NORSK ENTOMOLOGISK FORENING

NORSK ENTOMOLOGISK TIDSSKRIFT

Suppl. I

CONTRIBUTIONS TO THE KNOWLEDGE
OF THE DANISH AND FENNOSCANDIAN MOSQUITOES

CULICINI

BY
LEIF R. NATVIG

WITH 148 FIGURES IN THE TEXT, 41 TABLES, 12 PLATES
AND 1 FOLDING MAP

1948

*Utgitt med statsbidrag samt bidrag av
Det Norske Videnskaps-Akademi i Oslo, Nansenfondet
og Finn Hvistendahl, Teknisk-Kjemisk Fabrikk, Oslo*

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NORSK ENTOMOLOGISK FORENING

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Formann . . . Førstekonservator L. REINHARDT NATVIG, Zoologisk Museum, Sarsgt. 1, Oslo.

Nestformann Kontorsjef ANDREAS STRAND, Telegrafstyret, Oslo.

Sekretær . . . Konservator N. KNABEN, Zoologisk Museum, Sarsgt. 1, Oslo.

Kasserer. . . . Forsøksleder Øystein Husås, Zoologisk Museum, Oslo.

Redaktør . . . Statsentomolog T. H. SCHØYEN, Zoologisk Museum, Sarsgt. 1, Oslo.

Red.-komité . Statsentomolog T. H. SCHØYEN, dosent dr. philos F. ØKLAND, konservator L. R. NATVIG.

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Contents.

Preface.

Knowledge of European mosquito fauna is of comparatively recent date. Toward the end of the nineteenth century the discoveries of the rôle of mosquitoes as the vectors of human and bird malaria gave rise to more intensive studies in mosquito taxonomy and biology.

Though Ficalbi already in 1892—96 had published a revision on European mosquitoes it was not until 1910 and 1911 that some short papers by Goetghebuer and de Meijere on the Belgian and Netherlands Culicides resp. appeared. In the following years closer studies on European mosquitoes were published by Schneider (1914), Eckstein (1918) and Brolemann (1920—21). In the year 1920—21 several more important treatises appeared simultaneously, of which the most prominent were those of Edwards (1921), Lang (1920), Séguy (1920) and Wesenberg-Lund (1920—21). More recently the excellent handbooks of Marshall (1938) on the British mosquitoes, of Martini (1932) on the Palaearctic species, and of Stackelberg (1937) on the Culicides of USSR have contributed much to our knowledge of these insects, but still very little is known of Fennoscandian mosquitoes. Apart from the lists based on the revision by Edwards (1921) of the museum collections in Helsingfors, Copenhagen, and Stockholm, only scattered notes on single species were published. Concerning Norway no review has been published on mosquitoes since the "Enumeratio Insectorum Norvegicorum" (*4*, 1877) where only eight species were indicated.

With the location of Scandinavia at the nortwest corner of the Eurasian continent and the great extension north—south of the peninsula, interesting details concerning the geographical distribution could be expected just in this area.

The present treatise therefore intends to bring as its principal object a reliable general view of the mosquito fauna of Denmark and Fennoscandia with information on the distribution of the different species and their biology so far known. Though intensive collection has been carried out in Southern Norway since 1929, I am well aware of the fact that the programme could be fulfilled only to a certain extent. The vast area to be explored, the limited time of development of most mosquito species, and the fragility of the material collected, are all factors which make it a rather difficult task for one man to cover the entire field. Owing to other work it was not until 1939 that I could commence the final revision of the Fennoscandian mosquitoes and then war conditions made it difficult to obtain foreign material for comparison. Although mailing these fragile insects was subject to great uncertainty, the Scandinavian entomologists placed, with the utmost liberality, their mosquito material at my disposal. I had for inspection the greater part of the Fennoscandian Culicide-material, but there are still several unsolved problems. It might thus have been tempting to take up a closer study of racial properties of the northern mosquitoes, but this would require extensive series from different localities as well as a larger material from abroad. Under these circumstances I find it of little value to enter into speculations regarding northern races, but some indications will be found in the systematical part of this paper. However, in order to lay the foundation for future work the old museum collections have been carefully revised and some synonymical problems cleared up. It has, therefore, been unavoidable that this paper is burdened with much "old systematics".

In the geographical division I follow, for Denmark: Generalstabens Kort Danmark I—II (1916—17), for Sweden: Kemner: Catalogues Insectorum Sueciae (1940), for Norway: Strand: Inndeling av Norge til bruk ved faunistiske oppgaver (1943) and for Finland: A list of local names from the Finnish natural scientific area (1938). In the main these publications follow the administrative division of the lands, but, for practical purpose, some innovations have been introduced. In Sweden the county of Västerbotten is divided into a southern part: Västerbotten proper and a northern part: Norrbotten. Further the vast county of Lappland has been divided into five parts: Torne Lappmark, Lule Lappmark, Pite Lappmark, Lycksele Lappmark, and Åsele Lappmark (Kemner 1940, p. 115). In Norway the counties Hedmark and Opland are divided in a southern and a northern part, the county Buskerud in a western and an eastern part, the counties Telemark, Aust-Agder, Vest-Agder, Rogaland, Hordaland, Sogn og Fjordane, Møre og Romsdal, Sør-Trøndelag, Nord-Trøndelag, and Troms in an outer and an inner part, the county of Nordland in four parts (southern outer and inner, northern western and eastern), and the county of Finnmark into four parts (western, inner, northern, and eastern). Each division embraces a number of administrative districts and the exact boundaries of the new divisions may therefore be gained from official Norwegian maps. The main purpose of this new division of Norway is a practical one: to divide the vast counties in more convenient areas thereby facilitating the identification of the localities. Although a pure biographical division of Norway is not intended, the new division, when used in tabulated form, undoubtedly gives a more "natural" picture of the geographical distribution than the old division in counties. The topographical nomenclature used in this paper is in accordance with the papers mentioned above, and for details I refer to these publications. In the lists of distribution the following abbreviations have been used.

For Sweden:

Sk:	Skåne	Vrm:	Värmland
Bl:	Blekinge	Dlr:	Dalarna
Sm:	Småland	Jmt:	Jämtland
Öl:	Öland	Vb:	Västerbotten
G. Sand.:	Gotska Sandön	Nb:	Norrbotten
Ög:	Östergötland	Lpl:	Lappland
Sdm:	Södermanland	Lu. Lpm:	Lule Lappmark
Upl:	Uppland	T. Lpm:	Torne Lappmark
Vstm:	Västmanland		

For Norway:

Ø:	Østfold	VAi:	Vest-Agder (inner)
AK:	Akershus and Oslo	Ry:	Rogaland (outer)
HEs:	Hedmark (southern)	Ri:	Rogaland (inner)
HEn:	Hedmark (northern)	HOy:	Hordaland (outer part and Bergen)
Os:	Opland (southern)	HOi:	Hordaland (inner)
On:	Opland (northern)	SFy:	Sogn og Fjordane (outer)
Bø:	Buskerud (eastern)	SFi:	Sogn og Fjordane (inner)
Bv:	Buskerud (western)	MRy:	Møre og Romsdal (outer)
VE:	Vestfold	MRi:	Møre og Romsdal (inner)
TEy:	Telemark (outer)	STy:	Sør-Trøndelag (outer)
TEi:	Telemark (inner)	STi:	Sør-Trøndelag (inner)
AAy:	Aust-Agder (outer)	NTy:	Nord-Trøndelag (outer)
AAi:	Aust-Agder (inner)	NTi:	Nord-Trøndelag (inner)
VAy:	Vest-Agder (outer)		

Nsy:	Nordland (outer southern area)	TRy:	Troms (outer)
Nsi:	Nordland (inner southern area)	TRi:	Troms (inner)
Nnø:	Nordland (northeastern area)	Fv:	Finnmark (western)
Nnv:	Nordland (northwestern area)	Fi:	Finnmark (inner)
		Fn:	Finnmark (northern)
		Fø:	Finnmark (eastern)

For Finland (the Finnish names in brackets):

Al (A):	Alandia (Ahvenanmaa)
Ab (V):	Regio aboënsis (Varsinais-Suomi)
N (U):	Nylandia (Uusimaa)
Ka (EK):	Karelia australis (Etelä-Karjala)
Ik (Kk):	Isthmus karelius (Karjalan kannas)
St (St):	Satakunta
Ta (EH):	Tavastia australis (Etelä-Häme)
Sa (ES):	Savonia australis (Etelä-Savo)
Kl (LK):	Karelia ladogensis (Laatokan Karjala)
Oa (EP):	Ostrobotnia australis (Etelä-Pohjanmaa)
Tb (PH):	Tavastia borealis (Pohjois-Häme)
Sb (PS):	Savonia borealis (Pohjois-Savo)
Kb (PK):	Karelia borealis (Pohjois-Karjala)
Om (KP):	Ostrobotnia australis (Etelä-Pohjanmaa)
Ok (Kn):	Ostrobotnia kajanensis (Kainuu)
Ob (PP):	Ostrobotnia borealis (Pohjois-Pohjanmaa)
Ks (Ks):	Kuusamo
Lkem (KemL):	Lapponia kemensis (Kemin Lappi)
Le (EnL):	Lapponia enontekiensis (Enontekiön Lappi)
Li (InL):	Lapponia inarensis (Inarin Lappi)
Lps (PsL):	Lapponia petsamoënsis (Petsamon Lappi)

The following abbreviations have been used for collectors in the distribution lists:

H. Anth.:	Anthon, Henning	J. Smo.:	Sandmo, Johannes
P. Bk:	Bakken, Per	Stæg.:	Stæger, C.
Bhn:	Boheman, C. H.	Søg. A.:	Søgaard Andersen
KHF:	Forslund, Karl Herman	S-R.:	Soot-Ryen, T.
Y. H.:	Hagen, Yngvar	O. S.:	Sømme, Olaug Mathiesen
Hagl.:	Haglund, V. J. F.		
Klefb.:	Klefbeck, E.	S. S.:	Sømme, Sven
N. Knab.:	Knaben, Nils	H. P.S.:	Sønderup, H. P.
J. Knab.:	Knaben, Jørgen	Tjed.:	Tjeder, Bo
O. M.:	Meidell, Ove	T. Tjed.:	Tjeder, Tord
LRN:	Natvig, Leif R.	Tullgr.:	Tullgren, Albert
P. N.:	Nielsen, Peder	P. Wg.:	Wahlberg, P. F.
O. Rg.:	Ringdahl, O.	W-L.:	Wesenberg-Lund
O. Skj.:	Skjerven, Olav	Zett.:	Zetterstedt, J. W.

The natural basis for a discussion of the Fennoscandian Culicines from a zoogeographical standpoint must be a general view of their total distribution. As, however, only brief records are to be found in the handbooks, I have, for each northern species, compiled all available records of finds from Palaearctic localities outside Denmark and Fennoscandia. The distribution of these species in Canada and U. S. A. is, in some cases, merely briefly recorded.

As the boundaries of many European states are still not fixed and as no reference map for the exact situation was available I have used a pre-war map (1925) for reference. After some pondering I found that this plan would be the most practical one, especially in consideration of the quotations from several previous publications.

Concerning the systematics and nomenclature used in this paper I refer, for details, to chapter 5. The descriptions and illustrations of the species are, when not otherwise stated, based upon Danish and Fennoscandian material at hand, and mostly from slide preparations. I have drawn the figures myself with a drawing-pencil, either with the aid of a drawing-mirror, type l'Abbé; or with a projection apparatus, type Edinger. Afterwards my assistent has drawn in the figures in chine ink, under my supervision. As the exact measurements of the parts delineated are of no taxonomic interest, the magnification used for the figures is, in accordance with common practice by culicidologists, omitted. In delineating details of the larvae the following magnifications have been used. Mentum (Zeiss eyepiece, 4, objective 4 mm), antennae (Zeiss eyepiece 4, Leitz objective 3), comb-scales and pecten teeth (Zeiss eyepiece 6, objective 4 mm). Head of first instar larvae of *Th. bergrothi* (Zeiss eyepiece 6, objective 8 mm). Wesenberg-Lund and some other authors quote the length of the adult mosquito in millimetres, but as the length of the abdomen, to some degree, depends on the feeding state of specimens examined, I consider these measurements of minor importance. Like several investigators of *Anopheles,* I prefer the length of the wing as (an) indicator of the size of the mosquito, and this character is quoted whenever specimens from Denmark or Fennoscandia have been accessible for study. The length of the wing is measured on a straight line from the tip of the wing to the indentation point at the posterior border of the wing, just before the alula (Weyer, 1933, p. 402, fig. 2). As usually only a few specimens of each species have been measured for this character, the figures quoted must be taken merely as an indication of the size. In the tables illustrating the larval chaetotaxy the figures in the top line indicate the limit of variations, the median line: the average value, and the third line: the number of specimens investigated on the character proper.

In the list of finds from D e n m a r k, S w e d e n and F i n l a n d an exclamation mark b e h i n d the name of the locality indicates that I have inspected the specimen.

An interrogation mark before the name of the locality does not indicate any doubt as to the finding place, but merely emphasizes that the exact identification of the specimens is doubtful. In those cases where adults have been bred from larvae or pupae, this is indicated by the signs for male or female adults, being placed in brackets behind the finding date of the immature stage.

In chapters 3 and 9 information concerning geographical distribution and biology from places outside Denmark and Fennoscandia is printed in brevier.

The hydrogen-ion concentration and the iron contents of the breeding waters have been examined with the new "Hellige Komparator". The indicators used were: methylread (colour-disc.: 3060/5), bromcresolpurple (colour-disc.: 3060/7) and bromthymolblue (colour-disc.: 3060/9). However, several figures obtained by the use of bromcresolpurple were doubtful, and I have therefore discarded these measurements. As to the iron contents 10 ccm of the water to be tested is treated with 10 ccm of 20 % solution of Rhodankalium, 5 ccm of 20 % hydrochloric acid and 2 ccm of 3 % solution of superoxide of hydrogen. The colourdisc used is 3060/50. The hardness of the water has been determined against saponaceous solution (Clarks method: 45 ccm saponaceous solution $= 12° = 12$ g CaO). Checking up research in the year 1931 on the hardness of the water, I found that the chemist who furnished the saponaceous solution had made a mistake that makes all the figures obtained in that year useless. I have therefore discarded all these measurements. For each examination of the breeding waters the test-tubes have been thoroughly cleansed in advance with the water to be tested and most tests have been carried out twice In cases where the numerical values obtained on the colourdisc differed in the two tests, the mean value has been used. The technique used for the identification of the blood meal of the mosquitoes by means of the precipitin test is explained in the second part *(Anophelini)* of this paper.

The method employed for making slide preparations of Culicide terminalia is as follows: the tip of the abdomen of the dry specimen is cut off and placed in a watch glass in 10 per cent aquatic solution of caustic potash. In order to immerse the dried preparation in the potashlye, 2—3 minim of alc. abs. are dripped on it with a pipette. The watch glass is placed in a termostate at a temperature of about 50° C for an hour, the preparation then being washed for about 15 min. in aqua dest., repeated once, dehydrated and transferred from alc. abs. to a slide, embedded in Euparal and covered with a cover-slide. The preparations of the palps have been handled in the same way.

The siphonal index, i. e. the ratio of the length of the siphon to its width at the base, has been obtained from slide mounts, the preparations being drawn by aid of a projection apparatus, type Edinger, and the measurements calculated from the drawings.

During my work on the Fennoscandian mosquitoes I have received valuable help from investigators and others, and before concluding this paper I wish to convey my most sincere thanks to all those who have rendered me assistance.

In the years 1927/28, 1933, 1938 I had the opportunity to go through the chief part of my Norwegian mosquito material in the "Institut für Schiffs- und Tropenkrankheiten" at Hamburg, where the directors, the late Professor Dr. Nocht (1927/28), the late Professor Dr. Fülleborn (1933) and the late Professor Dr. Mühlens (1938) gave me very favourable working conditions. Professor Dr. E. Martini, chief of the entomological section, in 1927/28, introduced me to the difficult systematics and placed at my disposal the collection of Culicides and his extensive library. In 1933, when I worked out further collections of Norwegian mosquitoes in the institute, Professor Martini checked up the determinations of several doubtful specimens, and in the subsequent years he repeatedly furnished me with literature and material for comparison. In 1933, Dr. F. Weyer, assistant at the institute, instructed me in the technique of the identification of the blood meal of mosquitoes by means of the precipitin test, and in 1938 he introduced me to the statistic investigation of the maxillary index and wing length of *Anopheles*. To him I also owe some interesting excursions in the vicinity of Hamburg in order to study the biology of different races (sibling species) of *Anopheles maculipennis*.

Beside the Culicides which I collected myself, other Norwegians also supplied me with material. The late zoologist Mr. Ove Meidell collected mosquitoes and their larvae in south-western Norway (Ry). In the years 1934—1935 the district veterinarian Olav Skjerven got together a considerable material of mosquitoes from Trysil (HEn 20). More accidental collections were received from Director Reidar Brekke, Trondheim; cand real. Yngvar Hagen, Jeløy; cand. agric. Jørgen Knaben, Tønsberg; cand. real. Tordar Quelprud, Oslo; cand. real. L. Rosseland, Sandvika; Mr. Jonas

Sandmo, Målselv; Mr. Ottar Svendsen, Trysil, and Mrs. cand. real, Olaug Mathiesen Sømme, Oslo.

Mr. Soot-Ryen, curator at the Tromsø Museum, sent me for inspection important collections of mosquitoes by preference from northern Norway, and a few specimens were also received from the Bergens Museum.

Professor Dr. Peus, Berlin, repeatedly sent me German mosquitoes and slide preparations for comparison, and he liberally permitted me to make use of his excellent key to the *communis*-group of the genus *Ochlerotatus*. In 1934 I received from Professor Dr. R. Matheson, Ithaca, N. Y., U. S. A. and Dr. C. R. Twinn, Ottawa, Canada, material of *Aëdes nigripes* Zett., *A. nearcticus* Dyar and other North American species, and after the war further material of *A. nearcticus* has been placed at my disposal by Professor Matheson and Dr. A. R. Brooks, Ottawa. Further, I received from Mr. O. Ringdal, Hälsingborg, mosquitoes collected in southern Sweden.

Culicide collections for identification or revision were kindly sent me from: Univ. Museum, Åbo, Finland (Professor Dr. Linnaniemi and Professor Dr. Valle); Univ. Museum, Hälsingfors, Finland (Dr. R. Frey); Statens Växtskyddsanstalt, Experimentalfältet, Sweden (Professor Dr. O. Ahlberg); Zoologiska Institutionen, Univ. Lund, Sweden (Professor Dr. N. A. Kemner); Naturhistoriska Riksmuseet, Stockholm, Sweden (Professor Dr. O. Lundblad); Uppsala Univ. Zoologiska Institution, Uppsala, Sweden (Professor Dr. Sven Ekman); Univ. Zoologiske Museum, København, Denmark (Dr. S. L. Tuxen and the late Dr. Kai Henriksen) and Messrs Dr. K. H. Forslund, Experimentalfältet, Sweden; Mr. Peder Nielsen, lecturer, Silkeborg, Denmark; mag. sc. R. Storå, Nykarleby, Finland; Dr. Søgaard Andersen, København, Denmark and Mr. Bo Tjeder, Falun, Sweden.

The outline maps of Fennoscandia were placed at my disposal by Dr. Carl H. Lindroth, Djursholm, Sweden and the map showing the division of Denmark, Finland, Norway, and Sweden I received by courtesy of Mr. Soot-Ryen, curator at the Tromsø Museum. The unique photograph of a mosquito swarm on the back of a resting man, was received from the former Norwegian Minister at Helsingfors, Dr. Urbye. Some samples of brackish water from mosquito breeding waters have been tested by Dr. T. Pedersen, Biological Laboratory at the University of Oslo.

In the years 1935 and 1937 I secured admission to the Pharmacological Institute (Professor Dr. Klaus Hansen) at

the University in Oslo, where I made precipitin tests. Special literature was kindly lent me from Mrs. Laura Holmboe, Botanical Garden, Univ. Oslo; Lungegårdshospitalet, Bergen; The Agricultural High school Ås; Mr. T. H. Schøyen, Governmental Entomologist, Oslo; Professor Dr. L. Størmer, Palaeontological Museum, Univ. Oslo; University Library, Uppsala, Sweden. A valuable collection of papers in Russian on mosquitoes in U. S. S. R. has been received after the war from Professor Dr. A. A. Stackelberg, Leningrad. Photostate copies of papers not obtainable in Norway have been received through "Deutsches Entomologisches Institut, Berlin-Dalem, Germany (Regierungsrat Professor Dr. Sachtleben) and the University Library, Oslo. Valuable information and support of different kind has been given by: Professor Dr. H. C. Bendixen, Veterinary High School, København, Denmark; Professor Dr. Kaj Berg, Freshwater Lab., Hillerød, Denmark; Mr. P. Bergan, assistant, Zool. Laboratorium, Univ. Oslo, Norway; Mr. Bernhoft-Osa, curator, Stavanger Museum, Norway; Professor Dr. A. Brandt, Veterinary High School, Oslo, Norway; Mr. P. Brinck, amanuensis, Zoolog. Inst., Univ. Lund, Sweden; Professor Dr. Hjalmar Broch, Zoolog. Laboratory, Univ. Oslo, Norway; Mr. B. Christiansen, mus. stip. Oslo, Norway; Professor Dr. K. Dahl, Inst. Exp. Fischery, Oslo, Norway; cand. real. Y. Hagen, Jeløy, Moss, Norway; district veterinarian F. V. Holmboe, Stavanger, Norway; Rector Professor Holt, Veterinary High School, Oslo, Norway; Professor Dr. O. Holtedahl, Palaeont. Inst., Univ. Oslo, Norway; Mr. K. Kristoffersen, curator, Geolog. Mus., Univ. Oslo, Norway; Mr. Johs. Lid, curator, Bot. Mus., Univ. Oslo, Norway; Miss Dr. Montet, Zoolog. Mus., Bern, Switzerland; The Rev. K. Nissen, Lier, Norway; Professor Dr. R. Nordhagen, Bot. Mus. a. Garden, Oslo, Norway; Professor Dr. G. Olin, Bacteriological Laboratory, Stockholm, Sweden; Dr. O. Olstad, chief of the Governmental Game Investigations, Oslo, Norway; Professor Dr. Joh. Ruud, Biol. Lab., Univ. Oslo, Norway; Mr. L. Slagsvold, veterinary director general, Oslo, Norway; Mr. A. Strand, chief of bureau, Direction General of Norwegian Telegraphs, Oslo, Norway; Mr. S. Sømme, chief inspector of Freshwater Fisheries, Oslo, Norway; Professor Dr. Th. Thjøtta, Bacteriolog. Inst., Univ. Oslo, Norway; Professor Dr. M. Thomsen, Agricult. High School, København, Denmark; Mr. Aage Wildhagen, assistant, Governmental Game Investigations, Oslo, Norway.

I am specially indebted to Professor Dr. B. Føyn, Zoolog. Laboratory, Univ., Blindern, for the most valuable support and help he has extended to me and for the interest shown towards my investigation. Further thanks are due to the trustees of the scientific funds: "Professor Robert Colletts Legat", "Nansenfondet", "Norsk Varekrigsforsikrings Fond", "Statens Forskningsfond", and "Universitetets Jubileumsfond" for subsidies which made it possible to carry out extensive investigations in southern Norway. A large contribution to the printing expenses of this paper has been received from the trustees of Nansenfondet, and Director Finn Hvistendahl, Chemical Works, Oslo, has also liberally contributed with a considerable sum.

I am indebted to Professor Dr. A. Heintz, Palaeontological Museum, Univ., Oslo, who has kindly translated extensive parts of Russian papers into Norwegian. Though I have myself translated his text into English I hope that the quotations from Russian, in spite of this double translation, will cover the original text.

Of the 148 text illustrations in this paper, 27 have been reproduced from other works. I hereby beg to express my sincere thanks to univ.stip. Eilif Dahl, Oslo, Professor Sven Ekman, Univ. Zoolog. Inst., Uppsala, Sweden, Mr. Sigurd Johnsen, curator at the Zoolog. Museum, Bergen, N. D. Riley, F. Z. S., Keeper of Entomology and the Director of the British Museum (Natural History), further to Professor W. S. Patton, Liverpool, and Professor Dr. Wesenberg-Lund, Hillerød, Denmark, for their kind permission to make use of these illustrations. Detailed references will be found in the lettering of the figures.

I also wish to convey to the printers, Messrs A. W. Brøgger A/S, Oslo, my best thanks for their readiness and valuable technical suggestions.

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Oslo, December 18, 1947.

Leif R. Natvig.

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VI. Swamp-pool on the ridge south of the Sølen massif, Ytre Rendal (HEn 23), surrounded by open woodland (pines and birches). Characteristic are the tussocks of *Carex juncella* in the *Sphagnum*-moor. At the shallow border of the pool: larvae of *A. punctor*, in the deeper parts of the pool: larvae of *A. excrucians*. (Natvig phot.).

VII. Partly shaded snow-pool near the lake Sognsvannet (AK 13), 15. v. 1937. Larvae of *A. excrucians, communis* and *C. pipiens*. (Natvig phot.).

VIII. Small pools of brackish water near the sea-shore, Prestesand, Kirkeøya, Hvaler islands, 13. iv. 1938. Several larvae of *A. dorsalis, detritus, leucomelas* and a single larva of *A. communis*.

IX. Shoal water ("Verlandungszone") at the border of the lake Fiskumvannet (Bø 13), 3. vii. 1928. Pupae of *A. excrucians* at the border of the lake, male and female adults in multitudes in the grass. (Natvig phot.).

X. Rockpool near the sea-shore, Kirkeøya, Hvaler, 28. v. 1928. Larvae of *Neoculex apicalis*. (Natvig phot.).

XI. Mosquito swarm on a resting man. (Phot. Dr. Urbye).

XII. *Culex torrentum*. Side-view of male. Note the characteristic pointed and upturned palpi. (Orig.).

Chapter 1.

The external anatomy of the mosquito.

A. Imago.

The mosquitoes (Subfamily *Culicinae*) are slender nematocerous *Diptera* with narrow wings, slender legs and a long proboscis projecting forwards from the head. The proboscis, the palps, the head and body, the legs as well as the wing venation are all clothed with scales, which may be of different shape and size.

As in other insects, the body of the mosquito is divided into three divisions — head, thorax, and abdomen (fig. 1).

The head-capsule (fig. 2) is nearly globose, the front part being encircled by the large "compound" eyes which nearly meet above and below. Ocelli are lacking. In front of the head lies the clypeus, forming a conspicuous projection at the base of the proboscis. In the front of the head-capsule, just behind the clypeus, lies the frons. Peterson (1916, *3* (2), p. 17) points out that the front and the clypeus are not always distinguishable in *Diptera* and he therefore uses the term fronto-clypeus for the part in question. The crown of the head is termed the vertex (in many books referred to as occiput), the real occiput being reduced in the mosquito to a small plate projecting from the back of the head (compare Patton, 1929, *1*, p. 56). Matheson (1929, p. 106 et seq.) denominates this posterior part: the nape. Peterson (1916, *3*(2), p. 23) defines the occiput thus: "The occiput comprises all the area dorsad of an imaginary transverse line drawn thru the middle of the centrally located occipital foramen."

As to the denomination of some other parts of the head-capsule the descriptions by different authors do not exactly coincide and there must also be some misinterpretation. Martini in 1931 applied the term "Wange" to the narrow stripe behind the eyes, and Matheson (1929) use the denomination "cheek", evidently for the same part. In the first instance I applied this term myself till I noticed a figure in

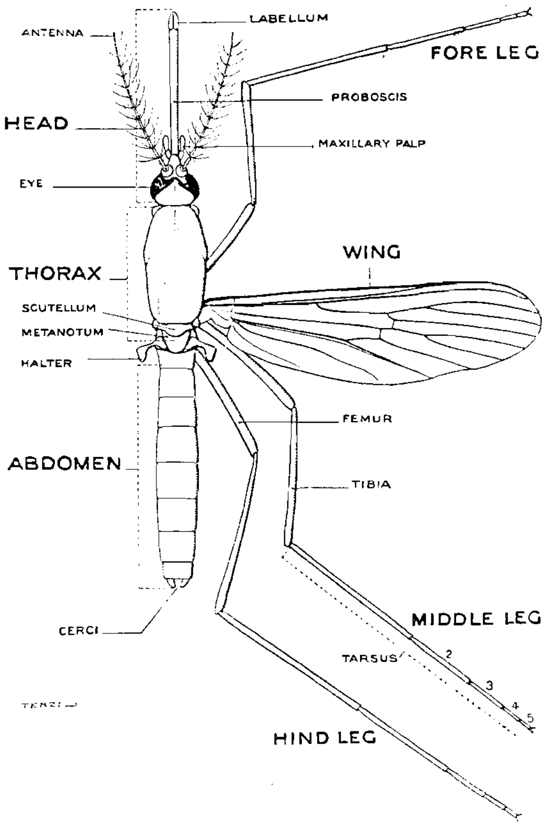

Fig. 1. Generalised diagram of a mosquito, to show the nomenclature of parts. (After Marshall 1938.)

the new edition of Martini's handbook of medical entomology (1941, p. 22, fig. 11), with the terms applied to the different parts of the head. For the part of the head-capsule just mentioned, Martini here applies the term "Schläfe", and alarmed by this I consulted the literature at hand. In "Bronns Klassen und Ordnungen des Tier-Reichs" de Meijere gives the following definition (1916, p. 15): "Wangen (genae) sind die zwischen Untergesicht und den Augen liegenden Bänder, oben sind sie durch den vorderen Stirnrand begrenzt." This seems to correspond exactly with the definition given by Patton (1929, *1*, p. 46): "In systematic work the term vertex is commonly used to include the area on the inner side, and to some extent below each eye, the

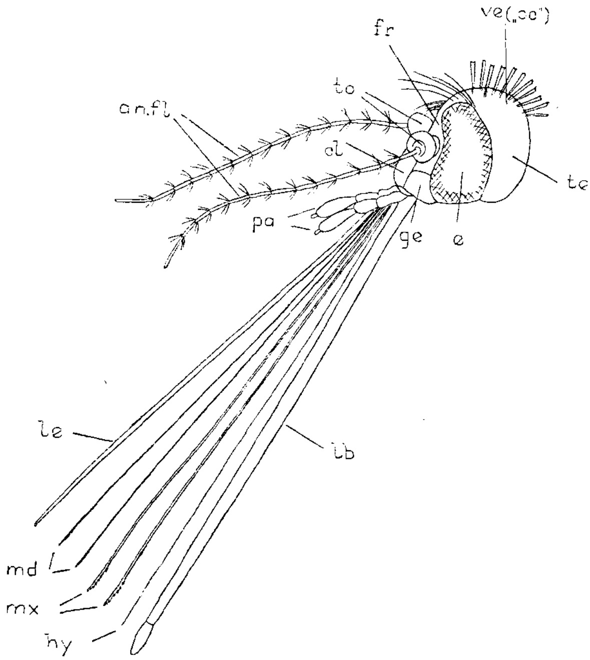

Fig. 2. Head and mouth-parts of a female mosquito. (Aut. del.). an.fl, flagellum of antenna; cl, clypeus; e, eye; fr, frons; ge, gena; hy, hypopharynx; lb, labium; le, labrum-epipharynx; md, mandibles; mx, maxillae; pa, palps; te, tempora; to, torii; ve, vertex; oc, occiput.

latter generally being known as the gena or cheek." If I understand Peterson (1916, p. 23) right he applies the term postgena for the same part as is here termed tempora. Finally Handlisch (in Schröder: Handbuch d. Ent., *3,* p. 102, 1925) gives the following definition: "Das Gesicht (Facies) den nach vorn gekehrten Teil des Kopfes mit Einschluß der zusammengesetzten und einfachen Augen. Es wird oben meist durch eine Quernaht von dem Scheitel, *v,* (vertex) geschieden, grenzt seitlich an den sogenannten Schläfen, *te,* (tempora), deren untere meist zwischen Augen und Kiefer eingeschobene Partien als Wangen, *ge,* (genae) bezeichnet werden, und an die Mundregion oder Mundteile." In the mosquitoes the true genae are quite bare, but Martini (1931) and Matheson (1929) describe the scales on the part of the head which they call the cheeks (Wangen). However this description corresponds exactly with the colour pattern on the stripe behind the eye, termed "Schläfe" by Handlisch (1925) and Martini (1941). I think that the denomination temporae or temples must be the correct one, and I therefore apply this term to the said part in the descriptions.

The head bears the antennae and the mouth-parts. The antennae are inserted on the median side of the compound eyes just above the base of the clypeus. As pointed out by Martini (1931, p. 2) there exists great diversity in the literature concerning the number of segments in the antennae, but Howard Dyar and Knab have ascertained that the mosquitoes of either sex have 15 segments in the antennae. The first segment of the antennae, the scape, is a narrow ring-like structure, which is obscured by the second segment, the globular and cup-shaped torus or pedicel. Concerning the true nature of the scape there still exist diverging opinions. Patton (1929, *1*, p. 56) remarks: "Each antenna is situated on a narrow ring by means of two chitinous points. This ring, which is obscured by the large torus (pedicel), pd., is referred to as the first segment or scape, s., but its structure suggests that it probably represents the antennal sclerite." Martini (1931, p. 2) is of a quite different opinion: "Die Auffassung von Peterson, daß der hier als 1. Antennenglied behandelte Abschnitt der Stechmückenfühler ein besonderer sonst fehlender Antennalsklerit der Kopfkapsel sei, der unter den Dipteren nur bei Culiciden (untersucht wurde *Psorophora*) und *Chironomus* vorkomme, kann aus vergleichenden Gründen nicht geteilt werden. Denn der Torus ist z. B. bei *Dixa* deutlich, wenn auch nicht so übertrieben entwickelt wie bei Culiciden, und hier ist die Natur des Grundgliedes als Fühlerglied unverkennbar, ferner besagt das Fehlen eines Antennalskleriten bei den übrigen Dipteren schon sehr viel, und endlich läßt sich der von uns als 2. Antennenglied aufgefaßte Torus nach seinem Bau (er ist Träger des Johnstonschen Organs) mit dem 2. Fühlerglied anderer Insekten homologisieren." The remaining 13 segments form the flagellum, the segments being of approximately uniform length in the ♀, the two distal flagellar segments being elongated in the ♂. Hairs are attached in whorls (verticils) round the segments. These hairwhorls are basal on all segments of the female flagellum and on the two most distal segments of the male, while in the male they are inserted at about the middle of the first eleven segments. The antenna of the ♂ has a bushy appearance and is said to be plumose, the hairs being

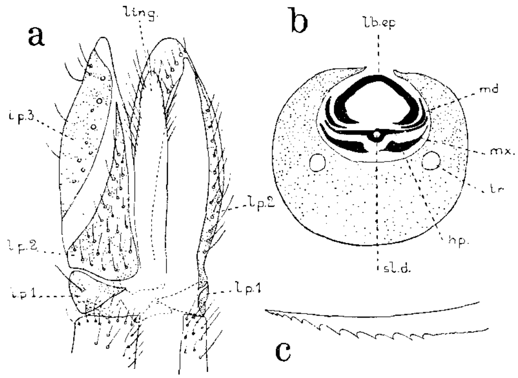

Fig. 3. Mouth-parts of the mosquito. (Aut.del.)
a, labellum of *T. bergrothi* Edw.; l.p. 1, l.p. 2, l.p. 3, segments of reduced labial palps; ling., lingula. b, cross-section through the proboscis (schematic); lb. ep., labrum — epipharynx; md, mandible; mx, maxilla; tr., trachea; hp., hypopharynx; sl.d., salivary duct; c, apical part of the maxilla of *T. annulata* Schrank.

numerous and very long. In the ♀ the flaggelar hairs are fewer in number and shorter and this type of antenna is said to be pilose.

The mouth-parts of the mosquito being of little taxonomic interest, a brief description will suffice for our purpose. In the female the proboscis externally is made up by the lower lip or labium, a hollow, cylindrical tube, which encloses the other mouth-parts, like a sheath, with the exception of the maxillary palps. The labium, which is clothed with scales and hairs, is dorsally narrowly open and terminates in the two pointed labial palps or labellae (fig. 3 A). Within the labium lies the upper lip or labrum-epipharynx, the hypopharynx and the paired mandibles and maxillae. The labrum epipharynx (fig. 3 B) is generally depicted as forming in cross-section a U-shaped channel which is ventrally closed by the hypopharynx. When apposed, the two elements form a closed channel through which the blood is drawn up by the pharyngeal pump. In contradistinction to this view R. Vogel (1921, pp. 268—269) remarks: "Die als Blutsaugrohr dienende Oberlippe — — — bildet sowohl beim Weibchen von *Anopheles* als beim Weibchen von *Culex* eine doppelwandige, ventral geschlossene Röhre, deren im Querschnitt annähernd elliptisches Lumen sich nur vorn an der Spitze und an der Basis beim Übergang in die Mundhöhle ventral öffnet.

Es sind also die in der Einleitung erörterten Angaben bzw. Abbildungen von Dimmock, Nuttal u. Shipley, Schaudinn und Eysell, wonach die Oberlippe der ganzen Länge nach einen ventralen, durch den Hypopharynx verschließbaren Spalt aufweißt, irrig. Dagegen sind die Abbildungen von R. O. Neumann (*Anopheles*), Hartmann u. Schilling (*Anopheles*) sowie Fülleborn (*Stegomyia*) mit ventral geschlossener Oberlippe zutreffend." In recent literature Marshall (1938, p. 61) mentions the two diverging opinions. Patton (1929, p. 81 a, fig. 54, 55, p. 82) depicts the labrum-epipharynx with the attenuated ends slightly overlapping, but he says that the food channel is closed ventrally by the flat upper surface of the hypopharynx. The hypopharynx or tongue is a thin lanceolate sclerotised blade with a list running along its ventral surface, through which a minute channel, the salivary duct passes from the tip backwards to the salivary pump· The mandibles and maxillae are the skin-piercing lancets, the mandibles being only lightly sclerotised; the maxillae are more strongly sclerotised and distally armed with a row of saw-like teeth (fig. 3 C), being of taxonomic interest in the biological races of *Anopheles.*

In the male the mouth-parts are not adapted for piercing, and to some extent they are modified. The hypopharynx is fused with the labium and the maxillae and mandibles are more or less reduced. Marshall and Staley (1935 a, p. 531) have made a closer investigation of the mandibles and maxillae of the British mosquitoes of the subgenera: *Anopheles, Aëdes, Finlaya, Ochlerotatus, Theobaldia, Culicella, Culex* and *Orthopodomyia* and state that maxillae were found in all specimens investigated. Mandibles were found in all specimens of genus *Orthopodomyia* and of subgenera *Anopheles* and *Theobaldia;* in most specimens of subgenera *Finlaya, Culicella* and *Culex;* but in no specimens of subgenera *Aëdes* and *Ochlerotatus*. The average length of the maxillae and (when present) of the mandibles varies greatly in different subgenera. The maxillary palps (or just "palps") are fixed immediately below the clypeus. They vary according to sex and tribe.

In the tribe *Anophelini* the palps of the male and the female are of approximately the same length as the proboscis, but the male palp is ornamented with long hairs on the fourth segment whereas the female palp is slender and not tufted. In the tribe *Culicini* the male palp, in all Northern species except *Aëdes cinereus,* is of the same order of length as the proboscis, and the three last segments are

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Concerning the number of segments in the palps the opinion of different authors are very diverging. Matheson (1929, p. 5) remarks: "At the base of the maxillae are the maxillary palpi consisting of three to five segments." As to the British mosquitoes Marshall (1938, p. 59) says: "The maxillary palps which are made up of five segments only, — — —." Petersen, in his monograph on the head-capsule and the mouth-parts of *Diptera* (1916, *3* (2), p. 38), remarks: "The maxillary palpi of the *Nematocera* figured have from two segments — *Geranomyia* and the female of *Psorophora*[1] — to five segments." Becker (1882) says concerning the palpi of *Culex pipiens* ♂: "Die kurzen — — — Unterkiefer tragen auf einer Tasterschuppe lange, viergliedrige Taster — — —" and as to the ♀: "Die Kiefertaster des Weibchens sind kurz, viergliedrig." Martini, who has published a special paper on the palps of the mosquitoes (1921 a, 25, pp. 295—301), quotes some diverging opinions concerning the number of segments. Thus Howard, Dyar and Knab found in the female *Culex pipiens* four **segments** and in the male five segments. According to Meinert the female palp of this species consists of three segments and the male palp of four. In the tribe *Culicini* Ficalbi interprets the female palp as three to four-segmented and the male palp as four-segmented, whereas Felt describes five segments in the palps of both sexes and according to Theobald the number of segments varies from one to six. Martini goes on (p. 296): "Um eine feste Grundlage zu erhalten, vergleiche man die Taster verwandter blutsaugender Nematozeren. Überall finden wir bei *Ceratopogon, Simulium, Phlebotomus* 4 wohl ausgebildete Glieder während stets ein 5. basales verhältnismäßig schwach ist, niemals einen ganzen Zylindermantel darstellt, aber von dem Stück derberen Chitins, das in die Maxillen übergeht, durch eine weiche biegsame Haut getrennt ist. Die Frage, ob wir diesen untersten Abschnitt als Schuppen oder als Glied bezeichnen sollen, ist natürlich bis zu einem gewissen Grade Geschmackssache. Es steht meiner Meinung morphologisch nichts im Wege, die Schuppe als Rest eines Gliedes zu

[1] a mosquito!

deuten." — — — He describes the male palps of several Genera and concludes (p. 299): "Eines erlaubt allerdings die Muskulaturanordnung nicht, alle Teile bis auf die beiden letzten Glieder als Basalstruktur anzusehen. Das Gelenk am Grunde des langen Gliedes wird durch die Muskelanordnung durchaus als ein funktionierendes erwiesen, ebenso das am Grunde der distalen Schuppe, also an der Basis des ganzen Tasters. Dagegen ist dieselbe aktive Beweglichkeit der proximalen Schuppen unwahrscheinlich, läßt also letztere eher als Teil der Maxille selbst erscheinen. Ursprünglich war ich der Meinung, man müsse in diesen beiden Basalschuppen die Homologe der Glieder 1 und 2 sehen und die Teilung des langen Gliedes sei eine sekundäre, welche eine Biegsamkeit des Gliedes, das sonst als lange Stange störend steif wäre, ermöglichen solle. Ich muß aber sagen, daß ich jetzt zu der umgekehrten Annahme neige." He concludes that the male and female palps in *Anopheles* consist of five segments, and in most other mosquitoes the male palp consists of segments Nos: 1, 2+3, 4,5. The female palp consists in *Culex* of segments Nos: 1, 2, 3, and in the other Northern mosquitoes of segments Nos: 1, 2, 3, 4.

Patton (1929, *1*, p. 71 and fig. 49, p. 72) describes the maxillary palps of *Culex pipiens*, and he interprets the two basal sclerites (Basalschuppen) as true segments. He therefore emphasizes that the female of this species has four palpal segments. Brunetti, in his critical review, seems mostly not to take into consideration the basal sclerites of the palps. Concerning the *Culex* group however he declares (1914, p. 21): "The question of 3 or 4 joints in the male in *Culex* rests practically on the division or otherwise of the long 1st joint; that of 5 joints, if so many are ever present, on the presence of a small basal joint, which, moreover, may perhaps be an antennal protuberance only, such as exists in many diptera and which (as in some species of *Phlebotomus*) has frequently given rise to controversy as to its exact nature."

In connection with these problems I have examined several slide preparations of male and female palps of the genera *Anopheles, Theobaldia, Aëdes (Ochlerotatus)* and *Culex,* and I do not fully agree with Martini concerning the interpretation of the segments. No doubt I have not examined slide preparations of the muscles in the palps, but in my opinion, the existence of muscles will only throw light on the actual function of the segments, and little information can be gained thereof concerning the phylogenetic

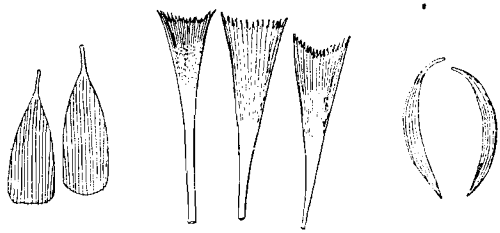

Fig. 4. Some examples of three common types of scales found on the head, thorax and abdomen of a mosquito. a, flat scales; b, upright forked scales; c, narrow curved scales. (After Patton and Evans 1929).

evolution. As to the muscles H. J. Hansen (1930, p. 242) remarks: "The coming into existence or disappearance of muscles to joints of thoracic legs or mouth-parts can be pointed out to such a degree not only in orders of the same class but in allied families of the same order, that in most cases such features are seen to be of secondary nature." In most species examined the two basal sclerites (Basalschuppen) are separated, and an incurvation in the middle of the basal "segment" seems to indicate that a fusion has taken place. As pointed out by Patton (1929, *1,* p. 71) the two basal segments are only indistinctly separated in *Culex;* he is here using the term segment for the same part that I have above denominated basal sclerite. From the preparations examined, I have got the impression that the interpretation of Patton is the correct one as to the two basal segments. In the middle of the long segment there may be a break and just at this point the chitin may be more or less membranous, forming a little "window" or, according to Martini, in some instances even a ring. Examining the cuticle in this part of the palps I can not find indications that we here have to do with a true joint, and that the long segment therefore actually should consist of two segments. According to this I am inclined to interpret the palps thus: in the genus *Culex* the male palps consist of five segments and the female palps of four; in the other Northern genera the male and female palps consist of five segments. Further research on the palps of the mosquitoes is however highly desirable.

The head bears bristles, hairs and scales which may be of taxonomic value (fig. 4). Bristles border the posterior

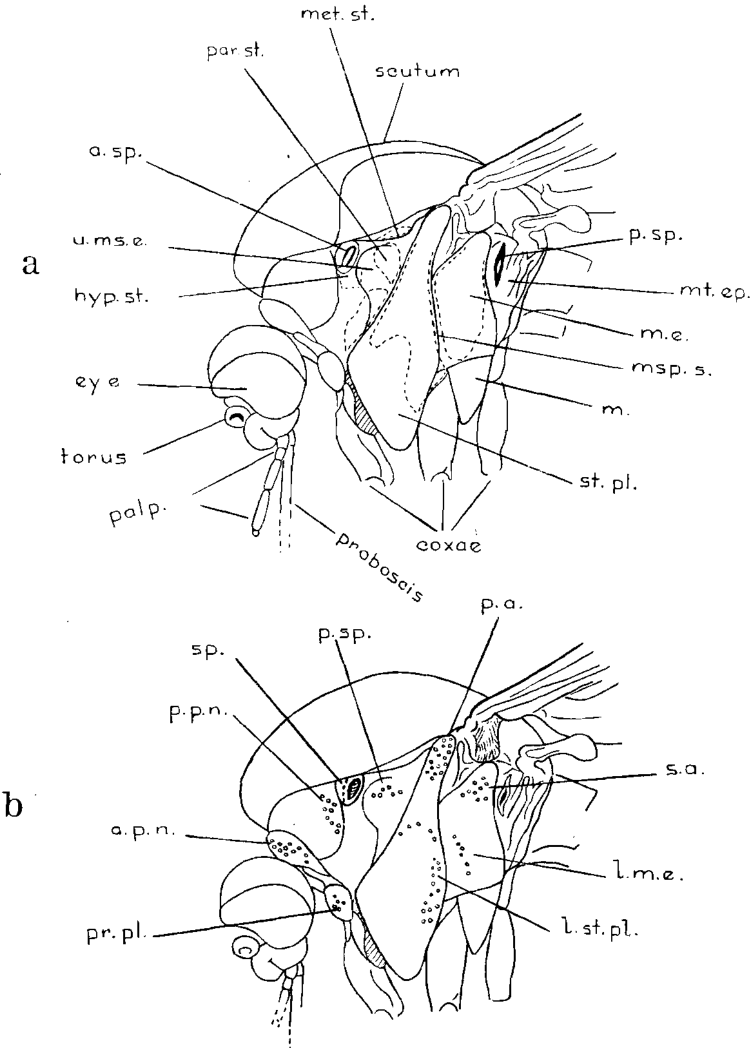

Fig. 5. Side-view of thorax (diagrammatic) to show pleural sclerites and scale-patches (a) and arrangement of bristles (b).
Figures redrawn after Peus (1933), lettering by preference according to Edwards (1932), terms for the scale-patches after Peus, other terms used by him in brackets. a, a.sp., anterior spiracle; hyp.st., hypostigmal; m,meron (Hypopleura); m.e., mesepimeron; msp.s., mesopleural suture; mt.ep.,metepisternum (dorsales Metepistern.); met.st.,

margin of the eyes. Hairs are projecting between the eyes and form the frontal tuft. The vertex is clothed with narrow curved scales. Upright forked scales are only found on the upper posterior part of the vertex and at the back of the head. The temporae are mostly clothed with broad flat scales.

The Thorax (fig. 5) is a somewhat rigid, wedge-shaped structure, formed by fusion of three segments, viz. the prothorax, the mesothorax and the metathorax. Of these body-segments only the mesothorax containing the wing-muscles, is well developed, the prothorax being reduced to lateral lobes and the methathorax is still more reduced than the prothorax. The dorsal surface of the mesothorax is denominated the mesonotum. Its principal part, the scutum is faintly divided in two sections, the anterior prescutum and the posterior mesoscutum. Posterior to the scutum lies the scutellum which in most Northern mosquitoes is a trilobed structure; in the genus *Anopheles* however the scutellum has nearly rounded outlines. The dome-shaped postnotum ("Mesophragma"), lying behind the scutellum, is a separate sclerite in the membrane between the mesonotum and the narrow metanotum.

The lateral parts of the thorax, the pleurae, are sclerotised. As emphasised by Patton (1929, *1,* p. 86) an important landmark on the pleurae is the mesopleural suture (map. s.); the large irregularly shaped sclerite, in front of it, is the mesepisternum and that posterior to it the mesepimeron. These sclerites are further divided in minor parts whose denomination will be seen from the figure. In the terminology I here follow Edwards (1932) but other terms applied to these parts are inserted in brackets. Patton (1929, *1,* pp. 85—87) has worked out a minute terminology for the minor divisions, but I think the terms here applied will suffice for our taxonomic purpose. Concerning the sclerite termed meron by Edwards (1932, p. 248, pl. 3, fig. 28, 29), Patton (l. c.) gives a different interpretation. This sclerite, lying between the middle and hind coxae, he

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metastigmal; par.st., parastigmal; p.sp., posterior spiracle; st.pl., sternopleural (ventr. Mesepistern); u.ms.e., upper mesepisternal (dors. Mesepistern). b, a.p.n., anterior pronotal (Pronot.); l.m.e., lower mesepimeral; l.st.pl., lower sternopleural (u.Mesepist.); p.a., pre-alar (o., Mesepist.); p.p.n., posterior pronotal (Proepim.); p.sp., post spiracular; pr.pl., propleural (Prostern.); s.a., sub-alar (o.Mesepim.); sp. spiracular denominates the m e s e u s t e r n u m, applying the term meron to the elongated sclerite articulating with the hind coxa.

Further thoracic landmarks are the a n t e r i o r s p i r a c l e, just behind the p o s t e r i o r p r o n o t u m, and the p o s t e r i o r s p i r a c l e, between the u p p e r m e s e p i m e r o n and the h a l t e r.

Peus (1933, *12* (1/2), p. 145—159) has with advantage used the scale pattern on the pleural sclerites for differentiation of the *Ochlerotatus*-species in the *communis*-group. His key will with some modifications, be employed here and a figure after Peus is reproduced below, (fig. 5) the terms being altered in part, according to the revised terminology applied by Edwards (1932, p. 248, pl. 3, fig. 28, 29).

Edwards (1921, *12* (3), p. 265) emphazises the importance of the pleural bristles for taxonomic purpose, and I quote below the details of interest for this treatise (Edwards, 1932, p. 4):

"A n t e r i o r p r o n o t a l, the bristles on the rounded pronotal lobes, — — —.

P o s t e r i o r p r o n o t a l (also called, probably wrongly, p r o - e p i m e r a l), on the part of the side of the thorax above the anterior pronotal lobes and in front of the spiracle. ——.

P r o p l e u r a l, a small group on the lower part of the propleurae, immediately above the front coxa; — — — — (these are the hairs described as prosternal by Christophers, but they do not belong to the sternum).

S p i r a c u l a r, a row immediately in front of the anterior spiracle, — — —. It is necessary to distinguish carefully between the spiracular and the posterior pronotal hairs; the former are usually shorter than the latter, and their position is b e h i n d a slight ridge which forms the posterior border of the posterior pronotum.

P o s t - s p i r a c u l a r, a group situate on the more or less membranous area of the pleurae behind the prothoracic spiracle, specially characteristic of the *Aëdes* group.

S t e r n o p l e u r a l, a more or less continuous row on the posterior border of the sternopleura.

P r e - a l a r, a group on the small knob immediately below and in front of the wing-root.

S u b - a l a r (or u p p e r m e s e p i m e r a l), immediately

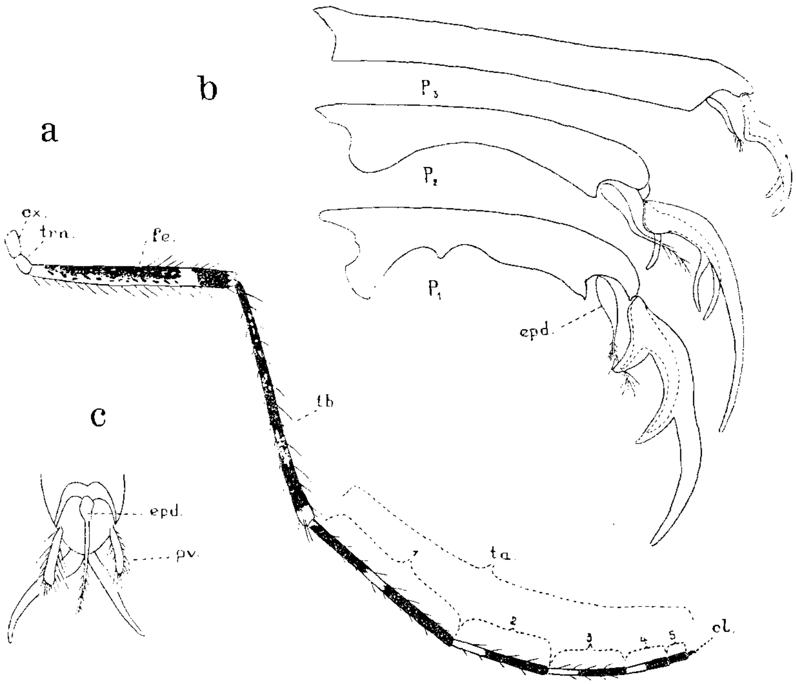

Fig. 6. The leg of the mosquito. (Aut. del.).
a, the hind leg of *T. annulata* Schrank; cx, coxa; trn, trochanter; fe, femur; tb, tibia; ta, tarsus; cl, claw; b, the claws of fore-, middle- and hind tarsus of *T. bergrothi* Edw. (male); epd, empodium; c, claw of hind tarsus of *Culex (Neoculex) apicalis* Adams (female); epd, empodium; pv, pulvillus.

below and behind the wing-root, on upper part of mesepimeron, in front of metathoracic spiracle.

Lower mesepimeral, often present on to middle or lower part of mesepimeron, usually towards its anterior margin; sometimes liable to be confused with the sternopleural."

The mesonotum is clothed with scales whose coloration and patterns furnish valuable diagnostic evidence. Eysell, who has made a fine investigation on the ecdysis of the mosquito, remarks concerning the scaling (1911, p. 329): "Wie das Haarkleid der Säuger, das Federkleid der Vögel, so zeigt auch das Schuppenkleid der Stechmücke Strömungen, deren Verlauf gesetzmässig festgelegt ist. Die Schuppenrichtung ist bei den Stechmücken eine solche, daß die Imago beim Schlüpfen nicht unnötige Wiederstände erfährt, ja daß sie im Gegenteil durch das Vorhandensein der Schuppen sogar bei diesem Werke unterstützt wird. Wie die Schienen der Eisenbahnen, die Eisen der Schlittschuhe, die Stahlkugeln in den Lagern der Fahrradachsen die Reibung ausserordentlich verringern, so verringern dieselben auch die Epidermisschuppen, Haare usw. der Stechmücke." Besides hairlike scales we also find hairs and bristles on the mesonotum, but these are of little use for diagnostic purposes.

Each thoracic segment bears a pair of legs, the mesothorax a pair of wings and the metathorax a pair of halteres.

The legs (fig. 6 A) of the mosquito are long and slender. Each leg consists of the following segments: the coxa, the trochanter, the femur, the tibia and the five segments of the tarsus, thus forming together nine segments. The joint between the femur and the tibia is known as the knee. Generally the length of the legs increases from ahead and backwards. The legs are clothed with scales, the colour of which may be of taxonomic value. Near the apex of the tibia a transverse row of hairs is, in some generae, accompanied by a more distal transverse row of stouter spines, known as the tibial scraper. The relative length of the several parts of the leg and the segments of the tarsus, have been used for taxonomic purpose. The tarsal segments are mostly slender and rod-like, except the fifth segment in the foretarsi of male *Anopheles* and fore- and midtarsi of male Culicines. Here the segment is concave at the under side, and carries spines and basal teeth (fig. 6 B). The fifth segment bears the claws. These may carry teeth and they vary considerably in size and shape, according to sex and species. Often the several pairs of legs of the same species differ concerning the shape of the claws. Between the claws is the median empodium and beneath them are the paired pulvilli (fig. 6 C). Also these structures, however, are variable in shape and may be of taxonomic value.

The long and narrow wings (fig. 7) of the mosquito and their venation are very characteristic. As the venation is of great taxonomic value, a nomenclature for these struc-

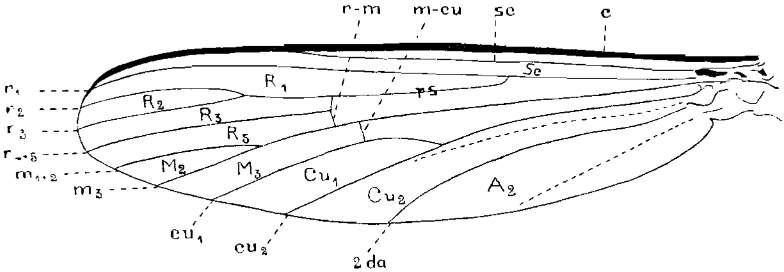

Fig. 7. Wing of *A. (O) excrucians* Walk. (Aut. del.). Labelled according to the R-C-N nomenclature, the old nomenclature in brackets. c, costa; sc, subcosta (auxilliary); r, radius, divides into simple anterior vein r (1st longitudinal) — and a primary branch r_s (radial sector) which divides into three branches: r_2 and r_3, (2nd long), r_{4+5} (3rd long), m_{1+2} and m_3 (4th long); cu_1 and cu_2 (5th long); 2nd a (6th long). The corresponding cells are indicated by capital letters.

tures became necessary. Unfortunately the interpretation of the wing veins did not coincide and in consequence therewith the terms applied to the individual vein by older authors, did not always agree. A uniform nomenclature for the wing venation of all orders of insects was established by Comstock and Needham (1898—99), partly based on previous studies by Redtenbacher (the R-C-N nomenclature). Recently Tillyard (1919, *44,* (3), pp. 533—718) has made closer investigations in the matter and published several corrections on this system. According to Patton and Evans (1929, *1,* p. 183) Christophers and Barraud have published an interpretation of the R-C-N nomenclature concerning the wing of the mosquito.

