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THE MITES (*ACARINA*) FOUND ON BUMBLE-BEES (*BOMBUS* LATR.) AND IN THEIR NESTS

(Ekol. Pol. 19: 57–71). There is a fairly abundant acarofauna associated with bumble-bees. The mites are found both on the bumble-bees and in their nests. The relationship between the mites and the hosts is sometimes very complex and variable, depending on the species, and even on the developmental stage of the mite. The ecological relation between the mites and the bumble-bees are most often of the type of phoresy, parasitism, or commensalism combined with detrimental effects. Most often found on the bumble-bees and in their nests are the following 3 species: *Parasitus fucorum* (De Geer), *Kuzinia laevis* (Dujardin), and *Scutacarus acarorum* (Goeze).

I. INTRODUCTION

The association, of various type, between mites and insects is a frequently encountered phenomenon. Noteworthy is the occurrence of numerous mites on social insects (ants, termites, wasps, honey-bees), and particularly on the apian hymenopters of the genus *Bombus* and in their nests. Our knowledge of the acarofauna associated with the bumble-bees is still poor. Only a few studies have hitherto been published dealing with this problem. Most of the papers merely consist of records and notes. Notes on mites associated with bumble--bees may be found in studies by Michael (1903), Oudemans (1926), Zachvatkin (1941), Vitzthum (1943), Türk, Türk (1957), Hughes (1961) and Rack (1964). The problem of mites present in bumble-bee nests

was also discussed by Postner (1952) in studies on the biology of these insects, and by Toumanoff (1951), in connection with his investigation of honey-bee diseases. In their preliminary studies on the diseases of bumble--bees Skøu, Nørgaard and Haas (1963) gave some more attention to this problem, mentioning the more frequently encountered mite species occurring on the bumble-bees.

In the concerned Polish literature one mention can be found in Kozłowski's (1958) communication in which this author says he found some unidentified species of *Parasitidae* and *Laelaptidae* on the bumble-bees, and no other data are available on this subject.

During his earlier studies on *Kuzinia laevis* (Dujardin) – a mite species closely associated with the bumble-bees (Chmielewski 1967, 1968), the author of the present paper also found other mite species occurring in large numbers on bumble-bees and in their nests, and he considered it justifiable to study the acarofauna associated with these insects.

II. MATERIAL AND METHODS

The study was carried out in the years 1964–1969. From the bumble-bee specimens captured the mites were picked up under a binocular dissecting microscope. The bumble-bees used for mite collecting came from the town area of Poznań, and from neighbouring areas, from Żary (near Żagań), from areas near Sandomierz, the Świętokrzyskie Mountains and from Kościelisko near Zakopane. Mites living in the bumble-bee nests were extracted from the nest material under the stereoscopic microscope. Before their being examined for mites the nests, found in the natural conditions, were transferred to small hives. In addition, material was also examined from nests of domesticated bumble-bees, i.e. nests built in specially-constructed small hives.

From the mites collected from both the bumble-bees and their nests permanent specimens were prepared by Faure-Berlese's method. The identification of the mites was performed on the basis of available descriptions, and guides. Most of the photographs were taken with the aid of the phase-contrast microscope.

III. RESULTS

1. Distribution of mites on the bumble-bees and in their nests

As has been found, the number of mites on the bumble-bees and their nests is usually very large. They are found chiefly on the dorsal side of the thorax and at the sides of the body, at the basis of the wings and, at the axils of the wing-veins. On the abdomen the mites most frequently attach themselves to the fore tergites and to the first sternites. More mobile, fast walking mite

species may also be found in other regions of the bumble-bee's body. 345 insects from the total number 905 of bumble-bee specimens examined appeared to be infested with mites. The female bumble-bees (queens) were found to be most frequently infested: mites were found in 107 from the 117 females-queens examined, while only 40% of the males, and even a smaller percentage of the workers - 25% (Tab. I) was infested. The following bumble-bee species are

Infestation of flying bumble-bees with mites

Tab. I

Bumble-bees (*Bombus* Latr.)			
Sex	Number of individuals examined	Mite - infested individuals	
		Number	%
Females (queens)	117	107	90.6
Males (drones)	248	98	39.5
Females (workers)	540	140	25.9
Total	905	345	38.3

most frequently and most intensely infested with mites: *Bombus terrestris* L., *Bombus lapidarius* L., *Bombus lucorum* L., *Bombus agrorum* F., *Bombus derhamellus* Kirby, as also *Bombus pratorum* L., and *Bombus hypnorum* L.

The same situation was found with regard to the nests: the nests most densely populated by mites usually belonged to those bumble-bee species the individuals of which were most frequently and most intensively infested, and particularly to *B. terrestris*, *B. lapidarius*, and *B. agrorum*. Nearly each nest is to some extent populated by mites. It is only at the beginning of nest building that the number of mites present is small, when nests may occasionally be found with no mites at all. Live mites are also missing from abandoned bumble--bee nests, especially when these are very dry. However, a closer examination usually reveals the presence of mite exuviae, body-cover fragments, and even dead bodies of mites. An analysis of the material derived from over 40 nests, mostly of the species: *B. terrestris*, *B. lapidarius* and *B. agrorum*, showed that all the nests had been inhabited by mites. The number of mites found in one nest varies with the size of the nest, its location, and stage of development. Several to several hundred individuals may be found, and mite populations may occasionally be found consisting of thousands of mites in one nest. It has been found that in a normally developing bumble-bee nest the mites are most numerous

in the outer portions of the nest, and especially in those areas where it touches the ground, at its floor, or in the external coat (cover) of the nest. Nests inhabited by depleted bumble-bee colonies, or those being at the final developmental stage are usually completely infested by mites. The mite populations found in the bumble-bee nests are usually mixed – polyspecific. Populations consisting of one species are rare. As regards the number of species and individuals – the acarofauna found in the nests built by the bumble-bees in natural conditions, i.e. in the woods, meadow, field, in moss, grass, in burrows in the soil and in tree-trunk holes, is richer than in culture. The direct contact of the nest with the natural substratum affects and differentiates the humidity, temperature and sanitary conditions of the nest, thus creating a favourable environment for a larger number of mite species, whose requirements as regards the living conditions often differ considerably, and facilitating their entering the nest from outside (e.g. from the soil). Nests in the hives artificially populated with bumble-bees are to some extent isolated from the influence of the external environment so the thermic and humidity conditions prevailing in them are relatively stable. The sanitary condition of these nests is usually satisfactory, and the only way of contact with the external environment is through the bumble-bees themselves. Owing to this, some of the mite species cannot enter the nests. Consequently, the number of species represented and the size of the mite population are smaller in artificially populated hives than in a bumble-bee nest in a natural habitat.

