The genus Bryobia and the species Bryobia praetiosa Koch

by
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I. Introduction

The question of how to consider *Bryobia praetiosa* Koch as a very limited species or as a species composed of biological strains, feeding on different foodplants, has repeatedly been a subject of discussion. A synopsis is given of the main literature dealing with the genus *Bryobia* and in particular with *Bryobia praetiosa,* and the writers mention the results of their transfer experiments.

II. General survey

a. Geographical distribution. The genus *Bryobia* is worldwide distributed. Though most of the species have been found between 20° and 60° N. and S. latitude, there are finding-places near the equator (Columbia) and at a very northern latitude, viz. at Spitzbergen. Table 1 gives a distribution survey in detail and shows that *B. praetiosa* has been found in many European countries, N. Africa (Morocco), Egypt, S. Africa, Canada and the United States, Argentina, Australia and New Zealand. It is an almost cosmopolitan species.

b. Foodplants. The different *Bryobia* species feed on various plant genera.

Webster (1912) mentions, that *B. pratensis* is found largely on clover (*Trifolium pratense*) and blue grass east of the semiarid region and largely as on orchard pest west of about longitude 100°. This mite is a general feeder and may be expected to attack clover, alfalfa, blue grass and probably other grasses, among them timothy. It may affect oats and probably other grains including buckwheat.

As to *B. praetiosa* in the United States Mc Gregor (1950) notes: apple, barley, burr clover, cantaloupe, Capsella sp., cherry, citrus, clover, flax, grain, grass, Iris sp., Malva sp., mustard, Narcissus sp., orange, peach, pear, Picea engelmani, prune, sweet pea, sycamore, walnut, weeds, wheat, wild oat.

Table 1 gives also a list of the foodplants on which *Bryobia* species have been mentioned in literature. As appears from this table *B. praetiosa* has also been found on: almond, apricot, blackberry, butter burr, currant, gooseberry, ivy, lucerne, pea, pear, plum, Poa pratensis, raspberry, strawberry, Thuja, Triticum repens, vine, violet.

III. Systematics

With regard to the "species" of the genus *Bryobia* (Cl. Arachnoïdea — O. Acari — S.o. Trombidiformes — fam. Tetranychidae) the systematic is rather complicated and partly dubious. The reason for this is the fact, that many mites collected from different foodplants have been described as new species. The very slight,

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Table 1. Distribution and foodplants of Bryobia species.

	Name of species:	foodplant:	Literature cited: [1])		
Europe.					
Belgium	*praetiosa*	apple, gooseberry	COOREMAN, J.	—	1944: 4
,,	,,	fruit trees, gooseberry	WYBOU, A.	—	1951: 7
Denmark	,,	gooseberry	FERDINANDSEN, C. et al.	—	R. **7**, 1919: 8
,,	sp.	lucerne, clover	FERDINANDSEN C. & ROSTRUP, S.	—	R **9**, 1921: 3
,,	*ribis*	currant	,, ,,	—	R. **9**, 1921: 3
,,	sp.	ivy, apple	Anonymus	—	R. **22**, 1934: 6
Germany	*graminum*	Triticum repens, Alopecurus pratensis, Ranunculus repens	GEYSKES, D. C.	—	1939: 3
,,	*nobilis*	gooseberry, Ribes alpinum	THOMAS, F.	—	1894: 4
,,	*ribis*	mosses	HANSTEIN, R. VON	—	1902: 1
,,	*praetiosa*	ivy, gooseberry, apple, cherry, blackberry, violet, butter bur	ZACHER, F.	—	1922:
,,	,,	vine, gooseberry, currant	KRAMER, O.	—	1936: 1
,,	,,	pear, apple, peach, plum, cherry, gooseberry, ivy	ROESLER, R.	—	1952:
England	*speciosa*	ivy, gooseberry	MICHAEL, A. D.	—	1892: 1
,,	*praetiosa*	ivy, gooseberry	ORMEROD, E. A.	—	1893:
,,	sp.	apple	THEOBALD, F. V.	—	R. **1**, 1913: 2
,,	sp.	gooseberry, currant strawberry	WARBURTON, C.	—	R. **11**, 1923: 2
,,	*praetiosa*	pear	WITHYCOMBE, C. L.	—	R. **12**, 1924: 2
Finland	,,	gooseberry, currant	VAPPULA, N. A.	—	R. **24**, 1936: 3
France	,,	cherry, strawberry	PUSSARD	—	(see ANDRÉ 1941: 2
,,	sp.	orchard trees	WILLAUME, F.	—	R. **18**, 1930: 2
Ireland	sp.	gooseberry	SHERRARD, O.	—	R. **14** 1926: 1
Italy	*speciosa*	??	BERLESE	—	(see GEYSKES 1939: 1
Netherlands	*nobilis*	gooseberry, ivy, peach	RITZEMA BOS, J.	—	1894: 2
,,	*ribis*	gooseberry, currant, Ribes alpinum	SCHOEVERS, T. A. C.	—	1919: 1
,,	*praetiosa*	Narcissus, Thuja	POETEREN, N. VAN	—	1924:
,,	*sarothamni*	Sarothamnus vulgaris	GEYSKES, D. C.	—	1939: 1
,,	*praetiosa*	ivy	,, ,,	—	1939: 1
,,	,,	peach	Tuinb. gids	—	1952: 43
Norway	*ribis*	raspberry	SCHØYEN. T. H.	—	R. **4**, 1916: 50
,,	*praetiosa*	gooseberry, pear, apple, ivy	FJELDDALEN, J.	—	1952: 1
Scotland	*humeralis*	mosses	HALBERT	—	(see GEYSKES 1939: 1
Spitzbergen	*serrata*	??	THOR, S.	—	(see ANDRÉ 1941: 43
Sweden	*praetiosa*	gooseberry	TRÄGÅRDH, I.	—	R. **2**, 1914: 16
,,	*borealis*	grasses	OUDEMANS, A. C.	—	(see GEYSKES 1939: 1
Ukraine	*ribis*	gooseberry	PACZOSKI, J. K.		R. **3**, 1915: 4
N.- and S. America					
Argentina	*praetiosa*	apple	GREENE, H. D.	—	R. **20**, 1932: 65

