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Bat fleas (Aphaniptera, Ischnopsyllidae) of Czechoslovakia. Contribution to the Distribution, Morphology, Bionomy, Ecology and Systematics, Part I. Subgenus Ischnopsyllus Westw.

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This paper has arisen from a complex investigation of bats and their parasites, realized in the Faculty of Natural Science, Charles University, in Praha. From the rich material of insect ectoparasites *(Heteroptera-Cimicidae, Diptera-Nycteribiidae, Aphaniptera-Ischnopsyllidae)* the elaboration of its largest part, the fleas, is given in the present paper.

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LITERARY REVIEW

The literature dealing with the family *Ischnopsyllidae* in more details is not extensive. A review of more important papers on this family as a part of the Paleartic fauna (except the original description of the species) is given in the following.

Among the morphological studies, two papers of D a m p f (1912a, b) are most important, dealing partly with the morphology of females of the European members of g. *Ischnopsyllus* characterized by eight combs, partly with the comparative morphology of male external copulatory

organs of these members of g. *Ischnopsyllus*. The morphological characters of various species or genera and higher units together with systematic notes are available in original descriptions, partly in larger monographs like Rothschild (1915), Wagner (1936, 1939a), Jancke (1938), Ioff, Skalon (1954), Ioff, Tiflov (1954), Hopkins, Rothschild (1956), Rosický (1957), partly in smaller contributions: Smit (1954b, 1954c, 1955b, 1960a), Ioff, Bondar (1956).

More ample data on the bionomy of adults have been given only by Hůrka (1957), the description of egg, larva I and some higher instar of *I. hexactenus* by Weidner (1937), description of egg and larva of instar I of *I. elongatus* by Chidini (1939), description of larval instar III of *I. intermedius* by Hůrka (1956). The results of primitive experiments with orientation and taxes of larval instar I and III of South-American species *Myodopsylla wolffsohni salvasis* without the morphological description of larva are reported by Hase (1931). In his paper, Rosický (1950) determines a special zone of *Aphaniptera* of bats inside the zones of *Aphaniptera*. An ecological study concerning the influence of the relative atmospheric humidity of the survival of bat fleas was given by Hůrka & Doskočil (1961).

The only physiological paper with a remark on bat fleas is that of Sgonina (1934), dealing with the dependence of external and internal conditions on the reception of food by adults of *I. simplex*.

Among the papers, most numerous are those on the faunistic, connected with a record of host (the data on hosts are available naturally even in the above mentioned monographs). Of the papers recording some larger area of distribution, I give the following: Aellen (1949, 1960 — Switzerland), Bogdanov (1953 — Uzbekistan), Buresh (1924 — Bulgaria), Cooreman (1950 — Belgium), Dampf (1926—Germany), Hůrka (1957 — Czechoslovakia), Ioff, Bondar (1956 — Central Asia), Ioff, Skalon (1954 — east Asiatic part of the U.S.S.R.), Ioff, Tiflov (1954 — southeast of European U.S.S.R.), Jurkina (1959 — Ukraine), Kohaut (1903 — Hungary), Liu (1939 — China), Martino (1955 — Bulgaria), Niewiadomska (1953 — Poland), Nordberg (1934 — Finland), Oudemans (1915b — Holland), Rosický (1957 — Czechoslovakia), Séguy (1938, 1944 — France), Skuratowicz (1954, 1957 — Poland), Smit (1953, 1954a — Denmark, 1955a — Austria, 1957b — Great Britain, 1960 — Afghanistan), Wagner (1939 — Yugoslavia).

More ample literary sources are given at each recorded species.

The literature on bat fleas in Czechoslovakia has been rather poor up to the present time. Thanks to Kolenati (1856) the first monographic paper on bat parasites was published in our country (in Brno) and probably many facts contained in the subsequent papers of this author, unfortunately without more accurate remarks, refer to the territory of Czechoslovakia. Nevertheless, the next important paper on this subject appeared as much as 70 years later. The first papers in this century were those of Seidel (1928, 1934) on bat fleas of Silesia and that of Maschke (1935) on parasites of vertebrates of Kralický Sněž-

ník (the report of *I. hexactenus* from the Polish side of this mountain). Rosický working on fleas of Czechoslovakia since the forties, records in his papers also some finds of fleas of the family *Ischnopsyllidae* (1943—44, 1947a, b, 1948, 1950b, c, 1953) summed up to the monographic study on fleas in the collection Fauna ČSR (1957). A small faunistical note on *R. unipectinata, I. hexactenus* and *N. pentactena* is given by Jurik (1955) and a further one, of a new locality of *I. obscurus* and *N. pentactena* by Šebek (1961). L. Hůrka (1962) records the findings of four interesting bat fleas from west Bohemia. Finally the author of the present paper, interested especially in insect ectoparasites of bats, beside the description of larva of *I. intermedius* (1956), published 4 faunistical and bionomical papers on *Ischnopsyllidae* from Czechoslovakia: Hůrka, Chalupský (1956), Hůrka (1957, 1958, 1959).

Some data on the faunistics referring to the territory of our country are given in the Hopkins, Rothschild monographic paper 1956.

MATERIAL AND METHOD

I have examined 3959 bat specimens belonging to twenty species (see Table 24) from Czechoslovakia, four species of *Rhinolophus ferrum-equinum* from west Caucasus, one specimen of *Myotis mystacinus* from Melk upon Danube in Austria (V. Hanák ScC examined 22 specimens of *Nyctalus noctula* from Albania) and quantitatively collected the ectoparasites of orders *Heteroptera, Diptera* and *Aphaniptera* from them. In order to secure as complete a collection of ectoparasites as possible (without which no bionomical or ecological conclusions can be reached) each bat was narcotized by ethylaether pro narcosi in a glass of one litre content. The handling a narcotized bat was much easier and the narcotized ectoparasites were picked out without difficulty (before the narcotization of the next bat the inspection of the bottom of the glass is needed because the ectoparasites fall out of the host's hair). A mild narcoze with ethylaether is quite harmless to the bats, if the active animals are placed on, since the ethylaether affects slowly the sleeping of unquite wakened animals. Only after a longer expositure will bats be killed. In any case, it is necessary to take the bat out of the bottle at the moment when the retardation of its cordial pulsation begins.

Thus I succeded in collecting a large quantity of ectoparasites from the territory of Czechoslovakia including 2878 speciemens of fleas. From the bat guano, 658 specimens of *I. intermedius* and larvae of two flea species *(I. intermedius, I. simplex)* were collected.

The collected material was preserved in 70% alcohol, the microscopic slides-medium used was Liquido de Swan, modification according to Kramář (Hrbáček and others, 1954: Jak a proč sbírat hmyz: 55). I didn't use the standart method when preparing the slides; for bionomical purposes I needed the eggs not to be destroyer in the females' abdomens. Liquido de Swan secures the preservation and a good view of the eggs.

The morphological descriptions in most cases are given on the basis of a detailed study of 50 specimens of both sexes in order to register the

individual variability of species, namely in chaetotaxy and in the number of spines in different combs. For the infrequent species, the collection of Dr. Rosický was available to me, containing 47 specimens of five species. As far as possible I have included in the morphological material studied also the specimens from foreign countries, namely one female of *I. octactenus* from Bulgaria, two males of *I. s. simplex* from Poland, one male of *I. s. mysticus* from Austria, one male and two females of *R. u. unipectinata* from Yugoslavia, six females of *R. u. unipectinata* from Roumania, one male of *R. u. unipectinata* from west Caucasus, one male and seven females of the same species from Albania, one male and one female of *R. u. turcestanica* from Uzbekistan and 9 males and 29 females of *I. elongatus* from Albania.

SPECIAL PART

A. FLEAS

Family **Ischnopsyllidae** Wahlgren, 1907

I. genus **Ischnopsyllus** Westwood, 1833

Ischnopsyllus. Westwood, 1833, Entomological Magazine, **1**: 362. Type species: *Ceratophyllus elongatus* Curtis; *Ischnopsyllus,* Westwood, 1840, Synopsis Genera Brit. Insects: 125; *Typhlopsylla.* Taschenberg, 1880, Die Flöhe: 63, 86; *Ceratopsylla.* Wagner, 1898, Hor. Soc. ent. Ross. **31**: 580; *Ischnopsylla.* Oudemans, 1906, Ent. Ber. Amst. **2**: 125 (nomen novum for *Ischnopsyllus* Westwood); *Ischnopsyllus* Westwood. Oudemans, 1909, Novit. Zool. **16**: 155 (key to genera); *Hexactenopsylla.* Oudemans, 1909, Ent. Ber. Amst. **3**: 5 (as subgenus valid); *Nychopsyllus.* Eysell, 1913 in Mense, Handb. Tropenkr. **1**: 78; *Nycteridiophyllus.* Dalla Torre, 1924, Ber. Natur. Med. Verl. Innsbruck **39**: 5 (synonymy of the genus); *Ischnopsyllus* Westwood. Smit, 1954c, Parasitology **44**: 144, 153, 154, 156 (erection of the subgenus *Ischnopsyllus* and *Hexactenopsylla); Ischnopsyllus* Westwood. Smit, 1954a, Danmarks Fauna **60**: 65 (characterization of genus-danisch); Ischnopsyllus Westwood. Hopkins, Rothschild M., 1956, Cat. Rothschild coll. Fleas **2**: 255 (synonymy, characterization); *Ischnopsyllus* Westwood. Rosický, 1957, Fauna ČSR, **10**: 292 (synonymy, characterization).

The dorsal margin of the frons minutely rugulose. Spines of genal comb obtuse. Maxilla irregularly four-edged, in the end truncate. The combs on the pro- and metathorax and on the abdominal tergites I, II, III, IV (V, VI). Segment V of tarsi with ventral pair of plantar bristles placed between first lateral pair. Fixed process of the male genital organ possessing two acetabular bristles. The sternum VIII of male strongly modified.

The genus is distributed mainly in the Palearctic Region, including also members from the Oriental, Ethiopian and Australian Region. It occurs predominantly on the members of the bat family *Vespertilionidae.*

At present, 17 species are known, forming a very heterogenous group. By the revision of the genus Smit, 1954c erected two subgenera *Ischnopsyllus* s. str. and *Hexactenopsylla* Oudemans.

Subgenus **Ischnopsyllus** Westwood, 1833

Preoral tuber relatively short, broad. Metasternum without a squamulum. Dorsal part of sternum IX of male broadened, truncate in the

end. Manubrium broad with a broadly rounded apex. Tendons of sternum IX making about half a convolution and those of the aedeagus about one whole convolution. The dorsal margin of apodema of aedeagus straight, apically not turned upward. The duct of spermatheca of female in the basal part distinctly dilated.

The members of this subgenus are distributed in the Palearctic Region, only *I. emminus* occurs in the Ethiopian Region.

S m i t, 1954c divides 13 members of this heterogenous subgenus into three groups:

a) *octactenus*-group, consisting of: *octactenus* (K o l e n a t i), *consimilis* (W a h l g r e n), *variabilis* (W a g n e r), *simplex simplex* R o t h s c h i l d, *simplex mysticus* J o r d a n, *hispanicus* J o r d a n, *dolosus* D a m p f, *emminus* J o r d a n et R o t h s c h i l d and very likely also *elongatus* (C u r t i s), *intermedius* (R o t h s c h i l d) and *plumatus* I o f f.

b) *obscurus*-group, containing *obscurus* (W a g n e r) only.

c) *needhami*-group, consisting of *needhami* H s ü and *liae* J o r d a n.

On the base of detailed morphological study of members of this subgenus I have come to the conclusion, that *I. elongatus, intermedius* and very like also *plumatus* form a special well characterizeable group (characters are given in the following text).

a) **octactenus**-group

Number of spines in the first abdominal comb distinctly lower than that in the metathoracic comb. In front of the ocular bristle in both males and females regularly two stronger setae (three setae at maximum in 20% males and 3% females); under the collar of mesonotum there are one to four pseudosetae; body length 1.7 to 2.7 mm.

The group consists of the species: *octactenus* (K o l e n a t i), *consimilis* (W a h l g r e n), *variabilis* (W a g n e r), *simplex* R o t h s c h i l d, *hispanicus* J o r d a n, *dolosus* D a m p f and *emminus* J o r d a n et R o t h s c h i l d.

In Czechoslovakia the following species have been found:

Ischnopsyllus (Ischnopsyllus) octanenus (K o l e n a t i), 1856

? *Pulex vespertilionis*. D u g e s, 1832, Ann. Sci. nat. **27**: 161, tab. 4, fig. 4; *Ceratopsyllus octactenus*. K o l e n a t i, 1856, Parasiten der Chiropteren, Brünn: 31; *Ceratopsyllus octactenus* K o l e n a t i. K o l e n a t i, 1863, Hor. Soc. ent. Ross. **2**: 42, tab. 4, fig. 12 (female); *Typhlopsylla octactenus* K o l e n a t i. T a s c h e n b e r g, 1880, Die Flöhe: 63, 87, tab. 4, fig. 22; *Ceratopsylla variabilis* var. *decempilata*. W a g n e r, 1898, Hor. Soc. ent. Ross. **31**: 538; *Ceratopsylla jubata*. W a g n e r, 1898, Hor. Soc. ent. Ross. **31**: 584, tab. 9, fig. 20, 22 (male); *Ceratopsylla octactenus* K o l e n a t i. R o t h s c h i l d, 1898, Novit. Zool. **5**: 543, tab. 16, fig. 7, 9 (female); *Ceratopsylla jubata* W a g n e r. K o h a u t, 1903, Állat. Közlem. **2**: 61, tab. 7, fig. 2, 7 (male); *Ischnopsyllus octactenus* K o l e n a t i. R o t h s c h i l d, 1906, Novit. Zool. **13**: 186 (*C. jubata* W a g n e r = synonym); *Ischnopsyllus octactenus* K o l e n a t i. R o t h s c h i l d, 1911, Novit. Zool. **18**: 52 (Kolenati's original description with author's notes); *Ischnopsyllus octactenus* (K o l e n a t i). D a m p f, 1912a, Rus. ent. obozr. **12**: 52—55, fig. 5 (male) (morphology of male genitalia, key); *Ischnopsyllus octactenus* (K o l e n a t i). D a m p f, 1912b, Ber. Bot. Zool. Ver. Rheinland-Westfalen, **1911**: 79—113, tab. 3, fig. 14, tab. 4, fig. 16b, 21,

tab. 5, fig. 26 (morphology of female, key, synonymy), tab. 2, fig. 5, tab. 3, fig. 13, tab. 4, fig. 22 illustrates *I. variabilis,* as it was already pointed out by Hopkins, Rothschild, 1956: 272; *Ischnopsyllus octactenus* Kolenati. Rothschild, 1915, Ent. mon. Mag. **51**: 86, 108, tab. 14, fig. 87 (male) (key, morphology, synonyms); *Ischnopsyllus octactenus* Kolenati. Wagner, 1936, Tierwelt Mitteleuropas B. **6**, 2. Lieferung, 3. Teil: 18, fig. 71 (male) (key); *Ischnopsyllus octactenus* (Kolenati). Jancke, 1938, Tierwelt Deutschlands **35**: 33—34, fig. 41b (male), fig. 41c is not female of *octactenus,* but that of *variabilis,* overtaken from Dampf, 1912b (key, morphology); *Ischnopsyllus octactenus* (Kolenati). Smit, 1953c, Bull. Brit. Mus. ent. **3**: 207, fig. 42 (male), 210, fig. 45, 46 (male) (differentiation of the male from *consimilis*); *Ischnopsyllus octactenus* (Kolenati). Smit, 1954a, Danmarks Fauna **60**; 70, fig. 84, 89 (male), fig. 81, 86, 90 (female) (key); *Ischnopsyllus octactenus* (Kolenati). Smit, 1954b, Natuurh. Maandblad **43**: 13—15, fig. 3, 5 (female) (differentiation of the female from *variabilis*); *Ischnopsyllus octactenus* (Kolenati). Smit, 1954c, Parasitology **44**: 151, fig. 11, 12 (female), fig. 22 (pseudosetae of mesonotum) (differentiation of the female from *consimilis*); *Ischnopsyllus (Ischnopsyllus) octactenus* (Kolenati). Hopkins, Rothschild, 1956, Cat. Rothsch. Col. Fleas **2**: 260—263, 272—276, fig. 305, 426, 444, 449, 455, 467, 468, 469 (male), 453, 464, 471, 474, 475, tab. 25B (female) (morphology, key, synonymy); *Ischnopsyllus octactenus* Kolenati. Ioff, Bondar, 1956, Tr. nauchn. issl. protiv. Inst. Kavkaza i Zakavkazja **1**: 110 (distribution in Central Asia); *Ischnopsyllus (Ischnopsyllus) octactenus* (Kolenati). Smit, 1957a, Hand. Ident. Brit. Ins., **1**, part 16: 46, 48, fig. 96, 101 (male), fig. 95, 107, 109 (female) (key distribution); *Ischnopsyllus octactenus* Kolenati. Hůrka 1957, Čs. parasitol. **4**: 150 (distribution, hosts); *Ischnopsyllus (Ischnopsyllus) octactenus* (Kolenati). Rosický, 1957, Fauna ČSR **10**: 293, 296—298, fig. 97B, 99D (male), fig. 98E (female) (key, morphology, synonymy); *Ischnopsyllus octactenus* Kolenati. Jurkina, 1959, Praci Inst. Zool. AN Ukr. SSR **15**: 89, fig. 24A (male), 24B (female), female in all probability of *variabilis,* not of *octactenus,* as recorded by authoress! (morphology, key, distribution in Ukraine).

Male

(data based on 26 specimens from Czechoslovakia)

Lenght average: 2.2 mm (1.8—2.7). Wagner, 1898: 1.5 mm — *jubata;* Smit, 1954a: 2.25—2.5 mm.

Preoral tuber bent most frequently in a right-angle less frequently in a slightly acute angle. The row of the small setae on the anterior margin of frons composed of 12—19, most frequently 14—16 setae (Wagner, 1898: 1 specimen 17). Below the antennal fossa one long bristle, in front of which two or three shorter setae are situated in 80 p. c. and 20 p. c. of males respectively. Below them an irregularly distributed group of 7—14, most frequently 9—12 short setae. Occipital part of head possessing 4 long bristles in one row, above them shorter seta (2 only in three specimens). An irregular row of 7—11, most frequently 7—8 setae above the antennal fossa. The posterior margin of the occipital part of head possessing 9—12, most frequently 10—11 longer setae.

Comb of pronotum with 26—32, most frequently 28—29 spines (Kolenati, 1856 in the original description: 26; Wagner, 1898: 30, 32; Smit, 1953c: 28—31). One to three, most frequently two pseudosetae, very often various number on each body side under the collar of the mesonotum (Smit, 1954c: 156 also 1—3, most frequently 2, fig. 22). Metathoracic comb with 24—30, most frequently 26—28 spines (K.: 22, W.: 24, S.: 28—32). Mesonotum and metanotum with a relatively con-

spicuous "mane" of dorsal marginal setae. Metepimeron with 3—6, most frequently 4 lateral and 2—3, most frequently 3 distal bristles. Percentage of single combinations is as follows: 4+3 (36 %), 3+2 (17 %), 5+3 (15 %), 4+2 (12,5 %), 3+3 (11 %), 5+2 (6,5 %), 6+3 (2 %). Often various combinations on each body side.

The counts of the numbers of spines in the abdominal combs are as follows:

I. 11—19 most frequently 12—14 (K.: 10, W.: 16, S.: 11—18)
II. 20—28 most frequently 23—24 (K.: 20, W.: 24, S.: 20—28)
III. 16—23 most frequently 18—21 (K.: 16, W.: 22, 24, S.: 19—22)
IV. 14—20 most frequently 16—18 (K.: 16, W.: 18, S.: 15—18)
V. 10—15 most frequently 11—13 (K.: 12, W.: 12, S.: 11—16)
VI. 7—13 most frequently 9—12 (K.: 8, W.: 12, S.: 9—13)

The body of clasper with usually broad, slightly bent manubrium, four to five times as long as broad medially (D a m p f, 1912a: three times and five times in *variabilis,* but as suggested by figures, these number should be recorded upside down; the same is suggested by the S m i t' s drawing 1957a, fig. 101, as well as by H o p k i n s, R o t h s c h i l d, 1956: 274). The fixed process not distinctly separated; the distal part of the body of clasper unbroaded posteriorly (x *variabilis*). The dorsal margin possessing a group of 3 setae in its distal part, the last of which placed at a distal angle (x *variabilis*) which is almost rectangular (in *variabilis* distinctly rounded). The distal margin of the body moderately concave. Two equally strong, long, only slightly bent acetabular bristles placed at the ventral apical angle of the body, distinctly below the insertion of the movable process (similarly D a m p f, 1912a and oth.; R o s i c k ý, 1957: at the same level as the base of acetabular bristles). Movable process semilunar. A forwards tending seta placed at the anterior angle. The rounded part possessing 2 long setae submarginally in its dorsal part, 1 in the ventral part. Sensilium only moderately drawn out posteriorly (x *variabilis*), no seta placed on its ventral lobe.

Sternum VIII with proximal part much reduced, ventrally more or less regularly rounded, dorsally more or less regularly triangular, in some specimens the apex of the triangle even considerably rounded. The distal part approximately medially distinctly broadened due to concave deviation of dorsal margin. Dorsal part possessing one backward tending small seta at its upper angle; distal margin of sternum VIII in its dorsal part straight and without setae; only the surface of sternum possessing one longer bristle near the distal margin. The ventral part of distal margin, inclined obliquely forward, possessing a semicircular group of 6 long, flat, medially curved and broadened setae, the uppermost one being the strongest. Below these setae there is a group of smaller pigmented setae, most frequently 3. A pair of strong medially broadened setae placed slightly forward at the ventral angle. The ventral margin of sternum with 5—7 middle long bent setae (D a m p f, 1912a: 6—7).

The lower branch of sternum IX axe-shaped, broadest at the base. The upper branch of usual form.

Female*

(data based on 50 specimens, 49 from Czechoslovakia, 1 from Bulgaria) Length average: 2.3 mm (1.9—2.75). Smit, 1954a: 2.25—2.75 mm.

Preoral tuber bent, most frequently in a right angle, less frequently in a slightly sharp or obtuse one. The row of small setae on the frontal margin of head composed of 13—19, most frequently 14—16 setae (Wagner, 1898 in a description of *C. variabilis* var. *decempilata:* 16-single specimen only). Below the antenal fossa one long bristle, in front of which most frequently two shorter setae (three times 3, once 1) are situated. Below and in front of them an irregularly scattered group of 4—9, most frequently 6—7 short setae. Occipital part of head possessing (in all 50 specimens examined) 4 long bristles in one row, above them 1 shorter seta. An irregular row of 5—9, most frequently 7—8 short setae above the antennal fossa. The posterior margin of the occipital part of head possessing 9—12, most frequently 10—11 long setae.

Comb of pronotum with 24—32, most frequently 26—31 spines (W.: 30, Smit, 1953c.: 29—32). One to three, most frequently two pseudosetae under the collar of mesonotum. Comb of metanotum with 23—30, most frequently 26—30 spines (W.: 26, S.: 26—31). Metepimeron with 2—6, most frequently 3—4 lateral bristles and with 2—4, most frequently 3 distal bristles. Percentage of single combinations is as follows: 3+3 (38 %), 4+3 (31 %), 2+3 (10 %), 5+3 (8 %), 4+2 (6 %), 3+2 (4 %), 2+2 (1 %), 5+4, 6+3 (1 %). (Smit, 1954a records usually 4, sometimes 3 or 5 lateral and 3 distal bristles.)

The count of spines in the abdominal ctenidia are as follows:

I.	10—16	most frequently 11—14	(W.: 14, S.: 11—15)
II.	18—24	most frequently 21—23	(W.: 22, S.: 21—27)
III.	15—21	most frequently 16—19	(W.: 20, S.: 16—22)
IV.	11—17	most frequently 13—16	(W.: 18, S.: 13—18)
V.	8—13	most frequently 9—12	(W.: 16, S.: 9—14, Kohaut, 1903: 10)
VI.	7—11	most frequently 8—10	(W.: 10, S.: 9—13, K.: 8)

Hopkins, Rothschild, 1956 report that there are no substantial differences in the number of spines in the ctenidia of both sexes but the comparison of my data for males and females distinctly shows that males in this species, too, possess distinctly more spines in ab-

*) As it was already pointed out by Hopkins, Rothschild, 1956: 272 and confirmed by the author when studying the female material of *I. variabilis,* Dampf, 1912b included some specimens of *I. variabilis* into the 15 specimens of *I. octactenus* according to which the description had been made, as suggested by his figure 13 and 22. Thus the morphological data of Dampf on *I. octactenus* females taken over by further authors are incorrect and therefore not recorded in the present paper.

dominal ctenidia (already K o h a u t, 1903 reports the different number of spines in the last two ctenidia of male and female). The number of setae distinctly tends to a higher rate in males of this species — see the head, metepimeron.

Sternum VII with a lateral lobe, the distal margin of which is most frequently regularly convex, was straight in its lower part (x *variabilis*) Fig. I, 2, only in two of 50 specimens examined. The surface of sternum displaying an irregular row of 10—17, most frequently 12—14 setae (D a m p f, 1912b, fig. 14: 8 on one side, S m i t, 1954a, fig. 90: 6 on one side, S m i t, 1954c, fig. 11: 8, fig. 12: 6 on one side). Anal stylet of normal length (about three times as long as broad on the base), usually possessing one stronger seta on its base (5% females examined possessed two setae). The diameter of the dilated portion of a duct of spermatheca is practically the same as (a little larger) diameter of bursa copulatrix. Hilla of spermatheca a little longer than bulga, which is distinctly oval (longer than wide) and smaller than that in *I. variabilis,* see Fig. I.