In conformity with Edwards (1932) I apply the R-C-N nomenclature in this treatise. According to this system six main long veins enter the wing, i. e. the costa (c), subcosta (sc), radius (r), media (m), cubitus (cu) and analis (a). The veins may be simple or they are divided into branches (forks). A simple vein is an unbranched vein. A simple branch is an unbranched branch. The first branching from the main vein is termed the primary fork and the secondary branching takes place at secondary forks. The basal part of the vein, proximal to the fork, is the stem. The branches of the veins are indicated by small numbers added to the name of the vein, e. g. r_1 stands for the first branch of radius. When two branches have united, this is indicated by the two numerals added, e. g. r_{4+5} means the fused branches: radius 4 and radius 5. The radius separates at its primary fork into two unequal parts; the first of these is the simple vein r_1; the second gives rise to the remaining three branches of radius. This second part of the radius, including its branches, is termed the radial sector or vein r_s. Concerning the cross veins, we note the two apparent cross veins on each side at the base of the long vein about the middle of the wing (r_{4+5}). The anterior is probably not a true cross vein but is supposed to be origin of the long vein (r_{4+5}). The posterior is the radio-medial cross vein (r—m). The cross vein joining the media with the anterior branch of the cubitus is the medio-cubital cross vein (m—cu). The relative dimensions of details in the wing venation may exhibit variations which provide valuable indications for diagnostic purpose. Thus, for example, the distance between the cross-veins r—m and m—cu varies in different genera and species. This distance is generally measured in terms of the length of the posterior cross-vein (m—cu), but Marshall (1938) has introduced the term the shift of the m—cu. This means the numeral ratio obtained by dividing the length of the m—cu into the length by which it is distant from the r—m. The areas of the wing membrane, bordered by the veins, are named the cells, and they are denominated after the vein forming their anterior border. These brief remarks will possibly suffice for our purpose. For further details see the excellent handbook of Patton and Evans (1929), where a review of the different systems of nomenclature will be found.

A diagnostic feature, which at once characterizes the wing of the mosquito, is the appearance of the long vein (r_{4+5}), about the middle of the wing, between the two forked veins. Another characteristic feature is the scales. These cover the veins, and the posterior margin of the wing is fringed with scales of different shape. Also the scales covering the veins are of different shape and may be of interest for taxonomic purpose. In most species the wing scales are uniform dark, but some species have both dark and light scales on the veins, forming characteristic colour patterns. In *Anopheles maculipennis* and the subgenus *Theobaldia* the wing presents a spotted appearance, the scales in these spots being either exceptionally large or exceptionally numerous (fig. 8). On the wing-membrane we find minute hair-like structures, known as the microtrichiae. The

Fig. 8. Wing of *Theobaldia annulata* Schrank. (Orig.)

halteres represent the modified hind wings. They are elongated and consist of a cylindrical stem terminating in a globular body. Both the stem and the globule may be more or less clothed with scales.

The third region of the body of the mosquito, the abdomen, is made up of ten segments, all but the last two consisting of a dorsal sclerotised shield, the tergite, and a ventral sclerotised shield, the sternite, joined together by the unsclerotised, flexible membranes, the pleurae. The first abdominal segment has about half the length of the following, the spiracles lying in the soft membrane (pleuron) in the 2.—7. segment. The ninth and tenth abdominal segments are modified to form reproductive organs. Form and length of the abdomen is varying in the different genera, but may also, to a certain extent, depend on the feeding state of the specimen examined.

As to the origin and homology of the external organs of reproduction the opinions are very divergent and in consequence therewith also the nomenclature of these organs. Handlisch, in his handbook (1925, *1,* p. 1291) says: "An den männlichen Geschlechtsorganen beteiligen sich sehr oft die zu sogenannten Gonopoden umgewandelten Gliedmaßen des neunten Segmentes, teils als Tastteile teils als Halteapparate. — — — Das eigentliche Begattungsorgan aber ist nach meiner Überzeugung kein Derivat von Gliedmaßen, sondern eine Bildung eigener Art, die wir kurz als Penis oder Rute bezeichnen." Martini 1928 b, p. 150) is of a different opinion as to the terminology of these organs: "Das Wort Gonopoden sollte ebenfalls nicht eher aufgenommen werden, als eine Homologie der Teile durch alle Insektenordnungen festgestellt und der Wert der Valven als Gonopoden gesichert ist. Ebenso scheint mir dem Ausdruck "Coxit" gegenüber vorerst eine gewisse Reserve am Platz." In contradistinction to this, investigators as Christophers (1928), Feuerborn (1922), Freeborn (1924) and Snodgrass consider the external organs of reproduction as modificated abdominal appendages, and Imms (1925, pp. 43—44), after giving a brief summary of the views held by various authorities, says: "On the whole the balance of opinion inclines towards the theory of appendicular origin".

In the female the abdomen is either more or less pointed (*Aëdes)* or it is obviously blunt-ended (the remaining northern genera). A treatise in the genital armature of the female mosquito were published by Macfie and Ingram (1922, pp. 157—188), based on fifty West African species. The authors declare (l. c. p. 157): "It may be said generally that we have found in most cases well marked differences between distinct genera, but only slight or almost inappreciable ones between species of the same genus." They depict several species, but names are only given to some of the sclerotised parts. Christophers (1923), who devoted a closer study to the female abdominal segments and who established a terminology of the different parts, says: "The characters of the female hypopygium do not vary greatly throughout the sub-family and with few exceptions do not exibit any very striking lead as to their use in classification. In spite of this there are clearly very definite differences in the details that might be distinctly helpful in certain instances." The eighth segment is not usually much specialised, but this is the case with the succeeding segment (fig. 9). The ninth tergite is a small sclerite which in some genera has a ribbon-like form. The genital opening is situated in the intersegmental membrane posterior to the eight sternite, and behind this opening we find a small plate, named the postgenital plate, varying in different species. Posterior to the structures mentioned lies the tent segment, bearing the cerci. These are leaf-shaped in certain groups, but are usually more or less truncated stumpy flap-like organs. Round the genital opening are several sclerotized plates termed by Christophers (1923, pp. 704—705): sigma, insula and atrial plates. Nelson C. Davis (1926) has undertaken an attempt, on Brasilian Anophelines, to use the female terminalia in a classificatory scheme. As to the palaearctic mosquitoes the females of some species have been described and depicted by Brolemann (1919—1920), and a few by Séguy (1923), but, as far as I can see no general treatise on the female abdominal segment of the palaearctic species has hitherto been published. In the subgenera *Aëdes* and *Ochlerotatus* the cerci are mostly long and prominent and the eight abdominal segment retracted

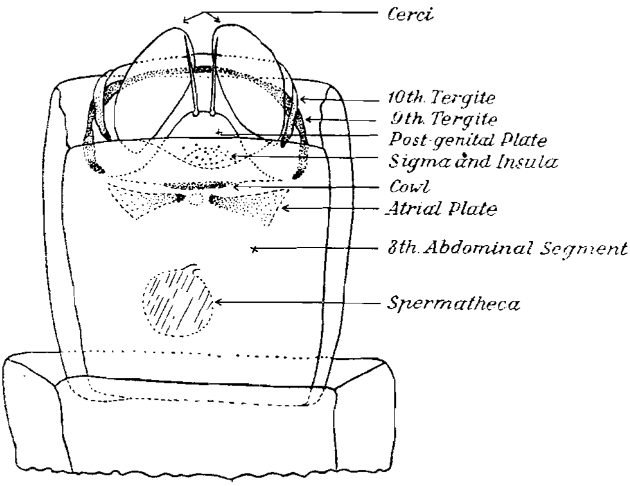

Fig. 9. Female terminalia of Anopheline mosquito. Diagrammatic. (After Nelson C. Davis 1926).

more or less completely within the 7th., whereas in the genera *Anopheles, Theobaldia, Culex* and *Mansonia* the cerci are short.

The morphology of the male external organs of reproduction is of the greatest importance in the classification, and, as emphasized by Feuerborn (1923, p. 192) the morphological details of these organs give valuable indication as to the real relationship of the different orders of insects. Since the fundamental work on the classification of the American mosquitoes by Howard, Dyar and Knab (1912) [2] an enormous amount of work has been done in describing and depicting the male genital organs in hundreds and hundreds of mosquito species. Unfortunately great diversity exists in the naming of the different parts, and this unsatisfactory state of things brought Edwards (1921, p. 23 et seq.) to a closer investigation of the male terminalia of the mosquitoes. In this classical treatise he clears up the morphological signification of these organs, their homology in the different genera and their most suitable denomination. At the end of his paper Edwards gives a valuable synopsis of the denomination of the different parts used

[2] Howard, Dyar and Knab: "The mosquitoes of North- and Central America and the West Indies." Washington 1912.

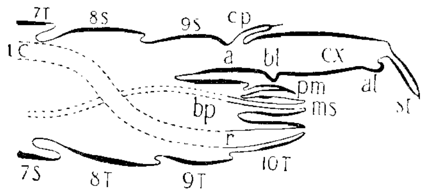

Fig. 10. Longitudinal section (diagrammatic) through distal abdominal segments of a male *Aëdes* subsequent to axial rotation. Sclerotised and unsclerotised membranes are indicated by thick and thin lines respectively. al, apical lobe; bl., basal lobe; bp., basal plate; cp., claspette; cx., basistyle; i.c., ileum-colon; ms., phallosome; pm., paramere; r., rectum; s., sternite; st., dististyle; t., tergite. (After Marshall 1938, redrawn from Edwards).

by previous authors. Already in 1915 Christophers,[3] in a paper on the male genitalia of *Anopheles,* had pointed out the important fact that in from 24 to 48 hours subsequent to the emergence of the male mosquito the eighth and the subsequent abdominal segments rotate axially through an angle of 180° (fig. 10). In other papers (1922 and 1923) he has worked out the ontogenesis of the male and female genital organs and the homologies of the terminal segments of the larva and the adult of the mosquitoes. In 1922—23 Christophers and Barraud published a proposal for a uniform denomination of the different parts of the male hypopygium. Comprehensive investigations on these organs have also been published by E. Martini (1922 and 1928), who not merely treated the object from a morphological point of view but who also, investigating the musculature, gave an insight into the action of the different parts. In the last mentioned paper he gave a critical review of the publications of some previous authors and he proposed a uniform German nomenclature for the different parts. In 1924 (p. 188 et seq.) Freeborn advocated that the nomenclature of the genitalia of the mosquitoes had to be brought in conformity with the ordinary denominotion used for these parts for insects in general· As really several culicidologists have a certain tendency to make a special science out of their investigations without taking into consideration the names used for other groups of insects, this proposal is of special importance.

[3] According to Marshall and Staley (1932) this fact is first mentioned by Christophers in the Roy. Soc. Rep. to the Malaria Committee, Fourth Series. London 1901.

As to the rotation of the hypopygium, Feuerborn, in his treatise mentioned above (1923 a, p. 192 et seq.) took as his starting point Bruel's observation (1897, p. 524) that vas deferens, in *Calliphora,* is coiled round the rectum. This rotation of 360 degrees is designated by Feuerborn as "Hypopygium circumversum". He confirmed the same fact for *Psychoda,* where the rotation is 180 degrees and he designates this as "Hypopygium inversum". He is of the opinion that the ductus and genital aperture can only gain their position dorsal to the rectum and anus through a postembryonal rotation of the segments in question. By comparative investigations of the apical abdominal segments in the larva, pupa and adult he could point out that the stigmata, rectum and genital aperture had quite the opposite position in the adult to that which must be expected when taking the morphology of the larva into consideration. Martini (1928 b, p. 148) points out that he posesses several preparations of male mosquitoes, not at all killed subsequent to emergence, where the rotation of the hypopygium failed. He emphasises that further investigations must be carried on and he suggests the possibility that the rotation is connected with the mating process.

In a paper on "Sexual selection and allied problems in the insects" Richards (1927) states that in the mosquitoes certain intersegmental muscles contract permanently soon after emergence and he says further (l. c. p. 343): "It is a remarkable fact that the twisting should not take place till after emergence, and this is probably only the case when there is no marked skeletal assymetry." According to Richards (1927, p. 332) the "hypopygium inversum" is to be found in some Asilid genera, in all the *Culicidae* (including *Dixa*), in the Eriopterine Tipulids, and all the *Psychodidae.* Lindner records it in *Diadocidia (Mycetophilidae)* while Richards has stated it in *Bombylius discolor* Mikan.

Further contributions to the elucidation of this problem are to be found in a treatise by Marshall and Staley (1932, pp. 368—381): "On the distribution of air in the oesophageal diverticula and intestine of mosquitoes." The authors state inter alia: "Shortly before the imago emerges, air accumulates under the pupal skin. This air is swallowed by the imago and pases directly into the stomach; the resulting distention of the abdomen helping to push the thorax forward so as to rupture the pupal skin. — — — Within an hour after complete emergence of the imago, the air in the mid-gut commences to pass forward into the (hitherto empty) oesophageal diverticula,[4] and after 12—22 hours the mid-gut no longer contains air. — — — In the case of male mosquitoes, the transference of air from the mid-gut to the oesophageal diverticula proceeds pari passu with the turning of the hypopygium, the two processes terminating at about the same time." They conclude thus: "Why this transfer of air to the diverticula coincides with the rotation being effected remains to be explained."

The abdomen in the male mosquito generally is longer than that in the female, at least relatively but often also absolutely. Snodgrass (1904, p. 179) has fixed the term "hypopygium" to the male genital segment and its appendages, i. e. the ninth segment. As however also other abdominal segments are of importance for the classification I prefer, in this treatise, in accordance with Freeborn (1924) and Martini (1931), to use the term "terminalia" for the hinder modified abdominal segments. Edwards (1932, p. 5) has also adopted this term as preferable to hypopygium.

As pointed out by Edwards (1920, p. 24) the terminalia of mosquitoes are composed of four distinct parts.

1) A more or less continuous sclerotised ring, representing the tergite and sternite of the ninth abdominal segment.
2) A pair of appendages of the ninth segment, more or less ventral in position.
3) Sclerotised pieces surrounding the anus.
4) Sclerites of the genital tube.

The figure (fig. 11), reproduced after Christophers (1922, p. 533), gives a good outlined general view. As to the nomenclature of the different parts see below.

In addition to the parts quoted above we also mention the eighth adominal segment, which is of interst in the Genus *Theobaldia,* in which some species bear a row of spines on the apical edge of the tergite. Freeborn (1924, p. 190) emphasises that this segment joins with those caudad of it in rotating on its longitudinal axis through an angle of 180 degrees.

The ninth segment is mostly a closed ring, dorsally and ventrally often expanded, laterally very narrow but rather stout (fig. 12 B). Martini (1928 b, p. 152) remarks: "Daher kann man ebensogut von einer Ventral- und Dorsal-

[4] see p. 55.

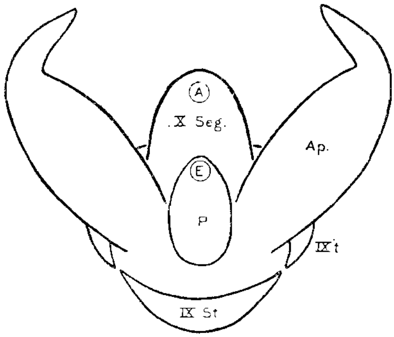

Fig. 11. General plan of male terminalia. (After Christophers 1922.) A, anus; Ap, basistyle; P, aedoeagus; X. Seg., proctiger; IX. St., IX. T., sternite and tergite of the ninth segment.

platte sprechen, welche in den Seiten durch Seitenbügel zusammengehalten werden. Der Seitenbügel trägt gelegentlich einen Gelenkfortsatz, — —." The ninth tergite is generally more or less distinctly bilobed, the lobes bearing bristles or spines. In *Aëdes, Ochlerotatus* and *Theobaldia* they are distinct but mostly moderately developed, in *Anopheles* they are only faintly visible. The ninth sternite exhibits few modifications, being usually represented by a narrow strip of chitin.

Within the sclerotised ring of the ninth segment arise, on the ventro-lateral margin, two large appendages, divided into two or three segments, and which act as clasping organs. These appendages have collectively been termed the f o r c e p s, but Freeborn (1924, p. 199) proposes the term g o n o s t y l e s, and points out that they develop from the exopodits of abdominal limbs. Edwards (1920) termed the basal segment of each appendage: the "side-piece", the second segment: the c l a s p e r and the ultimate: the claw. In 1932 he accepted the term "coxite" for the first segment, and the style for the second. As Freeborn (1924, p. 201) has pointed out that a small sclerite, at the outer base of the first segment, is really the c o x i t e, I find it consistent to use, with Freeborn, the term b a s i s t y l e for the first segment and d i s t i s t y l e for the second segment. The segmental nature of the claw is uncertain, and Freeborn therefore uses the term: appendage of the diststyle, avoiding the denomination claw as some tropical forms have other appendages in this place. However all the northern

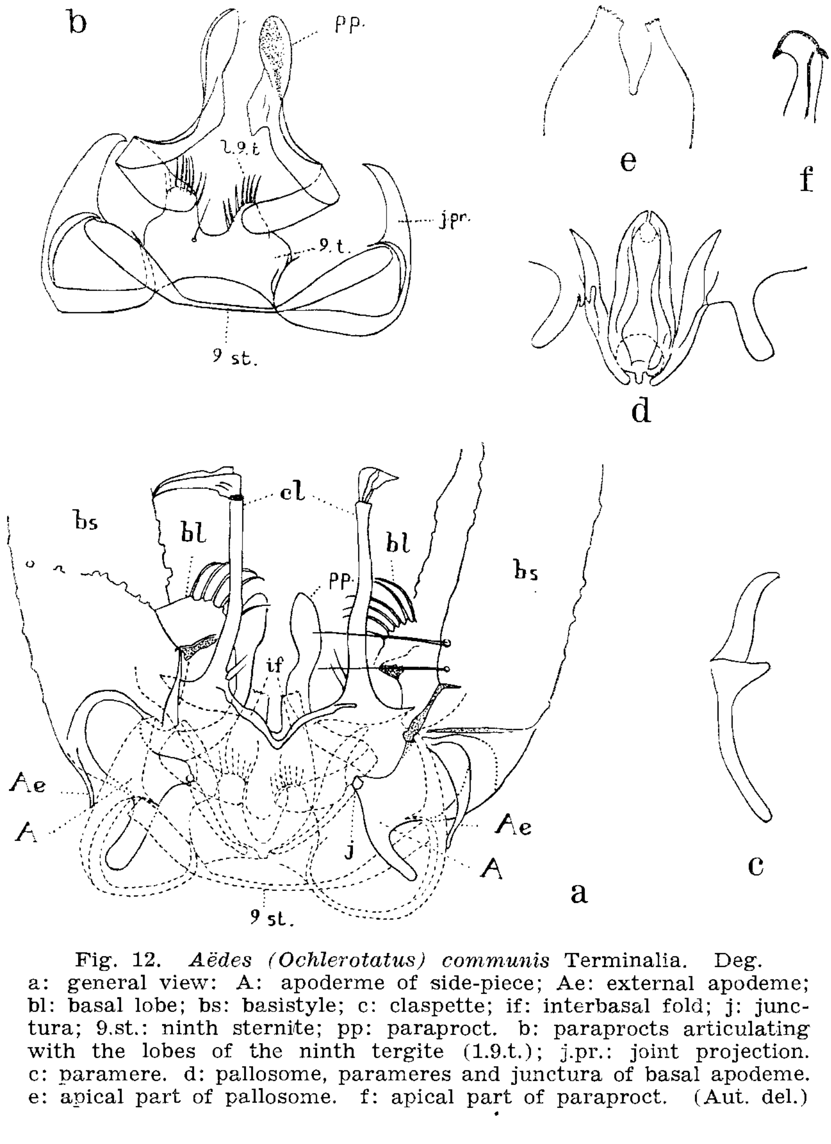

Fig. 12. *Aëdes (Ochlerotatus) communis* Terminalia. Deg. a: general view: A: apoderme of side-piece; Ae: external apodeme; bl: basal lobe; bs: basistyle; c: claspette; if: interbasal fold; j: junctura; 9.st.: ninth sternite; pp: paraproct. b: paraprocts articulating with the lobes of the ninth tergite (1.9.t.); j.pr.: joint projection. c: paramere. d: pallosome, parameres and junctura of basal apodeme. e: apical part of pallosome. f: apical part of paraproct. (Aut. del.)

mosquitoes have more or less claw-like appendages, and I therefore prefer the brief and plain denomination c l a w.

The b a s i s t y l e, in its most primitive form, is a hollow sclerotised tube, widely open at the base, tapering more or

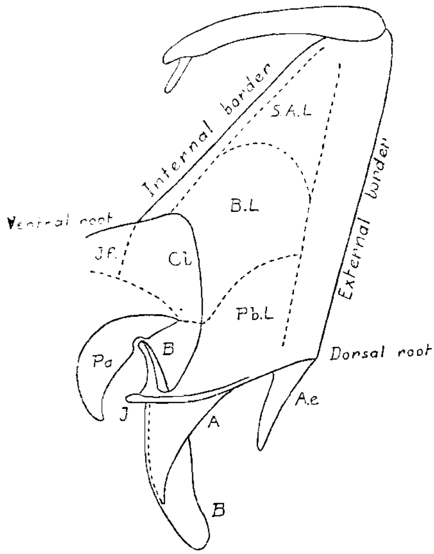

Fig. 13. Topography of the terminalia (redrawn after Christophers and Barraud 1922—3).
A, apodeme of side-piece; Ae., external apodeme; B., basal apodeme; Bl., area of basal lobe; Cl., area of claspette; If., interbasal fold; J., junctura; Pa., paramere; Pb.l. area of parabasal lobe and spines (Anopheles); S.A.l., area of sub-apical lobe. (Lettering partly altered according to terminology of this treatise).

less apically and without lacunae. This type we find in *Anopheles*. In other forms a lacuna, i. e. a membranous area, is hollowed more or less out of the inner face of the sclerotised basistyle. In *Theobaldia* this lacuna may extend about one third the way out from the base, in *Culex* about two thirds and the most extreme type we find in the genus *Aëdes*, where the lacuna extends from the base of the basistyle to its tip. As Edwards (1920, p. 28) remarks: "Here the side-piece forms a lower flap (ventral in actual position) and an upper flap (dorsal) connected on the outside by chitin and on the inside by thin membrane, which extend right up to the tip."

At the base of the basistyle there are some internal prolongations into the ninth segment. As these prolongations are of a somewhat complicated construction, the opinion of the authors differs to some extent as to their true nature, and I therefore find a closer reference necessary. At the external border of the basistyle we have the external apodeme (fig. 12, Ae), which joints to the joint-projection ("Gelenkfortsatz") of the sclerites of the ninth segment. The other internal prolongation, the apodeme of the side piece (fig. 12 A), is described by Christophers and Barraud (1923, p. 832) as follows: "An apodematous continuation of the dorsal portion of the anal surface of the side-piece". An instructive figure, published by Christophers and Barraud, is reproduced here (fig. 13), and I also refer to the figures of the genitalia of *Ochlerotatus communis* (fig. 12) and *Culex pipiens* (fig. 118), delineated after slide preparations. Edwards, who describes, as separate sclerites, some "basal plates", remarks (1920, p. 34): "The basal plates vary much in size, attaining their maximum in *Culex* and *Theobaldia.* They articulate near their inner extremities with the apodeme of the side-piece, and it is noteworthy that the size of the apodemes varies inversely with that of the basal plates. In very many cases . . . there is a definite fusion between the basal plates and the apodeme, so that it is impossible to say where one ends and the other begins." In contradistinction to the above-mentioned, Martini (1922 a), describing the apodemes, concludes: "Man sieht, daß ich ein gesondertes, der Basalplatte bei Edwards entsprechendes Stück nicht aufgefunden habe. Nur bei echten *Culex* scheint mir sich ein Teil der großen Myapophyse zu einer besonderen Platte abgetrennt zu haben." Valuable information on these problems is given by Christophers (1922, p. 563) who says:

"The base of the andropodite dorsally and externally is usually produced into the tissues as an apodematous extension. The apodeme has been sufficiently described by Edwards who calls it the apodeme of the clasper.

The basal apodeme (basal plate: Edwards). Whether the structure here referred to is homologous with the basal plate in certain other insects as thought possible by Edwards cannot, I think, at present be determined. . . . Passing round behind the rim of the clasper we shall, after passing the dorsal root come to the junctura, and then to a line where the original surface of the proandropodite has been cut away by the penis fissure. It is at this line that the apodeme forms. The apodeme can be most simply regarded as an apodematous ingrowth of the rim of the andropodite at this point. An important function of the basal apodeme is to give attachment to the powerful muscles which are inserted into the parameral plate. — — — If this conception of the nature of the basal apodeme be kept in mind there is no difficulty in understanding its relations with surrounding parts. Its relation to the apodeme of the clasper is a simple one, for whilst the apodeme of the clasper is an inward extension of the clasper base external to the dorsal root, the basal apodeme is an extension internal to this point. The two apodemes are in fact often connected or continuous with another as noted by Edwards."

Matheson (1929, p. 16) has depicted separated basal plates of *Aëdes stimulans*, and this figure is reproduced by Marshall (1938, p. 75) in his recent treatise on the British mosquitoes. I am inclined to agree with Martini that the basal plates are only parts of the apodeme of the side piece, at any rate in the *Aëdes (Ochlerotatus)*. Possibly they are separated in *Culex*, but from some of my slide preparations I have the impression that they still are fused through faint sheets of chitin. The figure, reproduced after Christophers and Barraud (1923), however clearly demonstrates the total fusion in the type depicted.

In the majority of northern mosquitoes the d i s t i s t y l e is a narrow, plain appendage, mostly tapering a little apically; this is the case in the genera *Theobaldia, Culex* and *Aëdes (Ochlerotatus)*. In *Aëdes* s. str. the dististyle is deeply bifid with a short basal arm and a longer distal arm which apically looks like a fish-tail. In *Aëdimorphus* the dististyle is broad and conspicuous compressed laterally and in *Taeniorhynchus* the diststyle have a peculiar character, being swollen and sharply curved in the middle.

The appendage of the dististyle, the c l a w, joins apically to the dististyle in *Theobaldia, Culex, Aëdes (Ochlerotatus)* and *Taeniorhynchus*. In *Aëdes* s. str. the claw is lacking, and in *Aëdimorphus* it is inserted subapically on the dististyle. In *Theobaldia* the claw is comparatively short and nail-like, in *Taeniorhynchus* the nail is very short and stout, in *Aëdimorphus* and *Aëdes (Ochlerotatus)* the appendage is longer and spine-like.

As to the comparative morphological interpretation of the several appendages of the basistyle the authors are of very different opinions, and therefore the names applied to these appendages are numerous and variable. Consulting the obtainable literature on the matter I have the impression that the most consistent and convincing treatise is that of Freeborn (1924), which is based not only on extensive original morphological investigations, but also takes into consideration the ontogenetic studies by Christophers

(1922). I can do no better than quote the following passages from this publication (1924, p. 202).

"Christophers (1922) has shown in a valuable ontogenetic study of the male terminalia that there is hollowed out of the inner edges of the gonostyle, which he terms "a n d r o p o d i t e s", a mass of tissue to which he has given the name "h y p a n d r o p o d i t e". The tissue of the hypandropodite is used for two purposes, (1) the ornamentation of the genital orifice (phallosome) and (2) the formation of a ridge which he terms the "harpagonal fold". This fold or ridge is the nucleus from which the projections long known as interbases are formed, and for this reason the author prefers the term "i n t e r b a s a l f o l d" — — —(fig. 13, if). This interbasal fold is constantly present in all mosquitoes (*Chaoborus*?), forming a ventral and lateral amphitheatre about the penis cavity and evidently serves to protect the genital opening (in mosquitoes at least). The multiplicity of forms that its projections assume offer valuable generic and subgeneric characters and the specific ornamentation of these forms serve as the most useful of the specific characters."

Freeborn considers as the most generalised form the projection of the interbasal fold found in *Theobaldia, Taeniorhynchus* and some other genera (not represented in the northern fauna). In these forms a conical lobe, bearing stout spines (*Theobaldia*) (fig. 14) or a rod (*Taeniorhynchus*) (fig. 48), lies at the base of the basistyle within a short lacuna. This type is the true b a s a l l o b e.

In *Anopheles* s. str. the fold is present ventral and lateral of the genital orifice, where it is sometimes lobed and always bears spines. By a very delicate sclerite the fold follows dorsally around the base of the basistyle, where it enlarges and forms single or paired protuberance bearing heavy spines. The ventral lobes have been designated as "claspette lobes" and the lobes which may occur dorsally are termed the "p a r a b a s a l l o b e s". Freeborn emphasises that they are both interbasal, i. e. projections of the interbasal fold.

Investigating different types Freeborn traces out the lines of development, from the generalised projection in *Theobaldia* to the more specialised types in *Aëdes* (*Ochlerotatus*) and *Culex*. In *Ochlerotatus* the lacuna completely separates the ventral c l a s p e t t e and the more dorsal basal lobe. In addition to this an a p i c a l l o b e has been formed by the prolongation of the dorsal flap of the basistyle. Freeborn also considers the subapical lobe in *Culex* as a projection of the interbasal fold, which is fused with the basistyle to the point where the sub-apical lobe branches off. His demonstration of intermediate forms makes this theory most convincing.

According to the above-mentioned we have the following types of projections of the interbasal fold: a) basal lobe (b. l.), b) claspette (cl.), c) sub-apical lobe (sa. l.), d) parabasal lobe (pb. l.). As to the claspette Freeborn (1924, p. 205) remarks: "It is difficult to tell when a basal lobe of the generalized type becomes a claspette, as the transition from a cone bearing slightly differentiated apical spines to a more slender base bearing a modified spine at its apex is very gradual." Dyar (1918 a, p. 71 et seq.) has pointed out the significance in classification of the typical claspette, i. e. a more or less slender stem supporting a flattened appendage which is mostly winged. Marshall (1938) uses the term claspette in a wider sense, but in my opinion it would be an advantage if the term could be limited to the classical definition. In this paper I intend to do so, and for the homologous structures in *Aëdes* s. str. and *Aëdimorphus* I propose the denomination claspettoid.

In the male the genital aperture opens behind the ninth abdominal segment. The last abdominal segments are fused into an anal projection which may have sclerites. As to the term "sclerite" Martini (1928 b, pp. 150—151) has some remarks: "Ein Wort nun über Sklerite und "Chitinisierungen". In der angelsächsischen Literatur ließt man immer wieder von Chitinisierungen, wo man bei uns von Skleriten spricht und hört, nämlich daß dies oder das bei der und der Form "chitinisiert" ist. Dabei wird ganz unberücksichtig gelassen, daß auch die weichen, oft glashellen Teile der Insektencuticula chitinisiert sind und daher der Ausdruck Chitinisation an sich ganz inadäquat ist." According to Imms (1925, p. 11), however, the intersegmental membrane is little or not at all chitinized. How it is, I find the term sclerite distinct and most useful, and it is also adopted in the handbook by Imms.

The anal projection, which is termed the tenth segment by Edwards (1920, p. 30), is designated proctiger by Freeborn (1924, p. 194) who says: "Proctiger (bearing the anus) has been frequently used by Crampton and other morphologists for this portion of the body and is an accurate and descriptive term that can be used with safety until the true homologies of the cone can be worked out. Inasmuch as two segments, the tenth and eleventh, undoubtedly enter into its make-up, the terms "segment" and "tenth" are not applicable." As Edwards, in Genera Insectorum (1932, p. 5) has accepted the term paraprocts, it will be consistent herewith to use the denomination proctiger.

The paraprocts form the ventral and sometimes ventro-lateral sclerites of the proctiger. In *Aëdes* the distal end of the paraproct has a simple curved hook bent dorsally (fig. 12), in *Theobaldia* it is furnished with furcations and in *Culex* the distal tip is ornamented with a cluster of spines, the "crown" (fig. 118). At the base of the paraprocts the lateral arms arise. Encircling the base of the proctiger they form a circumanal sclerotised wall ending on the dorsal side of the proctiger and articulating with the lobes of the ninth tergite (fig. 14 C). In the genus *Culex* the paraproct also has ventral arms. These cylindrical, sclerotised projections branch from the dorsal edge of the paraprocts, bend outward, ventrally describing an arc along the inside of the base of the basistyle (fig. 121 c—d). Concerning the orientation of the ventral arms Freeborn remarks (1924, pp. 198—199): "In a natural position the tip is directed ventral of the proctiger, but in potash mounts it bends through an angle of 90 degrees and appears to lie in the same plane as the paraprocts, arising at their bases and recurving so that the tips may in some cases nearly reach the tips of the paraprocts."

As pointed out by Edwards (1920, p. 31) the proctiger may also have some dorsal sclerites. These are termed the epiprocts (ep.) by Freeborn (1924, p. 199). In the genera *Theobaldia* and *Aëdes* they are visible as sclerotised strips apically in contact with the paraprocts, but in the other northern genera they are hardly visible, being very faint, almost membranous.

The ejaculatory duct is membranous, but it is protected by lateral sclerites ordinary known as the penis valves. The authors however are of different opinion as to the nomenclature of these genital sclerites. Edwards (1920, pp. 33—35) proposes the denomination aedoeagus for the ensemble of chitinous structures of the genital tube of *Diptera,* i. e. the basal plates, the parameres and the mesosome, the last term covering the lateral penis plates and their furcations. Concerning the mesosome Freeborn (1924, p. 207) says: "Ontogenetically, however, Christophers has shown that the lateral plates (endopodites) become ornamented at the expense of the basistyle (exopodites) and may therefore

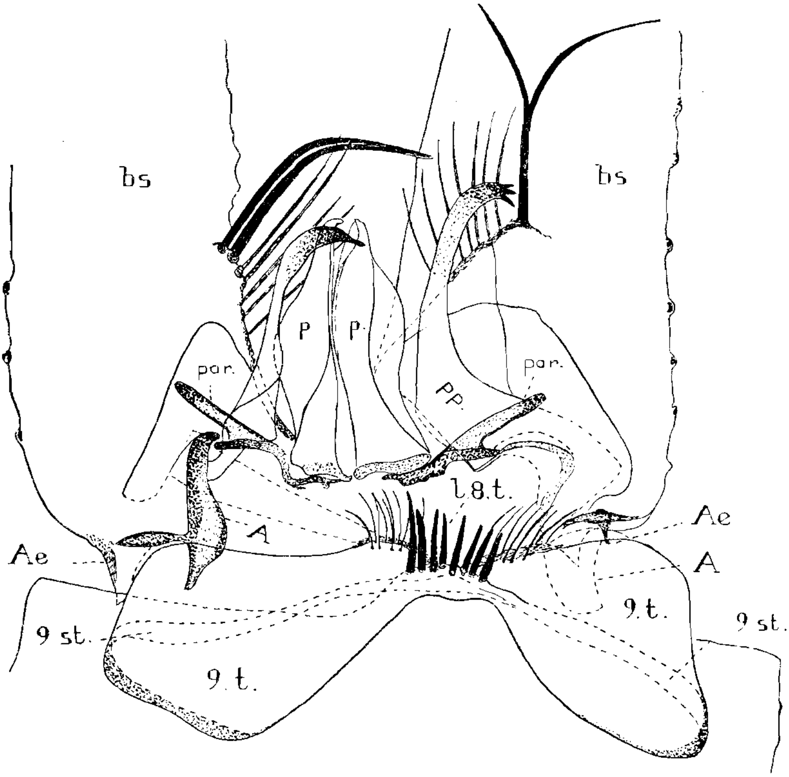

Fig. 14. *Theobaldia bergrothi* Edw.
Terminalia (in part) with the phallosome partly pushed out. 1.8.t., lobe of the eighth tergite. Lettering otherwise as in fig. 12. (Aut. del.)

be considered as organs of dual origin and hence worthy of a distinctive name for which phallosome seems more appropriate than mesosome." The term "mesosome" however, has again been employed by Matheson (1929) and Marshall (1938), but Edwards himself accepts the term "phallosome" (1932, p. 5). As will be seen from the synonymic list below several other names have also been applied, by different authors, to the genital sclerites.

In *Anopheles* the lateral sclerites of the phallosome are fused to form a slender tube, which is either without ornamentation (*A nigripes* Staeg.) or crowned with tiny leaflets (*A. bifurcatus* Meig., *maculipennis* Meig.). In the genus *Theobaldia* the lateral sclerites approximate each other and form an elongated clam shell shaped organ, the two plates being either separated (subg. *Theobaldia*) or they are apically fused (subg. *Culicella*). Two different types of the phallosome are also met with in the genus *Aëdes;* one line of development including the subgenera *Aëdes* s. str. and *Aëdimorphus,* where the sclerites are separated and of a somewhat complicated construction, the other line comprising the subgenus *Ochlerotatus* where the sclerites are curved forming a rough cylinder.

In *Aëdes cinereus* Meig. the sclerites are distally split in several claws. Owing to the dark colour of the chitin, details can in general hardly be seen, but I possess a somewhat pressed slide preparation (fig. 106) where the claws diverge to some extent. Martini (1931, p. 241) and Marshall (1938, p. 98) have depicted the phallosome of this species, but they do not mention details in the text. Yamada however has described another species, *Aëdes esoënsis,* from Japan and Sachalin, which have the sclerites curved and apically split into five claws. According to Martini (1931, p. 245) this species is closely allied to *A. cinereus.* As far as can be seen from the preparate, the sclerites of *A. cinereus* split into four claws, one shorter and three longer ones. The lateral sclerites of the phallosome in *Aëdimorphus vexans* Meig. are depicted and briefly described by Brolemann (1920, pp. 53—54). A closer examination of the rather small sclerites shows that they are furnished with apical furcations, morphologically representing an intermediate type to the extreme forms found in several non-European species of *Aëdes* (fig. 106).

In the genus *Aëdes* the sclerites, as mentioned above, form a simple cylinder, but to judge from the diverging descriptions the sclerotisation evidently is more or less developed in the different species. Freeborn thus (1924, p. 206) says: "The lateral plates are now curved to form a rough cylinder but are separated from each other dorsally and ventrally except at one point on the ventral side, the ventral bridge (upper bridge of Dyar). In *Aëdes,* this constitutes the entire equipment of a poorly chitinized structure that is easily overlooked in a potash preparation." Matheson, describing the phallosome (mesosome) of *Aëdes stimulans* (1929, p. 16) has evidently another type: "In this species the penis valves form a somewhat cylindrical-shaped organ chitinized on the sides and over the dorsum. The median ventral portion is not chitinized except at the base where there is a complete ring. The portion over the dorsum has been called the l o w e r b r i d g e, and that on the ventral side the u p p e r b r i d g e." Most of the northern species of *Aëdes (Ochlerotatus)* seem to agree more or less with this type of development.

As emphasized by Freeborn, the varied and grotesque splitting of the lateral plates in *Culex* gives rise to a multiplicity of lobes that have become the despair of the systematists. He says (1924, p. 206): "No greater confusion has been manifest anywhere in the study of the culicid genitalia than in the interpretation of the processes of the *Culex* phallosome." He depicts a drawing from a potash-balsam mount of the phallosome of *Culex pipiens* and compares it with a preparation of an alcoholic specimen. When a microscopic mount is made, the phallosome is rotated from its normal position, through an angle of 90 degrees, the relationship of processes being lost by the dechitinization of the thin chitin that makes up the body of the lateral plates. Freeborn (1924, p. 207) concludes thus: "The possibility of homologizing the various processes is a hopeless undertaking even with alcholic specimens and its attempt has led to considerable confusion. The most sensible manner of dealing with this organ in taxonomy is to follow the lead of Edwards (1921) and merely state the number of processes present and proceed to describe them in the order that they normally lie in a microscopic mount. The hopeful note is that, unnatural as the position assumed in balsam mounts may be, it is nearly always the same for the same species."

In the subgenus *Neoculex* the lateral sclerites of the phallosome are extended in a plane (at least in the balsam preparation) and apically dentated (fig. 120 c). This apical dentation of the sclerites is also present in most northern *Ochlerotatus,* but the teeth are minute and not so well developed as they are in *Neoculex.*

The p a r a m e r e s (pm) are small sclerites formed by the sclerotisation of a portion of the inner wall of the penis cavity. They are either Y-shaped (*Ochlerotatus*) (fig. 12) or semilunar (*Culex*) (fig. 118) and articulate with the basal apodeme (basal plate of Edwards) of the basistyle. In the normal position the parameres are but slightly inclined to the axis of the phallosome and basally they are in contact with the corresponding parts of the phallosome sclerites. They act as levers, and preliminary to copulation they are rotated into a position more or less perpendicular to the

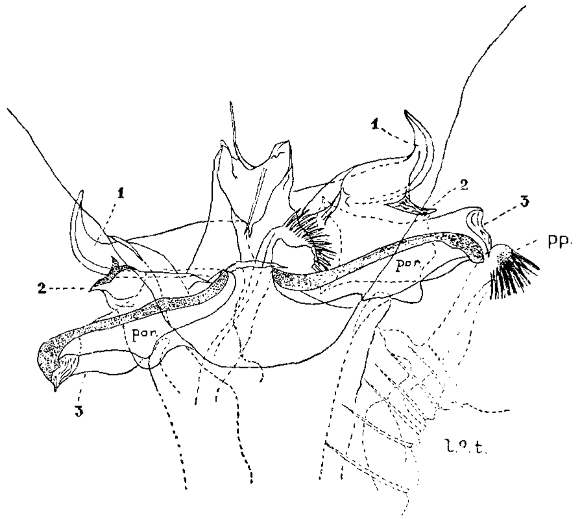

Fig. 15. *Culex pipiens* L.
Terminalia (in part) with the penis pushed out. Lettering as in fig. 12. (Aut. del.)

axis of the phallosome, thereby pushing out the phallosome sclerites (fig. 14 and 15).

According to Martini (1922 a) the rotation of the parameres is due to the contraction of a *M. protrusor* extending from the basal apodeme to the distal arm of the paramere; the retraction to the original position being effected by a *M. retractor,* extending from the basal arm of the phallosome to the external apodeme.

As the researches on the terminalia of the mosquitoes are scattered in a lot of papers, I hope that the synopsis below, including the various denominations applied to the different parts, will be of some use to students of these matters. The terms employed in this treatise are, with a few exceptions, in accordance with Freeborn (1924), the synonyms marked with an asterisk being compiled from the original papers, the others are quoted from the publications of Christophers (1922), Edwards (1920) and Freeborn (1924).

Ninth segment.

Ninth tergite.

Ninth tergite (Edwards 1920*, Marshall 1938*, Matheson 1929*, de Meijere 1919)

IX. tergite (Martini 1922, 1928*, Peus 1942*)

Sternite du 9e segment (Brolemann 1919*)

Lobes of the ninth tergite.
Lobi d. IX. Tergiten (Martini 1922*)
Basal appendages (Dyar 1918*, Wesenberg-Lund 1920—21*)
Inferior claspers (Newstead 1911)
Setaceous lobes (Felt 1905*)
Ninth Sternite.
Ninth sternite (Edwards 1920*, Marshall 1938*, Matheson 1929*, de Meijere 1919)
Tergite du 9e segment (Brolemann 1919*)
Gonostyle.
Gonostyle (Crampton 1920)
Clasp (Felt 1904*)
Claspers (Theobald 1907*)
Forceps (Edwards 1932*, Marshall 1938*, Martini 1928*, Matheson 1929*)
Forcipules genitales (Brolemann 1919*)
Klammerapparat (Eckstein 1920)
Valve (Martini 1928*)
Zange (Martini 1922*)
Basistyle.
Basistyle (Crampton 1923)
Basal clasp segment (Felt 1904*, Felt 1905*)
Basal joint of forceps (part of ninth sternite) (de Meijere 1919)
Basal lobe (Nuttal and Shipley 1901*)
Coxite (Edwards 1932*, Marshall 1938*, Peus 1942*)
Grundglied d. Valve (Martini 1922*)
Halteklammer (Eckstein 1920)
Pleuron *(Tipulidae)* (Snodgrass 1904*)
1er article des forcipules (Brolemann 1919*)
Side piece (Christophers and Barraud 1923*, Dyar and Knab 1919, Edwards 1920*, Matheson 1929*, Wesenberg-Lund 1920—21*)
Superior clasper (basal joint) (Newstead 1911)
Dististyle.
Clasper (Christophers and Barraud 1923*, Edwards 1920*, Matheson 1929*, Nuttal and Shipley 1901*)
Clasp filament (Howard, Dyar, Knab 1912, Wesenberg-Lund 1920—21*)
Endglied d. Valve (Martini 1922*)
Greifhaken (Martini 1928*)
Klammerhaken (Eckstein 1920)
2e article des forcipules (Brolemann 1919*)
Stylus (terminal joint of forceps) (de Meijere 1919, Peus 1942*)
Style (Edwards 1932*, Marshall 1938*)
Superior clasper (second joint) (Newstead 1911)
Terminal clasp segment (Felt 1904*, 1905*)
Claw (Dyar 1918*).
Claw (Marshall 1938*, Matheson 1929*)
Appendage of the clasper (Christophers and Barraud 1923*)
Appendage of the diststyle (Freeborn 1924*)
Spine (Felt 1905*, Matheson 1929*, Wesenberg-Lund 1920—21*)
3e article des forcipules (Brolemann 1919*)
Zahn am Greifhaken (Martini 1928*)
Basal lobe (Freeborn 1924*).
Basal lobe (Christophers and Barraud 1923*, Edwards 1920*, Dyar 1918*, Marshall 1938*, Matheson 1929*, Wesenberg-Lund 1920—21*)

Basallappen (Martini 1922*, 1929*)
Claspette (Felt 1905*)
Claspette (*Taeniorrhynchus*) (Edwards 1920*)
Harpago (*Mansonoides*) (Edwards 1913)
Verrue basale (Brolemann 1919*)

Apical lobe.
Apical lobe (Dyar 1918*, Edwards 1920*, Marshall 1938*, Matheson 1929*, Wesenberg-Lund 1920—21*)
Apicallappen (Martini 1922*, 1928*)
Claspette (Felt 1905*)
Saillie apicale (Brolemann 1919*)

Sub-apical lobe (*Culex*).
Sub-apical lobes (Christophers and Barraud 1923*, Howard, Dyar and Knab 1912, Marshall 1938*)
Sub-apical spines of the claspette (Felt 1905*)
Lateral process of the side piece (Edwards 1913)

Parabasal lobe (*Anopheles*).
Parabasal lobe (spines) (Marshall 1938*)
Basal lobe (Edwards 1920*)
Claspette (Felt 1905*)
Parabasal lobe (Christophers 1922*, Christophers and Barraud 1923*)
Parabasalborsten (Peus 1942*)

Interbasal fold.
Hypandropodite (excl. genital chitinization) (Christophers 1922*)
Harpagonal fold (Christophers 1922*)
Kommissur der Valven (Martini 1928*)

Claspette.
Claspette (*Aëdes*) (Edwards 1920*, Matheson 1929*)
Claspette (*Anopheles*) (Marshall 1938*, Peus 1942*)
Harpago (Dyar 1918*, Christophers and Barraud 1923*, Wesenberg-Lund 1920—21*)
Harpes (*Aëdes* in part) (Felt 1905*)
Gonapophyses (Brolemann 1919*)
Intermediate appendage (Newstead 1911)

External apodeme.
Gelenkfortsatz (Martini 1928*)
Kleine Myapophyse (Martini 1922*)

Apodeme of the side piece.
Apodeme (Edwards 1920*, Matheson 1919*)
Große Myapophyse (Martini 1922*)
Große Muskelfortsatz (Martini 1922*)

Basal plates (Edwards 1920*)
Basal plates (Matheson 1929*)
Apodeme aliforme (Brolemann 1919*)
Intromittent organ (p. p.) (Newstead 1911)
Ligament (Dyar 1918)
Basal apodeme (Christophers and Barraud 1923*)

Aedoeagus.

As pointed out by Freeborn (1924, p. 208) it is impossible to produce an accurate synonym list for the nomenclature of the different parts unless the specific description of all species described by each author were to be consulted. The list of terms compiled here cover terms applied to one or more parts of the aedoeagus.

Cylindre perianale (Brolemann 1919*)
Divisions of harpagones (*Culex*) (Edwards 1913)

Divisions of mesosome (Edwards 1920*)
Dorsale Brücke (Martini 1928*)
Genital filament (Newstead 1911)
Harpago (*Culex*) (Felt 1905*)
Lateral plates of the phallosome (Christophers and Barraud 1923*)
Lower dorsal bridge (Edwards 1920*, Christophers and Barraud 1923*, Matheson 1929*)
Mesosome or penis (Marshall 1938*, Matheson 1929*)
Penis (de Meijere 1919)
Penis sheath or theca (Christophers 1915*)
Penis valves (Matheson 1929*)
Phallosome (Freeborn 1924*)
Plates of harpagones (Dyar and Knab 1909)
Second to fourth plates of unci (*Culex*) (Dyar 1918*)
Seitenplatten (Martini 1928*)
Sklerozierten Teilen d. Penis (Martini 1928*)
Unci (*Aëdes*) (Felt 1905*, Wesenberg-Lund 1920—21)
Upper (ventral) bridge (Edwards 1920*, Christophers and Barraud 1923*, Matheson 1929*)
Ventrale Brücke (Martini 1928*)

P a r a m e r e (Edwards 1920*, 1932*, Matheson 1929*, Freeborn 1929*, Marshall 1938*)
First uncal plate (Dyar 1918*)
Gonapophyses (de Meijere 1919)
Intromittent organ (p. p.) (Newstead 1911)
Parameral plate (Christophers and Barraud 1923*)
Uncus (Edwards 1914)
Trigonapophyses (de Meijere 1919)
Hebel (Martini 1928*)

P r o c t i g e r.
Anal segment (Christophers and Barraud 1923*, Edwards 1932)
Afterkegel (Martini 1928*)
Analsegment oder Analkegel (Martini 1928*)
Tenth abdominal segment (the authors)

P a r a p r o c t s (Freeborn 1924*, Edwards 1932*).
Bras peniens de l'armature du ♂ (Brolemann 1919*)
Cerci (Christophers 1923)
Harpagones (*Aëdes*) (Felt 1905*)
Harpes (Dyar and Knab 1909, Wesenberg-Lund 1920—21*)
Major limbs of harpes (*Culex*) (Felt 1905*)
Submedian lamelle (p. p.) (Newstead 1911)
Tenth sternite (Edwards 1920*, Matheson 1929*, de Meijere 1919)
Ventrale sklerosierte Streifen des Analkegels (Martini 1922*, 1928*)
Ventro-lateral plates (Christophers and Barraud 1923*)

V e n t r a l a r m o f p a r a p r o c t s (Freeborn 1924*)
Basal projection of harpes (Dyar and Knab 1909)
Basal arm of tenth sternite (Edwards 1920*, Matheson 1929*)
Minor limbs of harpes (Felt 1905*)
Outher branch of harpes (H. D. K. 1912)
Seitenarm (Martini 1928*)

E p i p r o c t s (Crampton 1918, Freeborn 1924*).
Dorsale Analkegelsklerite (Martini 1928*)
Dorsal plates (Christophers and Barraud 1923*)
Submedian lamelle (p. p.) (Newstead 1911)
Tenth tergite (Edwards 1920*, Matheson 1929*, de Meijere 1919)

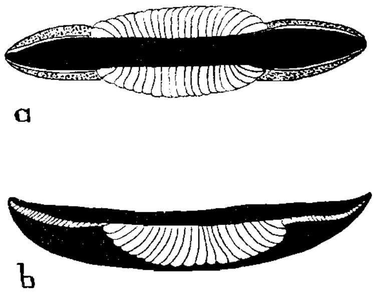

Fig. 16. Egg of *Anopheles bifurcatus* L.
a, plan; b, side view. (Aut. del.).

B. Eggs.

With the exception of the Anopheline eggs, no special investigation on mosquito eggs in Denmark or in Fennoscandia is known to have been carried out. The brief details given below, therefore, mainly are based on the investigations published by Marshall (1938, p. 31 et seq.).

The shell of the egg is built up of three distinct layers. The innermost layer, the thin vitelline membrane, surrounds the yolk. The intermediate layer, the endochorion, is hard and opaque, while the outer layer, or exochorion, in most cases is flexible and transparent. In new-laid eggs, the endochorion is also transparent, but under normal conditions it darkens rapidly and soon becomes opaque.

As emphazised by Marshall the eggs of the Anophelines are boatshaped, the upper surface which represents the deck, being slightly concave, and the lower surface, which represents the hull, being markedly convex (fig. 16). The "deck" is surrounded by a delicate striated frill, and the stability of the egg-boat is further augmented by a pair of centrally placed, small ribbed, lateral floats containing air.

The eggs of Anopheline mosquitoes are laid separately on water, those of the northern species of the genus *Culex* and of the subgenus *Theobaldia,* on water in raft-like masses (fig. 17); those of the northern species of the genus *Aëdes* and of the subgenus *Culicella,* separately (fig. 18, A—C) and mostly in hollows in the ground or on low-lying

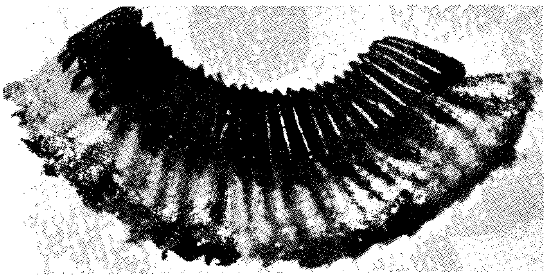

Fig. 17. Egg-raft of *Culex pipiens* with the larvae burst out of the egg-shell when fixed in alcohol. (After Wesenberg-Lund 1915.)

areas which become flooded during rainy periods. The eggs of raft-laying species are of circular cross-section and taper slightly, the larger (anterior) end being rounded and the other end bluntly pointed. The eggs are deposited with their larger end downwards, the upper surface of the raft being noticeably concave. The egg of *Culex* is furnished with a cup-like c o r o l l a in the anterior end (fig. 18, D, E), which possibly has some hydrostatic function. The eggs of *Aëdes* vary in shape from narrowly to broad ovoid, and they generally have a more or less flattened portion, or base, extending from one end to the other. In many cases therefore, the "plan" and "elevation" views of an Aëdine egg are markedly dissimilar.

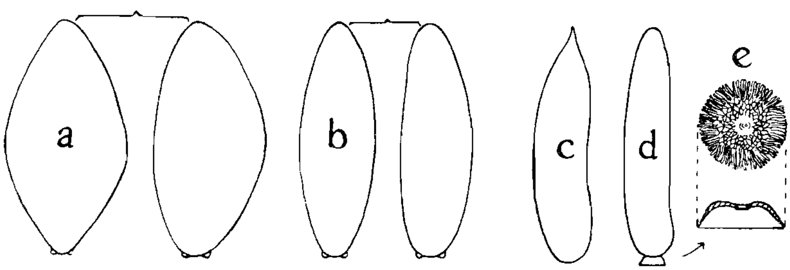

Fig. 18. Outline of Culicine eggs.
a, *A. (O) rusticus;* b, *A. (O) punctor;* c, *T. (Cul.) morsitans;* d, *Culex pipiens* with attached "corolla"; e, plan and side view of corolla. (After Marshall 1938).

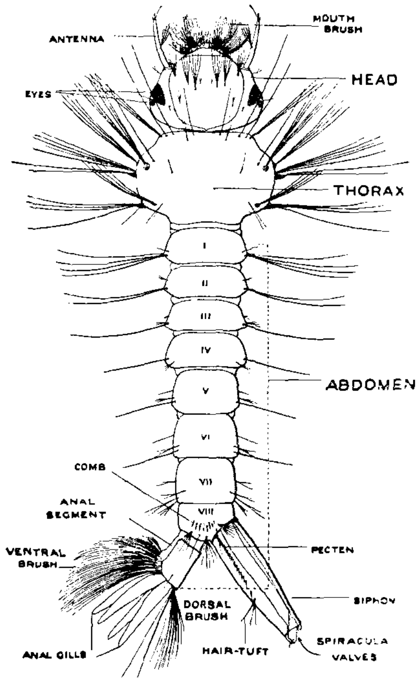

Fig. 19. Larva of a Culicine mosquito (*Aëdes cinereus*) viewed from above. The eight abdominal segment is shown twisted through 90 clockwise, to display the anal segment and the left side comb. (After Marshall 1938).

C. Larvae.

The body of the mosquito larva consists of three principal regions: head, thorax and abdomen (fig. 19).

As this paper deals only with the Culicine mosquitoes, the description given below is of the Culicine larva, but for the sake of comparison some brief remarks concerning the Anopheline larva are given. The larvae of the two tribes *Anophelini* and *Culicini* differ in several respects, but they can at once be distinguished by the presence or absence of the siphon. The siphon, present in all Culicine larvae, is a tail-like tube projecting dorsally from the eighth abdominal segment, and the spiracles are situated at the tip of this siphon. The Anopheline larvae lack the siphon and the spiracles are situated dorsally on the eighth abdominal segment. The resting position of these two types of larvae

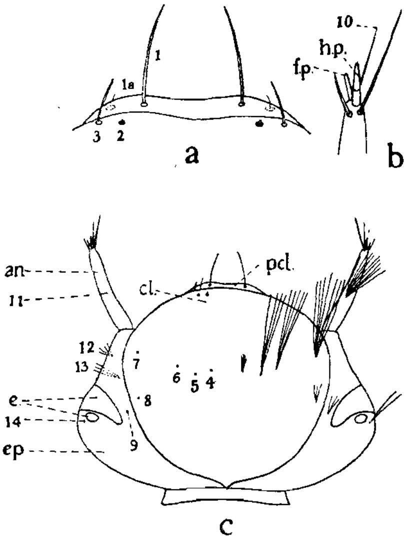

Fig. 20. Nomenclature of larval head-hairs in Culicines. a, clypeus of *Aëdes cinereus*; b, tip of right antenna of same; c, head of 4th instar larva of same
Legend: an., antenna; cl., clypeus; e., eye; ep., epicranical plate; f.p., finger-like process; pcl., preclypeus; h.p., hyaline process; sb.h., subapical hairs. Numbered hairs: (1) inner preclypeal; (1a) outer clypeal; (2) inner clypeal; (3) outer clypeal; (4) postclypeal; (5) inner frontal; (6) mid frontal; (7) outer frontal; (8) sutural; (9) trans-sutural; (10) terminal; (11) antenal; (12) basal; (13) sub-basal. (After Marshall 1938).

is also very characteristic. The Anopheline larvae normally rest parallel to the water surface maintaining their position by peculiar abdominal, dorsal float-hairs and by the expanded valves surrounding the spiracles. The Culicine larvae are hanging head downwards from the surface of the water, being only supported by the capillary action of the valves at the tip of the siphon.

In most species the head of the Culicine larva (fig. 20) is decidedly broader than long; it is rounded and somewhat flattened dorsoventrally. Three sclerotised, curved plates form the head-capsule. They are: 1) the f r o n t o - c l y - p e u s (fr.-cl.) on the dorsal surface, 2) the two e p i c r a - n i a l p l a t e s (ep.-pl.) covering the lateral surfaces as well as the ventral surface. These three plates meet in the e p i c r a n i a l s u t u r e (ep.-sut.). Anterior to the fronto-clypeus lies the narrow p r e c l y p e u s, on which is located the labrum, carrying the paired m o u t h - b r u s h e s.

The a n t e n n a e are inserted on the outer angles of the head, near the extremities of the epicranial suture. In the subgenus *Theobaldia* and the genus *Aëdes* they are relatively short and either straight or slightly curved. In the subgenus *Culicella* and the genus *Culex* the antennae are longer and mostly elegantly curved. In the genus *Taeniorhynchus* the antennae are very long, and, according to Wesenberg-Lund, the distal part is modified into a very long, extremely flexible f l a g e l l u m (fig. 49). The antennal shaft is smooth-surfaced in the subgenus *Finlaya,* but in all other northern Culicine species it is covered with small forward directed spines. As pointed out by Wesenberg-Lund (1920/21, p. 11) the outer part of the antenna is almost always of a darker colour than the inner part. At the tip of the antennae there are two appendages, which probably have a sensory function. Thus Raschke (1887, p. 25, pl. V, fig. 7) described the shorter appendage as an olfactory organ (»Riechkolben«). The s e n s o r y a p p e n d a g e s are accompanied by three hairs, two of which are inserted more or less subapically. Projecting from the shaft of the antenna is the a n t e n n a l t u f t, in general a fan-shaped group of fine hairs from a single stout base. The position of the antennal tuft is mostly at, or beyond, the middle of the antenna, varying somewhat in the different species. In *Finlaya geniculatus* the antennal tuft is reduced to a single hair, in *A. cinereus* and *Aëdimorphus vexans* it consists of 5—6 hairs of moderate length, in *Aëdes* is varies from 5 to 9 hairs and in *Theobaldia, Culex* and *Taeniorhynchus* the number is from 12 to about 25 longer hairs.

