botrichium lunaria*. As shown by table I, also in the present investigation this species was twice met with in the Achillea millefolium variant and once in the only relevé from the Teucrium chamaedrys variant above 1000 m.

b. Teucrium chamaedrys variant. (relevés 22–35).

This community is pastured or mown or sometimes at present left untouched. Differential species are *Teucrium chamaedrys*, *Vicia cracca*, *Sedum sexangulare* and *acre*, *Agrimonia eupatoria*, and *Dianthus carthusianorum*. The slopes on which it occurs face South or East, with an angle of 15–45°. On the average the altitude is 780 m, the extremes are 500 m and 1020 m, respectively.

V. THE PLACE OF THE CRYPTOGAMS

A. General notes.

SCHERRER (1925) reported 8 species of mosses and 3 of lichens from the limestone grassland-vegetations in the Swiss Jura Mountains but noted that through lack of knowledge the moss layer was not exhaustively sampled. All taxa listed by Scherrer occur also in the presently described limestone grasslands from the central French Jura. These are[1]): *Cylindrothecium concinnum* (= *Entodon orthocarpus (Brid.) Lindb.*), *Brachythecium glareosum*, *Ditrichum flexicaule*, *Ctenidium molluscum*, *Chrysohypnum chrysophyllum* (= *Campylium chrysophyllum (Brid.) J. Lange*), *Rhytidium rugosum*, *Tortella tortuosa*, *Cladonia furcata*, *Cladonia pyxidata*, and *Peltigera canina*. The two firstnamed species occured in all of the relevés of Scherrer.

In Braun-Blanquet & Moor's description of the Mesobrometum erecti typicum not a single taxon of cryptogams is listed; they reported, however, some mosses said to be typical of the Xerobrometum brittannicum Br.-Bl. & Moor 1938 prov. All species recorded by them were also encountered during the present author's work in the Jura; the same is true for an

[1]) The names are cited as they appear in Scherrer's list. When they are outmoded, the name as appearing in the Index Muscorum (VAN DER WIJK & collab. 1969) is added in parentheses.

investigation in the South of Engeland made in 1970, in limestone grasslands belonging not to the Xerobrometum but to the Mesobrometum (unpubl.; in prep.).

TANSLEY (1939), was also of the opinion that the greater part of the English chalk- and limestone grasslands belongs to the Mesobrometum, and listed the cryptogams occuring in these vegetations in extenso. The taxa found to be most frequent were *Pseudoscleropodium purum* and *Camptothecium lutescens*. The only lichens of some importance were *Cladonia rangiformis* and *Cladonia sylvatica*.

SHIMWELL, in two recent papers (1971a, b) on the limestone grasslands of Great Britain referable to the Eu-Mesobromion, listed more than 70 taxa of cryptogams from this vegetation type.

About 1/3 of the species were also found in our relevés in the French Jura. More will be said in the present author's forthcoming publication on the limestone grasslands of South England and their cryptogams.

In POTTIER-ALAPETITE's work on the central French Jura (1943) she listed only 4 mosses from vegetations belonging to the Mesobrometum seselietosum, viz. *Pseudoscleropodium purum*, *Hylocomium splendens*, *Camptothecium lutescens*, and *Rhytidium rugosum*. These mosses occured only from 2–5 times in a total of 25 relevés. With the exception of a lichen, *Cladonia endivaefolia* (= *Cladonia foliacea (Huds.) Schaer. var. convoluta (Vain.)*[1]), all the cryptogams reported by her from other vegetations in the Jura Mountains appear also in our table II.

In the subdivision of the Irish Mesobromion cryptogams also play an important part (BRAUN-BLANQUET & TÜXEN 1952); it contains tens of species of mosses and lichens.

In the limestone grasslands in the extreme South of the Netherlands (prov. of Limburg) BARKMAN (1953) came across a record number of cryptogams, viz. 88 taxa. About one half of these extend to the French Jura.

Finally a study of BRAND (1970) may be mentioned, dealing with Mesobromion grasslands in two areas of Western Germany, namely, the Eifel and the Teutoburgerwald, S. W. of Osnabrück. There he found 32 and 33 different taxa of bryophytes and lichens, respectively.

B. Cryptogam communities in the Mesobromion of the French Jura.

When collecting representative cryptogam samples in the relevés the author did not pay any attention to microcenoses of cryptogams. The taxa listed in table II may represent per relevé one or more microcenoses or, in case of similar growthform or way of exploitation of the habitat, one or several synusia (BRAUN 1968, BARKMAN 1968, 1970).

