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THE BEES (*APOIDEA, HYMENOPTERA*) ON ALFALFA (*MEDICAGO MEDIA* PERS.) PLANTATIONS

II. TROPHIC RELATIONSHIP TO VEGETATION

ABSTRACT: Pollen found on the bodies of the honey bees and of wild bees visiting seed-plantations of alfalfa in the region of Lublin were subjected to a microscopic analysis. On this base the trophic relationships of individual species of the hymenopterans under study have been established and the role of these insects in the biocenose of flowering alfalfa has been described.

Contents

1. INTRODUCTION

During the flowering season alfalfa plantations are visited by the honey bee and many species of wild *Apoidea*. However, significant for the pollination of flowers is only the role of those species which trip the flowers when collecting pollen and nectar (D y l e w s k a et al. 1970a, 1970b).

Anasiewicz and Warakomska (1969) have carried out a floristic analysis of the pollen gathered by 17 bumble-bee species caught in flowering-alfalfa fields in the region of Lublin. In the pollen loads of 10 species they recognized alfalfa pollen which appeared to be the main component of diet of 4 of them. Benedek, Buglos and Manninger (1972) studied the pollen gathered by 15 species of wild *Apoidea* visiting winter vetch in Hungary. In 6 species they found pollen which might belong to alfalfa, or to common white clover (these authors did not distinguish between the pollens of these plant species).

The honey bee is reluctant to collect alfalfa pollen both because of its specific bio-chemical composition (Gubin and Chalifman 1954) and the specific structure of the flowers (Jabłoński 1970). However, according to some authors it is possible to make worker bees pollinate alfalfa flowers, by using an appropriate scent-training and creating an artificial hunger of pollen in a bee colony (Blagoveščenskaja 1955, Lecomte 1959, Pedersen 1961).

Maurizio (1964), Demianowicz, Lecewicz and Warakomska (1966), Demianowicz (1968), carried out a pollen-analysis of honey, and Smaragdova (1956) and Warakomska (unpublished data) an analysis of the bee bread – the single alfalfa pollen-grains which they found indicated that the worker bees had also visited alfalfa flowers, and probably pollinated some of them.

During her research on alfalfa plantations in the region of Lublin Anasiewicz (1975) found that honey bees represented 92–99% of all the *Apoidea* observed there. However, as the workers of the honey bee as a rule did not cause the flowers to be tripped when they collected nectar, their role as pollinators was not significant.

The present study is a part of the research on the *Apoidea* found on alfalfa plantations. Its aim is to describe the trophic relationships with vegetation, and to determine the role of individual species of these insects in the biocenose of flowering alfalfa.

2. MATERIAL AND METHODS

2.1. General

The floristic composition of the pollen found on the bodies of honey-bee workers, and of the females of wild bees, was investigated on the basis of specimens caught in the years 1966–1968 on alfalfa plantations in the region of Lublin. A detailed description of the study area and the crop-fields under research, as well as a description of the methods of insect capturing and observation can be found in a separate paper (Anasiewicz 1975).

2.2. A floristic analysis of the pollen found on the body of the honey bee

During the full flowering season of the plantations at Elizówka near Lublin on July 31, 1967 – a day of bright weather with no wind – 200 worker bees were captured at each of the following times: 7^{00}, 9^{30}, 13^{00}, 16^{00} and 17^{30} hours. The bees were subsequently

thoroughly examined for the presence of pollen on their bodies. From each sample 50 worker bees were selected from which pollen present in the proboscis fossa on the under side of the head was collected. After being defatted in chloroform and ethyl alcohol the pollen grains were mounted on slides with glycerin jelly. On the basis of these slides a microscopic analysis of 100 pollen grains in three fields of view was carried out, the taxonomical identity of the pollen grains was established and the percentage of the pollen of individual plant species in the entire collection was determined.

2.3. A floristic analysis of the pollen collected by wild bees

By using the "pick out" method of catching at the plantations at Elizówka near Lublin, Łabunie (Zamość district) and at Chełm Lubelski a total of 4076 individuals of wild *Apoidea* was collected. They represented 17 bumble-bee species [1118 individuals described earlier by Anasiewicz and Warakomska (1969)] and 104 wild bee species (2958 individuals including 1510 females). Females of the wild bee species were examined thoroughly and on the body surface of 882 of them, belonging to 54 species, pollen collections were found. From the body surface of each pollen-carrying female a pollen sample was taken for a microscopic analysis performed according to the description given for the honey bee.

3. THE RESULTS OBTAINED FROM A FLORISTIC ANALYSIS OF THE POLLEN COLLECTED BY THE *APOIDEA* SPECIES UNDER STUDY

3.1. The honey bee (*Apis mellifica* L.)

The worker bees that were observed on the plantations appeared to collect from alfalfa flowers almost exclusively nectar, and over the whole study period the total number of bees collecting pollen was only 6.

A thorough examination of 1000 worker bees caught at the Elizówka plantation showed that 18 of them had very small initial loads of pure alfalfa pollen on their hind limbs. On each of the 982 worker bees a pollen-clod was found on the under side of the head. A microscopic analysis of the pollen scraped of the heads of 250 worker bees (50 individuals from each sample) showed that it consisted of alfalfa pollen grains with only a small amount of pollen of the weeds present in the plantation, or growing in the immediate surroundings. Fairly often complete, or bitten alfalfa anthers were found, sometimes still immature. In the alfalfa pollen sterile pollen-grains were frequently found. Often, too, immature pollen was found whose proportion together with the sterile pollen came up to 50%, and in several cases up to 90%. The pollen clod of one of the worker bees consisted mainly of *Melilotus* sp. pollen, and alfalfa pollen only constituted an admixture of about 15%.

Tab. I. Floristic composition of the pollen carried by wild bees of the family *Halictidae*

Bee species	Number of females		Plant species found	
	examined	with alfalfa pollen	total number	dominant species
Halictus tumulorum L.	44	33	28	*Medicago media, Achillea* type, *Trifolium repens, T. pratense, Melilotus* sp., *Papaver* sp., *Sinapis arvensis*
H. malachurus (K.)	40	5	23	*Achillea* type
H. linearis Sch.	38	6	20	*Achillea* type, *Taraxacum* type
H. calceatus Scop.	30	3	19	*Taraxacum* type, *Achillea* type, *Serratula* type, *Plantago* sp.
H. pauxillus Sch.	25	12	23	*Achillea* type, *Medicago media*
H. albipes (F.)	21	5	16	*Medicago media, Achillea* type, *Taraxacum* type, *Papaver* sp.
H. rubicundus Chr.	19	19	15	*Medicago media, Trifolium pratense*
H. laticeps Sch.	9	2	13	*Trifolium pratense, Sinapis arvensis, Achillea* type, *Taraxacum* type
H. nigripes Lep.	8	1	5	*Taraxacum* type
H. maculatus Sm.	7	2	12	*Achillea* type
H. villosulus (K.)	5		6	*Taraxacum* type
H. fulvicornis (K.)	5	3	12	*Trifolium pratense, Papaver* sp., *Achillea* type
H. lucidulus Sch.	3		2	*Trifolium pratense, Taraxacum* type
H. fasciatus Nyl.	3		9	*Berteroa incana, Raphanus raphanistrum*
H. lativentris Sch.	3	1	6	*Trifolium repens, T. pratense, Achillea* type
H. eurygnathus Bl.	2		5	*Trifolium pratense, Taraxacum* type
H. quadrinotatus (K.)	2		5	*Achillea* type, *Taraxacum* type
H. minutus (K.)	2		2	*Arctium* sp., *Achillea* type
H. quadricinctus F.	1		3	*Centaurea cyanus, Sinapis arvensis*
H. scabiosae (Rossi)	1		2	*Achillea* type
H. laevigatus (K.)	1		1	*Taraxacum* type
H. zonulus Sm.	1		1	*Taraxacum* type
H. leucozonius Sch.	1		1	*Taraxacum* type
H. morio (F.)	1	1	2	*Medicago media, Taraxacum* type
Rhophitoides canus (Ev.)	138	138	18	*Medicago media*