D i s t r i b u t i o n (see Map 1)

European and west Asiatic species up to the present time known from Morocco (Magazan), Spain, France, Eire, Great Britain (North Ireland, Scotland, England, Wales), Holland, Denmark, Sweden (Göteborg-W a h l g r e n, 1907), Germany, Switzerland, Italy (Toscana), Sicily, Sardinia, Austria, Czechoslovakia, Poland, Hungary, Yugoslavia, Bulgaria, Greece (Agostili), Corfu, the U.S.S.R.: Ukraine (Zakarpatskaja, Kievskaja, Poltavskaja, Dnepropetrovskaja oblast, Crimea), Kazachstan (Chimkent, Tjulkubas, Ilinskaja dolina), Kirghizia (Frunze), Uzbekistan (Tashkent, Surchan—Darijskaja oblast), Tadzhikistan (Dushanbe formerly Stalinabad) and from eastern Afghanistan (river valley of Bashgul, Nuristan, 1100 m — P e u s, 1957).

In Czechoslovakia it has been reported from Brno *Pipistrellus pipistrellus* (R o s i c k ý, 1944) and from *Plecotus auritus* (R o s i c k ý, 1953) and from Plzeň from *P. pipistrellus* (L. H ů r k a, 1962). K o l e n a t i's find from Praděd from *Amblyotus atratus* (= *Eptesicus nilssoni*) in 1858 remains problematic, because this probably dealt with another species with 8 combs.

My material was collected on *Pipistrellus pipistrellus* only, in 6 localities (see Map 2).

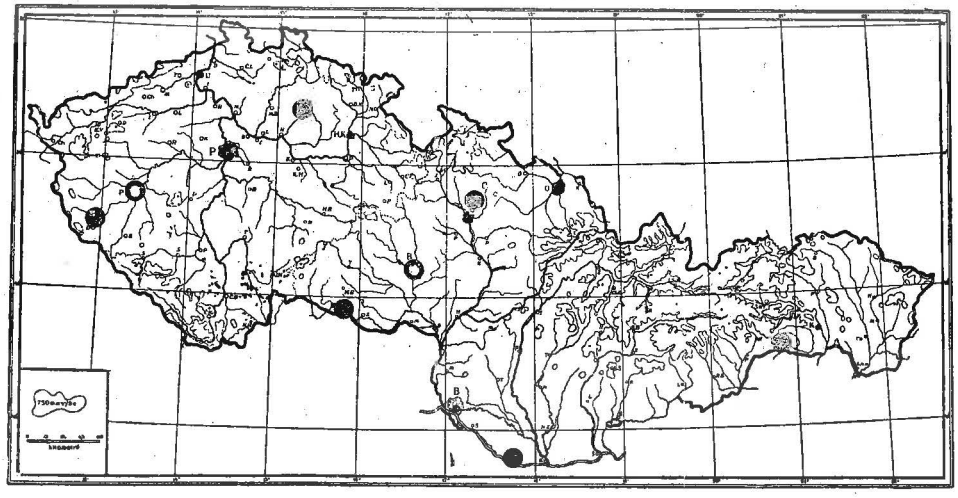
B o h e m i a : Horšovský Týn (Domažlice d.), 29. XII. 1956 — ♂, 7 ♀♀; Lázně Sv. Trojice (Jičín d.), 20. IV. 1959 — ♂, 3 ♀♀.
M o r a v i a : Vranov n. Dyjí (Znojmo d.), 22. II. 1958 — 3 ♀♀; Šternberk (Olomouc d.), 30. I. 1959 — 5 ♂♂, 12 ♀♀.
S l o v a k i a : Čičov (Komárno d.), 28. VI. 1955 — 17 ♂♂, 37 ♀♀; Drienovec-cave (Košice d.), 17. II. 1961 — ♂, 5 ♀♀.

The whole material contains 92 specimens (25 ♂♂, 67 ♀♀) from six localities.

There is also one female in my collection from Primorsko in Bulgaria (southern part of Bulgarian shore of the Black Sea), collected 5. VI. 1957 from *P. pipistrellus* by V. Hanák. In addition to my own material, from the locality of Brno 2 ♂♂, 3 ♀♀ individuals of this species from Rosický's collection were available to me.

The flea *Ischnopsyllus octactenus* is distributed over the whole territory of Czechoslovakia with its principal host *P. pipistrellus.*

Map 1 Area of distribution of the flea *Ischnopsyllus octactenus* (K o l.).



Map 2 Distribution of the flea *Ischnopsyllus octactenus* (Kol.) in Czechoslovakia; ● — author's find, O — literary data.

H o s t s

Pipistrellus pipistrellus is a principal host of this flea species in the whole area. The area of distribution of this bat overlaps to the east (China, Japan, Korea) the present known area of *I. octactenus.* Among

other members of genus *Pipistrellus, P. kuhli* (Morocco, Spain, 3 localities in Italy, Greece) has been often recorded as a host. In west Ukraine the flea was found on *P. nathusii* (Tatarinov, 1956, Jurkina, 1959), in Toscania and Sicily it was collected on *P. savii* (Hopkins, Rothschild, 1956, Peus, 1959). Among other bats, *Myotis nattereri* (Ireland, England, Holland, Poland) and *M. mystacinus* (England, Denmark, Germany) are most frequently recorded as hosts of *I. octactenus.* It was found also on *Eptesicus serotinus* (England, Holland, Germany, Sicily), *Barbastella barbastellus* (France, Germany, Poland, Switzerland), *Nyctalus leisleri* (Ireland, England, Bulgaria) and *Nyctalus noctula* (England, Holland). Single reports concern *Myotis daubentoni* (England—Thompson, 1938), *Vespertilio murinus* (Denmark—Smit, 1953a), *Eptesicus nilssoni* (Sweden—Wahlgren, 1907) and *Rhinolophus ferrumequinum* (Morocco—Aellen, 1960).

In Denmark one female was found on *Delichon urbica* (Smit, 1953a); in Rothschild's collection in the British Museum, there is one male from *Mus musculus* from Corfu (Hopkins, Rotschild, 1956). In Costa Lima & Hathaway's Catalogue (1946) even *Myotis emarginatus, Rhinolophus hipposideros* and *Plecotus auritus* are recorded as hosts of *I. octactenus.*

In Czechoslovakia, I have found this flea species on *P. pipistrellus* only, Rosický (1953) also on *Plecotus auritus.*

It may be concluded, therefore, that *I. octactenus* is a flea of the originally three-dwelling bats of genus *Pipistrellus.* In fact, the great majority of other presently known hosts are either exclusively tree-dwelling bats, too. *(N. leisleri, N. noctula),* or the bats living behind the bark of trees, in accumulated timber, behind shutters etc. *(M. nattereri, M. mystacinus, E. serotinus, E. nilssoni, B. barbastellus, M. daubentoni,*

Table No. 1 Infestation of *Pipistrellus pipistrellus* with *Ischnopsyllus octactenus* (Kolenati).

period	number of bats examined	number of bats with fleas	number of fleas	average per one bat	maximum per one bat
summer	73	32	58	0.8	4
winter	111	18	34	0.3	4
total	184	50	92	0.5	4

V. murinus, P. auritus). The finds reported by Lima & Hathaway (1946) from *M. emarginatus* and *R. hipposideros* as well as the find from *R. ferrumequinum* from Morocco seems to be a pure chance, as all these bats are typically cave-dwelling. The finds on *D. urbica* and *Mus musculus* are naturally incidental, again, as these chance hosts occured in the neighbourhood of a bat hosts colony (probably in both cases in the lofts of buildings).

Notes on bionomics

I found eggs in the abdominal cavity of 3 female specimens on 20. IV., in the female from Bulgaria on 5. VI. and in 60 p. c. of females in a nursing-colony of *P. pipistrellus* from Čičov on 28. VI. 1955. I found no eggs in any of 12 females on 30. I., nor in any of 5 females on 17. II.,

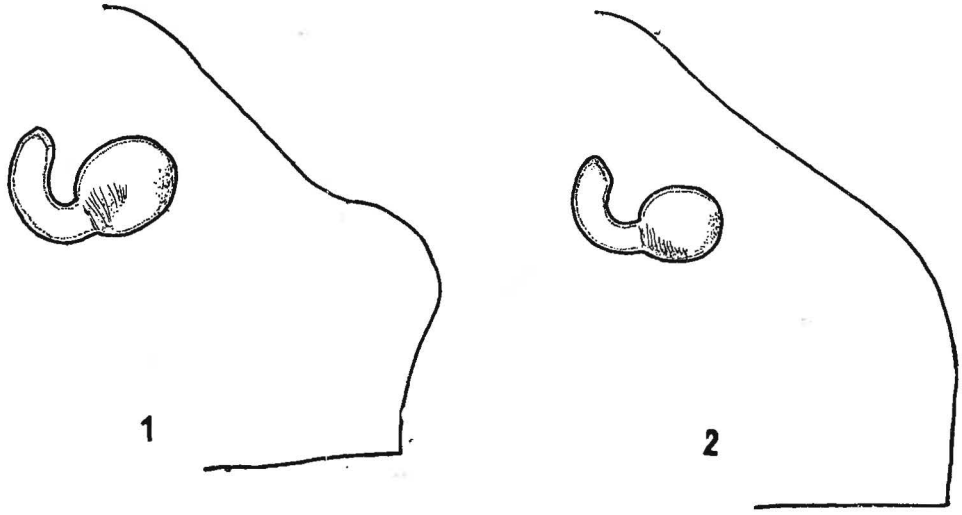


Fig. I. Shape of the posterior margin of sternum VII and spermatheca:
1 — *I. variabilis* (Wagner) (♀, 16. VII. 1957, *Pip. nathusii*, fish-pond Velký Tisý); 2 — *I. octactenus* (Kolenati) (♀, 29. XII. 1956, *Pip. pipistrellus*, Horšovský Týn).

nor in females on 5. and 16. II. and 23. III. from Rosický's material as well as in 3 females from Vranov on 22. II. and in 7 females from Horšovský Týn on 29. XII. Consequently, the maturing of eggs does not take place in females of this species during the hibernation period of the hosts. Jurkina (1959) reports the find of females with developed eggs in May from Ukraine.

The sex ratio is different in the summer and winter period. In the summer period the sex ratio of males to females was 1: 2 (18 ♂♂, 40 ♀♀), in the winter period nearly 1: 4 (7 ♂♂, 27 ♀♀).

Also the average infestation is different in bats of summer roosts and those of the hibernation quarters as given in Table 1.

The common parasitization of *I. octactenus* with an other flea species on a single host specimen was found only during the hibernation period: on 7 specimens (of 111 examined) of *P. pipistrellus* from two localities *Nycteridopsylla eusarca* was found together with *I. octactenus*. Freeman (1946) reports the common parasitization of one *P. pipistrellus* specimen from Ireland (6. I. 1946) by 5 specimens of *I. octactenus* and two females of *Nycteridopsylla longiceps* and so does Aellen (1960) from France. L. Hůrka (1962) found *I. octactenus*

together with *I. hexactenus* on one specimen of *P. pipistrellus* from Horšovský Týn.

Notes on systematics

Characters of male: the presence of a "mane" on thoracic tergites II and III; it differs from *intermedius* which also possesses a mane in the smaller number of spines in the first abdominal comb (*octactenus* 11—19, *intermedius* 18—28) and by the shape of sternum VIII, from *consimilis* by a sharp dorsal angle of the distal part of the corpus of clasper and from *plumatus* by an other shape of sternum VIII.

Characters of female: distinguishable from all except *variabilis* and *consimilis* by the combination of the following characters: preoral tuber curved at a right angle, the comb of abdominal tergite I containing only half as many spines as the metathoracic comb; it differs from *consimilis* by the shape of distal margin of sternum VII, from *variabilis* also by a different shape of distal margin of sternum VII, by a smaller number of spines in all combs namely in abdominal IV, V and VI, by a smaller oval bulga of spermatheca (Fig. I, 2) and most frequently 3—4 lateral bristles on metepimeron.

One to three most frequently 2 pseudosetae under the collar of mesonotum in both sexes.

Ischnopsyllus (Ischnopsyllus) variabilis (Wagner), 1898

Ceratopsylla variabilis. Wagner, 1898, Hor. Soc. ent. Ross. **31**: 582, tab. 9, fig. 16 (male); *Ischnopsyllus variabilis* (Wagner). Dampf, 1912a, Rus. ent. obozr. **12**: 52—55, fig. 6 (male) (morphology, key); *Ischnopsyllus variabilis* (J. Wagn.). Dampf, 1912b, Ber. Bot. Zool. Ver. Rheinland-Westfalen, **1911**: 79—113, tab. 2, fig. 6, tab. 3, fig. 15, tab. 5, fig. 29 (female morphology, key); *Ischnopsyllus variabilis* Wagn. Wagner, 1936, Tierwelt Mitteleuropas B. **6**, 2. Lief., 3. Teil: 18, fig. 68 (male) (key); *Ischnopsyllus variabilis* (Wagner). Jancke, 1938, Tierwelt Deutschlands **35**: 33, fig. 40a (male), 40b (female) (key, morphology); *Ischnopsyllus variabilis* (Wagner) Smit, 1954b, Natuurh. Maandbl. **43**: 11—15, fig. 1 (male), fig. 2, 4 (female) (morphology, key, differentiation from *I. octactenus*); *Ischnopsyllus variabilis* (Wagner). Smit, 1954a, Danmarks Fauna **60**: 70, fig. 91 (male), fig. 92 (female) (key); *I. variabilis,* Ioff, Tiflov, 1954, Opred. Aphaniptera jugovostoka SSSR: 98, fig. 155 (male) (key, distribution in south-east of R.S.S.R.); *Ischnopsyllus (Ischnopsyllus) variabilis* (Wagner). Hopkins, Rothschild, 1956, Cat. Rothschild. Coll. Fleas **2**: 260, 263, 269—271, fig. 461 (male), fig. 462, 456 (female) (morphology, key, synonymy); *Ischnopsyllus (Ischnopsyllus) variabilis* (Wagner). Rosický, 1957, Fauna ČSR **10**: 293, 296, 302—303, fig. 97D, 99J (male) (morphology, key, synonymy); *Ischnopsyllus variabilis* Wagner. Jurkina, 1959, Praci Inst. Zool. AN Ukr. S.S.R. **15**: 89—90, fig. 25A (male), fig. 25B (female) (morphology, key, distribution in Ukraine).

Male

(data based on one specimen from Czechoslovakia)

Length 2.4 mm, Smit, 1954a: 2—2.25 mm.

Preoral tuber bent at a right angle; the row of anterior margin of frons consisting of 15 setae (Wagner, 1898: 14, 18). Below the antennal fossa 1 long bristle, with two shorter setae anteriorly. Below them an irregularly dispersed group of 13 small setae. Occipital part of head possessing 4 long bristles in one row, above them 2 short setae. An irre-

gular row of 9 setae above the antennal fossa. The posterior margin of the occipital part of head possessing 11 long bristles.

Comb of pronotum with 30 spines. Under the collar of mesonotum there are 4 pseudosetae on one side of the body, 3 on the other side. Metanotal comb with 35 spines. Metepimeron with 2 lateral and 3 distal bristles on each side.

The abdominal combs with 22, 35, 31, 24 and 24 spines.

Corpus of clasper with usually broad, slightly curved manubrium, three times as long as medially wide (W a g n e r, 1898 in the original description 4½ times as long, which is too much; D a m p f, 1912a also three times as long). The fixed process not distinctly separated; the distal part of the body of clasper distinctly broader posteriorly (the dorsal margin of the body turned upwards — x *octactenus*). The dorsal margin possessing a group of 3 setae in its distal part; the distance between the last seta and the distal margin of body is the same as the distance between individual setae (x *octactenus*). The distal margin of body straight, only the lower third turned slightly backwards. Two equally strong, slightly curved, long acetabular bristles placed at the ventral apical angle of the corpus, distinctly below the insertion of the movable process. The movable process irregularly foursided, its width distinctly increasing towards dorsal margin. The anterior upper angle about 60°, the posterior one forming a sharp clawlike projection. At the posterior angle one forward tending seta, at the anterior part of dorsal margin two short setae. The lower part of the inner side of the movable process provided with one long seta.

Sensilium (= pygidium by D a m p f, 1912a) with the lower part of its apical margin prolongated into a transparent process possessing one small seta in the middle of the dorsal margin (x *elongatus*).

Sternum VIII with proximal part much reduced, lowly triangular. The apical part only a little distally broadened with a concave dorsal margin. One backwards tending small seta placed at the upper angle of the broadened part; on the vertical part of distal margin 3 (D a m p f, 1912 a: 5—6) similar setae. The lower part of distal margin obliqued forwards, possessing a semicircular group of 6 long, flat, medially curved and broadened setae. A pair of similar perhaps still broader setae situated slightly forward at the ventral angle. The ventral margin of sternum with 5—6 medium long setae (D a m p f, 1912a: 7—8).

F e m a l e

(data based on 8 specimens from Czechoslovakia)

Length average 2.3 mm (2.05—2.4). S m i t, 1954a: 2.25—2.75 mm.

Preoral tuber bent at a right or slightly obtuse angle, in one specimen at a slightly sharp angle. The anterior margin of frons possessing a row of 15—17 (W a g n e r, 1898: 15—17; D a m p f, 1912b: 17) setae. Below the antennal fossa one long bristle with 2 shorter setae anteriorly in all 8 specimens examined. Below and in front of them an irregularly scattered group of 4—8 setae (D a m p f, 1912b, fig. 6: 7). Occipital part of head possessing in all 8 specimens 4 long bristles in one

row, above them one shorter seta. An irregular row of 6—7 short setae above the antennal fossa (D., fig. 5: 6). The posterior margin of the occipital part of head possessing 10—13 long setae.

Comb of pronotum with 30—32 spines (W.: 30, 28; D.: about 30). 1—4 pseudosetae, often a different number on each side of the body under the collar of mesonotum (I found 2—3 most frequently). Comb of metanotum with 24—29 spines (W.: 24, 28; D.: 31). Metepimeron most frequently with 2 (13×), rarely with 3 (3×) lateral bristles (S m i t, 1954b: regularly 2) and with 3, but once with 2 and 4 distal bristles.

The counts of spines in the abdominal ctenidia are as follows: I: 14—20 (W.: 12, 14, 18), II: 25—30 (W.: 24, 28), III: 23—28 (W.: 22, 26), IV: 21—24 (W.: 20, 24; Smit, 1954b: 19—25), V: 15—19 (W.: 14, 18, 20; D.: 20; S.: 16—19), VI: 15—19 (W.: 14, 16, 20; D.: 19; S.: 13—18).

Sternum VII with a distinctly formed ventral lobe, the distal margin of which is in its upper part more or less deviated backwards; the lower part of dorsal margin distinctly concave (x *octactenus*) below the arching, see Fig. I, the surface of sternum possessing an irregular row of 11—17 setae (D.: 7 on one side; S., fig. 92: 8 on one side). Anal stylet of an usual length (about three times as long as broad on the base) possessing one stronger seta on its base. Diameter of the dilated portion of duct of spermatheca practically the same as (a little larger than) the diameter of bursa copulatrix. Hilla of spermatheca insignificantly longer than bulga, which is almost square, distinctly larger than that in *I. octactenus,* see Fig. I.

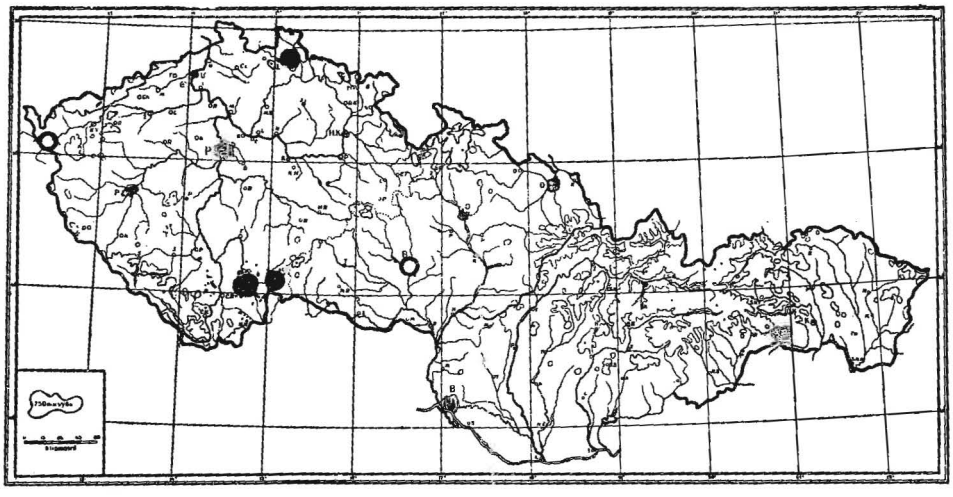
After the careful study of my material of *I. variabilis* females, I had to confirm the assumption of H o p k i n s, R o t h s c h i l d (1956: 272) below, that the figures 5, 13 and 22 in D a m p f's paper (1912b) refer to a female of *I. variabilis* and not to *I. octatenus.* Namely the fig. 22 illustrating the female genital organs proves to be undoubtedly that of *I. variabilis.* Thus the D a m p f's data on females of *I. octactenus* are incorrect. Also the fact that D a m p f did not succeed in finding more reliable characters for the differentiation of *I. octactenus* and *I. variabilis* proves the above. Othervise he surely must have noticed at least the number of spines in abdominal ctenidia IV—VI.

D i s t r i b u t i o n (see Map 3 and 4)

This species has been found up to the present time in central, southeast and east Europe: France (Digne, Bouches-du-Rhône), Holland (prov. Limburg), Denmark (Jalgerspris—Sjaelland), Germany (Wiesbaden), Poland (Poznian region), Czechoslovakia (Bohemia, Moravia, Slovakia — 9 localities), Hungary (Szigetesep), Austria (Linz), Switzerland (Genève, Rolle, Lausanne, Canton du Valais — at altitude of 1923 m), Italy (Firenze), Greece (Agostoli-Keffalenia), Yugoslavia (Senj-Croatia, Ljubljana—Slovinia), Bulgaria (Kamchia river), Roumania (Dobrodgea), the U.S.S.R.: Ukraine (Volynskaja, Poltavskaja oblast), Russian S.S.R. (Leningradskaja, Kalininskaja, Moskovskaja, Kurskaja, Voroniezhskaja, Rostovskaja, Stavropolskaja, Astrachanskaja, Saratowskaja and Uljanovskaja oblast, Chistopol).

From Czechoslovakia this species was reported by Rosický (1953, 1957) from *P. pipistrellus* from Brno. E. Heutschel found 3 ♂♂, 2 ♀♀, 27. IV. 1911 on *B. barbastellus* in Cheb, specimens deposited in Rothschild's collection in the British Museum at Tring (Smit, 1954b; Hopkins, Rothschild, 1956; Rosický, 1957).

Map. 3 Area of distribution of the flea *Ischnopsyllus variabilis* (Wagn.).



Map 4 Distribution of the flea *Ischnopsyllus variabilis* (Wagn.) in Czechoslovakia; ● — author's find, O — literary data.

My material comes from 5 localities in Bohemia and 2 in Slovakia.
Bohemia: *Myotis mystacinus* — Lomnice n. Lužn. (d. J. Hradec), 7. V. 1955 — ♀; fish-pond Velký Tisý (J. Hradec d.), 8. VIII. 1955 — ♀; fish-pond Potěšil (J. Hradec d.), 17. VII. 1957 — ♀; fish-pond Kačležský (J. Hradec d.), 20. VII. 1958 — ♀. *Pipistrellus nathusii* — fish-pond Velký Tisý (J. Hradec d.), 16. VII. 1957 — ♀, 14. IX. 1958 — ♀. *Myotis dasycneme* — Bílá Desná (Jablonec n. Nisou d.), 24. II. 1958 — ♂.
Slovakia: *Vespertilio murinus* — Zádiel valley (Košice d.), 11. VII. 1955 — ♀; *Barbastella barbastellus* — Hačava-cave (Košice d.), 7, II. 1958 — ♀.

Total material contains 9 specimens (♂, 8 ♀♀) from 7 localities.

Distribution of this flea is sporadic and rare all over our country, more abundant in the fish-pond regions possessing plenty of old hollow trees (e. g. the district of Jindřichův Hradec).

Hosts

This relatively rare species has been found on 14 bat species in the above named area, most frequently on the members of genus *Pipistrellus*. As *P. pipistrellus* is the most common species and as the individual species of this genus (namely *P. nathusii*) are indistinguishable without a help of an expert, *P. pipistrellus* is most frequently recorded as a host (Germany, Switzerland, Austria, Czechoslovakia, Poland, Roumania, the U.S.S.R.) Nevertheles, the principal host of this flea is probably *P. nathusii* in the whole of the at present known area, which seems to be sufficiently demonstrated by the finds from the U.S.S.R., Switzerland and by the author's material, too. Aellen (1960) arrived at the same conclusion. In France and Greece this flea was found on *P. kuhli*. *I. variabilis* has been further recorded twice from *Myotis mystacinus* (Holland, Hungary). There are but single reports on the following hosts: *Myotis dasycneme* (Holland—Smit, 1954b), *Myotis daubentoni* (Switzerland—Aellen, 1960), *Nyctalus noctula* (Italy—Smit, 1954b, Hopkins, Rothschild, 1956), *Nyctalus leisleri* (Bulgaria—Smit, 1954b, Hopkins, Rothschild, 1956), *Eptesicus serotinus* (Roumania—Smit, 1954b, Hopkins, Rothschild, 1956), *Eptesicus nilssoni* (U.S.S.R.—Markova, 1939: 7 flea specimens on 109 bats), *Myotis nattereri* (Yugoslavia—Smit, 1954b, Hopkins, Rothschild, 1956), *Barbastella barbastellus* (Czechoslovakia, Cheb—Smit, 1954b, Hopkins, Rothschild, 1956) and *Plecotus auritus* (U.S.S.R.—Markova, 1939).

The author found 9 specimens of this flea on 5 various hosts in Czechoslovakia. This fact proves the diversity of hosts given in literature. Table 2 shows the parasitization of individual bat species with this flea.

