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# The Concept of the Acarinium and the Acarinia Zones

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**Abstract.** In this paper attention is given to the mites of the order Parasitiformes which are characterized by a nidicolous type of parasitism. An acarinium is considered to be a community of mites which parasitize a certain terrestrial vertebrate and live in its nest. Together with other synecological units the acarinium and the host form the biocenosis of the nest. Acarinia of a certain ecological groups of vertebrates which are associated with a certain biotopes or microbiotopes are very similar or identical. This is the case of a higher ecological unit which may be determined as a zone of acarinia. Each acarinia zone of a certain ecological group of vertebrates distinctly differs from the acarinia zone of another group, in spite of the fact that exchange relations exist between them. The authors mark main groups of factors which promote the formation of acarinia zones: influences of the outer environment, of the bionomics and ethology of hosts and of the bionomics and ethology of mites, and in each acarinia zone distinguish several trophically different groups of parasitic mites. Main acarinia zones in Central Europe are: the zone of small terrestrial mammals, the zone of larger terrestrial rodents, the zone of bats, the zone of squirrels and dormice, the zones of birds nesting in the crowns of trees and on the ground and the zone of swallows. In conclusion the authors deal with various phenomena observed in acarinia zones.

In the large group of mites many of them are parasitic. This fact manifests itself nearly by all types of parasitism known in the animal kingdom. Various types of parasitism may be mentioned such as that of ticks, Laelapidae, Dermanyssidae, chiggers, Sarcoptidae, Demodicidae, of the genus *Pneumonyssus*, *Sternostoma* etc. It is very difficult to cover all these types of parasitism within the complex of the whole group and to determine the laws by which they are governed. It is therefore necessary to analyse each group separately and to emphasize features by which the parasitism in it is characterized from the ecological viewpoint.

In this paper attention is given to the order Parasitiformes which are primarily characterized by a nidicolous type of parasitism. Many analogical phenomena common to nidicolous parasites of the class Insecta, e.g. fleas (ROSICKÝ 1950, 1957), are found with these mites. From the order Parasitiformes the following families are given particular attention: Laelapidae, Haemogamasidae, Liponyssidae, Dermanyssidae, Spinturnicidae, including nidicolous species from the family Ixodidae.

Vitzthum (1941) takes as a basis the classification proposed by Deegener (1917, 1918) which is an attempt to classify the associations in the animal kingdom. However, this classification in which the parasitic forms are called by the term parasitium, is not quite suitable to our purpose because we do not have in mind only the nutritional relations as follows from the definition of a parasitium, but broader associations, including paraphagium, synoecium and symphorium which are primarily characterized by various ecological factors.

Bearing in mind the ecotopic, nutritional, contact and synecologic conditions in mammalian nest, Rosický (1953) therefore proposed the term "acarinium" to designate a community of mites, mainly of the order Parasitiformes, living on the host and in its nest. Similar conditions which characterize nidicolous parasitism and relevant communities of fleas (aphanipterium—Rosický 1950) have been taken as a basis. Mrciak and Rosický (1959) later analysed in detail the properties of acarinia as distinct ecological units; they were summarized later by Daniel (1964) at the 1st International Congress of Acarology.

In the present paper this synecologic unit is revised in order to confront our concept with the latest results obtained while investigating the distribution and ecology of mites of the order Parasitiformes, primarily the relationship mite—host—its nest. We have taken into account the classification of all nidicolous parasites and nest inhabitants, as proposed by Nordberg (1936) who investigated the fauna of bird nests and as re-analysed later by Woodroffe (1953) and we have also considered the comparative ecological data published by Tagil'tsev (1962). As basic materials we have used papers of our working team (Mrciak 1963, 1964, Mrciak et al. 1966, Mrciak, Rosický 1956, Mrciak, Tovornik 1959, 1966, Dusbábek 1962, 1964 etc.) and other publications from different parts of the Palearctic region (e.g. Vysotskaya, Bregetova 1957, Mrciak, Brander 1965, Costa 1961, Khudyakov 1963, Rejtblat 1964 etc.).

## 1. Acarinium and acarinia zones

1.1. We consider an acarinium to be a group of mites of the order Parasitiformes which parasitize a certain terrestrial vertebrate and live in its nest. In accordance with Audy (1965) the nest is regarded as a specific artifact, including its function as the ecological niche and its relation to the ecosystem. An acarinium is a peculiar synecological unit of mites, mainly of the order Parasitiformes of various nutritional relations (haematophagous, predatory, necrophagous, often saprophagous mites and other groups) dependent upon host and its job and function in the nest, characteristic for similar microclimatic conditions. An acarinium, together with other synecological units (e.g. aphanipteria, communities of Chilopoda, Collembola, Coleoptera etc.) and with the host create the whole biocenosis of the nest. Each individual acarinium is defined by a concrete qualitative and quantitative composition of mentioned mites on a certain host and in its nest. As demonstrated by Mrciak et al. (1966) acarinia consist of fur mites and nidicolous mites but these

two components are not always clearly distinguishable. The concept of acarinia, however, cannot be applied to other animal groups. For example the mites of the suborder Mesostigmata can be divided in 8 groups according to their relationship to insects (SAMŠIŇÁK 1957). The problems of the parasitism of mites of the order Parasitiformes on insects and their communities requires further studies yet.