2. The most abundant mite species on bumble-bees and in the nests of these insects

As indicated by the data supplied by the examination of the bumble-bees for mites, and by the investigation of the material from the nests populated by bumble-bee colonies, most closely associated with these insects are the following three mite species: *Parasitus fucorum* (De Geer), *Kuzinia laevis* (Dujardin) and *Scutacarus acarorum* (Goeze).

Individuals of *P. fucorum* (Fig. 1), commonly occurring and fairly abundant on bumble-bees and in their nests, are of brown colour varying in hue. On account of their relatively large body-size they are well visible even to the naked eye, both on the insects and in the nest material. Their body length is about 1300–1500 μ, and the breadth about 600–750 μ. They possess long, strong limbs, and belong to the fastest runners among mites. The tarsi of all the four pairs of limbs bear curved claws with which the mites attach themselves to the body of the host, this function being sometimes aided by the chelicerae.

P. fucorum is exceptionally frequently encountered, more frequently than the other species; it occurs on the worker bumble-bees. Usually single or 2–3 individuals are found on a worker bumble-bee. The largest number of individuals – 78 of this species was found on a worker *B. lucorum* (Boruja near Nowy Tomyśl. Aug. 25, 1969, leg. det. Chmielewski). It also occurs on the males, but is most frequently found on the female (queen) bumble-bees where also it is most abundant, and it overwinters on the queen bumble-bees. Never were eggs and larvae of this mite found on flying bumble-bees. This finding and the presence of large populations of *P. fucorum* in the bumble--bee nests indicate that the species breeds in the nest of the host. *P. fucorum* may often be found together with other mite species on the same bumble-bee. This species has been known in many countries. It has not hitherto been reported to occur in Poland, although it is very common here. Its occurrence in Poland was first found by the author of this paper in Poznań and in areas near this town (Poznań, April 15, 1967, on female *B. terrestris* and *B. lapidarius* leg. Chmielewski, det. Samŝinak; Bolechowo near Poznań, May 10, 1967, on a female *B. terrestris* leg., det. Chmielewski). This mite species very often occurs in large numbers in bumble-bee nests. It was found to be abundant particularly in the nests of *B. terrestris*. Individuals of *P. fucorum* were found in each of the 40 nests, of different bumble-bee species, investigated by the author.

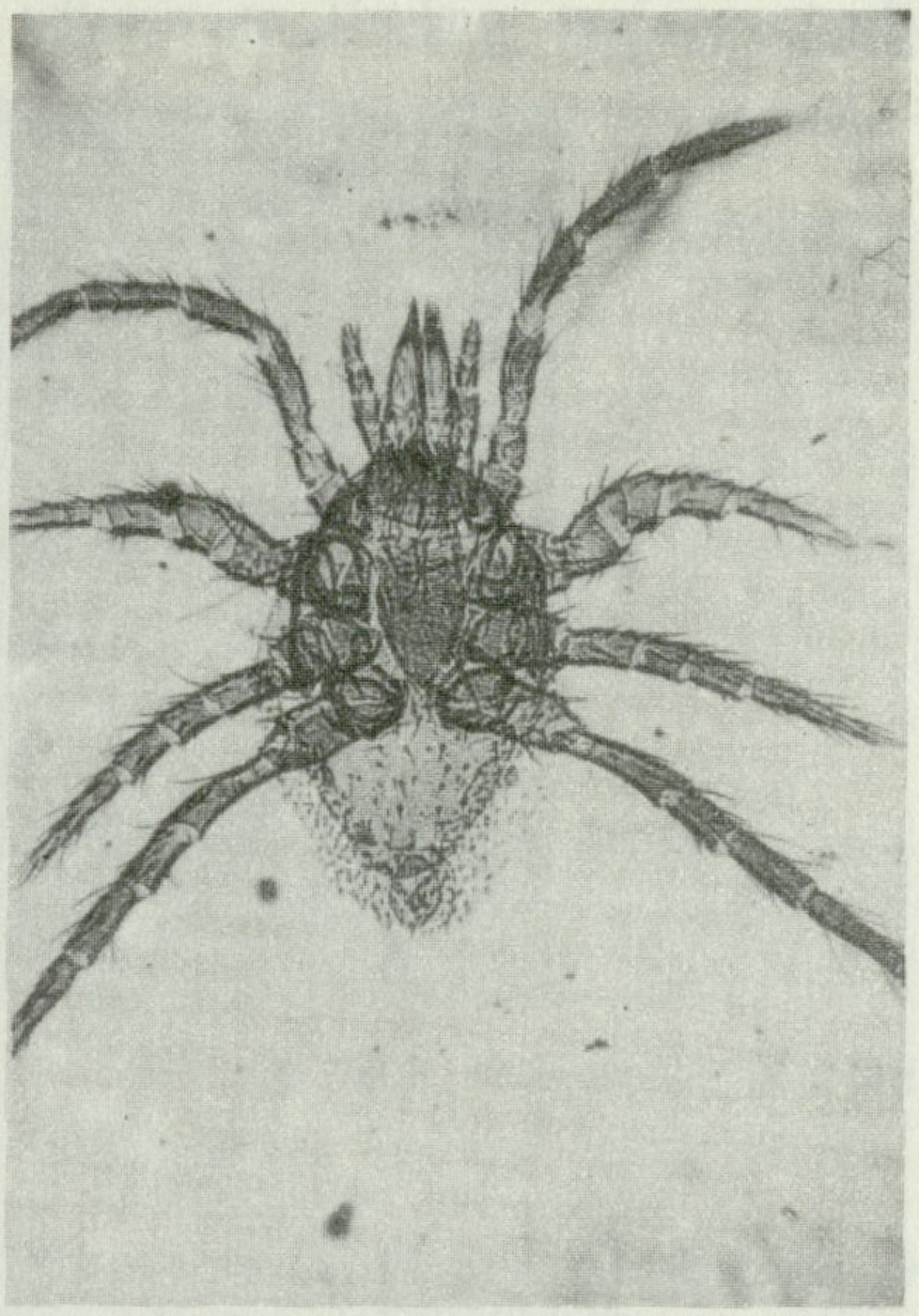

Fig. 1. *Parasitus fucorum* (De Geer) individual found on a female (queen) *Bombus terrestris* L. (microscope)