Consequently, *I. variabilis* is a flea of tree-dwelling bats of the genus *Pipistrellus*. The principal host is *P. nathusii*, secondly *P. pipistrellus* when inhabiting cavities of trees. The further 11 hosts also belong either to the typical tree-dwelling species *(P. kuhli, N. noctula, N. leisleri)* or occur often in trees, in acumulated timber etc. *(M. daubentoni, M. mystacinus, M. dasycneme, M. nattereri, E. serotinus, E. nilssoni, V. murinus, B. barbastellus, P. auritus)*. That *P. nathusii* is a principal host is supported by the fact, that the present known distribution of the flea corresponds well with that of this bat.

Table No. 2 Review of the hosts of *Ischnopsyllus variabilis* (W a g n e r) according to author's material.

bat species	number of specim. examined	*Ischnopsyllus variabilis*					
		number of bats with fleas (%)	males	females	total	average per one bat	maximum per one bat
Pipistrellus nathusii	3	2 (67)	0	2	2	0.66	1
Myotis dasycneme	3	1 (33)	1	0	1	0.33	1
Vespertilio murinus	28	1 (3)	0	1	1	0.035	1
Myotis mystacinus	144	4 (3)	0	4	4	0.027	1
Barbastella barbastellus	250	1	0	1	1	0.004	1

Notes on bionomics

I found eggs in the abdominal cavity of females on 7. V., 11., 17. and 20. VII., 8. VIII. and 14. IX. I found no eggs in females on 7. II. and 16. VII. Consequently it seems that the females lay eggs during the whole active period of host.

According to my material the sex ratio appears to be favourable for females in this species (♂, 8 ♀♀). Also the material of Rothschild's collection suggests this fact (5 ♂♂, 17 ♀♀). Neverteheles, to ascertain the real state much larger material would be necessary.

There could be little said about the extent and average infestation of the principal host on the basis of my sparse material especially because I did not have the opportunity to examine any larger colony of hosts from the cavities of trees. However, it seems that the average infestation with this flea is not high.

The common occurence with another flea species on one host specimen was mentioned by S m i t (1954b) who found a male of *I. variabilis* together with a female of *I. simplex* on a female of *M. mystacinus* in Holland. My material, too, proves the fact that the simultaneous infesta-

Table No. 3 Associated parasitization of *I. variabilis* (W a g n e r) and other fleas on one host specimen.

host species / flea species	*Myotis mystacinus*	*Myotis dasycneme*	*Barbastella barbastellus*	*Vespertilio murinus*	number of species infested
Ischnopsyllus simplex	2×	1×	—	—	2
Ischnopsyllus obscurus	—	—	—	1×	1
Ischnopsyllus hexactenus	—	—	1×	—	1

tion with *I. variabilis* and *I. simplex* is note a mere chance, namely on *M. mystacinus* (see Table 3).

Notes on systematics

Characters of male: the form of sensilium, which is largely developed, the elongated lobe with a seta; the form of movable process with a sharp distal angle.

Characters of female: distinguished from all other females except *octactenus* and *consimilis* by the following combination of characters: preoral tuber bent at a right angle, the first abdominal comb containing a half of the spines as the metathoric comb. From both *consimilis* and *octactenus* distinguished by a larger number of spines in abdominal combs IV, V, VI; by the shape of sternum VII; by the greater bulga of spermatheca and usually with two lateral bristles on the metepimeron.

The number of pseudosetae under the collar of the mesonotum for both sexes 1—4 (most frequently 2—3).

Ischnopsyllus (Ischnopsyllus) simplex Rothschild, 1906

I. simplex has been found only in the northwestern part of Europe. Up to the present time the known limits of distribution are in the north Praestebakke (latitude 59°00′, Norway), in the south Genève (latitude 46°10′N., Switzerland),*) in the west Northern Ireland (Fermanagh) and in the east Hačava-cave (long 20°50′E., Czechoslovakia), where one female of this species was found by the author. Unfortunately no details are known to me of the find in Hattula, Finland.

In Spain (Sevilla) a very closely related species *I. hispanicus* Jordan was described in 1942, from *M. nattereri,* found also in Morocco (Mazagan). The close relationship of these two species is confirmed by the fact, that the females are morphologically indistinguishable. A more distant relationship exists between the former species and *I. dolosus* (= *I. terres* Jordan, 1929) described in 1912 by Dampf from Caucasus (Nalchik—R.S.S.R.) and found up to the present time only in Caucasus-cape: Stavropol-region, Armenian-Gochcha lake and Daghestan-Makhachkalin district).

In the present literature, there are given two subspecies separable only in the males: *I. s. simplex* Rothschild and *I. s. mysticus* Jordan. The subspecies *mysticus* was regarded by its author evidently as that occuring in east Europe. However, the find in west Europe (Holland), and my experiences from Czechoslovakia prove, that the situation is certainly not so simple. As I succeeded in obtaining a large material of both subspecies (262 males), I shall try to solve the problem of their origin and to determine them on the basis of morphology and ecology.

*) Balcells (1955) recorded indeed 5 ♂♂ and 2 ♀♀ of *I. simplex* Rothsch. from *M. nattereri* in Spain (Barcelona prov.) but his record probably refers to *I. hispanicus* Jord. I asked the author in a letter for more details, but I have not yet received an answer.

Ischnopsyllus (Ischnopsyllus) simplex simplex Rothschild, 1906

Ceratopsylla octactenus Kolenati. Rothschild, 1898 (nec Kolenati, 1856), Novit. Zool. **5**: 543 (partim — material from *M. nattereri*); *Ischnopsyllus simplex.* Rothschild, 1906, Novit. Zool. **13**: 186; *Ischnopsyllus schmitzi.* Oudemans, 1909a, Tijdschr. Ent. **52**: 97—104, tab. 9, fig. 4, 5 (male only, female = *I. intermedius* Rothschild); *Ischnopsyllus schmitzi.* Oudemans, 1909b, Zool. Anz. **34**: 736—741, 731—fig. 6 (female genital organ); *Ischnopsyllus simplex* Rothschild, 1910, Ent. mon. Mag. **46**: 253 (*schmitzi* Oudms. = *simplex* Rothsch.); *Ischnopsyllus simplex* Rothschild. Dampf, 1912a, Rusk. ent. obozr. **12**: 41—47, fig. 2 (male, morphology of genital organ, key); *Ischnopsyllus simplex* Rothschild. Dampf, **1912***b*, Ber. Bot. Zool. Ver. Rheinland-Westfalen, **1911**: 79—113, tab. 1, fig. 4, tab. 3, fig. 11, 12, tab. 4, fig. 17c, tab. 5, fig. 23, 24, 27, (female, morphology, key, synonymy); *Ischnopsyllus simplex* Rothsch. Rothschild, 1915, Ent. mon. Mag. **51**: 86, 108, tab. 14, fig. 88 (male), 89 (female) (key, morphology, synonymy); *Ischnopsyllus simplex* Rothschild. Wagner, 1936, Tierwelt Mitteleuropas **6**, Lief. 2, Teil 3: 18, fig. 69 (male), 70 (female) (key); *Ischnopsyllus simplex* (Rothschild). Jancke, 1938, Tierwelt Deutschlands **35**: 34, fig. 43a (male), 43b (female) (key, morphology); *Ischnopsyllus simplex simplex* Roths. Jordan, 1942, Eos **18**: 244, fig. 2 (male) (differentiation from ssp. *mysticus* Jordan); *Ischnopsyllus simplex simplex* Rothschild. Smit, 1954a, Danmarks Fauna **60**: 70, fig. 83, 95 (male), 85, 96 (female) (key); *Ischnopsyllus simplex simplex* Rothschild. Smit, 1954b, Natuurh. Maandbl., **43**: 11—15, fig. 9 (male); *Ischnopsyllus (Ischnopsyllus) simplex simplex* Rothschild. Hopkins, Rothschild, 1956, Cat. Rothsch. Coll. Fleas **2**: 261, 287—290, fig. 428, 448, 453, 454, 485, 486 (male), 484, 488 (female) (morphology, key, synonymy); *Ischnopsyllus (Ischnopsyllus) simplex simplex* Rothschild. Smit, 1957a, Hand. Ident. Brit. Ins. **1** (16): 46, 48, fig. 102 (male), fig. 106, 108 (female) (key, distribution); *Ischnopsyllus (Ischnopsyllus) simplex simplex* Rothschild. Rosický, 1957, Fauna ČSR **10**: 298—299, fig. 99F, H (male) (morphology, synonymy, distribution in Czechoslovakia).

Male

Forma typica (data based on 30 specimens, 28 from Czechoslovakia, 2 from Poland).

Length average 2.18 mm (1.8—2.3 mm), Smit, 1954a: 2—2.5 mm.

Preoral tuber bent at an obtuse angle, the lower part short. Anterior margin of frons possessing a row of 12—17, most frequently 13—16 small setae. Below the antennal fossa one long bristle extends reaching over the genal process; in front of this bristle two shorter setae (one only in one specimen). Below them an irreguarly situated group of 7—14, most frequently 9—13 small setae. Occipital part of head possessing 4 bristles in one row (5 only in one specimen), above them one shorter seta. An irregular row of 7—13, most frequently 9—10 setae above the antennal fossa. The posterior margin of the occipital part of head possessing 8—12, most frequently 10 long setae.

The prothoracic comb with 26—32, most frequently 28—30 spines, that of metanotum with 20—30, most frequently 22—26 spines. Under the mesonotal collar there are 1—4 (1—22%, 2—52%, 3—22%, 4—4%), most frequently 2 pseudosetae. Metepimeron with 3—7, most frequently 4—5 lateral and 1—3, most frequently 2 distal bristles. The rate of single combinations is as follows: 5+2 (32%), 4+2 (30%), 6+2 (16%), 4+1 (10%), 4+3, 3+5, 5+1, 7+2 (3%). Often various combinations on each body side occur.

The number of spines in the abdominal ctenidia are as follows:

I.	7—16 most frequently 8—12	IV.	10—20 most frequently 14—18
II.	16—27 most frequently 20—24	V.	8—17 most frequently 10—12
III.	14—25 most frequently 18—22	VI.	6—14 most frequently 8—12

The body of clasper with almost straight, broad manubrium, length to width ratio 2: 1 (a little less) (D a m p f, 1912a also 2: 1). Below the sensilium the dorsal margin of body turns suddenly upwards and forms a strongly sclerotized, right-angled or acute-angled, at the apex rounded, anterior angle (Fig. II, 2). At a small distance from the anterior angle a backwards curved bristle is placed on the dorsal margin of the body. Behind the bristle there is a small and narrow hump, separating the fixed process. Below the dorsal margin the fixed process shows a row of 3—4 backwards extended setae with more rounded dorsal and more distinctly angular ventral posterior angle. A pair of acetabular bristles from which the upper one is stronger and more sclerotized are placed above the middle of the distal margin on the fixed process. The movable process in form of a broad sickle, its distal margin below the middle distinctly bent inside. The anterior angle about 50—60° with one forward tending seta, next to it on the inner side two smaller setae. Below the convex dorsal margin two submarginally placed setae, another one situated in the bend of the distal margin. The inner side possessing a group of 4—5 small setae on the surface.

Sternum VIII well developed. The proximal part broad, the distal part narrower, towards the end distinctly broadened (Fig. II. 4). The narrowest part is most frequently by one fourth (at maximum by one half) narrower than the distal end possessing a thin apical hook curved downwards on the upper margin. The distal margin of sternum below the apical hook strongly concave reaching over the posterior margin of the hook. The lower part of the distal margin vertical. Over the middle of the posterior margin of strenum VIII, in its maximal curvature a strongly broadened, flat, curved bristle situated. At the ventral rectangular posterior angle two similar broadened and curved bristles. A curved row of 5 long, thin bristles (but once 6 bristles found on one side) on the surface of sternum between the upper broadened bristle and the pair of bristles at the posterior ventral angle. The ventral margin of sternum possessing a row of 5—7 stronger setae in a distal part. Close to the pair of broadened bristles at the ventral angle one long thin seta on the ventral margin of sternum. The group of 2 (70%) or 3 (30%) most frequently forward-tending shorter setae on the surface of sternum above the insertion of the ventral pair of broadened bristles. From them towards the book-shaped process there is a group of 3—8, most frequently 4—5 short, transparent, flat setae (D a m p f, 1912a: above a dozen).

The lower branch of sternum IX on its ventral margin straight, dorsally distinctly convex, often with a hump in the middle (Fig. II. 1).

The apical sclerites of phallosoma lower and broader, their ventral margin behind the angle usually straight (in exactly horizontal position) (Fig. II, 3).

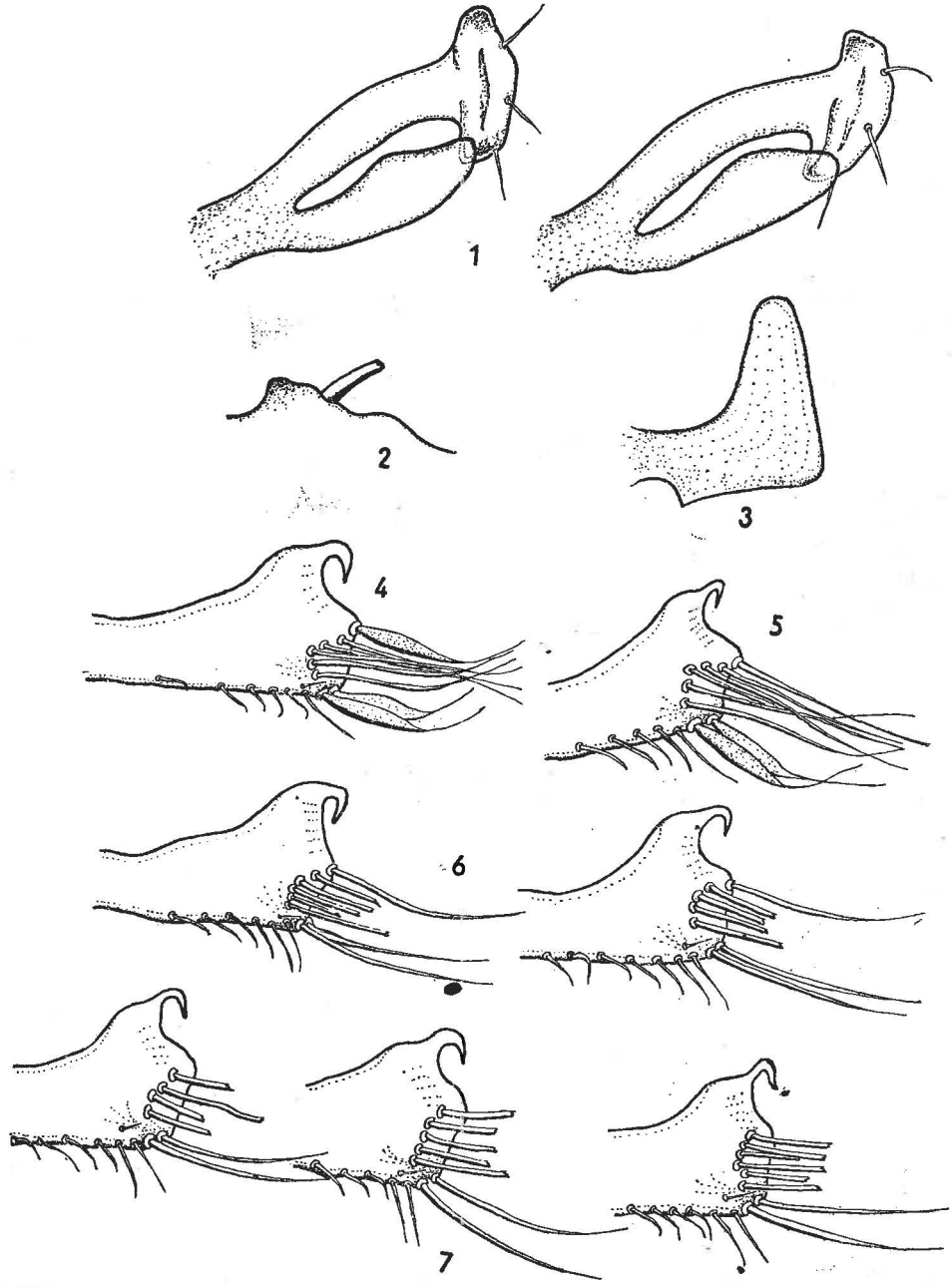


Fig. II. *Ischnopsyllus simplex simplex* Rothschild:
1 — sternum IX (♂, 8. VIII. 1955, Lomnice n. Lužnicí, *M. nattereri*; ♂, 15. VIII. 1956, Ovesné Kladruby, *M. nattereri*); 2 — dorsal margin of the body of clasper (♂, 8. VIII. 1955, Lomnice n. Luž., *M. nattereri*); 3 — apical sclerite of the phallosome (the same specimen as in Fig. 2); 4 — distal part of sternum VIII in typical form (♂, 17. VIII. 1957, fish-pond Melichar, *M. daubentoni*); 5 — the same in form B (♂, 15. VIII. 1956, Ovesné Kladruby, *M. nattereri*); 6 — the same in form C (*M. mystacinus,* Velký Tisý); 7 — the same in form D (*M. mystacinus,* Velký Tisý, Domažlice).

Beside the males of this typical form I found some specimens differing from them in several details. Considering these forms as not being beyond the subspecific variability and summing up the characters, I mark them only by capitals.

Form B (Fig. II, 5): The bristles on the distal margin of st. VIII in its maximal curvature not broadened, in fact as broad as each of the 5 bristles on the surface of sternum (total 26 specimens from 3 localities).

Form C (Fig. II, 6): The bristle at distal margin of st. VIII in its maximal curvature not broadened, nearly as broad as each of the 4—5 (4—30%, 5—70%) bristles on the surface of sternum. Two bristles at the posterior ventral angle of sternum either as broad as the bristles on the surface or a little broader but not broadened and curved at the end.

Out of 14 specimens of this form from 6 localities, 3 specimens possessed 4 bristles on each side, 8 speciment 5 bristles on each side and 3 specimens 4 bristles on one side, 5 bristles on the other one.

Form D (Fig. II, 7): The bristle in the maximal curvature absent. A row of 4—6 (4/4-once, 5/5-twice and 5/6 once) bristles on the surface of sternum. Two bristles in the posterior ventral angle a little larger than those on the surface but not broadened.

Four specimens of this form from two localities.

Ischnopsyllus (Ischnopsyllus) simplex mysticus, Jordan, 1942

Ischnopsyllus simplex mysticus. Jordan, 1942, Eos **18**: 244—246, fig. 3 (male); *Ischnopsyllus simplex mysticus* Jordan. Smit, 1954b, Natuurh. Maandbl. **43**: 12—14, fig. 6—8 (male) (the find in Holland); *Ischnopsyllus simplex mysticus* Jordan. Smit, 1954a, Danmarks Fauna **60**: 71, fig. 97 (male); *I. (I.) simplex mysticus* Jordan. Smit, 1955a, Cat. Faunae Austriae **19** z: 4 (the finds in Austria); *Ischnopsyllus (Ischnopsyllus) simplex mysticus* Jordan. Hopkins, Rothschild, 1956, Cat. Rothschild Coll. Fleas **2**: 261, 290—292, fig. 487 (male) (morphology, key, synonymy); *Ischnopsyllus simplex mysticus* Jordan. Hůrka, 1957, Čs. Parasitol. **4**: 148, 163 (distribution, hosts); *I. (I.) simplex mysticus* Jordan. Rosický, 1957, Fauna ČSR **10**: 299—300, fig. 99E, G (male) (morphology, synonymy, the finds in Czechoslovakia); *Ischnopsyllus simplex mysticus* Jordan. Hůrka, 1958, Ochrana přírody **13**: 96—97 (the problem of the origin of ssp. *mysticus*).

Male

(data based on 30 specimens from Czechoslovakia)

Length average 2.01 mm (1.8—2.3 mm).

Preoral tuber bent at an obtuse angle, the lower part short. The row of 12—17, most frequently 14 setae on the anterior margin of frons. Below the antennal fossa one long bristle extends reaching over the genal process, in front of this bristle two shorter setae (three only in one specimen). Below them an irregular group of 6—14, most frequently 10—13 small setae. Occipital part of head possessing 4 bristles in one row (3 only in one specimen), above them one short seta. An irregular row of 6—12, most frequently 8—9 setae above the antennal fossa. The posterior margin of the occipital part of head possessing 8—14, most frequently 10 long setae.

The prothoracic comb with 24—32, most frequently 28—30 spines, that of metanotum with 20—30, most frequently 24—26 spines. Under the collar of mesonotum there are 1—4 (1—36.5%, 2—46%, 3—16%, 4—1.5%), most frequently 1—2 pseudosetae. Metepimeron with 3—6, most frequently 4—5 lateral and 2—3, most frequently 2 distal bristles.

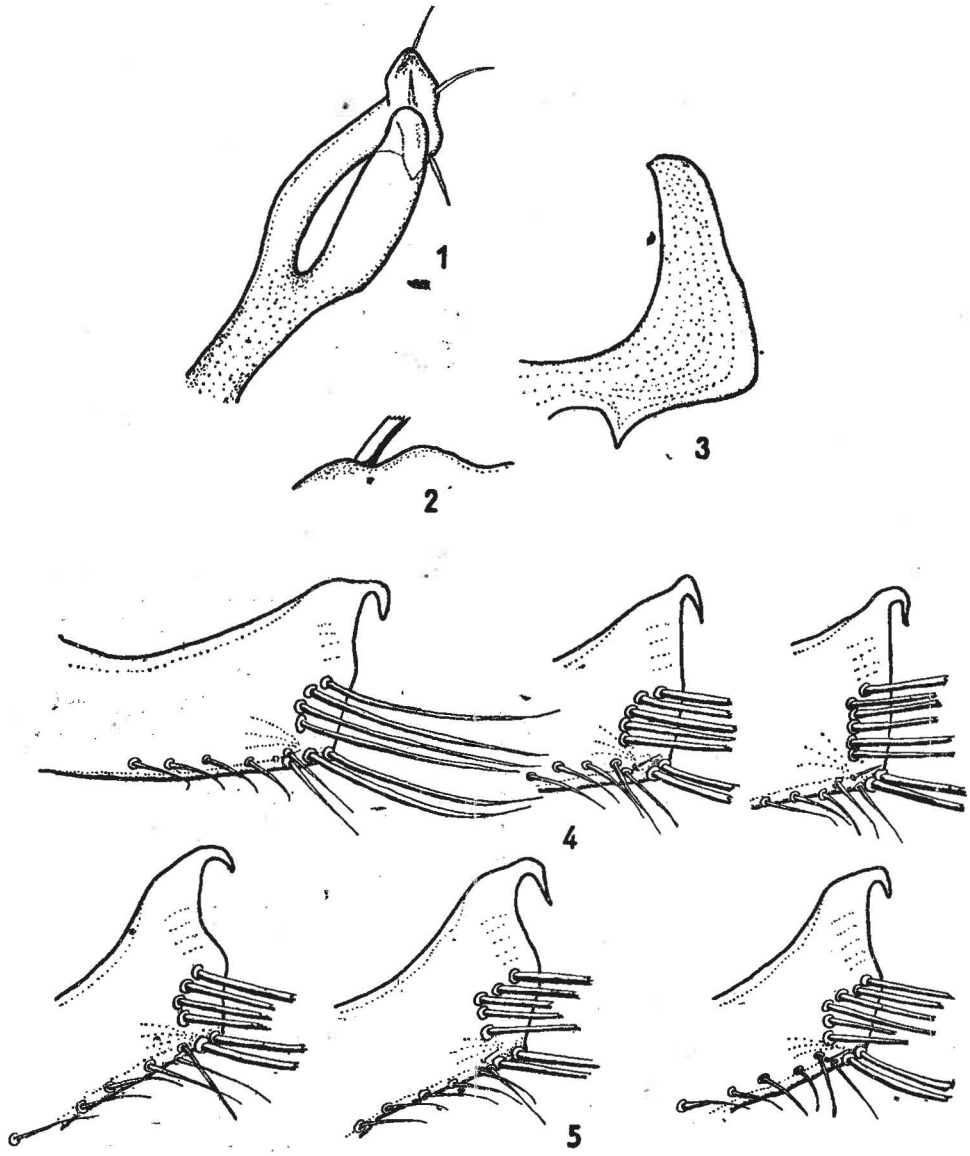


Fig. III. *Ischnopsyllus simplex mysticus* Jordan:
1 — sternum IX; 2 — dorsal margin of the body of clasper; 3 — apical sclerite of the phallosome (all *M. mystacinus*, Domažlice); 4, 5 — distal part of sternum VIII (both *M. mystacinus*, Velký Tisý).

The rate of individual combinations is as folows: 5+2 (34%), 4+2 (31%), 6+2 (21%), 5+3 (7%), 4+3 (3.5%), 3+2 (3.5%).

The number of spines in the abdominal ctenidia are as follows:

I.	7—16 most frequently 10—12	IV.	12—20 most frequently 14—16
II.	16—28 most frequently 22—24	V.	8—14 most frequently 9—11
III.	15—24 most frequently 16—20	VI.	6—12 most frequently 8—10

The body of clasper with nearly straight, broad manubrium — length to width ratio as 2: 1. The dorsal margin of body of clasper rises gently below the sensilium forming a little sclerotized, obtuse or most frequently rounded anterior angle (Fig. III. 2). The hump behind the curved bristle higher and broader. The fixed and movable precesses as well as acetabular bristles similar to those of the subspecies *simplex* R o t h s c h.

The narrowest part of sternum VIII most frequently by three fifths (at minimum by one half) narrower than the posterior part with a hookform process. The distal margin of sternum below the process almost straight (Fig. III, 4) or in the middle slightly triangularly deviated, the peak of the deviation reaching the same level as the hookform process (Fig. III, 5). The broadened bristle at the middle of the posterior margin of sternum absent. On the surface in its lower part a long more or less straight or slightly curved row of 4—6 (4—61%, 5—32%, 6—7%) long bristles (sometimes a different number on each side.) In 62 males the arrangement of bristles on both sides of sternum and the rate of individual combinations was as follows: 4/4—32 sp. 52%, 5/5—12 sp. 20%, 4/5—11 sp. 18%, 5/6—4 sp., 6/6—2 sp., 4/6—1 sp. At the ventral posterior angle of sternum two bristles either as broad as the bristles on the surface, or a little longer, but never broadened. The ventral margin of sternum in its distal part with a row of 4—7, most frequently 5—6 longer setae. Close to the ventral pair of bristles one long thin seta. The group of 2 (70%) or 3 (30%), most frequently forward tending shorter setae above the insertion of the ventral pair of bristles. From them towards the apical hook a group of 3—7, most frequently 4—5 short, transparent flat setae.