The two pairs of e y e s are situated behind the antennae, nearly at the middle of the sides of the epicranial plates. The large crescent-shaped eyes in front are the developing c o m p o u n d e y e s of the future adult, and just behind them lie the small l a r v a l e y e s.

Of great importance for the classification of the mosquito larva is the arrangement of hairs or group of hairs on the body of the larva, the c h a e t o t a x y, and special attention has been paid to this matter in recent publications. Martini (1923 a) published a comprehensive investigation on the chaetotaxy of the German mosquito larvae, where he specified the variability in relation to the number of hairs in different species. Recently Marshall (1938) gave detailed information as to the British mosquito larvae.

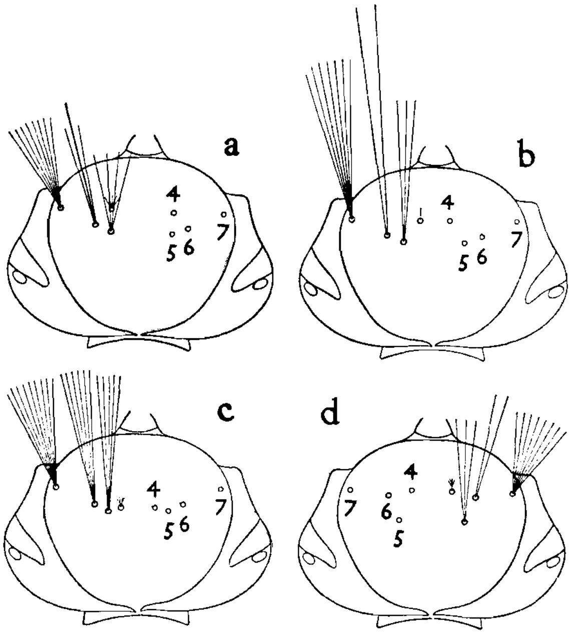

Fig. 21. Relative positions and lengths of frontal and postclypeal hairs in different subgenera of northern Culicines.
a, Subgenus *Theobaldia*; b, subgenus *Culicella;* c, subgenus *Aëdes*; d, subgenus *Ochlerotatus*. 4, postclypeal hair; 5, 6, 7, inner mid and outer frontal hairs. (After Marshall 1938).

There are several hairs on the head of the mosquito larva, those of principal importance for the classification of the Culicine larvae being the frontal hairs, and to some extent also the postclypeal hairs. Martini (1923 a) has assigned standard numbers to each pair of hairs of the head, of the three thoracic divisions and of each of the abdominal segments. These numbers start in each case by No. 1 (fig. 22).

Of the hairs of the head there are mainly two pairs possessing diagnostic value: the mid frontal hairs (standard No. 6) and the inner frontal hairs (standard No. 5). It has proved practical, in order to indicate how many branches each of these two hairs (No. 6 and No. 5) have, to use a formula in the shape of a fraction, named the frontal hair formula, for instance thus: $^4/_7$. The numeral above the fraction line refers to the mid frontal hairs (No. 6) and the one below to the inner frontal hairs (No. 5). The arrangement of the frontal and postclypeal hairs in different genera and subgenera will be seen from the accompanying figures (fig. 21).

The broad and flat thorax is the most conspicuous part of the larva. It consists of three fused segments — the prothorax, the mesothorax and the metathorax. The segments are indicated by the arrangement of the paired groups of hairs. Wesenberg-Lund (1920—21) has with advantage used the hairs along the dorsal anterior margin of the prothorax for differential purpose and he remarks (1920—21, p. 11): "Twelve hairs or hair-tufts on the frontal margin may probably be the original number, but now and then one or other of these tufts are suppressed". He puts the different hairs and their number of branches in a hair-formula, and says: "The hair formula of *C. morsitans* 231124421132 is to be understood in the following way: In the median line two hairtufts, consisting of four hairs; laterally two double; they are followed by two single hairs; then follows a tuft with three hairs, and at the extreme end a tuft with two hairs." Martini only uses the half formula, and remarks (1923 a, p. 553) that the median hair of Wesenberg-Lund in reality is a group of three hairs. He counts each hair and his (half) formula therefore consists of eight hairs (1, 1, 2; 2; 1; 1; 3; 2). The thoracic hair formulae quoted below in the descriptions of the different larvae, are put up consistent with the view of Martini. The lateral hairs (fig. 22, Nos. 9—12), by some authors named the "pedichaetae", are situated on low tubercles. They may also be of value for diagnostic purpose.

The abdomen. Concerning the number of abdominal segments Christophers (1922, p. 537) says: "It is usual to refer to the mosquito larva as having nine abdominal segments. The spiracular apparatus is considered an outgrowth from the tergite of the eighth segment, whilst the so-called ninth segment in this notation is the small lobular piece that carries the sub-dorsal hairs and ventral fan. This notation is, however, incorrect. A study of the segments and of their developmental history shows that whilst much of the apparent eighth segment is actually this structure, the greater part of the spiracular apparatus must be assigned to the tergite of a hitherto unrecognised ninth abdominal segment. The small terminal segment is the tenth abdominal segment." As most authors quote only nine abdominal segments, I will, in this paper, consistent with

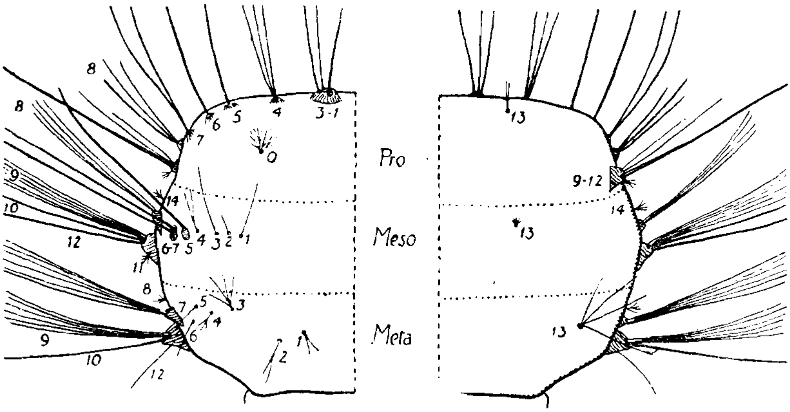

Fig. 22. Thoracic chaetotaxy of Culicine larva. (After Puri and Barraud).
Culex (dorsal hairs on left, ventral on right). (After Marshall 1938).

Marshall (1938, p. 48), denominate the segment bearing the anal gills, the anal segment.

The first seven abdominal segments carry conspicuous lateral hairs, and in some species (*A. cinereus, A. vexans, O. dorsalis* and *O. caspius*) the position and branching of these hairs may be of value for diagnostic purpose.

The most distinctive feature on the larval abdomen is the prominent respiratory tube, named the siphon, projecting from the dorsal side of the eighth abdominal segment. Two broad tracheae extend up the siphon, ending in the spiracles, which are surrounded by five valves, viz. the medio-dorsal valve, two latero-dorsal valves and two ventral valves. A curious sclerotised internal rod, known as the stirrup-shaped piece, may be seen through the chitinous wall of the tube in the distal end of the siphon. The bases of the five, flap-like valves articulate with the somewhat expanded distal end of the stirrup-shaped piece. When the larva desires to dive, this piece is drawn into the siphon by means of retractive muscles and the valves are folded together, but when the ascending larva reaches the surface of the water the stirrup-shaped piece is pushed outwards, causing the valves to diverge, thus forming a more or less star-like figure in the water surface. Concerning the function of the valves, Marshall (1938, p. 50) says: "The entry of water into the trachea is to some extent prevented by the protective action of the valves, but chiefly (as recently shown by Keilin, Tate and Vincent) owing to the exudation of an oily secretion from certain perispicular glands." In this paper Keilin, Tate and Vincent (1935, pp. 257—261) describe and delineate the glands in the fourth larval instar, but the authors point out that the glands may be seen in all larval instars though less differentiated in the first one. In contradistinction to this view Montschadsky (1936) emphazises that the secretion from the salivary glands play the principal role in the prevention of the entry of water into the tracheae, and he points out that the diving larva may often be seen "licking" the tip of the siphon with its mouth-parts.

Even Wesenberg-Lund (1920/21, p. 13) indicated that the form of the valves differs from species to species, and detailed investigation on this feature has been carried out by Montschadsky (1927, pp. 479—498). In his monograph on the mosquito larvae of USSR (1936 ,pp. 50—62) he gives a comparative review of this feature in *Dixinae, Anophelini, Culicini* and *Chaoborinae,* and in the special part of this monograph he publishes illustrations of the stigmal plates and the valves for most species dealt with.

The shape and proportions of the siphon are of diagnostic importance, especially the siphonal index, i. e. the ratio of the length of the siphon to its width at the base. In all northern species but *Taeniorhynchus richiardi* there are, in the basal half of the siphon, two ventro-lateral rows of closely set, flattened teeth, each row denominated collectively the pecten. The single pecten-tooth consists of a stout sclerotised spine, which mostly is furnished with some ventro-basal denticles. The arrangement of the pecten-teeth, their size, and the shape and number of the denticles are characteristic for the different species. Ventro-laterally the siphon is ornamented with one or more pairs of opposed hair-tufts. Thus the genus *Culex* have several ventral tufts in contrast to the other northern larvae with only one pair of ventral tufts. In the genus *Theobaldia* the tufts are placed towards the base of the siphon, whereas they are placed towards the centre of the siphon in the genus *Aëdes.*

On each side of the distal end of the eighth segment is an assemblage of peculiar flattened scales called the comb. The comb-scales are directed with their apex posteriorly, each scale being either fringed with bristles or, in some cases, furnished with denticles. The number of comb-scales varies in different species, from 8 (*Aëdes riparius* D. K.) up to 148 (*Culicella morsitans* Theob.); in the first named species they are arranged in a single row, but mostly they stand in a more or less rectangular patch. Posteriorly the comb is encircled by five hairs named the pentad hairs.

The dorsal side of the anal segment is covered by a sclerotised plate called the saddle, which in many species extends somewhat down the sides of the segment. Marshall (1938, p. 51) remarks that the term saddle is a somewhat unfortunate one, as the sclerotised plate in many cases (Genus *Theobaldia,* genus *Culex, A. punctor* and *A. nigripes)* completely encircles the segment. The shape of the saddle and the saddle-hair may be useful for identification of species. The caudal end of the anal segment is furnished with two conspicuous groups of hair; the dorsal brush and the ventral brush or ventral fin. The dorsal brush is composed of an inner pair of more or less tufted hairs and an outer pair of long stout hairs which in some species may be slightly branched.

The ventral brush is described by Marshall (1938, p. 51) thus: "The ventral brush (or, as it is sometimes called, the fin) is formed by a "staggered" row of tufted hairs, arising, in Anophelines, exclusively from a ventro-distal grid of transverse bars. In the majority of British Culicines, however, the tufted hairs are situated partly upon, and partly proximal to, the grid, in which case they are known as the cratal and precratal tufts respectively. The absence or presence of precatal tufts (as well as their actual number) is not infrequently of assistance in regard to identification."

At the apex of the anal segment are four papilliform processes, the anal gills, which surround the anus. As pointed out by Marshall (1938, pp. 51—52) the gills are covered with chitin, deprived of its customary waterproof coating of cuticulin, and they are therefore permeable to fluids. The Norwegian material shows, as previously remarked by several authors, that even within the same species the length of the anal gills may vary considerably (fig. 64, 120). Wesenberg-Lund says concerning the anal gills: (1920—21, p. 15): "they seem to be most strongly developed in water which is extremely dark and peaty". Martini (1922 e, p. 82; 1923 b, pp. 235—59) made some investigation on this matter and pointed out that the length of the anal gills depended to some extent on the physico-chemical characters of the water in which the larvae was reared. Larvae reared in water containing salt were shorter than those of larvae from fresh water. Formerly most authors supposed that the main function of the anal gills is respiratory but later investigation has changed the opinion concerning this point. Wigglesworth (1933 a, 1933 b) sums up the results of his investigation on the function of the anal gills thus: "It is concluded that the anal gills are primarily water-absorbing organs, and are only incidentally concerned in respiration." However, A. Krogh (1939, p. 106 et seq.) quotes recent experiments carried out by Koch and Krogh (1936), Koch (1938) and Wigglesworth (1938) which prove that the anal gills by preference are salt absorbing organs.

The description of the larva above and the descriptions and illustrations of larvae in the systematical part of this paper, are, when not otherwise stated, based upon full grown larvae. During growth the larva moults four times, each stage between two of the successive moults being named an instar. The first instar larva is indicated by the presence of the egg-breaker, a small, sharp tooth projecting from the fronto-clypeus and situated between the eyes (fig. 41). As to the egg-breaker, Marshall (1938, p. 53) says: "This egg-breaker — — — occurs in at least two distinct forms — the cutting point being at the apex of a cone in the one case, and in the centre of a chisel-ended projection in the other. The egg-breaker is of the latter type in all species of British mosquitoes except those of the genus *Aëdes*.". The typical chisel-formed egg-breaker I have found in a *Theobaldia* larva, but as far as I can see the first instar larva of *Neoculex apicalis* has a cone-shaped egg-breaker (fig. 116). In the three later instars the relative positions of the various diagnostic hairs are the same, but in each one of the succeeding instars most hairs have more branches than in the preceding instars. Also the pecten teeth and the comb-scales mostly increase in the same manner. As only few northern species have been examined re the chaetotaxis of different larval instars, I refer to the papers of Martini (1923), Marshall (1938) and Stadtmann-Averfeld (1923 a, pp. 105—52) for details.

D. Pupa.

Comparatively little has been published on the pupa of the Culicines and it might therefore be of some interest to quote even older investigations on this stage.

The first description of a mosquito pupa in Scandinavian literature is found by Degeer (1776. pp. 320—2 and Pl. 17, fig. 7—12) who i. a. gives a detailed description of the respiratory trumpets and the paddles.

In contradistinction to previous authors Palmén (1877) declares that the trumpets of the mosquito pupa have no respiratory function. Concerning *Culex* the author (1877, p. 64) remarks:

"Nach meiner Auffassung sind die Prothoracal-Kiemen bei *Corethra* identisch mit den "Prothoracal-hörnern", oder den oft sogar ganz stattlich verzweigten wahren Tracheenkiemen. Gewöhnlich, werden denselben, z. b. bei *Culex* offene Stigmen zugeschrieben, wie dies oben bei *Corethra* der Fall war. Bei genauer Untersuchung der Puppe von *Culex* finde ich aber gar keine Stigmen. Die Cuticula ist an der Basis des Organs fein queergestreift, gegen die Spitze ziemlich deutlich gegittert, aber immer continuirlich. Zuletzt bildet sich oben eine Vertiefung, an deren Wandungen die Cuticula schuppenförmig erscheint, ohne aber irgend einen offenen Porus zu zeigen. Das Organ ist mithin auch bei *Culex* nur ein kiemenartiger Anhang; es wäre auch a priori schwer zu begreifen daß wirkliche Tracheenkiemen (am letzten Segmente) und offene Stigmen gleichzeitig in Funktion wären. Diese Organe sind accessorische Hautduplicaturen, denen man keineswegs, wie es bisweilen geschieht, den hohen morphologischen Wert dorsaler Gliedmaßen zuerkennen darf."

These misinterpretations were subsequently corrected by Hurst (1890, p. 11) who has proved by experiments on *Culex* pupae that the cavity of the respiratory trumpets communicates directly with that of a tracheal trunk at its base.

Meinert, in his fundamental investigations "De eucephale Myggelarver" (1886, p. 389), delivered a brief description of the pupa of *Culex annulatus*,[5] with special mention of the construction of the respiratory trumpets. He further points out (1886, p. 397) that the pupa of *Anopheles maculipennis* is very similar to the *Culex* pupa; however the respiratory trumpets are somewhat broader, especially at the distal end.

[5] *Theobaldia annulata.*

The figures (Pl. I) indicate that the author has been aware of differences in the chaetotaxy of the last abdominal segments in the pupa.

The peculiar pupa of *Mansonia*[5b] *richiardii* Fic. was described by Wesenberg-Lund (1920, pp. 13—17) who i. a. remarks: "The most characteristic features in the anatomy of the hitherto known *Mansonia*-pupæ are that the trumpets do not diverge but converge, that the trumpets are provided with a long strong chitinized hook for insertion into the roots of the water plants; the two hooks meet each other so that the two trumpets form a half-circle over the cephalothorax. Another remarkable structure is that the stellate hair tufts on the hind part of the first abdominal segment are wanting. The paddles are cleft at the apex. — — — A little before the spot where the tube attenuates passing into the accuminated part, there is a point of weakness where the chitin is thin, and where the apical part breaks off very lightly." Recently Marshall (1938, p. 265) has published investigations which prove that the respiratory trumpets are broken off just in this point when the adult is about to emerge, and the pupa rises to the surface of the water.

Concerning the systematics of the mosquito pupae, little has been published in Scandinavian literature beyond the details mentioned above. Wesenberg-Lund (1920, p. 12) says: "It is a well known fact that it is almost quite impossible to distinguish the species in this stage; even species which belong to different subfamilies: Anophelinæ and Culicinæ are in the pupa-stage extremely similar. — — — The greatest diversity may probably be found in the number and arrangement of the setæ on different parts of the body; from this structure Meijere (1911, p. 138) has tried to separate the pupæ of *C. morsitans, Theobaldi, cantans* and *nemorosus,*[6] but, as far as I can see, without any result. I have been unable to detect real differences between the pupa of the Danish species. The very large pupa of *C. annulatus* and *C. morsitans*[7] can, if they appear in the swarms of *C. nemorosus,*[8] be recognized only by their size; the pupa of *C. pipiens* and *C. nigritulus*[9] have very long rodlike trumpets, much longer

[5] b *Taeniorhynchus.*

[6] *Theobaldia morsitans* Theob., *T. fumipennis* Steph., *Aëdes (Ochlerotatus) cantans* Meig., *A. (O) communis* Deg.

[7] *A. (O) annulipes* Meig.

[8] *Theob. annulata* Schrank., *T. morsitans* Theob.

[9] *A. (O) communis* Deg.

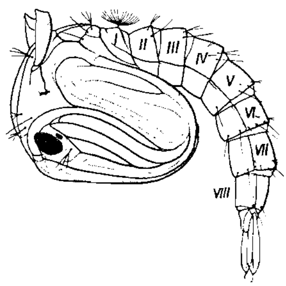

Fig. 23. Pupa of a mosquito. (After Marshall 1938).

than in any of the other Danish mosquito pupæ. The paddles of *C. nigripes* are longer than those of *C. nemorosus,* its nearest relation. The pupa of *C. nigripes* are black, those of *C. annulipes* [10] yellow, most others greyish. I have tried among the Danish species to find a diversity in the number and arrangement of the seta, but I confess that also upon that point it has been impossible for me to find real and tenable characters."

Lang (1920, p. 8) aptly describes the mosquito pupa as follows: "Generally speaking, it resembles a comma with a gigantic dot. The dot of the comma is the head and thorax of the pupa, and the tail its abdomen." The appendages of the head and the thorax can be seen through the cuticle enclosing the cephalo-thorax. The most conspicuous features of the cephalo-thorax, however, are the compound eyes of the future adult, accompanied by the small pupal eyes, further the dorsally placed respiratory trumpets, which are narrowed at the base and which diverge distally. The shape of these trumpets has, with advantage, been used by De Meijere (1911, pp. 150—1) for differentiation of the genera, and my recent paper (Natvig, 1942, p. 3) indicates that the shape of the respiratory trumpets may differ in near species.

The abdomen of the pupa is dorsoventrally flattened and consists of nine segments, which are curved round the caudal end of the cephalothorax, somewhat resembling the tail of a crayfish (Fig. 23). Marshall (1938, p. 55) points out that the small terminal segment carries the two oval plates or paddles which overlap one another. Each paddle is supported by a midrib, and near the point where the

[10] *A. cinereus* Meig.

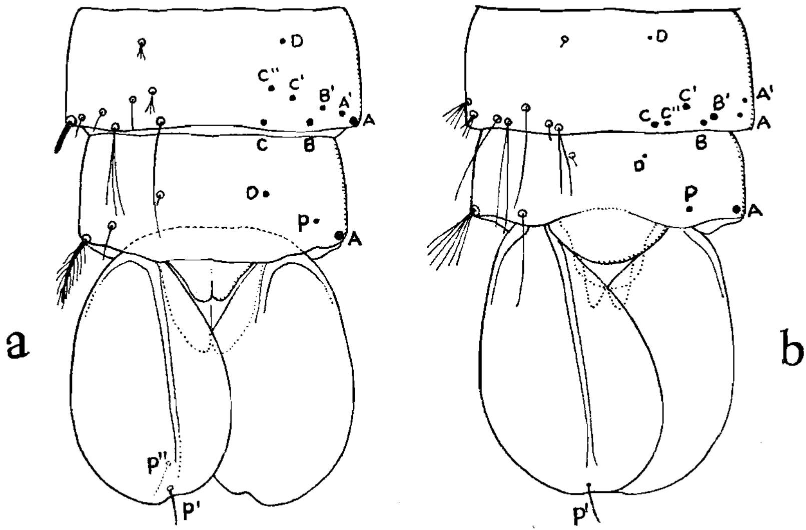

Fig. 24. Dorsal abdominal chaetotaxy of (a) an Anopheline *(A. maculipennis)* and (b) a Culicine pupa *(A. (O) rusticus)*. p, paddle-hair; p″, accessory paddle-hair. Lettering otherwise as in text. (Redrawn from Marshall 1938).

midrib reaches the margin of the paddle, a paddle-hair may be found, viz. in Anopheline mosquitoes on the ventral surface of the paddle and in the genus *Culex* on the dorsal surface of the paddle (Fig. 24 a—b). The margin of the paddle may be fringed with small hairs or spines, which, as pointed out by Peus (1930 a, p. 57, and fig. 5—6), may be useful for differentiating the species.

In recent time much attention has been paid to the chaetotaxy of the mosquite pupae, thus Marshall (1938, p. 57) mentions papers by Macfie [11] and Senevet [12] dealing in detail with the matter. Unfortunately these papers have not been accessible in time. However, Theodor (1924, pp. 341—5) describes the pupa of the following Culicine species, occurring also in our region: *T. annulata; Cul. morsitans; A. (O) caspius* and *Culex pipiens*. Here only a brief review on the principles of arrangement of the hairs and their formulae shall be quoted. According to Marshall (1938, p. 56) the

[11] Macfie, J. W. S. (1920): The chaetotaxy of the pupa of *Stegomyia fasciata*. (Bull. Ent. Res., *10* (2), 161—169).

[12] Senevet, G. (1930): Contribution à l'étude des nymphes de Culi- *fasciata*. (Bull. Ent. Res., *10* (2), 161—169).

segments of the pupal abdomen carry, both dorsally and ventrally, various paired hairs. On the dorsal side of the first segment a pair of palmate, floating hairs arise. It is supposed that the resting pupa maintains its upright position in the water surface, chiefly by means of the palmate hairs and the respiratory trumpets. These palmate hairs are found in all northern Culicines exept *Taeniorhynchus richiardii* (see above; by W-L they are termed: the stellate hairs).

As to the chaetotaxy of the remaining abdominal segments, it will suffice to quote Marshall (1938, p. 56) who i. a. remarks:

"The dorsal hairs of segment III to VIII are of special importance for diagnostic purposes. As will be noted from the accompanying illustration (fig. 24) segment VIII carries three hairs, and each of the five preceeding segments eight hairs, on both sides. The hairs on each of the dorsal segments III—VII are arranged as follows:

a) A row of three conspicuous hairs A, B, C, arising from the apical margin of the segment: the hair A being situated at (or in some cases slightly above) the apical "corner" of the segment.
b) A second row of three, less conspicuous hairs A′; B′; C′; lying slightly above the row A, B, C.
c) A hair C″, usually lying (except on segment VII) nearer to the centre line than C. In Culicines, this hair lies on or near the apical margin of the segment (fig. 24 b) while in Anophelines (except on segment VI, where it occupies the Culicine position) it lies in a more basal situation than hair C′ (fig. 24 a).
d) A hair D, lying nearer to the basal margin of the segment than any of the other seven hairs."

Chapter 2.

Brief description of internal anatomy of the female mosquito.

A detailed description of the internal anatomy of the mosquito lies beyond the scope of this paper, the intention of which being by preference to bring together information on the systematics and biology of the northern mosquitoes. As, however, scattered references to certain internal organs have been inevitable, a brief description may be desirable, merely as a more complete explanation of the figure (fig. 25).

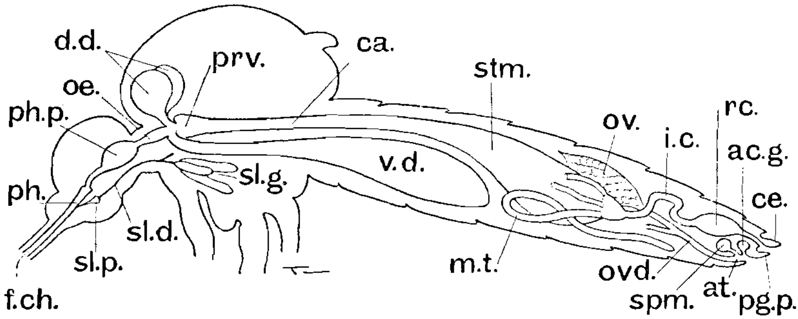

Fig. 25. Diagram showing certain internal organs of a female mosquito. ac.g., accessory gland; at., atrium; ca., cardia; ce; cercus; d.d., dorsal diverticula; f.ch., food channel; i.c., ileum-colon; m.t. Malpighian tube (one of five); oe., oesophagus; ov., ovary; ovd., oviduct; ph., pharynx; ph.p., pharyngeal pump; pg.p., postgenital plate; prv., proventricullus; rc., rectum; sl.d., salivary duct; sl.g., salivary glands; sl.p., salivary pump; spm., spermatheca; stm., stomach; v.d., ventral diverticulum. (After Marshall 1938).

Those specially interested in the anatomy of the mosquito, are referred to the works of Eysell, 1924, pp. 181—9. Giles (1900, pp. 21—34), Marshall (1938, pp. 76—9), Martini (1941, pp. 30—8), Matheson (1929, pp. 25—7), Patton and Cragg (1913, pp. 109—12) and Patton and Evans (1929, pp. 152—5), from which papers details are quoted here.

The internal organs of peculiar interest for our purpose are the alimentary canal, the salivary glands, the reproductive organs and the fat body.

The alimentary canal is composed of three principal divisions of different origin, viz. the fore-gut, the mid-gut and the hind-gut. In the insect embryo the fore-gut and the hind-gut arise as invaginations of the cuticle, and they are both lined with a chitinuous layer. The mid-gut, however, is the main digestive part which is lined with a specialized epithelium. In this division secretion and absorption take place.

The fore-gut consists of the pharynx and the oesophagus. The most prominent part of the pharynx is the pharyngeal pump, the lumen of which is lined with three longitudinal sclerotized plates, joined at their margins by flexible membranes. In cross-section the chamber is triangular in shape. According to Martini (1941, p. 33) the mosquitoes have two pharyngeal pumps of which the posterior is the greater one. By means of muscles attached to the plates, the chamber may be alternately expanded and contracted rapidly, and liquid is sucked up the food-channel and forced on to the oesophagus, a simple tube, connecting the pharynx with the proventriculus. Near the posterior part of the oesophagus lies the crop which consists of three oesophageal diverticula. Two of these lie dorsally at the posterior part of the thorax, while the ventral diverticulum extends backwards to the sixth or seventh abdominal segment. The proventriculus is a two-way valve, surrounded by a thick sphincter muscle. Marshall (1938, p. 77) emphasises the importance of the selective action of this valve. Thus blood sucked up by the female is admitted direct into the mid-gut, while fruit juices, water and similar fluids are temporarily shunted into the diverticula.

The mid-gut is a straight tube, more narrow in the thorax and gradually widening within the first two thirds of the abdomen. At the point where the mid-gut connects with the hind-gut the long Malphigian tubes arise. In general the number of the Malphigian tubes of insects is a pair number, and as to the structure two types of tubes may be found. The mosquitoes, however, have the unusual number of five Malphigian tubes which seem all to be of the same structure. The tubes act as excretion organs and the waste products are emptied into the hind-gut.

The hind-gut, on its course backwards to the anal opening, varies in size and shape. These parts have been called ileum- colon and rectum. In the latter part are six rectal papillae which absorb the water from the excrements.

The two salivary glands are situated in the thorax, on each side of the oesophagus and above the fore-legs. Each gland is tri-lobed and consists of two longer tubes (acini), conspicuously narrowed in the middle, and a central smaller tube. The ducts from these tubes unite near the base of the gland in a salivary duct. The two salivary ducts pass forward into the head where they unite into the common salivary duct which leads to the musculous salivary pump. This pump forces the salivary fluid into the wound along the gutter in the hypopharynx.

The reproductive organs consist of two ovaries, located dorsal to the stomach in the abdomen. From each ovary an ovarian duct leads to the muscular common oviduct which widens caudally and forms the atrium.

Here also open the sperm-ducts from the spermathecae, which in Culicines are three in number and in Anophelines one only, further the duct from the accessory glands. In the northern mosquitoes of the genus *Culex* and *Taeniorhynchus* and the subgenus *Theobaldia,* which deposit their eggs in rafts, the secretion from the accessory glands serves the purpose of cementing the eggs together.

The fat-body of insects is made up of irregular masses of cells in which globules of fat and other substances are deposited. In these fat-bodies nutrient products are stored for use in special periods of the life of the insect. The stored material may be disposed of during histogenesis, in the reproductive period and during time of hibernation. Some few mosquitoes hibernate, in the femal sex, as adults, and in specimens going into "complete hibernation" the fat-body is strongly developed. Thus Wesenberg-Lund (1920—21, 150, fig. 18, a, b) has figured some illustrative cross-sections from the abdomen of *Culex pipiens.* One cut from a specimen caught in the last part of October shows the enormous fat-body, and another cut from a specimen taken in April demonstrates the fat-body conspicuously reduced in size, most of it having been absorbed during time of hibernation.

Chapter 3.

General notes on the life history of the northern Culicine mosquitoes.

The Danish and Fennoscandian *Culicini* may be divided into four biological groups according to the behaviour of the adults or the habitats of the larvae. The four groups are: 1) the domestic species which hibernate as adults in houses. In our region this group includes the following species: *Theobaldia annulata, T. subochrea, Culex pipiens pipiens* and *C. pipiens molestus.* 2) the rural species, which breeds in temporary pools, ditches, ponds etc. This group includes the bulk of the northern species, viz. *Theobaldia alascaensis, T. bergrothi, T. (Cul.) morsitans, T. (Cul.) fumipennis, Aëdes (Ochlerotatus) cantans, annulipes, riparius, excrucians, cyprius, flavescens, cataphylla, leucomelas, communis, punctor, sticticus, nigrinus, diantaeus, intrudens, pullatus, nigripes, nearcticus* and *rusticus; Aëdes (Aëdes) cinereus, Aëdimorphus vexans, Taeniorhynchus* *richiardii, Culex (Neoculex) apicalis* and *Culex torrentium.* 3) The halophilous species are *A. (O) dorsalis, caspius* and *detritus.* These species are chiefly found in brackish water and therefore by preference occur near the seashore, but from abroad *A. dorsalis* and *caspius* have also been recorded from inland places in non-salt waters (e. g. Marshall 1938, p. 26). 4) The single arboreal species found in our region is *Aëdes (Finlaya) geniculatus,* the larvae of which are found in waterfilled cavities in trees.

The larvae at hand are, with few exceptions, of Norwegian origin and the biological remarks below therefore solely concern, when not otherwise emphasised, conditions in Norway.

According to the vertical distribution the Culicines may be divided into 3 groups.

1. group. Lowland species. They are: *T. morsitans, T. fumipennis, A. (O) dorsalis, cantans, riparius, detritus, leucomelas, sticticus, Finlaya geniculatus, Neoculex apicalis, Culex pipiens molestus.*

2. group. Species which are found from the lowlands and towards mountainous regions. These are arranged according to the highest point at which they have been found: *A. (O) excrucians, communis* up to about 990 m above sea level); *A. (O) intrudens* (up to about 700 m above sea level); *T. alascaensis, T. bergrothi, A. (O) cataphylla* (up to about 620 m above sea level); *T. annulata, subochrea* (up to about 520 m above sea level); *A. (O) nigrinus, diantaeus, Aëdes cinereus, Aëdimorphus vexans, Culex pipiens, C. torrentium* (up to about 270 m above sea level).

3. group. Alpine species. *A. (O) nearcticus,* which occur in the arctic part of the Scandinavian peninsula, have been found in the high mountains in Tydalen (STi 37), *A. (O) nigripes* is hitherto only found in the arctic parts of Norway and Sweden. *A. (O) pullatus,* which in Central and Southern Europe occurs in mountainous regions even in high altitudes, has, in Northern Norway, a coastal distribution.

The rural species vary greatly as to the character of the environment of their breeding-waters. Some species, e. g. *A. (O) flavescens* (not found in Norway) decidedly prefers open-lying waters, whereas others are more or less typical woodland species. However, ubiquitous species as *A. (O) communis* and *A. (O) punctur* seem to be less particular in their demand concerning the environments of the breeding-waters. From abroad *A. (O) communis* is recorded as a decided woodland species, and also in our region the larvae of this species by preference are found in more or less shaded waters. In mountainous regions of Norway, however, larvae of *A. (O) communis* may be found in quite open-lying places, the breeding-waters being faintly shaded by dwarf-birches (Pl. IV). The larvae of *Theobaldia bergrothi* are found in open-lying waters in more northern degrees of latitude, but in southern Norway the larvae prefer overshadowed waters. According to Hecht (1931, p. 6) this alternation of breeding places is denominated "geographischen Brutplatzwechsel" by Martini. Most probably it is connected with a preference for breeding-waters of definite temperatures, as is also indicated from my observations on the mountainous form of *A. (O) excrucians*. For details see Chapter 9 under this species. Experiments by Hecht (1931) strongly indicate that the ovipositing mosquito prefers breeding-waters within definite limits of temperature. It is noticeable that this preference for definite temperatures was found in *Anopheles,* which places its eggs on the water-surface, as well as in "*Stegomyia fasciata*" which deposits its eggs above water-level.

On the nature of the breeding-waters Marshall (1938, p. 26) i. a. says: "As regards the particular physical and/or chemical factors upon which the mosquito-breeding potentialities of a given collection of water depend, very little is at present known. It was at one time believed that the hydrogen-ion concentration of water — — — profoundly affected the conditions of larval existence, but this theory is now generally discredited. The investigations of the effects of various chemical factors has proved equally inconclusive." I do not feel quite convinced, however, that the hydrogen-ion concentration is without interest, and I quote Mac Gregor (1929, p. 155) who i. a. remarks: "It may therefore be stated that although the pH index is not an infallible guide, it does in the majority of instances provide a reliable index as to whether the necessary combination of chemical and biological factors in any given waters are such that they will permit the development of the larvae of particular species." Further papers by Buchmann (1931) and J. B. Schmitt (1943) support this opinion.

Though the tests of pH in breeding-waters of Norwegian *Culicini* (Table 1) are by far too few for definite conclusions, they, at any rate, give some indication as to the preferences of some species. As could be expected the most ubiquitous species, *A. punctor, communis* and *excrucians* also exibit the greatest tolerance concerning the degree of pH in their breeding-waters. Concerning *T. bergrothi* the tests hitherto obtained are rather few for definite conclusions.

Table 1.

Degree of pH in breeding-waters of Norwegian *Culicini.*

	4.5-4.9	5.0-5.4	5.5-5.9	6.0-6.4	6.5-6.9	7.0-7.6	Number of breeding places
T. (T) alascaensis					1		1
T. (T) annulata ..					1		1
T. (T) bergrothi ..			2 (5.6)		3	1 (7.6)	6
T. (C) morsitans .		1 (5.4)	1	3		1 (7.5)	4
A. (O) dorsalis ...				1 (6.1)	1	1 (7.1)	3
A. (O) cantans ...					2 (6.7)	1 (7.5)	3
A. (O) excrucians	1 (4.8)	3	3	2	6 (6.9)		15
A. (O) detritus ...			1 (5.9)	2	1	2 (7.6)	6
A. (O) leucomelas						2 (7.1)	2
A. (O) communis .	3 (4.5)	4	5	3	2	1 (7.5)	18
A. (O) punctor ...	1 (4.8)	5	6	4	2	3 (7.6)	21
A. (O) sticticus ...			1 (5.9)				1
A. (O) diantaeus .				1			1
A. (O) intrudens ..				2			2
A. (O) nearcticus .			1				1
C. (C) pipiens ...			1 (5.5)	2	1	2 (7.4)	6
							91

The figures in brackets are the lowest resp. the highest degree of pH found. The figures in the last column are the number of breeding-places where the degree of pH have been tested.

Only a few tests of the percentage of salt in the breeding-waters of Norwegian *Culicini* have been carried out. *A. dorsalis* has been found in waters with a percentage of salt up to 0.0749 % NaCl and was associated here with larvae of *A. communis, punctor* and *leucomelas*. *A. detritus* was found in waters with a percentage of salt up to 0.835 % NaCl associated with larvae of *A. leucomelas.*

Allowing for the relative few facts hitherto known concerning these matters the association with each other of the larvae of different mosquito species, has been the subject of studies of several investigators abroad (i. a. Buxton 1924, pp. 296—99; Kirkpatrick 1925, pp. 202—3). In Table 2, below, I have grouped the Norwegian larvae according to this point of view. As will be seen, of the two ubiquitous species *A. punctor* and *communis* have been found associated with many other species; *A. punctor* with 13 different species, *A. communis* with 11 species, further *T. bergrothi* with 8 species, *A. cataphylla* with 7; *T. morsitans, A. dorsalis, A. intrudens* and *Neoculex apicalis* each with 5 other species. Remarkable is the rather few other species with which larvae of *A. excrucians* have been found associated.

Table 2.

	T. alascaensis	T. annulata	T. subochrea	T. bergrothi	T morsitans	O. dorsalis	O. cantans	O. excrucians	O. detritus	O. cataphylla	O. leucomelas	O. communis	O. punctor	O. sticticus	O. diantaeus	O. intrudens	O. nearcticus	A. cinereus	C. apicalis	C. pipiens	C. torrentium	Anop. maculipennis
T. (T) alascaensis (2)	**2**																					1
T. (T) annulata (5)		**1**	1	1	1															2		
T. (T) subocrea (1)		1		1																		
T. (T) bergrothi (33)		1	1	**20**						1			2						3	7	2	1
T. (C) morsitans (16)		1			**9**		1					2	2						1			
A. (O) dorsalis (6)						**1**			2	1		1	1									1
A. (O) cantans (6)					1		**5**						1									
A. (O) excrucians (34)								**23**				9	7		1	1						
A. (O) detritus (7)						2					2	2	2									1
A. (O) cataphylla (5)				1		1					1	1	2		1	1						
A. (O) leucomelas (3)									2	1			1									
A. (O) communis (45)					2	1		9	2	1		**12**	16		5	1	1	1		1		
A. (O) punctor (51)				2	2	1	1	7	2	2	1	16	**25**	1			1		1	1		
A. (O) sticticus (1)													1									
A. (O) diantaeus (7)								1		1		5			**1**	3						
A. (O) intrudens (7)								1		1		1			3	**1**		1				
A. (O) nearcticus (1)												1	1									
A. (A) cinereus (3)												1				1		**2**				1
C. (N) apicalis (11)				3	1								1						**4**	2		
C. (C) pipiens (30)		2		7								1	1						2	**20**	1	
C. (C) torrentium (2)				2																1		2
Anoph. maculipennis (- -)	1			1		1			1									1			2	

The association with each other of the larvae of different species of Norwegian *Culicini*.

The figures in brackets are the number of breeding-places in which each species was found.

The bold figures show the number of times each species occurred alone.

It would have been tempting to bring together biological facts in a life-history calendar of the Norwegian Culicines, but this would meet with some difficulties owing to the vaste extension north—south of our country. Eventually the material had to be divided into several groups in order to give a fairly correct picture of the different biological conditions. I do not consider the material at hand sufficient for such a task; however some indications will be found in chapter 9 under the biological remarks concerning the different species.

Wesenberg-Lund (1920—21, p. 136) has published a life-history calendar concerning the Danish Culicines. He divides them into three biological groups. Group 1 includes: *A. dorsalis, caspius, cantans, annulipes, excrucians, flavescens, detritus, cataphylla, communis, punctor, diantaeus, sticticus* and *Finlaya geniculata.* The author says: "A characteristic of the first group is that all the species winter exclusively or mainly as eggs. Group 2 consists of: *Th. morsitans, A. (O) rusticus* and *Taeniorhynchus richiardii* which hibernate in the larval stage. Group 3, including *T. annulata* and *C. pipiens,* hibernates as adults. In a review on the biology of the Danish Culicines Wesenberg-Lund (1920—21, pp. 133—56) i. a. touches the problem of the longevity of the mosquitoes and he indicates that in damp, cold summers the females probably may survive up to about three months. He further points out the difference of the forest pools, which teem with larvae of different species and the temporary ponds upon the meadows and plains where only two-three species were found. In many temporary pools in the open W-L did not find mosquito larvae at all. In describing the association of larvae of different species with each other the author emphasises "the almost incredible regularity with which the development of the species takes place. — — The temperature and degree of moisture, which forces one species to pass from one stage to another, has no influence at all upon another species which only awaits its appointed time". Wesenberg-Lund is of the opinion that most Danish Culicines are "really very stationary animals", but suggests that the brackish water species *A. caspius* has a "somewhat greater power of spreading".

Concerning the nourishment of the mosquitoes the males are vegetarians, sucking nectars of flowers and juices of fruits but even female mosquitoes may not infrequently be found sucking vegetable juices. Wesenberg-

Lund (1920—21, p. 144) observed females of *A. communis* sucking on blossoms of *Taraxacum vulgare.* "*On the* meadows almost every flower had one or two females of *O. communis* and many three or four; the females were sitting on the flowers and pierced their proboscoides into the heads now here now there." In a cold, rainy period in 1920 W-L was attacked by *A. (O) flavescens* and *A. cantans.* He says: "It struck me that many of these specimens were gorged with a fluid which could not be blood being clear like water. Squeezing the females clear drops appeared. They were sweet like sugar and were unquestionably honey. — — The fact of the matter is unquestionably that the lust of blood of the *Aëdini* at all events in our country, is dependent on the temperature, and that vegetable matter, more especially in the cold spring months plays a much greater role in the mosquitoes than we have hitherto thought". Among some mosquitoes sendt me from Jylland, two males and two females of *A. (O) caspicus* were labelled: "Caught on *Chrysanthemum vulgare,* in sunshine" (Here translated from Danish).

Marshall (1938, p. 247) quotes from Britten a peculiar habit of *C. pipiens* and *Taeniorhynchus richiardii.* He observed the mosquitoes "settled on the outside of thistle-heads and piercing the involucral bracts to obtain the honey". Philip (1943) records that among other mosquitoes *A. vexans* extensively visited flowers of goldenrod (Solidago). He found males as well as females, during both day and night. Myers (1928, pp. 57—8) publishes some very interesting observations on *Culex pipiens* females feeding on skim milk in a dairy. He points out the fact "that the warm milk, freshly brought in from the cowshed and apparantly odorous, is entirely neglected in favour of that which has accumulated a relatively stable "skin" of cream. — — — The skin formed by the cream is thus apparently an essential condition for feeding".

However, the females of most northern Culicine species are bloodsuckers, and most probably they are not able to produce fertile eggs without having a previous meal of blood. The relative attractiveness, however, of different kinds of blood (i. e. mammalian, avian or reptilian) seems not to be the same for all mosquito species. Concerning the northern Culicines, I fully agree with Matheson (1929, p. 39) who says regarding the North American species: "Our knowledge of the food of the adults is not very accurate or complete." From abroad detailed investigations as to the bloodnourishment of several mosquito species (i. a. Hecht 1933) and the reaction on mosquito bites (i. a. Hase 1928; Hecht 1929 a—b; Kemper 1930; Pawlowsky u. Stein 1928) has been published, but few such records are available from our region. However, in order to bring at least a review of the scattered observations available from our region, I compile below details from Wesenberg-Lund (1920—21) concerning Denmark and my own observations from Norway.

T. (T) alascaensis. No records. *T. (T) annulata.* Denmark: Blood-filled specimens numerous in stables in Jylland. Attack man (W-L). Norway: Readily attack man. Blood-filled specimens found repeatedly in horse and cow-stables (N!). Sweden: Lund: Attack man (O. Ryberg 1933). *T. (T) subochrea.* No records.

T. (T) bergrothi. Norway: Attack cattle. Blood-filled specimens found in cow-stable. (N!).

T. (Cul.) morsitans. Denmark: "I have never found females whose stomachs were red and distended by blood." (W-L). Norway: No records. *T. (Cul.) fumipennis.* No records.

Taeniorhynchus richiardii. Denmark: Attack man. (W-L).

A. (O) dorsalis. No special records.

A. (O) caspius. Denmark: Very annoying to man. "The Valby mosquitoes" (W-L).

A. (O) cantans. Denmark: Attack man. "The bites of this species — — — much worse" [than that of *A. communis*] (W-L). Norway: No records.

A. (O) annulipes; A. (O) riparius. No records.

A. (O) excrucians. Denmark: Attack man. "They bite vigorously" (W-L). Norway: Attack man in partly shaded places. In mountainous regions attacks of this species observed even in bright summer-nights. The sting proper is not painful. (N)!

A. cyprius. No records.

A. (O) flavescens. Denmark: The species attacked the horses in the meadow. "I observed that the species attacks cattle and horses more than man" (W-L).

A. (O) detritus; A. (O) cataphylla. A. (O) leucomelas; A. (O) nigripes; A. nearcticus. No records.

A. (O) communis. *Denmark:* Attack man and cattle. "The attack is always worst in the biggest and darkest part" [of the wood] (W-L). Norway: The species is a very annoying and persistent biter. In the lowlands these mosquitoes attack by preference at night or, by daytime, in shady places but in dusky weather even in open land. In the mountains I have been attacked by this species in the afternoon even in bright sunshine. Repeatedly found in houses and cow-stables. (N)!

A. (O) punctor. Denmark: No records. (W-L). Norway: Is probably the most persistent biter among our mosquitoes and in many places this species is very annoying. In mountainous regions *A. punctor* is very often found in houses, cow-stables and hog-pens. Attack by preference in the evening or at night, but in mountainous regions even on hot days, in bright sunshine. (N)!

A. (O) sticticus; A. (O) nigrinus. No records.

A. (O) diantaeus. Denmark: Attack man (W-L). Norway: No records.

A. (O) intrudens. Norway: I have been attacked by this species in woodland, on a sunny day. It has ben found in dwellings, cow-stables and hog-cotes (N)!

A. (O) pullatus. No records.

A. (O) rusticus. Denmark: Attack man. "The attack began at about seven o'clock (25. v.) and was unaltered when I left the place at half past eight" (W-L).

A. (F) geniculatus. Denmark: Attack man. (W-L).

A. (A) cinereus. Denmark: Attack man. "The sting was almost imperceptible. — — — Afterwards my hand had got more than fifty punctures, it was covered with a common purple colour and rather aching" (W-L). Norway: On two occasions I have been attacked by this species, in partly shaded places. (N)!

A. (A) vexans. No records.

Neoculex apicalis. No records.

Culex pipiens pipiens. Denmark: "Nevertheless we do not hear anything of attacks of *C. pipiens* in our country, and I myself have suffered no attacks from this species in early spring" (W-L). Norway: No records.

Culex pipiens molestus. Denmark: The following remarks by Wesenberg-Lund (1920—21, p. 146) obviously concern this species: "Only during winter, when the mosquitoes arrived in the rooms, have I been the object of their attacks; when I have heard that people have been attacked in their rooms by mosquitoes in winter, and I have been able to examine them, it has almost always been shown that the trouble was caused by *C. pipiens*." Norway: Females found in Krohgstøtten hospital, Oslo, in the first days of October. They were reported to have been rather annoying to the patients and staff. By a subsequent precipitin-test the contents of the stomach of two specimens proved to be human blood. Sweden: Lund: Attack man (Ryberg 1933).

Some specimens received from Stockholm with the report that they had been very annoying in dwellings (January). (N)!

Culex torrentium. No records.

The relation of mosquitoes and reindeer has been dealt with in chapter 4. Unfortunately there are few observations from Fennoscandia concerning the mosquito-s p e c i e s which actually attack reindeer. In mountainous regions in Tydalen (STi 37) I repeatedly observed *A. punctor* Kirby attacking reindeer and also specimens of *A. nearcticus* Dyar were caught in the same regions in reindeer herds. Bergman (1916, p. 336) records the species *Ochlerotatus maculatus* Meig. [= *A. cantans* Meig.] and *nemorosus* Meig. [=*A. communis* Deg.] attacking reindeer in Målselv (TRi 29) in July—Aug. 1915. Though I have not seen the specimens proper, I consider it most probable that Bergman's *maculatus* is *A. excrucians* Walk., *A. cantans* Meig. not being found in the northern part of Scandinavia.

A problem hitherto rather neglected is the role played by the b i r d s as a source of blood to the mosquitoes, and the following observations from Norway may therefore be of some interest.

In 1939 the ornithologist, cand. real. Yngvar Hagen, sent me 2 mosquitoes caught on nestlings of the Sparrow-Hawk (*Accipiter nisus* (L)) from Lesjaskogen (On 36) 19. juli 1939. In an accompanying letter he informs me that he observed several mosquitoes attacking the nestlings, by preference at the base of the beak and round the eyes. Having convinced himself that the mosquitoes actually filled themselves with blood from the nestlings, he caught the two specimens which were sent me for inspection. They were both typical *A. punctor.* In the same letter Mr. Hagen further quotes some observations made the 12th of July 1938 on nestlings of the Rough-legged Buzzard (*Archibuteo lagopus* (Brünn.)) from Hjerkin (On 37). The nestlings were covered with about twenty mosquitoes each, which attacked the cere and round the eyes, but Mr. Hagen could not see that the victims made any effort to get rid of their tormentors.

In the report on the investigations on the biology of the grouse in Norway, carried out 1921—1927 under the direction of the Bergens Jæger- og Fiskerforening, the ornitologist, Mr. Bernhoft-Osa published (1928) some observations on this problem made at Djup in Hallingdal (Bv. 25 Al). On the 17th of July 1926 he observed a half-grown grouse chicken (*Lagopus lagopus* L.) sitting under an overhanging stone and being surrounded by a swarm of mosquitoes. Several specimens settled on the chick and tried in vain to sting through the feathers covering the trunk, but reaching the neck and the head of the chick, they succeeded in sucking blood, by preference at the ear opening and round the eyes. Mr. Bernhoft-Osa observed 5 mosquitoes attacking the chick simultaneously, and in all he counted 8 mosquitoes flying away with blood-filled stomach from this chick. Some specimens caught by Mr. Bernhoft-Osa and deposited in Bergens Museum, were sent me for inspection. Those which could be determined were all *A. communis.* In a letter from November 1940 Mr. Bernhoft-Osa informs me that he has observed mosquitoes attacking nestlings of the Hooded Crow (*Corvus cornix* L.), a Gull (*Larus* sp.) and the Lapwing (*Vanellus vanellus* (L)).

From the zoologist, Mr. Bengt Christiansen, I received 6 mosquitoes caught 2. july 1947 on nestlings of the Golden Eagle (*Aquila chrysaëtus* (L)) at Myllinga, Rondane (HEn). Several mosquitoes were sitting in the nest but the specimens caught were actually attacking the nestlings. The mosquito specimens received were somewhat denuded and only 3 specimens could be identified, viz. 1 specimen of *A. excrucians* Walk. and 2 specimens of *A. intrudens* Dyar.

I have further received information concerning mosquitoes attacking birds from dr. O. Olstad, chief of The Governemental Game Investigation, Oslo, and from his assistent, cand. real. Aage Wildhagen. Unfortunately, no mosquito specimens have been caught. Dr. Olstad repeatedly observed mosquitoes attacking nestlings of the Rough-legged Buzzard (*Archibuteo lagopus* (Brünn)) and the Kestrel (*Cerchneis tinnunculus* (L)). Mr. Wildhagen, 29. May 1947, investigated several nests of the Rook (*Corvus frugilegus* L) lying in a dark fir-grove in Nydalen, Furnes (HEs. 18). He observed that many nestlings, which at this time were fully feathered and nearly fledged, were attacked by mosquitoes. The insects by preference attacked the birds in the region between the eye and the corner of the mouth. The victims did not make any effort to get rid of the mosquitoes that filled themselves with blood. Obviously closer investigation as to mosquitoes attacking birds and their nestlings would be of the utmost interest, especially in connection with the problem concerning the source of blood to the mosquitoes of the Far North.

As to the swarming of the male mosquitoes and the mating, Knab (1906, pp. 123—33) has published a comprehensive review with bibliography on the phenomenon and lately Marshall (1938, pp. 295—304) records the observations from Britain. From our region the only records are from Sweden (Degeer 1776, pp. 312—14) and from Denmark (Wesenberg-Lund 1920—1, pp. 152—56). Wesenberg-Lund records an observation by Mr. Krüger concerning the swarming of *T. annulata* medio October. The mosquito-swarms were hovering over the chimney-top of a house. The two swarms observed consisted of about 200 to 400 specimens. "The swarms undulated to and fro." Probably the swarming began at about 5 o'clock and the swarms disappeared at six o'clock. W-L also records the swarming of *A. (O) communis* and *A. (O) cataphylla*. "The swarming took place a fortnight after the mosquitoes were hatched; the swarms consisted only of from twenty to fifty individuals; but of such small swarms there were many hundreds around the ponds; they were always standing in the small open spaces between the trunks, mainly from one to two meters above the ground. — — The mating process took place in the deep shadow of the trees at every time of the day." The same author also gives detailed observations on the swarming and mating of *O. fletcheri* [= *A. (O) flavescens* Müll.] These observations are quoted in this paper in chapter 9 under that species. As to *C. pipiens* W-L repeatedly observed swarming in the latter part of September. "The swarms — — — always stood in sheltered places, commonly behind a large lime tree; the mosquitoes always faced the wind which was very slight. The swarm was formed about six o'clock, and was still hovering after it was so dark that I could see nothing. — — — The shape of the swarms was that of a column, commonly about two or three meters high and one meter thick. The height from the ground was about five or six meters."

From abroad several records concerning the hibernation of different Culicine species have been published (i. a. Eckstein 1920; Galli-Vallerio u. G. Rochas 1902; Hecht 1938 a—b; Martini u. Teubner 1933) but from our region only scattered records are available. As to *T. annulata* W-L records from Denmark that this species commonly hibernates in houses, cellars and sheds but he also supposes that they may hibernate in old hollow trees (1920—21, pp. 116—17). In Norway (Oslo) I once found females as well as males of *T. annulata* in a dwelling on the 25th of January. The females had been very annoying to the inhabitants. Concerning *C. pipiens* W-L (1920—21, pp. 149—51) records that the females already in the latter part of September "have found their places of hibernation. — — — One day in April/May they leave the wintering localities like a cloud". The author made cross-sections of the abdomen of these females at different times and the accompanying illustrations gives a picture of the life-history of this species. Regarding the fat-body of the hibernating females the author i. a. remarks: "For my own part I am inclined to suppose that the fat-body of the hibernating *C. pipiens* females derive from those fat-masses, which the animal has accumulated during the larva stage in freshwater, and which it, passing the pupa stage, has taken over into the imago stage." In Norway (Oslo) I have found female *C. pipiens* in the cellar of dwellings ultimo September.

Several observations have been published abroad on larval Hydrachnids parasiting on mosquitoes (i. a. Marshall and Staley 1929; Münchberg 1935, 1936, 1937). In the Fennoscandian material at hand I have repeatedly observed such parasites on different Culicine species from Norway, Sweden and Finland.

Regarding the problem of Culicines as transmitters of diseases and parasites comparatively little is up to the present known from our region. The most important paper is that of Olin (1942, pp. 220—247) where the author gives conclusive proof that tularemia may occur in Swedish mosquitoes. According to previous publications (Lundmark 1939; Malmgren 1935; Olin and Malmgren 1935; Olin 1938 a—b) mosquitoes had been suspected of spreading the disease. Olin (1942) discusses the different clinical forms of tularemia from Gävleborg and Lappland during the years 1934 to 1940. The ulceroglandular type dominates in the Gävleborg epidemics, and the glandular type is almost as frequent as the first mentioned form in the Lappland epidemic.

"In the Gävleborg cases the ulcer is most often found on the lower extremities and the women completely dominate this group. — — — In not less than 17 of the 19 glandular cases in Lappland, the lesions were situated on the face or neck", and the men dominate among the cases. Olin points out that "in Gävleborg county it is extremely common for the women to go barelegged in the summer" but in Lappland people dare not go barelegged on account of the mosquito-pest. As to the lesions in face and neck these parts of the body are most exposed to bites of mosquitoes in the far north. In 1938, when a large number of cases of tularemia occurred in Forsbacka in the Gävleborg county, "about fifty local mosquitoes of a like appearance were captured one late August night. Two examples were sent to Dr. Edwards in London who determined them to be *Aëdes cinereus*. The other mosquitoes were crushed in a mortar, suspended in physiologic saline and inoculated subcutaneously into two guinea pigs. Seven days later, one of the animals died and the other, which was distinctly ill, was killed. Autopsy revealed changes typical of tularemia in both animals and *B. tularense* was isolated from the blood". In discussing the different site of the mosquito bites, lower extremities, upper extremities, face and neck, Olin i.a. points out the different mode of clothing. A fact, not directly pointed out by Olin, but which most probably will give further explanation to this results, is the behaviour of the mosquitoes. According to my observations most mosquitoe species avoid direct sunshine. Only in the barren high mountains have I been attacked by mosquitoes in open areas in sunshine and the few observations on *Aëdes cinereus* indicate that this species only attacks in daytime in partly shaded places. Similarly *A. (O) excrucians* and *A. (O) punctor,* in the afternoon, were flying just above the grass as long as the sun was burning, but, as it grew cooler, the mosquitoes ascended and attacked face and neck immediately. Supposing the outdoor work is commonly made by day, these facts probably also will contribute to the explanation of the dominating mosquito bites on the lower extremities as pointed out by Olin in Gävleborg county.

Th. Thjøtta (1941, pp. 285—86) describes a case of tularemia probably caused by the bite of mosquitoes. The sufferer, a man, was attacked by multitudes of mosquitoes when trouting in northern Norway. The insects by preference bit him in the back of the neck and the primary lesion occurred in the very spot, where he was bitten. According to Thjøtta he had no dealings with any kind of rodents.

As to other diseases and parasites transmitted by mosquitoes in Scandinavia, very little is found in the literature. However, by courtesy of professor H. C. Bendixen, København; professor A. Brandt, Oslo; amanuensis P. Brinck, Lund; district-veterinarian F. V. Holmboe, Stavanger; professor G. Olin, Stockholm and professor dr. med. Th. Thjøtta, Oslo I have received some information relating to these matters which may be summed up as follows.

Encephalitis of the St. Louis or Authumn type do not occur in Denmark or Scandinavia, neither is Equine encephalomyelitis known from our region.

Fowl Pox (*Epithelioma contaginosum*) is known from Denmark but occurs neither in Norway nor in Sweden.

Concerning plasmodia of birds, K. G. Wingstrand (1947, pp. 1—31) has recently published a paper on *Leucocytozoon* and *Haemoproteus* in different species of Swedish birds but the intermediate (insect) hosts are not dealt with. As far as known no paper on plasmodia of birds has been published in Denmark or in Norway.