[1]) R = Review of Appl. Ent. For the other data see literature list, page 335—336.

Table 1. Distribution and foodplants of Bryobia species.

	Name of species:	foodplant	Literature cited: [1])
Canada			
B. Columbia)	*praetiosa*	deciduous trees, grasses	VENABLES, E. P. — R. **31**, 1943 : 364
N. a Scotia)	,,	apple	NESBITT, H. H. J. — R. **35**, 1947 : 411
O ario)	*pratensis*	plum	CAESAR, L. — R. **1**, 1913 : 405
,,	,,	quince, apricot, almond peach	TREHERNE, R. C. — R. **6**, 1918 : 23
Q bec)	,,	clover, cereals	DU PORTE, E. M. — R. **4**, 1916 : 485
I. A.(Columbia)	,,	clover, lucerne, beans	FIGUEROA, J. — R. **9**, 1921 : 207
A ona)	*brevicornis*	lucerne	EWING, H. E. — 1922 : 10
C ifornia)	*pratensis*	apple	WELDON, G. P. — R. **2**, 1914 : 553
,,	,,	almond, plum, peach	DE ONG, E. R. — R. **9**, 1921 : 513
,,	*praetiosa*	lucerne	CARTWRIGHT, W. B. et al. — R. **21**, 1933 : 594
,,	,,	walnut, peach	BOYCE, A. M. — R. **27**, 1939 : 261
I ho)	*pratensis*	orchard trees, clover	SMITH, R. H. — R. **11**, 1923 : 12
K nsas)	*praetiosa*	apple	Anonymus — R. **15**, 1927 : 268
K ntucky)	,,	blue grass	GARMAN, H. — R. **15**, 1927 : 540
M ntana)	*pratensis*	clover, sweet peas	COOLEY, R. A. — R. **2**, 1914 : 536
N braska)	*longicornis*	*Bikukulla cucullana* L.	EWING, H. E. — 1922 : 663
N . Jersey)	*praetiosa*	clover, fruit trees	WEISS, H. B. — R. **3**, 1915 : 566
N . York)	,,	*Narcissus, Agropyron repens*	BLANTON, F. S. and HAASIS, F. A. — 1942 : 413, 415
egon)	,,	apple, apricot, pear, plum, peach	WEBSTER, R. L. — 1932 : 10
N. Carolina)	,,	clover, lucerne, pea	,, ,, — 1932 : 10
N. Dakota)		plum, cherry	SEVERIN, H. C. — R. **7**, 1919 : 183
Utah)	*pratensis*	wheat, barley, oat, wild grasses	DOANE, R. W. — R. **5**, 1917 : 507
Washington)	*praetiosa*	raspberry	FRANK, A. — R. **8**, 1920 : 208
,,	,,	fruit trees	NEWCOMER, E. C. & YOTHERS M. A. — R. **16**, 1928 : 432
,,	*pratensis*	sugar cane	HOLLOWAY, T. E. & LOFTIN, U. C. — R. **8**, 1920 : 79
Africa.			
Egypt	sp.	"lebbek"-tree	WILLCOCKS, F. C. — R. **2**, 1914 : 505
,,	*praetiosa*	??	TRÄGÅRDH, I. — R. **2**, 1914 : 169
Morocco	,,	almond, pear	ANDRÉ, M. — 1941 : 259
S. Africa	sp.	plum	MALLY, C. W. — R. **9**, 1921 : 84
Asia.			
Formosa	sp.	rose	KISHIDA, K. — R. **24**, 1936 : 274
Punjab	sp.	*Chrysanthemum*	SAPRA, A. N. — R. **29**, 1941 : 269
Australasia.			
N.S. Wales)	*praetiosa*	apple, pear	GURNEY, W. B. — R. **3**, 1915 : 492
Queensland)	,,	*Citrus*	BENSON, A. H. — R. **6**, 1918 : 112
Sth. Austr.)	,,	apple, pear	KEMP, H. K. — R. **36**, 1948 : 246
Tasmania)	*pratensis*	apple	THOMAS, P. H. — 1926 : 188
,,	*praetiosa*	apple, almond, peach plum, clover, grasses	EVANS, J. W. — R. **31**, 1943 : 311
Victoria)	,,	apple, pear, almond fruit trees	WARD, K. M. — R. **21**, 1933 : 480
New Zealand	*praetiosa*	apple	MILLER, D. — R. **10**, 1922 : 467