The lower branch of sternum IX on its ventral margin straight, dorsally straight, too, or only slightly convex (Fig. III, 1).

The apical sclerites of phallosoma higher and narrower, their ventral margin behind the angle concave (in an exactly horizontal position) (Fig. III, 3).

A b n o r m a l m a l e s

In my material there are two males, one of them being an intermediate between both subspecies, the other truly monstrous.

The i n t e r m e d i a t e specimen: The sternum VIII in its narrowest part by one third narrower than at the distal margin; the posterior margin of sternum below the apical hook deviated, the deviation reaching over the posterior margin of the hook; at the ventral posterior angle of sternum two broadened curved bristles-consequently, the characters of ssp. *simplex* R o t h s c h i l d.

The bristle above the middle of the distal margin of sternum in its maximal curvature absent; 4 bristles on the surface of sternum; the anterior angle of the body of clasper little sclerotized, rounded. The lower branch of sternum IX dorsally straight; the apical sclerites of phallosoma higher and narrower-consequently, the characters of ssp. *mysticus* Jordan. One specimen from the material of 13 males found on 13. V. 1957 in a summer colony of *Myotis mystacinus* at the pond Velký Tisý in Southern Bohemia.

The monstrous specimen: sternum VIII in its narrowest part by seven tenths narrower than on the distal margin; the posterior margin of the left sternum straight, the broadened bristle absent; 4 bristles on the surface; 2 broadened bristles at the ventral posterior angle. The posterior margin of the right sternum convex, the maximal deviation reaches over the apical hook; in the middle of maximal curvature one broadened bristle; 4 bristles on the surface of sternum; one broadened and one normal bristle at the ventral posterior angle. Sternum IX as in ssp. *mysticus,* at the right side moderately deformed. The anterior angle of the dorsal margin of body of clasper as in ssp. *simplex.*

One specimen from the same material as the previous one.

Jordan's intermediate specimen: one of the five male according to which the ssp. *mysticus* was described has a following combinations of characters: sternum VIII with one broadened bristle above the middle of the distal margin; the bristles on the surface and two bristles at the ventral posterior angle as in ssp. *simplex.* The remaining characters as in ssp. *mysticus.* Jordan, 1942 determines this specimen (figured by Smit, 1954b, Fig. 8) as intermediate between both subspecies. Again, this male was found on *Myotis mystacinus.*

Female of *I. (I.) simplex* Rothschild*)

(data based on 50 specimens from Czechoslovakia)

Length average 2.2 mm (1.7—2.7 mm). Oudemans, 1909b: 2.7—3.05 mm; Smit, 1954a: 2.25—2.5 mm.

Preoral tuber bent at an obtuse angle, the lower part short. The row on the anterior margin of frons consisting of 12—16, most frequently 14—15 (Oudemans: 14; Dampf, 1912b: 14—17) setae. Below the antennal fossa one long bristle, overlapping the genal process, in front of which there are 2 shorter setae. Below them an irregularly dispersed group of 4—8, most frequently 5—6 (D.: 8) small setae. Occipital part of head possessing 4 bristles in one row (in one of the specimens examined 3), above them 1 small seta. Above the antennal fossa an irregular row of 5—10, most frequently 6—8 setae. The posterior margin of occipital part of head possessing 10—14, most frequently 10 long setae.

*) As already mentioned above, there are no morphological characters for the differentiation of females of both subspecies. As I did not succeed in finding any reliable characters, I give the description of females of both *I. s. simplex* Rothschild and *I. s. mysticus* Jord. simultaneously.

Comb of pronotum with 26—33 (O.: 30—34, D.: 30—33), most frequently 28—31 spines. One to four (1—20%, 2—53%, 3—22%, 4—5%), most frequently 2 pseudosetae under the collar of mesonotum. Comb of metanotum with 20—31 (O.: 22—28, D.: 22—29), most frequently 24—26 spines. Metepimeron with 3—6, most frequently 4—5 lateral and 2—3 (2—66%, 3—34%) distal bristles. The rate of individual combinations is as follows: (based on 200 specimens examined) 4+2 (35%), 5+2 (18%), 4+3 (17%), 5+3 (12,5%), 3+2 (9%), 6+2 (4%), 6+3 (2,5%), 3+3 (2%).

The number of spines in the abdominal ctenidia are as follows:

I.	6—16 most frequently 8—13	(O.: 8—14, D.: 8—17)
II.	17—26 most frequently 18—22	(O.: 20—22, D.: 19—24)
III.	14—23 most frequently 15—20	(O.: 16—18, D.: 15—21)
IV.	10—20 most frequently 12—17	(O.: 14—16, D.: 3—17)
V.	7—15 most frequently 8—11	(O.: 10—12, D.: 9—14)
VI.	6—12 most frequently 7—10	(O.: 8—10, D.: 7—11)

Sternum VII with a broad ventral lobe, the posterior margin of which distinctly convex-concave in its lower part approximately in 50% of specimens, moderately convex in 50% of specimens (see Fig. IV). The surface of sternum possessing 8—22, most frequently 12—16 (O.: 3—7 on one side, D.: 7—11, S m i t, 1954a, fig. 96: 7) setae in an oblique longitudinal row, curved forward in its lower part. The posterior margin of tergite VIII straight or moderately concave in its lower part. Anal stylet of usual length (three times as long as broad on its base), having two stronger setae on its base. Diameter of dilated portion of spermathecal duct approximately the same as (a little larger) diameter of bursa copulatrix. Strongly curved hilla and oval bulga of spermatheca approximately of the same length, or hilla slightly longer.

L a r v a of *I. (I.) simplex* R o t h s c h i l d

Larvae of instar I, possessing a frontal egg-breaker, instar II and III are morphologically indistinguishable.

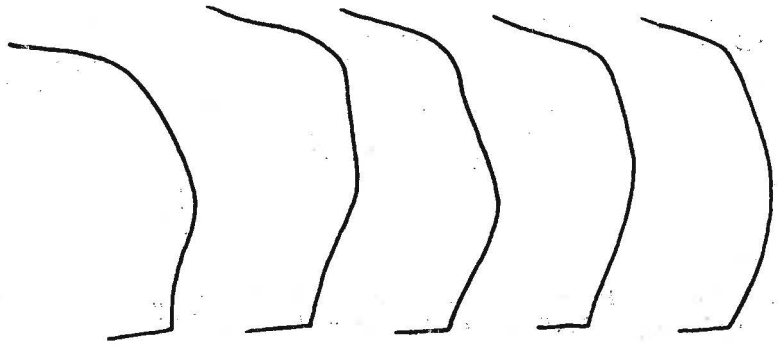
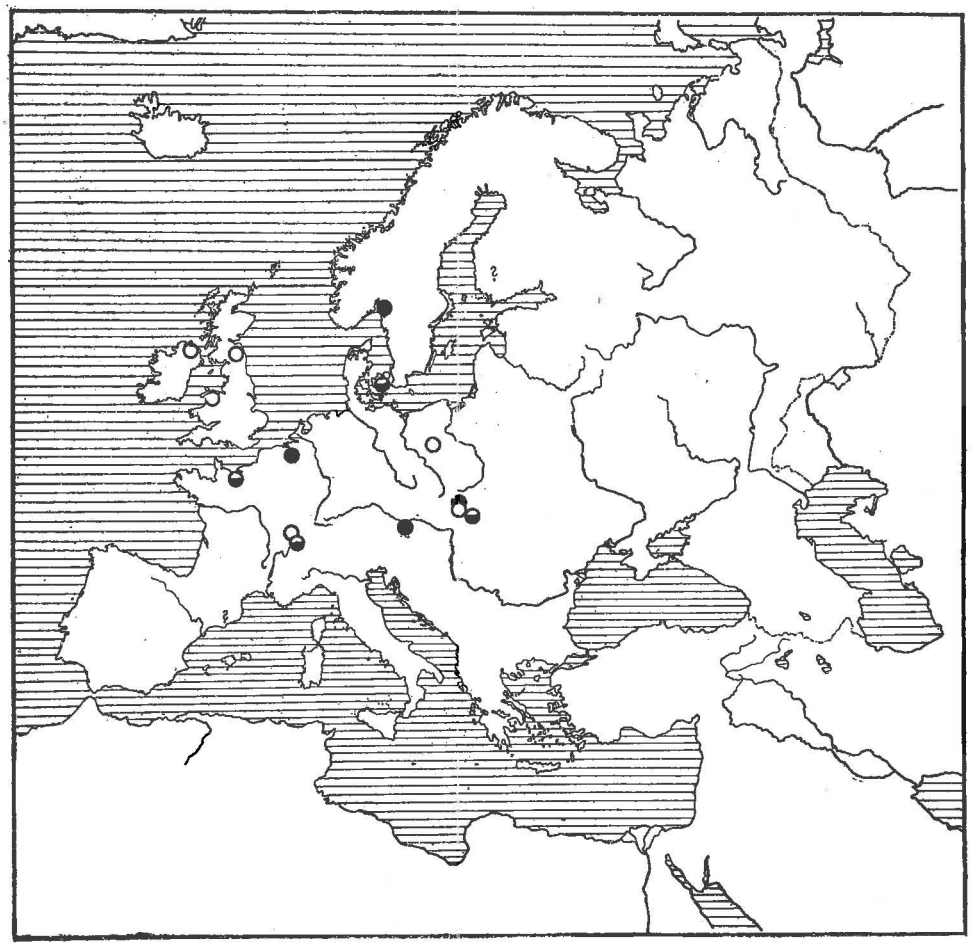


Fig. IV. Variation of shape of the posterior margin of sternum VII in *I. simplex* Rothschild (according to specimens of the nursing colony of *M. natterері,* 8. VIII. 1955, Lomnice n. Lužnicí).

H e a d: 3 long and 3 short setae in the posterior row, 5 long and 1 short seta in the anterior one, 3 setae above mandible, 2 setae at the base of antenna and 3 setae in the vicinity of the labial palps. Antennal length (without a central stiff hair) to its maximal width ratio 4: 1, length of the central stiff hair to the length of antenna 1: 2.5—2.7, therefore the hair is relatively longer than in *I. intermedius.* The second joint of maxillary palps is 1.5 times longer than the basal one.
T h o r a x and a b d o m e n: chaetotaxy — thoracic segment I: $4M_1 4m_1$, $2M_2 2m_2$, $2M_3 6m_3$;*) thoracic segment II and III: $4M_1 4m_1$, $2M_2 2m_2$, $4M_3 4m_3$; abdominal segments I—VIII: $4M_1 4m_1$, $2M_2 2m_2$, $6M_3 6m_3$; abd. segment IX:



Map 5 Limit finds of *Ischnopsyllus simplex* R o t h s c h., known up to the present time. O — *I. s. simplex* R o t h s c h., ◍ — *I. s. mysticus* J o r d., ◒ — only females found.

*) M_1 — long dorsal seta, m_1 — short dorsal seta; M_2 — long lateral seta, m_2 — short lateral seta; M_3 — long ventral seta, m_3 — short ventral seta.

$6M_1 2m_1$, $2M_2 2m_2$, $4M_3 4m_3$; abd. segment X: anal comb in two rows the upper one possessing 2—3 (most frequently 3), the lower one 7—8 (most frequently 8) setae; there are 8—11 sturts, most frequently 9, out which 4—6, most frequently 5—6, are short and 3—5, most frequently 4, are longer.

The length of larval instar I: 1.5—1.7 mm (based on 3 specimens).
The length of larval instar II: 1.8—2.5 mm (based on 9 specimens).
The length of larval instar III: 2.8—3.7 mm (based on 20 specimens).

Al larval instars were found in guano of a small female colony of *Myotis mystacinus* in Lednice, south Moravia, on 17. VIII. 1958.

Distribution (See Map 5, 6)

I. simplex simplex Rothschild was found in Great Britain (North Ireland, England, Wales), France, Belgium, Holland, Germany, Switzerland, Czechoslovakia, Poland (Poznian), ?Finland (Hattula—Nordberg, 1934), ?Spain (prov. Barcelona — Balcells, 1955). In Denmark (Sjaelland-Dyehaven) one female of *I. simplex* was found without decision to which subspecies it belongs.

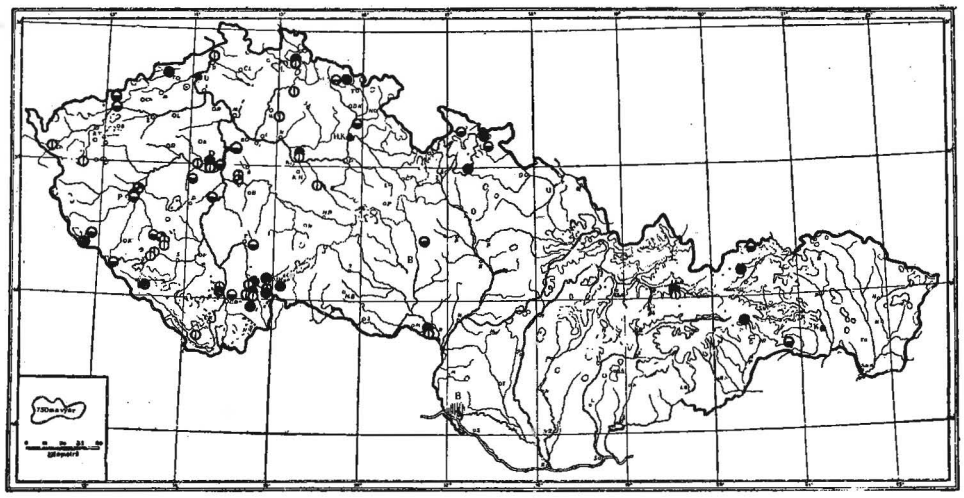
From Czechoslovakia this subspecies has been recorded (with exception of Hůrka, 1957) only from Cheb from *B. barbastellus* on 20. VIII. 1907, 2 ♂♂, 1 ♀, E. Hentschel — Hopkins, Rothschild, 1956; material deposited in Rothschild's collection.

My material of 198 males comes from 20 localities in Bohemia, 2 in Moravia and 1 in Slovakia.

Bohemia:

Forma typica

Myotis nattereri — Cheb, 30. XI. 1958 — 2 ♂♂; forester's house by fish-pond Smyslov (Strakonice d.), 27. VI. 1957 — 1 ♂; Velký Bor (Klatovy d.), 5. VI. 1956 — ♂; Lomnice n. Lužnicí (Jindřichův Hradec d.), 8. VIII. 1955 — 62 ♂♂, 5. VIII. 1958



Map 6 Distribution of the flea *Ischnopsyllus simplex* Rothsch. in Czechoslovakia; ⦶ — *I. s. simplex* Rothsch., ● — *I. s. mysticus* Jord., ◒ — only females found. ◓ — literary data of *I. s. mysticus* Jord.

— 12 ♂♂; house by fish-pond Dvořiště (Jindř. Hradec d.), 17. VII. 1957 — 10 ♂♂, 5. VIII. 1958 — 1 ♂, 5. VII. 1959 — 3 ♂♂; house by fish-pond Velký Tisý (Jindř. Hradec d.), 21. V. 1954 — 4 ♂♂; house by fish-pond Potěšil (Jindř. Hradec d.), 16. IX. 1958 — 2 ♂♂, 5. VII. 1959 — 1 ♂; Jílové (d. Praha-west), 3. XI. 1955 — 1 ♂; Srbsko (Beroun d.), 15. III. 1959 — 4 ♂♂; Loubí (Děčín d.), 7. IV. 1958 — 1 ♂; Bílá Desná (Jablonec n. Nisou d.) 24. II. 1958 — 2 ♂♂; castle Valdštejn (Semily d.) 12. IV. 1959 — 1 ♂; Býchory (Kolín d.), 19. VII. 1959 — 10 ♂♂.

Myotis mystacinus — Sedlec by Dívčice (Č. Budějovice d.), 27. VII. 1958 — 1 ♂; house by fish-pond Velký Tisý (J. Hradec d.), 13. V. 1957 — 4 ♂♂, 26. VIII. 1957 — 1 ♂; house by fish-pond Potěšil (Jindř. Hradec d.) 17. VII. 1957 — 3 ♂♂, 4. VIII. 1958 — 3 ♂♂; Býchory (Kolín d.), 19. VII. 1959 — 1 ♂; Bílá Desná (Jablonec n. Nisou d.), 24. II. 1958 — 4 ♂♂.

Myotis daubentoni — Horažďovice (Klatovy d.), 5. VI. 1956 — 8 ♂♂, 12. VIII. 1958 — 1 ♂; Bílá Desná (Jablonec n. Nisou d.), 24. II. 1958 — 1 ♂; Melichar fish-pond (Mladá Boleslav d.), 17. VIII. 1957 — 1 ♂.

Myotis myotis — Karlštejn (Beroun d.), 31. I. 1956 — 3 ♂♂; Bílá Desná (Jablonec n. Nisou d.), 24. II. 1958 — 1 ♂.

Myotis dasycneme — Bílá Desná (Jablonec n. Nisou d.), 24. II. 1958 — 2 ♂♂.

Myotis bechsteini — Černá v Pošumaví (Český Krumlov d.), 8. IV. 1955 — ♂.

Forma B

Myotis nattereri — Ovesné Kladruby (Cheb d.), 15. VIII. 1956 — 23♂♂; Horažďovice (Klatovy d.), 11. XI. 1956 — 1♂.

Myotis mystacinus — house by fish pond Velký Tisý (Jindř. Hradec d.), 12. VI. 1957 — 2♂♂.

Forma C

Myotis mystacinus — house by fish-pond Velký Tisý (Jindř. Hradec d.), 13. V. 1957 — 1 ♂, 12. VI. 1957 — 2 ♂♂, 16. VII. 1957 — 2 ♂♂, 26. VIII. 1957 — 1 ♂; house by fish-pond Potěšil (Jindř. Hradec d.), 17. VII. 1957 — 2 ♂♂, 5. VII. 1959 — 2 ♂♂; Pařížov (Čáslav d.), 31. VII. 1957 — 1 ♂.

Myotis nattereri — house by fish-pond Dvořiště (J. Hradec d.), 5. VII. 1959 — ♂.

Forma D

Myotis mystacinus — house by fish-pond Velký Tisý, 13. V. 1957 — 1 ♂, 25. VIII. 1957 — 1 ♂, 6. VIII. 1958 — 1 ♂.

Myotis nattereri — Lomnice n. Lužnicí (Jindř. Hradec d.), 8. VIII. 1955 — 1 ♂

Moravia:

Forma typica

Myotis myotis — cave Na Pomezí (Šumperk d.), 28. I. 1959 — 1 ♂.

Forma C

Myotis mystacinus — pavilion Tři gracie near Lednice (Břeclav d.), 17. VI. 1958 — 1 ♂.

Slovakia

Forma C

Myotis mystacinus — ice-cave Demänovská Dračí (Lipt. Mikuláš d.), 14. II. 1961 — 1 ♂.

Through the kindness of prof. Dr. W. Skuratowicz from Poland I obtained 2 males of a typical form from the locality Poznian collected on *M. nattereri.*

I. simplex mysticus Jordan was found up to the present time only in Norway (Praestebakke, 21. VIII. 1907 — Jordan, 1942), Holland (Boerderijgrot, Heerderberg — Limburg prov., 9. XII. 1952 — Smit, 1954b), Austria (Wels, 17. VIII. 1913, Ebelsbergs, Linz, Lunz am See — Jordan, 1942, Smit, 1955a), Czechoslovakia (Hůrka, 1957, 1958, 1959, Rosický, 1957) and east Poland (letter communication of prof. Skuratowicz, 1961).

From Czechoslovakia it has been collected in Jílové from *B. barbastellus,* in Obora near Lnáře from *M. mystacinus* (Rosický, 1957) and in

Třemošná near Plzeň from *M. mystacinus* (L. H ů r k a, 1962), beside the records of H ů r k a (1957, 1958, 1959).

My material of 56 males is from 14 localities in Bohemia, 3 in Moravia and 1 in Slovakia.*)

B o h e m i a :

Myotis mystacinus — Zelenov near Domažlice, 9. VIII. 1956 — 1 ♂; Kašperské Hory (Klatovy d.), 25. III. 1958 — 1 ♂; Sedlec near Dívčice (Č. Budějovice d.), 27. VII. 1958 — 1 ♂; Dunajovice (Jindř. Hradec d.), 30. V. 1958 — 2 ♂♂; house by fish-pond Velký Tisý (Jindř. Hradec d.), 13. V. 1957 — 5 ♂♂, 12. VI. 1957 — 3 ♂♂, 16. VII. 1957 — 5 ♂♂, 26. VIII. 1957 — 6 ♂♂; house by fish-pond Potěšil (Jindř. Hradec d.), 17. VII. 1957 — 5 ♂♂, 5. VII. 1959 — 4 ♂♂; Novosedly n. Než. (J. Hradec d.), 7. VIII. 1958 — 1 ♂, 17. V. 1959 — 2 ♂♂; Kačlehy (Jindř. Hradec d.), 20. VII. 1958 — 1 ♂; Karlštejn (Beroun d.), 27. X. 1957 — 1 ♂; Býchory (Kolín d.), 19. VII. 1959 — 2 ♂♂; Krkonoše-mountains, Černý důl, 19. III. 1959 — 1 ♂; Bílá Desná (Jablonec n. Nisou), 24. II. 1958 — 3 ♂♂; Mikulov II (Teplice d.), 13. III. 1958 — 3 ♂♂.

Myotis nattereri — Lomnice n. Lužnicí (Jindř. Hradec d.), 5. VIII. 1958 — 1 ♂; house by fish-pond Velký Tisý (Jindř. Hradec d.), 21. V. 1954 — 1 ♂.

M o r a v i a :

Myotis mystacinus — pavilion Tři gracie near Lednice (Břeclav d.), 17. VI. 1958 — 2 ♂♂; gallery Sarkander near Zlaté Hory (Bruntál d.), 29. I. 1959 — 1 ♂.

Myotis bechsteini — gallery Franz Franz (Bruntál d.), 30. I. 1959 — 1 ♂.

S l o v a k i a :

Myotis mystacinus — ice-cave Demänovská Dračí (Lipt. Mikuláš d.), 14. II. 1961 — 2 ♂♂.

Eptesicus nilssoni — ice-cave Demänovská Dračí (Lipt. Mikuláš d.), 14. II. 1961 — 1 ♂.

Beside this material additional 4 ♂♂, found by prof. Štorkán in Jílové (d. Praha-west) on *B. barbastellus* and 2 ♂♂ of 15. V. 1951 from Obora u Lnář from *M. mystacinus*, all specimens from Rosický's collection, were available to me, as well as 1 ♂ collected by the author in Melk a. Donau, Austria, on *M. mystacinus* on 21. VIII. 1960.

668 specimens of females of *I. simplex* found in 40 localities in Bohemia, 5 in Moravia and 2 in Slovakia are from the following places:

B o h e m i a :

Myotis nattereri — Cheb, 30. XI. 1958 — 2 ♀♀; Ovesné Kladruby (Cheb d.), 15. VIII. 1956 — 38 ♀♀; Domažlice, 7. VIII. 1956 — 1 ♀; Černá v Pošumaví (Č. Krumlov d.), 24. III. 1958 — 2 ♀♀; Horaždovice (Klatovy d.), 11. XI. 1955 — 1 ♀; Velký Bor (Klatovy d.), 5. VI. 1956 — 1 ♀; house by fish-pond Dvořiště (J. Hradec d.), 17. VII. 1956 — 17 ♀♀, 5. VIII. 1958 — 2 ♀♀, 5. VII. 1959 — 18 ♀♀; fish-pond Velký Tisý (Jindř. Hradec d.), 16. IX. 1958 — 12 ♀♀, 5. VII. 1959 — 4 ♀♀; Lomnice n. Lužnicí (Jindř. Hradec d.), 8. VIII. 1955 — 145 ♀♀, 5. VIII. 1958 — 29 ♀♀; Chýnov-cave (Tábor d.), 1. II. 1957 — 2 ♀♀, 15. I. 1958 — 1 ♀; Jílové (d. Praha-west), 3. XI. 1955 — 5 ♀♀; Karlštejn (Beroun d.), 11. XI. 1956 — 1 ♀; Srbsko (Beroun d.), 15. III. 1959 — 2 ♀♀; Praha-Troja, 16. II. 1956 — 6 ♀♀; Loubí (Děčín d.), 7. IV. 1958 — 3 ♀♀; Bílá Desná (Jablonec n. Nisou d.), 24. II. 1958 — 16 ♀♀; castle Valdštejn (Semily d.), 12. IV. 1959 — 3 ♀♀; Býchory (Kolín d.), 19. VII. 1958 — 32 ♀♀.

Myotis mystacinus — Zelenov near Domažlice, 9. VIII. 1956 — 2 ♀♀; forester's house by Špičák (Šumava-mountain), 3. IX. 1957 — 1 ♀; Lnáře (Strakonice d.), 6. VI. 1956 — 3 ♀♀; Sedlec (Č. Budějovice d.), 27. VII. 1958 — 4 ♀♀; Hosín (Č. Budějovice d.), 24. III. 1958 — 1 ♀; Dunajovice (Jindř. Hradec d.), 30. V. 1958 — 4 ♀♀; fish-pond Velký Tisý (Jindř. Hradec d.), 13. V. 1957 — 31 ♀♀, 12. VI. 1957 — 12 ♀♀, 16. VII. 1957 — 34 ♀♀, 17. VII. 1957 — 2 ♀♀, 19. VII. 1957 — 4 ♀♀, 26. VIII. 1957 — 8 ♀♀, 6. VIII. 1958 —

*) During the print I succeeded in finding two other localities in Slovakia: Belanská cave (Bel. Tatry-mountains) and ice-cave near Dobšiná; host: *M. mystacinus*.