Filaria. From Denmark C. H. Hansen (1909, p. 129) published a case of *Dirofilaria immitis* from a dog imported 4 years previously from France. He also calls attention to two older cases, the one published by Krabbe (1872) the other mentioned in the journal of the Veterinary High School in København. Both were from imported dogs. Neither in Norway nor in Sweden has *Dirofilaria immitis* been observed. In a paper on the Filarid, *Setaria equina* (Abildg.) in Sweden, Brinck (1946, pp. 118, 120) discusses the possible insect carriers of the Microfilaries. He i. a. indicates mosquitoes among the insects suspected, but hitherto no closer observations on the matter are available from Sweden. *Setaria equina* (Abildg.) is also known from Denmark, and prof. Bendixen, (in a letter), indicates the possibility of mosquitoes as carriers. Margit Haaland (1928, pp. 3—22), in a paper on the blood parasites of the Willow Grouse (*Lagopus lagopus* L.) in Norway, describes a new trypanosom, *Trypanosoma lagopodis* Haaland, and indicates the possibility of mosquitoes as carriers. However, closer investigation on this matter is not published. She further i. a. describes a Microfilaria and a species of *Leucocytozoon* from the Willow Grouse. In the paper mentioned above, Wingstrand mentions Microfilaria found in Sweden in the following birds: *Corvus corone cornix* L., *Corvus frugilegus* L. and *Turdus ericetorum philomelos* Brehm.

Apart from the above-mentioned no records, as far as known, have been published on northern Culicines as carriers of diseases or parasites to man and animals. Considering future investigations I therefore esteem it of interest to conclude with a brief review of such records from abroad concerning Culicine species which are found within our region.

Anthrax. Experiments conducted with *Aëdes sylvestris* Theob. [= *A. vexans* Meig.] showed that it can transmit anthrax. Transmission seemed to be mechanical. (Morris 1918).

Autumn encephalitis. "Among 51 000 mosquitoes taken in the Maritime Province of the Russian Far East, in foci of the disease, *Culex pipiens* was one of the two species found infected. (Petrishtscheva and Shubladze 1940).

Equine encephalomyelitis. Experimental transmission of equine encephalomyelitis has been obtained with *A. (O) vexans* in USA. (Davis 1940, Riley 1938), further with *A. dorsalis* and *A. geniculatus* (Steinhaus 1946, p. 437).

St. Louis encephalitis. In experiments *A. vexans* transmitted St. Louis encephalitis from fowls to fowls (Hamon, Reeves and Gray 1943, Mitamura 1937) Experimental transmission of the disease with *Culex pipiens* is recorded by Reeves, Hamon and Izumi 1942, Hamon, Mc.D. and Howitt 1942 and Hamon, Reeves and Gray 1943).

An important record was published in 1942 by the U. S. Department of Agriculture. This year nearly 10 000 mosquitoes, flies and other biting insects were collected and tested for viruses of encephalitis and encephalomyelitis. The insects were identified, frozen and shipped in dry ice to the San Francisco laboratory of the University of California. They were divided into "pools" according to family and species, washed, ground and the "liquid" injected into mice. One pool composed of the American species *Culex tarsalis* produced symptoms of St. Louis sleeping sickness. Another pool of the same species produced the western equine sleeping sickness. This is the first time that mosquitoes collected in the field have been proved to be carrying the disease virus. (Can. Ent., 74, No. 4, 1942).

Yellow fever. *A. geniculatus* experimentally transmitted yellow fever to *Macacus rhesus*. (Robaud, Colas-Belcour and Stefanopoulo 1937; Steinhaus 1946, p. 433).

Tularemia. "No infection resulted when mosquitoes (*Culex apicalis*) fed on healthy mice or rabbits. — — — Of two mice that swallowed infected mosquitoes, however, one died of tularemia. — — — It is suggested that the infection of animals by swallowing infected mosquitoes is of considerable importance in the epidemiology of the disease." (Bozhenko 1937.)

Experiments carried out by Philip, Davis and Parker (1932) with the mosquitoes *Th. incidens, A. aegypti* (= *Stegomyia fasciata*) and *A. vexans*, showed that mechanical transmission of *Bacterium tularense* was occasionally possible. The authors consider the transmission possible in the following ways: 1) the mosquito biting after having been interrupted during its meal on the infected animal; 2) the mosquito being crushed on the skin with or without subsequent rubbing. 3) by deposition of the mosquito excrements on the skin. They conclude: "In nature, however, the occurrence of infection in this manner is not likely to occur at all commonly." Of the three mosquito species mentioned only *A. vexans* occurs within our region. Steinhaus (1946, p. 169) mentions recent research by Olsufiev on mosquitoes and tularemia.

Fowl-Pox. (*Epithelioma contaginosum.*) In recent years the following mosquitoes have been recorded as transmitting pox, at least under experimental conditions: *Aëdimorphus vexans* (Matheson, Brunett and Brody, 1931, Brody 1936); *Culex pipiens* (Blanc and Caminopetros 1930; Bos 1934; Kligler, Muckenfuß and Rivers 1928, 1929; Stuppy 1932); *Theobaldia annulata* and *Anopheles maculipennis* (Bos 1932, 1934). Kligler and Ashner (1931) demonstrated that the virus is present in *Culex pipiens* caught in the wild.

Plasmodia of birds. Experiments showed that the presence of *Plasmodium relictum* in *Culex pipiens* does not make it immune from reinfection (Sergent 1940). *Plasmodium cathemerium* and *P. inconstans* was transmitted from infected to healthy canaries (Huff 1927). The same author describes experiments carried out with a view to determining the mechanism by which certain individual mosquitoes (*Culex pipiens*) escape infection with parasites of avian malaria following repeated feedings on blood highly infectious to other individuals of the same species. The degree of infection in susceptible mosquitoes appears to be determined by some inherent characteristic of the individuals in an almost constant manner (Huff 1934). Experiments carried out by Roubaud and Mezger (1934) indicate that the degree of infection is due to racial characters in the *Culex pipiens* group.

Filaria. Chia-hsien Yen (1938) considers, on account of experiments undertaken with *Aëdes vexans* in Minnesota, this species one of the most susceptible species to infection with *Dirofilaria immitis*. The author, however, emphasises that a species of mosquitoes susceptible in one place may behave quite different in another. Therefore the problem of susceptibility is one which must be solved locally. Summers (1943) carried out similar experiments with *Aëdes vexans* in southern Lousiana, but the filarial larvae failed to develop. According to Roubaud and Colas-Belcour (1937) larvae of *Dirofilaria immitis* completed their development in French females of *Aëdes geniculatus* and *Aëdes punctor*. Phillips (1939) records the development of larvae *Dirofilaria immitis* to the infective state in *Aëdes excrucians* in Massachusetts. Hu (1931) records i. a. infective larvae of *Dirofilaria immitis* in the labia of *Aëdes vexans* and *Culex pipiens* in Maryland. The author remarks that the rather uniform density of infection found to be peculiar to each species of mosquito appears to indicate that each has a characteristic limit in its range of variation in susceptibility. Highby (1943) records the complete larval development of *Dirofilaria scapiceps* in *Aëdes vexans* and *A. excrucians*. According to Causey (1939) mature larvae of the filarid *Foleyella brachyoptera* were found in *Culex pipiens* experimentally fed on the frog *Rana sphenocephala*. Lee (1926) records filarial larvae, almost certainly those of *Filaria bancrofti*, in *Culex pipiens* in the province of Kiang Su.

Other parasites. Eckstein (1922) records "what were probably gregarines" in *Aëdes cinereus* and *A. vexans*. A Nematode occurred in *Culex pipiens* and further a Trematode. Shakhov (1927) records the Mermitid *Agamomermis* from *Aëdes dorsalis* and *A. cantans* near Kharkow. Hesse (1925) records the Schizogregarines *Caulleryella pipiens* Buschkin from *Culex pipiens* (Straßburg) and *Caull. annulatae* Breslau from *Theobaldia* *annulata* (Germany) and *Aëdes rusticus* (France). Sergent (1925) records *Herpetomenas algeriense* from *Culex pipiens* fed on owls harbouring *Trypanosoma noctuae* and *Haemamoeba ziemanni*. *Plasmodium relictum* was recovered from *C. pipiens* fed on infected canaries. Woodcock (1914 a) describes some "Crithidia" from the intestines of *Culex pipiens* and suggests their connection with Trypanosomes. In a further paper (1914 b) the same author i. a. remarks: "It seems best, therefore, to regard this parasite from *Culex pipiens* for the time being a *Leptomonas*, its name becoming *L. fasciculata* (= *Crithidia* f. N. Mc. N. and T., nec Leger)."

Concerning these forms Reichenow (1929, pp. 555—6) i. a. remarks: "Da die Arten der Gattung *Trypanosoma* in ihrem Überträger gleichfalls die Crithidiaform annehmen, ist es bei Befunden von Crithidien in Blutsaugern schwer zu entscheiden, ob es sich um nichtwirtwechselnde Arten der Wirbellosen oder um Trypanosomen handelt. So habe sich einige als Crithidien beschriebene Arten als Entwicklungsstadien von Trypanosomen herausgestellt. — — — Für manche andere Art wird sich in Zukunft wohl das Gleiche ergeben, so für die Crithidien in Stechmücken die bei diesen Insekten nicht nur im Darm, sondern auch in den Speicheldrüsen gefunden werden, und von welchen schon von verschiedenen Autoren Beziehungen zu Vogeltrypanosomen wahrscheinlich gemacht worden sind."

Concluding I may mention that Stackelberg (1937, p. 247) has some lines to the effect that: "*Culex pipiens* is the transmitter of avian malaria (Grassi). In experiments carried out by V. Groizkaja *C. pipiens* was infected with *Plasmodium praecox (Proteosoma)* in 83 to 92 per cent. This mosquito also transmits the avian parasite *Haemoproteus danilewskyi*. Other protozoan parasites recorded from *C. pipiens* are: *Herpetomonas algeriense, H. culicis, Crithidia fasciculata,* and different *Leptomonas*. Sporozoa infecting *C. pipiens* are *Nosema culicis, Thelohania legeri, Caulleryella pipiens* and others. The mosquito transmits the larvae of *Wuchereria bancrofti* (provoking elephantiasis) and further *Dirofilaria immitis* in dogs. The Filarid *Acanthocheilonema perstans* does not complete its development in *C. pipiens*."

Chapter 4.

The Mosquito Pest in the Far North.

Older Narratives and Recent Researches.

Even in older times the narratives of travellers in the Arctic mentioned the exceptional mosquito pest, and more lately there are few explorers who have published books from these regions without making complaints of the mosquito plague. Although many authors thus have devoted more or less close descriptions to the phenomenon, this information is scattered in the most different publications, and various details therefore presumably will escape the attention of entomologists.

As far as I can see, no general view of the literature on the mosquito pest in the far North has hitherto been published, and as some principal facts in the biology of northern mosquitoes are connected with this phenomenon, I find it well worth publishing a review here of the works available. I am well aware of the fact that still much information, not included here, exists, but I think the most essential has been taken into consideration. In a compilation like this, reiterations and consequently some monotony are inavoidable, but on the other hand the ferocity of the northern mosquitoes, again and again emphasised by different authors, will confirm the credibility of their often rather drastic narratives. Publications written in German are here cited in that language, the others are translated from the original language.

The oldest book where more comprehensive information on the northern mosquitoes is found, is "Historie de gentibus septentrionalibus" by Olaus Magnus, who devotes two chapters in his book to these insects. In the Basel edition of this work from 1567 there is also a most drastic illustration of the mosquito pest in the Far North (fig. 26). Here Olaus Magnus, amongst other things, reports (Chap. V., p. 281): "In the most remote regions of the North one is greatly tormented by big mosquitoes, ashore and on sea, especially by their stings and unbearable singing, when one is obliged to sleep in the broad daylight, which constantly prevails there day and night. In order to avoid this pest the inhabitants use worm-wood.[13] which they impregnate with vinegar and then dry and smoke, so that the mosquitoes, when they notice the bad smell thereof, have to fly away. They also quit, when one sprinkles a boil up of wormwood, herb-of-grace [14] or of black caraway,[15] if available, over ones head and limbs; one may also use bootblack in connection with scorched and smoked juniper scrub. But when one wants to sleep, a little tent is required, made of linen or birch bark, in order to be able to sleep under this cover in safety for the attacks of the mosquitoes and be completely secluded from these singing insects, so that one is not bored during ones rest by two evils: their stings and their unbearable sound." — — — (Chap. VI, p. 282): "In order that the beasts of burden might be left at peace from mosqui-

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[13] Wormwood: *Artemisia absinthium* L.
[14] Herb-of-grace: *Ruta graveolens* L.
[15] Black caraway: *Nigella sativa* L.

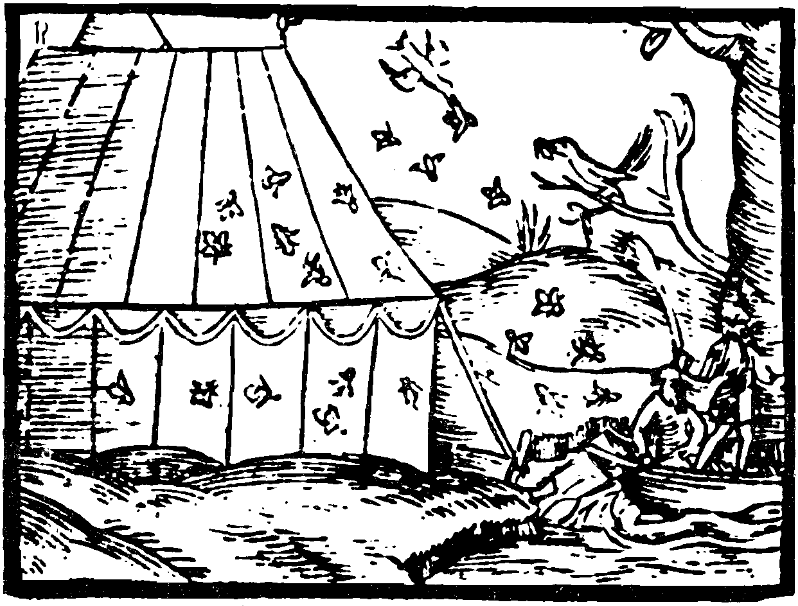

Fig. 26. The mosquito pest in the far north.
(After Olaus Magnus 1573.)

toes and flies while grazing, the herdsmen use to kindle a fire of junipers brush — juniper is plentiful everywhere in the grazing fields as well as in the forests — or else they set fire to the fir trees near the root, and they burn fragrant bulrush or the dry roots of fern, because the smoke from one or the other of all these plants is an excellent remedy to keep such animals at a distance." [16]

About one hundred years later Johan Scheffer in his work: "Histoire de la Laponie" (1679, pp. 331—332) gives a description of the great nuisance inflicted upon Lapps and reindeers by an "espece de grans moucherons". It becomes, however, evident by the description that punctures of *Simulidæ* as well as *Culicidæ* are involved. He describes how the reindeer retire to the highest mountain regions in order to get rid of their pests, and how the Lapps drive away the bloodsuckers with fire, and how they cover their face as well as their body at night to avoid the insects. Also they smear the face with "une couche de resine

[16] Translated from the Swedish edition.

ou de poix", probably meaning the oil made of birch bark, used in the North for rubbing in against the bloodsucking insects.

The description by Carl Linné in his "Flora Lapponica" (1737), of the mosquito pest in Swedish Lappland, has become almost classical. The following is quoted from the Swedish edition (p. 30) that appeared in 1905:[17] "I should think that nowhere in the worlds does this species[18] of mosquito appear in such immense quantities as in the forests of Lappland, where they may compete in number with the dust of the ground, flying about, constantly singing in an irritating song, produced by the wings, this species hardly lets the wanderer have any rest during the nights and not even during the hottest day, unless there blows a contrary wind, against which it fights with difficulty. When the naked hand is extended, there is immediately a legion there, that settles and cover same with a black colour, and if one strokes them away with the other hand and kills the whole crowd, then this is hardly accomplished before just as many others have come to take the place of the first ones. It is hardly possible to breathe freely, as they crowd into both nose and mouth."

In the well known work by Erich Pontoppidan, often quoted by zoologists: "Det første Forsøg paa Norges Naturlige Historie" (1752) the mosquito pest is no doubt mentioned (II, p. 77), but more exact observations are missing.[19]

However, in "Travels through Sweden, Finland and Lapland to the North Cape in the years 1798 and 1799" by Joseph Acerbi we meet (1802, *2*, p. 34), a rather drastic description of the mosquito pest: "We arrived at Lappajärvi in the evening. — When we arrived at the borders of the lake, we fell in with two Lapland fishermen. — On approaching them we found that they had besmeared their faces with tar, and covered their heads and shoulders with a cloth to protect themselves from the mosquitoes. — Their meagre and squalid looks discovered evident signs of wretchedness. They were covered from head to foot by swarms of mosquitoes, from whose stings their clothing scarcely shielded them. They were melting with heat, yet they dared not throw off their covering, much less remove from before the fire. Our arrival added millions of these flies to the myriads already

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[17] Translated into English here.

[18] *Culex vulgaris!*

[19] "The first attempt of a Natural History of Norway."

there, as their numbers were continually increasing in our passage thither. It was impossible to stand a moment still; every instant we were forced to thrust our heads into the midst of the smoke, or to leap over the flames to rid ourselves of our persecutors. — —". He writes about a sojourn at the lake of Kervijärvi (p. 50) as follows: "Though it was now drawing towards midnight, the torment we suffered from the mosquitoes, instead of being abated was increased. The night was perfectly calm, and the insects attracted by the effluvia of our Laplanders pursued us in our course, surrounded us, and involved us as in a cloud. After travelling three miles over reindeer-moss, and through stunted shrubs, we arrived greatly fatigued at the banks of the river Pepojoveivi, where we found a fire with some Lapland fishermen sitting by it, — — — The mosquitoes this night annoyed us so terribly, that it was not without the utmost difficulty we were able to swallow a morsel of victuals. There was not so much as a breath of wind: the column of smoke that issued from the fire mounted straight upward in the atmosphere, so that we were deprived of the benefit of fumigation, and of taking what food we had, under the protection of a cloud of smoke. We were obliged to eat with gloves on; and at every morsel we put into our mouths we were under the necessity of drawing aside the veils that covered our faces, very gently and with great circumspection, for fear of the insects entering along with our refreshment. In spite of all our precautions the mosquitoes where sometimes swallowed together with our viands. — —."

In the year 1804 Grape published a work: "Utkast till Beskrifning öfver Enontekis Sokn i Torneå Lappmark" [20] from which I extract the following complaint of the mosquito evil: (p. 98) "Towards the end of the month of June they appear in multitudes and begin to invade the houses. In calm and close weather they sit in the forest in such quantity on willow and birch bushes that they nearly (p. 99) conceal twigs and leaves. If the bush is shaken, the swarm rises, and one is in a haste as if in a mist, that really obstructs the view. With the increasing summer heat they grow more vivacious and fill the air in all localities, where blow and winds do not wipe them away. At noon and in strong sunshine they are, however, less in motion. If, in calm weather, one stops ever so little, thousands of mosquitoes out of the

[20] "Sketch of description of Enontekis parish in Torneå Lappmark" (translated from the Swedish original).

surrounding millions of myriads are busy searching all possible accesses to the skin. Without a mask or net covering the face it is impossible to keep them away. A mixture of fish oil or pitch oil and tar smeared over the face is the only thing known that keeps them away, on account of its strong smell, and although this ointment, that must often be renewed, is not without smart, especially when, one is in considerable perspiration in the heat of the sun, this trouble is much to prefer to the painful and insupportable mosquito stings. Those who must stay in the open are therefore provided with a horn or a bottle wherein above mixture is kept."

Amongst those publishing in their travel narratives the usual complaint about the mosquito pest of the Far North, is also the well known Swedish cleric Petrus Læstadius whose journals from his mission travels in Lappmarken appeared in the years 1831 and 1833. However, as his description brings nothing essentially new, (compare Edition: 1928, 2., pp. 120—121) I refrain from citing.

Per contra, the travel report of the famous Swedish entomologist, Johan Wilhelm Zetterstedt: "Resa genom Sweriges och Norriges Lappmarker förrettad År 1821 (Andra Delen, 1822)" [21] deserves a closer comment as one may evidently ascribe a special reliability to his description being that of a professional. From his sojourn in Bosekop in Alten on August 9th he reports (pp. 134—138): "In a quantity beyond all thought and description the mosquitoes swarm about in these regions. Legions of these bloodsucking beings rise into the air and obscure the sky. If the ocean were divided into drops, only then it would be possible to begin some sort of comparison between their number and that of the mosquitoes of the North. The summer loses all its pleasure here, as the summer is just the time of activity and life of these pests. The morning has then hardly unfolded its joy and the evening its calm when the mosquitoes in cloudlike hosts swarm about the one who stays in the open and deprives him of both desire and capability to be concerned in any occupation. Does he stop for a moment, then millions of these unpleasant guests crowd from all directions and not only cover face and hands, but even creep under the clothes, seeking the naked body, not returning until they have filled themselves with blood. Shortly before rain they are at

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[21] "Travel through The Lapplands of Sweden and Norway in the year 1821." (Translated from the Swedish original.)

their most atrocious: they precipitate themselves like sharp needles upon the wanderer, and their voracity is so great, that they have no time to seek suitable places but immediately stick on, even to the thick homespun russet clothes. — — — The mosquitoes appear with the summer heat and disappear with it; from the beginning of July till end of August is then their most joyful period, and within a few weeks they are hatched from their eggs, celebrate their wedding and lay their eggs for a new generation. — — — Even the most gentle person cannot help getting vexed with the unheard of impertinence of these contemptuous creatures. One swings branches with plenty of leaves round about oneself all in vain; while the branch is brandished about the head, the lower army rushes ahead in the same moment and attacks from below; one fences as if the question were to defend one's life against superior enemy; one turns furious, one flees away, but the insupportable furies pursue until one finally has to throw oneself on the ground and conceal ones face in the grass, impotent and conquered, after a protracted fight in the most wretched of all wars.

Not only the human beings are here tormented by this pest, but also the animals. Every vein wherein warm blood flows, is a much desired source where these swarming little beings guided by their fine smell, gather to quench their thirst. — — — The cattle descend into the water, or they flee to the high points, often quitting a good pasture of the valley, in order that they may not be disturbed by the mosquitoes. Therefore, in these regions, one kindles smoke issuing fires everywhere, especially in the summer nights, whereto the cattle come by themselves. I observed more than once how the horses, cows and sheep by their own free will gathered around these smoke kilns where the mosquitoes dare not pursue them. They remain several hours standing in the middle of the smoke, and when they finally have left the kiln, then they are free from the stinging insects, as long as the smell of the smoke still prevails about them. — —— The sting itself is not only always painful in the first moment, but its effect is also often terrible. Persons with sensitive nerves fall into convulsions from these stings. I have seen persons whose face was so swollen by mere mosquito stings that they were completely unrecognizable. — — —."

Nearly as dramatic as the description of the mosquito pest by Zetterstedt is that by Ludvig Kr. Daae in his book:

"Skisser fra Lapland, Karelstranden og Finland"[22] (1870, p. 60) from where I quote the following lines: "Every higher animal is pursued with a frenzy from which they must flee. The unprotected ears of the dogs are bit bloody by mosquito stings. The reindeer seeks refuge in the rough wind of the seashore or on the snow patches of the cold mountain tops.

At Karelstranden where cows and sheep are attended to with care, fires are kindled for them, and they seek refuge in the thick smoke until they are scorched. Only that which is almost insupportable to the stronger animals drives the weaker mosquitoes away. Strong smoke, strong wind, strong sunshine, heavy rain delivers from mosquitoes. The few and mighty of the creation learn to prefer any such inconvenience to the fellowship of the weak millions. But all these mosquito-scares have to be powerful. If one seeks shelter from the wind behind a stone the mosquitoes also refuge thitherward and start their meal.

Their power to detect torn places or careless incompleteness of net or gloves testifies of fine observation. If for instance the net has stuck to the perspiring ear, then scores of proboscides bore through the net. It is, however, an exaggeration that they should be able to sting through gloves or clothes."

The well-known book: "Om Lappland och Lapparne"[23] (1873) by G. von Düben is of special interest to our subject, as it inter alia describes quite thoroughly the behaviour of the reindeer towards the mosquitoes (p. 39): "Close after midsummer the mosquitoes come, and then one starts to attend to the reindeer. — — — There are certain places where the reindeer go to themselves when they are tormented and chased by the mosquitoes: it is such places that are exposed to winds, so that the mosquitoes blow away. — — — Wherever one passes those reindeer that are in the region, join. The instinct drives them to join together as it is said that the mosquitoes have less power over them when they are tightly together in a herd. — — —". (P. 40): "Big fires are kindled (on the windward side) and produce smoke by a cover of sour turf in order to drive the mosquitoes away — — —. The air is getting cool after August and the mos-

[22] "Sketches from Lappland, the Shore of Carelia and Finland." (Translated from the Norwegian original.)
[23] "About Lappland and the Lapps." (Translated from the Swedish original.)

quitoes grow less numerous; the reindeer then also begin to show a tendency to spread and they are again left on their own. — — —. (P. 85.) A worse torment to the reindeer and an insupportable one even unto man are the countless mosquitoes in the otherwise so pleasant Lappland summers. — — — The reindeer are tormented by this vermin in that way, that they partly fly into their ears and nostrils, partly attack all places where the skin is thin. The skin of the budding or not yet fully developed horns is strongly attacked and is sometimes completely covered by mosquitoes or full of red points from little blood drops oozing out. The Lapp himself does not seem to mind the mosquitoes very much; he maintains a constant fire and smoke in his turf-hut, that is all. But the settler, all non-Lapp inhabitants, and the traveller, must use a net or smear himself with tar, pitch oil or something similar; without some such step it is hardly bearable to stay for a few hours in the open during the worst mosquito season. In Russian Lappland the mosquitoes are so fierce that one has to keep up smoke even on-board; fire is made on a flat stone and covered with sour peat (Friis). — — — The mosquitoes are said also to contribute greatly to the driving of the reindeer up to the mountains. Although I have seen and felt them (the mosquitoes) right upon the glaciers of Sulitjelma, they are more reasonable and less numerous on the mountains, and are considerably checked by the prevailing low temperature, more frequent rain and stronger winds than lower down around the mountains and in the valleys. Thus the reindeer there finds a better if not fully good place, and no doubt this relative getting rid of the mosquitoes is one of the reasons why they, being used to it, like so much to retire up there, just as their wild brothers often live in the neighbourhood of the mountains and upon them — — —".

(P. 87): "It is, on the other hand, the mosquitoes who during their heydays keep the reindeer of the Woodland Lapp together; without the mosquitoes it would be hard for him to milk his herd. When the mosquito period is over, the woodland reindeer, who are wilder than the barren ground reindeer, do not go in search of the fires and smoke in the "kerdan", but may stray and actually do stray much farther about in wood and field. In order to rid themselves of the mosquitoes they are used to rush most violently through brushwood, the denser the better, thus wiping the mosquitoes off, or to stand in the water during the hotter part of the day, like our cattle."

In his book: "Naturskildringer og Optegnelser fra mit Jæger- og Reiseliv." [24] (1877) the Norwegian forester J. B. Barth has a description as short as it is saucy about his encounter with the hosts of mosquitoes of Finmark (p. 8), but I renounce further citation as the essential points are quoted below by Pottinger.

One of the most exhaustive reports on the mosquito plague in the Far North is written by Sir Henry Pottinger who in his fine book about travels in northern Norway (1905) consecrates a whole chapter to the mosquitoes: "The Realm of the Grey Terror", and illustrates the horrors in a drastic picture. I will then terminate with extracts of his descriptions, so full of humour. He writes i. a. (p. 96): "The horses are a distressing sight. From nose to tail, from hoof to withers. Their unfortunate bodies are covered with what might be taken at a casual glance for gray blanket clothing, but reveals itself to inspection as a textile mass of seething insect life, so closely set that you could not anywhere put the point of your finger on the bare hide. And yet, quivering all over, stamping, shaking, lashing their tails, they continue to graze, perhaps conscious how much fuel is required to replace the life that is being incessantly drained from them. — — —"

(P. 97.) "That I have to dwell so much on this distaseful theme is wearisome to me, and must be so to the reader, but one might as well try to ignore the presence of vehicles and foot-passengers in the streets of London as that of mosquitoes on the Arctic field. I have spoken with those who have had experience of the pests in all parts of the world as well as in that region, and for numbers, size and venom they all give the palm to the demons of Finmark and Lapland. For such small creatures they exhibit an astonishing amount of character and diabolical intelligence. They will dash through smoke like a foxhound through a bullfinch, creep under veil or wristband like a ferret into a rabbithole, and when they can neither dash nor creep, will bide their time with the pertinacious cunning of Red Indians. We wore, as I have said, stout dogskin gloves, articles with which they could not have much previous acquaintance, and yet they would follow each other by hundreds in single file up and down the seams, trying every stitch in the hope of detecting a flaw; every inch of the sewing was outlined by their un-

[24] "Descriptions of Nature and Notes from my Hunting and Travel Life."

broken ranks. — — —" Mr. Pottinger has also shaped his own idea as to h o w these unreasonable quantities of mosquitoes are able to satisfy their demand for blood (p. 98):

"It is one of the great mysteries of creation. On the uninhabited field of Finmark they must, as a rule, exist on vegetable diet, the chance of blood so rarely occurs; there is no local life except a few birds with impervious feathers. In the summer-time the Lap drives his reindeer to the sea. No native is fool enough to cross the field at that season unless he be driven there to by the rare call of duty, or tempted by the gold of a mad Englishman, and there may be, at the outside, half a dozen such madmen in half a century.

In the valleys and by the rivers, that is, in the permanently inhabited parts of Northern Norway, the mosquito plague can at times be bad enough, but in its hideous redundance it exists only on the bare field, a primeval and enduring curse, inexplicably developed to its utmost in a region seemingly the most unsuitable for its effective working: the less chance of blood, the more bloodsuckers."

(P. 104): "Now, I find myself troubled with doubts similar to those of the aforesaid angler, namely, whether readers will credit my account of the field mosquitoes as given in this and the following chapter. And I shall therefore also pay myself the poor compliment of adducing, at intervals, evidence in confirmation of it, and also begin by that of a Norwegian official; [25] but this, be it noticed, will be purely independent testimony."

(P. 105): "But I have to do with his remarks about the field mosquitoes, and will quote the following passage: "The most remarkable, or, to speak more correctly, the one remarkable thing in our journey across the field was the enormous mass of mosquitoes which, as the weather was all the time clear, still, and very warm, incessantly plagued both men and horses. No sooner had our train occupied one of the hollows for a bivouac than the air round about the encampment was so filled with them that they enveloped the whole place like a thick veil, which even obscured the brightness of the sun. I tried if the report was true that a man could with a stick write letters of the alphabet in the swarm of insects, and found the truth of it so far confirmed that the letters were actually visible when I had finished them, but the swarm then immediately closed again over them."

[25] J. B. Barth!

(P. 119.) "In Mr. Cutcliffe Hyne's admirable book, "Through Arctic Lapland" — he and his friend underwent, forty years later, much the same ordeal as ours. I find a passage so appropriate to the situation that I cannot help quoting it: "We passed that night in a condition bordering on frenzy, and let not those who merely know the mosquito in Africa, India, and the Americas, judge us too harshly when I say that at times we wished most heartily that we had never set foot in so detestable country. Cold we could have endured, privation we were prepared for, but this horrible stew of flies ground upon the nerves till we were scarcely responsible for our actions."

All the above authors have described the mosquito pest of the North more or less closely, but it was the well known German limnologist Prof. Dr. Thienemann who first scientifically attacked the connected problems. Thienemann stayed in Abisko in Swedish Lappland in the years 1936, 1937, and 1938 in order to make limnological studies, and he also submitted the mosquito problem to a closer examination (1938 a). First he asked himself (p. 307): "Weshalb gerade hier solche Massenentwickelung von Stechmücken?" and continues: (p. 311): "Die gewaltige Stechmückenentwickelung in Lappland ist natürlich nur möglich, wenn wenigstens zeitweise, d. h. im Frühjahr, Mückenbrutgewässer in großer Anzahl vorhanden sind. Prüfen wir die hierfür notwendigen Voraussetzungen. In erster Linie müssen selbstverständlich abflußlose Hohlformen des Bodens vorhanden sein, in denen sich das Wasser sammeln kann. In dem gebirgigen Gelände des Abiskogebietes sind größere und kleinere, flachere und tiefere Senken und Mulden in Mengen vorhanden." (P. 312): "Genügende Wassermengen zur Füllung dieser Bodenvertiefungen stehen im Frühling im Abiskogebiet auch zur Verfügung. — — — Das Schmelzwasser durchsetzt das ganze Gelände, es erfüllt die Mulden und Senken, die so zu Gewässern werden. Die jährliche Regenmenge ist hier nur gering; es ist so gut wie ausschließlich der schmelzende Schnee der die in jedem Frühjahr in unendlich großer Zahl in Lappland entstehenden Tümpel speist. Doch so einfach ist es nicht zu verstehen, daß das Schmelzwasser in diesen flachen oder auch tieferen Bodensenken wirklich stehen bleibt und daß sich diese Tümpel immerhin mehrere Wochen lang halten. Denn im allgemeinen ist der Boden in diesen Senken und im Birkenwald überhaupt ein lockerer. — — Weshalb versichert das Wasser nicht allmählich in den Unter-grund?" (P. 313): "Es ist der Frostboden, der hier die wasserstauende Schicht darstellt und so die Entstehung der Frühjahrstümpel erst ermöglicht." Prof. Thienemann has further measured the temperature with a maximum thermometer and stated that the surface water of the puddles and ponds that lie immediately over the frozen ground could rise to 20—22° C daily. He sums up his results as follows (p. 318): "Die Sonnenstrahlung ist also ein klimatischer Faktor, der für die Massen'entwichlung der Stechmücken ebenfalls Bedingung ist. Damit haben wir die typisch arktischen physiographischen Voraussetzungen für die Bildung der zahlreichen Mückenbrutstellen und die Entstehung der Stechmückenplage erkannt: die Schneemassen liefern bei ihrem Schmelzen die Wasserfüllung der Bodenvertiefungen, der allgemeinen verbreitete Frostboden hällt des Wasser zurück und staut es auf, die Sonnenstrahlung erwärmt es auf die für die rascheEntwicklung der Mückenbrut notwendigen Temperaturen.

The frost in the ground is, of course, a well known phenomenon of the North which may cause traffic difficulties. Various papers have already been published on this subject. It is however the merit of Thienemann that he has stated the limnological significance of the frozen ground in the Arctic. In my opinion he has found the final solution of this part of the mosquito problem in his fine work.

The second problem is the nourishment of these immense masses of mosquitoes. Because I have come to a result, different from that of Thienemann, this question has to be the object of a closer discussion. But I will first quote what Thienemann mentions hereon. He says (l. c. pp. 320—21): "Die *Aëdes*-Weibchen sind überaus blutdürstige Tiere. Es ist weiter bekannt, daß auch nach der Begattung die Eier erst reifen können wenn Blut in den Magen der Mücke gelangt ist. Die Mücke muß also nach dem Schlüpfen und der Begattung erst einmal gestochen haben, ehe sie zur Eiablage schreiten kann. Aber welche Tiere liefern in Lappland das Blut für die ungeheuren Mückenmassen? Warmblüter müssen es bei der Untergattung *Ochlerotatus,* zu der unsere Formen gehören, sein.

Die wenigen Menschen und Renntiere reichen dazu nicht aus; auch wenn man annimmt, daß Vögel die Blutspender sein können, bleibt das Mißverhälltnis zwischen Mückenmassen und der Zahl der blutliefernden Warmblüter bestehend. Und so hebt Martini (1931, S. 93) mit Recht hervor: "Ein großes Rätsel ist es noch, wie die blutdürstigen *Aëdes*-Arten, welche im Norden in so ungeheuren Mengen vorkommen, in den anscheinend wenig belebten Tundren ihre Nahrung finden." Ich glaube, meine Frühjahrsbeobachtungen 1938 haben uns der Lösung dieses Rätsels nahe gebracht.

Die Blutlieferanten müssen Warmblüter sein, die im Gebiete in wirklich großen Mengen vorhanden sind. Und da kommen meiner Meinung nach in erster Linie nur die Nagetiere in Frage. Das wurde mir im Frühling 1938 recht klar: "Überall raschelt es im Waldboden; große Wühlmäuse (der sogenannte "Rattenkopf") huschen durch das dürre Gezweig. Aber die auffallendsten Tiere sind doch die putzigen Lemminge. — — — In geradezu unglaublichen Mengen leben diese Tierchen im Birkenwald, überall sieht man ihre Löcher; immer wieder hört man ihr Quicken; in großer Zahl huschen sie über die Schneefelder am Rande des Jokk. Die Lemminge sind die Tiere, die der Vorfrühlingslandschaft hier ein ganz besonderes Gepräge geben" (Thienemann 1939). Nun ist das Jahr 1938 allerdings ein richtiges "Lemmingjahr", ein Jahr in dem diese Nager in unbeschreiblich großen Massen vorhanden sind; in solchen Jahren wandern sie bis auf die höchsten Bergkuppen und die Gletcher, während sie sonst auf die Birkenregion und untere Fjällregion beschränkt sind. Doch giebt es stets Wühlmäuse in Mengen in jener Gegend. Neben dem Lemming (*Lemmus lemmus*) geht *Microtus ratticeps* und *Evotomys rufocanus* bis in die untere Fjällregion. Dazu kommen in der Birkenregion noch *Evotomys glareolus, Microtus agrestis, Arvicola terrestris.* Ich kann es natürlich nicht beweisen, daß diese Nager die Hauptblutlieferanten der lappländischen Stechmücken sind, halte es aber für im höchsten Grade wahrscheinlich, ja bin persönlich davon überzeugt. Natürlich können daneben auch Vögel in Frage kommen. Die Untersuchung des von den Mücken aufgesogenen Blutes konnte den strengen Beweis erbringen. Damit wäre dann das letzte Glied in der Kette der die Stechmückenplage in Lappland bedingenden Faktoren geschlossen.' — — — Es giebt Jahre mit starker und solche mit schwacher Mückenentwicklung. Die Stärke der Entwicklung ist natürlich wiederum auf diesen Ursachenkomplex zurückzuführen. Welche Teilursache in jedem Jahr die wichtigste und ausschlaggebende ist, wird verschieden und nicht immer leicht festzustellen sein. Doch dürften die klimatischen Verhältnisse des Winters und Frühlings stets die Hauptrolle spielen."

When I am now about to discuss the theory of Thienemann, viz. that small rodents are the main blood source of the mosquitoes, I would shortly mention my studies in the field, pertaining to this subject. In the year 1916 I took part, as an entomological expert, in the extensive Norwegian and Swedish governmental investigations on the reindeer grazing ground problems in Northern Scandinavia. On this occasion I arrived about the middle of May in Målselv (TRi 27) and my investigation lasted until the first days of September. For a closer study of the behaviour of the reindeer to Oestrides and bloodsucking insects I procured two young reindeer that were often brought along upon the mountain. These studies were continued in the years 1918—1925, partly in the mountains of Tydal (STi 37), partly in Rana in Nordland (NSi). I lived these years in the summer in tent amongs the Lapps, strayed with them when the reindeer sought new grazing grounds and consequently had an extraordinary opportunity to study the life of the reindeer in the summer months at closest range. Also in Tydalen I had two young reindeer for the biological studies.

In his paper Thienemann states (p. 321), that the year 1938: "ein richtiges "Lemmingjahr" ist", but it does not seem to have been clear to him that the foundation of his theory consequently is based upon extreme circumstances. In the same way as the mosquitoes, so are also the higher animals subject to periodical changes, and this is not least so with the rodents. Particularly the lemming is an excellent example of an animal species that may periodically appear in enormous quantities and then undertakes extensive wanderings. Thienemann mentions that they then: "bis auf die höchsten Bergkuppen und Gletscher wandern", but perhaps still more typical are the migrations of the lemmings from the mountain into the valley and plains where they may advance right down to the coast (also compare Ekman 1920, p. 5). Twice have I met with lemming years, viz. in 1922 in the mountains of Tydal and in 1926 in Rendalen. The impression one gets of the lemming migration in the mountain region is as described above by

Thienemann. The animals do not wander in dense masses, but, maintaining a certain distance between the single individuals, they all run in the same direction.

What in my opinion goes against the probability that these animals should be the main source of blood to the mosquitoes, is their restlessness. Only now and then the lemmings are quiet for some moments, then they slip further into the grass and through the dwarf birches where every mosquito would be shaken off. Much has been published on the biology of the lemmings and their migration years; here I may for instance refer to the papers of the Norwegian zoologists (Collett, 1911—12, pp. 142—162; S. Johnsen, 1928, pp. 105—116; O. Nordgård, 1923, pp. 3—11). According to Collett (1911—12, pp. 154—56) the lemmings, in the years of migration, are attacked already in the autumn by a bacterial disease which is extremely contagious to these rodents. This disease exterminates the majority of them during the winter and the succeeding spring. The lemming carcasses pollute the drinking water and people may thus be infected with the "lemming fever", a disease which has been connected with tularemia by Thjøtta (1930, p. 590). In 1926 I was occupied with researches in the mountains of Tydal (STi 37), and that year I could hardly walk 10 meters along without running across lemmings everywhere, but in the previous and succeeding years these rodents were only occasionally met with. It has even occurred that I crossed the mountain plateau to and fro all the summer, without discovering a single lemming. These observations may be confirmed by statements from the literature. Collett remarks for instance (1911—12, p. 146): "The year following upon a great lemming year, almost all the life that at other time is met with in the mountain region will have disappeared; no lemming is to be seen, hardly a bird, the mountains "stand almost empty"." [26] Brehm reports something similar (1918, p. 234): "Während der meisten Jahre ist übrigens, nach Ekman, die Fortpflanzung recht bescheiden, und Lemminge sind dann eine sehr seltene Erscheinung." Also the other small rodents are subject to periodical variations. These animals have not been so thoroughly investigated in this respect as the lemmings, but ample evidence for our use may be found in the literature. Thus Collett, for instance, says (1911—12, p. 156): Coincident with the lemmings also microtes and other small

[26] Translated from the Norwegian original.

mammals vanish that may have appeared in excess during the same years." [27] If then, as Thienemann supposes, the small rodents were the chief purveyors of blood to the mosquitoes, the arctic mosquito pest as well would be subject to great and clearly noticeable changes, but this is, as far as I know, not the case.

Only twice in my life have I personally experienced the horrible arctic mosquito pest, viz. first as a quite young man in the summer 1910 near Archangelsk on the White Sea (USSR), and then in 1916 in Northern Norway in Målselv. I remember very well a walk in the afternoon along the shore of the river Dvina. We passed through a little birch-tree grove where, in the shadow, branches and leaves were quite covered by mosquitoes. My companion had brought along a pointer which was eagerly running to and fro in the bush. Soon the poor animal came whining back and his white colour had been transformed into grey; he was covered all over with mosquitoes. We had to return home immediately, and I believe that it would be impossible to stay in these places in the evening. Also in Målselv have I experienced real "diabolical nights" with the arctic mosquitoes.

That year I was engaged in researches on the biology of the reindeer Oestrides and it was of special interest to get some good photos of the egg-laying Oestrides. As it was exceptionally hot in daytime this summer, we decided to ascend the mountain in the evening and to stay that night up on the plateau with the young reindeer to be experimented upon. From the military depot I had received a big tent, folding beds and mosquito nets, but as we intended to make only a short excursion we preferred to make everything as simple as possible and took along small lapp tents to sleep in. These little "tents" really are just tent shaped sleeping-bags, but w i t h o u t bottom and intended for use i n s i d e a lapp hut (koje). The ascent passed moderately well but as soon as we had reached the plateau and would continue our march along a little depression of the field, we found ourselves in the "Realm of the Grey Terror". Legions of mosquitoes surrounded us. My two assistants, myself and the poor reindeer, everyone was enveloped in a mist of mosquitoes. When we had reached our goal the little tents were at once erected, but they proved quite unfit as the mosquitoes entered by hundreds from below. There

[27] Translated from the Norwegian original.

was then nothing else to do than to make up a fire. Putting damp twigs on the top my assistants produced as much smoke as possible. Sleep was out of the question, and we passed the night as near to the smoke as we could. Tears would run down our cheeks, but anything was better than the mosquitoes. Pocket handkerchiefs were tied round our heads and we smoked our pipes throughout the night, but all in vain. We all looked rather miserable the next day and our faces were so swollen that they were unrecognisable. I felt as though I had fever. I have not obtained any good picture of the mosquito swarm myself, but the rare photo by Dr. Urbye (pl. XI) gives some impression of the multitude of mosquitoes in the Far North. The reindeer also suffered under the attack of the mosquitoes. The insects covered the region around their nostrils, their eyes, ears and horns. But it was striking to notice how patiently the reindeer would bear this torment, although they too tried to come as close as possible to the smoke.

In the years 1928—45, when I collected mosquitoes every summer in southern Norway, I had the opportunity to make comparison with the arctic quantities of mosquitoes. In districts where the mosquitoes used to be especially intrusive the peasants have given special local names to these insects. They always claim that there are "especially big mosquitoes" which cause the affliction. My researches have shown me that such "local mosquitoes" belong to one of the common species of that region, but the locality has always been especially favourable for mosquito-breeding. In the mountain regions of southern Norway I have never, even at night, met with such quantities of mosquitoes as in the arctic part of the country. However, in certain mountain districts they may represent an extraordinary pest.

My investigation on Norwegian reindeer parasites soon brought me to the conviction that the reindeer play an essential part as a blood source for the mosquitoes. When the "tame" reindeer are let free, they seek in the day-time some snow-field up on the mountain. Chiefly snowfields lying in a depression below the highest peaks are thus frequented and the herd will stay there the whole day. On account of the low temperature the egg-laying oestrides are not so intrusive here as further down on the plateau, and yet animals standing at the edge of the snowfield are attacked by the oestrides. A whirl-pool-like motion in the herd may at times be noticed when the tormented reindeer try to get rid of their pests by running. In the evening when it gets cooler, the animals seek down, and soon they are distributed over wide grazing fields. Although they keep moving nearly all night and only snatch some green growth here and there, I have noticed that the blood-filled horns mostly were covered with mosquitoes. On several occasions during the summer the reindeer herd is being forced to stay the whole day on the lower plateau. When the young fawns are to be marked in the ears, or when the lapps want to milk their does, the whole herd must be driven into a corral where they are kept all day. Towards the evening before the reindeer are liberated, the mosquitoes approach by thousands and they have now an excellent occasion to quench their bloodthirst.

One may wonder if there really are reindeer enough to satisfy these excessive quantities of mosquitoes and I believe this must be the case. Certainly I have no information of the most recent years, but I quote the figures of a normal year, viz. 1926 (Natvig, 1929, p. 278). There were then about 135 000 domestic reindeer in Norway of which about 100 000 in Finmark Fylke. The reindeer raising companies of southern Norway, run by Norwegians, owned about 11 000 reindeer, and the remaining 124 000 were Lapp property. However, this is not all. According to an agreement between Norway and Sweden the Swedish Lapps are entitled to stay in summer time with their reindeer herds in Troms and Nordland Fylke (Convention between Norway and Sweden, 1919, pp. 6—22, 53—61). After the 1st of May the first ones may cross the border but they are under obligation to quit Norway by the end of September. However, not all herds are admitted to the Norwegian grazing grounds at the same time and the regulation varies somewhat for the different districts. In Troms Fylke the Swedish Lapps may stay during the summer with 39 000 reindeer (from Karesuando and Jukkasjärvi). Furthermore Swedish Lapps (from Arjeplog, Sorsele, Tärna and Vilhelmina) have access to Nordland Fylke with a total of 28 000 reindeer.

Considering the enormous distances these reindeer herds cross during the summer, what masses of mosquitoes attack the individual animal every night, and also that a single meal of blood is sufficient to mature the eggs of the mosquito, then everything goes in favour of the view that the reindeer represent the chief source of blood for the arctic mosquitoes. It must be admitted that also other mammals and perhaps birds as well may contribute their share. Thus I have received a couple of observations of mosquitoes of the genus *Ochlerotatus* attacking young birds in their nest. But compared with the far bigger reindeer, smaller animals scarcely play any noticeable part.

The correctness of my theory, based upon Norwegian conditions, would be confirmed in a convincing manner if it could be proved that similar conditions also prevail in other regions inhabited by reindeer. We therefore have to consider more closely the literature treating this subject. A summary of facts concerning the distribution of the reindeer has been published by Jacobi (1931, pp. 146—154) and Natvig (1933, pp. 8—18) has compiled the available information of the occurrence of the reindeer oestrides in the American and Eurasian continents .

The relation between northern mosquitoes and the reindeer is treated briefly by Jacobi (1931, p. 244), but especially the Swedish zoologist Lönnberg has made this question the subject of closer examination (1909). He is even of the opinion that the mosquito pest constitutes one of the chief causes of the migratory habits of the reindeer herds. Thus he says (1909, p. 47): "For the migration in the spring there are consequently three fundamental causes: 1) need of access to grazing fields with weeds and grass; 2) need of adequate fawnings-places for the does; 3) necessity of avoiding the insect pest and the heat."[28] Regarding the w o o d l a n d reindeer he reports (1909, p. 185): "In order to protect themselves against mosquitoes and other insects the reindeer go into the dense brush and run about there so that the twigs wipe them free from their foes. If there is windy weather, they go out on open bogs, also down to sea-shore and find there bot coolness and liberation from mosquitoes, thanks to the wind. Also about the wild woodland reindeer in Finland the report is that it runs through the thickets in the same way during the mosquito season, and it is said that it becomes meagre to such a degree during this "run-about period that the meat is not edible" (Granit). The wild and the "tame" woodland reindeer thus have exactly the same methods to procure for themselves alleviation against the mosquito pest."[29] About the conditions in Lule Lappmark Lønnberg (1909, p. 58) quotes an old narrative from 1740 by Olaus Modeen, part of which runs thus: "About midsummer time, when the days begin to turn warm, and the mosquitoes appear, all who have some rein-

[28] Translated from the Swedish original.
[29] Translated from the Swedish original.

deer, move away from the heat and the mosquitoes that the reindeer cannot stand, — — —." According to the same author (Lønnberg 1909, pp. 41—42) Fellman says that the reindeer Lapps of Finnish Lappmarken would find it difficult to keep their big reindeer herds unless they were permitted to stay in the coast districts of Norway during the mosquito season. We now turn our attention to the circumstances farther east and notice the narrative of Schrenk (Lønnberg, 1909, p. 39) about the migrations of one of the tribes (Syrjäner) in the land of the Samoyeds in Northern Russia) [30]: "— — — At the beginning of June, when the fawning is ended, the speed [of travel] is increased in order that one may get away from the mosquitoes which in the forests and in their proximity would become a great nuisance to the reindeer herds." Lehtisalo who has published a work on the reindeer raising of the Yurak-Samoyeds, reports about the mosquito pest (1932, p. 85): "Die dicke Behaarung schützt nur den Rumpf des Renntieres von den Mücken, aber die Gegend um die Augen, die Schnauze, die Lippen und Ohren ist den Stichen bloßgestellt. Die ersten Mücken erscheinen auf der Tundra Anfang Juni zu derselben Zeit wie die Käfer, die Fliegen und die ersten Gewächse. An warmen und stillen Sommertagen, wenn die Mückenwolke das Renntier in ihrem Mantel hüllt und in einer Säule über ihm schwärmt, leidet das Tier sehr. Die Mücken saugen sich besonders an ermüdeten und schwachen Renntieren an, die nicht imstande sind, mit dem Kopf und den Beinen heftig um sich zu schlagen. Nach Zitkow liegt ein solches Renntier, nachdem es ganz erschöpft ist, bisweilen hilflos und unbeweglich da, während ihm die Mücken in grauer Schicht die Schnauze, den Kopf und gewisse andere Körperteile bedecken. Ein frischer Wind verjagt die Insekten und befreit die Rentiere von den Qualen."

v. Middendorff has given very detailed description of the mosquito pest in Sibiria. To quote the following extract (1867, *4*, pp. 830—31): "Die unzähligen, die Luft erfüllenden Scharen von Bremsen, Stechfliegen, insbesondere aber Muskito's aller Art gehören zu den Qualen von welchen man sich keinen Begriff machen kann, bis man sie in ihrer Urheimat aufgesucht. Blutgierig, in drei- und vierfachen Schichten übereinander sitzend, bedeckten die Mücken mit dichten Maßen unseren Körper, sondierten unabläßig mit ihren Stacheln, fanden jede Blösse, jede schwache Stelle der Klei-

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30 "Reise durch die Tundren der Samojeden." Dorpat 1854. II Theil.

dung heraus; sie punktierten und tätowierten auf unserer Haut dieselben Figuren hervor welche unsere Fellkleidung zierten, indem sie die Nadellöcher der Nähte sich zu Nutze machten, ohne ein einziges unbesetzt zu lassen; sie krochen uns unabweisbar in den Mund, in die Nase, in die Augen und Ohren. Es läßt sich weder sehen noch hören, noch athmen. Tausend erschlug man auf einen Sclag, und Millionen rückten zum Ersatze heran. Alles Beobachten wurde vereitelt. Nachts wussten sie unter die Kleidungsstücke sich zu stehlen unter die man sich verkroch. In fieberhafter Aufregung ging der Schlaf verloren und gewann endlich erschöpfende Ermüdung die Oberhand, so wurde man des Schlafes nicht froh. Mit dick geschwollenen Lippen, ja, wiederholt mit völlig verschwollenen Augen und polsterartig gedrungenem Gesichte erwachte man zu neuen Qualen. Offenbar handelte es sich für die Mücken selbst um die verzweifeltesten Anstrengungen: es galt während ihres kurzen Lebens doch wenigstens ein Mal sich satt zu trinken. Der Durst von dem sie geplagt werden dürfte noch quälender sein als unsere Leiden, und dennoch müssen offenbar Myriaden dieser Thiere, von denen es in den ödesten thierleere Oeden der Urnatur wimmelt, sterben ohne zu dem erstrebten Trunke zu gelangen.

Diese Moskito-Plage halte ich für das schlimmste Hinderniß, welches sich dem Pionier der Kultur entgegengestellt, und zwar eben so wohl in der Kalten, als gemäßigten und tropischen Zone. Daß aber die vielberufene Moskito-Qualen unter den Tropen von den sibirischen wirklich noch übertroffen werden, dafür vermag ich zwei gewichtige Zeugen anzuführen. Humbolt [31] sehnte sich inmitten der sibirischen Baraba-Sümpfe nach den Martern der Orinoco-Ufer, wo er doch die Luft mit Moskito's angefüllt gefunden hatte, und Seeman.[31b] der in raschem Übergange aus den wildesten Mangle-Sümpfen in die Polargegenden des Beringsmeeres versetzt wurde, fand die Moskito-Qualen in den lezteren schlimmer. — — —

D i e M o s k i t o p l a g e i s t o f f e n b a r d i e H a u p t u r s a c h e d e r W a n d e r u n g e n d e r R e n n t i e r e u n d d e s R o t h w i l d e s,[32] wie weiter unten am betreffenden Orte näher nachgewiesen werden wird. Überall im Norden wie im Süden Sibiriens wurden wir von ihr emp-

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[31] Asie centrale, I. p. 81.
[31b] Reise um die Welt, II, p. 31.
[32] Emphasised here.

fangen, und nur im äußersten Küsten-Gebiete des Eismeeres, so wie inmitten des Eises das uns im Ochotskischen Meere und auf den kleinen Inselklippen desselben umlagerte, fanden wir uns von der Moskitoplage befreit. Auf der Großen Schantar-Insel war sie unausstehlich so wie man den unmittelbaren Küstensaum verließ. An der Boganida, nahe der äußersten Waldgränze, wo unter 71° n. Br. der verkümmerte Krüppelwald nur noch schwachen Schutz gewäht, war die Mückenplage kaum zu ertragen gewesen, während unter nahe dem 74sten Breitengrade, am Taimyrsee mitunter zwar noch Schaaren von Mücken sich zeigten, aber es waren offenbar selbst nur Verschlagene, denen unheimlich zu Muthe war, so daß ihnen das Stechen verging. Nur die stillen warmen Mittage zu Anfang August söhnten sogar unter 74½° n. Br. die Mücken so weit mit ihrem Geschicke aus, daß sie ihren blutgierigen Gewohnheiten wieder nachgingen, indessen ohne Nachdruck. Wo beides zusammentrifft weicht die Moskito-Plage und deshalb sind die Krymm und Chile [33] in dieser Hinsciht von bewährten Rufe, deshalb hat in dieser Hinsicht das gebirgigere Ostsibirien vor Westsibirien den Vorzug. Der Seewind der am Ochotskischen Meere, vom Eise landeinwärts ziehend, sich allnächtlich um die Sommermitte einstellte brachte uns Labsal."

In the second part of the 4th volume (1874) v. Middendorff has treated the migration of the reindeer very closely, and referring to our theme we find a particular section (l. c. p. 1125): "Das Geschmeiß und andere Erbfeinde als Ursache des Wanderns" where he says word by word: "Suchen wir nach dem Grunde der die Rennthiere zu ihren Wanderungen treibt, so können wir uns fast bei der Annahme beruhigen daß sie ursprünglich Waldthiere sind welche dem Geschmeiße im Frühsommer zu entgehen suchen, und nicht früher zur Waldgränze zurückkehren wagen als bis sie von ihren Peinigern sicher sind.

Hat man die fürchterliche Mücken- und Moskito-Plage in Sibirien durchgemacht die ich zu Anfang dieses Bandes und in meiner Abhandlung über die Baraba beschrieben; hat man die durch Fruchtbarkeit gesegnesten Landstriche daselbst verödet gefunden, weil weder Menschen noch Hausthiere es vor Geschmeiß auszuhalten vermocht; hat man die Nomaden Süd-Sibiriens mit ihren Heerden schon frühe im Jahre aus den fettesten Weidegründen der Steppe sich auf die noch spärlich grünenden Gebirgshöhen begeben gesehen;

[33] Pöppig, Reise I, p. 343.

hat man selbst im hoheren Norden Sibiriens die Rücken der Rennthiere von hakig bewaffneten Bremsen-Larven sieb- oder vielmehr durchschlagartig durchlöchert gefunden, gesehen wie die Thiere sich schütteln um ihre Peiniger geschoßartig von sich zu schleudern; hat man endlich erlebt wie ängstlich der Nomade seine Rennthiere zur Plagezeit überwacht, und wenn sie auf und davon sind, sicher voraussagt wo sie zwischen West bis Ost auf der Nordhälfte des Horizontes zu finden sein müssen, da sie unaufhaltsam gegen die wehende Luftströmung ziehen; — hat man das Alles selbst erlebt, so zögert man gewiß nicht, die Bedeutung anzuerkennen welche das Hervorkommen des Geschmeißes für die armen Geplagten hat.

Sei es daß die Thiere zu immer höheren und höheren, zu immer luftigeren und kühleren Gebirgsgipfeln hinansteigen; sei es daß sie vor ihren Peinigern sich ins Wasser versenken, oder wie am Ochotskischen Meere sich dicht an die überhängend tropfenden, zur Flutzeit gestrandeten Eisblökke drängen, nicht hier, nicht dort der Gefahr achtend daß das reißende Thier und der Mensch sie in dieser Lage so leicht berückt — überall sehen wir zur Sommerzeit in dem Geschmeiße das dem Moder der Urwildnisse entsteigt, die große Hauptfrage für das Leben der Rennthiere."

The descriptions by Middendorff of the almost incredible mosquito pest of Sibiria is however confirmed by many other travellers. I may shortly mention that already in 1839 the Russian lieutenant v. Wrangel published remarks about the mosquito pest of Sibiria in his travel report. The author thus (p. 339) describes his joy because of the approaching spring in Nis-hne-Kolymsk, and he continues: "Aber leider war unsere Freude nicht von langer Dauer: am 4. Juni schon stellten sich die hier gewöhnlichen ungeheuren Mückenschwärme ein, die die Luft nicht selten verfinsterten und mit ihren unendlichen Bissen uns jeden Genuß im Freien verbitterten." In his description of the fishing and hunting habits of the inmates of the villages of Černoussov and Pokhodsk, he also depicts (l. c. p. 343) how they, mounted on horseback, pursue the reindeer along the valleys: "So suchen sie die Renntiere auf, die, um sich der Hitze und der Mücken zu erwehren, bis an den Hals im Wasser zu stehen pflegen, — — —." More recently v. Toll (1909, p. 223) mentions that many reindeer perished in Kasace in 1893 as a result of the mosquito pest.