Tab. II. Floristic composition of the pollen carried by wild bees of the family *Andrenidae* and *Melittidae*

Bee species	Number of females		Plant species found	
	examined	with alfalfa pollen	total number	dominant species
Andrenidae				
Andrena propinqua Sch.	52	2	24	*Sinapis arvensis, Raphanus raphanistrum, Melilotus* sp.
A. gelriae Vecht.	44	40	17	*Medicago media, Trifolium pratense, Vicia* sp.
A. dorsata K.	15		18	*Sinapis arvensis*
A. gravida Imh.	14	1	22	*Sinapis arvensis, Tripleurospermum inodorum, Melilotus* sp.
A. labialis K.	7	7	11	*Medicago media, Trifolium repens, T. pratense*
A. flavipes Pz.	6	1	11	*Sinapis arvensis, Achillea* type
A. bicolor F.	5		15	*Campanula* sp.
A. nigrospina Th.	3		5	*Berteroa incana*
A. chrysopyga Sch.	3	3	4	*Medicago media, Sinapis arvensis, Raphanus raphanistrum, Achillea* type
A. combinata Chr.	3	1	14	*Raphanus raphanistrum, Sinapis arvensis, Fagopyrum sagitatum*
A. florea F.	1		2	*Trifolium pratense, Achillea* type
A. wilkella K.	1	1	3	*Medicago media*
Panurgus calcaratus (Scop.)	10	2	6	*Taraxacum type*
Melittidae				
Melitta leporina Pz.	178	176	33	*Medicago media, Trifolium repens, T. pratense, Melilotus* sp.
Dasypoda plumipes Pz.	10		7	*Taraxacum* type

Tab. III. Floristic composition of the pollen carried by wild bees of the family *Megachilidae*, *Apidae* and *Colletidae*

Bee species	Number of females		Plant species found	
	examined	with alfalfa pollen	total number	dominant species
Megachilidae				
Megachile willoughbiella K.	11	11	12	*Medicago media*
M. centuncularis (L.)	5	5	10	*Medicago media*, *Lotus corniculatus*, *Taraxacum* type
Anthidium manicatum (L.)	2	2	6	*Ballota nigra*
Osmia aduncta (Pz.)	2		5	*Echium vulgare*, *Sinapis arvensis*
O. fulviventris (Pz.)	1	1	4	*Achillea* type, *Taraxacum* type
O. atrocaerulea Schill.	1		1	*Sinapis arvensis*
Heriades truncorum (L.)	3	1	3	*Taraxacum* type
Chelostoma maxillosum (L.)	1		6	*Convolvulus arvensis*, *Ranunculus* sp.
Apidae				
Eucera longicornis L.	39	35	8	*Medicago media*, *Vicia* sp., *Trifolium pratense*
Clissodon furcatus (Pz.)	4	2	4	*Galeopsis tetrahit*, *Medicago media*
Anthophora quadrimaculata (Pz.)	11	5	12	*Galeopsis tetrahit*, *Ballota nigra*
Colletidae				
Colletes daviesanus Sm.	21		3	*Achillea* type
Prosopis communis Nyl.	3	1	5	*Achillea* type, *Medicago media*
P. difformis Ev.	1		1	*Campanula rapunculoides*

3.2. Solitary bees (*Apoidea solitariae*)

In contrast to the honey bee, which usually forms one-species pollen loads on its legs, wild *Apoidea* were very often found with mixed pollen, and it was not always possible to distinguish a clearly dominant species.

Tables I–III contain the results of a floristic analysis of the pollen collected from the body surface of wild bee females. The results of a similar analysis of the pollen carried by the bumble-bee females and workers that visited flowering alfalfa can be found in the paper by Anasiewicz and Warakomska (1969).

The term "type" used several times in this paper (after Zander 1941, 1951) refers to those cases where it was impossible to identify the plant species on the basis of the morphology of their pollen. Within the individual "types" pollen of the following plant species was most likely to occur: in the *Achillea* type – *Tripleurospermum inodorum*[1], various species of the genus *Anthemis* L., *Achillea millefolium* and *Matricaria chamomilla*; in the *Taraxacum* type – various species of the genus and *Sonchus* L., *Leontodon autumnalis*; in the *Saratula* type – *Onopordon acanthium* and various species of the genus *Carduus* L.

4. TROPHIC RELATIONSHIPS OF *APOIDEA* AND THEIR ROLE AS ALFALFA POLLINATORS

The following species were found to visit alfalfa fields for nectar and pollen: *Apis mellifica*, *Eucera longicornis*[2], *Rhophitoides canus* (Fig. 1), *Melitta leporina*, *Megachile willoughbiella*, *M. centuncularis*, *Clissodon furcatus*, *Halictus rubicundus*, *H. tumulorum*, *H. morio*, *H. albipes*, *Andrena gelriae*, *A. wilkella*, *A. labialis*, *A. chrysopyga*, *Prosopis communis*, and *Bombus terrestris* (L.), *B. lucorum* (L.), *B. distinguendus* Mor. For the females and workers of most of these species alfalfa appeared to be the main source of nectar and pollen.

The solitary bees and bumble-bees, for which alfalfa was not the main source of food, occurred in the fields under study in search for nectar and pollen on the weed plants. The following species showed a very strong trophic relationship to *Tripleurospermum inodorum*: *Halictus linearis*, *H. malachurus*, *H. maculatus*, *H. pauxillus* and *Colletes daviesanus*. From the females of these species pollen of almost pure *Achillea*-type composition was collected, derived, most likely, from *Tripleurospermum inodorum*, a weed showing an exuberant growth in the plantations studied, where the above-named bee species were observed and caught. The *Achillea* type of pollen appeared to be attractive also to the species *Halictus albipes* (Fig. 2), in whose collections of pollen it supplemented the pollen of alfalfa or *Sonchus arvensis*, and to *Halictus laticeps* and *H. fulvicornis* on whose females it occurred third in sequence after *Sinapis arvensis* and *Raphanus raphanistrum*, or following *Papaver* sp.