1 ♀; fish-pond Potěšil (Jindř. Hradec d.), 17. VII. 1957 — 23 ♀♀, 4. VIII 1958 — 6 ♀♀, 5. VII. 1959 — 8 ♀♀; Novosedly n. Nežárkou (Jindř. Hradec d.), 7. VIII. 1958 — 3 ♀♀, 17. V. 1959 — 4 ♀♀; Kačlehy (Jindř. Hradec d.), 20. VII. 1958 — 1 ♀; Jílové (d. Praha-west), 28. X. 1957 — 2 ♀♀; Rájov (Chomutov d.), 12. III. 1958 — 1 ♀; Mikulov II (Teplice d.), 13. III. 1958 — 3 ♀♀; Bílá Desná (Jablonec n. Nisou d.), 24. II. 1958 — 21 ♀♀; Býchory (Kolín d.), 19. VII. 1959 — 13 ♀♀; Pařížov (Kutná Hora d.), 31. VII. 1957 — 2 ♀♀; Krkonoše-mountain, Černý důl, 19. III. 1959 — 3 ♀♀.

Myotis daubentoni — Bílá Desná (Jablonec n. Nisou d.), 24. II. 1958 — 2 ♀♀; Karlštejn (Beroun d.), 11. XI. 1956 — 1 ♀; Horažďovice (Klatovy d.), 5. VI. 1956 — 13 ♀♀, 13. VIII. 1958 — 10 ♀♀.

Myotis dasycneme — Bílá Desná (Jablonec n. Nisou d.), 24. II. 1958 — 16 ♀♀.

Myotis myotis — Domažlice, 25. IV. 1956 — 1 ♀; Plzeň, 20. IX. 1958 — 1 ♀; Koněprusy (Beroun d.), 2. IV. 1956 — 1 ♀; Srbsko (Beroun d.), 25. XI. 1956 — 1 ♀; 13. IV. 1958 — 2 ♀♀; Karlštejn (Beroun d.), 27. III. 1955 — 4 ♀♀; 31. III. 1955 — 2 ♀♀, 20. IV. 1958 — 1 ♀; Nový Knín (Příbram d.), 8. III. 1958 — 2 ♀♀; Jílové (d. Praha-west), 16. I. 1955 — 1 ♀, 22. II. 1959 — 1 ♀; Chýnov-cave (Tábor d.), 15. I. 1958 — 1 ♀; house by the fish-pond Potěšil (Jindř. Hradec d.), 16. IX. 1958 — 1 ♀.

Barbastella barbastellus — Srbsko (Beroun d.), 31. XII. 1954 — 1 ♀, 24. XI. 1956 — 1 ♀;; Karlštejn (Beroun d.), II. 1955 — 1 ♀, 11. XI. 1956 — 1 ♀; Praha-Troja, 14. XI. 1956 — 5 ♀♀; Jaroměř (Náchod d.), 18. III. 1956 — 1 ♀; Herlíkovice (Trutnov d.), 19. III. 1959 — 3 ♀♀.

Plecotus auritus — Bílá Desná (Jablonec n. Nisou d.), 24. II. 1958 — 2 ♀♀.

Moravia:

Myotis nattereri — cave Na Pomezí (Šumperk d.), 28. I. 1959 — 2 ♀♀; Heřmanovice (Bruntál d.), 29. I. 1959 — 4 ♀♀.

Myotis mystacinus — pavilion Tři grácie near Lednice (Břeclav d.), 17. VI. 1958 — 12 ♀♀; gallery Sarkander by Zlaté Hory (Bruntál d.), 12. I. 1959 — 2 ♀♀.

Myotis myotis — cave Na Pomezí (Šumperk d.), 20. XI. 1955 — 1 ♀; Sloup-cave (Blansko d.), 1. II. 1959 — 1 ♀.

Slovakia:

Barbastella barbastellus — Hačava-cave (Košice d.), 7. II. 1958 — 1 ♀.

Myotis mystacinus — ice-cave Demänovská Dračí (Lipt. Mikuláš d.), 14. II. 1961 — 17 ♀♀.

Females only were found in 12 localities in Bohemia, 2 in Moravia and 2 in Slovakia. During the print one female was found in Aksamitka-cave near Červený Kláštor (Northern Slovakia), host *M. myotis*. The find of a female from Hačava-cave gives the most eastern limit of distribution of this species.

It may be concluded that the subspecies *mysticus* Jordan has been found rather in the eastern part of the area of the flea distribution, while the subspecies *simplex* Rothschild occurs equally over the whole presently known area if this flea. The territory of Czechoslovakia having been up to the present time the recognized limit of distribution of the flea has been thoroughly searched for the distribution of both subspecies. It seems that here the occurrence of both subspecies at the present time is not determined geographically but ecologically, according to the hosts— on *M. nattereri* ssp. *simplex,* on *M. mystacinus* mainly ssp. *mysticus* (60%), less ssp. *simplex* (40—20% forma typica, 20% B, C, D forms).

In agreement with the occurrence of the principal hosts in regions abounding in stagnant waters, the distribution of *I. simplex* is restricted to placed of this kind (see the accumulation of localities of the species in South-Bohemian fish-pond region in the map 5).

Hosts

Myotis nattereri and *Myotis mystacinus* are regarded as the principal hosts on the whole area of distribution of the ssp. *simplex* Rothsch. Often also *M. daubentoni* has been reported as a host. Further records are on *Myotis myotis* (Belgium — L e r u t h, 1939, Holland — O u d e m a n s, 1915b, Germany — D a m p f, 1912, Czechoslovakia — H ů r k a, 1957) and *Plecotus auritus* (England — H o p k i n s, R o t h s c h i l d, 1956, Belgium — L e r u t h, 1939, Germany — D a m p f, 1912b, Saarland — H u s s o n, D a u m, 1957 and Switzerland — A e l l e n, 1960). Four times *Pipistrellus pipistrellus* (Holland — O u d e m a n s, 1915b, Germany — D a m p f, 1912b, Switzerland — J o r d a n, R o t h s c h i l d, 1920, A e l l e n, 1960) and *Barbastella barbastellus* (England — H o p k i n s, R o t h s c h i l d, 1956, Holand — O u d e m a n s, 1915b, H o p k i n s, R o t s c h i l d, 1956, Czechoslovakia — H o p k i n s, R o t h s c h i l d, 1956, Switzerland — A e l l e n, 1960) have been recorded. Two records have been given on *Rhinolophus hipposideros* (Germany — D a m p f, 1912b, England — G e o r g e, 1954) and *Rhinolophus ferrumequinum* (France Jura — H u s s o n, D a u m, 1957, England — G e o r g e, 1954). Single records have been given on *Myotis dasycneme* (Holland — O u d e m a n s, 1915b), *Myotis bechsteini* (Czechoslovakia — H ů r k a, C h a l u p s k ý, 1956), *Myotis emarginatus**) (France — H o p k i n s, R o t h s c h i l d, 1956), *Vespertilio murinus* (Belgium — H o p k i n s, R o t h s c h i l d, 1956) and *Eptesicus nilssoni* (Finland — N o r d b e r g, 1934).

Subspecies *mysticus* J o r d a n has been found most frequently on *Myotis mystacinus* (Norway — J o r d a n, 1942, Austria — J o r d a n, 1942, S m i t, 1955a, Holland — S m i t, 1954b, Czechoslovakia — R o s i c k ý, 1957, H ů r k a, 1958, 1959, Poland — S k u r a t o w i c z, letter communication, 1961). Further records are that of R o s i c k ý, 1957 from *Barbastella barbastellus* (4 ♂♂) and of H ů r k a, 1958 from Myotis *nattereri* (2 ♂♂) both from Czechoslovakia. According to Prof. Skuratowicz's letter communication (1961) the flea was found on *Pipistrellus pipistrellus* in Poland.

Author found *I. simplex* on 9 bat species in Czechoslovakia. The infestation of individual bat species is given in Table 4. Table 5 shows the distribution of the total revised material of males of both subspecies from Czechoslovakia according to the hosts (author's and Rosický's material).

Both tables suggest that in Czechoslovakia *Myotis nattereri* is the principal host of the spp. *simplex,* followed by *M. mystacinus* (*M. dasycneme* is a very rare species in the territory of Czechoslovakia).

The principal and most frequent host of ssp. *mysticus* is *Myotis mystacinus,* on which I found 87 p. c. of all males in my material. The finds on other bats (*Barbastella barbastellus, M. nattereri, M. bechsteini, E. nilssoni*) are a mere chance, as suggested by the averaging infestation on one host specimen. Probably they are caused by contact with the principal host, which is quite possible on all reported bats. However,

*) Author's find from this bat from Czechoslovakia (H ů r k a, 1957) has to be suppressed. The real host was *M. nattereri.*

Table No. 4 Review of the hosts of *Ischnopsyllus simplex* Rothschild according to author's material.

bat species	number of specim. examined	*Ischnopsyllus simplex*					
		number of bats with fleas (%)	males	females	total	average per one bat	maximum per one bat
Myotis nattereri	114	88 (77)	146	360	506	4.4	15
Myotis mystacinus	144	91 (63)	87	229	316	2.2	7
Myotis dasycneme	3	3 (100)	2	16	18	6.0	7
Myotis bechsteini	5	2 (40)	2	0	2	0.4	1
Myotis daubentoni	208	20 (10)	11	26	37	0.18	3
Barbastella barbastellus	250	5 (2)	0	14	14	0.05	5
Myotis myotis	1291	21 (2)	5	21	26	0.02	3
Eptesicus nilssoni	26	1	1	0	1	0.04	1
Plecotus auritus	417	2	0	2	2	0.005	1

Table No. 5 Review of the hosts of both subspecies and intermediate males of *Ischnopsyllus simplex* Rothschild (according to total material from Czechoslovakia).

bat species	*Ischnopsyllus simplex* Rothschild, males							
	Ischnopsyllus s. simplex		*Ischnopsyllus s. mysticus*		intermediate and monstr. specimens		total	
	number of specimens	%	number of specimens	%	number of specimens	%	number of specimens	%
Myotis nattereri	144	98.6	2	1.4	0	0	146	100
Myotis mystacinus	35	38.5	54	59.3	2	2.2	91	100
Myotis dasycneme	2	100	0	0	0	0	2	100
Myotis bechsteini	1	50	1	50	0	0	2	100
Myotis daubentoni	11	100	0	0	0	0	11	100
Myotis myotis	5	100	0	0	0	0	5	100
Barbastella barbastellus	0	0	4	100	0	0	4	100
Eptesicus nilssoni	0	0	1	100	0	0	1	100
total	198	75.6	62	23.7	2	0.7	262	100

it is noticable, that even in case of the common shelter shared by the colonies of *M. nattereri* and *M. mystacinus,* which was found partly in an about 20 m long barn of the forester's house in Býchory *(M. mystacinus* one corner of the roofing and *M. nattereri* in the other one), partly in the attics of the building at the fish-pond Potěšil, the occurence of fleas remains specific, as ssp. *mysticus* was never found on *M. nattereri* in either case.

From the comparison of principal hosts of the ssp. *simplex* within the whole area of its distribution ascertained by means of the data in literature, it appears, that the flea has been most frequently recorded from *M. mystacinus* in the northern and western part of Europe (Great Britain, Belgium, Holland, ?Denmark, Switzerland), from *M. nattereri* in the remaining parts of the area. It is probably due to the distribution of both bats: *M. mystacinus* is a more abundant and eurychoric species spreading to latitude 62—63°N., while *M. nattereri* gradually disappears towards the north.

According to the present knowledge it may be concluded: *M. mystacinus* is the principal host of *I. (I.) s. simplex* Rothschild in the northern and western part of the distribution area af the flea followed by the less abundantly occuring *M. nattereri.* On the contrary, *M. nattereri* is the principal host in the remaining parts of the area (with exception of mountain regions) followed by *M. mystacinus.* In all probability, this flea develops occasionally even in the colonies of *M. daubentoni* (Czechoslovakia, Horaždovice) and *M. dasycneme.* It was found only sporadically on other hosts, mainly during their migration and hibernation period, when the exchange of fleas among various hosts species can occur.

Among the secondary hosts, *Myotis myotis* is the most frequent (one of the commonest bats of Central Europe), further in a descending frequently *Plecotus auritus, B. barbastellus, P. pipistrellus, M. bechsteini, V. murinus, E. nilssoni.* The finds on *R. hipposideros, R. ferrumequinum* and *M. emarginatus* are a mere chance.

M. mystacinus is a principal host of ssp. *mysticus* Jordan. The other presently known bats, on which it is was found (*B. barbastellus, M. nattereri, M. bechsteini, E. nilssoni, P. pipistrellus*) are but secondary hosts.

Areas of distribution of both principal hosts of *I. simplex* Rothsch. are much larger than that of the flea.

Notes on bionomics

The fleas develop in the summer colonies of their principal hosts. Larvae being first described in this paper live in guano of the host bats. They go througt three larval instars. On 17. VI. 1958 I found all three larval instars in a thin layer of guano of *M. mystacinus* in the attics of the pavilion Tři grácie near Lednice in south Moravia. Individual generations of fleas are not temporarily restricted within one colony of bats. I did not succeed in determining the number of generations in a year.

The occurrence of females with eggs throughout the year is given in Table 6. Maximum of females with eggs corresponds also in this species

Table No. 6 Percentage of females of *I. simplex* Rothsch. with developed eggs, during the year (on the left: females with eggs; on the right: females without eggs).

I.	0%	100%	V.	75%	25%	IX.	60%	40%
II.	0%	100%	VI.	86%	16%	X.	2 specimens without eggs only	
III.	16%	84%	VII.	89%	11%	XI.	11%	89%
IV.	42%	58%	VIII.	68%	32%	XII.	0%	100%

to the period of the colony life of bat females. The low value in August is due partly to the freshly hatched fleas, partly it is perhaps influenced by the bionomy of the principal host, the colonies of which disperse much sooner than those of *Myotis myotis,* as the maturing of the young is completed earlier.

The sex ratio on the hosts is different in the period of active life of bats and during hibernation. In the summer period, the ratio is approximately 1: 2 in favour of females (210 ♂♂, 495 ♀♀) on the principal hosts; of course, this ratio changes during the summer period according to the local conditions (a development of a new generation etc.). During the period of migration and hibernation of bats, when the number of parasites cannot be completed, the sex ratio in this species changes due to the lower viability of males to an average 1:4 in favour of females (41 ♂♂, 164 ♀♀).

Average infestation. There was an average number of 6 fleas per specimen of *M. nattereri* in the nursing-colony (adult females with young — 63 specimens). Maximum number on 1 host specimen was 15 fleas. Most abundantly infested are the females before the birth of young. After the young are born, the average infestation gradually declines to half at the time, when the fleas walk fully on the young. In summer there was found an average number of 2 fleas on two adult males. Naturally, in the hibernation quarters the average infestation is decreased. There were 3 fleas on adult females and young (on the basis of 20 specimens), 1 flea on adult males (9 specimens examined).

The average infestation of *M. mystacinus* by *I simplex* is rather lower in our country. In the summer colonies, I found an average number of 4 fleas per bat (on the base of 70 specimens): ♀♀ ad. — 5.2; ♀♀ juv. — 3.3; ♂♂ juv. — 2.3. The higher infestation of adult females is due to their almost double average infestation before the birth (on 13. V. and 12. VI. 1957 the average infestation of pregnant females of *M. mystacinus* in the locality Velký Tisý was 9 fleas per specimen, on 16. VII. and 26. VIII. 1957 the infestation decreased to the average number of 4 fleas). On two adult males an average number of 3 fleas was found. In winter I found 1 flea only per specimen of adult females and young (out of 42

specimens): ♀♀ ad. — 2.6; ♀♀ juv. — 1.0; ♂♂ juv. — 0.6. The same value of the average infestation was found also in hibernating adult males (on the basis of 22 specimens).

As suggested by Table 4, an average infestation with this flea is 4.4 in *M. nattereri* and 2.2 in *M. mystacinus*. Such a high infestation is due to the manner of life of the hosts, inhabiting often various fissures, roofing connections, narrow spaces between the timberwork and wall, i. e. such an environment as where their guano accumulates at a small

Table No. 7 Associated parasitization of *I. simplex* Rothschild and other insect ectoparasites on one host specimen.

host species / ectoparasite species	*M. nattereri*	*M. daubentoni*	*M. mystacinus*	*M. dasycneme*	*M. myotis*	*M. bechsteini*	*B. barbastellus*	*P. auritus*	total	number of species infested
Ischnopsyllus hexactenus	8×	—	1×	—	5×	—	3×	1×	18×	5
Ischnopsyllus variabilis	—	—	2×	1×	—	—	—	—	3×	2
Ischnopsyllus intermedius	—	—	—	—	4×	—	—	—	4×	1
Nycteridopsylla pentactena	—	—	1×	—	—	—	—	—	1×	1
Nycteribia kolenati	—	18×	—	—	—	—	—	—	18×	1
Nycteribia latreillei	—	—	—	—	1×	—	—	—	1×	1
Nyctebiria vexata	—	—	—	—	1×	—	—	—	1×	1
Basilia nana	1×	—	—	—	—	2×	—	—	3×	2
I. hexactenus *I. intermedius*	—	—	—	—	1×	—	—	—	1×	1
I. hexactenus *N. vexata*	—	—	—	—	1×	—	—	—	1×	1
I. hexactenus *N. kolenati*	—	—	—	—	—	—	—	1×	1×	1

distance from the colony. Hatching fleas can easily attack their hosts and cause the high average infestation.

The associated parasitization of 1 host specimen by *I. simplex* and other insect ectoparasites confirmed by numerous common finds is given in Table 7. Most freuqent associated parasitization ocurring in adult males is due to the manner of life of males in the summer period. In the literature, the associated parasitization by this flea with another species is mentioned only by Smit (1954b), who had found *I. simplex* together with 1 ♂ of *I. variabilis* on one female of *M. mysta-*

cinus on 11. I. 1951 in the southern part of Limburg prov. in Holland, by Skuratowicz (1957) recording a find of *I. s. simplex* together with *I. hexactenus* and *N. pentactena* on several *M. nattereri* specimens on 19. I. 1955 in Poznian, Poland, and by Aellen (1960), recording a find of *I. s. simplex* together with *I. hexactenus* on *M. mystacinus* and on *B. barbastellus* — both cases being from the winter period. All eventualities mentioned above occur also in my material from Czechoslovakia.

Physiology

Sgonina (1934) investigated the influence of internal and external conditions on the food reception in *I. simplex* (9 specimens used in experiments). She investigated the dependence of engorging of the fleas on the temperature and on chemical irritation. At the temperature of 26° C one flea out of 9 experimented individuals engorged in one case, 7 in another. None engorged at 38.5° C on a drop of distilled water. *I. simplex* engorged neither man nor *Rana ridibunda.* Authoress summarised the experiments to show that the engorging was dependent not only on the temperature but also being caused sufficiently by the chemical irritation only.

Notes on systematics

Characters of the female of *simplex* Rothschild: indistinquishable from *I. hispanicus;* both subspecies indistinguishable, also. From all other females with eight combs differs by the following combinations of characters: preoral tuber bent at a highly obtuse angle, the lower part very short (remains a pistol stock); the first abdominal comb contains only half a many spines as the metathoracic comb; diameter of the dilated part of the duct of spermatheca almost equal to that of bursa copulatrix.

Characters of the male of *simplex* Rothschild: from all known species distinguishable by the shape of the movable process and by the presence of a curved bristle behind the anterior angle of the dorsal margin of the body of clasper.

Characters of larva: the antena 2.5—2.7 times as long as its central stiff hair; the second joint of maxillary palp 1.5 times as long as the first one; most frequently 9 sturt bristles.

Characters of male of *simplex simplex* Rotschild: the distal margin of sternum VIII strongly concave, the deviation reaches distinctly over the dorsal hookformed process; the anterior margin of the body of clasper strongly sclerotized, right-angled to acute-angled, on the tips rounded; the lower branch of sternum IX dorsally distinctly convex, often with a rounded hump in the middle; the apical sclerites of phallosoma lower and broader; the narrowest part of sternum VIII by one third to one fifth (most frequently one fourth) narrower than the distal margin with the hook.

Characters of male of *simplex mysticus* Jordan: the distal margin of sternum VIII almost straight or in the middle straightly trian-

gularly deviated, the deviation reaches at its highest point to the same level as the hookformed process; the anterior angle of the body of clasper less sclerotized, strongly obtuse-angled or rounded; the lower branch of sternum IX dorsaly straight or only slightly convex; the apical sclerites of phallosoma higher and narrower; the narowest part of sternum VIII by one fifth to one seventh (most frequently one sixth) narrower than the distal margin with a hook.

The number of pseudosetae under the collar of mesonotum is 1—4, most frequently 2 for both sexes, in simplex mysticus Jordan most frequently 1—2.

Subspecies *mysticus* has been regarded by its author J o r d a n (1942) as an evident subspecies of eastern Europe. As the presently known eastern limit of distribution of *I. simplex* goes through Poland and Czechoslovakia (T a t a r i n o v, 1956 examined 14 specimens of *Myotis mystacinus* in Transcarpathian Ukraine without any find of the flea; J u r k i n a (1959) does not record in her paper on fleas of Ukraine any *I. simplex*) more frequent occurrence of this eastern subspecies in the territories of the above states would be expected. According to the letter communication of Prof. S k u r a t o w i c z (1961), several specimens were discovered quite recently in the eastern part of Poland. Most localities have been reported from Czechoslovakia (20), partly due to the authors intesive collecting of bat fleas in this territory. He did not obtain any specimen of this subspecies until he was able to examine extensive material of *Myotis mystacinus* (H ů r k a, 1957). Map 6 suggests that no geographical division of both subspecies can be accepted in Czechoslovakia. Considering this fact it is noticable, that all the previously known finds of subspecies *mysticus* outside Czechoslovakia, not only in the west (Holland), but also in the east (Austria) and almost 90 p. c. from finds from Czechoslovakia are from *M. mystacinus.* In my opinion this fact may be explained as follows:

Due to the influence of glacial ages, the west and east European populations of bats were separated and isolated and so were their parasites. The glaciated mountains of Varician arch*) and of the Alps were the boundary. In the larger west European part of the area *I. simplex simplex* occurred (the isolation on the Pyrenean peninsula gave rise to *Ischnopsyllus hispanicus*), in the eastern part of the area *I. s. mysticus* developed. This last named form developed probably in the populations of *M. mystacinus* only. When this natural limit disappeared the bat populations living near this limit intermingled, causing the present state of distribution of both flea subspecies, *I. s. simplex* over the wide presently known area of the flea on both principal hosts *M. nattereri* and *M. mystacinus* and *I. s. mysticus* in the eastern part, mainly on *M. mystacinus* as the principal host.

I. s. mysticus is evidently a young subspecies. The above described forms of *I. s. simplex* are either crossbreads of both subspecies or developmental transitions between them. Form B was found once on all examined members in the summer colony of *M. nattereri* (Ovesné Kladruby), to which a certain genetic stability in developing and some dif-

*) namely that of Krkonoše, Krušné hory and Šumava.

ference of this form may be ascribed. In the colonies of *M. mystacinus*, there may be found several forms on one host specimen. In the nursing-colony of this species at the fish-pond Velký Tisý in southern Bohemia, all forms recorded in this paper were found during one summer, including ssp. *simplex* f. typ. and of course ssp. *mysticus*. Table No. 8 shows an abundant occurrence of individual forms and of both subspecies as well as of abnormal males on the principal hosts (different forms of ssp. *simplex* and abnormal males were not found on other hosts).

Table No. 8 Review of the hosts of individual *I. simplex* Rothschild forms (according to author's material).

bat species	*I. simplex simplex*					*I. simplex mysticus*	intermed. specimens	monstrous specimens	total
	typical form	form B	form C	form D	total				
Myotis nattereri	118	24	1	1	144	2	0	0	146
Myotis mystacinus	17	2	13	3	35	54	1	1	91

The fact, that the majority of described forms of *I. s. simplex* (beside the exceptional form B) as well as both abnormal males (and also the Jordan's intermediate specimen) were found on *M. mystacinus* suggests the decisive importance of this bat species for the origin of the subspecies *mysticus*.

All these facts seem to prove that origin of *I. s. mysticus* vas due to the species infestation of geographically isolated populations of *Myotis mystacinus* and that it possesses an expressly ecological character.

In my opinion, the separation of both subspecies into two different species would not be correct at present.

b) **elongatus**-group

The combs of metathorax and tergum I of abdomen consisting of about equal number of spines. In front of the ocular bristle there are most frequently 3 setae in males (2 only in 10 p. c. of males), in females 3 setae at least in 15 p. c.; under the collar of mesonotum there are one to five to six pseudosetae; body length 2.2 to 3.5 mm.

The group consisting of *I. elongatus* (Curtis), *intermedius* (Rothschild) and evidently also *plumatus* Ioff.

Ischnopsyllus (Ischnopsyllus) elongatus (Curtis), 1832

Ceratophyllus elongatus. Curtis, 1832, Brit. Entomol. **9**: 417, tab. 417 (female); *Pulex elongata*. Gervais, 1844, Hist. Nat. Ins. Abt. **3**: 372; *Ceratopsylla subobscura*. Wagner, 1898, Hor. Soc. ent. ross. **31**: 586, tab. 9, fig. 15 (male); *Ceratopsylla elongatus* Curtis. Rothschild, 1898, Novit. Zool. 5: 534, fig. 1, 542, tab. 16, fig. 6, 8 (male), fig. 10 (female); *Ceratopsylla elongatus* Curtis. Kohaut, 1903, Allat, Közlem. **2**: 60, tab. 7, fig. 1 (male); *Ischnopsyllus elongatus* Curtis. Oudemans, 1909, Zool. Anz.