The determination of such natural synecological unit seems to be very useful for theoretical and practical considerations, for the evaluation of relations between individual hosts and between their groups, and for the evaluation of the relation of parasitic mites to man while making epizootological and epidemiological analyses.

1.2. Individual acarinia in nature are not restricted within themselves, but in certain biotopes (habitats); as a rule, there is a larger number of acarinia parasitising hosts of the same species and living in their nests. This is directly connected with the distribution of vertebrates in the area. Between the individual hosts a definite communication exists which causes some interchanges in the acarinia of a vertebrate species in a certain locality.

Far more important is the question whether an exchange takes place of some parasitic mites between hosts of different species belonging to a certain ecological group of hosts which are either related to each other from the taxonomic viewpoint or are leading the same way of life from the ecological viewpoint. Our material demonstrates that a very intensive exchange of mites of the order Parasitiformes takes place in nature between members of a certain ecological group of terrestrial vertebrates. Acarinia of certain ecological groups of vertebrates which are, as a rule, associated with certain biotopes or microbiotopes, usually with certain soil layers where these vertebrates have their nests or shelters, are very similar or identical (NAUMOV 1963, MRCIAK, DANIEL 1962 etc.). Basically this is the case of a higher ecological unit which may be determined as a zone of acarinia. When collecting large numbers of mites of the order Parasitiformes from small terrestrial mammals and from other ecological groups of mammals and birds in a given geographical area, it becomes evident from the material in hand that certain groups of parasitic and nidicolous mites are associated with certain ecological groups of hosts. Each acarinia zone of a certain ecological group of vertebrates distinctly differs from the acarinia zone of another group, in spite of the fact that exchange relations may exist between them.

1.3. There are three main groups of factors which promote the formation of acarinia zones:

1.3.1. Influence of the outer environment. The main factor here is the association of hosts and mites infesting them with certain geographical and ecological complexes (regions and biomes). The requirements of hosts and their mites for a certain microclimate of the environment make the animals with the same requirements gather only in certain types of burrows or nests.

1.3.2. Influences of the bionomics and ethology of hosts. In this second group it is the distribution of burrows and nests of hosts in the area, the search for shelter and food in certain places which are characteristic for individual ecological groups

of vertebrates. Of major importance is the migration and rambling of the animals in the area, the settlement of the area by animals which have left their paternal burrows, the renewal of populations of murine mammals from places of their survival, the settlement of burrows by other species of mammals, the permanent settlement of the area or of certain suitable places only, outbreaks of rodents, transportation of mites by beasts or birds of prey etc. This group of factors is very important in the dispersal of mites in the acarinia zones.

1.3.3. Influences of the bionomics and ethology of mites of the order Parasitiformes. In this third group of factors it must be emphasized that these mites are mostly parasites of homoiothermic vertebrates and in their development are directly dependent on the nest or body cover of the vertebrate. The highest number of species is found on those hosts which build permanent nests, e.g. the richest acarinia are to be found in the underground nests of small mammals (MRCIAK et al. 1966). Location of the nest plays a decisive role in the settlement by mites; this may be accounted for by the microclimate of underground nests which function as thermostats (DANIEL 1965). The small specificity of some species to their hosts which enables them to survive when the hosts are interchanged, is also an important factor. The mites pass from one host to another during sexual contact, contact in the nest, from prey to the carnivorous animal etc. After the death of their host the mites spread in the environment in search for new hosts. The migration of the mites in the acarinia zone of small terrestrial mammals was reported by MRCIAK et al. (1966) after demonstrating that artificial underground nests become inhabited by parasitic and nidicolous mite species of the order Parasitiformes within a short time and that they can also be found in the litter and upper layer of humus.

1.4. According to the relationship to host and the frequency of occurrence, several trophically different groups may be distinguished in acarinia, especially in their fur component:

1.4.1. Main parasites—specific or typical of certain host. For example in the acarinia zone of small terrestrial mammals the main parasite of *Clethrionomys glareolus* is *Laelaps clethrionomydis*, of *Ondatra zibethica*—*L. multispinosus*, of *Mus musculus*—*L. algericus*, of *Apodemus agrarius*—*L. jettmari*, of *Sciurus vulgaris*—*Hirstionyssus sciurinus* etc. The host may have either one main parasite or several main parasites, e.g. the main parasites of *Arvicola terrestris* are the mites *Laelaps muris* and *Hyperlaelaps amphibius*, of *Microtus arvalis*—*L. hilaris* and *H. arvalis*. In some cases one mite species may be the main parasite of related hosts, for example *L. agilis* is the main parasite of the mice of the subgenus *Sylvaemus*. Some hosts have no main parasites e.g. the genus *Crocidura* in Central Europe.