Another relatively common, primarily on the bumble-bees, mite species is *Scutacarus acarorum* (Fig. 2). The author found it to occur also in Poznań (Poznań, April 15, 1967, on female *B. terrestris*, leg. Chmielewski, det. Samŝinak; on female *B. lapidarius* and *B. agrorum*, leg., det. Chmielewski). These mites are brown in colour, or brown with a reddish hue. They are usually dark--coloured, though occasionally individuals were also found with a fairly light body colour. This species is rather characteristic for its body shape – the body being dorso-ventrally flattened thus forming a round disk. The mites of this species are the smallest of all mites found on bumble-bees. They are

therefore difficult to see with the naked eye. The body of an individual of *S. acarorum* is about 220 μ long, and about 210 μ broad. Individuals may sometimes be found which are broader than they are long. The legs of these mites are short, and all, except the 4th pair, are terminated with curved claws

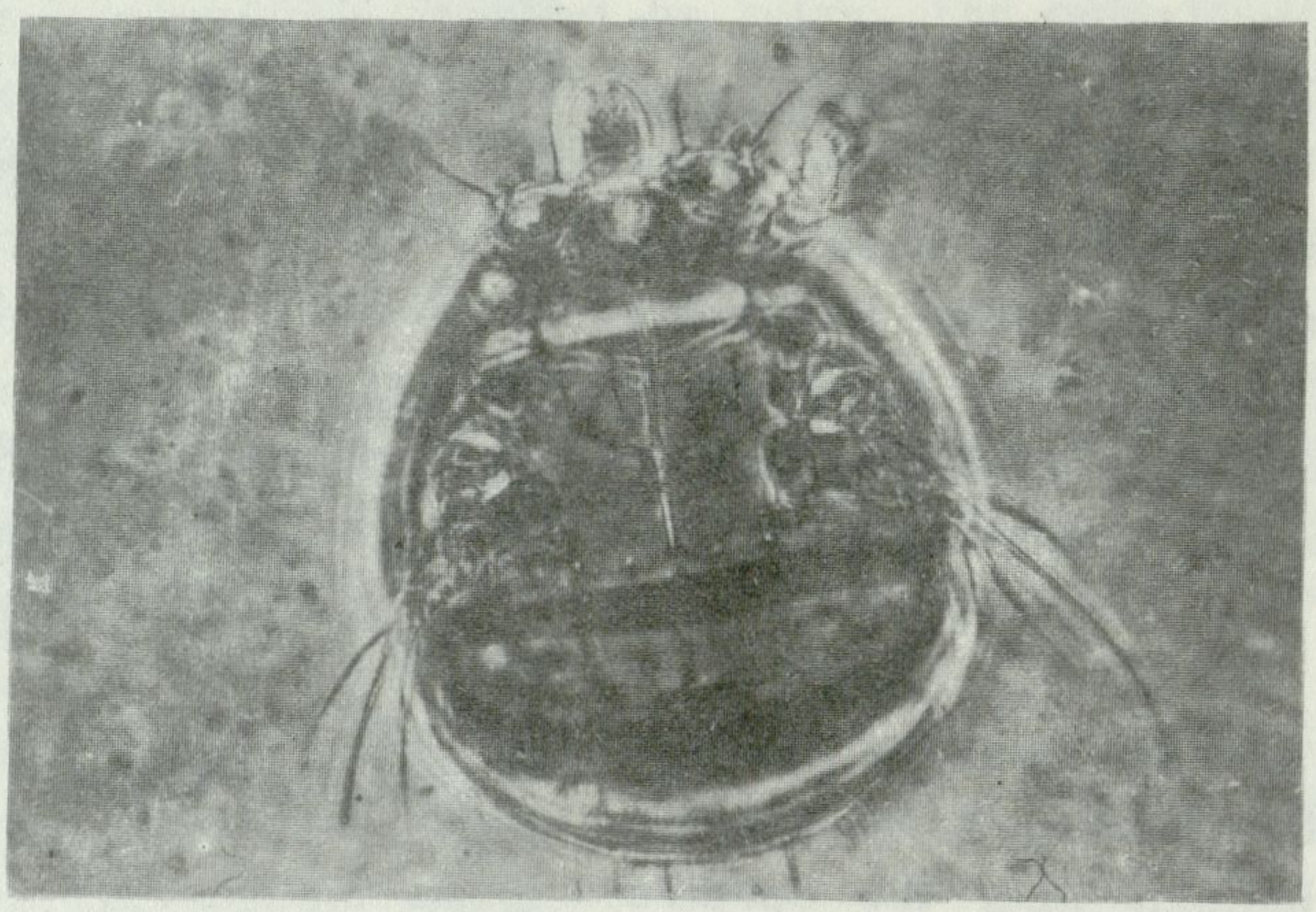

Fig 2. *Scutacarus acarorum* (Goeze) individual found on a female (queen) *Bombus lapidarius* L. (phase-contrast)

which enable them to cling to the body of a bumble-bee and move amidst its thick hair. The mites attach themselves to the host's body by their mouth parts, the mouth parst thus playing the role of an attachment organ. These mites were also observed on mites belonging to a different species, namely *P. fucorum*, occurring on bumble-bees. Individuals of *S. acarorum* were several times found attached to the limbs, at the joints – chiefly at the tibia-genu and the genu--femur articulations, where the body covering is thinner. *S. acarorum* was found to occur most frequently and most abundantly on the queens of *B. terrestris* and *B. lapidarius*. The largest number of mites on one host – 56, was found on a female *B. terrestris*, and the second largest – 25 specimens – on a female *B. lapidarius*. In the nests of the bumble-bees this species was seldom found, and only in small numbers.