However, not only in the northern parts of Asia but also in the corresponding regions of the American continent the mosquito pest is immense. Thus Henry W. Elliott in his book: "An arctic province. Alaska and the Seal Islands" (1886) reports about the hinterland of the Bristol Bay (p. 395): "The tundra, however, which fronts the whole of that extensive coastline of Bering Sea and the Arctic Ocean, is indeed cheerless and repellent at any season. In the summer it is a great flat swale, full of bog-holes, shiny and decaying peat, innumerable sloughs, shallow and stagnant, and from which swarms of malignant mosquitoes rise to fairly torture and destroy a traveller unless he be clad in a coat of mail." The trouble sems to be rather widespread, as he further says (pp. 405—06): "There is one particularly distressing and hideous feature that belongs to this entire area of the Alaskan coast tundra and marshy moors of the interior and its forests, its river-margins, and, in fact, to every place except those spots where the wind blows hard. It is the curse of mosquitoes — the incessant stinging of swarms of these blood-thirsty insects, which come out from their watery pupæ by May 1st (with the earliest growing of spring vegetation), and remain in perfect clouds until withered and destroyed by severe frosts in September and October. The Indians themselves do not dare to go into the woods at Kolmakovsky during the summer, and the very dogs themselves frequently die off from effects of mere mosquito-biting about their eyes and paws only, for that thick woolly hair of these canines effectually shields all other portions of their bodies. Closehaired beasts, like cattle or horses, would perish here in a single fortnight at the longest, if not protected by man.

Universal agreement in Alaska credits the Kuskokvim mosquito as being the worst. They do not appear elsewhere in the same number or ferocity, but they are quite unendurable at the best and most-favored stations. Breeding here, as they do, in these vast extents of tundra sloughs and woodland swamps, they are able to rally around and embarras an explorer beyond all reasonable description. Language is simply inadequate to portray that misery and annoyance which the Alaskan mosquito-swarms inflict upon us in the summer, whenever we venture out from the shelter of trading-posts, where mosquito-bars envelop our couches and cross the doors and windows to our living-room. Naturally, it will be asked. What do the natives do? They, too, are annoyed and suffer; but it must be remembered that their bodies are daily anointed with rancid oil, and certain ammoniacal vapors constantly arise from their garments which even the mosquito, venomous and cruel as it is, can scarcely withstand the repellent power of. When the natives travel in this season, they gladly avail themselves, however, of any small piece of mosquito-netting that they can secure, no matter how small. Usually they have to wrap cloths and skins about their heads, and they always wear mittens in midsummer. The traveller who exposes his bare face at this time of the year on the Kuskokvim tundra or woodlands, will speedly lose his natural appearance; his eyelids swell up and close; his neck expands in fiery pimples, so that no collar that he ever wore before can now be fastened around it, while his hands simply become as two carbuncled balls. Bear and deer are driven into the the water by these mosquitoes. They are a scourge and the greatest curse of Alaska." That these swarms of mosquitoes also constitute a special torment to the reindeer and even may influence their migrations becomes evident from the following remarks: (p. 398): "Reindeer have a most extended range in Alaska, where an immense area of tundra and upland moors yield an abundance of those mosses and lichens which they most effect. Innumerable sloughs and lakes afford these deer a harbor or refuge from cruel torments of mosquitoes, when the wind does not blow briskly in summer; — — — (p. 397): "Reindeer cross the Kvichak River in large herds during the month of September, as they range over to and from the Peninsula of Alaska, feeding and also to escape from mosquitoes."

Closing these extractions from the literature I would like to quote the chief Veterinarian, Seymour Hadwen who reports on the mosquitoes in his work: "Reindeer in Alaska" as follows (1922, p. 67): "Mosquitoes are a serious pest in the north and cause much annoyance to man and beast. In Alaska they consist of only few species, although they are very numerous. Reindeer suffer a great deal from the mosquito, but being so heavily coated they appear to resist attack better than do some animals, excepting during the time when their hair is newly shed. *Culiceta alaskaensis* Ludlow and *C. impatiens* Walker are the large snow mosquitoes which come out early in spring. *Aëdes punctodes* Dyar is the common form, and is the worst mosquito attacking reindeer on the coast of Alaska, where it appears about the latter part of June. The Lapps always say that the mosquitoes help them to round up their herds at marking time, about June 20; it is probable however, that the warble fly, which appears about that time, may also play a part.

According to Dyar, *Aëdes cataphylla* Dyar, of which a few specimens were collected on the coast, is the species which is abundant along the Yukon Valley."

After all that has been published on the relation between reindeer and mosquitoes in various parts of northern America and Eurasia there may hardly be any doubt that the reindeer are the chief source of blood to the mosquitoes in vaste territories of the North. Whether the immense mass production of the arctic mosquitoes is at all imaginable without access to the big reindeer herds of the North, remains an open question for the present. According to narratives by various travellers there exist some arctic regions, for instance places in northern Scandinavia, where there are no reindeer nor other warm-blooded animals to be seen and yet mosquitoes abound just in these regions. I refer in this respect to the statements of Martini, Pottiger and Thienemann. Similar reports I received personally from travellers in artic Norway. After all that has been ascertained up till now about the connection between blood nourishment and egg production in mosquitoes, (i. a. Hecht 1933, pp. 25—40, Weyer, 1934, pp. 146—152) it is very little probable, however, that there should be several species just amongst the arctic mosquitoes who are able to breed without having blood meals. But further research on the spot is required until this question can have its final reply.

Chapter 5.

Classification, variability and abnormities, nomenclature and synonymy.

The species concept of the older authors, often based on more or less superficial characters of the imago, does not at all correspond with modern systematics. Even a prominent investigator as Theobald by preference used such artifical characters as the scales in his classification (1901—10), and it was not until the monograph by Howard, Dyar and Knab (1912) that a modern system of the mosquitoes was established, based on adult as well as larval characters. These authors also pointed out the importance of the male genital organs for the classification of this group. Further important contributions to the systematics of the *Culicidae* have been published in several papers by Dyar (1918 a—b, 1921, 1922, 1928), Edwards (1921, 1932), Martini (1923, 1931) and others, and it may be assumed that the systematics of the mosquitoes is now well founded in its main features. Having studied only Fennoscandian mosquitoes, I do not feel competent to discuss the phylogenetic importance of the different characters, and I refer to the above named papers for details. However, it may briefly be mentioned that obviously several characters have evolved independently along different lines of development. Other characters as i. a. the dentation of the tarsal claws and the pointed or bluntened abdomen of the female adults, the egg-laying habits and the size of the larval flabellae, the shape (length) of the antennae and the length of the siphon are biological adaptations and therefore of little phylogenetical importance.

Though a detailed description of the external anatomy is given in the first chapter, a brief review of the most important taxonomic characters may be practical. The following remarks, of course, concern solely the Danish and Fennoscandian mosquitoes.

In the adult the shape of the palps is of taxonomic importance. In the male the palps of the *Anophelini* have a "golf club" appearance and only the penultimate segment is hairy, whereas in *Culicini* the three last segments bear hair whorls of different length and shape. In the genus *Theobaldia* the ultimate segment is distinctly swollen, in the genera *Taeniorhynchus* and *Aëdes* to a lesser degree. In the subgenus *Aëdes* the male palp is very short, approximately of the same length as in the female. In *Culex* the ultimate segment of the palp is slender and tapering towards apex, and the upturned palps (pl. XII) are very characteristic of this genus. The female palps in the tribus *Anophelini* are of about the same length as the proboscis whereas the female palps in the *Culicini* are of about 1/8—1/4 the length of the proboscis. As only few figures of female palps are to be found in the literature, I have made slide preparations and delineated female palps of the majority of northern species. The illustrations show (fig. 31, 50, 55, 68, 112) small differences in the shape and relative length of the segments in most species, but, as I have only a few slide preparations of each species, little can be said concerning the variability of the female palps. However, the illustration of the distal segments in the palpi of three specimens of *Theobaldia annulata* (fig. 33) indicates that some caution is advisable until the female palps have been investigated on a more extensive material.

On the thorax the yellowish spiracular bristles distinguish the genus *Theobaldia* from all other northern mosquito genera.

The wing venation may in some cases be of diagnostical value. In the genus *Culex* the stem of the fork r_{2+3} is very short. In the genus *Taeniorhynchus* the shift of the cross-veins m—cu is about 3.0. Other minor characters will be found in the keys.

In the legs the "tibial scraper" on the hind-femorae distinguishes the genus *Aëdes,* in which also the first hind-tarsal segment is shorter than the tibia, whereas the first hind-tarsal segment in the genus *Culex* is as long as the tibia. In the genus *Aëdes* the claws on the front and middle tarsi are nearly always toothed. The genus *Culex* is distinguished by the presence of pulvilli.

The abdomen is more or less pointed in the genus *Aëdes,* in all other northern *Culicini* it is blunt-ended.

In some cases the scales may be of diagnostic value. In *Anopheles maculipennis* and *Theobaldia annulata* the wing-scales aggregate in some parts of the veins and there form distinct spots. The very broad wing-scales distinguish *Taeniorhynchus richiardii.* The broad and flat scales on the posterior pronotum are peculiar to *Aëdes rusticus.* In *Aëdes (Finlaya) geniculata* the snow-white scale-patches on the pleurae and the snow-white lateral patches on the abdominal segments are very characteristic. As to the dark and light scaled wings and the more or less white-ringed tarsal segments in different species I refer to the keys.

As the male genitalia are considered to be of basic systematic importance I have devoted a broad discussion to these organs in the first chapter of this paper, but merely from a morphological and systemical point of view. In the genera *Theobaldia* and *Taeniorhynchus* a lacuna extends about one third the way out from the base of the basistyle. The basal lobe is of a conical shape and bears stout spines resp. a strongly sclerotised rod; claspettes are absent. This type is the most primitive one in the *Culicini.* In the genus *Culex* the lacuna extends about two thirds from the base, and a subapical lobe, carrying spines and appendages of different shape, is present. In the genus *Aëdes* the lacuna extends from the base to the tip of the basistyle, dividing into a lower flap and an upper flap. Basal and apical lobes of the basistyle are mostly present. True c l a s p e t t e s are present in the subgenus *Ochlerotatus* and c l a s p e t t o i d s in the subgenerae *Aëdes* and *Aëdimorphus*. The peculiar shape of the d i s t i s t y l e at once distinguish the genus *Taeniorhynchus* and the subgenera *Aëdes* and *Aëdimorphus*. In the subgenus *Ochlerotatus* two groups are well distinguished by the genitalia, viz. the *rusticus*-group and the subgroup *Hyparcticus* of the *communis*-group.

In the past many authors considered the genital armature of a species as absolutely constant and differences in these organs were supposed to complicate or even prevent successful interbreeding between species. Though a discussion of these problems lies beyond the scope of this paper, some quotations from recent literature may be of value. In an investigation on the variability of the genitalia of the bug *Eurygaster integriceps* Put. Kerkis (1931, pp. 129—143) states that the external characters are not more variable than the genitalia. He i. a. remarks (l. c. p. 139): "Es muß — — — angenommen werden, daß der Grund des Wertes der geschlechtlichen Merkmale für systematische Zwecke keinesfalls in der größeren Konstanz derselben im Vergleich zu anderen Organen des Tierischen Organismus gelegen ist — — —, ebensowenig darin, daß dieses Organensystem etwa prinzipiell anders geartet sei als jedes andere System oder jedes einzelne Organ des tierischen Organismus — — —, sondern einzig und allein in der außerordentlichen Mannigfaltigkeit und häufig in der großen Kompliziertheit der Strukturen, welche eine große Anzahl von "Merkmalen" ergeben, die dann auch mit so großem Erfolg von den Systematikern der einzelnen Insektgruppen zu ihren zwecken ausgenutzt werden."

In some insect groups the genitalia are of great taxonomic importance, in other groups less or even of no systematic value at all. The old theory that the male and female genitalia exactly correspond to each other in the same species, as a positive and a negative picture deserves, in many cases, some corrections. I. a. Dobzhansky (1930) states that in the genus *Drosophila* the males have very complicated genital organs whereas the female genitalia are rather simple and distinct differences in different species are not to be found. Mayr (1944), in his inciting book: "Systematics and the origin of species", sums up as to these problems (l. c. p. 44): "The genitalia (sexual armatures) of insects and other arthropods often show specific characters with comparatively little individual and considerable geographic variation. They are therefore useful in taxonomic work, although their importance is frequently no greater and sometimes less than that of other structural characters." Another vexed problem has been raised by W. Horn in several papers (1932, pp. 66—67; 1933, p. 143; 1934, pp. 9—11), viz. the possibility of d i m o r p h i s m of the male genitalia in the same species (*Pogonostoma elegans hamulipennis,* a C i c i n d e l i d of Madagascar). Recently J. Brown (1944, pp. 70—72) has proved d i m o r p h i s m of the male genitalia in C h r y s o m e l i d: *Arthrochlamys bebbianae* Brown. In this paper he i. a. says: "Renewed study confirmed the occurrence of copulatory organs of distinct types, as well as the occurrence of variation of a continuous nature. Two of the confined females produced offspring with organs of both types. Males of *bebbianae* vary in size, color, and sculpture, but those with different types of copulatory organs vary around the same means as regards these other characters. Thus it seems unlikely that the differences in the organs are due to environmental or growth factors. The occurrence of true dimorphism, demonstrated by the rearing mentioned above, is indicated." Concerning female genitalia Dobzhansky (1927, but quoted from Dobzhansky 1941, p. 33) found differences in the shape of the spermatheca in a number of mutants of *Drosophila melanogaster* Meig.

In the l a r v a e the presence or absence of a siphon is of the utmost diagnostic importance; in the *Culicini* the siphon is present and in the *Anophelini* it is absent. In the *Culicini* the chaetotaxy is the most important character and, as stated by Martini (1923 a, p. 582), by preferance the p o s i t i o n of the hairs. The most easily perceptible character distinguishing the genera of C u l i c i n e larvae is the number and position of the siphonal hairtufts. In the genus *Culex* the siphon is ornamented with s e v e r a l p a i r s of ventral hairtufts, in other northern genera the siphon has one pair of ventral hair-tufts only. In the genus *Theobaldia* these hair-tufts are placed basally, in *Aëdes* in about the middle of the siphon. The peculiar modified siphon in *Taeniorhynchus* at once distinguishes this genus. In the subgenus *Ochlerotatus,* the larvae of the *rusticus*-group are immediately distinguished by several pairs of d o r s a l hairs at the siphon. Other distinguishing characters of *Culicini* are; the shape and position of the frontal hairs, the dorsal prothoracic hairs, the lateral abdominal hairs, the number and shape of the comb-scales and the pecten teeth, the shape of the siphon (the siphonal index) and the shape and length of the anal gills. As will be seen from chapter 1 C, the variability in the length of the anal gills calls for some caution in the usage of these organs for diagnostic purpose. Concerning the genus *Aëdes* no larval characters have been found distinguishing the several subgenera. However, in the subgenus *Ochlerotatus* the *annulipes*-group is well characterised by the six pre-cratal tufts in the ventral brush.

As to the pupae I refer to chapter 8 D for distinguishing characters of the genera. Only few species have been distinguished in the pupal stage and further studies are needed.

Concluding, it may be pointed out that in the genus *Theobaldia* both adult as well as larval characters are found, which differentiate the two subgenera *Theobaldia* and *Culicella,* but in the other northern genera no such conformity in larval and adult subgeneric characters is present.

Concerning the variability of species, several authors (i. a. Marshall 1938, p. 210; Martini 1931, pp. 282—84, 290—91, 320; Peus 1929 c, pp. 122—23) have noted differences within species, and in chapter 9 I have described colour-variations within some northern species. The tables in chapter 9 on the larval chaetotaxy of northern Culicines demonstrate differences between Norwegian and English as well as German larvae. However, until detailed investigation on a more extensive material has been made a close comparison of the figures would be of less interest. Krüger (1927, pp. 285—97) in a paper on the larval chaetotaxy of *Aëdes meigenanus* [= *punctor* Kirby], sums up his results thus: "Zusammenfassend läßt sich also sagen, die Zahl der Striegeldornen variiert unabhängig von der Zahl der Haaräste. In der Variabilität der einzelnen Haaren dagegen zeigt sich eine Durchgehende Abhängigkeit, die sich über den ganzen Körper erstreckt. Zwischen links und rechts aber ist sie deutlich größer als zwischen vorn und hinten. Nach diesen ergebnissen müssen wir annehmen, daß es Faktoren gibt, welche sämtliche Haare gleichmäßig beeinflussen. Ferner muß man annehmen, daß für die Haarteilung und die Striegeldornenverteilung nicht die gleichen Faktoren maßgebend sind." He also mentions that the number of hairs may probably increase with the increasing size of the larva. In my opinion, a general investigation of the zoogeographical variation of the mosquito species, from a modern standpoint, is still wanting. With the great range of distribution of several species, geographical races would not be improbable; closer comparison of the North American species with those of the northern Palaearctic Region most likely would unveil both additional common species as well as true geographical races, i. a. forms hitherto considered as synonymous with European species. Having myself a very limited material from abroad at hand, I can bring no distinct facts about these problems, but a consideration of the literature has convinced me that further work along these lines is needed.

In a treatise on the signification of zoogeographical finds for the estimation of the [geological] age of recent animals, Heberdey (1939, pp. 151—52) i. a. remarks: "Ganz allgemein wird heute wohl die monophyletische Entstehung neuer Tierformen angenommen. Es wird darunter verstanden, daß eine neue abspaltende Rasse oder Art zunächst in einem einzigen einheitlichen und geschlossenen Areal auftritt, und daß daher, wenn sich aus einer Stammart gleichzeitig oder nacheinander an verschiedenen Stellen neue Formen entwickeln, diese zu verschiedene Rassen oder Arten werden." That isolation plays an important part in the process of speciation is also emphasised by Mayr (1944, p. 33) who does not consider the separation solely from a geographical point of view. He i. a. says: "It is now becoming more certain with every new investigation that species descend from groups of individuals which become separated from the other members of the species, through physical or biological barriers, and diverge during this period of isolation. The concept of the isolated population as incipient species is of the greatest importance for the problem of speciation." Concerning the monophyletic process of speciation I feel incompetent to discuss this problem from a genetic standpoint. However, Mayr (1944, p. 64) states: "Recent genetic work has, furthermore, shown that subspecific differences are usually not due merely to one or two gene mutations, but apparently to a great many mutational steps, as well as additional chromosomal rearrangements. As a matter of fact, it now appears that the genetic differences are invariably more extensive than the few superficial morphological ones would indicate." This statement is very important as the monophyletic process of speciation would be the only basis for zoogeographical considerations.

Some Culicine species, or better pairs of species, viz. *Theobaldia annulata* and *subochrea, Ochlerotatus dorsalis* and *caspius* as well as *Culex pipiens* and *molestus,* which have also been found in our region, have been the subject of different opinion as to their taxonomic rank. Some authors consider the one from each of these pairs merely as a variety (race) of the other one, but other authors are of the opinion that both forms of each pair are distinct species. Being interested in the zoogeographical side of the problem I have mapped up the two first named pairs, and though not all places published could with certainty be located, at least a general view of the geographical distribution has been obtained.

Th. annulata has a rather wide distribution in the western Palaearctic region. It has been found from the southern Scandinavia (Alvdal at about 62 degrees of northern latitude) in the north, through North and West-Germany, in England, France, Portugal to the Canaries in the south. In the Mediterranean countries it is recorded from Algeria and Palestine, and in USSR it is recorded from Leningrad in the north to Crimea and Caukasus in the south. The easternmost record is from Ural. According to the records published *Th. subochrea* is mainly found in two areas, the western area being from Norway (Alvdal) and South Finland in the north, through West-Germany and England to North-France in the south. The eastern area is from Palestine, Mesopotamia and Persia to Tschimgana, Fergana and Taschkent in the east. A record from Macedonia connects the two areas mentioned. Several finds of *subochrea* larvae in brackish water indicated the halophilous character of this form and Stackelberg (1937, p. 103) consider it a typical halophilous mosquito. Contrary to this, Marshall (1938, p. 217) emphasises that *subochrea* breeds also in non-salt water, and the Norwegian find is from fresh-water. As to the taxonomic characters of *Th. annulata* and *subochrea* those of the genitalia overlap to some degree; both forms have the incised claw of the diststyle and also the larval characters may overlap. The only morphological character hitherto known in which the two forms decidedly differ is the colouring. Martini (1931, p. 213) reports of an unsuccessful attempt of experimental breeding of *subochrea* from the primitive species. Of special interest is also the recognition of the autogenous and stenogamous character of *Th. subochrea*. Considering these facts and the sympatric distribution of the two forms in the north-western area I am not inclined to regard *subochrea* as a race of *annulata*. Until further information is available I would prefer to regard the two as s i b l i n g s p e c i e s in the sense of Mayr.

On the problem sibling species Mayr (1944, p. 200) i. a. says: "We have defined as sibling species sympatric forms which are morphologically very similar or indistinguishable, but which posess specific biological characteristics and are reproductively isolated. — — — Sibling species and "biological races" have been so consistently confused by several recent authors that it is necessary to analyse the sibling species problem thoroughly before we can attempt to discuss intelligently what we consider bona fide biological races" and (p. 151): "The category of sibling species does not necessarily include species which are phylogenetically siblings, for example, the members of a superspecies. The term sibling species is arbitrarily limited to species which are as similar as are twins or quintuplets. The term is merely a convenient label for a not-infrequent taxonomic situation and has been adapted from the equivalent German and French terms. It is used only as a practical category, not clearly separable from other groups of similar species."

Concerning *A. dorsalis* and *caspius* I have mapped solely the distribution in the Eurasian continent, and it turns out that *dorsalis* has a distinctly more northern range of distribution than *caspius*. The northernmost European record is from U S S R (Sorokka in Karelia pomorica occidentalis, at about 64 degree of northern latitude). The species is further recorded from Finland, the southern Sweden and Norway, from Denmark, North-Germany, England and central France and eastwards through Austria, Hungary, Bulgaria, Crimea and North-Kaukasus. According to the recorded finds the northern border of the range of distribution in the Eurasian continent goes from Sorokka, through Ural-Irkutsk to the Maritime Province of the Russian Far East. The southernmost find in Asia is Ting-Hai in China. As to *A. caspius* this species is found from the southern Finland in the north, through Denmark, Germany, England, Belgium, France, Portugal to the Canaries in the south. In eastern Europe it is recorded from Austria, Hungary, the southern part of USSR, Rumania, Turkey and Macedonia. It is widely distributed in the Mediterranean and extends in North-Africa from Algeria in the west to the Nile valley in the east. Further it has been found in Sinai, Asia Minor, Arabia, the Persian Gulf and Punjab. The easternmost records from Asia are S-W Mongolia and the Gobi desert. Though *A. caspius* extends conspicuously more southwards than *dorsalis,* the two forms are sympatric in many lands in the north-western area of distribution. In several places larvae of both forms have been found associated, and though larvae of *A. caspius* mainly are found in brackish water they have also been recorded from fresh waters. Concerning the taxonomic characters, opinions somewhat diverge. Martini (1931, pp. 282—85), discussing intermediate types, bases his opinion by preference on the colouring of the mesonotum, though he also indicates differences in the abdominal colouring of the two forms *dorsalis* and *caspius*. Stackelberg (1937, p. 138) considers the two as subspecies and points out that intermediate forms are found in a median zone in USSR. On the other hand Marshall (1938) gives clear-cut taxonomic characters in the colouring of thorax, abdomen and wings. Those Danish and Fennoscandian specimens which I have inspected agree well with Marshall's description. The taxonomic characters of the genitalia are distinct and also the larvae seem to be well differentiated. Until further information is available I consider *A. (O) dorsalis* and *caspius* as sibling species. However a closer investigation of the *dorsalis*-group with its different Palaearctic and Nearctic species is very much needed, and probably several forms hitherto described as species will turn out as geographical races.

The third pair of "species", *Culex pipiens* and *C. molestus*, apparently is widely distributed but as the records concerning *C. molestus* are comparatively few I consider a mapping of minor interest. It has to be emphasised that *C. p. pipiens* does not oviposit without blood meal (anautogeny) and requires a large space for pairing (eurygamy), whereas *C. p. molestus* oviposit without any food in the adult stage (autogeny) and it mates even in small cages (stenogamy). Richards jr. (1941) remarks that American autogenous strains have been found which do not agree in structural characters with the description of *C. p. molestus*. Differential taxonomic characters of *C. p. pipiens* and *C. p. molestus* have been pointed out by Marshall and Staley (1935 b, pp. 501—06) and Marshall (1938, pp. 243—44). Cross-mating between the two forms have been carried out by Tate and Vincent (1936, pp. 136—43) and Weyer (1935 b, pp. 104—115 and 1936, pp. 202—07) and in most principal facts the results coincide. Tate and Vincent sum up their results thus: "Cross-mating was easily obtained between the two races, autogenous and anautogenous, in both directions: male autogenous + female anautogenous; and male anautogenous + female autogenous. Stenogamy and autogeny are hereditary characters. Stenogamy always appears in the F_1 generation,

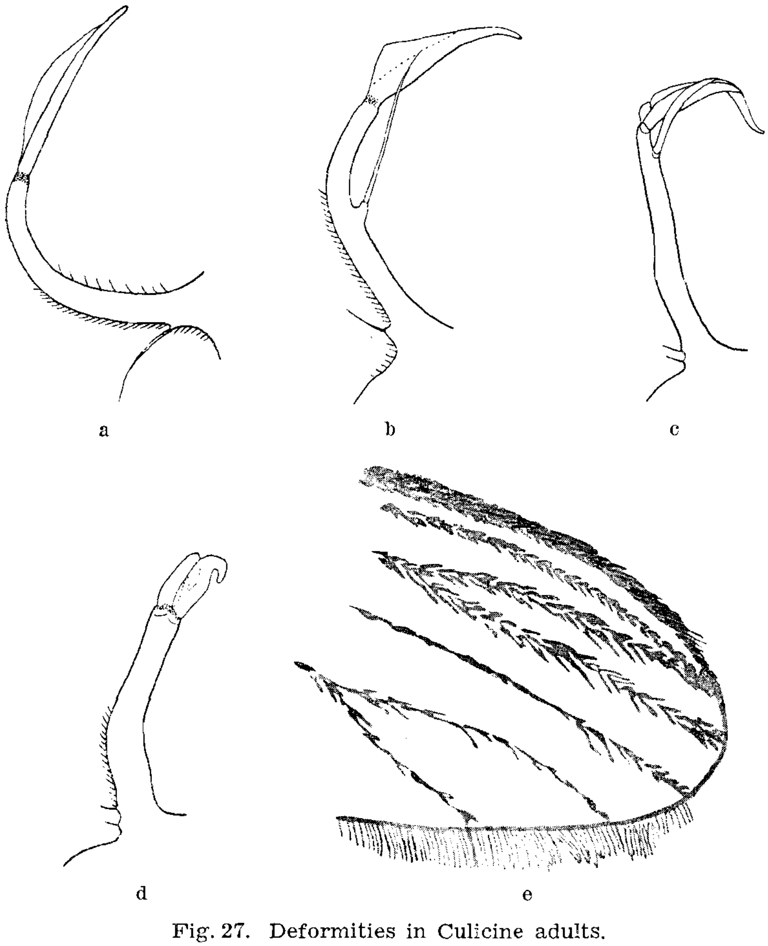

Fig. 27. Deformities in Culicine adults.
Claspettes of: a—b, *A. nigripes* (Zett.); c—d, *A. communis* (Deg.); e, tip of wing of *A. nearcticus* Dyar. (a—d, after Natvig 1934, e, after Natvig 1930).

but autogeny sometimes appears in the F_1 generation and sometimes not until the F_2 generation." They, however, emphasise: "Much further work on genetical lines is necessary, however, before the mode of inheritance of the racial characters of the two races can be discussed with confidence." According to these facts the two forms *C. p. pipiens* and *C. p. molestus* are treated as races in this paper.

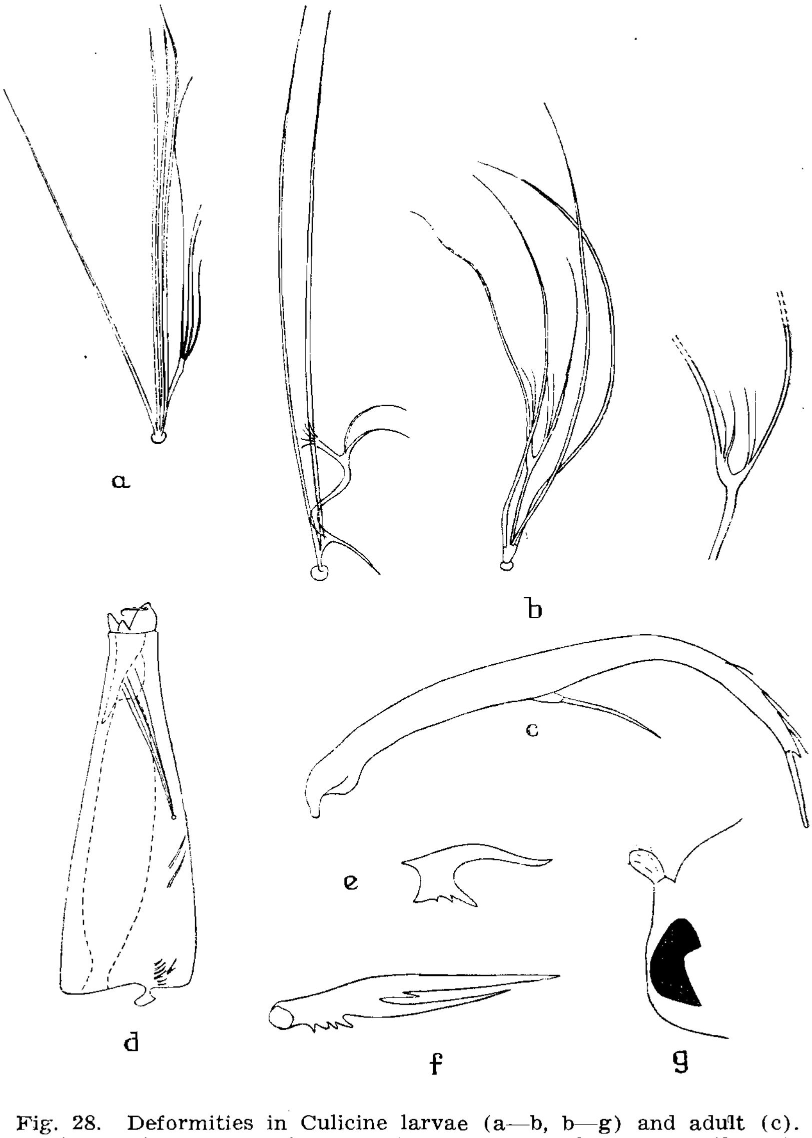

Fig. 28. Deformities in Culicine larvae (a—b, b—g) and adult (c). a, abnormal siphonal tuft *(A. (O) punctor)*; b, abnormal prothoracic hairs *(A. (O) excrucians)*; c, dististyle with abnormal spine *(A. (O) punctor)*; d, siphon with abnormal pecten *(A. (O) excrucians)*; e—f, abnormal pecten teeth; e, *A. (O) punctor*; f, *A. (O) cantans*; g, head of larva with deformed antenna *(Culex pipiens)*. (Aut. del.).

Abnormities are rare within northern Culicines. I have previously (Natvig 1934) described some anomalities in Culicide genitalia, i. a. in the claspettes, and indicated that the shape of an appendage seems to be a function of its position on the stem of the claspette. In northern Culicine larvae hairs of an abnormal shape, abnormal pecten teeth and even an abnormal pecten have been found. For details I refer to the illustrations (fig. 27—28).

The classification applied in this paper is, in its main features, coincident with Edwards (1932). However some general remarks may be justified. Martini (1923, p. 588) divided the family *Culicidae* in the three subfamilies *Dixinae, Culicinae* and *Corethrinae.* The last mentioned subfamily is now denominated *Chaoborinae.* His system coincides in general with that previously established by Howard, Dyar and Knab (1912), but he raises the Anophelines to the rank of a tribus.

The subfamily *Culicinae* is, in our region represented by two tribus: *Culicini* and *Anophelini.* As to the classification of the *Culicini* Edwards (1932, p. 63) i. a. remarks: "It has not been found possible to base the classification entirely on adult characters — the generic distinctions of the adults are often very slight and indefinite — but the larvae, pupae and life-history have also been taken into consideration." According to this he recognises five main groups, three of which are found in our region, viz. the *Theobaldia-Mansonia* group, the *Aëdes* group and the *Culex* group. Martini (1923 a, p. 586) discusses the problem if the genus *Theobaldia* has to be combined with the genus *Culex* in one main group, and he points out the peculiar *Culex*-like larva of the American species *Theobaldia (Culicella) melanura* Coq. However, in his monograph (1931) he places *Theobaldia* at the beginning of the *Culicini* and the *Culex* at the end of the system. and this grouping we also find in the monograph of Edwards (1932). Concerning the *Theobaldia-Mansonia* group Edwards (1932, p. 64) says: "The members of this group, together with the genus *Trichoprosopon,* are perhaps the nearest living representatives of the primitive stock which has given rise to all the Culicine mosquitoes." As to the *Culex* group he further remarks: "It may be that the main features of this group, especially the possession of pulvilli and the slight scale-development, are to be regarded as primitive, and it should perhaps be placed first instead of last on this account, but in some respects (e. g. structure of male coxit and multiple tufts on the lengthened larval siphon) it is no doubt specialised, and there seems no adequate reason for departing from the recent arrangement of myself and Martini in which *Culex* is placed at the end of the Culicinae."

In accordance with the above, I arrange the Danish and Fennoscandian mosquitoes in the following system:

Culicidae	*Dixinae*			
	Culicinae	*Anophelini*		
		Culicini	*Theobaldia*	*Theobaldia*
				Culicella
			Taeniorhynchus	*Coquilletidia*
			Aëdes	*Ochlerotatus*
				Finlaya
				Aëdes
				Aëdimorphus
			Culex	*Neoculex*
				Culex
	Chaoborinae			

The many vexed questions of synonymy are among those difficulties that face the student of mosquitoes. A quotation from the prominent investigator Edwards gives a clear picture of the situation. He (1932, p. 2) i. a. remarks on these problems: "The chief points of disagreement are in regard to the interpretation and use of specific names published before 1850; in many cases no types now exist, and the correct application of these names must always be a matter of personal opinion and conjecture. — — — There is much to be said for the view of Martini that where no type exists and the meaning of the author is not clear and unambiguous, the old names should be disregarded; this is the opposite extreme from the view of Dyar, who arbitrarily assigned all such names to some place in the system." I confess that I fully agree with Martini in his point of view. In general the synonymy applied in this paper coincides with that of Edwards. In some cases, however, where inspection of types, historical specimens or studies of literature have brought me to a diverging interpretation, I have made corresponding alterations in Edward's synonymy. These are as follows. In accordance with Marshall (1938, p. 107) the name of *A. (O) cantans* Meig. is used instead of *A. (O) maculatus* Meig. I have previously pointed out

(Natvig, 1942) that *Theobaldia bergrothi* established by Edwards (1921 a) on Fennoscandian specimens, but in another paper (1921 b) interpreted by him as synonymous with *T. glaphyroptera* Schin., is in reality a distinct species. *Taeniorhynchus nikolskyi* Sching. is, according to Stackelberg (1937, p. 116), quoted as synonymous with *Taeniorhynchus richiardii* Fic. The name of *C. flavus* Motsch. has been abandoned as synonym of *A. (O) cyprius* Ludl. according to Peus (1937, p. 242). I have previously elucidated (Natvig 1945) that *Culex alpinus* Linnaeus is not identical with *A. (O) nigripes* (Zett.) and the name is therefore abandoned from the synonyms of this species. *A. (O) parvulus* Edw. is placed as synonymous with *A. (O) nearcticus* Dyar in this paper. An inspection of the two males of *C. fusculus* Zett. in Zetterstedt's collection at the University of Lund, Sweden, proved that both were *A. punctor* Kirby. I have corrected the synonymy in accordance with this fact. The synonymy of *A. (O) sticticus* (Meig.) is, by preference, quoted in accordance with Peus (1933, pp. 153—58), but the names of *C. hirsuteron* Theob., *C. aestivalis* Dyar, *C. pretans* Grossbeck, *A. gonimus* D. K. and *A. vinnipegensis* Dyar have been included in the synonym-list, according to C. M. Gjullin (1946, p. 230). Also the synonymy of *A. (O) nigrinus* (Eckstein) is in coincidence with Peus (1933, p. 155), but I have added the name of *O. sticticus* var *concinnus* Steph. (*Wesenberg-Lund* 1920—21, p. 92) to the list; for details see chapter 9. As to *Aëdes cinereus* Meig. I had for inspection specimens of *C. ciliaris* L. from Zetterstedt's collection; all were *A. cinereus*. Of two specimens of *C. nigritulus* Zett., from the same collection, one is *A. cinereus,* but the other one most probably is a species of the *communis*-group. I therefore agree with the synonymy of Edwards (1932) as to this species. As stated above I have treated *Culex pipiens* L. and *C. molestus* Forskål as races. In Edwards' synonym list of *C. pipiens* I have abandoned the names of *C. bifurcatus* L. and *C. vulgaris* L. Further the synonyms *C. molestus* Forskål, *domesticus* Germar and *haematophagus* Ficalbi are transferred to the race *C. pipiens molestus* (Forskål). A detailed statement of these alterations will be found in chapter 9.

Concluding I give below a review of the nomenclature used in recent handbooks, for the Culicine species found in Denmark and Fennoscandia.

Theobaldia (Theob.) alascaensis Ludl. (Edwards 1921 b, 1932; Marshall 1938; Martini 1931; Matheson 1929; Stackelberg 1937) = *Culicella (Culiseta) alascaensis* Ludl. (Dyar 1928).

Theob. (Theob.) annulata (Schrank). (Edwards 1921 b, 1932; Marshall 1938; Martini 1931; Séguy 1923; Stackelberg 1937; Wesenberg-Lund 1920—1.)

Theob. (Theob.) subochrea Edw. (Edwards 1921 b, 1932; Marshall 1938; Martini 1931, Séguy 1923) = *Theob. (Theob.) annulata subochrea* Edw. (Stackelberg 1937; W—L 1920—1.)

Theob. (Theob.) bergrothi Edw. (Edwards 1921 a) = *Theob. (Theob.) glaphyroptera (Schin.)* p. p. (Edwards 1921 b) = *Theob. (Theob.) borealis* Sching. + *Th. glaphyroptera* (Schin.) p. p. (Martini 1931) = *Theob. (Culicella) borealis* Shing. + *Theob. (Theob.) glaphyroptera* Schin. p. p. (Stackelberg 1937.)

Theob. (Culicella) morsitans (Theob.) (Edwards 1921 b, 1932; Marshall 1928; Martini 1931; Matheson 1929; Séguy 1923; Stackelberg 1937) = *Culic. morsitans* (Theob.) (W—L 1920—1.)

Theob. (Culic.) fumipennis (Steph.) (Edwards 1921 b, 1932; Marshall 1938; Martini 1931; Séguy 1923; Stackelberg 1937.)

Taeniorhynchus (Coquilletidia) richiardii (Fic.) (Edwards 1921 b, Marshall 1938, Séguy 1923) = *Taeniorhynchus Richardi* Fic. (W-L 1920—1) = *Mansonia (Coq.) richiardii* Fic. (Edwards 1932; Martini 1931.)

Aëdes (Ochlerotatus) dorsalis (Meig.) (Dyar 1928; Edwards 1921b, 1932; Marshall 1938; Matheson 1929; Martini 1931) = *Aëdes (Ochl.) caspius dorsalis* Meig. (Stackelberg 1937) = Ochl. curriei (Coq.) (Séguy 1923; W-L 1920—1.)

Aëdes (Ochl.) caspius Pall. (Edwards 1921 b, 1932; Marshall 1928; Martini 1931; Stackelberg 1937; W-L 1920—1) = *Aëdes (Ochl.) punctatus* Meig. (Séguy 1923.)

Aëdes cantans (Meig.) (Marshall 1938; Martini 1931; Séguy 1923) = *Aëdes (Ochl.) maculatus* (Meig.) (Edwards 1921 b, 1932; Stackelberg 1937 = *Ochl. cantans* Meig. + *Ochl. vexans* Meig. (W-L 1920—1.)

Aëdes (Ochl.) annulipes (Meig.) (Edwards 1921 b, 1932; Marshall 1938; Séguy 1923; Stackelberg 1937; W-L 1920—1) = *Aëdes (Ochl.) quartus* Martini (Martini 1931.)

Aëdes (Ochl.) riparius D. K. (Dyar 1928; Edwards 1932; Matheson 1929; Stackelberg 1937) = *Aëdes (Ochl.) semicantans* Martini (Edwards 1921 b; Matini 1931).

Aëdes (Ochl.) excrucians Walk. (Dyar 1928; Edwards 1921 b, 1932; Matheson 1929; Martini 1931; Séguy 1923; Stackelberg 1937.)

Aëdes (Ochl.) cyprius Ludl. (Edwards 1932; Stackelberg 1937) = *Aëdes frey* Edw. (♂ only) + *Aëdes (Ochl.) lutescens* Fabr. (Edwards 1921 b) = *Aëdes (Ochl.) variegatus* Schrnk., p. p. (Martini 1931).

Aëdes (Ochl.) flavescens (Müll.) (Dyar 1928; Edwards 1932; Matheson 1929; Marshall 1938; Stackelberg 1937) = *Aëdes (Ochl.) lutescens* (Fabr.) (Edwards 1921; Séguy 1923; W-L 1920—21) = *Aëdes (Ochl.) variegatus* Schrnk. p. p. (Martini 1931).

Aëdes (Ochl.) detritus Hal. (Edwards 1921 b, 1932; Marshall 1938; Séguy 1923; Stackelberg 1937; W-L 1920—21) = *Aëdes (Ochl.) salinus* Fic. (Martini 1931).

Aëdes (Ochl.) cataphylla Dyar. (Dyar 1928; Edwards 1932; Matheson 1929; Stackelberg 1937) = *Aëdes (Ochl.) cataphylla* var. *rostochiensis* Martini (Edwards 1921 b; Martini 1931) = *Aëdes (Ochl.) prodotes* Dyar (W-L 1920—21).

Aëdes (Ochl.) leucomelas (Meig.) (Edwards 1932; Marshall 1938; Martini 1931; Stackelberg 1937) = *Aëdes (Ochl.) salinellus* Edw. (Edwards 1921 b).

Aëdes (Ochl.) nigripes (Zett.) (Edwards 1932; Martini 1931; Stackelberg 1937; W-L 1920—21) = *Aëdes (Ochl.) alpinus* L. (Dyar 1928, Edwards 1921 b; Matheson 1929.)

Aëdes (Ochl.) nearcticus Dyar. (Dyar 1928; Edwards 1932; Matheson 1929) = *Aëdes (Ochl.) nearcticus* Dyar + *Aëdes (Ochl.) parvulus* Edw. (Edwards 1932; Martini 1931; Stackelberg 1937) = *Aëdes (Ochl.) parvulus* Edw. (Edwards 1921 b.)

Aëdes (Ochl.) communis (Deg.) (Dyar 1928; Edwards 1921 b, 1932; Marshall 1938; Matheson 1929; Séguy 1923; Stackelberg 1937; W-L 1020—21) = *Aëdes (Ochl.) nemorosus* Meig. (Martini 1931.)

Aëdes (Ochl.) punctor (Kirby), (Dyar 1928; Edwards 1932; Marshall 1938; Martini 1931; Matheson 1929; Séguy 1923; Stackelberg 1937; W-L 1920—21) = *Aëdes (Ochl.) punctor* var. *meigenanus* Dyar. (Edwards 1921 b.)

Aëdes (Ochl.) sticticus (Meig.) (Marshall 1938; Stackelberg 1937) = *Aëdes (Ochl.) lateralis* Meig. (Martini 1931) = *Aëdes (Ochl.) sticticus* Meig. + *Aëdes (Ochl.) nigrina* Eckst. (Edwards 1921 b) = *Aëdes (Ochl.) dorso-vittatus* Vill. (Séguy 1923) = *Aëdes (Ochl.) sticticus* Meig. + *Aëdes (Ochl.) lateralis* Meig. (Edwards 1932.)

Aëdes (Ochl.) nigrinus Eckst. (Stackelberg 1937) = *Aëdes (Ochl.) sticticus* Meig. (Martini 1931) = *Aëdes (Ochl.) sticticus* var. *concinnus* Steph. (W-L 1920—21.)

Aëdes (Ohl.) diantaeus H. D. K. (Dyar 1928; Edwards 1921 b, 1932; Matheson 1929; Martini 1931; Stackelberg 1937; W-L 1920—21.)

Aëdes (Ochl.) intrudens Dyar. (Dyar 1928; Edwards 1921 b, 1932; Matheson 1929; Martini 1931; Stackelberg 1937.)

Aëdes (Ochl.) pullatus (Coq.) (Dyar 1928; Edwards 1932; Matheson 1929; Martini 1931; Stackelberg 1937) = *Aëdes (Ochl.) pullatus* var. *jugorum* (Vill.) (Edwards 1921 b) = *Aëdes (Ochl.) jugorum* (Vill.) (Séguy 1923.)

Aëdes (Ochl.) rusticus Rossi. (Edwards 1921 b, 1932; Marshall 1938; Séguy 1923; Stackelberg 1937; W-L 1920—21) = *Aëdes (Ochl.) diversus* Theob. + *Anopheles elutus* Edw. (Martini 1931.)

Aëdes (Finlaya) geniculatus (Oliv.) (Edwards 1921 b, 1932; Marshall 1938; Séguy 1923; Stackelberg 1937; W-L 1920—21) = *Aëdes (Finl.) ornatus* Meig. (Martini 1931.)

Aëdes (Aëdes) cinereus Meig. (Dyar 1928; Edwards 1921 b, 1932; Marshall 1938; Martini 1931; Matheson 1929; Séguy 1923; Stackelberg 1937; W-L 1920—21.)

Aëdes (Aëdimorphus) vexans Meig. (Dyar 1928; Edwards 1921 b, 1932; Marshall 1938; Martini 1931; Matheson 1929; Séguy 1923; Stackelberg 1937.)

Culex (Neoculex) apicalis Adams. (Dyar 1928; Edwards 1921 b, 1932; Marshall 1938; Martini 1931; Matheson 1929; Stackelberg 1937) = *Culex pyrenaicus* Brolem. (Séguy 1923.)

Culex (Culex) pipiens L. (Dyar 1928; Edwards 1932; Marshall 1938; Martini 1931; Matheson 1929; Séguy 1923; Stackelberg 1937) = *Culex pipiens* L. + *Culex molestus* Forsk. + *Culex nigritulus* W-L. (Edwards 1921 b.)

Culex (Culex) molestus Forskål. (Marshall 1938.)

Culex (Culex) torrentium Martini (Edwards 1932) = *Culex (Culex) torrentium* Martini syn. *exilis* Dyar (Martini 1931) = *Culex (Culex) exilis* Dyar (Stackelberg 1937).

Chapter 6.

Previous investigation on mosquitoes in Denmark and Fennoscandia.

The literature on culicides of our faunistic region is quite summary excepting several notes on *Anopheles* and malaria scattered in medical journals and other papers. As however the malaria problem in the North will be treated in the second part of this work, I here take into consideration entomological publications only. A few special works on northern culicides exist, but most information is found in synoptical works. When treating this matter I find it more lucid to review the literature separately for each of the 4 northern countries.

Denmark.

The first real information regarding Danish Culicides is found in "Fauna Insectorum Fridrichsdalina" (1764, p. 86) by O. F. Müller, who specifies the following mosquitoes: *Culex pipiens, C. bifurcatus, C. fasciatus* and *C. flavescens.* The two latter are marked with an asterisk and in the foreword the author remarks: "Asterismus nouis speciebus apposui, ut a iam notis dignoscerentur". In "Zoologiae Danicae Prodromus" (1776, p. 182) he lists 3 species, viz.: "*Culex pipiens, C. flavescens* and *C. bifurcatus*"; however, *C. ciliaris* Linn. is here taken as a synonym of *C. flavescens.*

More than 60 years then pass until C. Stæger indicates no less than 13 species of mosquitoes in his work: "Systematisk Fortegnelse over de i Danmark hidtil fundne Diptera. I *Culicides* et *Tipulariæ culiciformes*" [34] (1839, pp. 549—560). With this list he has created the first real foundation of a Danish culicidology. Stæger here describes a new species of *Anapheles: A. nigripes,* and mentions furthermore the following species: "*Anopheles maculipennis* Hoffgg. Meig. Macq.; *A. bifurcatus* Meig. Macq.; *Culex pipiens* Lin. Fabr. Meig. Macq.; *C. nemorosus* Meig. Macq; *C. ornatus* Hoffgg. Meig. Macq.; *C. nigripes* Zett.; *C. annulatus* Fabr. Meig. Macq.; *C. cantans* Hoffgg. Meig. Macq.; *C. annulipes* Meig.; *C. vexans* Meig.; *C. dorsalis* Meig.; *Aëdes cinereus* Hoffgg. Meig. Macq." The foreword indicates that Stæger made his collections mainly in the surroundings of Köbenhavn. But also the two entomologists Drewsen and Schiødte have con-

[34] Systematic list of Diptera found in Denmark till this day.

tributed to his list, the latter with collections from Sjælland and the northern parts of Jylland.

In 1839 J. C. Schiødte published a travel report: "Beretning om Resultaterne af en i Sommeren 1938 foretagen entomologisk Undersøgelse af det sydlige Sjælland, en Deel af Laaland, og Bornholm",[35] wherein he lists the following culicides from southern Sjælland: "*Culex annulipes* Meig.; *Cul. nemorosus* Meig.; *Cul. cantans* Meig.; *Cul. vexans* Meig.; *Cul. ornatus* Meig."

The above works have only considered the imagines, but in 1886 a publication by Fr. Meinert: "De eucephale Myggelarver" [36] appeared describing (pp. 375—397) larvae of: "*Culex annulatus, C. nemorosus,*[37] *Anopheles maculipennis, A. nigripes*" and also adding information about their biology. The larvae and pupae and details of their morphology are moreover illustrated in plate I.

During the following years no one seems to have occupied themselves in particular with mosquitoes until Wesenberg-Lund in the beginning of our century took up this group in his field of studies. His first work on the subject: "Über *Culex-Mochlonyx-Corethra,* eine Anpassungsreihe (in Bezug auf das Planktonleben der Larven)" appeared in 1908. The author points out the biological line of development in *Culex, Mochlonyx* and *Corethra.* In *Culex* both the larva and the pupa are surface dwellers, they are dependent upon access to the surface. The larva of *Mochlonyx* has no doubt a sipho, but the larva lives mostly quite submerged and is not dependent upon access to the surface. The pupa of *Mochlonyx* is a surface dweller. In *Corethra* both the larva and the pupa have a closed tracheal system and they live in the deeper layers of the water.

Although the next publication: "Bidrag til nogle Myggeslægters Biologie" [38] (1914) chiefly treats *Mochlonyx* and *Corethra,* the author also gives (pp. 4—7) some information about morphology and function, especially of the respiration

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[35] "Report on the results of an entomological research of southern Sjælland, part of Laaland, and of Bornholm, undertaken in the Summer 1838."

[36] "The eucephal mosquito larvae."

[37] The larva shown in fig. 17, plate I, is certainly not *nemorosus.* The dorsal hairs pictured on the respiration tube, the far outstanding terminal teeth of pecten and the position of the ventral hairs of the respiration tube, everything indicates *Ochlerotatus rusticus* (Rossi), a species that is also pointed out by Wesenberg-Lund as common in northern Sjælland!

organs, in *Culex* and *Anopheles*. In figure 1 and 3 the sipho and valves of *Culex* are illustrated.

In 1918 Wesenberg-Lund published a fine study: "Anatomical description of the larva of *Mansonia Richardii*[39] (Ficalbi) found in Danish freshwaters" wherein he closely details the morphology and anatomy of the larva of this species of mosquito, new to Denmark. By comparative research of the anatomy of the sipho of *Mansonia* and *Culex* the author shows how the sipho of *Mansonia,* that serves to penetrate into roots of plants, has arisen through the modification, especially of the sipho valves, of the ordinary culicide type. The siphonal longitudinal muscles which in *Culex* serves to open and close the valves, are used by the larva of *Mansonia* when penetrating into the roots. The description is rendered intelligible by an abundance of instructive illustrations.

The small work: "The Pupa-stage of the mosquitoes" (1920) treating in a popular form the adaptations of the pupae of the culicides, briefly mentions the difficulty in determining even the genera. Finally the author gives a description of the morphology and biology of the pupa of *Mansonia.*

In 1919 Wesenberg-Lund published a popular preliminary report on his mosquito studies that had extended over many years: "Bidrag til Stikmyggenes Biologie".[40] At last, in 1920—21 his great monograph of the mosquitoes appeared: "Contribution to the Biology of the Danish Culicidæ", which counts among the most important Danish biological works. However, in this treatise also the morphology of the imagines and especially of the larvæ is decribed closely and in detail. Based upon comparative studies of the mouth parts of the larvæ Wesenberg-Lund established two main types representing biological adaptions. He also used the chætotaxis of the larvæ for differentiation of the species. The observations regarding biology and development of the different species, continued for years, have brought to light an abundance of new facts and essentially enlarged our knowledge. Justly Wesenberg-Lund has eliminated *C. nigripes* Zett. that was indicated by Stæger as a Danish species. Then only 12 Danish species remained but W. L. could add the following 13 as new for Denmark: "*Ochlerotatus curriei*

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[38] "Contribution to the biology of some genera of mosquitoes."
[39] *Taeniorhynchus richiardii* (Fic.)!
[40] "Contribution to the biology of the mosquitoes."

(Coquillet), *O. lutescens* (F.), *O. excrucians* (Wlk.), *O. detritus* (Haliday), *O. punctor* (Kirkby), *O. prodotes* (Dyar), *O. rusticus* (Rossi), *O. diantœus* (Howard, Dyar and Knab), *O. sticticus* (Meig), *Tœniorynchus Richardii* (Ficalbi), *Culicella morsitans* (Theobald), *Culex ciliaris* Linné, *C. nigritulus* Zetterstedt." Of these 13 species Wesenberg-Lund has found 12 himself. *O. Sticticus* was collected by Mr. Kryger in Western Jutland. According to Wesenberg-Lund there were then recorded 25 species of Culicides in Denmark. The greater part of the work is consecrated to the *Culicines,* but in the second part the author also treats the malaria question in Denmark in connection with the Anophelines.

Wesenberg-Lund has also treated this problem in the two papers: "Sur les causes du changement intervenu dans le mode de Nourriture de *l'Anopheles maculipennis*" [41] and "Les Anophélines du Danemark et les Fièvres paludiennes" [42] (1921) as well as in "Undersøgelser over de danske Malariamyg og dansk malaria" [43] (1921).

The small paper: "Om myg og Myggeplage" [44] (1925) gives a popular description of the biology of various mosquitoes and the torment that they cause. The latest publication by Wesenberg-Lund on mosquitoes is: "Nyere Undersøgelser over Malariamyg" [45] (1934).

Regarding the existence in Denmark of two races of *Anopheles maculipennis: messeae* and *atroparvus,* information has been given by Missiroli, Hackett and Martini (1933, p. 55) and also by Hackett and Missiroli (1935, p. 57).

Sweden.

The oldest information on Swedish Culicides is found in "Flora Lapponica" (1737), where Linné describes two species: *Culex vulgaris* and *Culex alpinus* (p. 363—364).

These species are then mentioned in "Animalia per Sveciam observata" (1737, p. 127) under reference to "Flora Lapponica".

In "Fauna Svecica" (1746, p. 328, Nr. 1116) Linné has united *Culex vulgaris* and *C. alpinus* as synonyms under *"Culex cinereus; abdomine annulis octo".* In Editio Decima

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41 Quoted from Kai Henriksen (1937, p. 288).
42 Quoted from Kai Henriksen (1937, p. 288).
43 "Researches on the Danish malaria mosquitoes and Danish malaria."
44 "On mosquitoes and mosquito pest."
45 "Recent researches on malaria mosquitoes."

of his "Systema naturæ" (1758) where be introduced the binary nomenclature the species is then called (p. 602. Nr. 224) *Culex pipiens,* with reference to "Flora Lapponica", p. 363, 364. It appears as if he has meant the two names *C. vulgaris* and *C. alpinus* as synonyms. Martini (1922 c, p. 108) seems to be in doubt concerning *vulgaris.* However, the two synonyms are repeated in the second edition of "Fauna Svecica" (1761) in the same way as in the first edition. Linné describes a new species, *Culex ciliaris,* in "Systema Naturæ" Editio duodecima reformata (1767, p. 1002), but the synonymy of the two other species is unaltered.

Charles Degeer has in his "Memoires pour servir a l'Historie des Insectes" (1776, *6,* pp. 298—324) delivered a thorough description of the mosquito and its stages of development. His statements are mainly extracted from Reaumur, but on pages 312—316 Degeer has published interesting original observations, especially on mosquitoe swarms and the population of mosquitoes. P. 316—324 contain a description of the species *Culex communis* (*C. pipiens* L.) which in 1818 was described by Meigen under the name of *nemorosus* and known for years by that name. Edwards (1921, p. 315), however, is of the opinion that Degeer's description is sufficient for an absolutely sure identification of the species and he has therefore reintroduced the name of *communis* in the litteraure.

Johan Wilhelm Zetterstedt in his work: "Resa genom Sveriges och Norges Lappmarker förrättad år 1821" [46] (1822) presents, as already mentioned above, a close description of the mosquito pest in Lappland, but his conception of the systematics of mosquitoes is still strongly influenced by Linné. He says (1822, p. 138): "In reality there are only three kinds (species) of mosquitoes, which on account of their stings are such a nuisance in the North.",[47] and on p.139 he mentions as the first "species" the "real mosquito", *Culex pipiens.* By the description, however, it becomes evident that it must be an *Ochlerotatus,* but more exact identification of the species is not possible. The two remaining "species" are *Simulia reptans* Meig. (*Culex reptans* Linn.) and *Ceratopogon pulicarius* Meig. (= *Culex pulicarius* Linn.).

The same conception of the idea "species" is found with *G. Dahlbom,* who in his handbook: "Kort Underrättelse om

[46] "Travel through the Lapplands of Sweden and Norway, undertaken in the year 1821."

[47] Translated from the Swedish original.

Skandinaviske Insekters allmänare Skada och Nytta"[48] (1837, p. 328) under the name of *Culex pipiens* Linné, gives some information about mosquitoes in Lappland and their fighting.

The first synopsis of Swedish mosquitoes answering more modern requirements is found in Zetterstedt's: "Insecta Lapponica" (1840), in which (pp. 806—808) the following species are described: "*Culex annulatus* Fabr. Meig.; *C. nemorosus* Meig. (= *C. sylvaticus* Meig.); *C. cantans* Meig. (= *C. maculatus* Meig.); *C. pipiens* Lin. De Geer Fabr. Meig. Dahlb.; *C. ciliaris* Lin. (= *C. rufus* Meig.); *C. nigripes* n. sp.; *Anopheles bifurcatus* Meig. Lin. (= *C. trifurcatus* Fabr.; *C. claviger* Fabr.); *A. maculipennis* Meig." Regarding the newly described species: *C. nigripes* Zetterstedt expressly remarks (p. 807): "Hab. in Groenlandia Mus. D. Westermanni, in Lapp. a me frustra quaesita, vixque ibi obvia. (Groenlandia)." He also says (1840, p. 808): "Obs. *Aëdes cinereus* Meig. nec in Lapponia nec in Suecia haetenus est inventa."