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,,	,,	fruit trees, gooseberry	WYBOU, A. — 1951:
Denmark	,,	gooseberry	FERDINANDSEN, C. et al. — R. 7, 1919:
,,	sp.	lucerne, clover	FERDINANDSEN C. & ROSTRUP, S. — R 9, 1921:
,,	*ribis*	currant	,, ,, — R. 9, 1921:
,,	sp.	ivy, apple	Anonymus — R. 22, 1934:
Germany	*graminum*	Triticum repens, Alopecurus pratensis, Ranunculus repens	GEYSKES, D. C. — 1939:
,,	*nobilis*	gooseberry, Ribes alpinum	THOMAS, F. — 1894:
,,	*ribis*	mosses	HANSTEIN, R. VON — 1902:
,,	*praetiosa*	ivy, gooseberry, apple, cherry, blackberry, violet, butter bur	ZACHER, F. — 1922:
,,	,,	vine, gooseberry, currant	KRAMER, O. — 1936:
,,	,,	pear, apple, peach, plum, cherry, gooseberry, ivy	ROESLER, R. — 1952:
England	*speciosa*	ivy, gooseberry	MICHAEL, A. D. — 1892:
,,	*praetiosa*	ivy, gooseberry	ORMEROD, E. A. — 1893:
,,	sp.	apple	THEOBALD, F. V. — R. 1, 1913:
,,	sp.	gooseberry, currant strawberry	WARBURTON, C. — R. 11, 1923:
,	*praetiosa*	pear	WITHYCOMBE, C. L. — R. 12, 1924:
Finland	,,	gooseberry, currant	VAPPULA, N. A. — R. 24, 1936:
France	,,	cherry, strawberry	PUSSARD — (see ANDRÉ 1941:
,,	sp.	orchard trees	WILLAUME, F. — R. 18, 1930:
Ireland	sp.	gooseberry	SHERRARD, O. — R. 14 1926:
Italy	*speciosa*	??	BERLESE — (see GEYSKES 1939:
Netherlands	*nobilis*	gooseberry, ivy, peach	RITZEMA BOS. J. — 1894:
,,	*ribis*	gooseberry, currant, Ribes alpinum	SCHOEVERS, T. A. C. — 1919:
,,	*praetiosa*	Narcissus, Thuja	POETEREN, N. VAN — 1924:
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Scotland	*humeralis*	mosses	HALBERT — (see GEYSKES 1939:
Spitzbergen	*serrata*	??	THOR, S. — (see ANDRÉ 1941:
Sweden	*praetiosa*	gooseberry	TRÄGÅRDH, I. — R. 2, 1914:
,,	*borealis*	grasses	OUDEMANS, A. C. — (see GEYSKES 1939:
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ntario)	*pratensis*	plum	CAESAR, L. — R. 1, 1913: 405
,,	,,	quince, apricot, almond peach	TREHERNE, R. C. — R. 6, 1918: 23
,,	,,	clover, cereals	DU PORTE, E. M. — R. 4, 1916: 485
uebec)	,,	clover, lucerne, beans	FIGUEROA, J. — R. 9, 1921: 207