[1]) The name of this lichen is cited as appearing in POTTIER-ALAPETITE (1943). In parentheses the name as appearing in: Schlüssel europäischer Flechten (POELT, J) 1969. 3301-Lehre. The nomenclature of the lichens in the present paper is based on the study of Poelt.

A. PINGUICULA VULGARIS – BROMUS ERECTUS VEGETATION.

This community contains two mosses, *Cratoneuron commutatum* and *Tortella densa*, which do not occur together in any other relevé. The firstnamed taxon has been reported several times from similar, sometimes wet, calcareous stations, also in the Jura Mountains (i.a. HILLER 1954, TRONCHET 1955). It also occurs in a comparable vegetation, like the Pinguiculo vulgarae – Cratoneuretum Oberdorfer 1957. However, *Tortella densa* was found neither by WIEDMANN (1954) nor by OBERDORFER (1957) in communities bearing much resemblance to our Pinguicula vulgaris – Bromus erectus vegetation. In the Würmsee and the Ammersee region both mosses are quite absent from an otherwise quite comparable vegetation type, the Schoeno - Brometum Wiedmann 1954, which is as a whole rich in cryptogams. WIEDMANN (1954) gave a synoptic table of 18 taxa of cryptogams occuring in the Schoeneto – Brometum. BRAUN (1968), too, after studying extensively the cryptogam communities of "Kalkflachmoore" in Bavaria failed to record the occurrence side by side of *Cratoneuron commutatum* and *Tortella densa*. Phytogeographically notable is the report by MEYLAN (cited by HILLIER 1954) of *Tortella densa* from a station at ca. 1 300 m altitude near Le Suchet in the Swiss Jura, a locality ca. 40 km E. of Champagnôle. The species was met with by the present author in relevé 25, between Chalesmes and Les Planches, ca. 20 km E. of the station near the Lac de Chalain; see figure 1.

In CRUNDWELL & NYHOLM'S work on Tortella (1962) *Tortella densa* is not reported from the Jura Mountains.

B. EU-MESOBROMION

1. *Mesobrometum collinum typicum.*

The number of cryptogams in the relevés of this community fluctuates between 3 and 13. There are, as a whole, 20 different taxa of bryophytes, on the average 5 per relevé. Lichens are quite absent; see table II. The bryophytes suggest a subdivision of the community, viz. between relevés 3–7 on the one and 8–14 on the other hand. In the first group *Calliergonella cuspidata* and *Campylium chrysophyllum* show a high degree of presence, whereas the second is characterized by *Ctenidium molluscum*, *Rhytidiadelphus triquetrus*, and *Pseudoscleropodium purum*. This differentiation is not borne out by the phanerogams, although they, too, show some differences between the two types. Relevés 3–7 lack, e.g. *Primula veris*, *Orchis ustulata*, *Gentianella germanica*, *Hieracium pilosella*, *Anemone pulsatilla*, *Plantago lanceolata*, and *Campanula rotundifolia*.

2. *Mesobrometum collinum hypericetosum.*

The subdivision into two variants tallies with the distribution of the cryptogams. The community yielded 38 taxa of cryptogams, 3–16 per relevé, on the average 8.

a. Achillea millefolium variant.

This variant lacks a number of taxa occuring with a high degree of presence on the next: *Tortella tortuosa, Cladonia pyxidata var. chlorophaea, Pleurochaete squarrosa, Ditrichum flexicaule, Tortella inclinata, Cladonia rangiformis,* and *Cladonia furcata var. furcata.*

b. Teucrium chamaedrys variant.

All taxa of lichens found by the author in the limestone grasslands of the French Jura occur in this variant.

In the moorlands and grasslands of Bavaria BRAUN (1968) distinguished a number of synusia consisting of cryptogams belonging to taxa appearring in Table II. The only of his synusia found by the present author in the Jura was that of Rhytidium rugosum Poelt 1954, which, besides this species, contains: *Abietinella abietina, Hypnum cupressiforme var. lacunosum, Thuidium philibertii,* and *Entodon orthocarpus.* It is particularly well developed in the subassociation Mesobrometum collinum hypericetosum. In Calluna heathlands, Nardus stricta grassland, and light, dry forests BRAUN found a synusia of *Pleurozium schreberi,* containing besides *Cladonia furcata, Pseudoscleropodium purum, Cladonia pyxidata,* and *Ditrichum flexicaule.* A fragmentary form of this was found by the author in the Teucrium chamaedrys variant. It is notably that these taxa occur together in the Jura, too, but without the acidiphilous *Pleurozium schreberi.*

Finally it should be mentioned that our lists of cryptogam taxa from the limestone grasslands of the central French Jura are incomplete, as during our investigations in June numerous acrocarpous mosses were scarcely or no longer to be found. *Pottia lanceolata,* for example, was only found as a single plant with a sporogonium in a sample of *Fissidens adianthoides.* Fieldwork in spring would undoubtedly lead to an expansion of the list of cryptogams given here.