The third most abundant mite species on the bumble-bees is *Kuzima laevis*. On the bumble-bees, only the hypopus stage (= heteromorphic deutonymph) (Fig. 3) occurs. The number of individuals of *K. laevis* at the stage of hypopus, found mainly on queen bumble-bees, may vary considerably, from several to several hundred individuals. The average number, calculated from the number of *K. laevis* specimens found on 20 female *B. terrestris*, was 200 mites per one female. In one case as many as 1050 hypopi on one female *B. terrestris* were found. *K. laevis* hypopi may also be found, though in smaller numbers, on the

males (drones), and very rarely on worker bumble-bees. *K. laevis* hypopi are of a basically brown colour with many different hues. They are plate-shaped, dorso-ventrally flattened of rather a small size – about 250 μ long and about 150 μ broad. At this stage the mites do not feed and their mouth parts (gnathosoma) are considerably reduced. On the bumble-bee, they are located mainly on the ventral side on the first abdominal sternites, while on the dorsal side the largest numbers of individuals are found on the metathorax at the sites of attachment of the wings and at the thorax-abdomen junction. *K. laevis* hypopi cling to the body surface of the bumble-bee by a sucker plate, characteristic of this stage, located on the ventral side of the posterior part of the body. They remain motionless, attached side by side closely, usually forming a tight single layer covering the given part of the insect's body surface. Because of their small body size, they are sometimes difficult to discover in the thick hair of the bumble-bee. According to the author's estimation, about 75% of the bumble-bee queens examined for the presence of mites appeared to be infested by *K. laevis*. This species is also abundant and frequently found in the bumble-bee nests. Its biology is adjusted to the biology of the host.

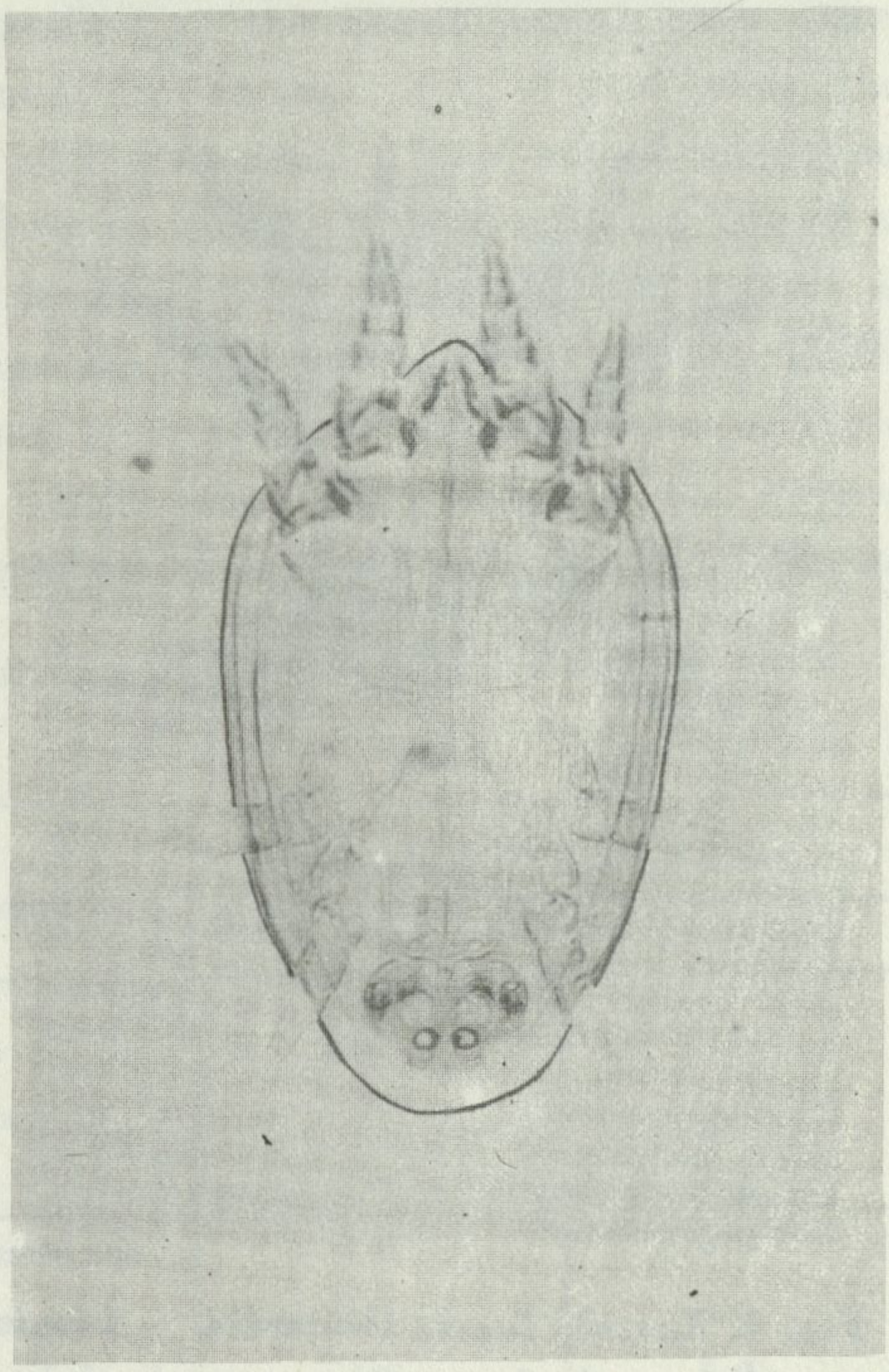

Fig. 3. *Kuzinia laevis* (Dujardin) – the hypopus stage, found on a female (queen) *Bombus agrorum* F. (phase-contrast)

In the spring already these mites appear in the nests that are being built by the queen bumble-bees which have survived winter. *K. laevis* hypopi, which have overwintered on the female bumble-bees, leave the body surface of their hosts and move to the new-built nests where they give rise to new mite populations. The whole life history of *K. laevis* is passed in the bumble-bee nest.