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[1] The plant names are given according to Szafer, Kulczyński and Pawłowski (1953).
[2] Full species names of the wild solitary bees are given in Tables I–III.

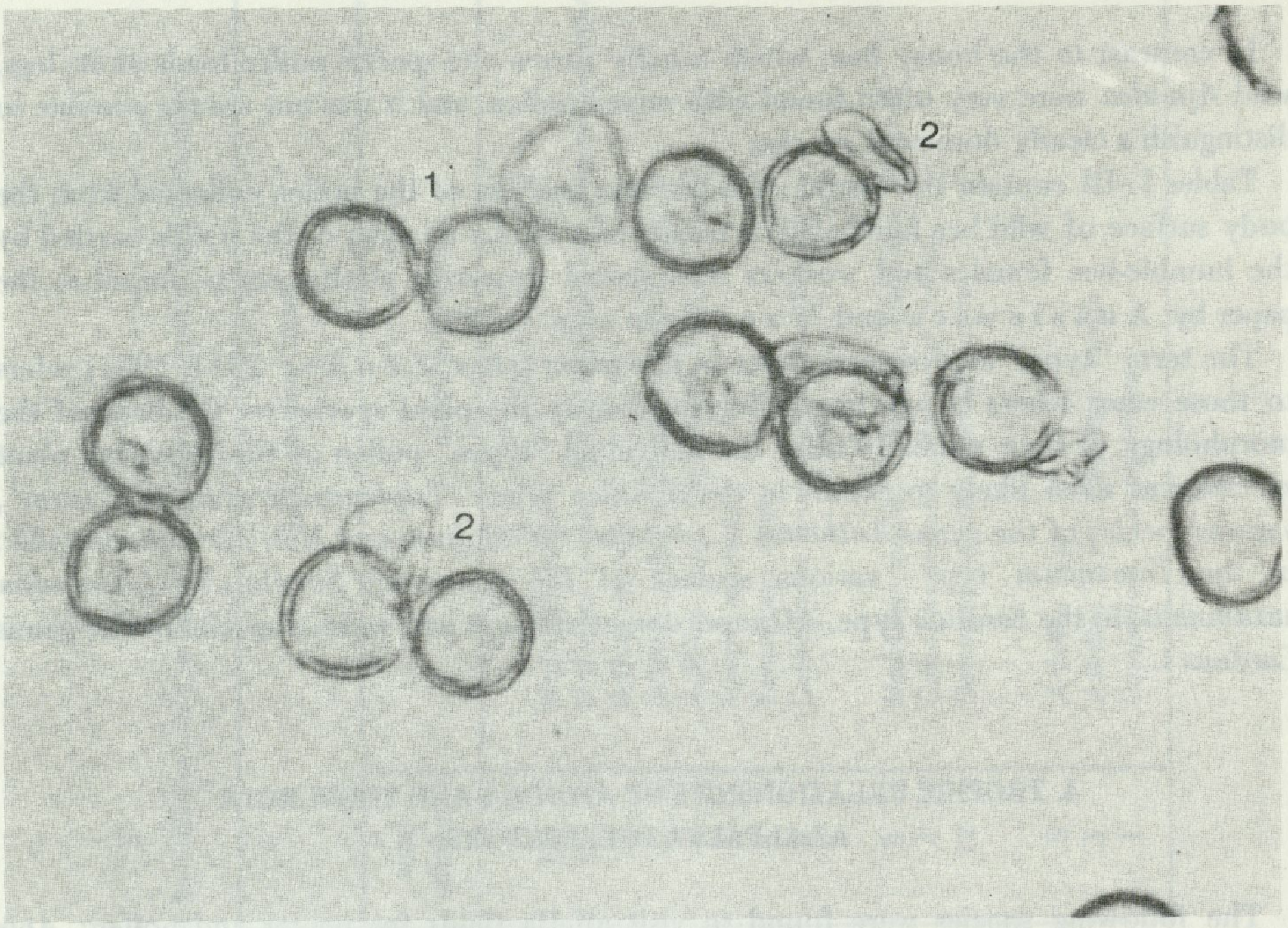

Fig. 1. Pollen collected by *Rhophitoides canus*

Magnified about × 600. *1* – *Medicago media*, *2* – sterile grains (not identified)

The *Taraxacum* type of pollen (of almost pure composition), probably collected from *Sonchus arvensis* growing abundantly in the alfalfa fields under research, was found to be carried by females of the species: *Panurgus calcaratus*, *Halictus calceatus*, *H. villosulus*, *H. nigripes*, *H. maculatus* and *Dasypoda plumipes* (Fig. 3). Slightly smaller amounts of *Taraxacum* type of pollen were found on the bodies of the females of *Halictus linearis*, *H. pauxillus* and *H. laticeps* and *Megachile centuncularis*.

Pollen of *Sinapis arvensis* and *Raphanus raphanistrum* (Fig. 4) dominated in the pollen collections of the females of *Andrena propinqua*, *A. dorsata* and *Halictus laticeps*.

Galeopsis tetrahit was found to be the main pollen plant for *Anthophora quadrimacu-lata* (Fig. 4). This weed species appeared to be readily visited also by the workers of the bumble-bee, *Bombus subterraneus* (L.) (Anasiewicz and Warakomska 1969).

Papaver somniferum and *Papaver* sp. sometimes dominated over the pollen of *Tripleurospermum inodorum* in the pollen collections of some females of *Halictus tumulorum* and *H. albipes* (Fig. 5).

Red clover pollen was found to be attractive to many species. It prevailed in the pollen collections of *Bombus ruderarius* (F.), *B. lapidarius* (L.), *B. hortorum* (L.) and *B. silvarum* (L.), and was found in considerable amounts also in *B. terrestris* (Anasiewicz and