S A (Columbia)	*brevicornis*	lucerne	EWING, H. E. — 1922: 10
izona)	*pratensis*	apple	WELDON, G. P. — R. 2, 1914: 553
alifornia)	,,	almond, plum, peach	DE ONG, E. R. — R. 9, 1921: 513
,,	*praetiosa*	lucerne	CARTWRIGHT, W. B. et al. — R. 21, 1933: 594
,,	,,	walnut, peach	BOYCE, A. M. — R. 27, 1939: 261
,,	*pratensis*	orchard trees, clover	SMITH, R. H. — R. 11, 1923: 12
daho)	*praetiosa*	apple	Anonymus — R. 15, 1927: 268
ansas)	,,	blue grass	GARMAN, H. — R. 15, 1927: 540
entucky)	*pratensis*	clover, sweet peas	COOLEY, R. A. — R. 2, 1914: 536
ontana)	*longicornis*	*Bikukulla cucullana* L.	EWING, H. E. — 1922: 663
ebraska)	*praetiosa*	clover, fruit trees	WEISS, H. B. — R. 3, 1915: 566
w. Jersey)	,,	*Narcissus, Agropyron repens*	BLANTON, F. S. and HAASIS, F. A. — 1942: 413, 415
ew. York)			
Oregon)	,,	apple, apricot, pear, plum, peach	WEBSTER, R. L. — 1932: 10
,,	,,		,, ,, — 1932: 10
th. Carolina)	,,	clover, lucerne, pea	SEVERIN, H. C. — R. 7, 1919: 183
th. Dakota)		plum, cherry	
Utah)	*pratensis*	wheat, barley, oat, wild grasses	DOANE, R. W. — R. 5, 1917: 507
Washington)	*praetiosa*	raspberry	FRANK, A. — R. 8, 1920: 208
,,	,,	fruit trees	NEWCOMER, E. C. & YOTHERS M. A. — R. 16, 1928: 432
,,	*pratensis*	sugar cane	HOLLOWAY, T. E. & LOFTIN, U. C. — R. 8, 1920: 79
frica.			
gypt	sp.	"lebbek"-tree	WILLCOCKS, F. C. — R. 2, 1914: 505
,,	*praetiosa*	??	TRÄGÅRDH, I. — R. 2, 1914: 169
orocco	,,	almond, pear	ANDRÉ, M. — 1941: 259
Africa	sp.	plum	MALLY, C. W. — R. 9, 1921: 84
sia.			
ormosa	sp.	rose	KISHIDA, K. — R. 24, 1936: 274
unjab	sp.	*Chrysanthemum*	SAPRA, A. N. — R. 29, 1941: 269
ustralasia.			
N.S. Wales)	*praetiosa*	apple, pear	GURNEY, W. B. — R. 3, 1915: 492
Queensland)	,,	*Citrus*	BENSON, A. H. — R. 6, 1918: 112
th. Austr.)	,,	apple, pear	KEMP, H. K. — R. 36, 1948: 246
asmania)	*pratensis*	apple	THOMAS, P. H. — 1926: 188
,,	*praetiosa*	apple, almond, peach plum, clover, grasses	EVANS, J. W. — R. 31, 1943: 311
Victoria)	,,	apple, pear, almond	WARD, K. M. — R. 21, 1933: 480
ew Zealand	*praetiosa*	fruit trees apple	MILLER, D. — R. 10, 1922: 467