1.4.2. Mites parasitic or living within the acarinia zone on all its members, without any distinctive specificity for certain species of a group of closely related species. These mites are very characteristic for certain zones, as they are usually encountered on all animal species belonging to the zone. For example in the acarinia zone of small terrestrial mammals they are *Haemolaelaps fahrenholzi*, *Eulaelaps stabularis*, *Haemogamassus nidi* etc., in the zone of birds nesting in the crowns of trees they

are *Haemolaelaps fenilis*, *Ornithonyssus sylviarum*, *Pellonyssus viator* etc. This group of mites, in contrast to specific main mites, are determined as secondary parasites or members of the acarinium. The term "secondary" does not mean here that these species are less important within the zone, but it should rather denominate the fact that besides the main parasites other species are existing along with them on their hosts. This group sometimes includes species which may be main parasites of a certain host, but under certain ecological or geographical conditions may occur on other hosts within the zone, for example *Laelaps muris* on *Pitymys subterraneus*, *L. agilis* on *C. glareolus* and *M. arvalis*, *L. hilaris* on the members of the genus *Apodemus*, *Hirstionyssus musculi* on *C. glareolus* etc.

1.4.3. Mites which are accidentally transferred to a certain acarinia zone from another zone. These are primarily transfers from neighbouring zones which occur during mutual contact of their various representatives, e.g. the transfer of *Laelaps agilis* to *Sciurus vulgaris*, of *L. hilaris* to *Marmota marmota*, of *Hirstionyssus sciurinus* to *C. glareolus*, of *Haemolaelaps fahrenholzi* and *Haemogamasus nidi* to birds etc. The quantitative representation of such accidental parasites in the acarinium of the host usually indicates that this is an accidental or often exceptional case only.

1.4.4. Species of mites which may be denominated as "attachable" species. They are mites of the order Parasitiformes which usually inhabit soil, leaf litter, moss, rotting logs, under rocks and tree bark etc. They are for example the species of the families Rhodacaridae, Parasitidae, Veigaiaidae, Neoparasitidae, Ascaidae, Macrochelidae, Pachylaelapidae, Phytoseiidae etc. which are considered to lead a predaceous way of life. It is impossible yet to elucidate the nature of the relationship of these mites to the vertebrates. It is important to note, however, that both adults and nymphs are sometimes encountered on various species of freshly captured small terrestrial mammals.

We may suppose that the adult forms become attached to the small mammals either in their nests or during the passage of the animals through leaf litter, moss, rotting logs etc. We must understand the occurrence of the mentioned species of mites as a definite, very frequent phenomenon which might indicate that these mites penetrate into the fur of the mammals in search of food or favourable temperature conditions or that they attach themselves to the mammals to be transported elsewhere.

These species, however, occur occasionally only amongst the fur of mammals, primarily terrestrial small mammals and rarely also on birds. On the other hand they are abundant in the nidicolous component of acarinia. Comprehensive results on the trophic relationships among all components of the nest biocenosis of small mammals in the environs of Leningrad were reported by VYSOTSKAYA (1964). From the total number of all specimens in the nest 30—40 % were ectoparasites (Gamasid mites and fleas), 20—25 % predators, 30—40 % saprophagous and the remaining 10—15 % necrophagous, coprophagous, mycetophagous nest inhabitants etc. As for the mites of the order Parasitiformes such an evaluation can be at present

knowledge only approximate, because the nutritional requirements of many species are still not sufficiently known.

Even more interesting is the fact that apart from the adults also the nymphs or only the nymphs are found of some mite species of this group, for example of the species *Eugamasus magnus*, *E. remberti*, *Euryparasitus emarginatus*, *Cyrtolaelaps mucronatus*, *C. minor* etc. which are known to lead a predaceous way of life. These species are known from literature to complete their development in the nests of various small mammals. We may presume that the nymphs of these species possibly become attached to the mammal which has built the nest and are transported elsewhere.

The objection that the mentioned species might infest the small mammals only after its killing, is of no avail. We have found mites on the live small mammals many times and thus it seems improbable that they infest dead animals. Insects, especially the beetles, may transport some mite species of the order Parasitiformes, between the acarinia zones and these contribute to the permanent existence of the acarinia zones. It is quite possible that even some mites of the *Oribatei* group might get attached to the mammals. However, we do not include them in the acarinia because *Oribatei* are a group with different requirements for outer environment and lead a different way of life.

It may be gathered from the above said that in each zone the acarinia are formed by different groups of mites of the order Parasitiformes. The ratio in the representation of individual groups in various acarinia may differ considerably.