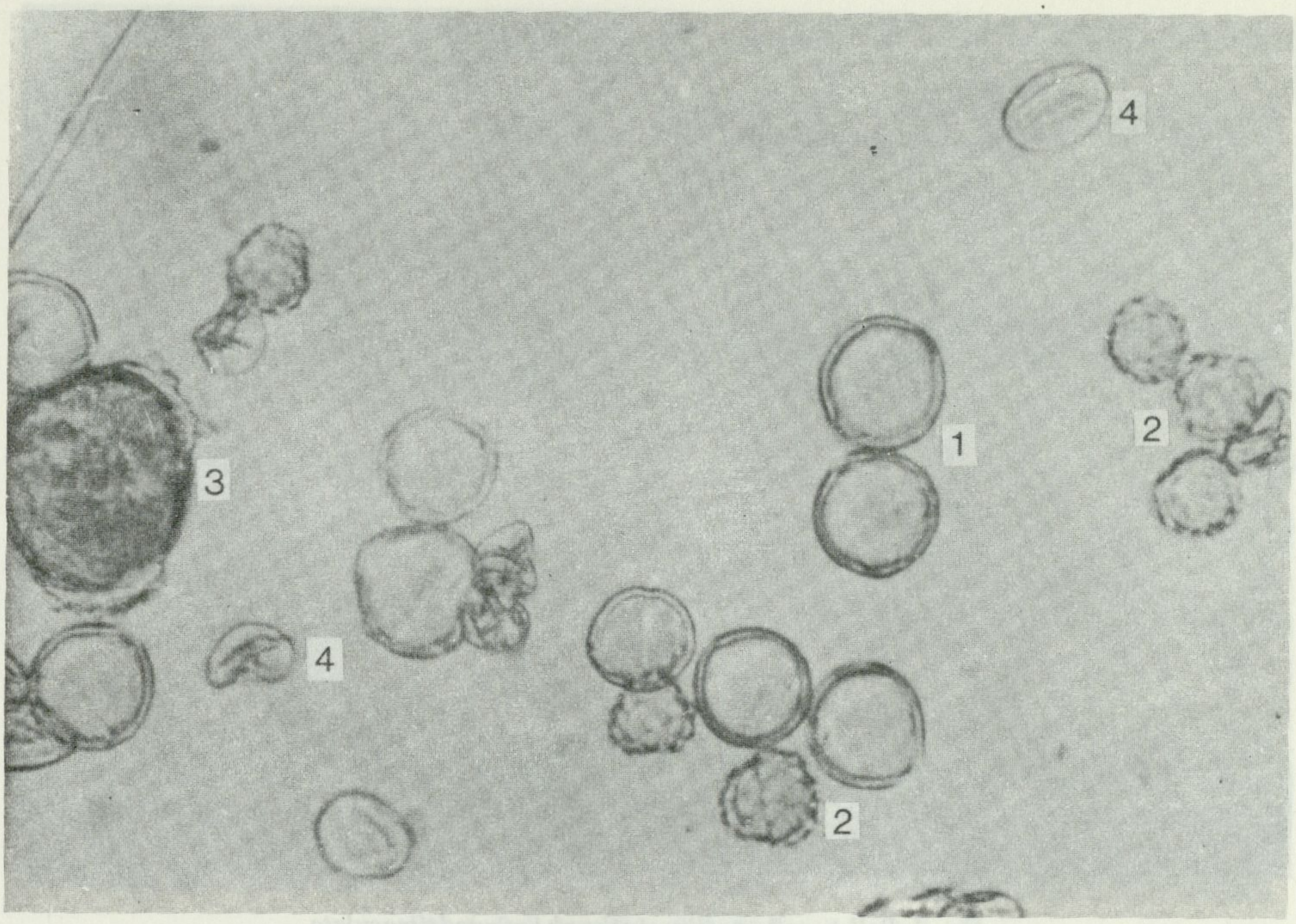

Fig. 2. Pollen collected by *Halictus albipes*

Magnified about × 600. *1* – *Medicago media*, *2* – *Achillea* type, *3* – *Convolvulus arvensis*, *4* – sterile grains (not identified)

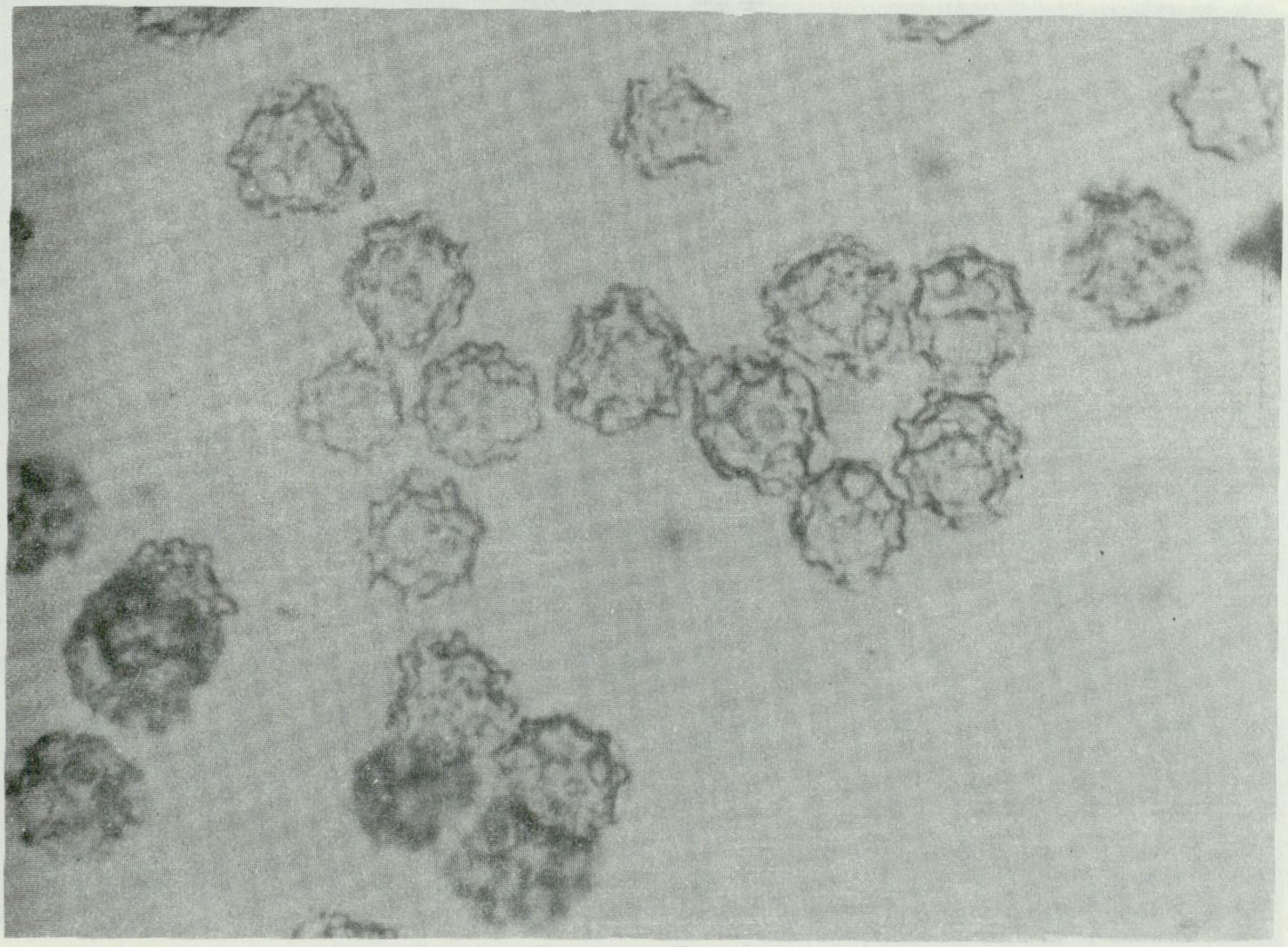

Fig. 3. Pollen of *Taraxacum* type collected by *Dasypoda plumipes* (magnified about × 600)