C. H. Bohemann has listed the following species in a travel report from 1845: "Resa i Luleå, Jockmocks och Quickjocks Lappmarker"[49] (p. 99): *Culex cantans, C. pipiens* and *C. sylvaticus* adding, on p. 101, *Aëdes cinereus,* but all of them without any closer description.

In a small treatise: "Bidrag till Kännedomen om Stickmyggorna och deras Fiender"[50] P.F.Wahlberg (1848, p. 257) publishes a few observations regarding flies of prey that pursue the culicides, simulides and ceratopogonides.

In the meanwhile the first volumes of the fundamental work for the knowledge of northern diptera by Zetterstedt appeared: "Diptera Scandinaviae Disposita et Descripta", and in the IX. volume (1850) the author gives (pp. 3453—3470) a detailed presentation of the Scandinavian mosquitoes, with exact descriptions and information about synonymity, literature, distribution and biology of the species. A total of 16 species is listed: *Culex pipiens* L.; *C. ciliaris* L.; *C. nemorosus* Meig.; *C. ornatus* Meig.; *C. nigripes* Zett.; *C. nigritulus* n. sp.; *C. fusculus* n. sp.; *C. annulatus* Fabr.; *C. cantans* Meig.; *C. annulipes* Meig.; *C. vexans* Meig.; *C.*

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[48] "Brief information about the more general harmfulness and usefulness of Scandinavian insects."

[49] "Travel in the Lapp districts of Luleå, Jockmock and Quickjock."

[50] "Contribution to the knowledge of the mosquitoes and their foes."

dorsalis Meig.; *Anopheles bifurcatus* Meig.; *A. nigripes* Stæg.; *A. maculipennis* Meig.; *Aëdes cinereus* Meig. Twelve of these species have been localized in Sweden. Regarding the rest Zetterstedt gives the following observations: *C. ornatus:* "Hab in silvis Daniæ Aug. Sept. rarius, teste D. Stæger; mihi nec in Svecia nec in Norwegia obvius"; *C. nigripes:* "Hab. forte in Lapponia; e Grönlandia duos mares quinque feminas obtinui"; *C. vexans:* "Hab. in Daniæ sylvis, Majo Augusto, rarius D. Stæger; mihi in Svecia non obvius"; *A. nigripes:* "Hab. in Dania rarissime; — —". In the XII volume of the same work (appeared in 1855) there are published supplementary information of distribution and a description of a variety of *C. nigripes* from Trolle-Ljungby in Skåne (p. 4836). In the following 49 years no one seems to have occupied themselves with Swedish mosquitoes, until E. Wahlgren published a small study in 1904: "Über einige Zetterstedtsche Nemocerentypen" in which he delivered an exact redescription of *Culex fusculus* Zett. The same author thereupon in 1905 published a synopsis of the Swedish mosquitoes in the series: "Svensk Insektfauna" 11,[51] under *Diptera Orthorapha, Nemocera* Fam. 1—9 (pp. 51—57) and listed the following species: *Anopheles claviger* Fabr.; *A. bifurcatus* L.; *Culex annulatus* Schrnk.; *C. cantans* Meig.; *C. annulipes* Meig.; *C. vexans* Meig.; *C. morsitans* Theob.; *C. dorsalis* Meig.; *C. ornatus* Hoffm.; *C. pipiens* L.; *C. fusculus* Zett.; *C. nemorosus* Meig.; *C. nigripes* Zett.; *C. nigritulus* Zett.; *Aëdes cinereus* Meig. The series is planned as a mere compilation, yet Wahlgren has made alterations in the list of Zetterstedt and added new species. Thus he has placed *C. ciliaris* as a synonym under *C. pipiens* L., *C. vexans* Meig. is mentioned as found in Öl., *C. ornatus* Hoffm. as found in S. Sv. (Southern Sweden) and *C. nigripes* Zett. as found in Sk? with the note: "Is a purely arctic species (Grönland, Alaska etc.)." [52] Moreover *C. morsitans* Theob. is added as a new species so that the list now embraces a total of 14 Swedish mosquitoes. Then comes the quite doubtful *C. nigripes* Zett., found in Skåne, as number 15. Wahlgren has published more detailed information about his finds of mosquitoes in the island of Öland in a more considerable paper: "Det ölandske alvarets djurvärld" [53] (1915, pp. 37—38; 1917,

[51] "Swedish insect fauna."
[52] Quoted from the Swedish original.
[53] "The animal world of the Alvar of Öland." (Rikard Sterner: "Flora der Insel Öland" (1938): "Die Alvare sind dürftige Weideländer, und die Beweidung hat beinahe jeden Baumwuchs ver-

p. 34) wherein he treats the three species: *Ochlerotatus maculatus* Meig.; *O. vexans* Meig. and *Theobaldia morsitans* Theob.

In the meantime Poppius has published his observations from Torne Lappmark in a small paper: "Om förekomsten af *Anopheles claviger* Fabr. i svenska Lappmarken"[54] (1912). He reports (pp. 127—128) how he observed *Anopheles*[55] already on the 10th of May in the woodland of Torne Lappmark and how the species later on, when the weather had become milder, would be quite intrusive. He states "*Culex*" *nemorosus* as the common mosquito in this regions.

In 1917 C. Lundström in his work: "Dipteren aus dem Sarekgebiete" (p. 676) gave a synopsis of the Nematoceres, including the following mosquitoes: "*Culex nemorosus* Meig.; *C. annulipes* Meig.; *C. nigripes* Zett." As Wahlgren (1905) doubted the statement about *C. nigripes* Zett. from Skåne the find from Sarek must be considered as the first confirmation that *nigripes* occurs in Sweden.

The mosquitoes of the naturhistoriska Riksmuseum in Stockholm were the object of a thorough revision by F. W. Edwards who in 1921 published the results of his examination in a small paper: "A synonymic list of the mosquitoes hitherto recorded from Sweden, with key for determining the genera and specien." In the preface the author says i. a.: "The examination of this material showed, as was expected, that in the case of some of the more difficult groups there were a number of species confused. — — — Species which have been found in adjoining countries (Finland, Denmark or North Germany) are inserted in square brackets both in the list and in the keys, since they are likely sooner or later to be found in Sweden." This new list contains the following species: *Anopheles maculipennis* Mg.; *bifurcatus* L.; *plumbeus* Steph. (= *nigripes* Staeg.); *Culex pipiens* L. (= *ciliaris* Zett.); *Theobaldia annulata* Schrank; *siberiensis* Ludl.; *bergrothi* n. sp.; *morsitans* Theob.; *fumipennis* Steph.; *Taeniorhynchus richiardii* Fic.; *Ochlerotatus vexans* Mg.;

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hindert. So wird den Alvarboden im allgemeinen nur mit einer lichten, niedrigen Pflanzendecke von Gräsern oder Zwergsträuchern und von Moosen und Flechten bekleidet. In ihren allgemeinen Zügen ähneln diese weiten, ebenen Felder einer Steppenlandschaft."

[54] "On the occurrence of *Anopheles claviger* Fabr. in Swedish Lappland."

[55] A more detailed mention of these observations will follow in the second part of this work.

maculatus Mg.; *semicantans* Martini: *annulipes* Mg.; *excrucians* Walk.; *lutescens* Fabr. (= *annulipes* Zett.); *caspius Pall.; dorsalis* Mg.; *alpinus* L. (= *nigripes* Zett.); *cataphylla* Dyar; *communis* Deg. (= *nemorosus* Mg.); *punctor* Dyar; *geniculatus* Oliv. (= *ornatus* Mg., *fusculus* Zett.); *Aëdes cinereus* Mg. Probably through a slip *O. caspius* is not qouted in brackets in the list, but in the key the species is noted as a non-Swedish one. This is in harmony with the statements of the work mentioned below. As the species is not found in the collection of the museum in Stockholm, it will, I suppose, have to be struck off the list for the present. Of the Swedish species, described at an earlier time, Edwards has, with some doubt, placed *O. fusculus* Zett. as a synonym of *geniculatus* Oliv., and in the same way *nigritulus* Zett. and (with a note of interrogation) *ciliaris* L. (nec Zett.) as synonyms of *Aëdes cinereus.* On the other hand the Swedish mosquito fauna is enriched with the following species: *A. plumbeus* Steph.; *T. siberiensis* Ludl.; *bergrothi* Edw.; *fumipennis* Steph.; *Taeniorh. richiardii* Fic.; *O. semicantans* Mart.; *excrucians* Walk.; *dorsalis* Mg.; *cataphylla* Dyar; *punctor* Dyar. No description is given of the new species *Theobaldia bergrothi,* but in the determination table it is characterized by the note: "Tarsi entirely dark." The list embraces a total of 23 Swedish species.

In his treatrise: "A revision of the mosquitoes of the palaearctic region", Edwards gives some details concerning his interpretation of *C. fusculus* Zett. as a synonym of *A. geniculatus* Oliv. Regarding his determination of *O. annulipes* Meig. from Sweden he is evidently somewhat in doubt. He thus says (1921 b, p. 305): "A female from Sweden (Östergötland, Haglund) may be this species, but is perhaps m o r e p r o b a b l y[56] *A. excrucians.*" The species *Theob. bergrothi,* which he introduced as new in his preceding work, he has now abolished and listed as synonymous with *Theob. glaphyroptera* Schin., and he remarks: (1921 b, p. 287): "The Finnish and Swedish female specimens for which I proposed the name *bergrothi* are almost certainly only *T. glaphyroptera.*"

On account of these publications the earlier editions of "Svensk Insektfauna" Fam. *Culicidae* had become quite out of date, and in the year 1922 Wahlgren issued a supplement in the same series, together with *Nemocera,* Fam. 12—13,

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[56] Emphasised here.

in which (pp. 257—260) the Culicides are thoroughly revised in conformity with the publications by Edwards.

In the years that now follow, several works appear regarding *Anopheles* and malaria. Although these works will be treated closer in the 2nd part of this publication, for the sake of completeness I shall mention them briefly also here. Ekblom & Ströman in 1930 published a paper: "Geographical and biological studies on the swedish Anophelines from an epidemiological point of view" in which we find an elucidation on the distribution of *A. maculipennis* and *A. bifurcatus*. The same authors have in 1932 treated A. maculipennis thoroughly in their paper: "Geographical and biological studies of *Anopheles maculipennis* in Sweden from an epidemiological point of view."

In the meanwhile the work: "Myggor-Nematocera" by F. W. Edwards appeared in the series: "Insektfauna inom Abisko Nationalpark" [57] where the following mosquitoes are listed (1931, *3.* p. 33): *Aëdes excrucians* Walk.; *A. punctor* Kirby; *A. nigripes* Zett.; *A. communis* Deg.

We find information about the two races *A. maculipennis messeae* and *A. mac. atroparvus* in Sweden (Lomma) (1933, p. 55) by Missiroli, Hacket, Martini in the publication: "Le razze di *Anopheles maculipennis* e la loro importanza nella distribuzione della malaria in alcune regioni d'Europa."

In the year 1933 some polemic writings appeared in Sweden in "Svenska Läkaretidningen" regarding the malaria problem. These receive more detailed mention in the 2nd part of the present work. I wish here to draw attention only to the paper by Olof Rydberg: "Är kännedomen om frossmyggornas nordiska utbredning tillfredsställande?"[58] wherein the author (p. 2) remarks that he was attacked (in Lund) by the mosquitoes: *Anopheles maculipennis* Mg.; *Theobaldia annulata* Schrank and *Culex pipiens* L. As will later be more closely elucidated, the only species of *Culex*, attacking man in Scandinavia is *C. molestus* Forskål. Therefore this will be the first information regarding the occurrence of the species in Sweden.

Hackett and Missiroli have published some information about the appearance in Sweden of three varities of *A. maculipennis: messeae, typicus,* and *atroparvus* in a publication: "The varieties of *Anopheles maculipennis* and their relation

[57] "Mosquitoes-Nematocera." "The insect fauna within the national park of Abisko."

[58] "Is the knowledge about the northern distribution of the malaria mosquitoes satisfactory?"

to the distribution of malaria in Europe" (1933, p. 61).

In the same year T. Ekblom communicated in "Bull. de la Société Path. exotique" (*28*) that *Anopheles maculipennis* in Sweden occurs in three races: *typicus, messeae* and *labranchiæ*.[59]

In a more recent work: "Les races suedoises de l'*Anopheles maculipennis* et leur rôle épidémiologique" (1938, p. 647—655) Ekblom has corrected his earlier statements to the effect that in addition to *typicus* and *messeae,* not *labranchiæ* but *atroparvus* is represented in Sweden.

The important study by Thienemann that has been mentioned before: "Frostboden und Sonnenstrahlung als limnologische Faktoren" contains (1938 a, pp. 308—311) a list of mosquitoes caught by the author near Abisko and identified by Prof. Dr. F. Peus in Berlin. The list embraces the following species: *Theob. alaskaensis* Ludl.; *Aëdes pullatus* Coq.; *A. nigripes* Zett.; *A. nearcticus* Dyar; *A. punctor* Kirby; *A. excrucians* Walk.; *A. communis* Deg. Out of these species *A. pullatus* is new to Scandinavia, *A. nearcticus* new to Sweden, and earlier statements regarding *A. nigripes* is now confirmed by collected males.

In 1941 K. H. Forsslund published a notice: "Eine Stechmücke (*Culex molestus* Forskål) als Krankheitserreger".

The mosquito fauna of Sweden accordingly embraces a total of 26 known species, amongst which one (*Anopheles maculipennis*) occurs in 3 races.

Norway.

Already Hans Strøm reports in his work: "Physisk og Oeconomisk beskrivelse over Fogderiet Søndmør, beliggende i Bergens Stift i Norge" [60] (1762, *1*, p. 191) about two species of mosquitoes: *Culex fuscus, rostre bifurco* and *Culex cinereus abdomine annulis fuscis octo.* His systematical statements seem however to be only quotations of Linné and the determination of the species of these mosquitoes is very doubtful.

The same is true regarding F. Walker, who in "List of the specimen of Diptera in the British Museum" (1848, pp. 6—8) under the name of *Culex pipiens* L. lists mosquitoes from Alten in Finmark. However, on the same pages he calls

[59] Quoted from Ekblom 1938.

[60] "Physical and economical description of the district of Søndmør, located in the diocese of Bergen in Norway."

the attention to the fact that these mosquitoes do **not** accord with *Culex* pipiens from more southern regions.

The first more reliable determinations are met with in the travel account by H. Siebke: "Om en i sommeren 1869 foretagen entomologisk reise gjennom Ringerike, Hallingdal og Valders" (1870, p. 59) in which the author publishes finds of *Culex pipiens* L.; *C. nemorosus* Meig.; *C. cantans* Meig. In the next report: "Bidrag til Norges Insektfauna. Beretning om en i Østerdalen foretagen reise i 1870" (1872, p. 58) the same species are listed from new localities. Finally, in the work of Siebke: "Enumeratio Insectorum Norvegicorum" (1877, IV, p. 192), so fundamental for the knowledge of the Norwegian insects, there is published an aggregate summary of mosquitoes known in Norway, embracing the following species: *Culex pipiens* L.; *C. ciliaris* L.; *C. nemorosus* Meig.; *C. fusculus* Zett.; *C. annulatus* Fabr.; *C. cantans* Meig.; *C. dorsalis* Meig.; *Anopheles maculipennis* Meig.

In the great synoptical work: "Norges Land og Folk",[62] *19, Tromsø Amt,* by *A. Helland,* there are some short notes on the mosquito pest (1899, p. 360) where the author applies the name of *Culex* as a collective denomination for mosquitoes, in accordance with the use of older times.

A popular paper by Lie-Pettersen (1906, pp. 128—141): »Lidt om myggene og deres utvikling“ [63] contains i. a. some original observations (p. 131) of an extraordinary swarm of mosquitoes on the mountain between Sogn and Voss in the month of July 1892.

F. V. Theobald, in his "Monograph of the Culicidae of the World", mentions (1907, *4,* p. 370) *"Culicada" nemorosa* from Altenfjord, Finmark, further (1910, *5,* p. 271) *Theob. annulata* and (1910, *5,* p. 483) *Aëdes cinereus,* both from Norway but without exact locality.

Th. Thjøtta gives information about the finds of *Anopheles,* up till then known in Norway, in his paper: "To tilfælder av tropisk malaria samt bemerkninger om den endogene forekomst af malaria i Norge" [64] (1917, p. 13).

In his synopsis of palaearctic culicides Edwards mentions (1921, p. 309) that he has examined females of *A. nigripes* Zett. from Finmarken and likewise (p. 310) males of *A. cata-*

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[61] "About an entomological travel through Ringerike, Hallingdal and Valders, undertaken in the summer 1869."

[62] "Land and people of Norway."

[63] "A little about the mosquitoes and their development."

[64] "Two cases of tropical malaria and remarks about the endogene appearance of malaria in Norway."

phylla rostochiensis Martini from Smålenene (Østfold) (R. Collett).

Hackett, Martini and Missiroli record (1932, p. 157) the appearance of *A. maculipennis messeae* in Oslo, and in 1935 Hackett and Missiroli list both *messeae* and *typicus* from Norway.

In a pamphlet "Mygg — Mygg" [65] (1939) *Soot-Ryen* informs us that *Culex pipiens* does not occur in northern Norway.

Finland.

In his publication "Zur Kenntnis des Lebens in den Stehenden Kleingewässern auf den Skäreninseln" (1900) Levander repeatedly mentions finds of "*Culex*" larvae in various biota, and discusses the nourishment of the larvae. The same author has published detailed observations about morphology, biology and nourishment of the malaria mosquito at Langviken, in his writing: "Mitteilungen über *Anopheles claviger* Fabr. in Finland" (1902) and he gives a summary of the known localities of *Anopheles* in *Finland,* at the end. Information about *Culex pipiens* and "*Culex*" *nemorosus* is communicated on the pages 8—9.

F. W. Edwards, in the treaties: "A revision of the mosquitoes of the palaearctic region" (1921) has offered much information of Finnish culicides. He gives here a description of two new species: *Aëdes (Ochlerotatus) freyi,* a male from Eriksberg and *A. (O) parvulus* a male from Kittilä. The species *Theobaldia bergrothi,* which he had previously established, he abolished again as synonymous with *Theob. glaphyroptera.*

In the meantime Richard Frey published a synopsis of the Finnish material that had been revised by Edwards: "Provisorisk förteckning över Finlands culicider" [66] (1921, pp. 98—101). This list embraces the following species: *Anopheles maculipennis* Meig.; *Culex pipiens* L.; *Theobaldia bergrothi* Edw.; *morsitans* Theob.; *Ochlerotatus vexans* Meig.; *maculatus* Meig; *excrucians* Walk.; *freyi* Edw.; *lutescens* Fabr.; *caspius* Pall.; *dorsalis* Meig.; *alpinus* L. (= *nigripes* Zett.); *cataphylla* Dyar; *diantaeus* H. D. K.; *communis* Deg.; *parvulus* Edw.; *punctor* Kirby and *Aëdes cinereus* Meig.

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[65] "Mosquitoes — and mosquitoes."

[66] "Preliminary list of the culicides of Finland."

Small notes on some new species are found in "Verzeichnis der in den Jahren 1926—1930 für die Fauna Finnlands neu hinzugekommene Insektenarten" (1931, p. 62) by W. Hellén. Here are mentioned: "*Culex apicalis* Adams; *C. parvulus* Edw.; *Theob. alaskaensis* Ludl." In a similar list for the years 1931—1935 (1936, p. 59) the species *Aëdes sticticus* Meig. and *A. intrudens* Dyar are recorded. Information on the two latter species is also found in the reports of *the entomological* society in Helsingfors (1932, pp. 64—65,, 68).

The Finnish mosquito fauna embraces a total of 23 species.

Chapter 7.

Research by the author on Fennoscandian mosquitoes.

This work started in 1927, when I took part in a course of exotic pathology and medical parasitology in the "Institut für Schiffs- und Tropenkrankheiten" in Hamburg and at the same time used the opportunity to work out the material of Norwegian mosquitoes, that I had brought with me. The material consisted of the old collection of the zoological museum of the university of Oslo as well as of mosquitoes collected by the Norwegian Finmark expedition.

There were — what was only to be expected — several erroneous determinations in the old collection from the museum, after the revision comprising the following species: *Theobaldia annulata* Schrank; *A (O.)dorsalis* Meig. *cantans* Meig.; *excrucians* Walk.; *communis* Deg.; *leucomelas* Meig.; *punctor Kirby; sticticus* Meig.; *cataphylla* Dyar; *Anopheles maculipennis* Meig.; *Culex pipiens* Linné. Out of these 13 species the following 4 were new to the Norwegian fauna: *excrucians, leucomelas, punctor* and *sticticus.*

In the short paper: "Die norwegische Finmarks-Expedition. *Culicidae*" (Natvig 1929, p. 241—249) I have published the arctic material, comprising the following species: "*Aëdes salinus* Fic.; *nemorosus* Meig. [= *communis* Deg.]; *meigenanus* Dyar [= *punctor* Kirby]; *nigripes* Zett.; *nearcticus* Dyar". It is striking that the *cantans* group is quite missing. New to Scandinavia is *A. salinus* Fic. [= *detritus* Haliday] and *A. nearcticus* Dyar, occurring in North America, and new to Norway is at any rate the exact establishment of the occurrence *A. nigripes* Zett., through males.

I wrote allready then about *A. detritus* Hal. (p. 242): "Da *A. salinus* als eine Art der Salzböden angesehen ist, ist dieser Fund bei Jesjavre ca. 4 km vom Meeresküste etwas auffällig und wären spätere Untersuchungen an Ort und Stelle sehr wünschenswert."

The results of this examination increased my interest in further studies of the mosquito fauna of Norway. On account of the northern location and the vast extension of our country, interesting details concerning the biology and geographical distribution of many species were to be expected, inasmuch as the investigation of the Norwegian Culicides hitherto have been much neglected compared with other parts of Fennoscandia. Several questions regarding the possible part played by mosquitoes as transferring agents of parasites and diseases are still awaiting their solution. However before these problems can be approached we must have the necessary base for such investigations, viz. sufficient knowledge of the composition of our mosquito fauna.

A circumstance which considerably influenced the way I had to organize my researches was the relatively short time of development of most mosquitoes. Many species of *Ochlerotatus* can be identified with certainty only in the larval stage or as male adults, and it is therefore impossible to fix the amplitude of variation in the females of these species except with the aid of laboratory-bred material. In order to bring together adequate material for breeding and study, it became imperative to cover a vast territory during the short period of development of these species.

After my experiences during excursions in 1928, I decided, in 1929, to procure a small motor-car, that would enable me to examine more extensive fields. In 1931 I changed the small open car against a limousine (Chevrolet), the seats of which were rebuilt to fold into a comfortable bed. A big aluminium trunk was bolted on to the rear of the car, where it served to keep nets, rubber boots, chemicals and other equipment. For the daily researches I used it with advantage as a laboratory desk. Specially constructed boxes of different size were placed in the back seat, easy to get at and to supervise. Some contained glasses for the breeding of mosquito larvae and others were stuffed with tubes for isolating female *Anopheles,* ready to oviposit.

As several publications appeared just in these years on the problems regarding the causes of the natural disappearance of malaria in certain regions of Europe and of the Anophelism without malaria, my attention was naturally directed upon the biology and geographical distribution of *Anopheles* in Norway. As new problems entered within the scope of science, also my researches were enlarged or altered, although a certain discontinuity then became unavoidable.

From 1931 till 1938 the hydrogen-ion concentration of 227 waters were examined with the new "Hellige Komparator". In 1931—32 I examined the iron contents of 72 waters with "Hellige Komparator". At the same time the hardness of the water was determined in 75 places against saponaceous solution (Clarks method). My first intention was to make closer investigations of the biocoenosis of *Anopheles,* and for this purpose I brought together, in the years 1931—33 samples of algae in a number of 130 as well as 141 samples of insects and other aquatic animals. However, it became more and more clear that satisfactory results of this investigation could only be expected with very extensive material. Furthermore, because this work demanded much time, and the prime object of my investigation, the distribution of the mosquitoes, would suffer a considerable delay, I decided to postpone these collections until further.

Next to the studies of the waters, possible occurrences of mosquitoes, especially of *Anopheles,* in dwellings, also cow-houses, horse-stables and pig pens were investigated. A total of 220 such investigations were made in 1934—1938, embracing about 180 localities in southern Norway where certain cow-houses were repeatedly visited during the year. Out of the mosquitoes thus caught a considerable number were fixed in alcohol for later examination regarding the number of maxillary teeth and wing length. These studies were carried through in the Tropical Institute in Hamburg in 1938 where I examined 937 specimens of *Anopheles,* using both wings and both maxillae of each specimen for the calculation. In 1934—1938 about 400 live *Anopheles* were brought to the laboratory and 392 of these isolated for oviposition. The batches of eggs received were examined as to races, the various types of eggs photographed and drawn, and in many cases the number of eggs in each batch was counted. Finally the identification of the blood meal of the mosquitoes by means of the precipitin test was carried out in 157 specimens. A detailed comment of the results of these investigations will follow in the second part of this treatise.

Although the various researches and measurings at each station required much time, I was able to cover 5—8 stations, within a distance of 100—120 kilometers, every day, and yet there was mostly time left to prepare the catch by daylight. Only when the catch of mosquitoes was exceptionally large, was I compelled to put up at some hotel where I could finish the preparations by electric light. When I was thus enabled to cover more than 40 000 kilometers during the years 1930—1938 and to examine hundreds of localities in different parts of southern Norway, this was only possible thanks to the motor-car. The limousine was especially valuable when it was important to get material of certain stages of development from stations within an extensive area in a few days, and likewise when distant stations were to be supervised regularly during the summer.

Though I have collected material from great parts of the southern and eastern Norway in the years 1928—1945 there are still wide areas unexplored as to culicides. This is especially true about the central mountain regions of southern Norway, extending from Jotunheimen in the north to the plateau of Hardangervidda in the south. From these vast lands there have been collected only a few mosquitoes from Ustaoset (Bv. 26. Hol). Also the majority of the coastal districts of western Norway are poorly, or in some cases, not at all examined, and Nord-Trøndelag is in this respect Terra Incognita. From the northern parts of Norway I received the collections of Tromsø Museum for examination, originating mostly from Troms Fylke.

Regarding finds of *Anopheles maculipennis* in southeastern Norway I published two small notes (Natvig 1929 b, 1930 a), in which was also mentioned the first Norwegian find of *Theobaldia alascaensis* Ludl. Some notes on anomalities in mosquitoes (Natvig 1930 a, 1934) have already been discussed in chapter 6.

In 1933 and 1938 I brought with me the Norwegian material of mosquitoes to Hamburg, where I worked it out in the Tropical Institute, having the collections there for comparison. As a result of this investigation no les than 14 species proved to be "new" to the Norwegian fauna, viz.: *Theobaldia bergrothi* Edw.; *fumipennis* Steph. *morsitans* *Theob.; subochrea* Edw.; *Aëdes (Aëdes) cinereus* Meig.; *Aëdes (Aedimorphus) vexans* Meig.; *Aëdes (Ochlerotatus) riparius* D. K.; *intrudens* Dyar; *diantaeus* H. D. K.; *Aëdes (Finlaya) geniculatus* Oliv.; *Culex (Neoculex) apicalis* Adams; *Culex torrentium* Martini; *molestus* Forskål; *Anopheles bifurcatus* Meig. Out of these species *C. torrentium* and *C. molestus* were new to Fennoscandia and *Th. subochrea, A. intrudens* and *diantaeus* were new to Scandinavia. In 1942 Mr. Soot-Ryen, curator at the Tromsø museum, sent me further collections of mosquitoes and here I recorded by far the most interesting finds from northern Norway, viz. those of *Aëdes pullatus* Coq. Though these investigations had brought many interesting facts, several species were at hand only in a few specimens and a real picture of the geographical distribution could therefore not be based solely on the Norwegian material. After some pondering I decided to enlarge the field of investigation to the fauna of Denmark as well as that of Fennoscandia, a region that was used as late as in 1939 in a catalogue of northern *Coleoptera*.[67]

After a critical comparison of the publications of Edwards, Frey and Wesenberg-Lund on the northern mosquitoes, I received the impression that a re-examination of the material might be desirable. As mentioned above, most Fennoscandian museums and colleagues have liberally put the material available at my disposal. However the inspection of the museum material has brought some disappointments inasmuch as most species were represented only by a few specimens or even by just one apiece. It is also regrettable that the documentary material of the valuable monograph of Wesenberg-Lund on the Danish mosquitoes has not been accessible. On the other hand the inspection of parts of the famous collection of Zetterstedt in Lund has disclosed very interesting facts. Some collections, brought together by private entomologists, were especially rich in specimens, and therefore delivered valuable contribution to the knowledge on the distribution of the northern mosquitoes.

As a result of these the investigations I could establish the fact that *Theob. bergrothi* Edw. is a valid species (Natvig, 1942). Edwards described this species as new to science in 1921, but abolished it in the same year as synonymous with *T. glaphyroptera* Schin.

Of *Aëdes vexans,* hitherto stated from Sweden in a single female specimen, I now found a male in material from Skåne. In the collection Zetterstedt a male of *A. (O) cyprius* Ludl. was found, and I also regard some females in the museum in Stockholm as belonging to the same species. Further a male of *A. (O) annulipes* Meig. was stated in the same collection. A closer investigation of specimens from Swedish

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[67] Victor Hansen, W. Hellén, A. Jansson, Th. Munster, A. Strand: "Catalogus Coleopterorum Daniae et Fennoscandiae." 1939.

Lappland, labelled by Zetterstedt: *C. cantans,* proved that both males and females are *A. (O) excrucians* Walk., the distribution of *cantans* thus being limited to the more southern parts of Scandinavia. A preliminary report on these facts and on the find of *Taeniorhynchus richiardii* Fic. in Finland has been published in Norsk Entomologisk Tidsskrift, 6 (4). (Natvig 1943).

In a little paper (Natvig 1945) I pointed out that *Culex alpinus* Linnaeus is not identical with *Aëdes (Ochlerotatus) nigripes* (Zett.) and that it would be an advantage if the name *Culex alpinus* could be discarded from culicidological literature, the type evidently being lost. A further paper (Natvig 1946) gives the differential characters of the female *A. (O) nigripes* (Zett.) and *A. (O) nearcticus* Dyar.

Chapter 8.

Table 3.

Keys to the genera of Northern Culicines.

A. *Imagines.*

1. (6) Female abdomen blunt, slightly tapering.
2. (3) Pulvilli present (fig 6 c), 1st tarsal segment of hind leg as long as the tibia (plate II); tarsi without pale rings .. *Culex*
3. (2) Pulvilli absent; 1st tarsal tegment of hind leg distinctly shorter than the tibia; tarsi with pale rings.
4. (5) Spiracular bristles (fig. 5 B sp.) present; the shift of m-cu: 0 (fig. 30 a), os less than 1 (fig. 30 c—d); wing scales narrow .... *Theobaldia*
5. (4) Spiracular bristles absent; the shift of m-cu about: 3; wing scales broad .... *Taeniorhynchus*
6. (1) Female abdomen pointed (fig. 51); long-tapering ...... *Aëdes*

B. *Terminalia.*

1. (6) Inner face of basistyle more or less divided into a lower and upper flap.
2. (3) Basistyle with a subapical lobe carrying spines and stout processes (fig. 118) .... *Culex*
3. (2) Basistyle without subapical lobe.
4. (5) Basal lobe heavily sclerotised, terminating in a long, very thick, round topped rod; claspettes (claspettoids) absent (fig. 48) ....*Taeniorhynchus*
5. (4) Basal lobe, when present, not heavily sclerotised, with or without conspicuous pointed spines; claspettes (claspettoids) present (fig. 12) .... *Aëdes*
6. (1) Inner face of basistyle not so divided; basistyle with a conical basal lobe carrying numerous spines (fig. 34) *Theobaldia*

C. *Larvae.*

1. (6) Siphon with one pair of ventral tufts.
2. (3) Siphonal tuft at or near base (fig. 35) .... *Theobaldia*
3. (2) Siphonal tuft near middle or beyond (fig. 57).
4. (5) Valves of siphon highly modified for subaquatic respiration (fig. 49) .... *Taeniorhynchus*
5. (4) Valves of siphon not specially modified .... *Aëdes*
6. (1) Siphon with several ventral tufts (fig. 115) .... *Culex*

D. *Pupae.*

1. (6) Respiratory trumpets normal in character.
2. (3) Hair A/VIII well above apical margin of segment ...... *Culex*
3. (2) Hairs A/VIII at apical corner of segment (fig. 24 b).
4. (5) On segment IV—V, hair B longer than hair C, and having 1, 2 or (rarely) 3 branches .... *Aëdes*
5. (4) On segment IV—V, hair B not longer than hair C, and having from 4 to 7 branches .... *Theobaldia*
6. (1) Respiratory trumpets modified for piercing submerged stems of aquatic plants (fig. 49) .... *Taeniorhynchus*

Chapter 9.

Description of the northern Culicine species. Distribution in Denmark and Fennoscandia. Distribution in general. Biology.

Genus *Theobaldia* Neveu-Lemaire, 1902.

Large mosquitoes with black and white, brown, yellowish and grey colours, without distinct metallic reflections. Eyes almost touching. Proboscis straight, moderately long, not swollen at apex. Palpi of the male somewhat longer than the proboscis. Palpi of the female short, with 5 segments, the ultimate segment rudimentary. The relative length of the segments and the shape of the ultimate segment may be useful for the identification of the species. Thorax broad, with well developed macrochaetae. Scutellum with three lobes, each with a group of bristles. Spiracular bristles present, usually pale in colour. Postspiracular bristles absent.

Wing with long fork-cells. Vein Analis extending far beyond origin of R_s (fig. 8). Some few long hairs on the base of radius on upper surface of wing, more numerous hairs present in this position on under surface of wing. At the apex of the hind tibiae a distal transverse row of stouter spines (tibial scraper). The first tarsal segment of hind leg shorter than the tibia. Both claws on anterior leg of male toothed, claws of female simple. Abdomen of female blunt tipped, cerci short. Male terminalia with simple basistyle; the lacuna may extend about one third the way out from the base. Basal lobe of moderate size, with stout spines. Dististyle simple, with short apical claw. Proctiger with stout paraprocts. Phallosome simple.

Head of larva more or less distinctly broad. The frontal hairs in a row; the inner frontal hairs ordinarily just behind the postclypeal hairs. The eight abdominal segment with numerous blunt-ended comb-scales. Single hair-tufts towards the base of the siphon. Saddle encircles completely the anal segment and is pierced by one or more pre-cratal tufts.

Respiratory trumpet of pupa short. Paddles more or less finely serrated round apical margin; one hair at or outside midrib.

In our region the genus may be divided in the two subgenera *Theobaldia* and *Culicella* which also differ in their biology.

In the subgenus *Theobaldia* the mid- and posterior crossveins lie in a line (fig. 30 a—b). If the tarsal segments are ringed, the ring embraces the base of the segment only. The sclerites of the phallosome strongly sclerotised, separated and hooked at the apex. Larvae with short sipho; hair-like teeth in the distal part of pecten. Antennae short, with antennal tuft of moderate size inserted about the middle of the antenna. Sensory appendages mostly close together at apex of antenna.

In the subgenus *Culicella* the shift of the posterior crossvein is about 1.0 or more (fig. 30 c—d). Tarsal rings embrace both the basal and apical end of the segments. The sclerites of the Phallosome faintly sclerotised, not divided at apex and without hooks. Larvae with long siphon; the distal hairs of the ventral valves are developed into stout hooked spines. Antennae long, with two long subapical hairs; antennal tuft of large size, well beyond the middle of the antenna.

As pointed out by Wesenberg-Lund (1920—21, pp. 26—27) the differences in the larval stage of the subgenera *Theobaldia* and *Culicella* are due to contrary habits. The larvae of the subgenus *Theobaldia* are bottom feeders. Their flabellae are feebly developed with many of the hairs transformed into comb-bristles. The fringes of the mandibulae are more slightly developed, and the hair-tufts on the maxillae may be absent. The inner edge of the mandibles are provided with stout thorns which may be dentated, and the triturating part of the mandibles is very stout. The larvae of the subgenus *Culicella* are plancton-eaters. As to these forms Wesenberg-Lund remarks: "We therefore find that in the surface dwellers the flabellae of the labrum, the fringe of the mandibulae, and the apical hair-tufts of the maxillae are all highly developed, whereas the triturating part of the mandibles is always feebly developed."

Concerning the bloodsucking habits, some species are known to attack man and mammals, other prefer birds, but some species have not been studied in this respect. The species of the subgenus *Theobaldia* pass the winter in the imago stage (females), whereas the species of *Culicella* pass the winter in the larval stage, possibly also in the egg stage. Most species deposit their eggs on the surface of water in boat shaped masses, but concerning the egg-laying methods of the subgenus *Culicella* little information is available. Wesenberg-Lund (1920—21, p. 138) supposes that the eggs of *Culicella morsitans* are laid singly. All our species of the genus *Theobaldia* breed in ground pools, but one case is reported by Marshall (1938, p. 230), where larvae of *Culicella morsitans* have been found in a waterfilled cavity in an elm tree.

Most species of the genus *Theobaldia* are confined to the temperate regions of Europe, Asia and America, but some species extend into southern regions. Edwards (1932, p. 106) provisionally also includes some species from Australia and New Zealand in this genus. Of the 23 species known, only 6 have been found in our region.

Table 4.

Keys to the northern species of *Theobaldia.*

A. *Females.*

1. (8) Posterior cross-vein and mid cross-vein in a straight line or nearly so (shift of the posterior cross-vein: 0) (fig. 30 a—b). Wings more or less distinctly spotted (subg. *Theobaldia).*
2. (3) Tarsal segments dark. Wings less obviously spotted *bergrothi* Edw.
3. (2) Tarsal segments with conspicuous basal white rings. Second abdominal tergite with a median pale stripe.
4. (7) Femora with pale pre-apical ring. First tarsal segment with white ring in the middle.
5. (6) Dark parts of abdominal tergites uniformly black. Wing spots distinct (fig. 8). Mid- and posterior cross-veins in line .... *annulata* Schrnk.
6. (5) Dark parts of abdominal tergites with scattered yellowish scales. Wing spots indistinct Mid- and posterior

cross-veins either in a line or posterior cross-vein lying beyond mid-vein .... *subochrea* Edw.

7. (4) Femora without pre-apical ring. First tarsal segment without white ring in the middle .... *alascaensis* Ludl.

8. (1) Shift of posterior cross-vein: about 1, 0 (fig. 30 c—d). Wings without distinct spots. (subg. *Culicella*).

9. (10) Proboscis clothed with dark scales. Abdominal sternites with diffused light and dark scales. At least the last tarsal segment dark .... *morsitans* Theob.

10. (9) Proboscis with scattered pale scales. Light and dark scales on abdominal sternites forming "inverted V" patterns. All tarsal segments with white rings *fumipennis* Steph.

B. *Terminalia.*

1. (8) Basistyle with a more or less distinct hairy, subapical knob. Phallosome strongly sclerotised, divided, apically hookformed (subg. *Theobaldia*).

2. (5) Tip of eighth tergite with a row of spines.

3. (4) The row of spines close-set. Subapical lobe knob-like. Dististyle not swollen apically .... *alascaensis* Ludl.

4. (3) The row of spines not close-set. Subapical lobe indistinct, not knob-like. Dististyle swollen in the apical third *bergrothi* Edw.

5. (2) Tip of eight tergite without a row of spines.

6. (7) Basal lobe with 2 (rarely 3) of the spines conspicuously stouter than the rest. Tip of eighth tergite usually devoid of spines .... *annulata* Schrnk.

7. (6) Basal lobe with 3 to 5 of the spines conspicuously stouter than the rest. Tip of eighth tergite usually with a few scattered spines .... *subochrea* Edw.

8. (1) Basistyle without a subapical knob or agglomeration of hairs. Phallosome not strongly sclerotised, the sclerites apically fused and not hookformed (subg. *Culicella*).

9. (10) Dististyle slender, width at centre about 1/16 of its length ....*fumipennis* Steph.

10. (9) Dististyle stout, width at centre about 1/12 of its length *morsitans* Theob.

C. *Larvae.*

1. (8) Antennae shorter than head; siphon comparatively short, from three to three and a half times as long as broad; distal teeth of pecten long and hair-like (subg. *Theobaldia*).

2. (7) Antennae short and stout; antennal tuft of moderate length; mid frontal hairs long with about 2—3 branches; inner frontal hairs short, with about 5 branches.

3. (6) Pre-cratal tufts 2(3), one of two of which perforate the saddle.

4. (5) Distance between post-clypeal hairs equal to, or greater than, distance between inner frontal hairs *annulata* Schrank

5. (4) Distance between post-clypeal hairs usually much less than distance between inner frontal hairs .. *subochrea* Edw.

6. (3) Precratal tufts 4, two of which perforate the saddle *alascaensis* Ludl.

7. (2) Antennae longer, rather slim; antennal tuft long; mid- and inner frontal hairs long, mid frontal hairs with about 7, inner frontal hairs with about 9 branches *bergrothi* Edw.
8. (1) Antennae decidedly longer than head, curved; siphon very long, about 6 times as long as broad; distal teeth of pecten not hair-like (subg. *Culicella*).
9. (10) Pecten terminating in 2—4 large isolated spines *fumipennis* Steph.
10. (9) Pecten without large isolated spines .... *morsitans* Theob.

Theobaldia (Theobaldia) alascaensis Ludlow.

Theobaldia alascaensis Ludl. (Can. Ent., *38*, p. 326) 1906
Culiceta sibiriensis Ludl. (Insec. Mentsr., *7*, p. 151) 7/1 1920
Theobaldia arctica Edw. (Bull. Ent. Res., *10*; p. 136) ult. Jan. 1920
Theobaldia wasilievi Sching. (Russ. Journ. Trop. Med. *5*, p. 548) 1927

Description.

F e m a l e. Front of h e a d with golden bristles forming a tuft between the eyes. Vertex ("occiput") with yellowish-white, narrow curved scales, intermingled with dark brown, upright forked scales and dark bristles. Eyes bordered with yellowish-white, narrow curved scales. Temporae with flat yellowish-white scales. C l y p e u s brown or blackish brown. P r o b o s c i s dark brown, basally and in the middle sparsely sprinkled with lighter scales. Labellae blackish brown. A n t e n n a e. Tori yellowish or dark brown, on inner side with yellowish-white scales. Flagellum blackish brown with a coating of minute white hairs and at the base of the segments bigger black hairs. The first segment of the flagellum may have some white scales at the inner side. P a l p i (fig. 31 c) about $^1/_7$—$^1/_6$ the length of the proboscis, coated with blackish-brown scales, and some white ones apically and at the joint of the first and second segment. T h o r a x. Anterior pronotal lobes blackish brown with yellowish narrow curved scales and dark bristles. Posterior pronotum blackish brown with yellowish-white narrow curved scales. Mesonotum chestnut-brown with a narrow, dark brown median line, accompanied by a somewhat broader one on either side. These stripes merge together in the posterior part of the mesonotum. In specimens from northern localities the colour of the mesonotum is darker brown, but the stripes are still visible. Scaling: yellowish-white, hair-like scales, which are replaced by somewhat broader and whitish ones at the sides of the thorax and at the antescutellar space. The scales may form two conspicuous whitish spots

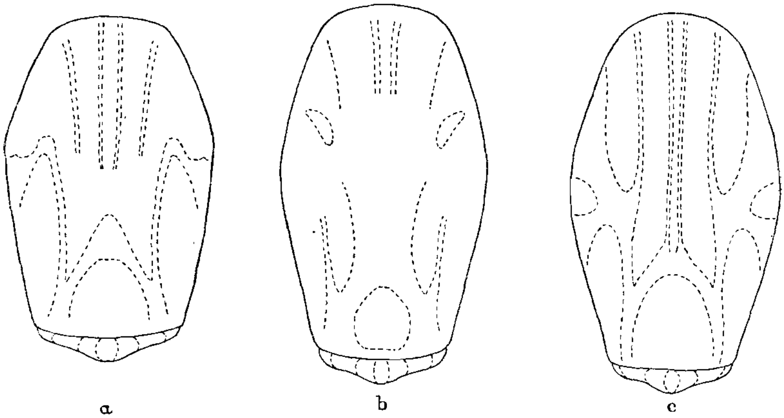


Fig. 29. Light ornamentation on the mesonotum of *Theobaldia*. a, *Th. bergrothi;* b, *Th. subochrea;* c, *C. morsitans.* (Aut. del.).

at about the middle of the dark lateral stripes. The sides of the mesonotum with pale brown or dark brown bristles, rather conspicuous in specimens from northern localities. Scutellum chestnut-brown or dark brown, with whitish narrow, curved scales and brown or blackish-brown bristles. Postnotum yellowish or dark brown. Wing. Stem of the fork r_{2+3} about half the length of the fork. Stem of the fork m_{1+2} about the length of the posterior branch. Cross-vein r—m nearly in line with cross-vein m—cu. Halteres with dirty yellowish stem and dorsally black, globule with some greyish scales. Legs. Femure dark brown on dorsal side, amply sprinkled with lighter scales, blackish brown to black just before knee spot. Knee spot white. Under side of femurae of a lighter colour. Tibiae dark brown with scattered light scales, apically with a whitish spot, which, especially in the hind legs, may be well developed. Tarsal segments dark brown with basal white rings on segment 1—4. These rings may be more or less ill-defined, particularly on fore and middle legs. In some of the specimens at hand, the segments 4—5 are uniformly dark, but in most specimens the basal white rings of segment 1—4 are rather conspicuous. In one specimen from Finland even all tarsal segments of the middle leg are white ringed. Abdomen. Tergites blackish brown with basal white bands, which are somewhat widened laterally, especially at

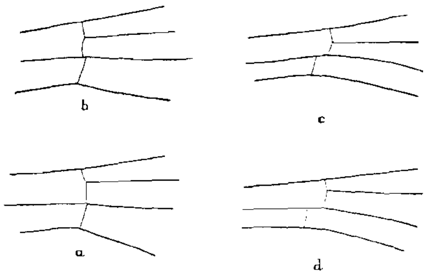


Fig. 30. Shift of cross-veins in the wing of the female *Theobaldia*. a, *Th. annulata;* b, *Th. subochrea;* c, *C. morsitans;* d, *C. funipennis*. (Aut. del.)

the posterior segments. First abdominal tergite with a few medial scales surrounded by bristles. The second tergite distinguished by pale median stripe. Abdomen blunt-ended, the last segment of a somewhat lighter colour than the remainder. Cerci short. Length of wing about 7.5 mm.

M a l e. P r o b o s c i s with light scaling predominating in the middle and at the base. A n t e n n a e. Tori blackish brown. Flagellum dark grey and white ringed. Hair-tufts long, greyish-brown. P a l p i exceed the proboscis about the length of the last, faintly swollen, segment. Scaling dark brown with light spots at the joints of the segments. Conspicuous white apical spots at the third segment. Hair-whorls with yellowish-brown reflections, the whorls rather long at the outer side of the third segment, at segment 4, and at the base of the ultimate segment. T h o r a x greyish brown. Colouring of the male abdominal tergites mainly in coincidence with that of the female. Abdominal segments with lateral, yellowish-brown hairs.

T e r m i n a l i a (fig. 32). Basistyle tapering apically. Basal lobe in general with two spines, but one of the Swedish specimens at hand has 3 spines on one of the two lobes. Basistyle with a distinct, hairy, subapical knob. Dististyle tapering and with at claw of moderate length; latter is not apically incised. Proctiger with stout, hooked paraprocts and a subapical group of sensory hairs. Sclerites of the phallosome separated and hooked at the apex. Lobes of the ninth tergite with 6—8 long, fine hairs. Lobe of the eighth tergite with a close-set row of 5—10 stout and blunt spines. In a specimen from Helsingfors (Finland), the lobe of the eighth tergite has two spines only.

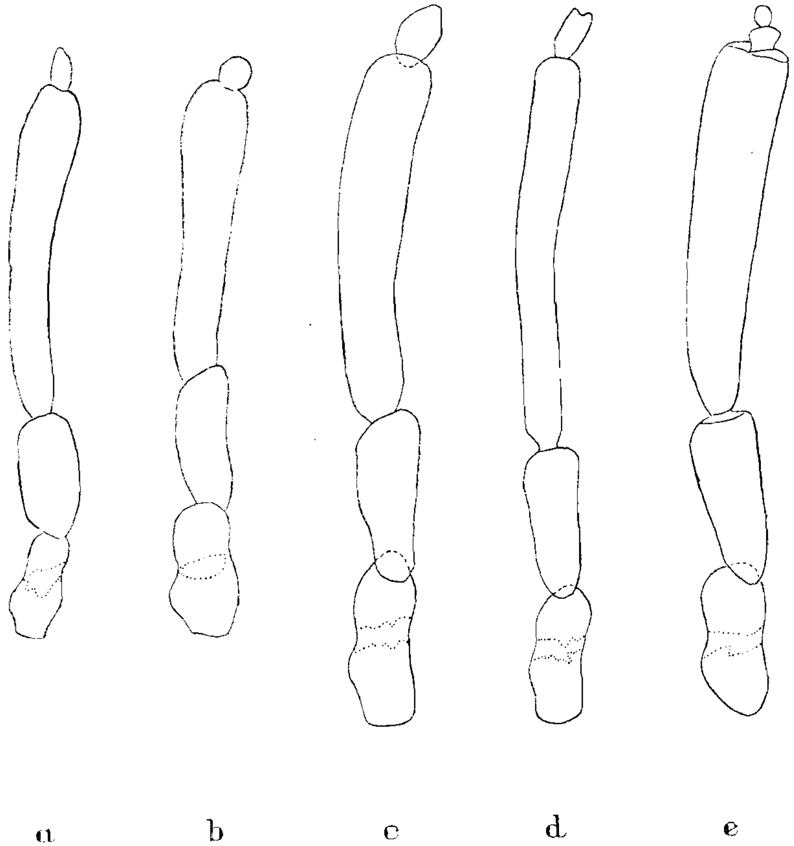


Fig. 31. Palpi of female *Theobaldia*.
a, *Th. glaphyroptera;* b, *Th. bergrothi;* c, *Th. alascaensis,* d, *C. morsitans;* e, *Th. annulata.* (Aut. del.).

L a r v a. Martini (1924 a, p. 437) who described the larva of *alascaensis,* emphasises that the pecten teeth are fewer but stouter in this species than in *annulata.* An examination of a greater material will, however, according to his opinion, demonstrate the fact that the range of variation for both species will overlap to some extent. The precratal hairs are four in number. P e u s (1929, p. 5, fig. 7) depicts some comb-scales of this species, but, in a more recent paper (1930 a, p. 55) he emphazises the great variability of the comb scales. In his opinion, neither the pecten teeth nor

Fig. 32. *Theobaldia (Theobaldia) alascaensis* Ludl. Terminalia (total view). The left diststyle is broken in the slide preparation. (Aut. del.)

the hairs are of diagnostical value in the subgenus *Theobaldia.* I have convinced myself that this is also the fact as to the northern material. According to Peus (1929 b, p. 4) the siphonal index for *alascaensis* is: 2.75 and for *annulata:* 3.8, whereas the corresponding features for northern specimens are: 2.65 resp. 3.37. In my opinion the best diagnostical character for differentiating these two species is the number of precratal tufts. These are, for *alascaensis:* 4, two of which perforate the saddle; the features for *annulata* are: 2 (3), one or rarely two perforating the saddle.

Geographical distribution.

Denmark. *Theob. alascaensis* has hitherto not been found in Denmark.

Sweden. *Upl.:* Stockholm! ♀ (Bohem.). *Vstm:* Vesteråstrakten! ♀ (Sellmann). *Dlr:* Lima! ♀: iv. 1924 (Tjed.); Lima. Limedsforsen! ♀: 18. v. 1933 (E. Dahl); Falun, Norslund! ♀: 15. v.—5. vii. (Tjed.); Falun, Kv. Trädgården! ♀: 23. ix. 1937 (B. Tjed.); Falun, Gruvan! ♀:

27. ii. 1918 (KHF); Falun, Vällan! ♀: 27. iv. 1918 (KHF); Floda, Syrholm! ♀: 21.—28. iv. (T. Tjed.); Floda, Flosjönoret! ♀: 17. iv. 1939 (T. Tjed.); Sundborn, Toxen! ♀: 6. v. 1934 (Klefbeck); Folkärna, Utsund! ♀: 17. v. 1939 (T. Tjed.); Ludvika, Brunnsvik! ♂ ♀: 25. v. —28. viii. (KHF); Ludvika, Ställviksberg! ♂: 16. vii. 1926 (KHF); *Jmt!* ♀, (Schönherr); *Nb!* ♀, (Bohem).

Norway. Ø. *1. Hvaler:* Isle of Kirkeøya, ♀: v. 1926 (T. Münst.); Kirkeøya, forest, ♀: 28. v. 1928 (LRN); AK: *13. Aker:* Skar, Maridalen, ♀: 6. v. 1928 (O. S.); *12. Bærum:* Snarøya, ♀: 13. v. 1928 (LRN); HEs: *13. Stange:* Ottestad, L: 24. vi. 1929 (SS); HEn: *20. Trysil:* Varåholla, ♀: 19. vi. 1935 (LRN); On: *26. Lesja:* L: 30. vii. 1936 (LRN); TRi: *28. Øverbygd:* Divielv, Øvre Målselv, ♀: viii. 1914 (B. Poppius); *29. Balsfjord:* Fjeldfrøskvann, ♀: 23. vii. 1926 (S—R); TRy: *14. Tromsøysund* Ramfjord, ♀: 22. v. 1926 (S—R); *15. Tromsø,* ♀: 4. vii. 1922 (S—R) Fø: *23. Sør-Varanger:* Kirkenes, ♀: 20. viii. 1935 (A. Wessel).

Finland. *Ab(V):* Karislojo! ♀, (J. Sahlb. Hellén); Kuustö! ♀. (Lundstr.); Karuna, ♀: 27. iv.—20. v. (Lundstr.); *N(U):* Kottby. ♀: 22. v. 1935 (Storå); Helsingfors! ♂ ♀, (Lundstr. Tiensuu); Helsinge! ♀ (Hellén), Tvärminne! ♀ (R. Frey); Tvärminne, Spikarna! ♂. (R. Frey). *Ka(EK):* Jääski, Valle! ♀ (Coll. Ehrenb.); *Kl(LK):* Soanlahti! ♀ (Coll. Ehrenb.). *Om(PK):* Nykarleby! ♀: 6. v. 1939 (Storå). *Ks(Ks):* Kuusamo! ♀ (J. Sahlb.). *L. kem. (Keml):* Sodankylä! ♀: 16. vi. 1938 (Kanervo). *Le(Enl):* Kilpisjärvi! ♀, (R. Frey). *Lps(Psl):* Petsamo; ♀, (Hellén).

Distribution outside Denmark and Fennoscandia.

According to Marshall (1938, p. 219) *Theob. alascaensis* has been found in England in the northern counties: Cumberland, Westmorland, Yorks, and in Scotland in: Dunbartonshire, Morayshire, Midlothian and Wigtownshire. As to the distribution in Germany, Martini (1931, p. 204) remarks: "Hamburg gehört zu den westlichsten Plätzen der Art — — — sie ist bekannt aus — — — Ostdeutschland (z. B. Wusserow b. Stettin), von Hamburg, ja aus der Lüneburger Heide". Peus (1929, b. p. 2) quotes the following localities: "Darss (Vorpommern), 17. vii. 1928; Svinemünde (Useedom), 22. viii. 1928; Forst Grumsin (b/Angermünde), 17. v. 1928; Plagefenn b/Chorin (Mark), 4. ix. 1927; Unterspreewald b/Schlepzig 22. vi. 1928; Oberspreewald (Forsthaus Eiche), 20. vi. 1928". Further the species has been found in Oberschlesien (Astron: Bauer), Lower Austria (Edw. 1921, p. 288) and also in Poland (Tarwid 1938). As to the distribution in URSS Stackelberg records: "Archangel (Edw.

Frey); Bolschesemelnaja Tundra (Kerzelli!); Distr. of Leningrad (Stackelberg, Montschadskiji) and Moskva distr. (Nikolskiji!); from the median Ural (Kolozov, Jacobson!); Siberia: Lake Schiro close to Minusinsk (Vagner!); Padun at Tunguska (Tschekanovskiji!); Irkudsk (Edw.); valley of river Tschelosin, s-e. part of Jakutsk distr. (Popov!); Kamtchatka (Klotschevskoe, sopka Schiveljotsch (Derjavin, Protopopov, Schmidt!)." [68] Further records are: Kaukasus: Kryschina (Mess 1929). According to Natvig (1933, p. 7) the species has been found in "Maudhavn", in the most northern part of the Taimyr peninsula in July—Aug. 1919 (H. U. Sverdrup). As to the distribution of *Theob. alascaensis* in the American continent, Dyar (1928, p. 250) records: "Alaska, Yukon Valley, Rocky Mountains in British Columbia, Montana, Wyoming and Colorado. The species frequents the far north and high altitude, but has not been found in the Californian mountains."

Biology.

As pointed out by Marshall (1938, p. 219) the knowledge of the ecology, of *Theob. alascaensis* is very scanty. Some information concerning the time of occurrence in Fennoscandia we may however gain from the dates, found on the labels on the specimens. Thus female adults have been found, in Sweden: 1 specimen at the break of February, but most specimens have been collected, either in April—May or in July—September. In the southern part of Norway females have been found in May, in Trysil: medio June and in northern Norway in June—August. However one specimen from Ramfjord (TRy 14) bears the date 22. v. on the label. In the southern part of Finland females occur in April—May and in the northern regions medio June. Only few males are at hand; two specimens from the median part of Sweden (Dalarna): ultimo May, and one male: medio August. In my opinion these dates indicate the occurrence of one generation only in Fennoscandia. The hibernating generation appears in spring; in the southern regions of Fennoscandia in April, in the more northern parts later on. The males (the new generation?) appear in July. Some of the finds indicate that the species may hibernate in the adult stage.

Only two Norwegian larvae have been found, one of which (4th instar) in a pond near the highway in Lesja (On 36) at 30. vii. 1937, associated with larvae of *Anopheles maculipennis*. The pH value in this pond was 6.8, and the pond itself was of a type which usually dried up in late summer. Concerning the second larva, collected in Ottestad, Stange (HEs 13) at 24. vi. 1929, no particulars are known. In Norway *Th. alascaensis* has been found from the coastal region and up

[68] Translated from the Russian text!

to 630 m above sea-level. Hitherto no finds are known from Western Norway or the very southern parts of the country. No observations have been made as to the blood-sucking habits of this species in Fennoscandia.

According to Marshall (1938, p. 219) no breeding places of *Theob. alascaensis* have been located in the British Islands. Peus (1929, p. 2—3) has published some researches on the biology of this species in Germany, and he i. a. says: — — — "Ich vermute eine imaginale Überwinterung, etwa in hohlen Bäumen u. dgl., die freilich noch nachzuweißen ist — — — Da sämtliche Tiere beim Anflug zum Stechen zu allen Tageszeiten erbeutet wurden, muss die Art als ausserordentlich stechlustig dem Menschen gegenüber gelten. — — — In ökologischer Hinsicht stimmen alle Funde in ihrem Charakter als Erlenbruchwald überein, der teilweise als Endentwicklung einer Flachmoorbildung anzusehen ist."

Concerning USSR Stackelberg (1937, p. 100) records: "The larvae are chiefly living in small open pools, occasionally associated with larvae of *Aëdes excrucians* and *A. flavescens* Muell. The species hibernates in the adult stage; the mosquitoes appear in spring, commonly at an earlier date than other hibernating species. In general it did not prevail in the wood — and taiga zone, but in places it is very common in the tundra."

Dyar (1919 a, p. 33) records Canadian finds (Rocky Mountains) in July and August, and he further remarks: "The larvae were found in a grassy pool by the railroad separated by a few feet from the Echo River, the pool having evidently been filled by flood water." He also found *Th. alascaensis* in British Columbia, in April-July, (Dyar 1920 a, p. 20) and he says: "Not uncommon in the Yukon Valley. The species is addicted to grassy pools, such as occur along river-beds, not in forest. It is absent from the forested Canadian region, but follows the mountains from the Yukon southwards into the Canadian plains." According to Dyar (1923 a, p. 40) the species has been found up to 7788 feet above sea level, at Yellowstone Lake, Wyoming.