1.4.5. The composition of the acarinia in particular zones differs according to the hosts, the character of biotopes, the relation to certain geographical regions etc. The boundaries of an acarinia zone with another zone are mostly determined by the way of life of vertebrates inhabiting the particular zone. An acarinia zone is identified according to the animals which predominate there and which provide the main features of this zone.

An acarinia zone is not an unchanging and non-dynamic formation. It is an ecological unit reacting to all changes which take place in its environment and in its own host component. There are always several zones of acarinia in an area. To be able to arrive at some theoretical as well as practical conclusions on the mites of the order Parasitiformes we must assume that on each member of a particular zone of acarinia all species of mites may occur which are characteristic for its zone n a given geographical area. In this way the occurrence of certain species can be predicted.

## 2. Main acarinia zones in Central Europe

According to present research the following acarinia zones can be determined in Central Europe:

2.1. The acarinia zone of small terrestrial mammals is the most typical component of Parasitiformes in Central European conditions. Of all vertebrate components in

Central Europe the small terrestrial mammals are least intact by man. A large number of host species inhabiting most different biotopes, from swampy lowlands to high mountain meadows, is responsible for the existence of various species of mites of the order Parasitiformes and at the same time for an intensive exchange of mites between individual acarinia.

The host species belonging to this acarinia zone are as follows: *Talpa europaea*, *Sorex araneus*, *Apodemus agrarius*, *A. flavicollis*, *A. sylvaticus*, *Clethrionomys glareolus*, *Microtus arvalis* and some others. The small mammals do not inhabit only natural biotopes which have been left intact by man, but also biotopes with culturocenoses which have been created and cultivated by man. They even penetrate into settlements or directly into human dwellings. The eusynanthropic species of small mammals have not only their own mites, but during migration can transport mites both living in their fur or in nests in free nature, into the human dwellings and adjoining buildings. As an example we can mention the findings of *Cyrtolaelaps mucronatus*, *Proctolaelaps pygmeus*, *Haemolaelaps fahrenholzi*, *Laelaps hilaris*, *L. agilis*, *Haemogamasus nidi*, *Hirstionyssus musculi* etc. on *Mus musculus* captured in human dwellings in several villages of southern and eastern Slovakia (Mrciak 1963).

In the acarinia zone of small terrestrial mammals the following species of mites (group of secondary parasites) are to be found regardless to a specific host: *Haemolaelaps fahrenholzi*, *Eulaelaps stabularis*, *Myonyssus ingricus*, *M. gigas*, *M. rossicus*, *Haemogamasus horridus*, *H. nidi*, *H. nidiformis*, *H. bregetovae*, *H. hirsutus*, *Hirstionyssus isabellinus*, *H. tatricus* and *Ixodes trianguliceps*, *I. apronophorus* etc. The mentioned species are most typical of this acarinia zone.

The main parasites of this zone are as follows: *Laelaps muris*, *Hyperlaelaps amphibius* (on *Arvicola terrestris*), *L. multispinosus* (on *Ondatra zibethica*), *Hirstionyssus musculi*, *L. algericus* (on *Mus musculus*), *L. clethrionomydis* (on *Clethrionomys glareolus*), *L. pitymydis* (on *Pitymys tatricus* and *P. subterraneus*), *L. hilaris* and *Hyperlaelaps arvalis* (on *Microtus arvalis* and *M. agrestis*), *L. agilis* (on *Apodemus flavicollis*, *A. sylvaticus*, and *A. microps*), *L. micromydis* (on *Micromys minutus*), *L. jettmari* (on *Apodemus agrarius*), *Hirstionyssus carnifex* (on *Talpa europaea*) and *Ornithonyssus bacoti* (on *Rattus rattus* and *R. norvegicus*). These mites often infest other mammal species of the zone as secondary parasites within the zone.

The attachable mite species characteristic for the acarinia zone of small terrestrial mammals are for instance: *P. crassipes*, *P. parvulus*, *Eugamasus kraepelini*, *E. magnus*, *E. remberti*, *E. loricatus*, *Poecilochirus necrophori*, *Veigaia kochi*, *V. propinqua*, *V. nemorensis*, *Euryparasitus emarginatus*, *Cyrtolaelaps mucronatus*, *C. minor*, *Macrocheles decoloratus*, *M. matrius*, *Pachylaelaps sculptus*, *Eviphis ostrinus*, *Cosmolaelaps gurabensis*, *Proctolaelaps pygmeus*, *Hypoaspis aculeifer*, *H. heselhausi*, *H. murinus*, *Pseudoparasitus angulatus*, *Epicrius mollis*, *Androlaelaps sardous* etc.

*Hirstionyssus sciurinus* is the accidental species which occurs on *C. glareolus* and there are some others.