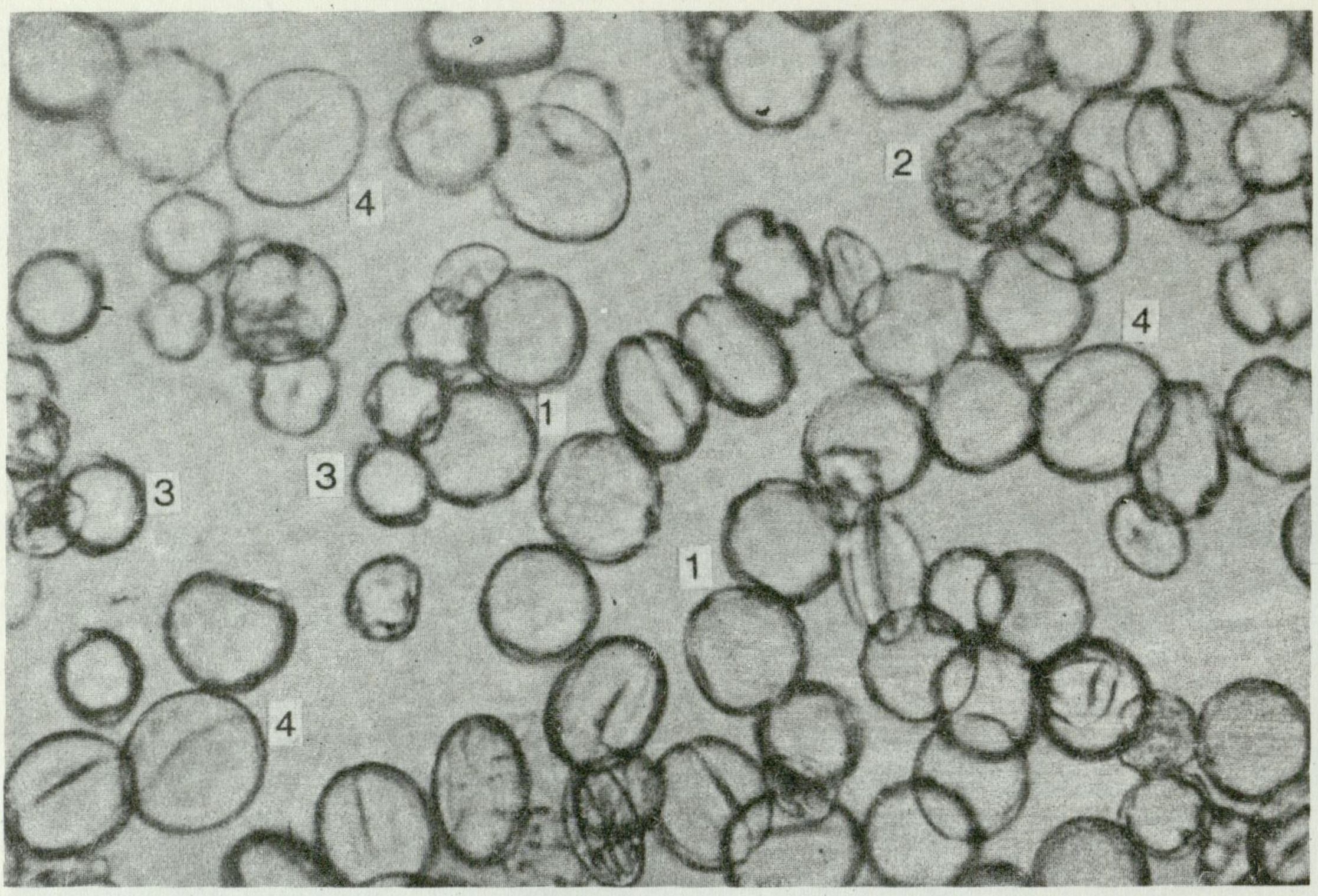

Fig. 4. Pollen collected by *Anthophora quadrimaculata*

Magnified about ×600. *1 – Raphanus raphanistrum, 2 – Sinapis arvensis, 3 – Hypericum* sp.. *4 – Galeopsis tetrahit*