34: 731, fig. 4 (female), 733; *Ischnopsyllus elongatus* (Curtis). Dampf, 1912a, Rev. Russ. Ent. **12**: 48, fig. 3 (male genital organ, key); *Ischnopsyllus elongatus* (Curtis). Dampf, 1912b, Ber. bot. zool. Ver. Reinland-Westfalen, **1911**: 79—113, tab. 1, fig. 1, tab. 2, fig. 7, tab. 4, fig. 16a, 18 (female morphology, key, synonymy); *Ischnopsyllus elongatus* Curtis. Rothschild, 1915, Ent. mon. Mag. **51**: 85, 107, tab. 14, fig. 83 (male), fig. 84 (female) (key, morphology, synonymy); *Ischnopsyllus elongatus* Curt. Wagner, 1936, Tierwelt Mitteleuropas B. **6**, Lief. 2, Teil. 3: 18, fig. 66 (male), fig. 67 (female) (key); *Ischnopsyllus elongatus* (Curtis). Jancke, 1938, Tierwelt Deutschlands **35**: 34, fig. 42a (male) 42b (female) (key, morphology); *Ischnopsyllus elongatus* Curt. Chidini, 1939, Bol. Soc. ent. ital. **71**: 131—134, fig. 1—5 (description of egg and larval instar I); *Ischnopsyllus elongatus* (Curtis). Smit, 1954a, Danmarks Fauna **60**: 72, fig. 98 (male), 99, 100 (female) (key); *I. elongatus*. Ioff, Skalon, 1954, Opred. bloch vost. Sibiri, daln. vostoka i prileg. rajonov: 124, fig. 339 A (male), 339 B (female) (key, distribution in U.S.S.R.); *I. elongatus*. Ioff, Tiflov, 1954. Opred. Afaniptera Jugo-vostoka SSSR: 97, fig. 153 (male), 242 (female) (key, distribution in southeast of RSSR); *Ischnopsyllus (Ischnopsyllus) elongatus* (Curtis). Hopkins, Rothschild, 1956, Cat. Rothsch. Coll. Fleas **2**: 260, 261, 264—266, fig. 457 (male), fig. 458 (female) (morphology, key, synonymy); *Ischnopsyllus elongatus* Curt. Ioff, Bondar, 1956, Tr. nauchn. issl. protivochumn. int. Kavkaza i Zakavkazja **1**: 110 (distribution in Central Asia); *Ischnopsyllus elongatus* Curtis. Hůrka, 1957, Českoslov. parasitol. **4**: 146 (distribution, hosts); *Ischnopsyllus (Ischnopsyllus) elongatus* (Curtis). Rosický, 1957, Fauna ČSR **10**: 294, 295, 303—304, fig. 97 A, F, 99 I (male), 98 A, I (female) (key, morphology, synonymy); *Ischnopsyllus (Ischnopsyllus) elongatus* (Curtis). Smit, 1957, Hand. Ident. Brit. Ins. **1** (16): 47, fig. 103 (male), fig. 93, 105 (female) (key, distribution).

Male

(data based on 12 specimens, 4 from Czechoslovakia, 8 from Albania) Length average 2.9 mm (2.5—3.1). Wagner, 1898 in his original description of *subobscura:* above 3 mm; Kohaut, 1903: 3 mm Smit, 1954a: 2.7—3.5 mm.

Preoral tuber bent at an almost right angle. The row of setae on the anterior margin of frons consisting of 17—23 (Wagner, 1898: 24) setae. Below the antennal fossa 1 long bristle, in front of which 3, only exceptionally 2 shorter setae. Below them an irregulary scattered group of 15—23 setae. Occipital part of head possessing 4 (10×)—5 (2×) bristles in one row (the angle-bristle at a distance from the former 3—4), 1—2 setae above them. An irregular, towards the end double row of 8—14 setae above the antennal fossa. The posterior margin of the occipital part of head possessing 11—15 long setae.

Protonal comb with 35—39 spines (Wagner, 1898: 40, Rothschild, 1898: 38, 42, 44, Kohaut, 1903*). 2—5 (2—5×, 3—10×, 4—5×, 5—4×) pseudosetae under the collar of mesonotum (Smit, 1954c: without a note on sex 1—6, most frequently 3). Comb of metanotum with 27—34 spines (W.: 32, R.: 34, 35, 38). Metepimeron with 5—7 (5—30 p. c., 6—58 p. c., 7—12 p. c.) lateral and 2 (8 p. c.) — 3 (92 p. c.) distal bristles. I found the following combinations: 6+3 (13×), 5+3 (6×), 7+3 (3×), 6+2, 5+2 (1×).

The counts of the number of spines in abdominal ctenidia are as follows:

I.	32—38 (W.: 36, R.: 35, 36, 40)	IV.	28—42 (W.: 42, R.: 35, 38, 40)
II.	39—49 (W.: 46, R.: 44, 49, 50)	V.	23—34 (W.: 32, R.: 30, 31, 33)
III.	36—47 (W.: 46, R.: 41, 44, 46)	VI.	22—32 (W.: 26, R.: 25, 27, 30)

*) data taken over from Rothschild (1898).

The body of clasper with a very broad manubrium. The fixed process separated from the body by a relatively deep incision. Proximal part of the fixed process possessing dorsally 3 setae of which the last one is the largest. Two acetabular bristles, the upper of which is broader on the base and narrowing apically, placed distinctly above the middle of the distal margin of the process. The movable process approximately in the shape of an isosceles triangle, the dorstal part of distal margin slightly concave. Dorsal margin possessing 1 forward tending seta at the anterior angle and 2 shorter setae. Apical angle not hookformly bent down. Below the dorsal margin on the inner surface of movable process 1 longer seta in the distal part.

Sensilium of a characteristic shape. Its ventral part extended distally in a process, which is more than twice as long as broad.. Seta of sensilium placed at the upper not extended part (X *variabilis*).

Sternum VIII with a large rectangular proximal part. The distal part broadened apically into form of fist, possessing at the upper angle a short but distinctly curved process. Below it the distal margin twice moderately incised; along the ventral cutting 8 long setae, the most upper and the last one near the margin, the other more or less on the surface of sternum. The ventral seta broad, thickened, the second, third and fourth one thin at the base and approximately in the middle immediately broadened and curved. The ventral margin of sternum with 3—4 medially long setae, in front of a group of 8 setae another shorter one.

Female

(data based on 25 specimens, 15 from Czechoslovakia, 10 from Albania)

Length average 3 mm (2.65—3.45). Kohaut, 1903: 3 mm; Smit, 1954a: 2.7—3.5 mm.

Preoral tuber bent at a right angle or slightly acute angle. The row of setae on the anterior margin of frons consisting of 17—25, most frequently 20—23 setae (Dampf, 1912b: 19—29, most frequently 20—21). Below the antennal fossa one long bristle, in front of which 3 shorter setae in 67 p. c., 2 in 33 p. c. of specimens examined (Dampf, 1912b, fig. 1: 3). Below and in front of them an irregular group of 8—14, most frequently 10—13 setae (D., fig. 1: 11). Occipital part of head possessing in all specimens examined 4 bristles (D., fig. 1: 3) in a row, above them 1 in 76 p. c., 2 small setae in 20 p. c. none in 1 specimen. An irregular row of 6—12, most frequently 9—10 small setae above the antennal fossa (D., fig. 1: 12). The posterior margin of the occipital part of head possessing 11—14, most frequently 12—13 long setae.

Comb of pronotum with 32—40, most frequently 36—38 spines (Rotschild, 1898: 36, 37, 38, Dampf, 1912b: 36—40). There are 2—5 pseudosetae under the collar of mesonotum (2—7×, 3—20×, 4—17×, 5—5×). Their number is very rarely equal on each of the body side. Comb of metanotum with 26—34, most frequently 27—31 spines (R.: 33, 29, 26, D.: 28—32). Metepimeron with 4—7, most frequently 5—6 lateral and 3 (94 p. c.) or 4 (6 p. c.) distal bristles. Individual com-

binations: 5+3 (44 p. c.), 6+3 (27 p. c.), 4+3 (17 p. c.), 7+3 (6 p. c.), 5+4 (4 p. c.), 6+4 (2 p. c).

The counts of spines in the combs of abdominal terga are as follows:

I. 26—35 most frequently 26—31 (R.: 37, 32, 25, D.: 28—33)
II. 29—41 most frequently 37—39 (R.: 46, 37, 36, D.: 35—41)
III. 29—39 most frequently 33—36 (R.: 45, 36, 30, D.: 32—37)
IV. 21—30 most frequently 25—30 (R.: 34, 30, 25, D.: 25—32)
V. 13—23 most frequently 16—20 (R.: 26, 22, 17, D.: 16—22)
VI. 11—18 most frequently 13—17 (R.: 20, 16, 11, D.: 13—16)

Sternum VII extended into a large lobe in its ventral part, the distal margin of which is moderately double concave. On the surface of the lobe on each side of sternum an irregularly distributed group of 16—26, most frequently 21—23 setae (R.: about 20, D.: 15—29). Anal stylet remarkably narrow and long, more than 4 times longer than wide on the base. Anal stylet of most specimens possessing an accessory seta at $^3/_4$ of its length, as also illustrated by Ioff and Skalon, (1954, fig. 339 B). On the contrary, Dampf, (1912b, fig. 16a) sketched the insertion of this seta at $^3/_5$ of length and Hopkins, Rothschild, (1956: 265), noted in the description of the female, that the insertion of this seta extends a little behind one half of stylet length (eastern and western populations?). Diameter of dilated portion of duct of spermatheca 2.5 times longer than that of bursa copulatrix. Hilla of spermatheca distinctly longer than its bulga.

Larva

Chidini (1939) discribed the egg and larva of instar I. The critical characters given by the original description are as follows:

The white ellipsoid eggs measuring about 0.70 by 0.33 mm.

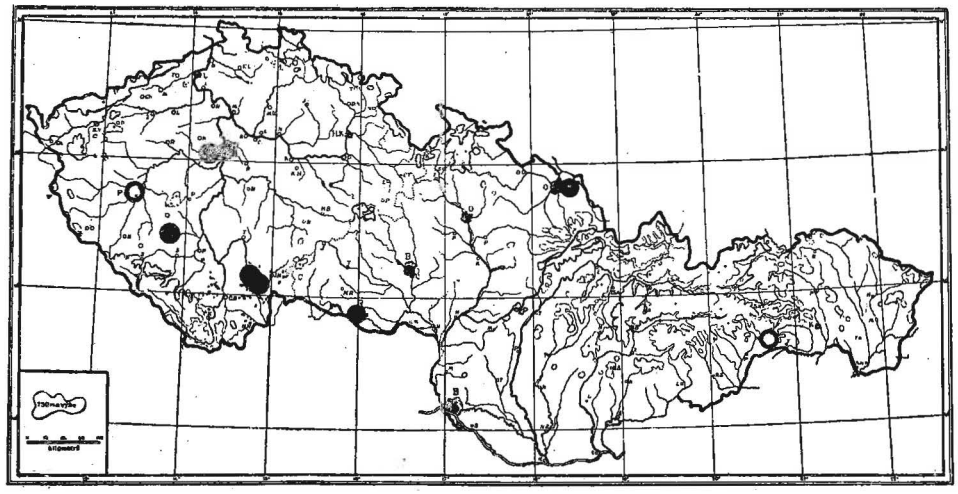
Larva white, 1.3 mm long and 0.15 mm wide. Antenna almost parallel, slightly narrower forward; the second joint of maxillary palp long, 3 times longer than the basal one. All thoracic segments with equal chaetotaxy: $2M_1$, $2M_2$, $4M_3$. Chaetotaxy of abdominal segments: I—VI: $2M_1$, $2M_2$, $4M_3$; VII—VIII: $4M_1$, $2M_2$, $6M_3$; IX: $2M_1$, $2M_2$, $4M_3$; X: $8m_1$, $2m_3$. When compared with more completely described larvae this diagnosis remains unfortunately insufficient.

Distribution (see Map 7, 8)

European and Asiatic species, found at present in Great Britain (England), France, Holland, Denmark, Germany, Switzerland, Italy, Albania (Shkodra, Tirana), Austria, Czechoslovakia, Poland, Hungary, Yugoslavia, Roumania, Bulgaria, U.S.S.R.: European part—many localities e. g.: Latvia, Bielorussia (Bielovezh primeval forest), Ukraine (Zakarpatskaja, Kievskaja, Nikolajevskaja, Poltavskaja, Dnepropetrovskaja, Charkovskaja oblast), Russia (Moskovskaja oblast, Priuralie, Voroniezhskaja, Saratovskaja (Volsk), Volgogradskaja (= Stalingradskaja), Rostovskaja oblast, Stavropolskij kraj, Caucasus); Azerbajdzhan; Kazachstan (Alma-

Ata, Dzharkent, Chilikskij rajon, Dzhambul env.); Kirghizija (Issyk-Kulskaja oblast: Przewalsk, Pokrovka); Uzbekistan (Tashkent); Japan (Hokkaido) and probably also China (Kwantun-peninsula) — one female probably of this species — I o f f, S k a l o n (1954: 124).

Map 7 Area of distribution of the flea *Ischnopsyllus elongatus* (Curt.)



Map 8 Distribution of the flea *Ischnopsyllus elongatus* (C u r t.) in Czechoslovakia; ◍ — author's find, ○ — literary data.

In Czechoslovakia it was found on *Nyctalus noctula* in Slovakia in Lipovník (Rožňava district) and in Plzeň—Bolevec also in *N. noctula* — L. Hůrka, (1962).

My material is from 4 localities from Bohemia and 2 from Moravia, all from *N. noctula.*

Bohemia: Břve (d. Praha-west), 2. V. 1959 — ♂, ♀; Blatná (Strakonice d.), 5. VI. 1956 — 2 ♀♀; Stará Hlína (Jindř. Hradec d.), 27. X. 1958 — ♀; fish-pond Potěšil (Jindř. Hradec d.), 24. V. 1959 — 3 ♀♀.
Moravia: Býčí skála near Znojmo, 4. VIII. 1959 — 3 ♂♂, 8 ♀♀; Ostrava—Karviná, 27. V. 1955 — 2 ♀♀ (coll. Jurik).

Total material of 21 specimens (4 ♂♂, 17 ♀♀) from *Nyctalus noctula* from 5 localities in Czechoslovakia and 38 specimens (9 ♂♂, 29 ♀♀) from the same host from 2 localities in Albania.

Hosts

In the whole area of distribution on this species occurs most frequently on *Nyctalus noctula,* which is its principal host. It was often found even on *Eptesicus serotinus* (Germany — Dampf, 1912; Holland — Oudemans, 1915b; Denmark — Smit, 1954a; Great Britain — Thompson, 1938, Hopkins, Rothschild, 1956, Smit, 1957a) and on *Vespertilio murinus* (Denmark — Smit, 1953a, 1954b; Germany — Hopkins, Rothschild, 1956; U.S.S.R. — Voroniezh — Hopkins, Rothschild, 1956, Bielorussia — Ioff, 1956). It was recorded several times from Ukraine from *Pipistrellus pipistrellus* (Jurkina, 1952, 1959, Tatarinov, 1956).*) Two records are given on *Myotis myotis* (Poland, Wrocław — Dampf, 1912b; Holland — Oudemans, 1915b) single record on *Pipistrellus nathusii* (Latvia — Eglitis, 1957), *Myotis daubentoni* (Latvia — Eglitis, 1957), *Myotis* sp. (Austria — Smit, 1955a) and *Barbastella barbastellus* (Great Britain — Thompson, 1938).

Ischnopsyllus elongatus (Curtis) is a parasite of three-dwelling bats. No wonder, therefore, that beside its principal host *N. noctula* it attacks even those which are mainly tree-dwelling *(P. pipistrellus, P. nathusii, M. daubentoni)* or live occasionally in trees and wood *(V. murinus, E. serotinus, B. barbastellus).*

The distribution of the principal host *N. noctula* corresponds well to the known distribution of *I. elongatus.*

Notes on bionomics

The egg and larva of instar I were described by Chidini (1939). At 25—30° C the larval hatching occurs in 2—3 days.

Eggs were found in the abdominal cavity of a female on 2. V. 1959 (Břve), of all 3 females on 24. V. 1959 (Potěšil), of one of two females on 5. VI. 1956 (Blatná) and of all 8 females from Znojmo on 4. VIII. 1959. A female found on 27. X. 1958 (Stará Hlína) possessed no eggs. On the

*) Jurkina (1959) states that this bat was a more frequent host of *I. elongatus* in Ukraine than *Nyctalus noctula.*

contrary, 35 p. c. females of 19. X. 1960 from northern Albania (Shkodra) and 55 p. c. females of the same data from central Albania (Tirana) possessed developed eggs; 10. p. c. of flea specimens found on 19. X. were immature. Jurkina, 1959 found the developed eggs most frequently in spring. In all probability, the reproduction of *I. elongatus* occurs from spring to autumn according to the long seasonal activity of the host bat *Nyctalus noctula.*

The sex ratio indicates that also in this species the females predominate on the host. This has been shown already by the material of Rothschild's collection (40 ♂♂, 65 ♀♀) and is confirmed in my material. From the material of Rothschild's collection, which is amply dated it may be concluded, that the sex ratio of this species, also, changes during the winter period more in favour of females.

Only Ioff (1956) mentioned the medium infestation. He found in average 1 flea on 2 specimens of *N. noctula* in July. Unfortunately there are no more mentions in literature, though it is evident, that the dates from the eastern and western part of area of this flea would differ, as for example in Great Britain this flea proves to be a common parasite of *Nyctalus noctula* (Rotschild, 1915, Smit, 1957a), but yet less frequent on *N. noctula* than on *P. pipistrellus* in Ukraine (Jurkina, 1959). Also in Czechoslovakia it appears not to be the most common flea on *N. noctula* as only 19 specimens of this flea were found on 111 carefully examined bat specimens from 10 localities, which represents an average infestation of 0.17. No specimen was found for example in a colony of 20 young in August and only 3 fleas were found in a colony of 36 adult pregnant females at the end of May. A higher average infestation — 1, was found only on 11 specimens of female colony from south Moravia. As this flea had not been recovered on any further bat species in Czechoslovakia *I. elongatus* seems to be a sporadical flea (at least in Bohemia) even on its principal host noctule. On the contrary 9 individuals of *N. noctula* from Shkodra in Albania showed an average of 1.8 and 13 individuals of Tirana 1.6 specimens of *I. elongatus.*

The associated parasitization of 1 host specimen with an additional flea species is mentioned by Aellen (1960) from Switzerland (Uster, 3. XII. 1958). He found *I. elongatus* on *N. noctula* together with *N. eusarca.* A similar associated infestation has been recorded by L. Hůrka (1962) from Plzeň. I did not succeed in finding *I. elongatus* with any another flea species as I examined the individuals of *N. noctula* only in the summer period.

Notes on systematics

I. (I.) elongatus (Curtis) is the type species of the genus *Ischnopsyllus* Westwood.

Characters of male: the shape of sensilium with posteriorly elongated lower part; the movable process in shape of an isosceles triangle; very broad manubrium.

Characters of female: anal stylet more than four times longer than wide at the base; the diameter of dilated part of duct of

spermatheca 2.5 times broader than that of bursa copulatrix; an irregular group of 16—26 setae on sternum VII.

Under the collar of mesonotum there are 1—6 (Smit, 1954c), (in my material 2—5) pseudosetae in both sexes.

Characters of larva: antenna two times longer than its central stiff hair; second joint of maxillary palp 3 times longer than the basal one.

Ischnopsyllus (Ischnopsyllus) intermedius (Rothschild), 1898

Ceratopsylla variabilis. Wagner, 1898 (partim), Hor. Soc. ent. ross. **31**: 582 (female from Saratov); *Ceratopsylla intermedius.* Rothschild, 1898, Novit. Zool. **5**: 543, tab. 17, fig. 15 (male); *Ceratopsylla Wagneri.* Kohaut, 1903, Állat. Közlem. **2**: 60, 62, tab. 7, fig. 3, 8, 9, 10 (male); *Ischnopsyllus schmitzi.* Oudemans, 1909a, Tijdschr. Ent. **52**: 96, tab. 9, fig. 1—3 (female only, male = *simplex* Rothschild); *Ischnopsyllus schmitzi* Oudemans. (partim) Oudemans, 1909c, Ent. Ber. Amst. **2**: 333 (female *schmitzi* Oudemans = *intermedius* Rothschild); *Ischnopsyllus intermedius* Rothsch. Rothschild, 1910, *Ent.* mon. Mag. 46: 253 (*Wagneri* Kohaut = *intermedius* Rothsch.); *Ischnopsyllus intermedius* (Rothschild). Dampf, 1912a, Rusk. Ent. obozr. **12**: 50—52, fig. 4 (male) (morphology of male genital organ, key); *Ischnopsyllus intermedius* (Rotbsch.). Dampf, 1912b. Ber. bot. zool. Ver. Rheinland-Westfalen, **1911**: 79—113, tab. 1, fig. 2, tab. 2, fig. 8, 9, Tab. 4, fig. 17a, b, 19, 20, tab. 5, fig. 30 (female morphology synonymy, key); *Ischnopsyllus intermedius* Roths. Rothschild, 1915, Ent. mon. Mag. **51**: 85, 108, tab. 14, fig. 85 (male), 8 (female) (key, morphology, synonymy); *Ischnopsyllus intermedius* Roths. Wagner, 1936, Tierwelt Mitteleuropas, B. **6**, Lief. 2, Teil 3: 18 (key); *Ischnopsyllus intermedius* (Rothschild). Jancke, 1938, Tierwelt Deutschlands **35**: 35, fig. 44a (male), 44b (female) (key, morphology); *Ischnopsyllus intermedius* (Rothschild). Smit, 1954a, Danmarks Fauna **60**: 71, fig. 93 (male), 94 (female) (key); *I. intermedius.* Ioff, Skalon, 1954, Opred. bloch vost Sibiri, daln. vost. i pril. stran: 124 (key, distribution in U.S.S.R., differentiation from *plumatus* Ioff); *I. intermedius.* Ioff, Tiflov, 1954. Opred. Afaniptera Jugo-vostoka SSSR: 98, fig. 154 (male) (key, distribution in southeastern part of R.S.S.R.); *Ischnopsyllus (Ischnopsyllus) intermedius* (Rothschild). Hopkins, Rothschild, 1956, Cat. Rothsch. Coll. Fleas **2**: 260, 261, 281—284, fig. 427, 446, 447, 450, 478, 479 (male), 477 (female) (morphology, key, synonymy); *Ischnopsyllus intermedius* (Roths.). Hůrka, 1956, Věst. Čs. spol. zool. **20**: 372—374, fig. 1 a—c (description of larva III); *Ischnopsyllus (Ischnopsyllus) intermedius* (Rothschild). Smit, 1957a. Hand. Ident. Brit. Ins. **1** (16): 45, 48, fig. 100 (male), 104 (female) (key, distribution); *Ischnopsyllus intermedius* Rothschild. Hůrka, 1957, Československ. parasitol. **4**: 146, 163 (distribution, hosts, bionomics); *Ischnopsyllus (Ischnopsyllus) intermedius* (Rothschild). Rosický, 1957, Fauna ČSR **10**: 293, 295, 300—302, fig. 96, 97C, 99A (male), 98B, H (female), enclosure III, 3 (female) (key, morphology, synonymy); *Ischnopsyllus intermedius* Roths. Jurkina, 1959, Praci Inst. Zool. AN Ukr. S.S.R. **15**: 88, fig. 23A (male), 23B (female) (morphology, key, distribution in Ukraine).

Male

(data based on 50 specimens, 49 from Czechoslovakia, 1 from Yugoslavia)

Length average 2.5 mm (2.2—2.85) Smit, 1954a: 2.5—3 mm; Jurkina, 1959: 2.5—2.75 mm.

Preoral tuber bent usually at a right angle, less frequently (about 15 p. c.) at a slightly obtuse or acute angle. The row of setae on the anterior margin of frons consisting of 18—27, most frequently 19—23 setae. Below the antennal fossa 1 long bristle, in front of which there are most frequently 3 (in 82 p. c.), rarely 4 (10 p. c.) or 2 (8 p. c.) shorter

setae. Below them an irregularly placed group of 7—15, most frequently 9—11 short setae. Occipital part of head possessing 4 bristles in one row (in 50 p. c. specimens examined the last bristle further from the thin, than the other 3 from each other), above them 1 (80 p. c.) or 2 (20 p. c) shorter setae. An irregular row of 5—9, most frequently 7—8 short setae extending above the antennal fossa. The posterior margin of the occipital part of head with 9—12, most frequently 11—12 long setae.

Comb of pronotum with 27—34 most frequently 28—32 spines. There are 1—5, most frequently 2—3 pseudosetae under the collar of mesonotum. Comb of metanotum with 21—30, most frequently 24—27 spines. Meso- and metanotum with a thin "mane" of dorsal marginal setae. Metepimeron with 1—6, most frequently 4—3 lateral and 2—5, most frequently 3 distal bristles. Percentage of individual combinations is as follows: 4+3 (50 p. c.), 3+3 (19 p. c.), 3+2 (7 p. c.), 5+3 (6 p. c.), 4+2 (5 p. c.), 2+4, 4+4, 5+2, 5+4, 5+5, 6+3, 6+4, 1+3 (1 p. c).

The numbers of spines in abdominal combs are as follows:

I. 18—28 most frequently 22—27
II. 24—33 most frequently 27—31 (K o h a u t, 1903: 28)
III. 18—29 most frequently 23—26 (K.: 24)
IV. 18—28 most frequently 22—25 (K.: 20)
V. 15—23 most frequently 19—21 (K.: 16)
VI. 11—22 most frequently 15—20 (K.: 16)

The body of clasper with almost stright manubrium 2.5—3 times longer than wide (D a m p f, 1912a: 2.5×). Distinctly formed fixed process in form of rhombus with rounded angles. The upper quite rounded angle showing 3 short setae. Two moderately curved acetabular bristles, the upper one being twice as wide as the lower one, both placed below the distal rounded angle of the fixed process. The movable process axe-shaped, with distinct almost rectangular distal angle, slightly convex upper margin and well developed anterior angle of about 60°. One larger forward-tending seta at the anterior angle, 2 larger setae submarginally below the dorstal margin and 1 longer seta in the dorsal part of the posterior margin. 2 setae at the anterior margin and 5 setae on the inner side.

Sensilium without seta.