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often variable, morphological differences on which authors based their species have also caused confusion.

Table 2 shows in a chronological sequence a name list, by which the mites of the present genus *Bryobia* have been described.

According to OUDEMANS (1927) *Acarus telarius*, as described by SCOPOLI (1763), has to be considered as the oldest *Bryobia* species. SCOPOLI mentions the species that LINNAEUS (Syst. Nat. ed. X, p. 616) described from *Tilia*, but says in his brief diagnosis "pedibus anticis longisoribes". It must be this characteristic, on which OUDEMANS has founded his opinion, that SCOPOLI had found a real *Bryobia* species. However, the lime-mite species is generally classified as a *Tetranychus* s.l., and nowadays is placed in the genus *Eotetranychus* (GEYSKES, 1939).

According to OUDEMANS (1905) *Acarus rufus* Schrank and *Acarus graminum* Schrank are synonyms of *B. speciosa* Koch while *Tetranychus cristatus* Dugès and *B. gloriosa* Koch should be synonyms of *B. praetiosa*. GEYSKES (1939) considers *B. graminum* as a distinct species. As to the very indefinite description of *T. cristatus* by DUGÈS, who also mentions a male, it is doubtful if his diagnosis concerns the *praetiosa* species, as OUDEMANS (1905) says, never a male of *B. praetiosa* has been found.

Table 2.

year	Name of mite :	Author :	Literature cited :
1763	*Acarus telarius*	SCOPOLI	OUDEMANS, 1927
1776	,, *rufus*	SCHRANK	,, , 1905
1781	,, *graminum*	,,	,, , 1905
1834	*Tetranychus cristatus*	DUGÈS	,, , 1905
1836	*Bryobia praetiosa*	KOCH	,, , 1905
1836	,, *gloriosa*	,,	,, , 1905
1838	,, *speciosa*	,,	,, , 1905
1838	,, *nobilis*	,,	,, , 1905
1850	,, *haustor*	HARDY	GEYSKES , 1939
1876	*Torinophora serrata*	CAMBR.	OUDEMANS, 1900
1885	*Bryobia pratensis*	GARMAN	THOMAS , 1894
?	,, *pallida*	,,	EWING , 1922
1894	,, *ribis*	THOMAS	THOMAS , 1894
1900	,, *serrata* CAMBR.	OUDEMANS	OUDEMANS, 1900
1904	,, *lapidum*	HAMMER	,, , 1905
1905	,, *cristata* DUGÈS	OUDEMANS	,, , 1905
1905	,, *graminum* SCHRANK	,,	,, , 1905
1922	,, *longicornis*	EWING	EWING , 1922
1922	,, *brevicornis*	,,	,, , 1922
1923	,, *humeralis*	HALBERT	GEYSKES , 1939
1930	,, *borealis*	OUDEMANS	,, , 1939
1936	,, *sarothamni*	GEYSKES	,, , 1939

KOCH (see VON HANSTEIN, 1902) based his species *B. praetiosa, B. gloriosa* and *B. nobilis* on differences in colour. VON HANSTEIN (1902) rejected the colour as a characteristic whereas OUDEMANS (1900) also classified *B. nobilis* and *B. gloriosa* as synonyms of *B. praetiosa*. CANESTRINI and FANZAGO (see VON HANSTEIN, 1902) considered B. nobilis as a colour-variant of *B. speciosa* and brought out new morphological details for a distinction between *B. praetiosa* and *B. speciosa*. BERLESE

(see OUDEMANS, 1900) also distinguished these two species only ; *B. speciosa* has broader lobes at the front side of the cephalothorax while the femora of the frontlegs bear 5 setae. OUDEMANS (1900) and TRÄGÅRDH (1914) mentioned that these charasteristics are variable and they considered *B. speciosa* as a synonym of *B. praetiosa*. Afterwards OUDEMANS (1912) changed his opinion as he accepted both as distinct species. However TRÄGÅRDH (see ANDRÉ, 1941) kept his point of view : *B. speciosa, B. gloriosa* and *B. nobilis* are varieties of *B. praetiosa*. GEYSKES (1939) mentions *B. praetiosa, B. speciosa* and *B. nobilis* as distinct species. He considers *B. haustor* HARDY as a synonym of *B. graminum*.

OUDEMANS (1900) considered *Torinophora serrata* Cambr., as described by this author, as a *Bryobia* species, which could be distinguished from *B. praetiosa* by differences in length of the legs. In his later publications OUDEMANS never mentioned this mite again. In 1930 THOR (see ANDRÉE 1941, footnote) considers *T. serrata* as identical with *B. praetiosa*. GEYSKES (1939) does not survey *serrata* in his list of European *Bryobia* species.