The species composition of acarinia within the zone changes according to the

biotope (field, forests at various altitudes, mountains, places settled by man, location of the nest in the terrain) and according to the hosts or their groups (shrews, voles, rats), but it always has a complex character. MRCIAK et al. (1966) has reported that there is no difference between the acarinia of insectivores, mainly shrews and some murine rodents (*Clethrionomys glareolus*, *Apodemus sylvaticus*). Only some mite species (of the genera *Hirstionyssus* and *Laelaps*) may indicate the relation of the nest to a certain mammal species. There is no great difference between individual acarinia of small terrestrial mammals. Each biogeographical subregion has a different composition of acarinia of small terrestrial mammals (which fact applies to all other acarinia zones).

2.2. The acarinia zone of larger terrestrial rodents in Central Europe is known to have only two hosts. The mites which are found in this zone are primarily *Haemogamasus citelli* (main mite on *Citellus citellus*) and *Hirstionyssus criceti* (on *Cricetus cricetus*). The latter species often passes to *C. citellus* and is a typical secondary parasite of the zone.

As the zone of larger terrestrial rodents is in the close vicinity and in frequent contact with the hosts of the acarinia zone of small terrestrial mammals, secondary species from this zone are quite often found there. Such accidental parasites of this zone are: *Haemolaelaps fahrenholzi*, *Eulaelaps stabularis*, *Haemogamasus nidi*, *H. hirsutus*, *H. horridus* etc.

2.3. The acarinia zone of bats is very limited and only exceptionally we find mites of the order Parasitiformes from bats on other hosts and vice versa. This zone is rich in species; although the bats do not build their own nests, the adaptation of the family Spinturnicidae to parasitic life often makes a high infestation of hosts possible. Many species of the zone are main parasites of certain host species (DUSBÁBEK 1962), e.g. *Spinturnix plecotinus* is parasitic on *Plecotus auritus*, *S. emarginatus* on *Myotis emarginatus*, *S. mystacinus* on *M. mystacinus*, *S. psi* on *Miniopterus schreibersi* etc.; other species parasitize members of a certain genus, e.g. *Paraperiglischrus rhinolophinus* and *Spinturnix euryalis* parasitize the genus *Rhinolophus*, *Spinturnix kolenatii* is parasitic on the genus *Eptesicus* etc. Some mite species infest a wide range of hosts, e.g. *Spinturnix myoti*, *Ichoronyssus flavus*, *Steatonyssus spinosus*, *Ixodes vespertilionis* etc.

2.4. The acarinia zone of the squirrel (*Sciurus vulgaris*) and the dormouse (*Glis glis*). The different way of life led by the common squirrel has resulted in a gradual formation of its own zone of acarinia. *Hirstionyssus sciurinus* is the main parasite of this zone. Also the dormice are infested with mite species from the zone of small terrestrial mammals. *Laelaps agilis*, the main parasite of the genus *Apodemus* occurs on the squirrel as an accidental parasite and *Euryparasitus emarginatus* as attachable species.

2.5. The acarinia zone of birds nesting in the crowns of trees includes primarily the nests of passeriform birds. Main parasites of this zone are: *Haemolaelaps fenilis*, *Ornithonyssus sylviarum* and others.

2.6. The acarinia zone of birds nesting on the ground. The influence of the acarinia

zone of small terrestrial mammals is clearly manifested in this zone as both are closely adjoining to each other. *Dermanyssus gallinae* and *Haemolaelaps fenilis* are the main parasites, *Haemolaelaps fahrenholzi*, *Haemogamasus nidi*, *Eulaelaps stabularis* are accidental parasites, and *Hypoaspis murinus*, *Eugamasus magnus*, *Euryparasitus emarginatus* are the attachable mites found in this zone. A detailed analysis of nests built by *Anas platyrhynchos* has been carried out by DANIEL and ČERNÝ (1963).

2.7. The acarinia zone of swallows includes primarily the nests of swallows (*Hirundo rustica* and *Delichon urbica*) on houses or some farm buildings (cowsheds, barns etc.). The typical mites are *Dermanyssus hirundinis*, *Ornithonyssus sylviarum* and *Eulaelaps novus*).

We do not think that these are all acarinia zones occurring in Central Europe proper. The enumerated zones only represent the actual status of our knowledge on mites of the order Parasitiformes. Further acarinia zones of rabbits, marmots, large beasts of prey, various birds with different types of nests, for example of bankswallows, crows etc. will be outlined in future, and various differences within the individual zones will be possibly determined.

## 3. Frequent phenomena in the acarinia zones

When studying the occurrence of acarinia and their zones, certain phenomena are observed which repeat themselves regularly.

3.1. In points of contact between two acarinia zones the mites often penetrate from one zone into another and give the acarinia of hosts a mixed character. For example the secondary and attachable mites from the acarinia zone of small mammals penetrate into the acarinia zone of larger rodents—the species *Haemolaelaps fahrenholzi*, *Eulaelaps stabularis*, *Haemogamasus horridus*, *H. nidi*, *H. hirsutus*, *Hirstionyssus talpae*, *H. isabellinus* are found in the nests of *Citellus citellus* and *Cricetus cricetus*. Similar phenomena can be noticed in the acarinia zone of the marmot (*Marmota marmota*).