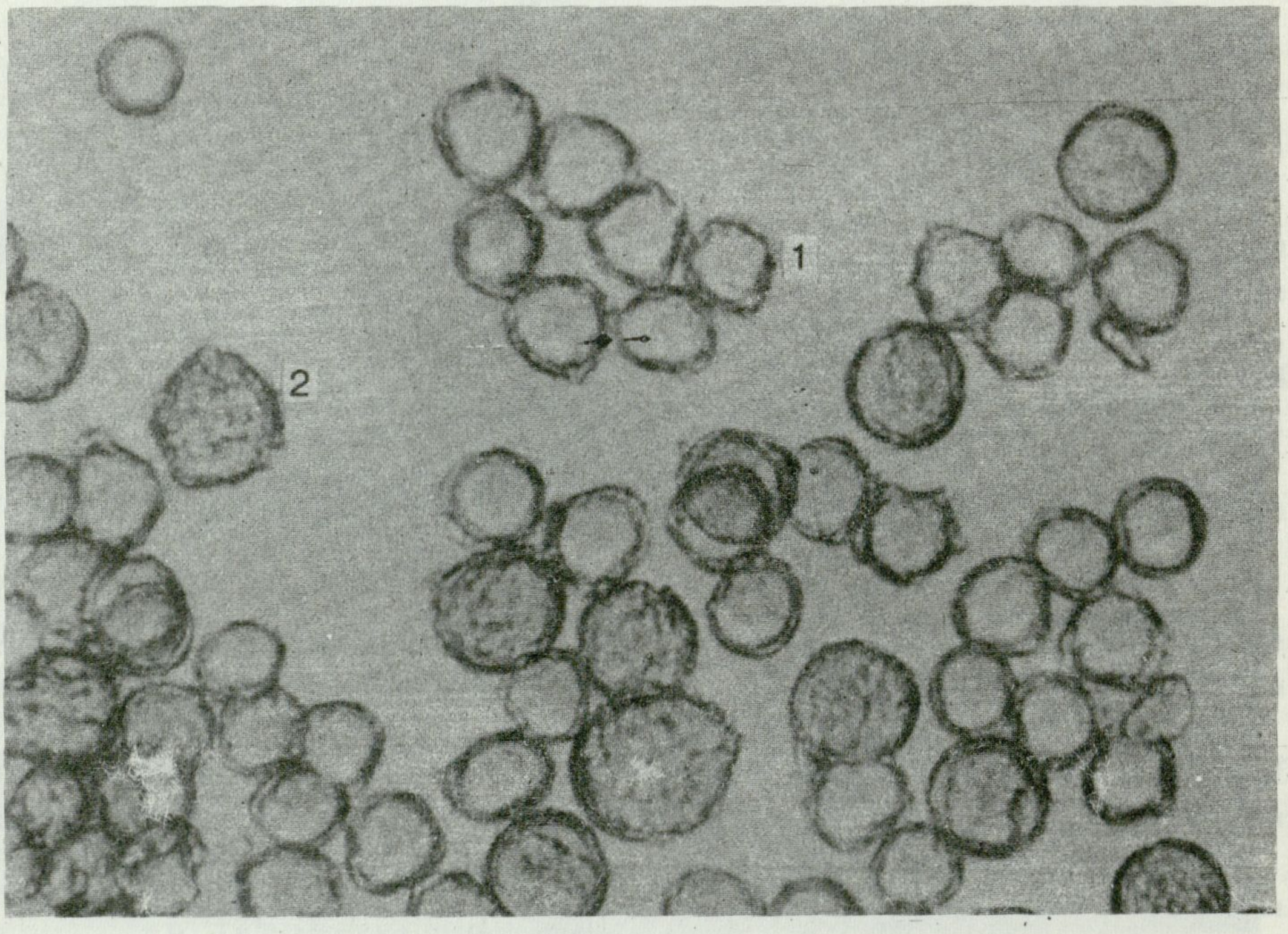

Fig. 5. Pollen collected by *Halictus albipes*

Magnified about × 600. *1 – Papaver* sp., *2 – Sinapis arvensis*

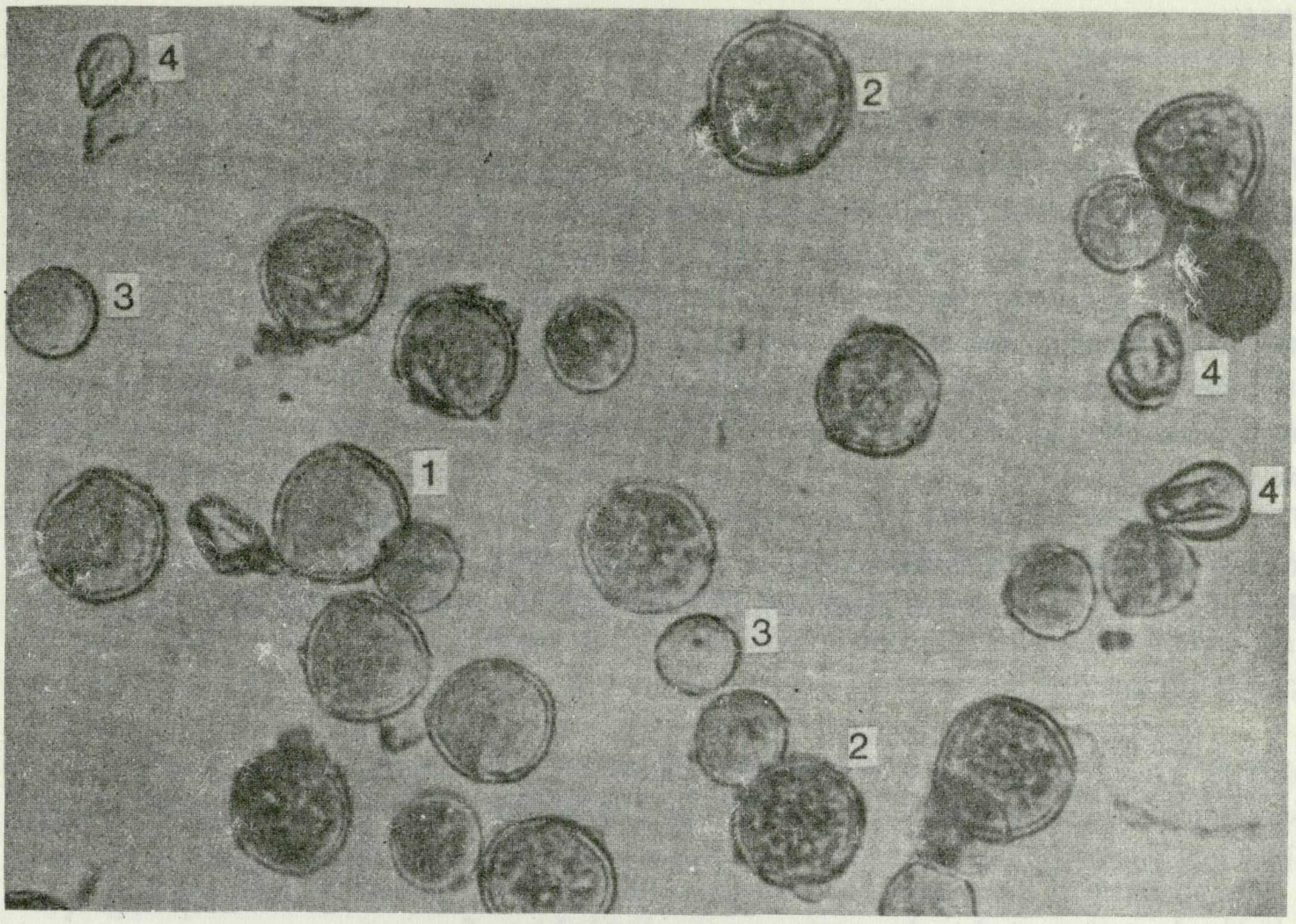

Fig. 6. Pollen collected by *Melitta leporina*

Magnified about × 600. *1* – *Medicago media*, *2* – *Trifolium pratense*, *3* – *T. repens*, *4* – sterile grains (not identified)