During the biological-ecological investigation of the mites (Chmielewski 1967, 1969) the author of this paper succeeded in developing culture methods enabling him to carry out experiments with this species under laboratory conditions, entirely separated from the bumble-bees. During the experiments,

under optimum conditions, the ontogeny of this species includes the following successive developmental stages: egg, larva, protonymph, deutonymph and the adult – male (Fig. 4), or female (Fig. 5). Under natural conditions these

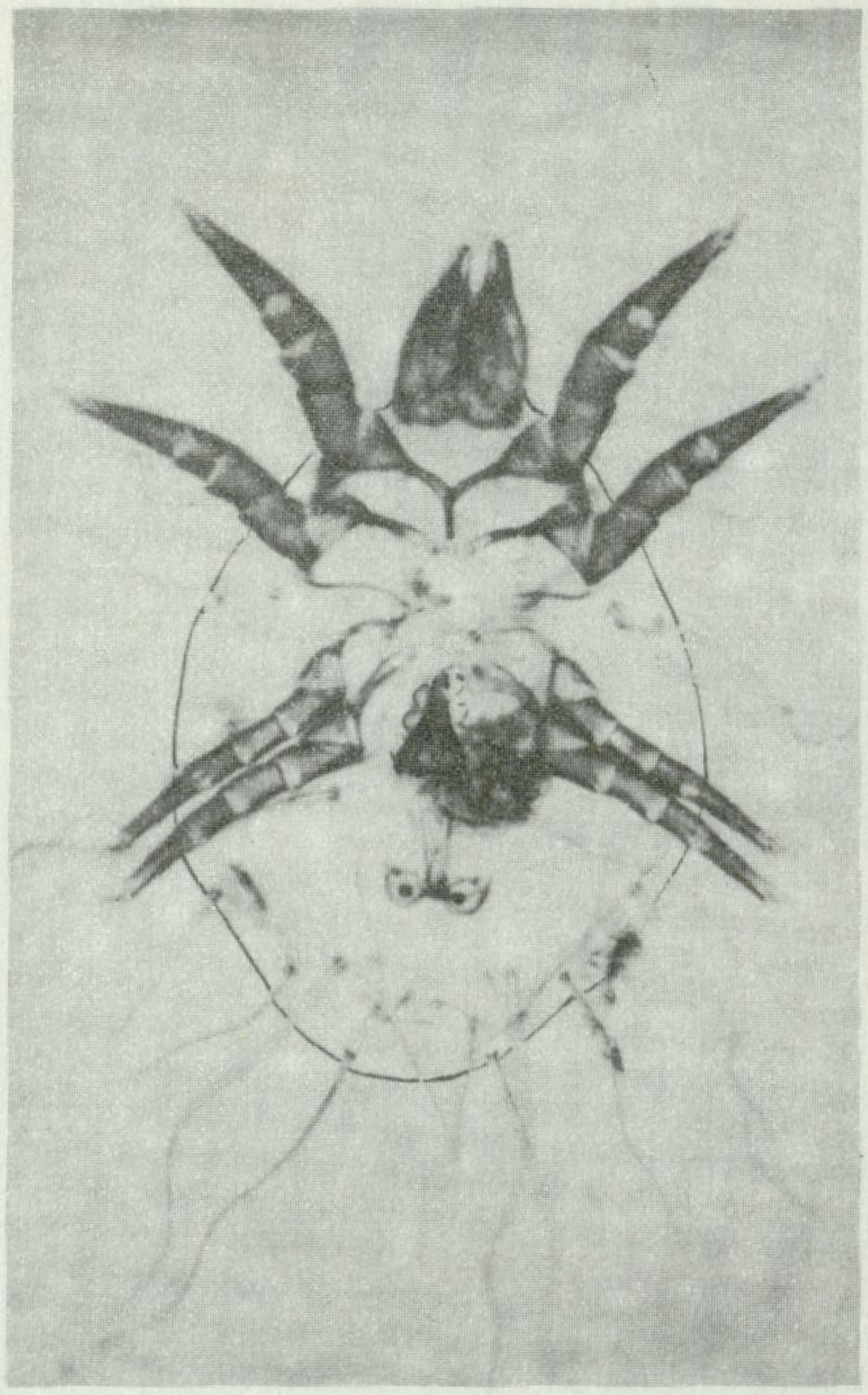

Fig. 4. *Kuzinia laevis* (Dujardin) – a male reared from the hypopus stage under laboratory conditions (phase-contrast)