VI. *LOCALITIES OF THE RELEVÉS*

1–2 : N.W. shore of the Lac de Chalain. 13–VI–1969.
3–4 : N. of Marigny along the road to Pont-du-Navoy (D 27). 13–VI–1969.
5–6 : N.W. shore of the Lac de Chalain. 13–VI–1969.
7 : Along the road from Fontenu to Songeson, S.E. of the Lac de Chalain. 16–VI–1969.
8–10: S. of Pont-du-Navoy. 7–VI–1969.
11–12: N. of the Lac du Vernois. 16–VI–1969.
13–14: Along the road from Fontenu to Songeson. 16–VI–1969.
15 : N. of Le Vaudioux, S. of Champagnôle. 17–VI–1969.
16–17: Plateau between Crans and Les Chalesmes, S.E. of Champagnôle. 6–VI–1969.

18 : E. of the road from Les Planches to Foncine-le-Bas. 9–VI–1969.
19 : Near Chez Rutillet, N. of the road from Foncine-le-Haut to Foncine-le-Bas. 9–VI–1969.
20–21: E. of the road Les Planches to Foncine-le-Bas. 9–VI–1969.
22–23: Near Chez Rutillet, N. of the road Foncine-le-Bas to Foncine-le-Haut. 9–VI–1969.
24 : Between the Lac de Chambly and Songeson. 7–VI–1969.
25–26: N. of Les Planches, near Champagnôle. 17–VI–1969.
27–28: Steep slope on the left bank of the river Saine, between Foncine-Haut and Foncine-le-Bas. 8–VI–1969.
29–31: S. of St. Claude along the road to Bellegarde. 11–VI–1969.
32 : E. of the road from Les Planches to Foncine-le-Bas. 9–VI–1969.
33 : Between Lac de Chambly and Songeson. 7–VI–1969.
34 : S. of Pont-du-Navoy. 7–VI–1969.
35 : Along the road from Crans to Les Planches, near Champagnôle. 12–VI–1969.

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Botanical Museum and Herbarium,
State University – Utrecht.

REFERENCES

BACH, R. et al., Die Nomenklatur der Pflanzengesellschaften. Mitt. flor.-soz. Arbeitsgem. N. F. 9, 118–123. Stolzenau/Weser. (1962).

BARKMAN, J. J., De kalkgraslanden van Zuid-Limburg. B. De Cryptogamen. Publ. Natuurhist. Gen. Limb. 6, 21–30 (1953).

————, Das synsystematische Problem der Mikrogesellschaften innerhalb der Biozönosen. In: Pflanzensoziologische Systematik. Ber. Intern. Symp. Stolzenau/Weser 1964, 21–48 (1968).

————, Enige nieuwe aspecten inzake het probleem van synusiae en microgezelschappen. Miscellaneous Papers 5, 85–116. Landbouwhogeschool Wageningen (1970).

BORNKAMM, R., Die Trespen-Halbtrockenrasen im oberen Leinegebiet. Mitt. flor.-soz. Arbeitsgem. N. F. 8, 181–208. Stolzenau/Weser. (1960).

BRAND, M., Kalkgraslanden van Eifel en Teutoburgerwoud. Kruipnieuws 32, (1): 1–12 (1970).

BRAUN, W., Die Kalkflachmoore und ihre wichtigsten Kontaktgesellschaften im Bayrischen Alpenvorland. Diss. Botanicae. Band 1. 3301 Lehre. 134 pp. (1968).

BRAUN-BLANQUET, J. & M. MOOR, Verband des Bromion erecti. Prodromus der Pflanzengesellschaften 5. Comité Int. du Prod. Phytos. 64. pp. Montpellier, (1938).

BRAUN-BLANQUET, J. & R. TÜXEN, Irische Pflanzengesellschaften. In: Die Pflanzenwelt Irlands. Veröff. Geob. Inst. Rübel in Zürich. Bern-Stuttgart. 25, 224–421 (1952).

BRAUN-BLANQUET, J. Pflanzensoziologie. 3e Aufl. 865 pp. Wien-New York. (1964).