In the United States four *Bryobia* species have originally been described viz. *B. pratensis* Garman, *B. pallida* Garman, *B. longicornis* Ewing and *B. brevicornis* Ewing. It turned out (EWING, 1922) that the description of *B. pallida* was based on immature individuals of *B. pratensis*. The differences between *B. longicornis, B. brevicornis* and *B. praetiosa* are situated in differences of form and size of the mandibular- and cephalothoracic plates and the tubercles of this last one. As a result of comparisons OUDEMANS (1911) decided that *B. pratensis* sent to him from the United States, was only a synonym of *B. cristata* Dug. (= *B. praetiosa* Koch, according to OUDEMANS !). Afterwards EWING (1922) and MCGREGOR (1950) also mention *B. pratensis* as a synonym of *B. praetiosa*. Nowadays *B. longicornis* and *B. brevicornis* are considered as synonyms of *B. praetiosa* (MCGREGOR, 1950).

About *B. ribis* Thomas and *B. praetiosa* the following notes can be given. THOMAS (1894, 1896) describes *B. ribis* as a distinct species with three pairs of squamous setae on the dorsum (*B. praetiosa* with 4 pairs). VON HANSTEIN (1902) also mentions *B. ribis* as a species, differing from *B. praetiosa*. At first OUDEMANS (1900) considered *B. ribis* and *B. praetiosa* identical as there should not be constant morphological differences. Later on OUDEMANS (1927) alters this opinion and he sees enough morphological differences, (as to the length of the front legs, the form of the pedipalps and the hairs of the tarsi) to accept both as two species. GEYSKES (1939) also mentions *B. ribis*.

B. lapidum Hammer (OUDEMANS, 1905), in 1804 originally described as *Trombidium lapidum* Hammer, has been placed as an only species in the genus *Petrobia* (GEYSKES, 1939).

GEYSKES (1939) also mentions the species *B. humeralis* Halbert, *B. borealis* Oudem. and the new species *B. sarothamni* GEYSKES. *B. borealis* coming from Norway, is almost morphological identical with *B. praetiosa* and may perhaps be seen as a geographic strain of *praetiosa*.

IV. BIOLOGY

a. General remarks.

The female *Bryobia*-mites are oviparous. The smooth spherical orange-

red coloured eggs (diameter about 0.2 mm) are deposited separately or in small groups. In the last case, according to ESSIG (1922), they are covered with a coarse web-like colourless material. Already before ESSIG, ORMEROD (1894) and WEBSTER (1912) spoke of a fine web which the *Bryobia*-mites produced on the leaf. In our breeding-experiments a web has never been observed. But the slightly sticky eggs are often covered with fine dust particles.

The larvae and adult mites are phytophagous. The leaf-tissue is pierced by the solid stilettes, and sap is sucked. It is not certain (GEYSKES, 1938) what ingredients of the plants are ingested but the chlorophyll plays an important role. By the stings small lighter-coloured lesions are caused on the leaves, and young leaves remain undersized. Moreover, the leaf discolours from bright-green to pale-green or brownish-grey. In serious cases, leaf-fall and sometimes dropping of the fruit as in the gooseberry occurs. One mite attacks the leaf on several places. *Bryobia*-mites have, — in contradistinction to other *Tetranychidae* —, a striking preference for the upper side of the leaf (COOREMAN, 1944 ; GEYSKES, 1939), although infestations of the under side of vine- and appleleaf (KRAMER, 1936 ; THOMAS, 1926) are known. COOREMAN suggests that the preference of *Bryobia* to the upper side may be due to the greater percentage of chlorophyll of the palisade parenchyma. Many plants indeed, among others ivy, gooseberry and red clover, have palisade parenchyma under the upper-epidermis of the leaf and above the under-epidermis spongy parenchyma. The reason why other Tetranychidae, which likewise prefer chlorophyll, attack the under side of the leaf is not yet very clear. According to GEYSKES (1938) mechanical factors are probably responsible for this behaviour, but apparently these factors do not hold for *Bryobia*.

That light also exerts influence, follows from observations of VON VITZTHUM (1923) and ANDRÉ (1941), who stated that *B. praetiosa* shuns sunlight and therefore feeds on the under side of leaves of vine and apple. In case of *B. praetiosa* on ivy it is really striking that the mites avoid direct sunlight. They prefer the upper side of those leaves, which are covered and shaded by other leaves. The same holds for *B. ribis* on gooseberry as they live mainly on the upper side of shaded leaves of the bushes planted in orchards (COOREMAN, 1944 ; HUS, 1933).