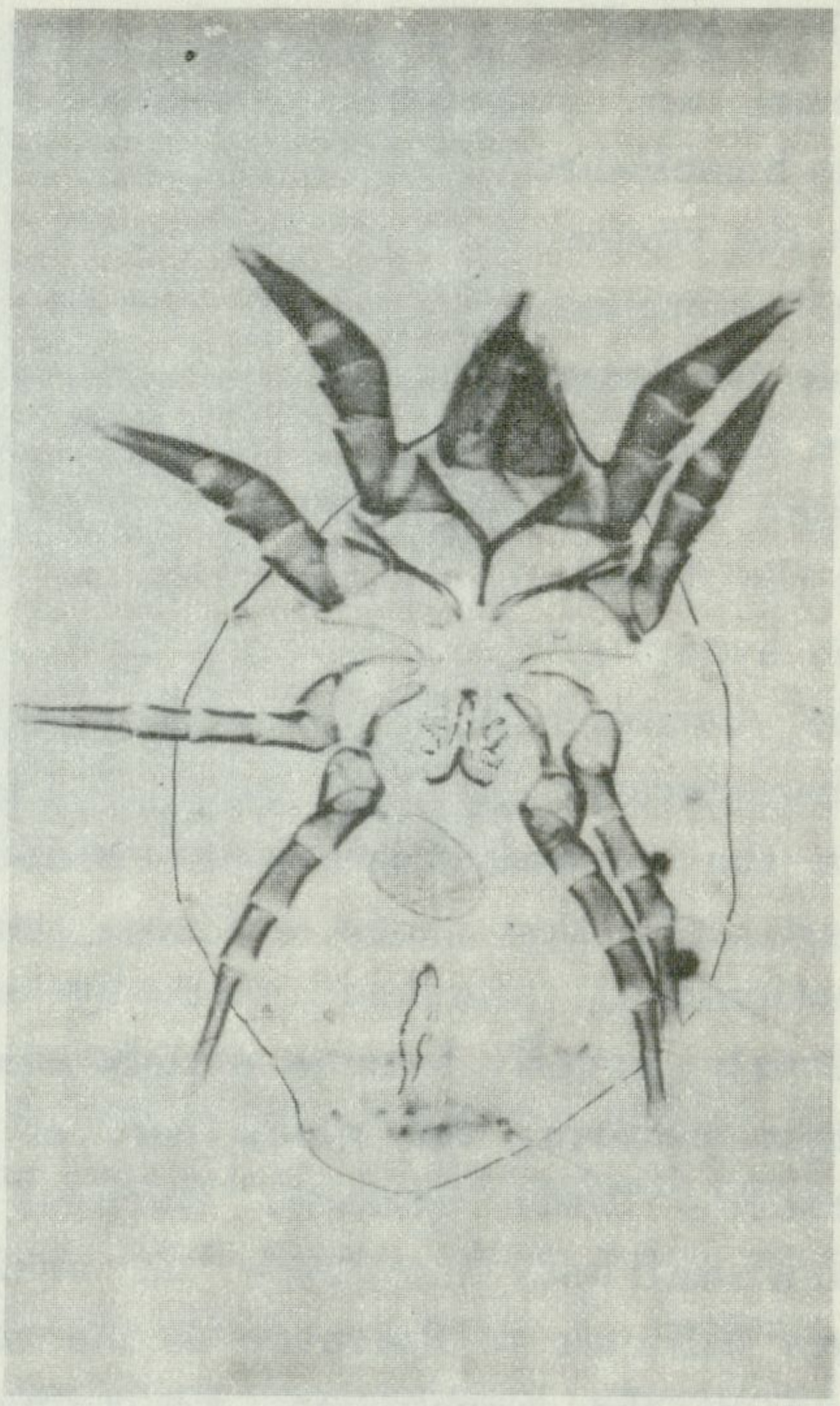

Fig. 5. *Kuzinia laevis* (Dujardin) – a female found in a nest of *Bombus lapidarius* L. (phase-contrast)

stages do not live on bumble-bees, but in their nests. They feed on the pollen and nectar supplied by the worker bumble-bees, on various organic refuse, as well as on the substance of which the cocoons are made and with which they are glued together.

The presence of *K. laevis*, like that of many other bombophilous mite species, in the bumble-bee nests leads on to the deterioration of the sanitary condition of the nests, due to the accumulation of products of metabolism – excrements, exuviae and dead bodies. Mass multiplication of *K. laevis* usually coincides with the period during which the growth of the bumble-bee colony and its nest comes to an end. This phase is followed by a progressing decline – the worker bumble-bees gradually die, while the mites and other representatives of the companion fauna populate the whole nest. Simultaneously, an abundant fungal and bacterial microflora develops in the nest. As the time passes the living conditions in the nest deteriorate and a suppresion of growth

of the mite population follows. At that time the protonymphs of *K. laevis* do not become transformed, as they usually do under optimum conditions, to normal homoiomorphic deutonymphs, but to heteromorphic deutonymphs, i.e. hypopi. Hypopi are most numerous in the autumn. They attach themselves in large numbers to the surviving bumble-bees, most of which are young females--queens. All those hypopi which are attached to the queen bumble-bees overwinter, while those which remain in the nest die. In the spring of next year the hypopi which have survived the winter will give rise to new mite populations in the nests constructed by the bumble-bees. Thus the hibernating stage of *K. laevis* is the hypopus. As such, the hypopus plays an important role in the survival and spreading of the species (Chmielewski 1967, 1969).

Most bumble-bees are infested by one mite species. However, two or three species are often found on the same bumble-bee, especially on the gueens (Tab. II). Of the total number 345 specimens examined, representing different

Mite species associations found on bumble-bees

Tab. II

Mite associations	Mite species found	Mite-infested bumble-bees	
		Number	%
Consisting of 1 species	*Parasitus fucorum*	164	47.5
	Scutacarus acarorum	18	5.2
	Kuzinia laevis	104	30.1
Consisting of 2 species	*P. fucorum* + *S. acarorum*	14	4.1
	P. fucorum + *K. laevis*	16	4.6
	S. acarorum+ *K. laevis*	17	5.0
Consisting of 3 species	*P. fucorum* + *S. acarorum* + *K. laevis*	12	3.5

bumble-bee species and infested by mites, about 60% were found to be infested by *P. fucorum*, 43% by *K. laevis*, and about 18% by *S. acarorum* (Tab. III).

Frequency of occurrence of three most important mite species on bumble-bees
(total number of bumble-bees examined – 905, therefrom 345 infested with mites)

Tab. III

Mite species	Mite-infested bumble-bees	
	Number	%
Parasitus fucorum	206	59.7
Kuzinia laevis	149	43.2
Scutacarus acarorum	61	17.6

P. fucorum and *S. acarorum*, like *K. laevis*, occur on the bumble-bees throughout the year, but they are most abundant on these insects during autumn-winter and in spring, when they are chiefly associated with the queen bumble-bees. In the condition known under the term anabiosis these three mite species overwinter on the bumble-bees and together with the bumble-bees they undergo the winter diapause. Those mites which do not succeed in attaching themselves to the insects and remain in the nests abandoned by the bumble-bees will die.

Besides the above-discussed three main bombophilous species hypopi of the genera *Histiostoma* and *Caloglyphus* were also found on the bumble-bees, though very rarely.