As to the bloodsucking habits of *Th. alascaensis* little is known. Martini (1924 a, p. 437) records that the species was very annoying on the 20th of March, at Escheburg in the vicinity of Hamburg and that even in bright sunshine at 2 p. m. According to Hadwen and Palmer (1922, p. 67) this species is one of the great snow-mosquitoes which in early spring annoy man and reindeer.

Theobaldia (Theobaldia) annulata (Schrank).

Culex annulatus Schrank. (Beitr. Z. Naturg., p. 97) 1776
? *Culex variegatus* Schrank. (Enum. Ins. Austr., p. 482) 1781
? *Culex nicaensis* Leach. (Zool. Journ., *2*, p. 292) 1825
Culex affinis Stephens. (Zool. Journ., *4*) 1825

Description.

Female. Head. Vertex ("occiput") in the middle with whitish, rather broad, narrow curved scales; next to the middle line, on either side, with a small dark spot; on the sides of vertex with broader, yellowish-white scales, inter-

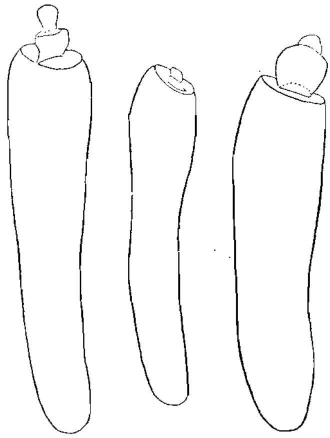


Fig. 33. The two distal segments of female palpi of *Theobaldia annulata* Schrank. (Aut. del.).

mingled with black upright scales. Temporae with broad yellowish-white scales. Eyes bordered with whitish scales and stout, black bristles with brown-golden reflections at apex. Clypeus dark brown or blackish brown. Proboscis blackish-brown and yellow sprinkled, apically darker. Labellae blackish brown. Antennae. Tori blackish brown with whitish scales. Flagellum blackish brown coated with minute brown hairs and at the base of the segments bigger black hairs. On inner side of the first segment of flagellum a few white scales. Palpi (fig. 31 c) blackish, sprinkled with whitish scales, especially abundant at apex of palpi and at the second segment. At the joint of the second and third segment they form a conspicuous white spot. Segment 3 broad, $^1/_7$—$^1/_{10}$ longer than segment 1 and 2 together. Ultimate segment constricted in the middle (fig. 33). Thorax: Anterior pronotal lobes brown or dark brown, with dirty-white scales and light bristles. Posterior pronotum brown or dark brown with yellowish-white narrow curved scales. Scutum blackish brown with black bristles and pale golden hair-like scales gradually more and more whitish nearer to the lateral border and on the antescutellar space. A distinct design on mesonotum is rare but in good specimens two longitudinal light stripes are noticeable in the anterior part of mesonotum, bordered by a lateral golden spot on each side (fig. 29 b). Otherwise dark and lighter longitudinal stripes alternate. Scutellum with whitish scaling and some black and more golden reflecting bristles. Postnotum brown or dark brown. Wing. Stem of the fork r_{2+3} and m_{1+2} as in *alascaensis* Scaling blackish, but at costa, subcosta and radius obviously sprinkled with yellowish-white scales. Clusters of scales at the base of the forks, in the region of the cross-veins and at the base of the radial sector. In the middle of the analis the scales are somewhat dilated. Halteres with yellowish-grey stem and nearly black globule clothed with scattered light scales. Legs. Dorsal side of femur blackish brown, more or less whitish sprinkled. Subapically with a white ring. Under-side generally yellowish-white, towards apex darker, but the colouring may be more or less varying. In some specimens the entire under-side thus may be quite whitish and the white, subapical ring is distinct on the dorsal side only. Knee spot conspicuously white. Tibiae blackish brown, more or less whitish sprinkled, towards apex entirely dark and with white scales at apex. Abdomen. Tergites blackish brown, second tergite with a whitish median stripe. Segments with pale basal bands, which are yellowish-white in the middle, running into pure white colour at the somewhat widened lateral spots. Small, indistinct, apical white spots at the sixth and seventh segment. On the eight segment the light scaling predominates on the dorsal side. Length of wing: 6.5 mm.

Male. Head. Scaling as in the female, but the upright forked scales are not so predominating. Bristles golden brown. Proboscis apically somewhat swollen, yellowish brown, more or less dark sprinkled. Antennae. Tori yellowish brown. Flagellum white and blackish brown ringed with greyish-brown hair-tufts with yellowish reflections. Palpi. The ultimate segment as long as the penultimate or even exceeding it a little. Scaling blackish-brown with yellowish-white rings at the base of the two last segments, at the base and apex of segment 2 and 3 and at the apex of the first segment. Further, scattered, more or less distinct light scales in the middle of the three last segments. Colour of thorax in general as in the female. In some specimens, however, the colouring is running more or less in whitish, and the golden spots may be indistinct. Abdomen. The segmental light bands broader than in the female. Claw formula: 2,1; 2,1; 0,0. Length of wing: 6—6.5 mm.

According to Martini (1931, p. 206) the species is variable, especially as to the light scaling. In specimens from Ana-

Fig. 34. *Theobaldia (Theobaldia) annulata* Schrank.
a, Terminalia (total view); b, Phallosome and paraprocts; c, Tip of dististyle with claw. (Aut. del.)

tolia he found very few light scales at the costa and at the legs.

Terminalia (fig. 34). Basal lobe of the basistyle with 2 stout apical spines. Paraprocts strongly sclerotised, apically with spines (up to 7 spines). Lobe of the eighth

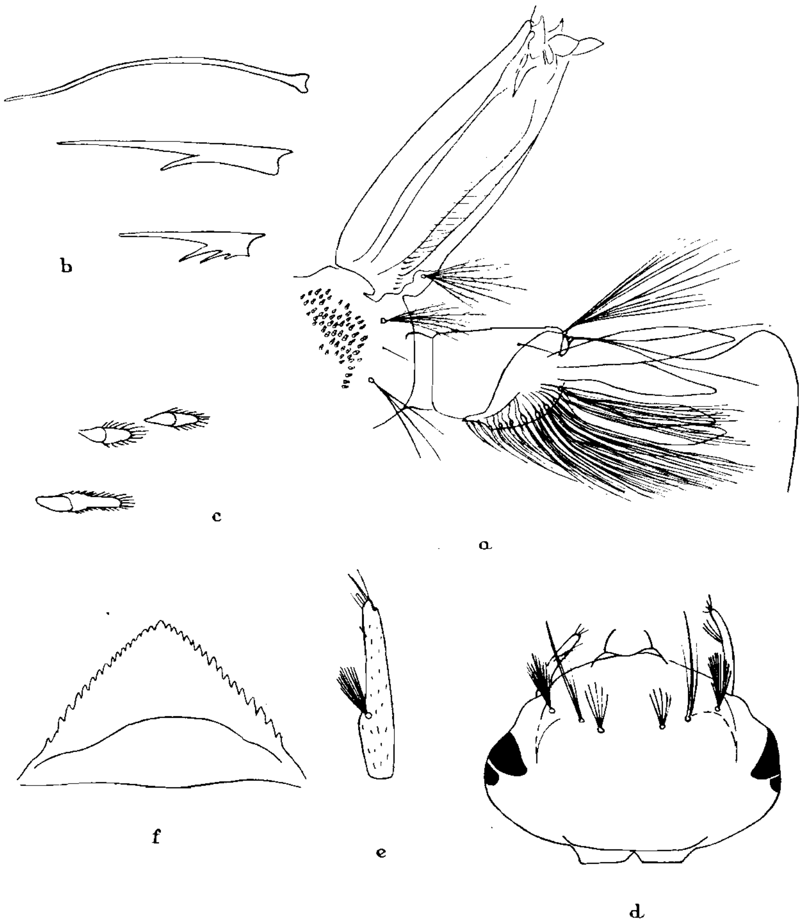


Fig. 35. Larva of *Theobaldia (Theobaldia) annulata* Schrank, in 4th instar.
a, Terminalia segments of larva; b, teeth and hair of pecten; c, comb-scales; d, head of larva; e, antenna; f, mentum. (Aut. del.)

tergite in general devoid of spines. Sclerites of the phallosome separated, strongly sclerotised and hooked apically.

A character, hitherto most probably overlooked, is the shape of the claw on the diststyle. Inspecting my slide preparations I recognised that in all *annulata* at hand the claw is distinctly incised apically (fig. 34). This character is also found in *subochrea,* whereas the remaining species of

Theobaldia have no incision in the claw. According to Marshall (1938, p. 210) the distinction between the terminalia of *Th. annulata* and *subochrea* may be difficult. On the basal lobe of *annulata* 2 or rarely 3 spines are stouter than the rest, whereas the number of these spines may be 3—5 in *subochrea.* In general the tip of the eight tergite is devoid of spines in *annulata* and with a few spines in *subochrea,* but the converse may also be found. Marshall concludes: "It follows therefore, that when the number of conspicuous spines on the basal lobe happens to be 3, the chances are that the species is *T. annulata* if the 8th tergite is devoid of spines, and *T. subochrea* if it is not; definite diagnosis cannot be made." Peus (1929, p. 123) depicts two specimens of *annulata* with spines on the tip of the eighth tergite, one with 1 spine and the other with 4 spines.

Larva (fig. 35). Head broader than it is long. Antennae short and straight, slightly curved outside the antennal tuft. Antennal shaft with spines in the basal part. Antennal tuft of moderate length and with 12 hairs, inserted just beyond the middle of the shaft. Sensory appendages and bristles in 2 groups, 2 appendages apically and 2 long bristles slightly below the apex. Inner frontal hairs with 4—7 branches, middle frontal hairs with 1—3 branches. The post-clypeal hairs and the inner frontal hairs are about the same distance apart. The eighth abdominal segment with about 52 blunt-ended, feathered scales. Siphonal index about 3.2. Pecten (spines and hairs), about ⅔ the length of the siphon. Precratal tufts: 2—3, one or two of which perforate the saddle, which is ventrally only half as long as it is dorsally. Anal gills about 1—1 ½ the length of the saddle. Concerning variability in chaetotaxis, see table below.

Table 5.

Larval chaetotaxis of Theobaldia (Theobaldia) annulata Schrank.

Number of branches in			Number of			Siphonal index
Frontal hairs			Comb. scales	Pecten		
out	mid	inner		teeth	hairs	
9—14 9.2 (12)	1—3 2.5 (10)	4—7 5.5 (11)	45—68 52 (5)	11—18 15.8 (6)	11—19 15.2 (6)	2.4—3.7 3.2 (5)

Table 6.

Thoracic hair formula.

Hair no.							
1	2	3	4	5	6	7	8
1	1	3—6 4.3 (8)	3—6 4.4 (7)	1	1	4—5 4.2 (6)	3—4 3.1 (7)

Geographical distribution.

Denmark: 1. *Jylland:* Tipperne! ♂: 17. viii. 1946, ♀: 20. ix. 1946 (Søg. A.); Svostrup! ♀: 22. ix. 1931 (P. N.), Silkeborg! ♂: 16. viii.—14. ix. 1930 (P. N.), Silkeborg!, in house, ♀: 2. viii. 1931 (Hagb. Hansen), Ry st.! ♀: 7. x. 1917 (P. N.), Fredericia! ♀: 26. viii. 1928 (P. N.).
2. *Sjelland:* Environs of København! ♂ ♀ (Stæg.), Ordrup at København! 13. xi. 1938 (H. Anth.), Tjustrup lake at Sorø (W-L), Hillerød (W-L), Næstved! ♀: 23. viii. 1930 (P. N.). *Lolland:* Maribo! ♂ ♀: 30. x. 1917 (H. P. S.), ♀: 3. viii. 1931 (P. N.), 28. xi. 1934 (H. P. S.).

Sweden: *Sk:* Lund! ♀: 24. v. 1932, in house (B. Tjed.), Lund! ♀ (Zett.); Råå! ♂: 30. vii. 1922 (O. Ringdahl), 9. ix. 1916 (O. R.); ♀: 14. viii. 1918 (O. R.); Skanör! ♂: 17. viii. 1915 (O. R.); *Bl:* "Blek!". ♀, (Zett.), Torhamn, Mochleryd! ♀: 23. iii. 1934 (A. Lewin). *Upl:* Stockholm! ♀ (Tullgr.); Ent. Anst. Experimentalfält! ♀; 30. iv.—10. xi; Danderyd, Klingsta! ♀: 14. viii. 1935 (KHF); *Dlr:* Falun. Kv. Trädgården! ♀: 23. ix. 1937 (B. Tjed.).

Norway: Ø: *1. Hvaler:* Kirkeøya, ♀: 13.—15. iv. 1938 (LRN). AK: *14. Oslo:* Bot. garden, in house. ♀♂: 25. i. 1938 (Aasheim); Bot. garden ♂: x. 1845 (Siebke); *13. Aker:* Bygdø, ♀: 31. xi. 1928 (Münst.); Ry: *20. Hetland:* Stavanger, ♂ ♀: 8. ix. 1931 (O. M.); Mosvann, ♀; 6. ix. 1931 (O. M.); Lassa, ♀: 2. ix. 1931 (OM); Hetland, L: 5. vi. 1931 (LRN); Stokka-Tjensvold, L: 29. viii. 1931 (OM); Bjørnevann, L: 15. vii. 1929 (LRN); HEn: *20. Trysil:* Vestby, ♀: 15. vi. 1934 (LRN); *26. Alvdal,* L: 21. viii. 1931 (LRN).

Finland: *Theob. annulata* Schrank has hitherto not been found in Finland.

Distribution outside Denmark and Fennoscandia.

Edwards (1931, p. 209) remarks on the general distribution of this species: "Throughout Europe, but probably commoner in the north than in the south where it seems to be largely replaced by *T. longiareolata.*" As to the British Isles Marshall (1938, p. 213) records: "*T. annulata* is so common in Britain that a list of its locality records would be of no scientific interest." According to Séguy (1925, p. 93) it is: "Trés commun dans toute la France, pendant toute l'année." Brolemann (1919) records it from Basses-Pyrénées in le Hameau, 6. vii. and from Haut de Billère, ix. The species is reported by Braga (1931, p. 50) from different localities in Portugal, and even in the Canaries (Las Palmas) it is found (Christophers 1929; Storå 1937, p. 19). In Germany it is recorded from Strassbourg by Eckstein (1919, p. 342), and Peus (1929 b, p. 3) remarks: "Es ist zwecklos alle Funde die mir aus den Provinzen Ostpreussen, Pommern, Brandenburg, Schlesien, Westfalen und Hessen verliegen, aufzuzählen, — — —." Further eastwards it is found in Lithuania in the primeval forest in Bialowies (Sack 1925, p. 263) and in Poland (Tarwid 1934, 1938). It is also recorded from Switzerland: Bern (Bangerter 1926); Orbeebene, Kanton Waadt (Galli-Vall. u. Roch. d. J. 1908); environs of Lausanne (Galli-Vall. 1917), from Austria (Schiner 1864), Hungary: Balaton (Mihályi 1941) and Romania (Martini 1928 c, p. 22). As to the distribution in USSR Stackelberg reports: "Leningrad distr.: Environs of Leningrad (Fedorov!); Ural (Eversman t. Edwards; probably from village Spaskoe; former gouv. Orenburg); Ukraina: Ukrainskoe polesje (Rybinskiji), Environs of Dnepropetrovsk (Gunzevitsch!); southern coast of Crimea (Velitschkewitsch!); northern Kaukasus: Environs of Krasnodarsk: Malaria-station! Essentuki, Pjatigorsk (Mess!); Dagestan: Petrovsk (Rjabov!) and Transkaukasia, where it is rather dispersed, chiefly in the mountain regions (Sajizev 1935)."[69] Concerning the southeastern distribution Edwards (1921, p. 289) remarks: "extending into Palestine (Jerusalem, Dr. Goldberg) and North Africa (Biskra, Algeria, Eversmann; etc.). Has not yet been found further east, but it is represented in the United States by an allied species."

Biology.

Larvae of *Th. annulata* has been found in Norway from the beginning of June to ultimo August, and only larvae in the last stage have been collected. The breeding places were: marsh pools, and old water-filled cellar-ditch and an open pond in a meadow. Larvae of *Th. annulata* have been found associated with larvae of *Th. subochrea, Th. morsitans* and *Culex pipiens.* Most adults have been found from April to September. The dates of the finds indicate that *Th. annulata* has two generations in the very southwestern parts of Norway, but from Trysil (HEn. 20) and northwards the species most probably has only one generation in the year. According to Wesenberg-Lund (1920—1, p. 118) Theobald

[69] Translated from the Russian text.

records that males as well as females of this species hibernate, but W-L remarks that he has investigated many hibernating places of *annulata,* but he has not found a single male, either in winter or in spring. It is therefore of special interest to note the find of adults in a house in the botanical garden in Oslo on the 25th January 1938. The gardener, who brought the mosquitoes assured that they had been very annoying to the people in the house. The material consisted of 7 males and 4 females. To be sure, Martini (1931, p. 208) records finds of larvae in Germany as late as January, but in the environs of Oslo larvae of *Th. annulata* did not occur in that season. I therefore consider the adults mentioned, males and females, as hibernating specimens. The females attack man as well as large animals, and I have caught blood-filled specimens in horse and cowstables on several occasions.

In Denmark Wesenberg-Lund (1920—1, p. 117) found the larvae in cement-reservoirs in dairy-farms and in cowhouses in farm yards; further in ditches mostly filled with urine near gates sheltered by old oaks below which the cattle regularly sought shade against the burning sun, also in a little pond covered with *Lemna* but with very decaying mud at the bottom. He further remarks: "Hitherto we have taken it for granted that the mosquito only hibernates in houses, cellars and sheds; but this is undoubtedly not correct. In 1916 on one of the last days in April, I was examining an old hollow beech and to my astonishment saw that many *T. annulata* were sitting in the bright sunshine on the wind-sheltered part of the trunk. I prodded the hollow part of the trunk with a walking stick and the mosquitoes rushed out of the trunk like smoke; all were females, which undoubtedly had their winter-quarters there. When I passed the same old beech late in October 1919, I again saw many imagines of the same species but now males as well as females, sitting and flying round the entrance to the hollow part of the trunk; no doubt they were seeking their winter quarters there." Wesenberg-Lund concludes: "The hibernating generation appears in September-October, hibernates in our houses, and lays its eggs indoors in stables etc.; from these eggs appear the summer generation, which disappears from our dwellings and lays its eggs mainly in natural ponds; most probably this generation has several broods, the egg-rafts being not all laid simultaneously, the males die off after the mating process but the females from these broods return to our cellars and hibernate there."

In Britain the larvae have been found in natural as well as in artificial collections of water and, acording to Marshall (1938, p. 212) no particular type of natural breeding place appears to be specially selected. He adds, however: "It is probable that water contaminated by nitrogenous matter provides an additional attraction, since tanks containing manure-water employed for gardening purposes are often found to be infested, sometimes to an almost incredible extent, with larvae of this species. *T. annulata* breeds both in non-salt and brackish water — the greatest salinity so far recorded for this species being 35.0 (sea water 100)."

In North-Germany the larvae are hardly found previous to the middle of May, mostly later; in Anatolia they already occur in March (Martini 1931, p. 208), Stackelberg records (1937, p. 102—3) that the species hibernates in the larval stage at the south coast of Crimea, Marshall (1938, p. 213) as well as Martini (1931, p. 208) emphasise that the bites of *Th. annulata* sometimes may be exceptionally severe.

Theobaldia (Theobaldia) subochrea Edw.

? *Culex penetrans* Rob. *Desvoid.* (Mem. Soc. Hist. Nat. Paris *3,* p. 407) 1828
Theob. annulata var. *subochrea* Edw. (Wesenberg-Lund. Kgl. D. Vid. Selsk. Skr. Nat. Math. Afd. (8), *7,* p. 1) 1920/21
Theob. subochrea Edw. (Ent. Tidskr., *42,* p. 50 1921
var. *ferruginata* Martini (Zeitschr. angew. Ent. *10,* p. 438) .. 1924

Synonymical and systematical remarks.

According to Edwards (1921, p. 289) and Peus (1930 a, p. 52) the description of Robineau-Desvoidy of *C. penetrans* in several respects agree with *Th. subochrea,* but the type specimen has been lost. In the paper of Wesenberg-Lund on the Danish mosquitoes, *Th. subochrea* is published as a variety of *annulata,* but Edwards (1921, p. 289), in his review of the palaearctic mosquitoes, records it as an independent species. This last opinion is strongly emphasised by Peus (1930, a., p. 58) who says: "Im Hinblick auf die erörterten morphologischen Unterschiede in allen Entwicklungsstadien leuchtet es ein, dass *Theob. subochrea* eine selbständige, zu *annulata* in keinerlei Beziehung stehende Art ist. Da zeigen auch die geographischen Befunde: Die Areale beider Arten überschneiden sich durch den grössten Teil von Europa hindurch." Martini (1931, p. 213), per contra, has some doubt: "Ich behandle die Art hier als selbständig, um mich an Edwards anzuschliessen, sowohl ich es nicht für ausgeschlossen halte, dass wir es nur mit einer geographischen Rasse von *annulata* Schrank zu tun haben." Stackelberg (1937, p. 103) is of the same view and says: "Most authors, and especially Peus (1930), consider this form as an independent species. The large material inspected, especially from the Central Asia and also the investigations of Montschadskij on the larvae, permit us decidedly to consider the form solely as an ecological race of the common and widely dispersed *Th. annulata*." [70]

Peus (1930 a, pp. 57—8) investigated the form *ferruginata* Martini, and he states that it conforms with *subochrea* in all essential characters. His material comprised 39 specimens, 11 of which had indications of light red stripes on thorax.

Description.

F e m a l e. H e a d. Front of head with blackish-brown, apically golden bristles forming a tuft between the eyes. Vertex ("occiput") black, a nude median stripe enclosed by broad, white, narrow curved scales, which are scattered at the sides so that the black integument shows in between. The sides of vertex and the nape with blackish-brown upright forked scales and scattered bristles. Temporae with broad flat white scales. Eyes bordered with white scales. C l y p e u s dark brown. P r o b o s c i s on dorsal side dark brown and whitish sprinkled, on the under side dark brown at the base and apex, otherwise the yellowish-white scaling predominating. A n t e n n a e. Tori yellowish-brown on the outer side, ashy grey on inner side with a spot of whitish scales. Flagellum dark brown coated with minute whitish hairs and at the base of the segments bigger dark brown hairs with lighter reflections. P a l p i dark brown sprinkled with white scales, which are numerous at the base of the first and second segment and at the apex of the ultimate segment. T h o r a x. Anterior pronotal lobes leather-brown with dirty yellowish-white broad, narrow curved scales, golden hairs and dark-brown bristles, apically with brown-golden reflections. Posterior pronotum leather-brown with yellowish narrow curved scales running into whitish ones at the posterior border. Mesonotum dark cinnamon-coloured, in the anterior third with a dark median stripe and a lateral dark line on each side. Scales hair-like, curved and with golden reflections, laterally and at the antescutellar space broader and more yellowish-white. In the anterior part of mesoscutum two lateral spots of golden scales (on each side), from which indistinct lines extend towards the scutel-

[70] Translated from the Russian text.

Fig. 36. *Theobaldia (Theobaldia) subochrea* Edw.
a, Terminalia (total view); b, lobes of the 9th tergite and tip of the 8th tergite; c, tip of dististyle with claw. (Aut. del.)

lum. Scutellum of the same ground-colour as scutum and with golden scales and bristles. Postnotum dull cinnamon-brown. Pleurae brownish, with a more ashy grey tinge, with yellowish-white scales and bristles and with pale golden bristles in front of anterior spiracle. Wing. Scaling on costa, subcosta, radius and cubitus dark brown and white sprinkled. Cross-vein m—cu, lies, in the Norwegian specimens, beyond cross-vein r—m, as previously quoted by Marshall (1928, p. 213) for English specimens. As far as I can see the character is more distinct in the females than in the males. Legs. Femurae almost entirely yellowish-white coloured with scattered dark-brown scales at the dorsal side only. The pale sub-apical ring can hardly be seen. Tibiae similarly light scaled, sprinkled with few dark scales. The first tarsal segment yellowish, the segments 2,3 and 4 dark with broad basal yellowish-white rings, the fifth tarsal segment dark. The contrasts, however, are not so conspicuous as in *annulata.* Abdomen. Dark parts of the tergites more brownish than in *annulata;* the second tergite with a whitish median stripe. Basal bands ochreous, running into whitish lateral spots. The dark parts of tergites sprinkled with ochreous scales. Venter yellowish-white scaled. Length of wing about: 6 mm.

Male. Proboscis ochreous, labellae blackish-brown. Palpi with ultimate segment distinctly longer than the penultimate. In *annulata* it is only slightly longer. The dark parts brownish and conspicuously sprinkled with yellowish-white scales. The light scaling predominates particularly at the last two segments. Wing spots indistinct.

Terminalia (fig. 36). As pointed out by Marshall (1938, p. 214) the characters are variable and can not be used with certainly in all cases. Peus (1929, p. 123) depicts two variants, one with 4 spines on the tip of the eighth tergite, the other specimen with 10, more or less stout spines. The same author (1930, p. 55) also indicates a difference, between *annulata* and *subochrea* in the number of hairs at the lobes of the 9th tergite. In *subochrea* he found 20—24 hairs at the lobe but mostly 8—10 hairs in *annulata;* in one specimen the lobe had 12 hairs. In the single Norwegian male specimen of *subochrea,* I found 15 hairs at the lobe, which indicates that this character may be of little use for differential purpose. As pointed out above, *subochrea* has the incised claw of the dististyle in common with *annulata.*

Larva (fig. 37). Peus (1930, pp. 55—56) emphasises that the post-clypeal hairs and the inner frontal hairs are

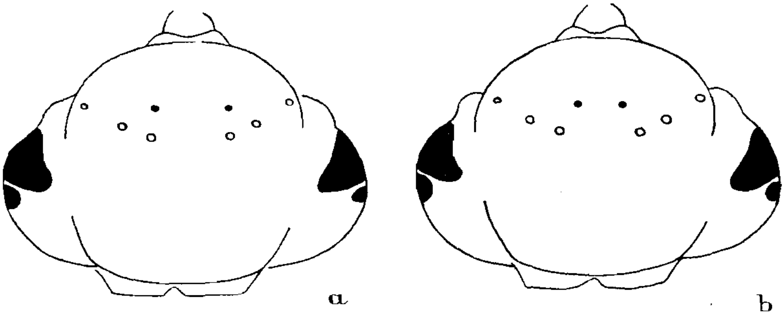


Fig. 37. Head of 4th instar larvae, showing relative position of frontal hairs in *Theobaldia annulata* (a) and *Th. subochrea* (b). (Aut. del.).

about the same distance apart in *annulata*, but in *subochrea* the inner frontal hairs are closer together than the other pair. However, Marshall (1938, pp. 215—16) has investigated this and other larval characters on a larger material, and he points out that the criterions mentioned overlap to some extent and are useless for diagnostic purpose in many cases.

Geographical distribution.

Denmark: *2. Sjælland:* Amager (W-L); environs of København! ♂, (coll. Stæg.); Næstved! ♀: 20. vii. 1918 (P. N.).

Sweden: *Th. subochrea* has hitherto not been found in Sweden. (N!)

Norway: HEn: *26. Alvdal:* L: 21. viii. 1931 (♂ ♀) (LRN).

Finland: *Ab(V):* Karuna! ♀: 17. iv. 1934 (Storå); N(U): Tvärminne! ♀: 19. v. 1935 (Storå).

Distribution outside Denmark and Fennoscandia.

According to Marshall (1938, p. 217) the species has been found in Britain in the counties: Dorset, Hants, Herts, Kent, London, Sussex and Yorks. In France it is reported from Troyes (Surcouf) (Séguy 1923, p. 95) and from Meuse: Revigny (E. Cordier) (Séguy 1925, p. 80). In Germany it is hitherto recorded from Wohldorf at Hamburg, June 1914 (Martini 1924) and from Wisselsheim at Bad Nauheim in Hessen, 25. vi. 1928 (Peus 1930 c, p. 668). From USSR Stackelberg records: "Several finds from Central-Asia: Tschimgana (Lisova). Environs of Old-Buchara, where it is very common (Montschadskiji.), from several localities in Fergana (Simanin.), further from Taschkent (Lisova.) and other places."[71] As to its south-eastern distribution the following details have been published: Beyrut (Gadeau de Kerville) (Séguy 1923); Persia (Ghilan, 950 m. Calhors; J. de Morgan), Palestine (Jerusalem Dr. Goldberg), Macedonia (Hadji Geul: Capt. J. Waterston), "in Mesopotamia this was the only form found, in other countries *Th. annulata* was found in the same localities" (Edwards 1921, p. 289). Stackelberg (1937, p. 103) remarks: "In Central Asia this form occurs in the same degrees of latitude as the chief form but not under the same conditions; in Mesopotamia in Central Asia the species is represented of var. *subochrea* Edw. only and the chief form is not found, in contrast to Crimea and Caukasus where hitherto only the typical form has been found."[72]

Biology.

The single Norwegian find is from the interior of the country, from Alvdal (HEn 26), where two larvae were found in a water-filled ditch near the highway, associated with larvae of *Th. annulata* and *Th. bergrothi.*

This find is in conformity with the results of English investigations. Thus Marshall (1938, p. 217) emphasises that like *Th. annulata, Th. subochrea* breeds both in non-salt water and in water of varying degrees of salinity. He further says: "The remaining few British localities from which *T. subochrea* has been since recorded are, without exception coastal: a fact which possibly indicates the distribution of mosquito-collectors rather than that of the species in question."

Contrary to this view Stackelberg (1937, p. 103) records the species as typical halophilous. Further Peus (1930 a, p. 58) has found *subochrea* in the Wetterniederung, in salt springs with a high salt- and ferruginous percentage, but he makes the following reservations: "Solange nicht weitere Beobachtungen vorliegen, ist es verfrüht diesem ökologischen Befund allgemeinere Gültigkeit zuzusprechen, doch deutet auch der Fund bei Kopenhagen ("brackish-water swamp" Edwards) und Queenborough ("brackish-water ditches" Edwards) auf eine Halophilie hin."

Theobaldia (Theobaldia) bergrothi Edwards.

Theobaldia bergrothi Edw. (Ent. Tidsskr. *42,* p. 50) 1921
Theob. glaphyroptera Schin. pp. (Edw.: Bull. Ent. Res. *12,* p. 287) 1921
Theob. borealis Sching. (Russ. Journ. Trop. Med. *5,* p. 548) .. 1927

Synonymical remarks.

In his review of the Swedish mosquitoes, Edwards (1921, p. 50) established a new species of *Theobaldia* with plain dark tarsal segments under the name of *bergrothi,* however, in his review of the palaearctic mosquitoes he remarked as to *Th. glaphyroptera:* "The Finnish and Swedish female specimens for which I proposed the name *bergrothi* are al-

[71] Translated from the Russian text.
[72] Translated from the Russian text.

most certainly only *Th. glaphyroptera.*" Since that time the Scandinavian *Theobaldia* with plain dark tarsal segments have been recorded as *glaphyroptera,* which has caused much confusion in the literature. In the year 1933 I investigated my Norwegian material of *Theobaldia* in the Tropical Institute in Hamburg, and the specimens with plain dark tarsal segments were all considered as *Theobaldia glaphyroptera.* To be sure, slide mounts of the terminalia were prepared, but, owing to other work, I had no time for a closer examination. As I, later on, took up again the investigation in Norway, the examination of the terminalia at once made it clear that the species at hand was quite different from *glaphyroptera* Schiner. My species did not agree with the species depicted in Lindner (Martini: 1931), but after a closer examination of the descriptions I strongly suspected that the mosquitoes belonged to the species *borealis* Schingarew, in spite of the fact that the figure in Lindner, of the genital organs of *borealis,* was quite misleading. At that time I had not the original description of *Th. borealis* at hand, and I therefore made a sketch of the terminalia of my species and sent it to prof. Stackelberg in Leningrad. He confirmed my opinion as to the identity of the species, and he kindly handed me his fine work on the Russian mosquitoes, where I could convince myself of the fact that the Norwegian *Theobaldia* with dark tarsal segments, were all the same species as described by Schingarew. Previously prof. Peus in Berlin had sent me larvae as well as male and female adults of *Th. glaphyroptera,* and through the courtesy of prof. Lundblad in Stockholm I received for inspection the females in the Naturhistoriska Riksmuseum, all determined and labelled *bergrothi* by Edwards. The old specimens did well agree with the description of *borealis* Schingarew, although they were rather faded in the colouring and obviously for this reason had been confused with *glaphyroptera.* More recently dr. Frey in Helsingfors handed me 4 females from the museum collection, including two of Edwards cotypes. The specimens were somewhat denuded, but a closer comparison demonstrated the agreement with the other *borealis.* I have further inspected the following collections: F i n l a n d : Zoological Museum, Åbo; coll. Fil. Mag. Storå, Nykarleby; S w e d e n : coll. Fil. Mag. K. H. Forslund, Experimentalfältet; Statens Växtskyddsanstalt, Experimentalfältet; coll. Bo Tjeder, Falun; D e n m a r k : Zoological Museum, København, and I could convince myself of the fact that *Th. glaphyroptera* is not represented in the Danish and Fennoscandian material. In the Norwegian material *Th. bergrothi* is even the the most common species of the genus. According to this I find it correct to strike the species *glaphyroptera* from the list of the Fennoscandian mosquitoes.

As to the synonymical question, the first detailed description has doubtless been published by Schingarew, but according to the rules of nomenclature, the name of *bergrothi* Edwards has to be maintained. *Th. bergrothi* Edw. is the single northern species with plain dark tarsal segments, and therefore the diagnostical remark: "Tarsi entirely dark", used by Edwards in his key for the Swedish *Theobaldia,* in my opinion, has to be approved as an acceptable diagnosis.

Description.

Female. Front of head with dark-brown, apically golden, hairs forming a tuft between the eyes. Vertex ("occiput") with golden narrow curved scales and upright forked scales, which are especially compact at the nape. Eyes bordered by whitish or yellowish-white scales. Temporae with broader yellowish-white scales. Clypeus dark brown. Proboscis blackish-brown or dark brown, apically somewhat lighter. Antennae. Tori dark-brown with some whitish scales at the inner side. Flagellum blackish-brown, clothed with minute white hairs and bigger blackish-brown hairs at the base of the segments. Palpi (fig. 31 b) blackish-brown sprinkled with light, whitish or golden scales. Thorax. Anterior pronotal lobes blackish-brown with golden, narrow curved scales and brown bristles with golden reflections. Posterior pronotum blackish-brown with golden narrow curved scales. Integument of mesonotum brown or blackish-brown with a narrow, dark median stripe, and a somewhat broader, lateral one, on each side. Ground colour of scaling dark brown with golden reflections. Narrow lines of golden, narrow curved scales on the black median stripe, divides into a fork at the antescutellar space, where the golden scales run into whitish ones. Lateral parts of mesoscutum with golden lines (fig. 29 a). Lateral border of mesonotum and antescutellar space with many dark-brown, apically lighter bristles. Scutellum with whitish and yellowish-white scales and bright bristles. The lateral golden spots at the anterior part of mesoscutum are missing in this species, but in typical specimens the colouring is more distinct than in other species of the genus *Theobaldia*. Stackelberg (1937, p. 104) remarks that the colouring of the thorax in the Russian *borealis* Sching. [= *bergrothi* Edw.] is very variable. In the northern material some specimens have the golden scales at thorax replaced by whitish ones, or the whole colouring is diffuse and the mesonotum therefore has a more brown-golden appearance. Postnotum blackish-brown. Wings with dark brown scales; wing spots not very distinct. The cross-vein r—m a little more distally placed than m—cu (fig. 30 a). Halter dirty-white with dark globule, which has few white scales. Legs. Front- and dorsal side of femurae blackish-brown, hind- and ventral side yellowish-white, as also is the basal part of femur. Front side of femurae sprinkled with dirty-white scales, which have a tendency to form a more or less conspicuous longitudinal whitish line. In the hind-leg the femurae are dark scaled at the dorsal side only. Ground colour of tibiae blackish-brown with a longitudinal white line at front side. Femurae and tibiae with yellowish-white scales apically. Knee spot conspicuous. Tarsal segments plain blackish-brown. At the under side of the first tarsal segment some lighter scales may be seen. Abdomen. blackish-brown with whitish or yellowish-white basal bands, the width of which decreases backwards. Venter white with some dark scales. Length of wing about: 6.5 mm.

Male. Proboscis blackish-brown sprinkled with fine metallic scales. Antennae: Tori blackish-brown. Flagellum dark and light ringed. Palpi exceed the proboscis about ⅔ the length of the swollen ultimate segment. Hair-tufts very long and dense at the apical third of the long segment and at segment 4, colour ash-grey with lighter reflections. Scaling blackish-brown with metallic scaling at the apex of the long segment and at the two last segments. Wing spots less distinct than in the female. First tarsal segment at the foreleg about ⅕ longer than the remaining four (fig. 38 a). Length of wing about: 6 mm.

Terminalia (fig. 39). Basistyle narrow, tapering. Basal lobe with two long curved spines. Dististyle long, somewhat swollen in the apical part. Claw not incised. Proctiger with stout, apically serrated paraprocts. Tip of the eight tergite with 5—14 stout spines. Mean value of 19 specimens: 8.9. Lobes of the ninth tergite with about 10 long hairs. Sclerites of the phallosome divided, strongly

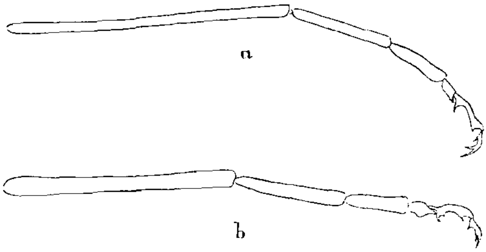


Fig. 38. Fore-tarsus of male *Theobaldia bergrothi* Edw. (a) and *T. glaphyroptera* Schin. (b). (Aut. del.)

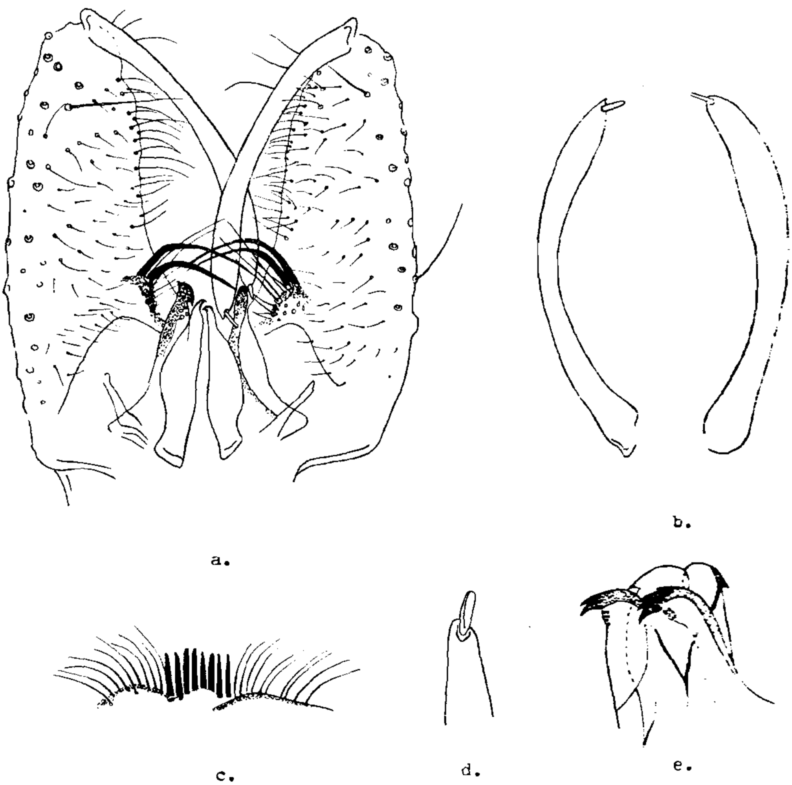


Fig. 39. *Theobaldia (Theobaldia) bergrothi* Edwards.
a, Terminalia (total view); b, dististyle; c, lobes of the 9th tergite and tip of the 8th tergite; d, tip of dististyle with claw; e, phallosome paraprocts. (Aut. del.)

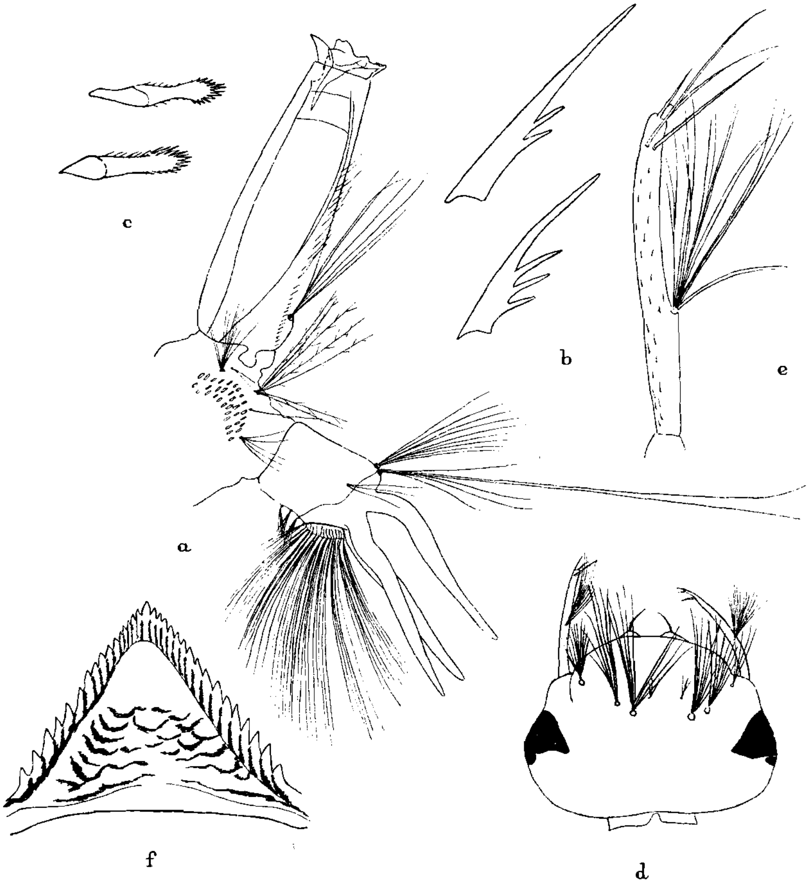


Fig. 40. Larva of *Theobaldia (Theobaldia) bergrothi* Edw. in 4th instar.
a, Terminal segments of larva; b, pecten teeth; c, comb scales; head of larva; e, antenna; f, mentum. (Aut. del.)

sclerotised and hooked apically. The more faintly sclerotised wings of the sclerites are laterally widened.

L a r v a (fig. 40). The rather short description of Stackelberg (1937, p. 105) reads as follows: "The larva is characterized by its short antennae, its comparative short siphon (index: 3.5) with a long pecten extending beyond the middle of the siphon. The basal part of the pecten ($\frac{2}{5}$) consists of deeply incised spines, the distal part of long and stout, rather dispersed hairs." [73]

From the Norwegian material of larvae, I can give the following description. Head slightly broader than long. The ratio obtained by dividing the width of the head in the length is about: 1.24 (average of 12 specimens). Antennae rather slim, faintly tapering from the insertion point of the antennal tuft. The outer and under side of the antennal shaft with fine spines. Antennal tuft which is inserted before the middle of the antennal shaft is about ⅔ the length of the shaft and consists of about 18 hairs. At the extremity of the antennal shaft is one longer and one shorter sensory appendage; further two longer hairs are placed somewhat subapically. Head with frontal hairs in a slanting row from the base of the antenna and inwards. Post-clypeal hairs noticeably closer together than the inner frontal hairs; mid frontal hairs with about 7 branches Dorsal prothoracic hair formula about: 1,1,3; 5; 1; 1; 5; 3. Concerning variability see table below.

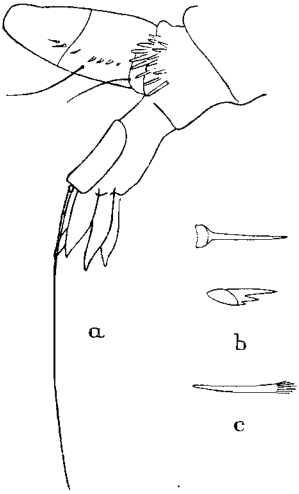
Table 7.

Variability of larval prothoracic hairs of *Th. bergrothi.*

Number of hair							
1	2	3	4	5	6	7	8
1	1	3—5 3.3 (15)	4—8 5.3 (23)	1	1	4—6 5.4 (21)	3

Comb-scales about 65. Siphonal index: 3.5. Pecten (spines + hairs) about ⅔ the length of the siphon. The spines outnumber the hairs. Siphonal tuft of about ⅔ the length of the siphon and with 6—7 branches. Saddle on ventral side only ⅔ so long as it is on dorsal side. Anal gills narrow, of about twice the length of the saddle. Precratal hairs 3, two of which perforate the saddle and one hair in the posterior incision of the saddle. Concerning chaetotaxy see the table below. I have previously been in some doubt about several small larvae from Tautra (MRy27) including two first instar specimens. The third instar specimens from this locality are *Th. bergrothi* Edw. and I now

[73] Translated from the Russian text.



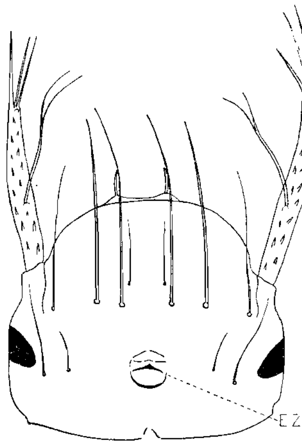


Fig. 41. Fig. 42.

Fig. 41. 1st instar larva of *Th. (Th.) bergrothi* Edw.
a, terminal segments of larva; b, pecten teeth; c, comb-scales.
(Aut. del.)

Fig. 42. Head of 1st instar larva. (Ez, egg-breaker). (Aut. del.)

also take the first instar specimens to be this species. A careful comparison with Marshall's description (1938, p. 212) of the first instar larva of *Th. annulata* unveiled differences in the pecten teeth as well as in the com-scales. As the first instar larva of *Th. bergrothi* is hitherto unknown, I have depicted the head and terminal segments of the larva. The number of pecten teeth in the two specimens at hand varied from 7 to 9 and the comb-scales from 14 to 15. It should be

Table 8.

Larval chaetotaxis of *Theobaldia (Theobaldia) bergrothi* Edw.

Number of branches in			Numer of			Siphonal index
Frontal hairs			Comb. scales	Pecten		
out	mid	inner		teeth	hairs	
10—15	6—9	6—13	57—74	13—24	8—18	3.2—3.9
12	7.4	8.8	65	18.8	13	3.5
(34)	(35)	(34)	(19)	(22)	(22)	(16)

mentioned that the locality lies outside the range of distribution hitherto known for *Th. annulata,* however *Th. bergrothi* has been found nearby (in MRi 60).

As pointed out above, the northern *Th. bergrothi* has been confused with the rather similar-looking *glaphyroptera,* but a closer investigation presents distinct differences in all stages, as demonstrated in the comparison below.

Th. glaphyroptera Schin.	*Th. bergrothi* Edw.
Female:	Female:
Scales and bristles light. Eyes without border of white scales. Palpi plain dark. Segment 3 about ⅓ longer than segment 1+2 together; the small ultimate segment oval. In anterior part of mesonotum a median golden line, accompanied by two lateral lines. Abdominal light bands comparatively narrow. Colouring of legs pale without contrasts. White longitudinal lines on femur and tibia.	Scales and bristles dark. Eyes with distinct border of white scales. Palpi sprinkled with light scales. Segment 3 as long as, or only slightly longer than segment 1+2 together. The small ultimate segment nearly circular. In anterior part of mesonotum a single median golden line. The pale abdominal bands broader. Colouring of legs with light and dark contrasts. Light scaling on femur and tibia tend to form longitudinal lines.
Male:	Male:
Palpi exceed the proboscis by about half the ultimate segment. The long segment rather straight and not swollen apically. Hair-whorls at the apical third of the long segment and at segment 4 of moderate length. The first tarsal segment of fore-leg nearly as long as the remaining 4 segments. Terminalia: basistyle with a subapical knob with a tuft of spatula-formed spines	Palpi exceed the proboscis by about ⅔ the length of the ultimate segment. The long segment somewhat curved and swollen subapically. Hair-whorls at the apical third of the long segment and at the segment 4 very long and dense. First tarsal segment of fore-legs exceed the remaining 4 segments by about ⅕. Terminalia: basistyle without any knob with tuft of spatula-formed spines.
Larva:	Larva:
Dorsal prothoracic hairs about: 1,1,3; 3; 1,1,5; 2. Pecten about ¾ the length of the siphon, the hairs outnumber the spines. Precratal hairs 5, 3 of which in saddle.	Dorsal prothoracic hairs about: 1,1,3; 5; 1; 5; 3. Pecten about ⅔ the length of the siphon, the spines outnumber the hairs. Precratal hairs 3, 2 of which in saddle.

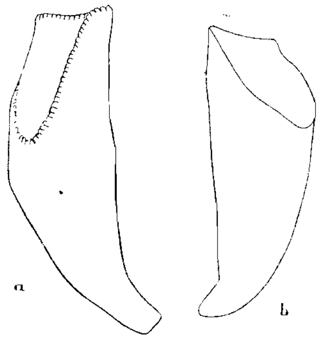


Fig. 43. Respiratory trumpets of pupa of *Th. bergrothi* Edw. (a) and *Th. glaphyroptera* Schin. (b). (Aut. del.)

Pupa (fig. 43 b):	Pupa (fig. 43 a):
Extremity of respiratory trumpets obliquely truncated, not deeply notched.	Extremity of respiratory trumpets more vertically truncated, deeply notched.

The above mentioned differences in the shape of the palpi and the tarsal segments of the forelegs, are distinctly seen in slide preparations only.

Geographical distribution.

Denmark: The species has not been found in Denmark!

Sweden: *Ög:* ♀ (Hagl!); *Upl:* Hlm! ♀, *Dlr:* Falun, Norslund! ♀: 24. v. 1932 (B. Tj.); Falun, Kv. Trädgården! ♀: 23. ix. 1937 (B. Tj.); Sundborn, Toxen! ♀: 9.—21. v. (Klefb.); Ludvika, Brunnsvik! ♀: 10.—26. vi. 1926 (KHF); Lima, Sörbäcken! ♀: 29. v. 1934 (Bj. Tj.). *Nb:* BS! (= Botnia Septentrionalis) ♀; (Bhn.).

Norway: Ø: *1. Hvaler:* Kirkeøya, ♀: 28. v. 1928 (LRN); AK: *7. Frogn:* pond at highway Oslo-Drøbak, L: 30. viii. 1931, (♀) (LRN); *13. Aker:* Østensjø, ♀; 5. v. 1934 (LRN); pond at Sognsvatnet, L: 9. v. 1937 (♀) (LRN); Skar, Maridalen, ♀: 6. v. 1928 (OS); pond at seashore, Fornebo, L: 2. v. 1937 (♀) (LRN); *32. Eidsvoll:* pond at Eidsvoll Bath, L: 15. viii. 1930 (♀) (LRN); HEn: *20. Trysil:* Vestby, 8. vi. 1934 (Skj); L: 8. vi. 1934 (♂♀) (LRN); Rekkeskjæret, ♀: 20. vi. 1935 (Skj); Grønoset, ♀: 30. v. 1935 (Skj); Kneiten, ♀: 19. vi. 1935 (Skj); Tenåsen (Lower), ♀: 11. vi. 1935 (Skj); *23. Ytre Rendal:*

pond at Storsjøen, L: 30. vii. 1930, L: 1. vii. 1935 (♂), ♀: 4—12. vii. 1935 (LRN); ♀: 30. vi. 1937 (LRN); 1. vii. 1939 (LRN); Sandodden, in a cow-stable, ♀: 9. vi. 1944 (LRN); *26. Alvdal:* pond at the highway, L: 21. viii. 1931 (♂ ♀) (LRN); B v: *18. Rollag:* Fetjan farm (55 km n. of Kongsberg), ♀: 19. v. 1932 (LRN); Hallingdal, ♀; 26. *Hol: Ustaoset,* ♂: 15. vii. (Quelpr.). V A y. *1. Tveit:* pond at Krageboen, L: 3. vi. 1931 (♀) (LRN); R y : *17. Sola:* Utsola, L: 27. viii. 1931 (OM); *20. Hetland:* Mosvann, L: 22. viii. 1931 (OM). R i : *49. Forsand:* Lerang in Høgsfjord, L: 14.—19. viii. 1931 (OM); Meling in Høgsfjord, L: 18. viii. 1931 (OM); Berge in Høgsfjord, L: 19. viii. 1931 (OM). H O y : *18. Fana:* waterfilled ditch at Tveitevann, L: 10. vii. 1929 (♂ ♀) (LRN); Kloppedalsvann, L: 10. vii. 1929 (♂ ♀) (LRN); Fjøsangervann, L: 10. vii. 1929 (♂ ♀) (LRN); Bjørnevann, L: 10. vii. 1929 (♂) (LRN). *22. Bergen:* Haukelandsvann, L: 10. vii. 1929 (LRN). S F y : *7. Gaular:* Viken, ♀: 27. vi. 1942 (N. Knab.). M R i : *60. Grytten:* pond at the base of Romsdalshorn, L: 22. viii. 1931 (♀) (LRN); S T i : *25. Rennebu:* Bjørkli farm, ♀: 1. viii. 1932 (LRN); *27. Soknedal:* pond at Vollan farm, L: 1. viii. 1932 (LRN); *38. Selbu:* pond near Selbusjøen, L: 2. viii. 1932 (LRN); N n ø : *39. Sørfold:* Røsvik in Salten, ♀: 31. vii. 1932 (S-R). T R y : *26. Malangen:* Sjåvikør, ♀: 18. viii. 1942 (S-R).

F i n l a n d : *AB(V):* Kuustö (Lundstr.); *N(U):* Helsingfors! ♀, (Tiensuu); *Ka(EK):* Kivikoski at the Saima canal (Adelung); *IK(Kk):* Muola Galitsina! ♀, (coll. Ehrenberg); *Ok(Kn):* Säräisniemi! ♀ (Wuorentaus); *Ks(Ks):* Paanajärvi! (Hellén); *Lkem(Keml):* Kittilä! ♀ (Krogerus); Salmijärvi! ♀ (J. Carpelon):, Sodankylä! ♀.

U S S R : *Kola Peninsula:* lake Imandra; environs of Murmansk (Schingarew); Chibinä (Fridolin), (Stackelberg 1937, p. 105) *Karelia olonetsensis:*, Petrosawodsk! (Günther).

Distribution outside Denmark and Fennoscandia.

Th. borealis is established by Schingarew (1927, p. 548) on specimens from the lake Imandra in Kola peninsula. One of the types of *Th. bergrothi* Edw., in the zoological museum at Helsingfors, is from Petrosawodsk. Further Stackelberg (1937, p. 105) records the species from the Far East: gouv. Irkutsk: Udinsk (Maslov). As to *Th. glaphyroptera,* he remarks that he has found this species in the environs of Leningrad, but as the specimens caught were females only, the finds have to be controlled. As these finds are closely connected with the southernmost Finnish localities for *bergrothi* I am inclined to consider the Russian female *"glaphyroptera"* as belonging to the species *bergrothi.*

Biology.

Concerning the biology of this species in U S S R Stackelberg (1937) gives no information.

In Norway I have found larvae in all months from the beginning of May to the end of August. It appears that they are not very fastidious as to the nature of the breeding water, and they even tolerate polluted water. Larvae have been found in temporary pools, inundation waters, swamp-puddles and in small as well as in bigger ponds. Most of the breeding waters lie in the shade, and larvae have been found in more open-lying waters in the autumn only. This may be taken as an indication of a preference for colder breeding waters. *Th. bergrothi* most probably is an arctic species, and in the southern part of its range of distribution, the egg-laying females find suitable breeding places in summer time in overshadowed waters only, whereas its typical breeding places, in more northern degrees of latitude, are open-lying waters.

Comparatively few researches on the hydrogen-ion-concentration have been carried out, but they indicate that the degree of pH in the breeding waters is of little if even any importance for the species. The degree of pH varies from 5.5 to 7.6. For details see table 1, p. 59.

In an inundation-pool in Ytre Rendal (HEn 23) single larvae of *Th. bergrothi* and *Ochlerotatus communis* were found associated with many *Anopheles maculipennis* and huge masses of *Culex pipiens* and *C. torrentium* Martini. Further larvae of *Th. bergrothi* have been found associated with larvae of *Th. annulata, Th. subochrea, O. cataphylla, O. punctor, Neoculex apicalis.* Adult females have been found in Norway in the time: 6. v.—7. ix.; the specimens from September, however, have been bred from larvae collected on the 30th of August. Male adults have been found during the period 15. vii.—21. viii. L have at hand Swedish females collected between 9. v.—26. vi. The northern finds indicates that the species have one generation in the year; the new generation appears in July—August and most probably the females hibernate.

As to the bloodsucking habits of *Th. bergrothi* few observations have been made. I have found *Th. bergrothi* twice in houses, and they have been collected several times in cow-stables, some of the specimens blood-filled. In Trysil (HEn 20) three specimens, one of which blood-filled, were caught on a cow in a field.

Theobaldia (Culicella) morsitans (Theobald.).

? *Culex flavirostris* Meig. (Syst. Beschr., *4*, p. 242) 1830
Culex morsitans Theob. (Mon. Cul. *2*, p. 8) 1901
Culex dyari Coquill. (J. N. Y. Ent. Soc. *10*, p. 192) 1902
Culex brittori Felt. (Ent. News, *16*, p. 79) 1905

Synonymical remarks.

Edwards' (1921, p. 289) says of this species: "I at one time considered that the North American *T. dyari* (Coq.) might be synonymous, but Dr. H. G. Dyar informs me that the two are distinct by hypopygial characters.

Meigen's statemant concerning the proboscis and palpi of his *C. flavirostris* (male) might possibly be taken as indicating this species, but he says "Füsse ganz braun", which presumably excludes it. Like the majority of Meigen's names *C. flavirostris* is unrecognisable."

Dyar (1928, p. 244) remarks as to *Culicella dyari* Coq.: "This species is closely related to the European *morsitans* Theobald. (? = *flavirostris* Meigen); but the male hypopygium does not completely correspond. It might be considered an American race of *morsitans,* although I judge the specific status best."

Matheson (1929, p. 180), however, considers *morsitans* synonymous with *dyari* and *brittoni,* and in accordance with this view Edwards (1922, p. 105), in his last monograph, places the two American forms as synonyms of the European *morsitans*.

Edwards (1932, p. 105) looked upon *Th. litorea* Shute as a variety of *morsitans* but Marshall and Staley (1933, pp. 119—24) raised it to specific rank owing to distinct differences in the male genitalia and the palps.

Description.