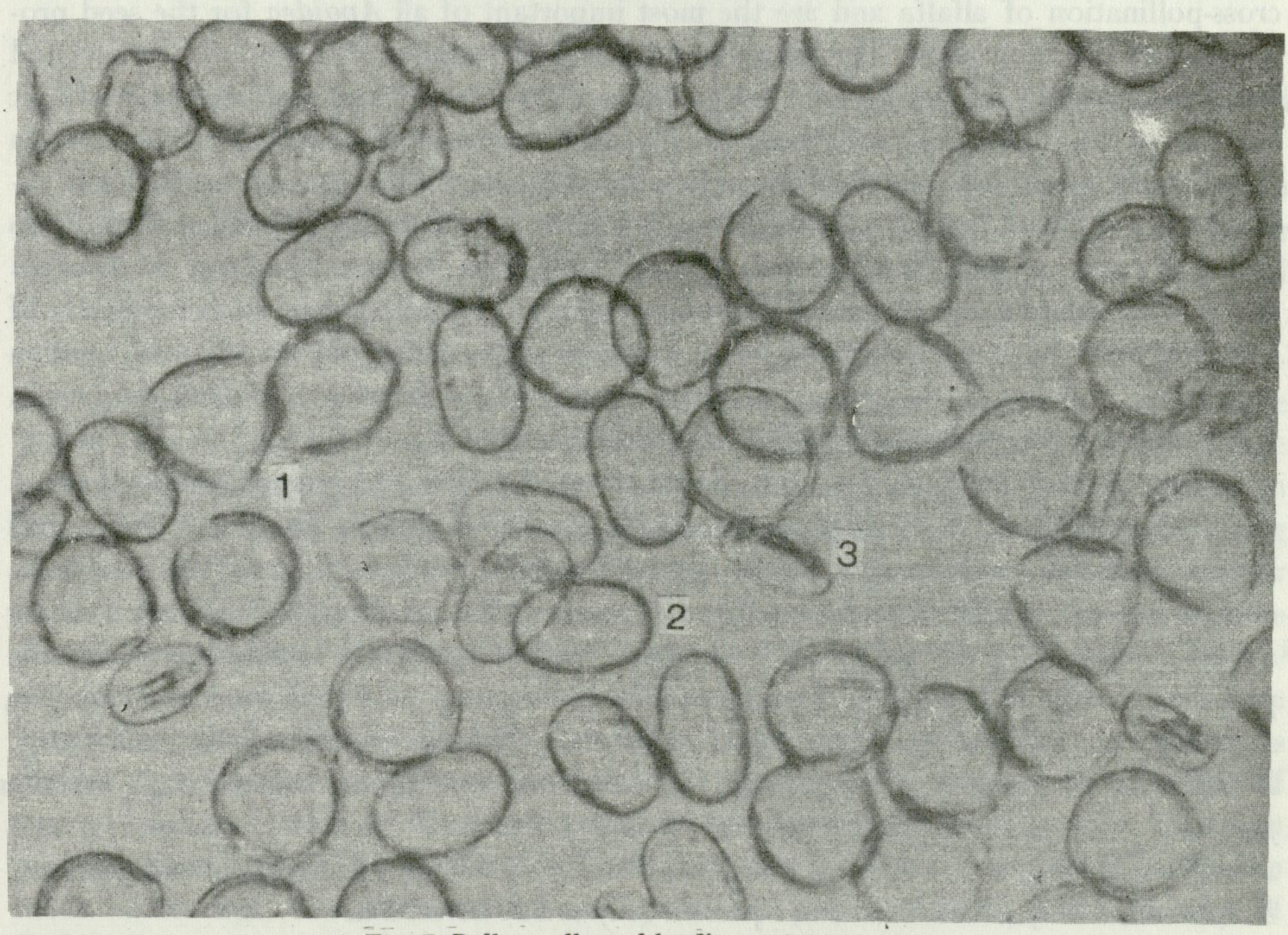

Fig. 7. Pollen collected by *Eucera longicornis*

Magnified about × 600. *1* – *Medicago media*, *Vicia* sp., *3* – sterile grains (not identified)

Warakomska 1969). Also the collections of *Eucera longicornis*, *Andrena gelriae*, *Halictus laticeps* and *Melitta leporina* (Fig. 6) appeared to contain large amounts of the pollen of this plant, coming up to as much as 30%.

White clover pollen was collected in large amounts by the females of *Andrena labialis* and *Melitta leporina* (Fig. 6), in which it was sometimes found to form large admixtures, and it even dominated over alfalfa pollen.

Vicia sp. appeared to be attractive to *Eucera longicornis* (Fig. 7). The pollen was found in considerable amounts, and it probably was derived from *V. sativa* which was grown in an adjacent field.

Noteworthy is also the presence of the pollen of *Berteroa incana*, which was found in considerable amounts on the bodies of the females of *Andrena propinqua* and *A. dorsata*. Possibly, this was collected from plants about 200–300 m far from the alfalfa plantation.

5. THE ROLE OF INDIVIDUAL SPECIES OF *APOIDEA* IN THE BIOCENOSE OF FLOWERING ALFALFA

On account of the manner of utilisation of nectar and pollen the *Apoidea* visiting the alfalfa plantations under observation can be divided into 5 groups.

Group I. This group includes those pollen-collecting females which trip alfalfa flowers, and for which this plant provides the basic source of food. They contribute to the cross-pollination of alfalfa and are the most important of all *Apoidea* for the seed production of this crop plant. The group includes a small number of honey bee workers and females of several species of wild bees and bumble-bees. On the basis of a microscopic analysis of the pollen it has been found that the females of *Eucera longicornis*, *Melitta leporina*, *Rhophitoides canus*, *Megachile willoughbiella*, *M. centuncularis*, *Halictus rubicundus*, *Andrena gelriae*, *A. wilkella*, *A. labialis*, *A. chrosopyga*, and according to Anasiewicz and Warakomska (1969), also *Bombus terrestris*, *B. lucorum* and *B. distinguendus* formed their collections mainly of alfalfa pollen. In the majority of individuals of these species alfalfa pollen exceeded 50%, coming up to 100% of a pollen collection. Included in this group were also about 35% of females of *Halictus albipes* in whose pollen collections alfalfa pollen constituted 40–100%.

Group II. This includes females which collected pollen and tripped alfalfa flowers. However, alfalfa only provided an accessory source of pollen for them. Only small amounts of alfalfa pollen were found admixed, usually no more than 5–10%, the basic component of a pollen collection being one-species pollen, or the pollen-collections being a mixture consisting of pollen of a number of plant species in similar, or in variable proportions. The following species are included in the group: *Andrena gravida*, *A. flavipes*, *A. propinqua*, *A. combinata*, *Panurgus calcaratus*, *Halictus maculatus*, *H. malachurus*, *H. linearis*, *H. nigripes*, *H. lativentris*, *H. calceatus*, *Anthidium manicatum*, *Clissodon furcatus*, *Anthophora quadrimaculata*, *Osmia fulviventris*, *Heriades truncorum*, and according to Anasiewicz and Warakomska (1969), also *Bombus lapidarius*, *B. ruderarius* Müll., *B. silvarum*, *B. equestris* (F.) and *B. hortorum*.

Group III. This group includes females of the species which collect alfalfa pollen, but do not trip the flowers. They visit primarily flowers that have been tripped, and scrape pollen off the andro-gynoecium. There exists a possibility of additional pollination of a flower that has been tripped before, but this is of no great practical importance. This is the manner in which alfalfa pollen is collected by some of the small body-size solitary bees. The group includes *Halictus tumulorum*, for which alfalfa pollen is the basic component of food, and *H. laticeps*, *H. fulvicornis*, *H. pauxillus*, and maybe also some other species in which smaller or larger amounts of alfalfa pollen were found as an admixture in the prevailing pollen of other plant species.

Group IV. Bees belonging to this group collect only the nectar from alfalfa flowers. They do not trip the flowers of alfalfa, and thus do not contribute to its cross-pollination. Only by chance they may trip a flower by striking against it during a visit. This group includes most of honey bee workers, the so-called nectar-foragers, males of wild bees and bumble-bees, males and females of parasitic species, as well as females and workers of wild bees and bumble-bees which collect nectar before starting to collect pollen.

Group V. This group includes females of wild bees and females and workers of bumble--bees in which no alfalfa pollen was found, and which do not participate in the cross-pollination of this plant. These individuals carried pollen of one or several plant species in varying proportions.