In the bumble-bee nests, in addition to *P. fucorum*, *K. laevis* and *S. acarorum*, also individuals of the following species were observed, in smaller numbers – sometimes only single individuals could be seen: *Kleemania plumosus* (Oudemans), this species being new to Poland (Poznań. Aug. 12, 1967, *B. terrestris* nest, leg., det. Chmielewski), *Tarsonemus fusarii* Cooreman, *Cheyletus eruditus* (Schrank), *Glycyphagus destructor* (Schrank), *G. domesticus* (De Geer); species of the genera: *Tyrophagus*, *Belba*, *Tydeus*, *Proctolaelaps*; representatives of *Uropodidae*, *Anoetoidea* and *Oribatei*.

3. Types of association of mites and bumble-bees

The ecological association of the bumble-bees and mites may vary in form and complexity. The most frequently encountered types of association of these arthropods is phoresy. A typical form of phoresy is the association between the mites and insects when the mites use the insects as a means of transport, and often hibernate on them. This type of association of the mites and bumble-bees is represented by *K. laevis* hypopi, which are carried by the bumble-bees and hibernate on these insects. Their number on a queen bumble-bee may sometimes be so large that the movements and flight of the latter are difficult, which no doubt is harmful to the insects. There may be hundreds, and sometimes more than a thousand hypopi on one insect. In such cases the phoresy may be regarded as changing to transport parasitism. The association of adult *K. laevis* and other developmental stages, except the hypopus, with bumble-bees is of the nature of commensalism, or it might be defined as commensalism bordering on an association which is harmful to one partner namely to insect in this case. As *K. laevis* passes the entire life cycle of the family of the bumble-bees, all its developmental stages may be found there. In the nest, these mites feed primarily on various organic refuse and remains of the food eaten by the bumble-bees, and on the pollen and nectar supplied by

the worker bumble-bees. If the multiplication of the mites is rapid, the mites may cause depletion of food supplies of the hosts. However, since the mass occurrence of the mites usually coincides with the end of growth of the bumble--bee colony, the damage caused by them does not much affect the hosts. During his investigation the author never found a case of destruction of the hosts and nest merely due to the presence of the mites.

The relationship between *P. fucorum* and bumble-bees is also a phoresy: the mites are carried by the bumble-bees and it is on the bumble-bees that they overwinter. The whole growth cycle of this mite species occurs in the hosts' nest. *P. fucorum* is regarded to be a coprophagous species (Vitzthum 1943), because it feeds on the excrements of the bumble-bees, so its presence in the nest may even be of advantage to the hosts.

S. acarorum is another mite species which uses the bumble-bees as a means of transport, at the same time probably being their parasite, for it feeds on bumble-bee haemolymph. This is indicated by the overall body structure of this mite species, its mouth parts by which it firmly clings to the skin of the insect, as well as its calm, almost sessile life, these features being characterictic of some parasitic mites. These mites are most frequently found attached to be under surface of the basal parts of the wings, usually at the axils of the wing-veins, and on the metathorax in areas where the intersegmental chitinous layers are thin. In these the areas the mites are attached side by side, often forming a typical rings around this part of the body of the bumble--bee.

Specimens of *S. acarorum* were found several times also on *P. fucorum*, clinging at the joints between particular segments of the limbs of this mite. The finding several times of *S. acarorum* on another mite species occurring on the bumble-bees is an interesting and rare case of a simultaneous primary mite acariasis and a primary and secondary acariasis (hyperparasitism) of insects, for some *S. acarorum* may occur direct on the bumble-bee, while others may be found attached to individuals of *P. fucorum* present on the bumble bee. In this case *P. fucorum* plays the role of a carrier of *S. acarorum* and is the vector of the infestigation of bumble-bees by this species. On one individual of *P. fucorum* up to a dozen *S. acarorum* may be found. The largest number of *S. acarorum* individuals ever found on one individual of *P. fucorum* collected from a queen *B. lapidarius* was 12. On the limbs of *P. fucorum* they are attached in the joint regions where the body-covering is thin.

Other mite species, less abundant in the nests of the bumble-bees, are not so closely associated with their hosts. Many species get where incidentally. Some of them, e.g. species of the families *Acaridae* and *Glycyphagidae* are polyphagous species, commensals or pests, feeding on the remains of the food

eaten by the bumble-bees, or on other organic wastes, while others feed on dead insects (necrophagous). Many mites feed on moulds and on the decaying plant matter (*Tarsonemidae*, *Anoetoidae*, *Tydeidae*, *Oribatei*, *Uropodidae*, *Gamasidae*). Some predatory mites, e.g. *C. eruditus*, are natural enemies of other mites occurring in bumble-bee nests. *P. fucorum*, *K. laevis* and *S. acarorum* were, for instance, found on *Psithyrus vestalis* Fourcr., and *P. rupestris* F. – species known to be parasites of bumble-bee nests.

The bumble-bee nest represents a kind of a specific micro-biocenosis in which the populations of mite, insects and other animals living in the nest acquire the features of a self-controlled association.

IV. DISCUSSION OF RESULTS

The research described in this paper has shown that there is rather an abundant acarofauna associated with the bumble-bees, and the relationship between the mites and the insects is diverse and complex. The following mite species are the most frequently encountered and most abundant, both in the nests of the bumble-bees and on the bumble-bees themselves: *P. fucorum*, *K. laevis*, and *S. acarorum*. In the nests, mixed, polyspecific mite populations are usually found. Associations consisting of 1, 2 or 3 mite species can also be found on the insects themselves.

In the literature concerned with the mites associated with bumble-bees mostly notes of the kind of records can be found. Data related to *K. laevis* can be found in the studies by Zachvatkin (1941), and by Türk and Türk (1957) which deal mainly with the morphological features of the mite species. In their preliminary investigations of the dideases of bumble-bees Skøu, Nørgaard and Haas (1963) also mention *K. laevis* found on flying bumble-bees, from which it may be inferred that the data relates to the hypopus stage of this species. The above authors also reported on having found *P. fucorum* on the bumble-bees, and also *Bombacarus buchneri* Stammer – an endoparasite living in the tracheae of these insects. In the literature, the data concerning *P. fucorum* is in general scarce. A note on this species can also be found in the study of mites by Vitzthum (1943).