The phenomenon of mites penetrating from the acarinia zone of small mammals into other acarinia zones which are adjoining to it is relatively frequent. It can be of epizootological importance in the natural foci of infections.

3.2. In the acarinia zone where more host species concentrate the species composition of acarinia is very rich. This may be explained by the fact that in such places always more main parasites of individual host species are represented, and when the mites multiply considerably they are passed to various hosts. In individual biotopes the places of survival of small terrestrial mammals are also places of a higher concentration of mites (both in qualitative and quantitative sense). Favourable places of concentration of small mammals and their acarinia are the banks of smaller streams, bushy growths on field borders, on ridges etc. Our investigations show that in regions with marked changes inflicted by human activities, for example

in the fields or artificial meadows, the acarinia species are poor due to a low number of host species inhabiting there (regular agrotechnical interference).

3.3. While in places of concentration of some host species an increase of mite species is noticed, the isolation of a host from other species brings about a decrease of the number of mite species on it. As a rule, the main parasites (or parasite) predominate on the isolated host species, or the mites disappear from it altogether.

A most typical example are the acarinia of the house mouse *Mus musculus*. When this species lives freely in nature among the members of the genus *Apodemus*, *Microtus*, *Sorex* etc., their acarinia consist of the following species: *Cyrtolaelaps mucronatus*, *Proctolaelaps pygmeus*, *Haemolaelaps fahrenholzi*, *Eulaelaps stabularis*, *Laelaps hilaris*, *L. agilis*, *L. algericus* (main parasite), *Haemogamasus nidi*, *H. hirsutus*, *Hirstionyssus musculi* etc. In farm buildings this composition of acarinia becomes decreased in number. In human dwellings only main parasite *Laelaps algericus*, occasionally also *Hirstionyssus musculi* which often infest the subfamily Murinae, have been most frequently found or no mites at all have been ascertained on this host. It stands to reason that during the reverse penetration i.e. from the human dwellings to free nature the occurrence of mites on the animal reverses also.

This, however, does not exclude the possibility that during the migration of mice a mite species may be carried along to farm buildings or even human dwellings where it is capable of multiplying. The mentioned cases can be always explained on the basis of our working hypothesis on the acarinia and does not exclude the regular phenomenon of isolation.

3.4. Accidental transfers may take place between the acarinia zones which are considerably different and where the hosts are slightly related, whenever the ecological conditions are favourable. Such transfers have been observed from the acarinia zone of the squirrel to the acarinia zone of the small terrestrial mammals and vice versa. (Findings of *Hirstionyssus sciurinus* on *Clethrionomys glareolus*, *Laelaps agilis* on *Sciurus vulgaris*, *L. hilaris* on *Marmota marmota* etc.) The transfer from one acarinia zone into another always depends on the contact of two animals from respective zones, or on the stay in places visited by various animals.

3.5. The association of certain mite species with the marked acarinia zones does not exclude the specificity of some mites to their hosts. A marked specificity exists within the acarinia zone, for example of *Laelaps algericus* for *M. musculus*, of *L. pitymydis* for *Pitymys subterraneus* of *L. clethrionomydis* for *C. glareolus* etc.

3.6. Under certain ecological conditions (earth excavation, use of some organic building materials, penetration of mites from synanthropic mammals and birds into human dwellings etc.) the obligatory or facultative haemophagous mites from individual acarinia zones may pass to man and feed on him (Mrciak 1958).