One to four generations of the several *Bryobia* species occur during a growing season. The duration of a generation amounts to 26 to 29 days (WYBOU, 1951). In heated greenhouses, according to MILLER (1925) right up to eight generations might occur.

The wintering takes place in the egg-stage. In The Netherlands, *Bryobia praetiosa* hibernates on the evergreen ivy in the perfect or nearly full-grown stage.

b. Biological differences.

Various authors, among others OUDEMANS (1906), GEYSKES (1939), assumed the occurrence of several biological or geographical strains of one or more *Bryobia* species. The often very slight and vaguely described morphological differences gave rise to a very much complicated and confused taxonomy. VON HANSTEIN (1902) concluded from breeding-experiments that the mite on gooseberry should be an adapted form of *B. ribis*. Mosses and other plants should be the natural foodplants for *B. ribis*.

ZACHER (1922) supposed the occurrence of biological strains of *B. praetiosa* : one on gooseberry, with one generation a season, and one on many other plants. VENABLES (1943) distinguished two strains of *B. praetiosa* ; one on summergreen trees with several generations a season and one univoltine strain on grasses and other low-growing plants.

Some *Bryobia* "species" have indeed characteristic biological features that separate them from others. The wintering in the perfect stage of *B. praetiosa* on ivy has already been mentioned above. All other known Bryobias hibernate in the egg stage. The number of generations in a season may also be a characteristic feature. According to ROESLER (1952), in W. Germany, the *Bryobia* on fruit trees develops four generations a season. On gooseberry, *Bryobia* is univoltine everywhere. All mobile stages are to be found on the gooseberry bushes from the end of March till June. VON HANSTEIN (1902) argues that these differences indicate the occurrence of two distinct species, *B. ribis* and *B. praetiosa*.

Finally, whether males occur or not may form a point of difference. This is a reason why OUDEMANS did not succeed in replacing the name *B. praetiosa* Koch, — the mite of which never a male had been found —, by *B. cristata* Dug., the species of which DUGÈS mentions the males (GEYSKES, 1939).

V. TRANSFER-EXPERIMENTS

By these experiments the question may be answered whether there are several *Bryobia* species or if there is only one species with several biological strains on various food plants.

Such experiments were already taken by several authors. VON HANSTEIN (1902) stated that mites (*B. ribis*) coming from mosses, feed on gooseberry, when transferred. RITZEMA BOS (1919) scattered *Bryobia*-mites, coming from ivy leaves, on gooseberry bushes. No one of the mites settled on gooseberry. ZACHER (1922) likewise got no positive results from the transfer of *Bryobia*, coming from ivy, on gooseberry and reversed. At the end of March WYBOU (1951) attached gooseberry twigs with *Bryobia praetiosa* to apple twigs free from *Bryobia*. These mites went over and even founded a second generation on apple. However, the transfer of *Bryobia* from apple on gooseberry failed. ROESLER (1952) could transfer *Bryobia praetiosa* from pear to pear or from pear to apple with success, but he did not succeed in transferring from apple or pear to gooseberry or vice versa.

During the spring of 1952 at the Entomological Laboratory of the Agricultural University at Wageningen experiments were carried out with *Bryobia praetiosa*, coming from Hedera Helix L. at Wageningen. The mites were always transferred one by one with the aid of a fine brush from the ivy leaf on the plants, such as : ivy, gooseberry, red clover, Zinnia and Buxus. The first three plants are mentioned as food-plants of *praetiosa*. On account of information from Prof. Dr W. K. J. ROEPKE at Wageningen, who remembered that *praetiosa* had induced injury to Zinnia and Buxus many years ago, these two plants were also included in the experiments.

a. Transfer from ivy on ivy.

On 6.III.1952, on each of 15, about 20—30 cm large root-bearing

growing-shoots of ivy, that had been potted in a heated greenhouse, 50 adult mites were transferred. The aim was to breed mites rapidly for further work.

The transferred mites were very mobile and soon part of them dropped from the leaves. One day after the transfer the bulk of the mites had disappeared from the plants. On 7.III.1952 the transfer was repeated. The mites dispersed all over the plant immediately. Many of them dropped again from the leaf to the ground or left the plants along the stem. Yet, a relatively small number of the mites remained on the plants. On 27.III.'52 eggs and even young larvae proved to be present. In the open country the mites of the winter generation disappeared gradually in the first half of April in order to make way for the young larvae of a new generation. Although the development in the heated greenhouse (average max. and min. temperature respectively 68° and 47°) was more rapid than outside, this breeding-method had to be dropped by the large mobility and the disappearing of the mites after the transfer. The mites, needed for the transfer-experiments, described below, were always taken from ivy leaf in the open field.

b. Transfer from ivy on gooseberry (Ribes Grossularia L.)