CRUNDWELL, A. C. & E. NYHOLM, Notes on the Genus Tortella I. Trans. Brit. Bryol. Soc. Vol. 4, (2), 187–193 (1962).

DIEMONT, W. H. & A. J. H. M. VAN DE VEN, De kalkgraslanden van Zuid-Limburg. A. De Phanerogamen. Publ. Natuurhist. Gen. Limb. 6, 1–20. Maastricht. (1953).

GIGON, A., Stickstoff- und Wasserversorgung von Trespen-Halbtrockenrasen (Mesobromion) im Jura bei Basel. Ber. Geobot. Inst. ETH. Stiftg. Rübel, Zürich 38, 28–85 (1968).

HILLIER, L., Catalogue des Mousses du Jura. Ann. Scient. Univers. Besançon. Botanique. 2 (3), 221 pp. (1954).

KAISER, E., Die Pflanzenwelt des hennenbergisch-fränkischen Muschelkalkgebietes. Feddes Repert. Beih. 44. Berlin-Dahlem. (1930).

KNAPP, R., Zur Systematik der Wälder, Zwergstrauchheiden und Trockenrasen des eurosibirischen Vegetationskreises. Manuskript; 12e. Rundbrief der Zentralstelle für Vegetationskartierung des Reiches. 84 pp.

KOCH, K., Die Halbtrockenrasengesellschaft am Lengeriche Berge unter besonderer Berücksichtigung der geschützten und schutzbedürftigen Gewächse. Abh. Westf. Prov.-Mus. Naturkunde (2), 1–8 (1931).

LIBBERT, W., Pflanzensoziologische Untersuchungen im mittleren Kocher- und Jagsttale. Veröff. Württ. Landsstellen f. Naturschutz. 15 (1939).

MÜLLER, TH., Die Gebüsch-, Saum-, Trocken- und Halbtrocken-rasengesellschaften. In: Der Spitzberg bei Tübingen. Ludwigsburg. p. 428–475 (1966).

OBERDORFER, E., Süddeutsche Pflanzengesellschaften. Pflanzensoziologie Band 10. Jena. 564 pp. (1957).

POTTIER-ALAPETITE, G., Recherches phytosociologiques et historiques sur la végétation du Jura central et sur les origines de la flora jurassienne. S.I.G.M.A. Comm. 81, 333 pp. Tunis, (1943).

SCHERRER, M., Vegetationsstudien im Limmattal. Veröff. des Geobot. Inst. Rübel in Zürich. 2, 116 pp. (1925).

SCHLEUMER, H., Die Pflanzenwelt des Kaiserstuhls. Feddes Beihefte 77, 170 pp. Dahlem bei Berlin (1934).

SCHWICKERATH, M., Das Hohe Venn und seine Randgebiete. Vegetation, Boden und Landschaft. Jena. 278 pp. (1944).

————, Die Vegetation der Kalktriften (Bromion-erecti-Verband) des nördlichen Westdeutschlands. Bot. Jahrb. 65, 212–252. (1932).

SHIMWELL, D. W., Festuco-Brometea Br.-Bl. & R. Tx. 1943 in the British Isles: The Phytogeography and Phytosociology of Limestone Grasslands. Part I(a) General Introduction; (b) Xerobromion in England. Vegetatio 23, (1–2) 1–27 (1971a).

————, Festuco-Brometea Br.-Bl. & R. Tx. 1943 in the British Isles: The Phytogeography and Phytosociology of Limestone Grasslands. Part II. Eu-Mesobromion in the British Isles. Vegetatio 23, (1–2), 29–60 (1971b).

ROCHOW, M., Die Pflanzengesellschaften des Kaiserstuhls. Zentralstelle f. Naturschutz und Landschaftspflege. 8. (1951).

TANSELY, A. G., The British Islands and their vegetation. Cambridge. 930 pp. (1939).
TRONCHET, A., Paysages botaniques et groupements végétaux du Jura Central. Ann. Scient. Univers. Besançon Bot. 2 (6), 19–44 (1955).
WIEDMANN, W., Die Trockenrasen zwischen Würm- und Ammersee. Ber. bot. Ges. zur Erf. der heim. Flora. 30, 126–162 (1954).
ZOLLER, H., Die Arten der Bromus erectus Wiesen des Schweizer Juras. Veröff. Geobot. Inst. Rübel in Zürich. 28, Zürich. 283 pp. (1954a).
————, Die Typen der Bromus erectuswiesen des Schweizer Juras. Beitr. Geobot. Landesaufn. der Schweiz. 33, Zürich. 309 pp. (1954b).