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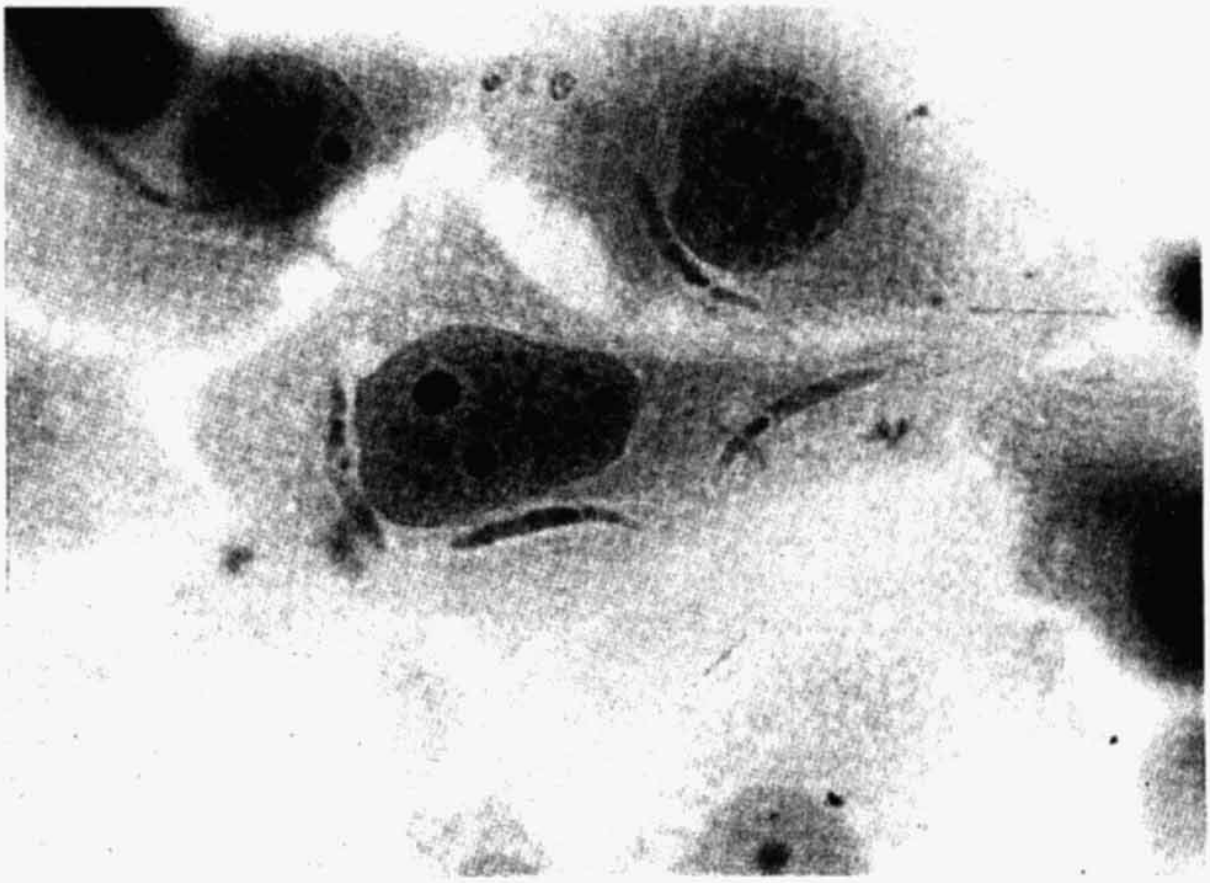