On 16.III.1952 on the leaves of a gooseberry bush with three shoots of about 25 cm length some 200 mites were transferred. Once more, the mites disappeared soon. Therefore, in case of next experiments leafy tops of the shoots were brought inside cylinders of glass, that were held in place by means of supports. Both openings of the cylinders (length : 12 cm, diameter : 6.5 cm) were closed with cheesecloth that was well tied near the woody shoot. On each of the data 19.III.1952, 1.V.'52 and 9.V.'52, within each cylinder approximately 150 mites were brought on the leaves once more. The mites proved to be very mobile all the time. They left the leaf, moved about inside the cylinder, and were found again on the leaf accidentally. The cylinders were protected from direct sunshine.

The results of the transfer were negative. In all cases, within 12 days after a transfer, living mites were found no longer. Certainly, there were deposited some eggs, but young larvae were not present. As adult mites may also start egg-laying inside an empty petri-dish, the egg-laying on the plant does not say anything about an affinity of the mites to gooseberry.

Our own experiments, therefore, agree with the results of all other investigators, demonstrating that a successful transfer of *B. praetiosa* from ivy on gooseberry is quite impossible. In this way, the assumption of two different *Bryobia* species, viz. *B. praetiosa* on ivy and *B. ribis* on gooseberry becomes plausible. When the occurrence of biological strains is supposed, these strains are at any rate very sharply outlined and tied to the special foodplant. Whether a biological strain is normally outlined so sharply may be doubted.

c. Transfer from ivy on red clover (Trifolium pratense L.)

Young clover plants were potted in flower-pots on 1.IV.1952, and

round the stems a circular collar of strong smooth prepared cloth ("Lancaster-cloth") was fitted after the manner of a cabbage-collar. On each of the data 4.IV.'52, 9.IV.'52 and 9.V.'52 the transfer of 150 mites on each of three plants was performed. A glass cylinder (length : 12 cm, diameter : 6.5 cm) that rested on the collar of Lancaster-cloth and that had been closed with cheese-cloth at the top was placed on each plant. At first, the mites went on sitting on the leaf better than they did on gooseberry, probably in consequence of the slight hair of the clover leaf. Just as in case of the transfer on gooseberry, again some eggs were laid. However, there was never an attack of the leaf to state and about ten days after a transfer all the mites were dead. Transfer-experiments with *B. praetiosa* from ivy on clover have not been performed by other research-workers. Before giving a conclusion about the occurrence of biological strains or of separate species, these experiments ought to be repeated on a larger scale.

d. Transfer from ivy on Zinnia elegans Jacq.

On the data 8.V.'52, 13.V.'52 and 14.V.'52, six very young Zinnia plants, that only had two leaves, were infested with 100 mites each. The plants had been grown in flower-pots and further screened by a glass cylinder. The mounting was equal to that in case of red clover. It was notable that the mites always fastened themselves immediately after transfer although they were very mobile. On 20.V.'52, a large number of eggs had been found on the leaf near the veins and on the stems among the hairs. On 30.V.'52, on all plants living mites were still present and a distinct injury was visible on the upper side of the leaves. Unfortunately, early in June, the plants died from fungal attack. The experiment was repeated on 30th July. Once more some Zinnia plants, about 10 cm high, that had already formed a number of eight leaves, were infected with 100 mites per plant. Though several mites left the plants via the stem, a large number remained on the plants. On 4th August, some tens of eggs proved already to be deposited on all parts of the plant. At 10th August several leaves already exhibited a distinct greyish-yellow leaf injury and on 17th August the first orange-red mobile young larvae appeared. The duration of the development of the egg was, with an average temperature of 22° C., about 20 days. Adult transferred mites were still present too. Zinnia elegans may apparently be a suitable foodplant for *B. praetiosa*. It is striking, that as such this plant has never officially mentioned in literature.

e. Transfer from ivy on Buxus sempervirens L.

On 28.II.1952 several young Buxus shrubs were infested with about a hundred mites on each of them. Soon after the transfer the mites left the leaves or dropped to the ground. Repeated transfer-experiments on 6.IV. '52 and 12.IV.'52 were also negative. The mites did not feed on Buxus.

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