There is particularly little information on *S. acarorum* in the literature. In his report on insect acariasis Kozłowski (1958) states he found *Scutacarus femoris* Gros on some unidentified *Parasitidae* collected from a nest abandoned by bumble-bees. This species is identical with that found by the author of this paper on *P. fucorum*, and also on the bumble-bees, for *S. femoris* is synonymous with *S. acarorum* (Rack 1964).

In addition to the three most abundant and most frequently encountered mite species occurring on the bumble-bees and in their nests the author also found some other, less abundant species. The most interesting of these are: *Cheyletus erudirus*, *Macrocheles glaber*, *Tarsonemus fusarii*, *Glycyphagus demesticus*, *G. destructor* and *Kleemania plumosus*. In the literature concerned (Michael 1901–1903, Oudemans 1936, Zachwatkin 1941, Vitzthun 1943, Toumanoff 1951, Postner 1952, Türk, Türk 1957, Hughes 1961, Skøu, Nørgaard and Haas 1963, Rack 1964) about 20 mite species, found on the bumble-bees or in their nests, are enumerated. Among those most often named are *Cerophagus granulatus* (Dujardin) and some species of the genus *Parasitus*. The data related to these species, however, is of the nature of a series of records, and concerns mainly those species which occur rarely and in smaller numbers, and sometimes only incidentally on the bumble-bees or in their nests; their association with the hosts is often very loose or does not exist at all.

In the Polish literature, apart from Kozłowski's report (1958), available to him the author of this paper did not find any data concerning the mites associated with the bumble-bees. The same is indicated by the Polish bibliographies of mites (Boczek 1962, 1966, Rajski 1963) and of insect diseases (Lipa 1963).

In the Polish or foreign literature no data can be found concerning the biology and ecology of the mites associated with the bumble-bees. The ecological observation carried out by the author, and his investigation into the biology of some mite species permit the statement that the nature of the ecological relationship between the mites and bumble-bees depends not only on the species of the mite, but also on the developmental stage of the mites, and the environmental conditions. For instance the association of the hypopus stage of *K. laevis*, which develops under a specific combination of the factors affecting the living conditions of the mites, with the bumble-bees is of the phoresy type, while the type of partnership of the adult mites and the remaining developmental stages, which remain in the nest all the time, may be defined as true commensalism, or commensalism bordering on a partnership where one partner is a pest to the other.

The extent of infestation of individual bumble-bées by mites depends on the sex and on the function of these individuals in the bumble-bee colony. The lowest degree of infestation was recorded for worker bumble-bees, then for drones, and the highest values were found for the queen bumble-bees. Those mites whose association with the bumble-bees is the strongest winter-over on the queen bumble-bees, and undergo together with them anabiosis (winter diapause). In the spring, they will be brought by the queen bumble-

-bees to the nests newly built by them and so they will give rise to new populations of the mite species.

The knowledge of the biology and ecology of the mites makes it easier to study and interpret the relationship between them and the insects.
For this reason it seems purposeful to carry out researches in this field.

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ROZTOCZE (*ACARINA*) WYSTĘPUJĄCE NA TRZMIELACH (*BOMBUS* LATR.) I W ICH GNIAZDACH

Streszczenie

Roztocze najczęściej i najliczniej występujące na trzmielach należą do trzech gatunków: *Parasitus fucorum* (De Geer) (Fig. 1), *Kuzinia laevis* (Dujardin) (Fig. 3) i *Scutacarus acarorum* (Goeze) (Fig. 2). Niekiedy spotyka się również inne gatunki, np. z rodzaju *Histiostoma* i *Caloglyphus*.

Badania wykazały, że na 905 trzmieli fruwających, poddanych analizie na obecność roztoczy, 38% było opanowanych przez roztocze. Najczęściej, bo w ponad 90% opanowane były samice – matki trzmieli, samce – w 40%, a robotnice w ok. 25% (Tab. I). Roztocze występujące jednocześnie na jednym trzmielu reprezentować mogą jeden, dwa lub trzy gatunki (Tab. II). Na 345 okazów trzmieli różnych gatunków opanowanych przez roztocze, u 60% z nich stwierdziłem *P. fucorum*, ponad 43% opanowanych było przez *K. laevis*, a na 18% znajdowały się *S. acarorum* (Tab. III).

Najsilniej i najczęściej opanowanymi przez roztocze okazały się trzmiele należące do gatunków: *Bombus terrestris* L., *B. lapidarius* L., *B. agrorum* F. i *B. lucorum* L.

Analizy materiału z 40 gniazd trzmieli różnych gatunków wykazały, że we wszystkich gniazdach występowały roztocze. Gniazda tych gatunków trzmieli, na których najliczniej i najczęściej występowały roztocze, były również najliczniej zasiedlone przez te pajęczaki. Najsilniej opanowane przez roztocze były gniazda należące do *B. terrestris*, *B. lapidarius* i *B. agrorum*.

Roztocze występujące w gniazdach tworzą populacje mieszane – wielogatunkowe, których komponentami są najczęściej występujące w dużym nasileniu gatunki: *P. fucorum*, który stwierdzony został we wszystkich badanych gniazdach trzmieli i *K. laevis*, który zasiedlał ok. 80% gniazd założonych przez trzmiele w warunkach naturalnych. *S. acarorum* znajdowałem w gniazdach w nieco mniejszym nasileniu i stosunkowo rzadko. Rzadziej, chociaż niekiedy w dość dużym nasileniu występowały w gniazdach następujące roztocze: *Glycyphagus destructor* (Schrank), *G. domesticus* (De Geer), *Cheyletus eruditus* (Schrank), *Tarsonemus fusarii* (Cooreman), *Kleemania plumosus* (Oudemans) i *Macrocheles glaber* (Müller). Spotkać też można roztocze z rodzajów: *Tyrophagus*, *Belba*, *Tydeus*, *Proctolaelaps*; przedstawicieli *Uropodidae*, *Gamasidae*, *Tydeidae*, *Anoetoidea* i *Oribatei*. Niektóre z tych roztoczy nie należą do gatunków bombofilnych, a w gniazdach trzmieli znalazły się zupełnie przypadkowo.

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