**Fig. 1.** 2nd merozoites in HeLa cells, 5 hours after inoculation. Stained with Harris's haematoxylin. (×1250)

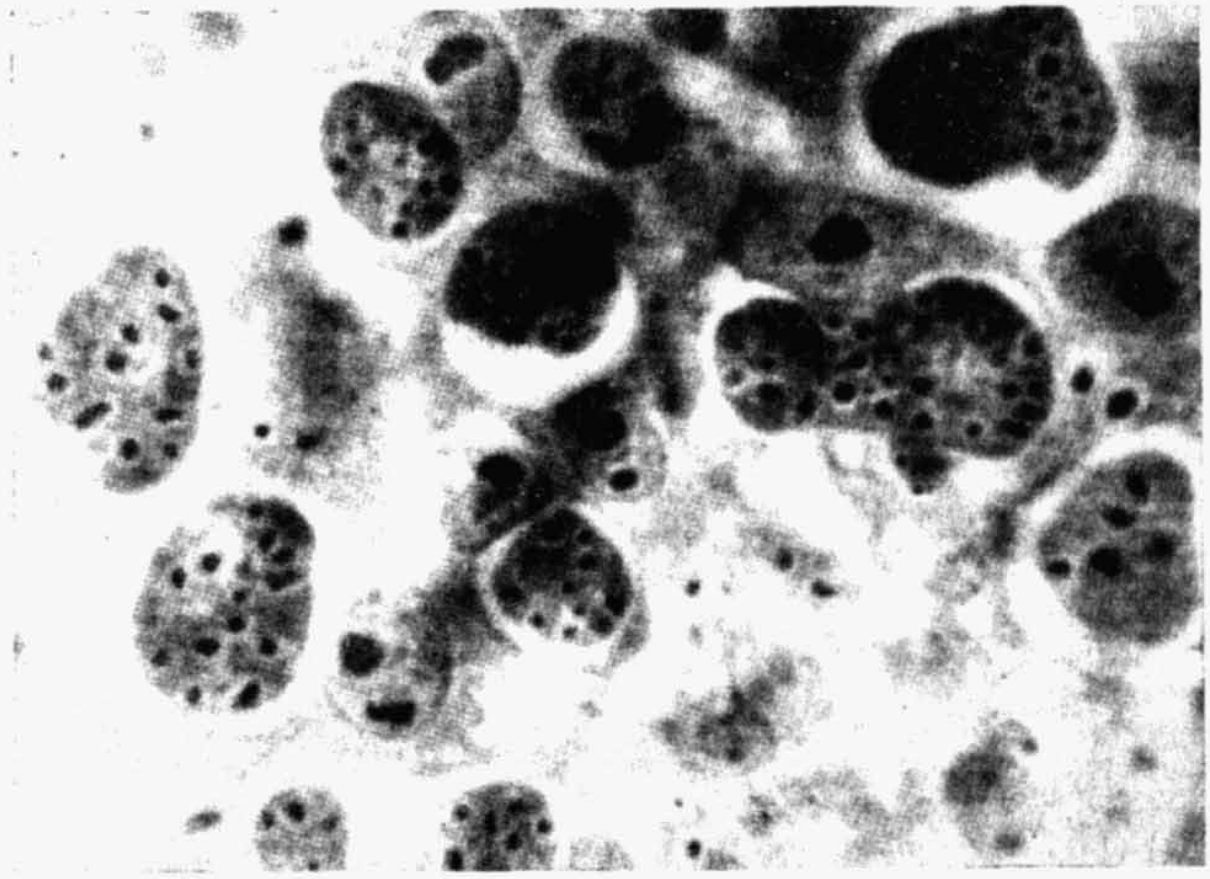

**Fig. 2.** The schizonts of 3rd generation – 24 hours after inoculation of 2nd merozoites into chick fibroblasts, Stained with Harris's haematoxylin. (×1250)

**Fig. 1.** Rosette of merozoites of the 3rd generation found after 24 hours in chick fibroblasts. Stained with Harris's haematoxylin. (×1250)

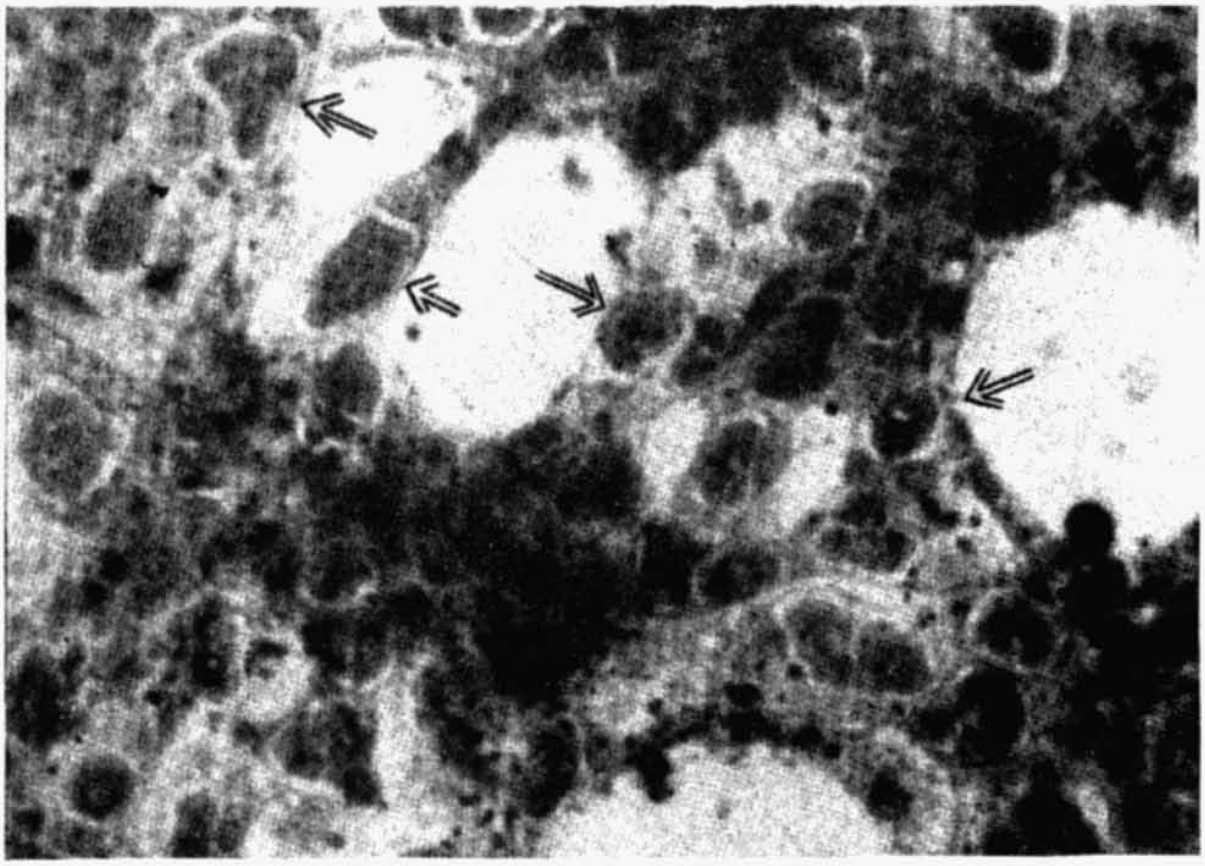

**Fig. 2.** A cluster of rosettes formed by 3rd generation of merozoites and found after 48 hours in chick fibroblasts. Stained with Harris's haematoxylin. (×400)