Sternum VIII very well developed, least reduced of all members of the genus. The proximal part almost square with the anterior ventral and posterior dorsal angles rounded. The distal and proximal parts connected dorsally by a fine membrane, broad with a straight dorsal margin. The dorsal posterior angle possessing 2 forward tending hookformed processes. The proximal part of sternum dorsally membraneus, possessing a group of 15—30 fine setae below the distal angle. The distal margin of sternum below the middle moderately curved inside. The ventral angle rounded, with distinctly convex ventral margin. At the ventral angle on the surface of sternum a group of 6 longer setae, 2 upper ones converging. The lower seta is evidently the strongest. Below this group of setae and partly among them 5—12 fine, transparent setae. Anteriorly

on the surface of sternum a row of 1—6, most frequently 3—5 setae (D a m p f, 1912a: 3—6) following the group of 6 longer setae. A row of 5—7 (5—70 p. c., 6—28 p. c., 7—2 p. c.) curved setae (D a m p f, 1912a: 5—7) on the ventral margin of the proximal part of sternum VIII.

Sternum IX with a reduced ventral part.

F e m a l e

(data based on 50 specimens from Czechoslovakia)

Length average 2.8 mm (2.25—3.1), S m i t, 1954a: 2.5—3 mm; J u r k i n a, 1959: 2.25—3.25 mm.

Preoral tuber bent most frequently at a right angle, very rarely at a shlightly obtuse or acute one. Anterior margin of frons with a row of 16—26, most frequently 18—21 setae (D a m p f, 1912b: 17—28, most frequently 20—21). Below the antennal fossa one long bristle, in front of which 2 in 85 p. c., 3 shorter setae in 15 p. c. of specimen examined. Below and in front of them an irregular group of 3—8, most frequently 5—6 short setae (D., fig. 2:6). Occipital part of head possessing 4 long bristles in a row (in 50 p. c. of specimens the distance between the last bristle and the third one is larger than the reciprocal distance of the 3 anterior bristles). One short seta in 80 p. c., two in 20 p. c., above the named row. An irregular row of 4—9, most frequently 6—7 short setae above the antennal fossa (D., fig. 2:6). The distal margin of the occipital part of head possessing 9—13, most frequently 11—12 longer setae.

Comb of pronotum with 28—34, most frequently 29—32 spines (K o h a u t, 1903: 28, D a m p f, 1912b: 29—35). There are 1—5, most frequently 2—3 pseudosetae under the collar of mesonotum, often a different number on each body side. Comb of metanotum with 20—29, most frequently 22—26 spines (K.: 22—26, D.: 20—28). Metepimeron with 2—5, most frequently 3—4 lateral and 2—4, most frequently 3 distal bristles. Percentage of individual combinations is as follows: 3+3 (38 p. c.), 4+3 (23 p. c.), 2+3 (13 p. c.), 4+4 (9 p. c.), 3+4 (7 p. c.), 2+4 (4 p. c.), 3+2 (3 p. c.), 2+2 (2 p. c.), 5+3 (1 p. c.). Very often different combination on each body side.

The number of spines in abdomidal ctenidia are as follows:

I. 18—28 most frequently 20—25 (K.: 18—22, D.: 19—27)
II. 21—32 most frequently 23—28 (K.: 22—24, D.: 23—35)
III. 17—28 most frequently 20—23 (K.: 18—22, D.: 21—28)
IV. 15—24 most frequently 16—20 (K.: 16—18, D.: 15—15*)
V. 12—22 most frequently 12—17 (K.: 10—14, D.: 10—22)
VI. 8—18 most frequently 11—14 (K.: 9—11, D.: 11—18)

Sternum VII with distinctly formed ventral lobe, the distal margin of which is moderately convex in its dorsal part, most frequently slightly concave or straight ventrally. The surface of sternum possessing an irregular row of 11—20, most frequently 13—17 setae (D.: 5—11 on one side, S m i t, 1954a, fig. 94:7). Anal stylet of a normal length (about 3

*) evidently a misprint on page 90; in spite of it, all authors took over this date e.g.: J a n c k e (1938), R o s i c k ý (1957), H o p k i n s, R o t h s c h i l d (1956).

times longer than wide at the basis). The base of stylet possessing 1 stronger and 1 thinner seta in 55 p. c. of females examined. The diameter of dilated portion of duct of spermatheca twice as large as that of bursa copulatrix. Hilla of spermatheca longer than bulga, which is roundish or moderately oval.

Larva

The individual larval instars differ in length, but there are neither morphological nor chaetotaxic differences between individual instars. It may be presumed, that larvae of instar I which was not available to me, possess a frontal egg-breaker as do all known larvae of genus *Ischnopsyllus*.

Head — 3 long and 3 short setae in the posterior row on each side of head, 5 long and 1 short seta in the anterior row. 3 setae above the mandible, 2 setae at each antenna and 3 setae in the surrounding of labial palp on each side. The antennal length (without the central stiff hair) to its greatest width ratio as 4:1; the hair length to the antennal length as 1:3. The second joint of maxillary palpe twice as long as the basal one.

Thorax and abdomen—chaetotaxy (numbers of very fine setae, hardly visible even by enlargement 200× not recorded): thoracic segment I: $4M_1$ $4m_1$, $2M_2$ $2m_2$, $2M_3$ $6m_3$: th. segment II and III: $4M_1$ $4m_1$, $2M_2$ $2m_2$, $4M_3$ $4m_3$: abdominal segment I—VIII: $4M_1$ $4m_1$, $2M_2$ $2m_2$, $6M_3$ $6m_3$; abd. segment IX: $6M_1$ $2m_1$, $2M_2$ $2m_2$, $4M_3$ $4m_3$: abd. segment X: anal comb in two rows, the upper one possessing 3—4 (most frequently 4), the lower one 7—8 (most frequently 8) setae; 10—13 anal sturts, most frequently 11 (4—7, most frequently 5 short and 5—6, most frequently 6 longer). The length of larval instar II 2.3—3 mm (based on 4 specimens). The length of larval instar III 4—4.5 mm (based on 8 specimens).

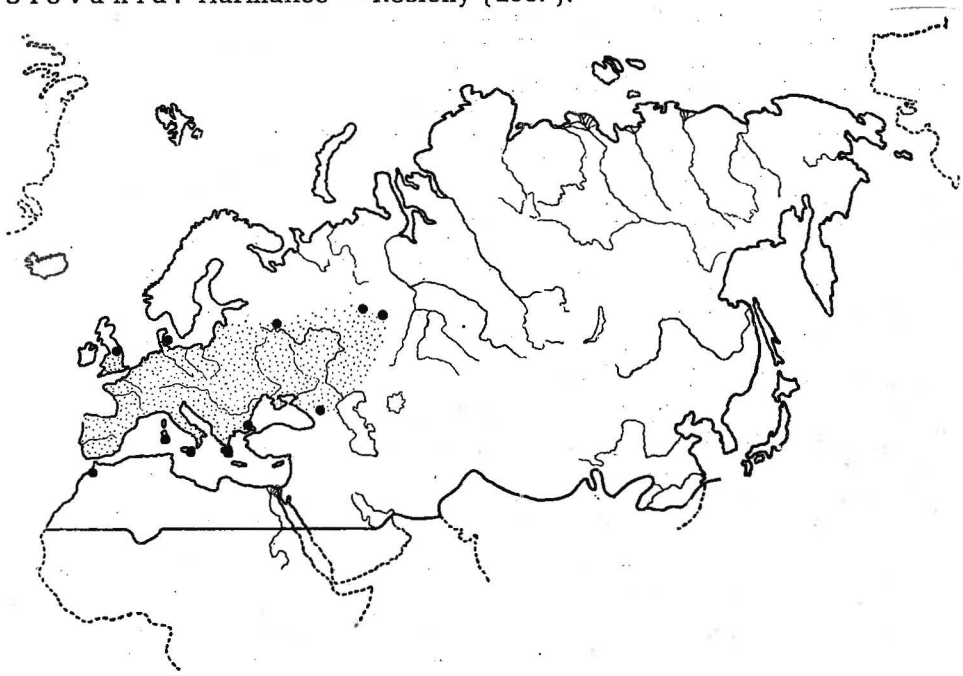
The larval material was obtained on 27. XII. 1955 and 3. VII. 1956 from guano of a nursing-colony of *M. myotis* in the attic of a church in Domažlice (west Bohemia).

Distribution (See Map 9, 10)

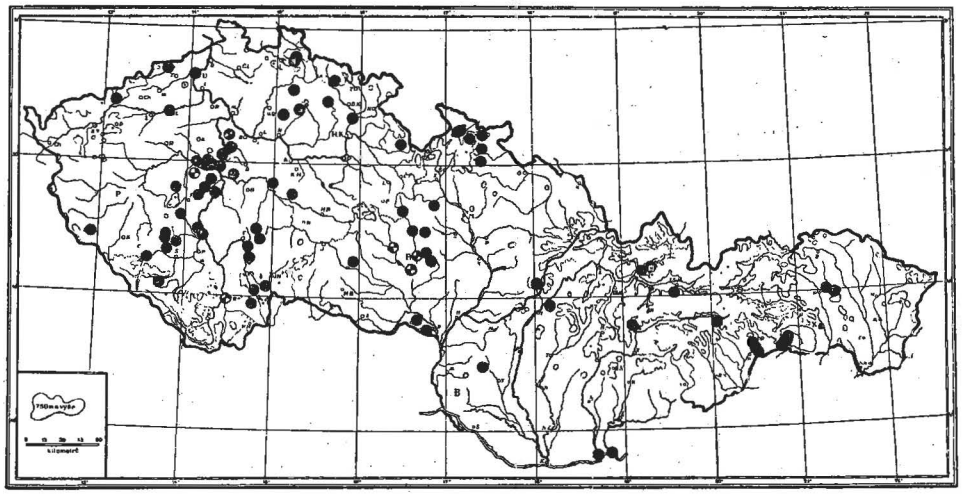
This species has been found in Azores, Morocco (near Casablanca), Portugal, Spain, England, France, Belgium, Holland, Denmark, Germany, Switzerland, Sardinia, Italy, Sicily, Austria, Czechoslovakia, Poland, Hungary, Yugoslavia, Roumania, Bulgaria, Greece (Patras) and in the European part of the U.S.S.R.: Ukraine (Dragobychskaja, Lvovskaja, Kijevskaja oblast, Crimea), Bielorussia (Bieloviezh primeval forest), Russia (Kaliningradskaja, Voroniezhskaja oblast, Saratov, Stavropol-Caucasus, Ural-Permskaja oblast, Sverdlovsk).

In Czechoslovakia there have been given the following literary dates (with exception of Hůrka, 1957). Bohemia: Praha, *M. myotis,* Pfleger leg. — Rosický (1944); Praha, *N. noctula,* ♂, ♀, coll. Rothschild — Hopkins, Rothschild, 1956; Č. Budějovice, *M. myotis,* Pfleger leg. — Rosický (1944, 1953, 1957); Jílové, January 1943, ♂, 4 ♀♀, *B. barbastellus,* Štorkán leg. — Rosický (1948, 1953, 1957); Koně-

prusy, Rosický (1957). Moravia: Brno, *P. pipistrellus,* Hrabě leg. — Rosický (1953, 1957); Tišnov — Rosický (1957); Moravia, *E. serotinus* (coll. Zool. Museum of Berlin Univ.) — Wagner (1932). Slovakia. Harmanec — Rosický (1957).



Map 9 Area of distribution of the flea *Ischnopsyllus intermedius* (Rothsch.).



Map 10 Distribution of the flea *Ischnopsyllus intermedius* (Rothsch.) in Czechoslovakia; ● — author's find, ◔ — literary data.

My material is from 48 localities in Bohemia, 16 in Moravia and 17 in Slovakia.

Bohemia:

Myotis myotis — Vykmanov (Chomutov d.), 12. III. 1958 — ♂, ♀; Domažlice, 25. VIII. 1955 — 7 ♂♂, 19 ♀♀, 25. IV. 1956 — 11 ♂♂, 11 ♀♀, 7. VIII. 1956 — ♂, 2 ♀♀, 25. IV. 1957 — 2 ♂♂, 5 ♀♀, 30. V. 1957 — 2 ♂♂, 9 ♀♀, 25. VII. 1957 — 5 ♂♂, 19 ♀♀, 13. VIII. 1958 — 2 ♂♂, 12 ♀♀; castle Rábí (Klatovy d.), 16. XII. 1958 — 2 ♀♀; Lnáře (Strakonice d.), 6. VI. 1956 — ♂, ♀; Blatná (Strakonice d.), 7. VI. 1956 — 13 ♂♂, 35 ♀♀; Kadov (Strakonice d.), 18. IX. 1955 — ♂, ♀, 5. VI. 1956 — 2 ♂♂, 12 ♀♀, 28. VIII. 1958 — 1 ♀; Březnice (Příbram d.), 27. VIII. 1958 — ♂, 2 ♀♀; Životice (d. Plzeň-south), 27. VIII. 1958 — 2 ♀♀; castle Zvíkov (Písek d.), 1. X. 1958 — 4 ♀♀; castle Orlík (Písek d.), 1. X. 1958 — 2 ♀♀; Vimperk (Prachatice d.), 19. VIII. 1956 — ♂; Chýnov-cave (Tábor d.), 15. I. 1959 — 4 ♀♀; Vřesce (Tábor d.), 24. III. 1958 — ♂, 2 ♀♀; Planá n. Lužnicí (Jindř. Hradec d.), 28. VIII. 1958 — ♂; Stráž n. Nežárkou (Jindř. Hradec d.), 18. V. 1958 — 5 ♂♂, 2 ♀♀, 7. VIII. 1958 — 5 ♂♂, 14 ♀♀; house by the fish-pond Potěšil (Jindř. Hradec d.), 27. VIII. 1957 — ♂; Třeboň (Jindř. Hradec d.), 31. V. 1958 — ♂, 3 ♀♀, 15. VI. 1958 — 3 ♀♀, 20. VII. 1958 — 3 ♂♂, 5 ♀♀, 3. VIII. 1958 — 5 ♂♂, 13 ♀♀, 21. VI. 1959 — 2 ♂♂, 28. VI. 1959 — 2 ♂♂, 2 ♀♀, 5. VII. 1959 — 5 ♂♂, 8 ♀♀; Nový Knín (Příbram d.), 18. III. 1958 — ♂, 2 ♀♀; Dobříš (Příbram d.), 2. VI. 1958 — 3 ♂♂, 5 ♀♀, 15. VI. 1958 — 2 ♀♀, 12. VII. 1958 — 2 ♂♂, 7 ♀♀, 3. VIII. 1958 — 2 ♂♂, 7 ♀♀, 3. V. 1959 — ♂, 6 ♀♀, 15. VI. 1959 — 5 ♂♂, 10 ♀♀; Mníšek (Příbram d.), 8. III. 1958 — ♀; Hořovice (Beroun d.), 22. VIII. 1959 — 4 ♀♀; Srbsko (Beroun d.), 23. I. 1955 — ♂, 2 ♀♀, 24. III. 1956 — 4 ♂♂, 2 ♀♀, 23. I. 1957 — ♀, 13. IV. 1958 — 3 ♂♂, 6 ♀♀, 27. X. 1958 — 2 ♀♀, 11. IV. 1959 — 2 ♂♂, ♀; Karlštejn (Beroun d.), 27. III. 1955 — 2 ♂♂, 3 ♀♀, 31. III. 1955 — 5 ♂♂, 4 ♀♀, 16. X. 1955 — 2 ♀♀, 31. I. 1956 — 3 ♂♂, 7 ♀♀, 25. III. 1956 — ♀, 11. IX. 1956 — 3 ♂♂, ♀, 15. II. 1957 — 3 ♂♂, 3 ♀♀, 27. X. 1957 — ♂, 27. X. 1958 — 3 ♀♀; Trněný Újezd (Beroun d.), 1. III. 1959 — ♂; Řevnice (d. Praha-west) 24. VIII. 1958 — 2 ♂♂, ♀; Dobřichovice (d. Praha-west), 7. IX. 1957 — ♂, ♀, 28. IX. 1957 — 2 ♀♀, 13. X. 1957 — ♀, 31. VII. 1958 — 9 ♂♂, 10 ♀♀, 3. VIII. 1958 — 3 ♀♀; Jílové (d. Praha-west), 16. I. 1955 — 4 ♀♀, 22. II. 1959 — ♂; Rataje n. Sázavou (Kutná Hora d.), 17. VII. 1959 — 5 ♂♂, 8 ♀♀; Praha-Troja, 18. II. 1958 — ♀; Panenské Břežany (d. Praha-east), 27. V. 1959 — 2 ♀♀; Mikulov (Teplice d.), 13. III. 1958 — ♂; Ústí n. Labem, 28. VII. 1959 — 3 ♂♂, 3 ♀♀; Bílá Desná (Jablonec n. Nisou d.), 24. II. 1958 — ♂, 3 ♀♀; castle Valdštejn (Semily d.), 12. IV. 1959 — ♀; Ledce (Mladá Boleslav d.), 17. VIII. 1958 — ♀; Lázně sv. Trojice (Jičín d.), 21. VI. 1959 — 8 ♀♀; Krkonoše-mountains, Černý důl, 19. III. 1959 — ♂; Jaroměř (Náchod d.), 1. XII. 1956 — ♀; Rokytnice in Orlice-mount. (Ústí n. Orlicí d.), 24. VIII. 1956 — ♂ (Štys leg.), Vlastějovice (Kutná Hora d.), 30. I. 1958 — 3 ♂♂.

Eptesicus serotinus — castle Pecka (Jičín d.), 17. III. 1959 — ♂; Lenešice (Louny d.), 14. V. 1959 — 15 ♂♂, 44 ♀♀; Praha-Botanic garden, 19. VIII. 1955 — ♂; Zbraslav (d. Praha-west). 8. X. 1958 — 3 ♀♀; Obořiště (Příbram d.), 7. VI. 1956 — ♀; Soběslav (Tábor d.), 8. VIII. 1958 — 3 ♂♂, 8 ♀♀.

Eptesicus nilssoni — Blatná (Strakonice d.), 5. VI. 1956 — 3 ♀♀; Bílá Desná (Jablonec n. Nisou d.), 24. II. 1958 — ♂, ♀.

Plecotus auritus — Kadov (Strakonice d.), 5. VI. 1956 — ♀; Březnice (Příbram d.), 26. VIII. 1958 — 2 ♀♀.

Barbastella barbastellus — Janov (Jablonec n. Nisou d.), 26. II. 1958 — ♂.

Moravia:

Myotis myotis — Trnava (Třebíč d.), 28. VII. 1958 — ♂, 3 ♀♀; Lednice (Břeclav d.), 17. VI. 1958 — ♀; Ochoz-cave (Brno-environs), 9. XII. 1948 — ♀ (coll. Jurik); Býčí skála-cave (Blansko d.), 14. III. 1959 — ♀, Gaisler leg.; Rájec n. Svitavou (Blansko d.), 19. V. 1959 — 2 ♂♂, Gaisler leg.; Sloup-cave (Blansko d.), 19. V. 1959 — ♂, 6 ♀♀; Brněnec (Svitavy d.). 4. III. 1959 — ♀; Javoříčko-cave (Olomouc d.), 27. I. 1959 — ♂; Suchá Rudná (Bruntál d.), 30. I. 1959 — 2 ♀♀; Na Špičáku-cave (Šumperk d.), 28. I. 1959 — ♀; Na Pomezí-cave (Šumperk d.), 20. XI. 1955 — ♂; Vápenice-quarry (Šumperk d.), 28. I. 1959 — ♀; Heřmanovice (Bruntál d.), 29. I. 1959 — 4 ♀♀; Valašské Klobouky (Gottwaldov d.), 5. VI. 1959 — 4 ♂♂, 14 ♀♀.

Eptesicus nilssoni — Poštovní gallery near Zlaté hory (Bruntál d.), 29. I. 1959 — 3 ♀♀.

Myotis blythi oxygnathus — Na Turoldě-cave (Břeclav d.), 21. II. 1959 — ♀, Grulich leg.

Slovakia:

Myotis myotis — Dubnica n. Váhom (Považská Bystrica d.), 5. VI. 1959 — 4 ♂♂, 5 ♀♀; Veličná (Dolní Kubín d.), 4. VI. 1959 — ♀; Dolní Kubín, 4. VI. 1959 — 3 ♂♂, 3 ♀♀; Izbica-cave near Harmanec (Banská Bystrica d.), 12. II. 1961 — ♀; Chlaba (Nové Zámky d.), 3. VII. 1955 — 25 ♂♂, 37 ♀♀, 17. IV. 1958 — ♀; Domica-cave (Rožňava d.), I. 1949 — ♂, ♀, Grulich leg., 9. VII. 1955 — ♂; Ardovská-cave (Rožňava d.), 5. II. 1958 — ♂; Demänovská Dračí ice-cave (Lipt. Mikuláš d.), 14. II. 1961 — 2 ♀♀; Lažanský-cave near Červená Skála (Banská Bystrica d.), 15. II. 1961 — ♂, ♀; Okružná (Prešov d.), 3. VI. 1959 — ♀.

Myotis blythi oxygnathus — Chlaba (Nové Zámky d.), 3. VII. 1955 — ♂; Izbica-cave near Harmanec (Banská Bystrica d.), 20. X. 1958 — 2 ♀♀, 12. II. 1961 — ♂; Hrhov (Rožňava d.), 31. V. 1959 — ♂, ♀; Hačava-cave (Košice d.), 7. II. 1958 — ♂.

Eptesicus serotinus — Driny-cave (Trnava d.), 11. II. 1961 — ♂; Dubnica n. Váhom (Považská Bystrica d.), 5. VI. 1959 — ♀; Štúrovo (Nové Zámky d.), 7. VII. 1955 — 2 ♀♀; Kapušany pri Prešove (Prešov d.), 2. VI. 1959 — ♂, 6 ♀♀.

Eptesicus nilssoni — Demänovská Dračí ice-cave (Lipt. Mikuláš d.), 14. II. 1961 — 2 ♂♂, 2 ♀♀.

Vespertilio murinus — Zadielská dolina (Košice d.), 20. VI. 1956 — ♂.

Rhinolophus hipposideros — Gombasek-cave (Rožňava d.), 9. III. 1959 — ♀, Grulich leg.

Further 520 specimens (255 ♂♂, 265 ♀♀) from guano of a nursing-colony of *M. myotis* from Domažlice (4. XII., 28. XII. 1955, 21. III. 1956, 2. I., 24. IV. 1957) and 138 specimens (78 ♂♂, 60 ♀♀) from guano of a *M. myotis* colony from Třeboň (21. VI. 1958) were obtained.

The total material contains 702 specimens (224 ♂♂, 478 ♀♀) from bats and 658 specimens (333 ♂♂, 325 ♀♀) from bat guano from 81 localities (+1 ♂ from Yugoslavia).

I. (I.) intermedius (Rothschild) is the commonest bat flea all over the territory of Czechoslovakia owing to the abundant occurence of *Myotis myotis.*

Hosts

Eptesicus serotinus is regarded as principal host over the whole area of distribution of the flea. The area of distribution of this bat largely exceeds the known area of the flea in the east. *Myotis myotis* is the second most often mentioned host, the not yet exactly known distribution of which also overlaps that of the flea in the east. In Belgium, Holland, Denmark and northern Germany this flea is often found on *M. dasycneme.* It has been found several times on *Nyctalus noctula* in the central part of Great Britain [once also in Germany, Czechoslovakia, Ukraine — Hopkins, Rothschild (1956) and in Switzerland — Aellen (1960)]. It has been found on *Nyctalus leisleri* in Great Britain (several times), in Bulgaria (Kamchia-river) and in Switzerland (Aellen, 1960). In the Azores, it was found several times on an endemic *Nyctalus azoreum. Vespertilio murinus* has been often recorded as a host of this flea. Unfortunately it is not possible to decide in the case of many dates whether they refer to *Myotis myotis* or *V. murinus.* There are only a few reliable records on *V. murinus* (twice from Germany — Hopkins, Rothschild, 1956; Bielorussia — Ioff, 1956; Czechoslovakia — Hůrka, 1957). *Pipistrellus pipistrellus* was recorded three times as a host of this flea (Holland — Oudemans,

1915b, Germany — Dampf, 1912b, Czechoslovakia — Rosický, 1953), twice *Myotis nattereri* (Holland — Oudemans, 1915b, Germany — Hopkins, Rothschild, 1956), *Barbastella barbastellus* (Germany — Dampf, 1912b, Czechoslovakia — Rosický, 1948) and *Plecotus auritus* (Holland — Oudemans, 1915b, Czechoslovakia — Hůrka, 1957). Single record refers to *Myotis mystacinus* (Holland — Oudemans, 1915b, Leruth, 1939), *Myotis daubentoni* (Belgium — Leruth, 1939, Cooreman, 1950), *Pipistrellus kuhli* (Greece — Hopkins, Rotschild, 1956, Peus, 1958), *Myotis blythi oxygnathus* (Czechoslovakia — Hůrka, 1957), *Eptesicus isabellinus* (Morocco — Grenier, 1957), *Eptesicus nilssoni* (Czechoslovakia — Hůrka, 1957), *Rhinolophus hipposideros* (Germany — Dampf, 1912b) and *Rhinolophus ferrumequinum* (Italy — Hopkins, Rothschild, 1956).

Female of *I. intermedius* from *Erithacus rubecula,* found on 25. V. 1903 in the Azores, is deposited in the Rothschild collection in the British Museum at Tring.

My material comes from 8 hosts, their parasitization being shown in Table 9.