6. FINAL COMMENTS

The seed alfalfa plantations under observation were during the flowering season visited by the honey bee, 104 species of wild bees and 17 bumble-bee species.

The honey bees, the dominant species, collected alfalfa nectar, reaching it through a slit at the side of the flower, and they did not trip the flowers. However, on the under side of the head of almost every worker bee a clod of pollen was found, which indicated that each of them had pollinated a certain number of flowers.

The behaviour of the wild bees and bumble-bees encountered on the alfalfa plantations varied. On the basis of direct observation and the results of a floristic analysis of the pollen collected by the females and worker bees it has been established that for 11 of the more abundant species of wild bees, and 3 bumble-bee species alfalfa provided the main source of nectar and pollen, and that they are characteristic of alfalfa. The following species were found to be the most important alfalfa pollinators on account of their abundance and fidelity to the plant species: *Rhophitoides canus*, *Melitta leporina* and the bumble-bee, *Bombus terrestris*. *R. canus* appeared to be very faithful to alfalfa. Most of the females were found to have collected almost pure alfalfa pollen, the insignificant admixture usually being pollen of other leguminous plants. Less faithful to alfalfa was *Melitta leporina* on whose body in addition to alfalfa pollen admixtures of pollen of various plants, a total of 33 species, most frequently leguminous – mainly *Trifolium repens* – were found. The bumble-bee, *Bombus terrestris* was found to have alfalfa pollen loads on its legs, but often with an admixture of pollen of other plants, mainly of *Trifolium pratense*, *Papaver* sp., *Lotus corniculatus* and *Hypericum* sp.

Eucera longicornis, *Andrena gelriae*, *A. labialis*, *Halictus albipes*, *H. rubicundus*, *Megachile willoughbiella*, *M. centuncularis*, *Bombus lucorum* and *B. distinguendus* were found to successfully trip the alfalfa flowers they visited, but they occurred there in small numbers.

Among the species characteristic of alfalfa was also *Halictus tumulorum*. This bee collected mainly alfalfa pollen. Because its females scrape off the pollen mainly of the flowers that have been tripped, the importance of this species as an alfalfa pollinator is rather small.

For 16 species of wild bees and 6 bumble-bee species alfalfa was found to be only an additional source of nectar and pollen. They pollinated a certain percentage of flowers and may therefore be defined as an element accompanying the characteristic species.

The remaider of the *Apoidea*, including 72 species of wild bees and 8 bumble-bee species, appeared to be alien to alfalfa. They were indifferent to this plant as a source of nectar and pollen and they were found in the biocenose of flowering alfalfa only because of their trophic relationships with the weed vegetation infesting the plantation. Among them also parasitic bees were present associated with the species in whose nests they parasitize.

The accompanying species and the species characteristic of alfalfa show clear trophic relationships also to white clover and red clover and to other leguminous plants. For this reason the presence of these plants in an alfalfa plantation, or near it, during the flowering season is most undesirable. Of certain importance as bee diverting plants are also the following: *Papaver* L., *Sonchus* L., *Hypericum* L., and for *Halictus albipes* also *Tripleurospermum inodorum*.

The trophic relationships shown by the wild *Apoidea* which pollinate alfalfa could be used as a factor attracting them to alfalfa plantations. Crop plants that compete with alfalfa could be sown in belts or islands within alfalfa fields and then completely removed immediately before the flowering of the plantation. Some of the hymenopterans lured will then pollinate alfalfa flowers. Negligence in removing these plants from flowering plantations would cause a reverse result – some insect pollinators would be diverted from alfalfa, and this would also lead to impurities in alfalfa seed.

In the area of seed plantations of alfalfa there should not be any too large density of plantations, because this causes too large dispersal of the wild pollinators. Seed plantations should be rather small – up to 0.5 ha, and of the shape of an elongated rectangle. In the vicinity of an alfalfa plantation there should not be any plantations of red clover, birdsfoot trefoil, or any other leguminous plants the flowers of which represent an important competitive factor, and cause some *Apoidea* to divert from alfalfa.

I wish to express my cordial thanks to Docent Dr. Z. Warakomska for her kind assistance in the identification of pollen.

7. SUMMARY

The present study is part of the research on the *Apoidea* found on alfalfa in the region of Lublin in the years 1966–1968 (Anasiewicz 1975).

A microscopic pollen analysis and direct observation made it possible to describe the trophic relationships of the insects under study, and determine their role in a biocenose of flowering alfalfa.

Close trophic relationships were found between alfalfa, and the honey bee and 14 species of wild *Apoidea* (Tabs. I–III). The honey bee was found to collect mainly the nectar, and in most cases it did not pollinate the flowers, whereas the wild *Apoidea*, and in particular *Rhophitoides canus, Melitta* leporina and *Bombus terrestris*, appeared to play a decisive role in alfalfa seed production, because when collecting pollen they tripped the flowers thus causing their pollination.

For 22 species of wild *Apoidea* alfalfa appeared to be only an accessory source of both nectar and pollen. These hymenopterans pollinated a certain percentage of the alfalfa flowers visited by them.

The remaining 80 insect species studied were found to be indifferent to alfalfa as a source of nectar and pollen, and they occurred on the plantation because of their trophic relationships with the weeds infesting alfalfa.

Figures 1–7 represent details from pollen slides prepared from the pollen collected by the different *Apoidea* species caught in the alfalfa fields under study.

8. POLISH SUMMARY (STRESZCZENIE)

Niniejsze opracowanie jest częścią badań nad błonkówkami pszczołowatymi występującymi na lucernie w województwie lubelskim w latach 1966–1968 (A n a s i e w i c z 1975).

Analiza mikroskopowa pyłku i bezpośrednie obserwacje umożliwiły poznanie powiązań troficznych badanych owadów i określenie roli, jaką odgrywają w biocenozie kwitnącej lucerny.

Pszczoła miodna i 14 gatunków dzikich błonkówek pszczołowatych były ściśle związane troficznie z lucerną (tab. I–III). Pszczoła miodna zbierała jednak głównie nektar i kwiatów najczęściej nie zapylała, natomiast dzikie pszczołowate, a zwłaszcza *Rhophitoides canus, Melitta leporina* i *Bombus terrestris*, miały decydujące znaczenie dla nasiennictwa lucerny, bowiem przy zbiorze pyłku otwierały kwiaty, co powodowało ich zapylenie.

Dla 22 gatunków dzikich błonkówek pszczołowatych lucerna była tylko dodatkowym źródłem pożytku zarówno nektaru jak i pyłku. Błonkówki te zapyliły pewien procent odwiedzonych kwiatów lucerny.

Dla 80 pozostałych gatunków badanych owadów lucerna była obojętna jako źródło pożytku, a na plantacjach znalazły się one z racji powiązań troficznych z roślinnością zachwaszczającą.

Figury 1–7 przedstawiają fragmenty preparatów mikroskopowych, sporządzonych z pyłku zebranego przez poszczególne gatunki błonkówek pszczołowatych, odłowionych na badanych plantacjach lucerny.

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