Table No. 9 Review of the hosts of *Ischnopsyllus intermedius* (Rothschild) according to author's material.

bat species	number of specim. examined	*Ischnopsyllus intermedius*					
		number of bats with fleas (%)	males	females	total	average per one bat	maximum per one bat
Eptesicus serotinus	55	22 (40)	22	65	87	1.58	6
Myotis myotis	1291	305 (24)	193	397	590	0.46	9 (38)+
Eptesicus nilssoni	26	6 (23)	3	9	12	0.46	3
Myotis blythi oxygnathus	78	5 (6)	4	3	7	0.09	2
Vespertilio murinus	28	1 (3)	1	0	1	0.036	1
Plecotus auritus	417	2	0	3	3	0.007	1
Barbastella barbastellus	250	1	1	0	1	0.004	1
Rhinolopsus hipposideros	741	1	0	1	1	0.0013	1

+ infestation due to the unnatural conditions

The above table shows, that *E. serotinus* is the principal host of *I. intermedius* also in Czechoslovakia. In the second place there is *M. myotis,* which is responsible for the abundant distibution of this flea, owing to its common occurence on the whole territory. *I. intermedius* develops also in the summer colonies of *Eptesicus nilssoni,* in our country (Blatná, 5. VI. 1956). Of course, this bat species is quite in-

significant for the abundance of the flea, as it occurs rather more often in winter in our country. Among other recorded bats, only *M. blythi oxygnathus* may be recorded as a regular host of this flea owing to its simultaneous occurence with *M. myotis* (not only in caves but in the attics of buildings, too). Other bats are but rare hosts of this flea. Perhaps there is a certain possibility of infestation of *Plecotus auritus* with *I. intermedius* too, as the colonies of this bat often occur in the same places as those of *M. myotis.*

Thus it may be concluded, that *I. intermedius* is a parasite of *Eptesicus serotinus* and *Myotis myotis.* In the northern part of Great Britain (the northern limit of distribution of the flea) it has been found on *Nyctalus noctula* and *N. leisleri,* in the Azores (the western limit of its distribution) on N. azoreum. Other recorded bats (with exception of *E. nilssoni, M. blythi oxygnathus,* perharps also of *V. murinus*) are but very rarely hosts of this flea. Many of them (*P. pipistrellus, P. kuhli, B. barbastellus, P. auritus, M. mystacinus)* are bats, living like the principal host *E. serotinus* in fissures, behind the wall wainscotting, under the material used for roofing etc.

Notes on bionomics

Larva of instar III was described by Hůrka (1956) from guano of a colony of *M. myotis.*

The fleas develop in the summer roosts of bats. As soon as towards the end of the hibernation period, still in the hibernation quarters, and far more during the migration to the summer roots, the flea females

Table No. 10 Percentage of females of *I. intermedius* (Rothsch.) with developed eggs, during the year (on the left: females with eggs; on the right: females without eggs).

I.	4%	96%	V.	96%	4%	IX.	75% 25%
II.	7%	93%	VI.	83%	17%	X.	75% 25%
III.	36%	64%	VII.	82%	18%	XI.	0% 100%
IV.	67%	33%	VIII.	84%	16%	XII.	0% 100%

were found with developed eggs (see Table 10). A short time after the arrival of the hosts at their summer roosts i. e. from the end of April to the beginning of May (depending on the weather), almost all females possessed developed eggs in their abdomidal cavity. The eggs are laid in the hair of hosts and from there they fall into the bat guano (there is some possibility of the larvae hatching on bats and of their subsequent falling into the guano — I found 1 specimen of larva on *M. myotis* in Ústí n. L.).

The larval development passing through three larval instars lasts approximately one month including the pupal stage, as it is suggested by the first appearing of the freshly hatched fleas on bats at the begin-

ning of June (2. VI. Dobříš, 5. VI. Valašské Klobouky, 6. VI. Lnáře). Further immature fleas were found in the regularly controlled colonies of *M. myotis* at the end of June and the beginning of July (21. VI. Třeboň, 3. VII. Chlaba, 12. VII. Dobříš), the next at the end of July (27. VII. Domažlice, 31. VII. Dobřichovice) and the last ones at the end of August (28. VIII. Domažlice, 26. VIII. Březnice). Thus 4—5 generations of *I. intermedius* develop in the summer colonies of bats (in the conditions of the attics) in our country.

During the hibernation period of bats (in December, January, March and April), large amounts of adult *I. intermedius* (over 600 specimens) were found in guano left by a colony of *M. myotis* in the loft of the church in Domažlice. The explication is simple. The last 5.—6. generation should have matured at the time when the bats were leaving or had already left their summer roosts. They hibernated, therefore, in bat guano, in all probability as pupae (found on 21. III. 1956) and hatched only after the return of bats in spring. The find of adult fleas in guano carried over to the room-temperature on December 4 as well as on March 21 or at the end of April proves, that the hatching was stimulated by a mechanical or thermic irritation. Possibly, both influences concur.

Total number of generations of this flea living in the attics of buildings is approximately 5—6 in our country. The last generation hibernates and hatches first after the return of bats. The emerged adults are negatively geotactic and very strongly positive anemotactic as can be proved by simple blowing into the glass with hatching fleas (all react immediately by lifting the anterior body end, by waving fore legs and some even by jumping, which is otherwise a rare phenomenon in this flea family). Both above-mentioned taxises enable the fleas to find their hosts. The strong positive anemotaxis causes the infestation even of other bat species, as the flea reacts to every air stream.

Considering the fact, that bat guano occurs on the floor of attics of the buildings, inhabited by bats and that e. g. churches inhabited often by the bat colonies possess a considerably high attics, there is a remarkable distance between hatched fleas and hosts in the roofing, I was interested in how long the freshly hatched fleas would remain alive and what is the maximum time during which the host to be found. The results of experiments (Hůrka, Doskočil, 1961) suggest that the freshly hatched, not yet sucking fleas of *I. intermedius* must find their hosts within 3—4 days (in the conditions of the attics of buildings). With increasing relative atmospheric humidity the time of survival is prolonged. It has been found that there are differences in the time of survival of males and females. The females survive at 20° C and 55 p. c. of r. h. by 7 hours, at 100 p. c. by about 1.5 day longer than the males. Three days are sufficient period for finding a host at a distance of even more than 20 m.

The rate of females with eggs reaching the maximum in May decreases with the progressing development of new generations of fleas in June, July and August (see Table 10). During these three months, the percentage of females with eggs keeps on the same level, in September it decreases again owing to the dispersion of bat colonies. A rapid

decline takes place in October in the period of migration of bats. There were found no females with eggs in November and December in the bat hibernation quarters. Similarly in January and February the percentage of females with eggs is very low. It increases considerably in March, when the bats renew their activity and reaches its maximum in May, at the beginning of the reproduction period of the hosts, when almost all flea females (including those hatched in April) have eggs in their abdomidal cavity.

The sex ratio of *I. intermedius* in hosts is practically the same in summer as in the hibernation period — 2:1 in favour of females (summer: 176 ♂♂, 376 ♀♀, migration and hibernation: 43 ♂♂, 92 ♀♀). Such a sex ratio on bats is but secondary, as the fleas hatch in guano in the ratio 1:1. I collected 520 specimens including 255 ♂♂ and 265 ♀♀ from guano in winter period (4. XII., 28. XII. 1955, 21. III. 1956, 2. I., 24. IV. 1957 — Domažlice) and 138 specimens consisting of 78 ♂♂ and 60 ♀♀ in the summer period (21. VI. 1958 — Třeboň). In the latter case apparently the hatching of the second generation has been registered, resulting in a remarkable proteradry of the flea. The lower vitality of males determines probably the sex ratio on the hosts, as proved already by the above-mentioned experiments.

As a rule the average infestation of bats by this flea species is different in the winter and summer period as well as in solitary males and in bats of nursing-colonies.

In solitarily living adult males, there was ascertained an average of 0.25 per specimen during the summer period. The males of *M. myotis* are, of course, often parasitized with an additional flea species living with an alien bat colony in the neighbourhood. In the nursing-colonies there was found on average 1 flea per host during the whole season (from the end of April to the beginning of August). Precisely, the infestation of nursing-colonies is as follows: adult females 1.54, sucklings up to the weight of 10—15 g with a very thin, tightiftting hair 0.1 and young of the weight of 15 g—0.85. The highest average infestation occurs in females after their arrival at the summer roots, where they are attacked by the previous year's generation of fleas hatched in spring. The ratio of infestation during the whole summer period was registered regularly in the colonies of *M. myotis* in Domažlice and in Třeboň. At the females' arrival, the average infestation is 2 fleas per host. This average remains up to the time when the sucklings reach about 15 g in weight (at the beginning of June), then drops approximately to one half owing to the partial migration of fleas to the young. This second average persists up to the time when the bats leave the colony. During the hibernation period the average infestation of bats is much lower: in adult females 0.4 in young 0.16 and in adult males 0.14.

In the summer colonies of *M. myotis,* there were found currently 0—3 fleas per specimen, rarely 6—9. An extreme infestation is realized, when a large part of the colony fails to return for any reasons to their previous roosts; now the mass of fleas of the last year's generation hatching in spring attacks the remaining individuals. Such a case was registered on 7. VI. 1956 in the attics of the castle in Blatná, where

because of the repairs of the roof, only 4 females from a normally large bat colony settled in the roofed part. I succeeded in catching two of them—one possessing 10, the other as much as 38 specimens of *I. intermedius.*

The average infestation of *Eptesicus serotinus* is higher than that of *M. myotis.* In nursing-colonies, there was found on average 3 fleas per individual host with an exception of 5 fleas on a bat. The adult males like those of *M. myotis* possess an average of 0.25 fleas per individual. In the hibernation quarters the average infestation of serotine naturally falls, in adult females and young, to an average of 1.33. No specimen of *I. intermedius* was found in 5 adult males in the hibernation quarters.

The associated parasitization of one host specimen by *I. intermedius* with other insect ectoparasites is shown in Table 11. The associated parasitization occurs in solitarily living males practically all the year long, in females and youngs during their migration and in

Table No. 11 Associated parasitization of *I. inetrmedius* (Rothschild) and other insect ectoparasites on one host specimen.

host species / ectoparasite species	*Myotis myotis*	*Eptesicus serotinus*	*Myotis blythi oxygnathus*	total	number of species infested
Ischnopsyllus hexactenus	23×	1×	—	24×	2
Ischnopsyllus simplex	4×	—	—	4×	1
Nycteridopsylla pentactena	—	2×	—	2×	1
I. hexactenus *I. simplex*	1×	—	—	1×	1
I. hexactenus *Nyct. latreillei*	1×	—	—	1×	1
I. hexactenus *Nyct. vexata*	4×	—	—	4×	1
I. hexactenus *Pen. dufouri*	1×	—	—	1×	1
Nycteribia vexata	30×	—	1×	31×	2
Nycteribia latreillei	33×	—	1×	34×	2
Penicillidia dufouri	2×	—	—	2×	1
Nyct. latreillei *Nyct. vexata*	13×	—	—	13×	1
Pen. dufouri *Nyct. latreillei*	2×	—	—	2×	1
Pen. dufouri *Nyct. vexata*	1×	—	—	1×	1
N. pentactena *Nyct. latreillei*	1×	—	—	1×	1

their hibernation quarters. Aellen, 1960 records the associated occurrence of this flea with *I. hexactenus* from *M. myotis* from Switzerland.

Notes on systematics

Characters of male: the presence of a "mane" on the thoracic tergit II and III; from *octanenus* and *consimilis* which also have manes, it differs by a higher number of spines in abdomidal ctenidium I (almost equal number in abd. ctenidium I and in the metathoracic one) and by the shape of clasper and sternum VIII and IX; from *plumatus* which also has a mane it can be distinguished by the different shape and chaetotaxy of sternum VIII.

Characters of female: distinguishable from all other species possessing 8 combs by the following combination of characters-nearly equal number of spines in abd. ctenidium I and in that of metathorax; anal stylet 3 times longer than wide on base; preoral tuber broad, bent at a right angle. From *plumatus* it differs by a greater number of spines in the abd. comb I (*plumatus* 15—22) and smaller number of setae on the sternum VII (*plumatus* 10—14 on one side).

The number of pseudosetae under the collar of mesonotum for both sexes 1—5, most frequently 2—3.

Characters of larva: antenna 3 times longer than its central stiff hair; the second joint of maxillary palp 2 times longer than the basal one. There are most frequently 11 sturt bristles.

The closely related species *I. plumatus* Ioff, 1946 found hitherto in Kazakhstan and Turkmenia (on *M. myotis*) takes the place of *I. intermedius* in Central Asia.

c) **obscurus**-group

There are 6—10 rather long pseudosetae under the collar of mesonotum. The dorsal margin of the body of clasper possessing a finger-like process. Anal stylet of female only two times longer than wide on the base; the diameter of the dilated portion of duct of spermatheca narrower than that of bursa copulatrix.

Argiropulo (1948) established an entirely separate subgenus for *obscurus,* in which even *I. needhami* Hsü was incorrectly included. According to the present state of systematics of the genus the species *I. obscurus* should be considered a mere special group.

Ischnopsyllus (Ischnopsyllus) obscurus (Wagner), 1898

Ceratopsylla obscura. Wagner, 1898, Hor. Soc. ent. ross. **31**: 584, tab. 9, fig. 21 (male); *Ischnopsyllus brachystylus.* Rothschild, 1910, Ent. mon. Mag. **46**: 254, fig. 1, 2 (female); *Ischnopsyllus obscurus* (J. Wagn.), Dampf, 1912a, Rusk. ent. obozr. **12**: 55—59, fig. 7 (male genital organes morphology, key); *Ischnopsyllus obscurus* (J. Wagn.). Dampf, 1912b, Ber. bot. zool. Ver. Rheinland-Westfalen **1911**: 79—113, tab. 1, fig. 3, tab. 3, fig. 10, tab. 4, fig. 16c, tab. 5, fig. 25, 28 (female morphology, key, synonymy); *I. obscurus.* Ioff, Skalon, 1954. Opred. bloch. vost. Sibiri, daln. vost. i prilezh. rajonov: 123, fig. 337 (male), fig. 75, 338, 339 G (female) (key, distribution in U.S.S.R.); *Ischnopsyllus obscurus* (Wagner). Smit, 1954a, Danmarks Fauna **60**: 72, fig. 101 (male), fig. 100, 102 (female, key); *Ischnopsyllus (Ischnopsyllus) obscurus* (Wagner). Hopkins, Rothschild, 1956, Cat. Rothsch. Coll. Fleas **2**: 260, 261,

267—269, fig. 459 (male), 460 (female) (morphology, key synonymy); *Ischnopsyllus obscurus* Wagn. Ioff, Bondar, 1956, Tr. nauch. issl. protiv. inst. Kavkaza i Zakavkazja **1**: 110 (distribution in Central Asia); *Ischnopsyllus obscurus* Wagner. Hůrka, 1957, Českoslov. parasitol. **4**: 150, 162 (distribution, hosts); *Ischnopsyllus (Ischnopsyllus) obscurus* (Wagner). Rosický, 1957, Fauna ČSR **10**: 304—306, fig. 98 F, I (male), 99 C, 100 A (female) (morphology, key, synonymy).

Male

(data based on 4 specimens from Czechoslovakia)

Length 2.8; 3; 3; 3.1 mm. Wagner, 1898: 2.5—3.25 mm; Smit, 1954a: 2.5—3.5 mm.

Preoral tuber bent at a moderately obtuse angle. The row of setae at the anterior margin of frons containing 21, 22, 23, 23 setae. Below the antennal fossa 1 long bristle, anteriorly to it 3 shorter setae in 3 specimens, 4 in one specimen. Below them an irregularly situated group of 12, 15, 17, 18 setae. Occipital part of head having 4 long bristles in one row (the last terminal seta more distant from 3 anterior ones), above them 1 small seta in two specimens and 3 small setae in the fourth one. Above the antennal fossa a row of small setae in the middle often interruped and doubled or tripled in the lower part, consisting of 14 setae in 2 specimens, of 15 setae in one specimen. The posterior margin of the occipital part of head with 16, 17, 18, 19 long setae.

Comb of pronotum with 42, 45, 46, 46 spines. There are 6—8 (6—2×, 7—4×, 8—2×) pseudosetae under the collar of the mesonotum. Comb of metanotum with 40, 41, 44, 45 spines. Metepimeron with 6—8 (6—3×, 7—2×, 8—2×) lateral and 3—5 (3—3×, 4—3×, 5—1×) distal bristles.

The numbers of spines in the abdomidal ctenidia are as follows: I — 33, 33, 36, 39; II — 45, 47, 49, 51; III — 41, 43, 44, 48; IV — 35, 36, 38, 39; V — 27, 28, 31, 32; VI — 27, 28, 30, 32.

The dorsal margin of the clasper having a long finger-shaped process between sensilium and the base of the distinctly formed fixed process. In this character it differs from all other members of the genus *Ischnopsyllus*. The fixed process broadened towards the end, possessing 3 setae at the dorsal and one seta at the distal margin in the 4 males examined (in agreement with the description of Wagner (1898) and Dampf (1912); Smit (1954b, fig. 101) illustrates the dorsal margin as having 4 setae, Ioff, Skalon (1954, fig. 337) only with 2 setae — the distal margin possessing only 1 seta according to these authors). Two strong almost straight and relatively thin acetabular bristles placed at the archform process of the posterior margin of the clasper, distinctly in its ventral part. The posterior margin of the clasper ends almost rectangularly, from the ventral angle extends a strong outer chitinous ledge. Movable process widely triangular: the distal, strong setae in its dorsal part. One thornlike seta at the dorsal angle, a group of fine setae below it. Below the middle on the side of the surface of movable process 3 longer setae, 1 of which tending down and overlapping the ventral margin of the process.

Sternum VIII distally broadened, having a pair of long setae at the ventral margin in front of ventral angle. Several thinner and shorter setae on the ventral and distal margin of sternum VIII.

Female

(data based on 7 specimens from Czechoslovakia)

Length average 3.1 mm 2.8—3.5). Wagner, 1898: 3—3.5 mm, Smit, 1954a: 2.5—3.5 mm.

Preoral tuber bent at a right or slightly acute angle. The anterior margin of the frons with a row of 18—26 setae (Wagner, 1898: not less than 18, most frequently 20—22; Dampf, 1912b: 23). Below the antennal fossa one long bristle, in front of which 2 shorter setae in 3 specimens, 3 in 4 specimens, below them an irregular group of 7—9 setae (D. fig. 3:9). Occipital part of head possessing 4 long bristles (the last one situated at a distance from the anterior 3), above them 1 short seta in 6 specimens, 2 in 1 specimen. An irregular row of 10—15 small setae above the antennal fossa (D., fig. 3: 9). The posterior margin of the occipital part of head displaying 16—21 long setae.

Comb of pronotum with 41—45 spines (Rothschild, 1910: 41, 41; D.: 40—50). There are 8—10 (8—7×, 9—3×, 10—3×) pseudosetae under the collar of mesonotum. Comb of metanotum with 39—43 spines (R.: 39, 43; D.: over 40). Metepimeron with 4—8, most frequently 6 lateral and 2—5, most frequently 3—4 distal bristles.

The numbers of spines in the abdominal ctenidia are as follows:

I. 28—33 (R.: 28, 30; D.: about 30)IV. 21—29 (R.: 25, 33; D.: about 30)
II. 37—45 (R.: 41, 35; D.: over 40) V. 15—20 (R.: 13, 13; D.: 18)
III. 30—37 (R.: 34, 32; D.: over 30)VI. 15—19 (R.: 16, 11; D.: 21)

Sternum VII with a relatively sharp lobe posteriorly in its ventral part. A row of longer setae extending along the dorsal and distal margin, below it a shorter row of small setae. Total number of setae in both rows 15—22, most frequently 17—18. Anal styled remarcably short only twice longer than wide on the base). Diameter of dilated portion of the spermatheca narrower than that of bursa copulatrix (in the two last named characters *I. obscurs* differs from all other members of g. *Ischnopsyllus*). Hilla of spermatheca a little longer than its bursa.

The total number of bristles, setae and spines tends evidently to a lower rate in females than males as in other species of the genus *Ischnopsyllus.*

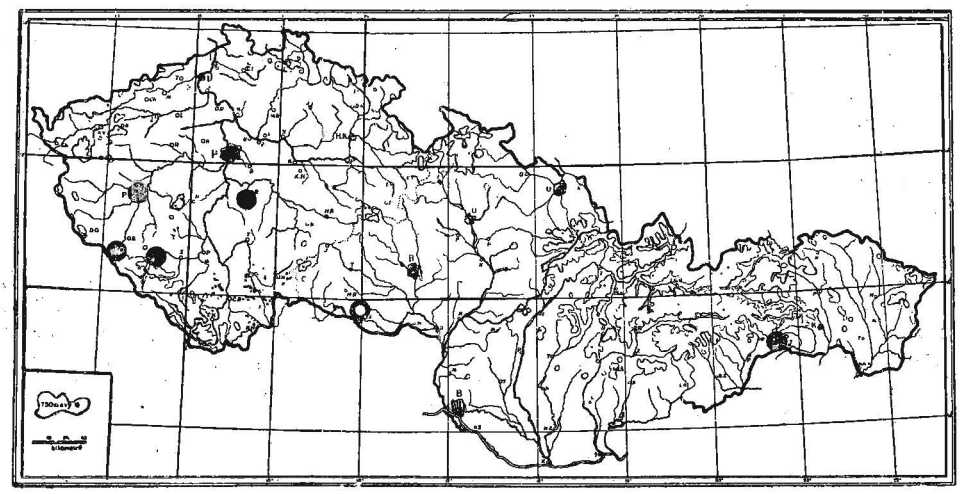
Distribution (See Map 11, 12)

An European and Asiatic species known at present from Norway, Denmark, Poland (personal communication of Prof. Peus — Rosický, 1957: 305), Czechoslovakia, Roumania , U.S.S.R. — European part many localities, e. g.: Ukraine, Bielorussia (Bialoviezh primeval forest), Russia (Kurskaja, Leningradskaja oblast, Voroniezh, Saratov, Volgogradskaja (= Stalingradskaja), Rostovskaja oblast, Stavropolskij kraj, northern Caucasus, Kazan, Transural; Asiatic part — Siberia: Novosibirskaja, Kemerovskaja oblast; Transbaicalia; Primorie; Voroshilov, Khasanskij rajon, Kazakhstan (Alma-Atinskaja oblast, Chilikskij rajon), Turkmenia (Kunja-Urgench), Kirghizia (Issyk-Kulskaja oblast, Tonskij rajon) and from China (Kwantung-peninsula).

From Primorie (maritime region of the U. S. S. R.) and China only females are known.

In Czechoslovakia I found this species for the first time in 1955 in Slovakia, further in 4 localitites in Bohemia, always on *Vespertilio mu-*

Map 11 Area of distribution of the flea *Ischnopsyllus obscurus* (W a g n.).



Map 12 Distribution of the flea *Ischnopsyllus obscurus* (W a g n.) in Czechoslovakia; ◍ — author's find, O — literary data.

rinus. Šebek (1961) records a find of male and female from Jevišovice in southern Moravia.

My material is from the following localities:

Bohemia: Černé jezero in Šumava-mountain (Klatovy d.), 1931 — ♀; Plzeň, without data — ♂, 2 ♀♀ (fleas gained from the alcoholic preparations of bats in National Museum of Praha); castle Rábí (Klatovy d.), 16. I. 1958 — ♂, ♀; castle Konopiště (Benešov d.), 25. V. 1958 — ♀.
Slovakia: Zádielská dolina (Košice d.), 11. II. 1955 — 2 ♂♂, 3 ♀♀.

Total material consisting of 12 specimens (4 ♂♂, 8 ♀♀) from *Vespertilio murinus* from 5 localities.

Hosts

According to the literary data, this species has been most freguently found on *Vespertilio murinus* in the whole area of distribution of the flea (Denmark, Czechoslovakia, U.S.S.R.) This bat is doubtlessly its principal host. In Norway one male was found on *Myotis daubentoni,* in Roumania 4 females on *Eptesicus serotinus* and in the U.S.S.R. (Leningradskaja oblast, Markova, 1938) 2 males and 5 females on 109 individuals of *Eptesicus nilssoni.* The distribution of the principal host *V. murinus* corresponds practically to the presently know distribution of the flea.

Notes on bionomics

Larval stage is not known so far. Females with eggs were found on 11. VII. 1955 in Zádielská dolina, another female found on 25. V. 1958 in Konopiště possessed developed eggs in her abdominal cavity. A female found in Rábí in January was without eggs.

On the base of my poor material as well as on the basis of the literature there can be little said about the sex ratio. Nevertheless, according to my material and to Markova's record 1938 the sex ratio seems to be 2:1 in favour of females in this species, also.

Regarding the intensity of infestation there can be added, that this flea was found on every fourth male of summer colony of the principal host *V. murinus* (of 20 examined). A total of 12 specimens of fleas were found on 28 *V. murinus,* which represents an average infestation 0.44 per host specimen. Markova (1938) found in a hibernation period but one flea male on 24 specimens of young of *E. nilssoni,* 6 fleas on 84 specimens of adult bats, the average infestation being, therefore, 0.065. Ioff, 1956 found in July 4 specimens of this flea on 6 *V. murinus* examined — 0.66.

On one of the examined specimens of the above-mentioned male-colony, there was found a female of *I. obscurus* together with a female of *I. variabilis.* Šebek, 1961 found male and female of *I. obscurus* together with 2 males and 1 female of *N. pentactena* on 1 female of *V. murinus* (17. IV. 1958).

Summary

The present paper is a first part of the monograph of the family *Ischnopsyllidae* of Czechoslovakia. This part contains the introductory chapters (review of literature, material, methods) and the subgenus

Ischnopsyllus Westwood [in Czechoslovakia 6 species: *I. octactenus* (Kolenati), *I. variabilis* (Wagner), *I. simplex* Rothschild, *I. elongatus* (Curtis), *I. intermedius* (Rotschild) and *I. obscurus* (Wagner)]. The synonymy, the description of adult stages, the description of larvae (as far as they are known), the hosts, bionomics and notes on systematics are given in all species.

Netopýří blechy (Aphaniptera, Ischnopsylidae) Československa, 1.

V prvé části monografického zpracování čel. *Ischnopsyllidae* Československa je kromě úvodních kapitol (přehled literatury, materiál a metodika) zpracován podrod *Ischnopsyllus* Westwood, obsahující u nás 6 druhů: *I. octactenus* (Kolenati), *I. variabilis* (Wagner), *I. simplex* Rothschild, *I. intermedius* (Rothschild), *I. elongatus* (Curtis) a *I. obscurus* (Wagner). U každého druhu je uvedena synonymika, popis imág a pokud jsou známy, i larev, hostitelé, bionomie a poznámky k systematice.

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