F e m a l e. H e a d. Front of head with yellowish-white narrow curved scales and dark bristles forming a tuft between the eyes. Vertex ("occiput") with yellowish-white narrow curved scales and above with many dark upright forked scales with lighter reflexes at the apexes. Temporae with flat yellowish-white scales. Eyes bordered by yellowish-white narrow curved scales. Clypeus leather-brown or dark brown. Proboscis blackish-brown, labellae often somewhat lighter. Antennae. Tori yellow or leather-brown. Flagellum blackish-brown with a coating of minute white hairs and bigger black hairs, with lighter reflections apically, at the base of the segments. Palpi (fig. 32 d), about ¼ the length of the proboscis, with dark brown scaling, ultimate segment lighter (often yellowish-white). Segment 3 narrow, about ¼ longer than segment $1 + 2$ together. Ultimate segment incised (fig. 32 d). Thorax. Anterior pronotal lobes brown with yellowish-white scales and light reflecting bristles. Posterior pronotum dark brown with dark golden narrow curved scales running into whitish ones at the posterior upper corner. Mesonotum brown with a black median line and two similar lateral lines. Scaling hair-like. Through alternation of fine, less reflecting scales, with coarser, intensively reflecting ones, a more or less distinct golden pattern on the mesonotum may result. In typical specimens a line of golden scales on the black median stripe divides into a fork at the antescutellar space, and the branches connect here with the lateral golden lines on the mesoscutum (fig. 29 c). Lateral border of mesonotum with bristles, especially dense at the posterior part. Scutellum dark brown with long dark and shorter, light reflecting, bristles, and with a median tuft of yellowish-white narrow curved scales. Wing with narrow, blackish-brown, scales. Shift of cross-vein m—cu about 1.0 (fig. 30 c). Halteres ashy-grey with some dirty-white scales at the globules. Legs. Femurae and tibiae blackish-brown with metallic reflections. Under side and base of femurae yellowish-white, also under side of tibiae. In some specimens front side of tibiae have a more or less distinct longitudinal line of yellowish-white scales. Knee spot yellowish-white, distinct; so is also the apical spot on tibia. Tarsal segments dark-brown. At the base and apex of segment 1 and 2, as well as at the base of segment 3 and 4, light scales. Abdomen metallic with light, comparatively narrow, basal bands, which may be somewhat widened in the middle. The bands are yellowish-white, and in some specimens they may be more or less distinctly divided into one median and two lateral spots. Length of body: 6.5—7.5 mm (W-L); Length of wing about 5.5 mm.

Fig. 44. *Theobaldia (Culicella) morsitans* Theob.
a, Terminalia (total view); b, phallosome and paraprocts; c, tip of diststyle with claw. (Aut. del.)

M a l e. H e a d as in female. P r o b o s c i s dirty-yellow scaled, apically darker. A n t e n n a e. Tori leather-brown. Flagellum dark-brown and white ringed. Hair-whorls long, dark-grey. P a l p i apically swollen exceeding the proboscis by about 4/5 of the ultimate segment. Hair-tufts dense and long at the apical third of the long segment and at segment 4. At the apex of segment 4 some stout spines at the outer side. The long segment dark at the base and at the narrow median point. Segment 4 and 5 with light basal spots. Length of body: 7.5—8 mm (W-L). Length of wing about: 5.5 mm.

T e r m i n a l i a (fig. 44). Basal lobe with 2—4 spines (average value of 10 specimens: 2.75), 2 of which are very long and stout. Diststyle evenly tapering towards apex. Claw not incised. Paraprocts sclerotised and apically serrated, in most specimens with 2 teeth, rarely with 3 teeth. Tip of the eighth tergite with 3—7 spines (average value of

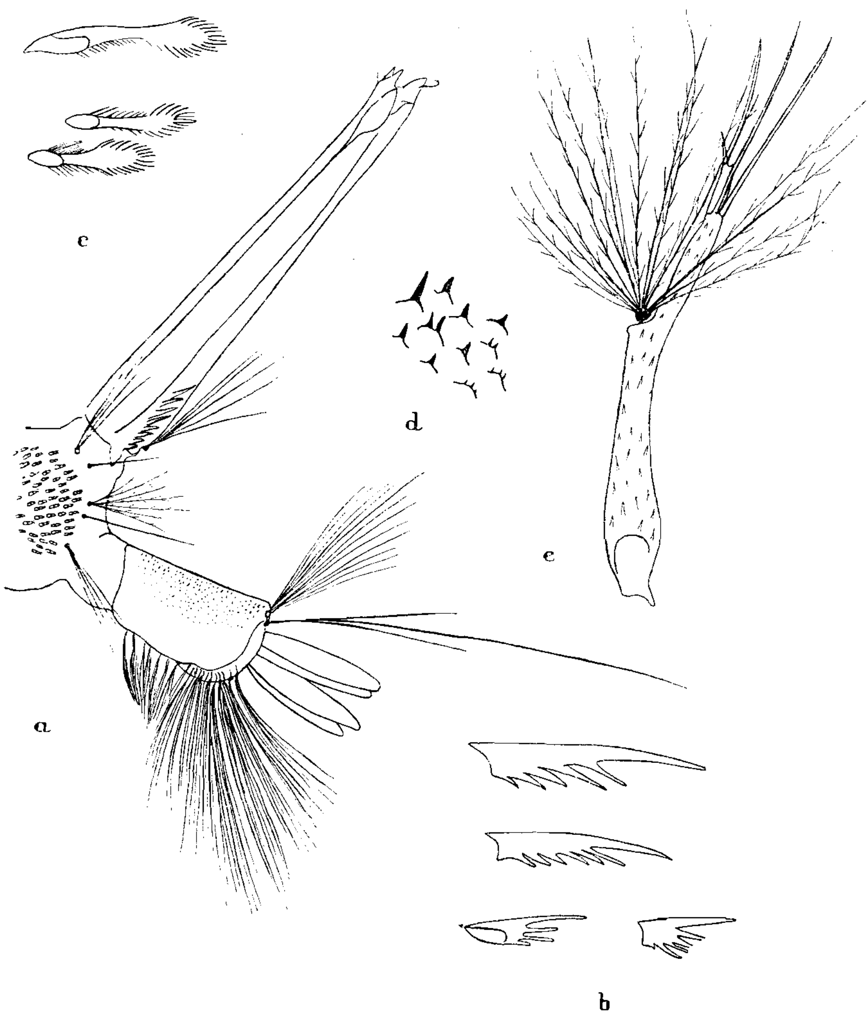


Fig. 46. Larva of *Theobaldia (Culicella) morsitans* Theob. in 4th instar.
a, Terminal segments of larva; b, pecten teeth; c, comb-cales; d, spines on dorsal side of saddle; e, antenna. (Aut. del.)

9 specimens: 4.9). Phallosome faintly sclerotised and apically not divided.

L a r v a (fig. 45—46). Head much broader than long. Antennae elegantly curved; antennal shaft with many spines

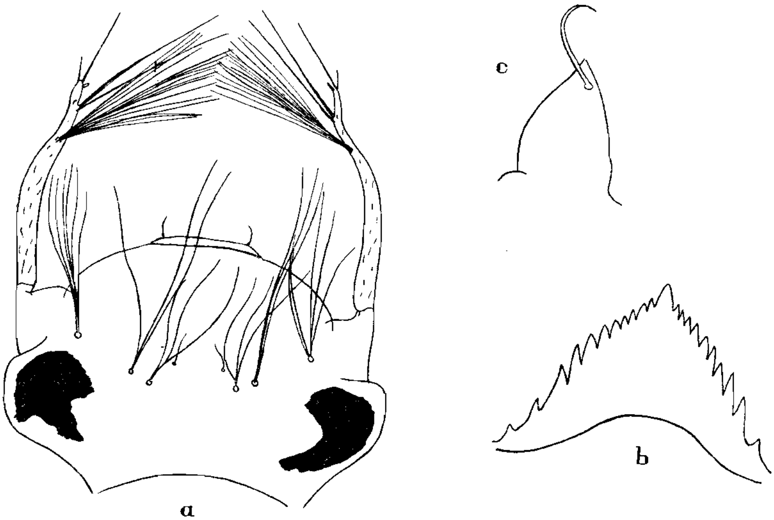


Fig. 46. Larva of *Theobaldia (Culicella) morsitans* Theob. in 4th instar.
a, head; b, mentum; c, ventral valva of siphon with curved spine. (Aut. del.)

in the basal part, conspicuously tapering from the insertion point of the antennal tuft. This is very long, consist of 18—20 hairs and is inserted near the outer third of the antennal shaft. Sensory appendages and bristles in 2 groups, of which the 2 bristles are conspicuously below the apex. Dorsal thoracic hairs about: 1,1,2; 1; 1; 3; 2. Abdomen with three and four-branched lateral hairs on the first segments. Comb with about 130 narrow, feathered blunt scales, which are mostly somewhat broader apically than at the base. Siphon long, narrow and fainthly tapering towards the apex. Siphonal index about: 6.1. Pecten with about 11 teeth which ventrally have 3—6 denticles. Siphonal tuft with 4—5 hairs of nearly half the length of the siphon. Apico-dorsal hairs diminutive. The distal hairs of the ventral valve developed into stout curved spines. Saddle well one and a half times as long as high. Dorsal brush: an outer pair of long stout hairs, consisting of a very long branch and two shorter ones, and an inner pair of 12—15 branched tufts. Ventral brush formula: 14 (15) + 6. Hair-tufts fan-shaped. Six precratal tufts, one of which in the posterior ventral incision of the saddle, the others perforate the saddle. Anal gills more or less tapering, somewhat shorter than the saddle.

Table 9.

Larval chaetotaxis of *Theobaldia (Culicella) morsitans* Theob.

Number of branches in				Number of		Siphonal index
Frontal hairs			Siphonal tuft	Comb scales	Pecten teeth	
out.	mid	inner				
3—9 6.3 (37)	1—3 2.1 (39)	1—4 2.8 (36	3—6 4.7 (19)	117—148 131.5 (6)	10—13 11.2 (42)	5.3—6.9 6.0 (10)

Geographical distribution.

Denmark: *1. Jylland:* Fanø! ♂: 10. viii. 1919 (P. N.) *2. Sjælland:* Stenholts Vang, Strødam, Grønholthegn (W-L). *3. Bornholm:* Ekkodal! ♂ ♀: 31. v. 1938 (P. N.).

Sweden: *Öl:* Lenstad 25. vii. 1916 (Wahlg.); *Ög.* (Hagl.); *Dlr:* Floda, Syrholn! ♀: 2. ix. 1938 (T. Tjed.); Vika, Karlslund! ♀: 25. viii. 1930 (Tjed.).

Norway: Ø: *1. Hvaler:* Kirkeøya: Brennesand, L: 14. vi. 1938 (♂ ♀) (LRN); Rev, L: 16. vi. 1938 (♂ ♀) (LRN); AK: *6. Aas:* pond at the highway Gjersjøen-Drøbak, L: 30. viii. 1931 (LRN); *30. Ullensaker:* pond south of Kløfta, L: 20. ix. 1931 (LRN); Bø: *4. Lier:* pond in the Lier valley, L: 19. v. 1938 (♂ ♀) (LRN); *2. Røyken:* pool in the forest at Værpen, L: 8. v. 1938 (♂) (LRN); pond at Nærsnes, L: 15. v. 1938 (LRN); TEy: *7. Bamle:* pond at Bamle, L: 3—7. vi. 1930 (LRN); VAy: *16. Vigmostad:* pond at Vigmostad, L: 7. vi. 1931 (LRN); Ry: *20. Hetland:* Lille Stokkevann, L: 5. vi. 1931 (OM). Stokka-Tjensvoll, L: 20. viii. 1931 (OM).

Finland: *Ab(V):* Kuustö (Lundstr.), Sammatti (I. Sahlb). *N(U):* Hattula (Wegelius). *Ta(EH):* Tvärminne! ♂ (Frey).

Distribution outside Denmark and Fennoscandia.

According to Marshall (1938, p. 240) the species is rather dispersed in the British Isles. In England it is found in the counties: Beds, Bucks, Dorset, Essex, Hants, Herts, Hunts, Kent, London, Middlesex, Norfolk, Shropshire, Suffolk, Surrey, Sussex, Westmorland;

in Wales: in Carnavonshire, Flintshire, Montgomeryshire and in Ireland in Kerry (Killarney). In the Netherlands it is recorded by de Meijere ((1911, p. 138) from Baarn (ultimo May and June), Hilversum (Ultimo April—June), Kortenhoef (May) and Paterswolde (July). As to the distribution in France, Séguy (1925, p. 79) records: "Très commun par place, de la fin de mars" and Brolemann (1919, p. 66) says: "Basses-Pyrenées: Le Hameau (27. iii. et 2. v.). Cette espèce qui parait être une forme de printemps, a disparu en juillet." Concerning Germany, Martini remarks: "Sie ist bei uns eine der häufigsten Arten." Schneider (1914) records it from the environs of Bonn as common. Martini (1931, p. 220): "— — — bei Brumath in Unterelsaß — — — häufig, bei — — — Graal und Mürits in der Rostocker Heide und Warnemünde — — —". It is also recorded by Peus (1929 b, p. 6) from: "Nauen (Mark Brandenburg): 20. v. 1928, Göttingen: 6. ix. 1927, Groß-Raum (Ostpreußen): 7. ix. 1928, Prerow (Darss): 18. vii. 1928, Luchsee (Brandenburg): 16. ix. 1928." Further eastwards it is found in Lettland by Peus (1934 b, p 75): "Schlenken eines Waldhochmoores am Rande des Tirulmoores bei Bienenhof südl. Riga: 15. vi. 1934 (2 Männchen, 1 Weibchen aus Freilandspuppen gezüchtet)"; in Estland: Päskälla swamp at Nömme (Reval) 28. viii. (Dampf 1924, p. 6); in Lithuania: Bialowies (Sack 1925, p. 264); Poland (Tarwid (1938 b); Hungary: Balaton (Mihályi 1941); Roumania (Leon 1911): Jassy. Waterston (1921—22, p. 135) publishes the following information as to its occurrence in Macedonica: "Taken by Colonel Wenyon with *T. fumipennis* on the Gumus Dere, April 20, 1918. Common according to Captain Cassidy, at Janes, who sent several examples dated April 24, 1918, also from Hortiach, Capt. J. A. Valentine, during the summer 1918. A severe biter." Charrier (1924) records the species from Tanger. As to the distribution in USSR Stackelberg (1937, p. 106) records: "Recorded from the District of Leningrad (Peterhoff: Montschadskiji. Environs of Luga: Stackelberg!); from the Median Ural (environs of Sverdlovsk: Kolozov); Ukraine (Ukrainskoje Polesje: Rybinskiji. Environs of Dnepropetrovsk: Guzevitch!). Crimea (Southern Coast: Velitschkevitsch!). North Kaukasus (Pjatigorsk: Mess!). West-Siberia (Barnaul: Simanin!).[74] Further records are: Basin of Dnjepr: Nischnepetrovsk, village Vasiljevka in Melitopol distr., outlet of river Samara (Dolbeskin 1928).

According to Dyar (1928, p. 244) the American form *dyari* Coquil. has been recorded from: Ontario, New Hampshire, New York, Massachusetts, New Jersey, South Dakota, Alberta, British Columbia, Yukon Territory. Recent records are: Maine (Bean 1946), Rhode Island (H. Knutson 1943), Indiana (Christensen a. Harmston 1944), Michigan (Irwin 1941) and Colorado (Lasky 1946).

Biology.

Larvae of *Th. morsitans* have been found in the southern Norway in two periods in the summer, namely: 14. iv. —7. vi. and 20. vii.—20. ix. Breeding-waters are: pools, small ponds, water-filled ditches and even a well. In Lilie Stokkevann larvae were found in a ditch with slowly run-

[74] Translated from the Russian text.

ning water. Some of the breeding-waters are situated in open places, others were more or less over-shadowed. The degree of pH in the breeding-waters varies from 5.4 to 7.5. Larvae of *Th. morsitans* have been found associated with larvae of *Th. annulata, O. cantans, O. communis, O. punctor* and *Neoculex apicalis.* All Norwegian adults of *Th. morsitans* have been bred from larvae. Some females from Sweden have been collected in the period 25. viii. —2. ix.

In Denmark Wesenberg-Lund (1920—21, p. 122), during three years made close research on the biology of this species and he points out that the eggs laid in summer are hatched in the autumn. As to the development he further says: "In the time from 1. x. to about 1. xii. the larvæ grow up, pass the three ecdysis-stages and are commonly full-grown before the ponds are covered with ice. — — — Undoubtedly very many of the *C. morsitans* larvæ die out during the winter; and this is, I suppose, the principal reason why the imago is comparatively rare in our country and much rarer than the larva."

In my opinion, the conclusions we may draw from the Scandinavian finds of *Th. morsitans,* are in full agreement with the observations published by Wesenberg-Lund. The larvae found in April—June are most probably the hibernating larvae, and those found in August—September are the new generation. Wesenberg-Lund thus concludes his investigations (1920—21, p. 123): "I therefore feel sure that *C. morsitans* in our latitudes has only one generation."

Researches carried out in Britain (Marshall 1938) and Germany (Martini 1931, Peus 1929) agree in essential points with the above mentioned. Marshall (1938, p. 230), however, points out that larvae of *Th. morsitans* once have been found in a water-filled cavity in an elm tree, in company with larvae of *Anopheles plumbeus* and *Aëdes geniculatus.* Martini is of the opinion that the species may hibernate in the egg stage also.

As to the blood-sucking habit of this species the authors are of different opinions. Wesenberg-Lund (1920—21) says: "I have hatched this species in many thousands at my laboratory, I have been sitting in the very same dried up ponds over which the females were flying and probably egg-laying, and I have caught them in the evenings when they came through the open windows facing the lake; moreover I have never found females, whose stomach were red and distended by blood."

Similar are the observations made by Martini (1931, p. 220): "*Th. morsitans* hat mich noch nie angegriffen, und ich finde auch in der Literatur keinen sicheren Nachweiß, daß sie Menschen oder Säugetiere gestochen habe." Marshall (1938, p. 230) only remarks: "All attempts in the laboratory to induce females of British *Culicella* to suck blood having so far been unsuccessful, — — —."

Eckstein (1920, p. 365) reports that he at several times found female *Th. morsitans,* associated with *Anoph. maculipennis* and a few *Culex apicalis,* in bird houses ("Vogelschutzhäuschen"). He succeeded in bringing *Th. morsitans* to suck blood on a Greenfinch, and he therefore considers it an established fact that *Th. morsitans* feeds on birds.

In contradistinction to this stands Waterstons remark (1920—21, p. 135): from Macedonia: "A severe biter" and further Stackelbergs (1937, p. 106) records from USSR: "The mosquitoes attack different hematherms, according to Velitschevitsch (1931) they also attack man." [75]

Theobaldia (Culicella) fumipennis (Stephens).

Culex fumipennis Steph. (Zool. Journ. *1,* p. 453) 1825
Culex ficalgi Noe. (Bull. Soc. Ent. Ital., *31,* p. 238) 1899
Culicada theobaldi de Meijere (Tid. v. Ent. *54,* p. 142) 1911

Systematical remarks.

The two species *Th. fumipennis* and *morsitans,* which, in the larval stage differ conspicuously, are very simillar as adults. Marshall (1938, pp. 220—24) emphasises the following characteristics by which *fumipennis* may be recognised.

1) In both sexes, the narrow leg-rings are conspicuous at all tarsal segments and the presence of an "inverted V" pattern of dark scales upon most of the abdominal sternites.

2) In females only, an aggregation of pale scales in the middle third of the proboscis.

3) In males only, the length of the last four foretarsal segments combined being practically equal to that of the first segment. The dististyle is somewhat more slender and the tip of the paraprocts usually with 2 (rarely 3) teeth.

As *Th. litorea* Shute has not been found in our region, the characters of this species has not been taken into consideration above.

In the few Norwegian specimens, with somewhat shrunken abdomen, the dark "inverted V" pattern is hardly visible,

[75] Translated from the Russian text.

but in some of the Danish specimens the pattern is very distinct. However, the aggregation of pale scales in the middle third of the proboscis as well as the leg-rings at all tarsal segments are more or less conspicuous in all specimens at hand.

As to the length of the tarsal segments of the fore-leg of the male, de Meijere records for *fumipennis* (1911, p. 142):

$$\text{ratio } \frac{\text{length of last 4 tarsal segments}}{\text{length of first tarsal segment}} \frac{117}{120} \text{ 0,97 and for}$$

morsitans (1911, p. 139):

$$\text{ratio } \frac{\text{length of last 4 tarsal segments}}{\text{length of first tarsal segment}} \frac{105}{125} \text{ 0,84}$$

According to Marshall and Staley (1933, p. 121) the corresponding figures are, for *fumipennis*: 1,06 and for *morsitans:* 0,8. Stackelberg (1937, p. 99) points out, in the male key, that in *fumipennis* the length of the first tarsal segment in the fore-leg is equal to or somewhat shorter than the last four segments combined. Further the length of the fore-tarsus is often shorter than the length of the fore-tibia. In *morsitans* the first tarsal segment distinctly exceeds the length of the last four tarsal segments combined, and the length of the fore-tarsus exceeds the length of the fore-tibia. However the few Norwegian specimens examined show no distinct differences in this respect. Thus the figures for the tarsal segments are: for *fumipennis:* 0,83 and for *morsitans:* O,84. The ratio $\frac{\text{tarsus}}{\text{tibia}}$ is for Norwegian *fumipennis:* 1,18 and for *morsitans:* 1,12. This indicates that the characters mentioned must be used with some caution for diagnostical purpose concerning Norwegian specimens. At any rate further research on a larger material is strongly needed.

The female palpi of *fumipennis* are very similar to those of *morsitans.* Neither in shape nor in the relative length of the segments are distinct differences to be found.

In the single Norwegian slide preparation of the male genitalia the basal lobe of the basistyle has four spines (fig. 47). The slender claw of the dististyle is not incised at the apex. The paraprocts have each 3 apical teeth. Tip of the eighth tergite with 3 spines. Sclerites of the phallosome faintly sclerotised and not divided apically. The length of wing in female *fumipennis* is about: 6,5 mm.

Concerning the larva of *Th. (Cul.) fumipennis* Marshall (1938, pp. 224—5) remarks: "In all four instars the larva

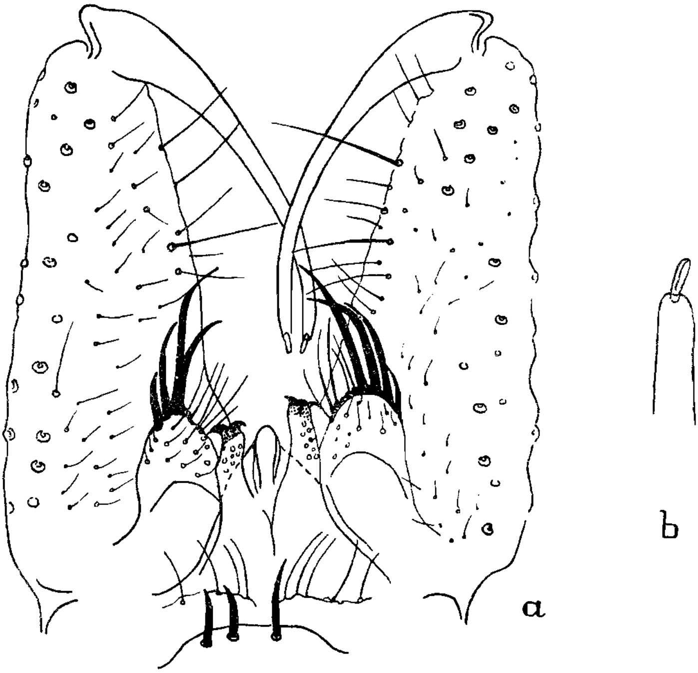


Fig. 47. *Theobaldia (Culicella) fumipennis* Stephens.
a, Terminalia (total view); b, tip of diststyle with claw. (Aut. del.)

of *T. fumipennis* is at once distinguished from that of — — *T. morsitans* — — by the conspicuous isolated spines which form the distal part of the pecten. In the later instars another diagnostic feature of this species is the presence at the tip (and on each side) of the siphon, of a prominent hair-tuft. The exceptional length of the siphonal tuft in the third and fourth instar — — — is also worthy of note."

Geographical distribution.

Denmark: 1. *Jylland:* Silkeborg! ♀: 21. vii, 1930 (P. N.), 16. viii, 1929 (P. N.); Nørholm! ♀: 7. vi, 1919 (P. N.); Resenbro! ♀: 29. v. 1921 (P. N.). 2. *Sjælland:* Refsnæs! ♀: 5.—21. viii, 1931 (P. N.)

Sweden: *Ö. G.:* (Haglund)!

Norway: *Ø:* 1. Hvaler: Kirkeøya, Rev, P: 14. iv. 1938 (♀) (T. L.). Vay: 3. *Oddernes:* Kristiansand. P: 24. v. 1929. (♂♀) (LRN).

Finland: Hitherto not found (N.)!

Distribution outside Denmark and Fennoscandia.

According to Marshall (1938, p.226) *Th.fumipennis* has been found in England in the counties: Berks, Bucks, Dorset, Hants, London, Middlesex, Norfolk, Notts, Shropshire, Somerset, Surrey, Sussex and Yorks; in Wales in Montgomeryshire and in Scotland in Inverness-shire, Ross and Cromarty, and Sutherlandshire. De Meijere (1911, p. 142) records it from the Netherlands from Baarn, Hilversum (ultimo May and June), Maarsbergen (May) and Amersfoort (June). Concerning France Séguy (1925, p. 79) says: "Environ de Paris, marais de Sucy (Avril)." It has also been found in the spring 1918 at Straßburg (Eckstein, 1920) as well as in Poland (Tarwid 1934, 1938). As to its occurrence in Macedonia, Waterston (1921—22) reports: "Colonel Wenyon found both sexes, April 20, 1918, of this species numerous in a dugout behind D. H. Q. in the Gumus Dere, a stream descending to the Struma valley. At Paprat, a few miles south of the previous locality and at a greater elevation. Captain P. J. Barraud also took some specimens, June 3—10, 1918, in a dried-up well near a stream." From USSR Stackelberg (1937, p. 110) reports: "Gouv. Leningrad (Stackelberg! Jacobson!). Also recorded from Ukrainskoe Polesje (Rybinskiji) and from Pre-Kaukasia[76] (Mess!); the records from Crimea (Velitschkevitsch, 1931) must be considered as incorrect, here we have to do with *Th. setivalva* Masl."[77]

Biology.

No northern larvae of *Th. fumipennis* are at hand. The female adult from Kirkeøya (Ø 1) was hatched from a pupa found in an old draw-well. The male and female adults from Kristiansand (Vay 3), were hatched from pupae found in an exposed pool at the edge of a greater pond, just outside the city of Kristiansand.

Concerning the biology of this species very few records have been published. Marshall (1938, p. 225) remarks: "There are no records — — — of *T. fumipennis* females entering buildings, nor their biting either human beings or domestic animals. All attempts to feed females of this species on blood, in the laboratory, have so far been unsuccessful; neither have any blood-feed females ever been captured. *T. fumipennis* breeds for the most part, in "open" situations, either in temporary pools or among the weedy margins of permanent pools. Evidence provided both by larval records and by field observations indicates that the eggs of this species — — — are laid either in dried-up hollows, or above the water level in partly filled ones. — — — So far as known the habits of the larva of *T. fumipennis* are very similar to those of the larva of T. *morsitans*." Stackelberg (1937, p. 110) says: "Larvae are found in shallow pools with grass vegetation, and also in pools covered with duckweed *(Lemna)*, often associated with the larvae of *Th. morsitans, Culex hortensis, C. apicalis,* more seldom with *Anopheles bifurcatus;* most of the time they pass near the bottom of the pools; they subsist on plancton.") Séguy (1923,

[76] The region north of the Caucasian mountains.
[77] Translated from the Russian text.

p. 92) records the following information on the subject: "La larve du *Theobaldia fumipennis* se recontre des le debut d'avril dans les mares herbeuses, en compagnie des larves d'*Anopheles*. Cette Larve vit aussi dans les mares courvertes de *Lemna* en compagnie des larves des *Theobaldia morsitans, Culex hortensis* et *pyrenaicus;* c'est le plus souvent l'habitat de ces larves a long siphon."

Genus *Taeniorhynchus* Lynch Arribalzaga 1891.

According to Edwards (1921, p. 191): "This genus may be distinguished in the adult stage from *Culex* by the absence of empodia; from *Theobaldia* by the absence of spiracular bristles; and from *Aëdes* by the absence of a definite "tibial scraper" (a close-set row of bristles at the tip), by the non-retractile eighth segment of the female abdomen and the structure of the male hypopygium." In the single northern species the wing-scales are much broader than those of any Danish or Fennoscandian mosquito and the shift of the cross-veins m-cu is very great.

The larval siphon and the pupal respiratory trumpets are strongly modified and form plant-piercing organs.

The genus is divided into four subgenera, one of which, *Coquilletidia,* is represented in our region. Most of the 27 species known are distributed in Africa and the Oriental Region, and solely one species, *C. richiardii* Fic. occurs in Denmark, southern Sweden and Finland.

Taeniorhynchus (Coquillettida) richiardii (Ficalbi).

Culex richiardii Fic. (Bull. Soc. Ent. Ital., *21,* p. 50) 1889
Culicada annulipes Schneider (Verh. d. Nat. Ver. d. preuss. Rheinl. u. Westf., *70,* p. 33 1914
?T. nikolskyi Sching. (Russ. J. f. Trop. Med., *5,* p. 546) 1927

Synonymical and systematical remarks.

The synonymy above is in accordance with Edwards (1932, p. 119) but the quotation from Schneider is added as it is obvious that Schneider ,under the name of *Culicada annulipes,* described *Taeniorhynchus richiardii* Fic. He thus emphasises the white ring in the middle of the first tarsal segments. The name of *T. nikolskyi* Sching. is also added to the list (Stackelberg 1937, p. 116).

From the literature it is evident that this species (*T. richiardii*) is rather variable in the colouring. Wesenberg-Lund (1920—1921, p. 104) says: "Metatarsi and tarsi yellowish, banded in the following manner: fore metatarsi and first two tarsi with traces of basal bands. On the mid-legs the bands are more distinct; the bands on the hind-legs are broader and still more distinct, but there is no broad, pale median metatarsal band, such as Theobald states with regard to *T. richiardii.*" Martini (1931, p. 226) describes a light coloured variety, and Stackelberg (1937, p. 116) remarks: "An investigation of the material of *Mansonia* from Central Asia, Kasakstan and W. Sibir, demonstrates that this species is rather varying in the colouring, i. a. in the colouring of the tarsalia. This is occasionally stated in European species of this genus (Wesenberg-Lund 1924, Martini 1930, 226). I therefore so far consider the species *Taeniorhynchus nikolskyi,* described (l. c.) by Schingarev, as a colour aberration only of the widely distributed *M. (C) richiardii* Fic."

Description.

Female. Head in front with golden bristles forming a tuft between the eyes. Vertex ("occiput") with pale golden narrow curved scales and black upright forked scales. Laterally with blackish bristles. Temporae with whitish broad flat scales. Clypeus yellowish brown or dark brown. Proboscis faintly broadening towards apex, at the base yellowish sprinkled with dark brown scales, in the middle yellowish scaled and in the distal part dark brown scaled. Labellae dark brown. Antennae. Tori yellowish brown with white scales at the inner side. Flagellum. First segment basally yellowish with some white scales. The remainder of flagellum dark brown with narrow yellow rings, clothed with minute whitish hairs and long dark brown hairs at the bases of the segments. Palpi (fig. 48 d) slender, about one fourth the length of the proboscis, scaling whitish and dark brown sprinkled. Penultimate segment about 2,5 the length of segment number three. Ultimate segment small, oval. Thorax. Anterior pronotal lobes brown with golden narrow curved scales and bristles. Posterior pronotum brown with golden narrow curved scales. Mesonotum brown, clothed with golden hairs and narrow curved, in part also hair-like, scales. Bristles above wing-root long, dark golden and with darker apexes. Scutellum brown with patches of yellowish-white narrow curved scales and golden hairs. Postnotum bare, leather brown. Pleurae with patches of whitish broad flat scales and golden bristles. Wing with intermixed dark brown and yellowish-white scaling. The scales rather

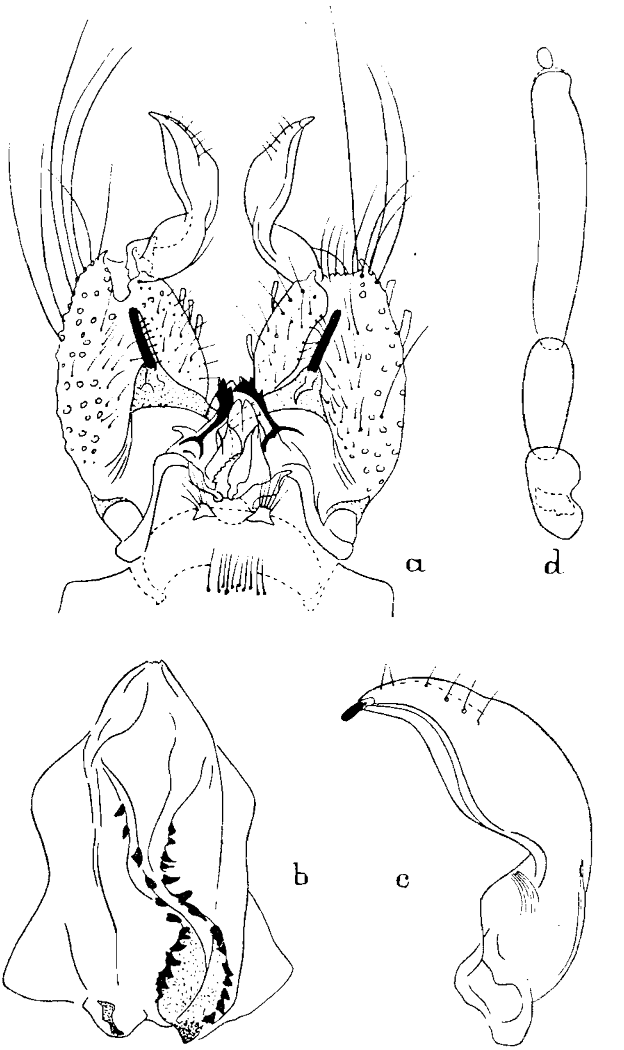


Fig. 48. *Taeniorhynchus (Coquilletidia) richiardii* (Fic.).
a, terminalia (total view); b, phallosome; c, diststyle; female palp.
(Aut. del.)

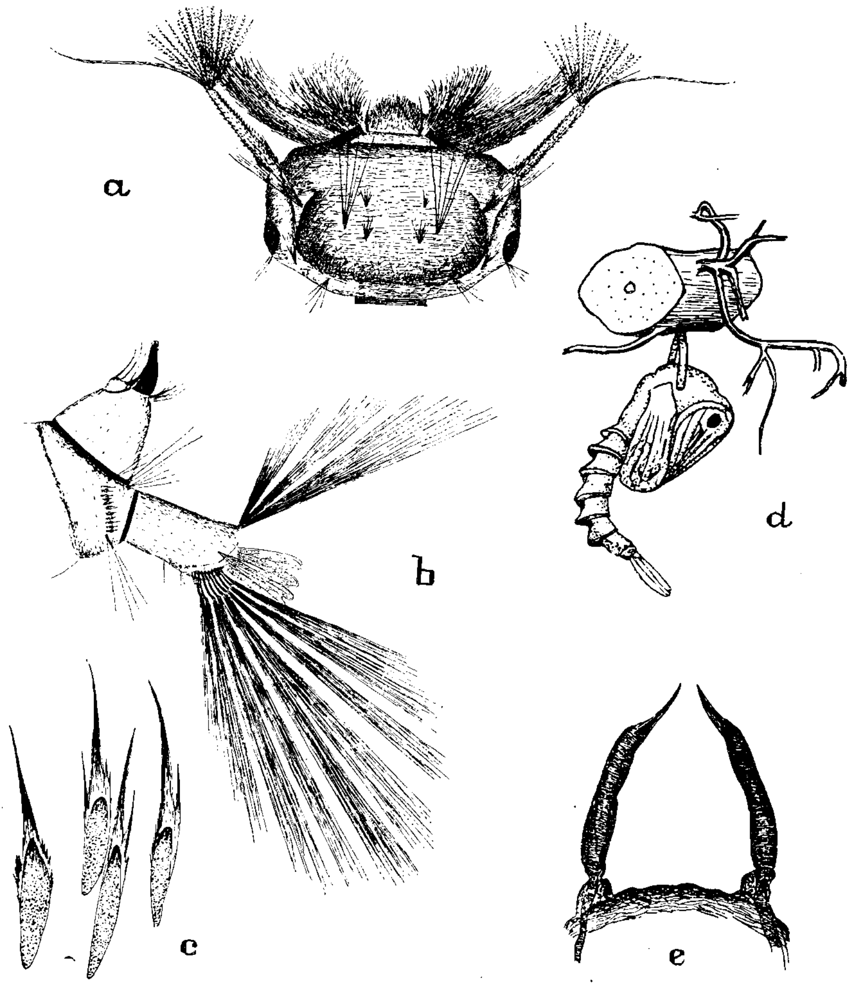


Fig. 49. *Taeniorhynchus (Coquilletidia) richiardii* (Fic.).
a—c, larva in 4th instar; a, head; b, terminal segments of larva; c, comb-scales; d, pupa attached to submerged vegetation; e, respiratory trumpets of pupa. (d, after Martini 1931, redrawn from W-L; a—c, e, after Wesenberg-Lund 1920—21.)

broad. The shift of m-cu about: 3. Halter pale yellow with some pale yellow scales at the globule. Legs. Femurae and tibia at front side sprinkled with white and dark brown scales, a dark ring embraces the femur apically. Back side of femurae and tibiae white scaled. Knee spot white. Tarsal segments dark brown scaled, with a basal white ring in fore-leg on segment 1—3, in some specimens even on 1—4, in mid-leg and hind-leg on all segments. First tarsal segment in all legs with a pale ring in the middle. First hind tarsal segment shorter than tibia. Claws simple. Abdomen. Tergites dark brown scaled, sprinkled with some white scales. The segments laterally with patches of white scales also with dark golden hairs. Venter white scaled. Length of body about 5 mm (W-L). Length of wing about 4,5 mm.

Male. Antennae. Tori dark brown. Flagellum brown and white ringed, the two long ultimate segments dark brown. Hair-whorls greyish with fox coloured reflections. Palpi dark brown and white sprinkled, the ultimate segment exceeds the proboscis. Apex of ultimate and penultimate segments dark. In the abdominal tergites the white scales in segment 2—5, tend to form basal bands, which are somewhat narrowed in the middle. In the last segment the white scaling predominates.

Terminalia (fig. 48). Basistyle stout, about twice as long as wide. Basal lobe heavily sclerotised and with a stout, rod-like spine. Apical lobe absent. Diststyle with a stout basal part, conspicuously narrowed and flexed in the middle and with distal part greatly enlarged and terminating in a point. Claw stout and comparatively short. Phallosome stout, with angulated sides and pointed apex. Along the mid-dorsal line of phallosome, on each side a sclerotised ridge with a row of denticles. Proctiger with heavily sclerotised and apically dentated paraprocts. Lobes of the ninth tergite with long slender spines.

Larva (fig. 49). Having no larvae from our region at hand, I here quote, in a somewhat abbreviated form, the description by Wesenberg-Lund (1920—21, pp. 104—105). "Head subquadrate, wider than long (5 : 3); antennae long and slender; a large hairtuft nearer the base than the apex, arising from a notch, terminal portion slender, flagellum like, very flexible and much drawn out, one of the terminal hairs situated not far beyond the tuft; dorsal hairs all in multiple groups; the anteantennal tuft large, multiple; lower frontal tuft absent; upper frontal tuft commonly with five hairs, between them four very small hair-tufts. Thorax transverse, angled at hair-tufts. Hair formula for the frontal border of the thorax 531105501135, between 5 and 0 a small hair-tuft; lateral hairs long, a few of them single, most of them in multiple tufts a few small tufts scattered over the dorsal side. Abdominal segments rather broad, — — — the long lateral hairs double; dorsally and ventrally every segment provided with two series of hair-tufts every segment carrying four tufts eighth segment without these hairs. Lateral comb of eighth segment with ten to twelve scales in a single, irregular row; each scale having a somewhat spatulated base and terminated by a stout spine, at the base of the latter on both sides a commonly smaller spine, followed by a series of still smaller weaker ones; hair-tuft behind the comb consisting of from three to four, long hairs. Air-tube about twice as long as wide; the basal part broad and strongly convex with black ring near base, the apical portion attenuated, consisting of thick lamellae with a group of hooks at the tip and with stout teeth on one side mesially. It bears a hair-tuft on each side near the middle, and two pairs of filaments at the base of apical projection; the one pair strongly curved, inserted upon two cushion-like parts of chitin and very movable. No pecten; two strong hairs at the base of the sipho. — — Anal segment much longer than wide, ringed by a chitinous plate; dorsal tuft of many long hairs, divided into two small and two large groups on each side, no particularly developed long bristles; ventral brush great, consisting of about eight to ten rays, each carrying from eight to ten, very flexible bristles; either no tufts or a few (two) very feebly developed tufts before the ventral brush. Anal gills four, equal, slender and not as long as anal segment."

P u p a (fig. 49). Description after Wesenberg-Lund (1920—21, pp. 105—06): "Thoracic mass subpyriform, rather large, indented behind the insertion of antennæ. Abdomen serrate, the segments largely expanded posteriorly; anal paddles oblong, cleaved at apex; the whole pupa quite hairless. No hairs on the cephalothorax; no fan-shaped dorsal tufts on first segment; no subdorsal hairs at the ends of the abdominal segment and no tufts on the angles. The most peculiar point in the structure of the pupa is the two air tubes; these are not as in other mosquito pupæ trumpet-shaped, but end in a long sharp, thorn-like process of a very peculiar shape and structure. The trachæ runs through the whole tube, ending at the apex in a minute, almost invisible aperture. The tube itself has in different parts a very remarkable, highly specialised structure; in the part nearest to the cephalothorax the structure resembles that of a trachea, being striped transversely; where the tube attenuates, the transversal stripes cease and are succeeded by a more homogeneous structure with a very fine irregular rhomboidal stripening, resembling that of a common pupa tube. A little before the spot where the tube attenuates, passing into the acuminated part, there is a weak point, where the chitin is thin and where the apical part breaks off very easily. At the same spot a chitinous ring runs round the tube, on the inner side leaving a cleft open. Outside this ring the tube acuminates; the inner half has almost the same structure as that on the other side of the ring, but the outer part is formed quite differently. It has a broad fringe of long hairy excrescenses and the utmost part, which is commonly corkscrew-shaped, and lying in another plane, has a hyaline transversally striped membrane on each side, which has inconspicuous saw teeth along the edges. It is this extreme part which must be used as a piercing organ. The tracheal tube, which runs from the apical opening to the above-named chitinous ring, has a rather narrow lumen, being only one-third broader than the tube in this part; immediately behind the ring it expands to almost the whole width of the tube, but tapers again and now runs as a narrow tube through the whole air-tube."

Geographical distribution.

D e n m a r k : *1. Jylland:* Silkeborg! ♂ ♀: 14. vii. 1919 (P. Nielsen); *2. Sjælland:* Donse, L: ix. 1914 (W-L); Hillerød, L: vi. 1918 (L. Pedersen, W-L).
S w e d e n : *Sk:* Råå! ♂: 14. viii. 1918 (O. Ringdahl); *Sm:* (Bhn); *Upl:* Stockholm (Bhn).
F i n l a n d : *N(U):* Långskär, Tvärminne! ♂ ♀ (R. Frey).

Distribution outside Denmark and Fennoscandia.

According to Marshall (1938, p. 271) the species has been recorded in E n g l a n d from the counties: Cambs, Cheshire, Dorset, Durham, Essex, Hants, Herts, Kent, London, Norfolk, Oxon, Surrey, Sussex and Yorks, from I r e l a n d from Ulster and Co.Wicklow. From B e l g i u m it is recorded by Goetghebuer (1925, p. 213) from: "Mont-Saint-Armand, Gand, Destelbergen (Fl.); Postel (Camp.) (Severin); Forêt de Soignes, Weerpede, Anderlecht, Genval (Brux.) (Tonnoir)." As to the distribution in F r a n c e Séguy (1923, p. 86) remarks: "Toute la France, commun par places: Meudon (Séguy: Mus. Paris); Rambouillet (Dr. Villeneuve) Benoite-Vaux (Septembre), Verrière

(Juillet—Aout), Marne: Villers-Doncourt (Cordier); Lyon, Grenoble (Dr. Villeneuve)." Further Eckstein (1918, p. 61) records it from Straßburg. From Portugal the species is recorded by Braga (1931, p. 45) from "Pinhel, Maio de 1926 (Braga)". In Germany the species is widely distributed. Martini (1920, p. 175—76) records it from Hamburg and Danzig, Peus (1929 b, p. 6) from Mark Brandenburg: "Kremmener See, Plagefenn bei Chorin, Wehrbellin-See, Spreewald, Tiefwerder bei Berlin" and (Peus 1930 c, p. 670) "Mellensee, 16. vi. 1929, Gr. Zernsee bei Werder a. d. Havel, 11. viii. 1929". Further (Peus 1929, p. 6) it is recorded from Pommern: "Prerow und auf dem Darss, Usedom (Swinemünde, Zinnowitz); Ostpreußen: am Rande des Schwendlunder Hochmoores; Schlesien: im ganzen Niederungsgebiet der Oder bei Breslau" and Schneider (1914, p. 34) records it from Siegburg (Bonn). As to the distribution in Italy Ficalbi (1896, p. 254) says: "Decrissi questa specie per l'Italia. La ho trovata prima nelle regione romagnola (Pineta di Ravenna), poi anche in Toscana (Bosco di Tombolo presso Pisa)." Further eastwards the species has been recorded by Peus (1934 b, p. 76) from Lettland: "An der "Lange" bei Zarnikau-Langeciems, bei Bienenhof (Riga), — — — Düna-Aa-Kanal bei Riga"; from Poland (Tarwid 1938 a); by Edwards (1921, p. 291) from Austria: Freistadt (Frauenfeld) and from Hungary: Keszthely (Kertész) from Balaton (Mihályi 1941); by Martini (1928, p. 22) from Bulgaria, and by Leon (1911, p. 150) from Roumania, where it is very common at the delta (Donau), in the swamps at Braila and in the valleys at Pruth, Jijia and Sireth. Waterston (1922, p. 134) records it as common in places in Macedonia, and, according to Séguy (1923, p. 86) it is also found in Palestine. Concerning the distribution in USSR Stackelberg (1937, p. 116) remarks: "Widely but very sporadically distributed in the European part of USSR, in the north the species goes to the Leningrad degree of latitude (Sablino in the environs of Leningrad: Stackelberg!); also recorded from Moskva distr. (Schingarev) and from the central Ural (Kolosov), from Ukrain (Karkov Tischtschenko, Ukrainian lowlands: Rybinsk, environs of Kerson: Jazenko), Crimea (Karadag!); Pre-Caucasia (Kuban: Dobrovolskij!), Trans-Caucasia (Grusia: Kalandadse 1931, Aserbeijdschan southern Mugan: Guzewitsch 1932), Turkmenia (Petrischtschev 1936), Usbekistan (village Syrdarjinsk: Montschadskij!). East Kasakstan (environs lake Nor-Sajsan, Semipalatinsk: Simanin), southern zone of West-Siberia (Rubzov, Bijsk, Minusinsk: Simanin!)."[78] Other records from USSR are: Ukraina, basin of Dnjepr (Dolbeskin 1928); Kirgisia (Petrischtscheva 1940) and N. Caucasus: Mosdoksk Malaria Station, 14. vi. 1930 (A. A. Mess 1939).

Biology.

On the biology of *Taeniorhynchus richiardii* in Denmark Wesenberg-Lund (1920—21, pp. 108—113) i. a. says: "In the autumn of 1914 I made many excursions to Donse, and I found many larvæ. — — — The larva was rare; the greatest number I was able to procure after searching for 4—5 hours was 10—15. — — The vegetation

[78] Translated from the Russian text!

was composed of *Acorus, Ranunculus lingua, Glyceria spectabilis* and *Typha angustifolia.* I have no impression that the larva preferred any of these plants to the others: if so it would probably be *Acorus.* — — — In June 1918 my assistant mag. sci. L. Pedersen found the larva of *Tæniorhynchus Richardi* in a sheltered little creek in Funkedam near Hillerød. — — — This spot was covered with submerged plants of *Sparganium* and *Scirpus;* the bottom round this was covered with *Fontinalis* and a few *Potamogeton natans.* Among the *Sparganium* I could get about twenty larvæ in one single catch, outside it only one or two. Taking the plants out with my hand I more than once got plants, on the roots of which I found the larvæ fastened. These plants were always *Sparganium.* — From the structure of the trumpets we must suppose that the pupæ like the larvæ are fastened to the plants and for their respiration use the air in the intercellular spaces. — — — The life-cyclus of the species is probably as follows: The female deposits its hitherto almost unknown eggs in the course of the summer. In autumn the eggs are hatched. In September we mainly find very tiny larvæ on the roots. Before winter most of the larvæ are full-grown and in this stage they winter. The pupation takes place in the latter part of May. Whether the imago winters we do not know but it is not probable that it should do so."

From Marshall (1938, p. 270) I quote: "In Britain, larvae of *T. richiardii* have been found attached to the roots of *Ranunculus, Acorus, Glyceria* (especially (*Glyceria fluitans*) and *Typha.* — — — Shute states that the females, though "very troublesome to men and animals" are "seldom on the wing until it is nearly dark". He also directs special attention to the fact that females of this species are likely to enter bedrooms during the night and to depart, gorged with the blood of the occupants, before daybreak; — — — Male adults of *T. richiardii* are in evidence from about the middle of July until the end of August." He also states that "a female of *T. richiardii,* captured and blood-fed by Shute, laid, in the laboratory a raft composed of 200 eggs".

In coincidence with the statements above Séguy (1923, p. 88) records from France: "Comme certaines larves d'Ephydrides, on trouve le plus souvent la larve du *T. richardii* accrochee aux racines du *Glyceria fluitans,* pendant les mois de juin et juillet. Il semble qu'il n'y ait qu'une génération par an. — — — Cette espece hiverne sous la forme larvaire."

As to the bloodsucking habits of *T. richiardii* the authors agree that this species is a very annoying and persistent biter. From Germany Martini (1920, p. 175) states: "Bei Hamburg kenne ich Plätze, wo sie wie ihre amerikanischen Verwandten äusserst häufig und lästig ist" and Peus (1929 b, p. 6): "Bildete stellenweise eine unerträgliche Plage" Goetghebuer (1925, p. 213) records from Belgium: "La ♀ pique énergiquement", Ficalbi (1896, p. 254) from Italy: "La femina, che va attorno specialemente nell imbrunire, ma anche di notte e talvolta di giorno, moleste colle sue puncture l'uomo e i mammiferi" and Waterston (1922, p. 134) from Macedonia: "When numerous it is a pest, and blood-gorged females were frequently brought in for determination with complaints of their severe bite." The most vivid picture of the blood-sucking habits of this species we find in a report by Martini and Zotta (1934, p. 183) from Romania: "En ce qui concerne la manière dont se comporte le *Mansonia* dans le delta, nous lisons, dans Zotta, que c'est le moustique le plus désagréable du delta. "Certaines années, ces moustiques apparaissent en véritables nuées, soit seuls, soit accompagnés de *A. pseudopictus.* En 1926, leur nombre était vraiment impressionnant. Il suffisait de s'arrêter quelques minutes dans la rue, dans un espace découvert ou au milieu du village pour en avoir de véritables essaims autour de la tête. Les *Mansonia* piquent certainement le jour, comme vers le soir, au crépuscule ou pendant la nuit et vers le lever du jour.

Vers le soir, la combativité des *Mansonia* augmente tant qu'on est obligé de les chasser presque constamment du geste. Si, à partir de 6 heures du soir, on veut aller jouir de la fraîcheur de l'air dans les dunes, on est immédiatement entouré de petits nuages de *Mansonia* qui, en seul et même instant, se posent et piquent. C'est un tableau caractéristique que celui des groupes de promeneurs sortis à la fraîcheur, qui agitent constamment de mouchoirs, de voiles, etc., pour se défendre contre ces insectes. La ville Sulina offre, à cet égard, un example édifiant, ainsi que n'importe quel marché de poissons à l'interieur du delta, ou même des personnes qui résident depuis longtemps dans le pays et sont plus ou moins immunisées contre les piqûres de moustiques, agitent automatiquement et sans arrêt un mouchoir autour de leur tête, sans se laisser distraire de leur travail habituel."

Genus *Aëdes* Meigen 1818.

Mosquitoes of moderate size, mostly of insignificant colour but often with white or golden markings on a dark ground.

Proboscis of uniform thickness, mostly not longer than the femur of the fore-leg. Male antennae plumose with the ultimate and the penultimate segments elongated; female antennae pilose. Palpi of the female in most species less than one-quarter of the proboscis. Eyes distinctly separated and with a row of orbital bristles. Anterior pronotal lobes widely separated. Spiracular bristles absent but a row of posterior pronotal bristles are overlapping the spiracle. Scutellum three-lobed with 3 groups of setae. Postnotum without setae. The tibiae of the hind leg longer than the first tarsal segment. A transverse row of hairs near the apex of the hind tibiae accompanied by a more distal row of 7—10 stout bristles, termed the tibial scraper. Pulvilli absent. The claws on the fore- and middle legs of the female with one or two teeth. Wing.

The forks of r_{2+3} rarely longer than the stem; the analis terminates distinctly beyond the base of the radial sector. The female a b d o m e n pointed, the eighth segment more or less retracted within the 7th. Male terminalia with a lacuna hollowed out of the inner face of the sclerotized basistyle. Proctiger simple without spines or hairs at the tip of the paraprocts.

L a r v a. Head wider than long. Antennae mostly short. Antennal tuft moderate or delicate, in general inserted in or before the middle of the antennae. The frontal hairs vary in position; the inner and mid frontal hairs either lie in a line with the outer frontal hair (subg. *Aëdes)* or the mid frontal hair lies more or less in front of the inner one *(Aëdimorphus, Ochlerotatus* and *Finlaya).* Comb-scales arranged in a distinct triangular patch (subg. *Ochlerotatus),* nearly in a row (subg. *Aëdes, Aëdimorphus*) or in a distinct single and evenly-aligned row (subg. *Finlaya*). Siphonal index mostly about 4 : 1. Pecten well developed. Ventral siphonal tufts inserted about the middle or conspicuously beyond the middle of the siphon. The two species *A. (O.) punctor* and *A. (O.) nigripes* have the anal segment with a complete sclerotized ring, whereas the remainder have the anal segment with a saddle only.

The genus *Aëdes* have been divided into several subgenera of which only four: *Aëdes, Aëdimorphus, Ochlerotatus* and *Finlaya* occur in our region. As to the foundation of these divisions Edwards (1932, p. 130) remarks: "In 1917 I defined a number of subgenera and groups on the structure of the male hypopygium, and this was adopted with some modifications by Dyar in the following year. Dyar took as primary characters for the division of the genus the presence or absence of claspettes, but it would now seem that another character to which I called attention in 1921 — the form of the phallosome — may be of more fundamental importance. These two characters, together with the form of the male palps, form the basis of classification of the genus — — —. No means of separating the subgenera with certainly in the female or the larval stage has yet been discovered." Concerning the northern *Aëdes,* I have the impression that the male genital organs give the only reliable characters for differentiation, inasmuch as the male palpa have a peculiar form in the subgenus *Aëdes* only. According to this I give below a key to the subgenera based on the male terminalia.

Table 10.

Key to the subgenera based on the male terminalia.

1. (4) Typical claspettes present. Sclerites of the phallosome plain, undivided.
2. (3) Basistyle with more or less developed apical and basal lobes .... *Ochlerotatus*
3. (2) Basistyle without apical and basal lobes .... *Finlaya.*
4. (1) Typical claspettes absent. Sclerites of the phallosome complicated, divided.
5. (6) Dististyle bilobed, inserted before the apex of the basistyle, without a movable claw .... *Aëdes.*
6. (5) Dististyle not bilobed, inserted at the apex of the basistyle. With conspicuous, movable claw inserted before the apex of the dististyle .... *Aëdimorphus.*

Table 11.

Key to the fourth instar larvae of *Aëdes*.

1. (44) Siphon without dorsal hairs.
2. (3) Antenna with unbranched hair and smooth shaft; abdominal tergites and sternites with paired stellate tufts; comb-scales arranged in a single, evenly-aligned row (*Finlaya*) .... *geniculatus* Oliv.
3. (2) Antenna with branched hair and spinose shaft; abdominal segments without stellate tufts; comb-scales arranged in patches or (when few in number) in a single, unevenly-aligned row.
4. (7) Last one or two pecten teeth widely detached from the rest; siphonal hair-tuft very small and well beyond middle of siphon; no long hairs near middle of front margin of thorax.
5. (6) All frontal hairs in line; mouth-brushes not combed; detached pecten teeth of same shape as the remainder (*Aëdes*) .... *cinereus* Meig.
6. (5) Inner frontal hairs somewhat behind the mid frontal hairs; mouth-brushes combed; detached pecten teeth plain, without denticles (*Aëdimorphus*) ...... *vexans* Meig.
7. (4) Either the pecten has no detached teeth, or the siphonal hair-tufts is larger and situated at about the middle of the siphon; long hair-tufts present near middle of front margin of thorax (*Ochlerotatus*).
8. (9) Antennae longer than head .... *diantaeus* H. D. K.
9. (8) Antennae shorter than head.
10. (21) Ventral brush with 5—7 pre-cratal tufts (*annulipes*-group).
11. (18) Siphonal index distinctly over 3; terminal pecten teeth more or less detached.
12. (15) Number of comb-scales not exceeding 15.
13. (14) Comb with 6—9 scales in one irregular row; frontal hair-formula 2: 2 .... *riparius* D. K.
14. (13) Comb with 9—15 scales arranged partly in two rows; frontal hair formula 1: 1 .... *cyprius* Ludl.

15. (12) Comb with 23—35 scales in a triangular patch.
16. (17) Siphon evenly tapering from base towards apex; apical hair on ventral valve not stout and hook-shaped; anal gills shorter than saddle .... *flavescens* Müll.
17. (16) Siphon rather slender, distinctly tapering from the middle; apical hair on ventral valve stout and hook-shaped; anal gills longer than saddle .... *excrucians* Walk.
18. (11) Siphonal index at most 3; all pecten-teeth close-set.
19. (20) Number of comb-scales 31—44 .... *annulipes* Meig.
20. (19) Number of comb-scales 28—48 .... *cantans* Meig.
21. (10) Ventral brush with at most 3 pre-cratal tufts.
22. (25) Anal segment ringed by the dorsal plate (saddle).
23. (24) Siphonal hairtuft distinctly beyond the pecten. All pecten-teeth close-set .... *punctor* Kirby.
24. (23) Siphonal hair-tuft within pecten or basal of the last pecten-tooth. The last two-three pecten teeth detached *nigripes* Zett.
25. (22) Anal segment not ringed by the dorsal plate.
26. (27) One or two simple detached pecten-teeth distinctly beyond siphonal tuft .... *cataphylla* Dyar.
27. (26) No pecten teeth beyond the tuft.
28. (35) Anal gills shorter than saddle.
29. (30) Siphonal tuft distinctly beyond middle of siphon *caspius* Pall.
30. (29) Hair-tuft usually before, rarely slightly beyond, middle of siphon.
31. (32) All comb-scales blunt-ended and exceeding 40 in number; inner mid-frontal hairs always branched .. *detritus* Hal.
32. (31) Comb comprising both blunt-ended and pointed scales, which average about 24 in number.
33. (34) Anal gills globular, about a third as long as the saddle; inner and mid-frontal hairs usually simple, one or other not infrequently bifid .... *dorsalis* Meig.
34. (33) Anal gills tapering, about half as long as the saddle; inner and mid-frontal hairs nearly always simple *leucomelas* Meig.
35. (28) Anal gills at least as long as the saddle.
36. (39) Comb with 50 or more scales in the patch.
37. (38) Comb-scales sharp-pointed; anal gills twice as long as the saddle .... *pullatus* Coq.
38. (37) Comb-scales blunt-ended, fringed; anal gills about as long as the saddle .... *communis* Deg.
39. (36) Comb with 10—24 pointed scales in the patch.
40. (41) Last few pecten-teeth detached .... *intrudens* Dyar.
41. (40) All pecten-teeth close-set.
42. (43) Mid and inner frontal hairs 2 : 3; comb with 20—24 scales .... *sticticus* Meig.
43. (42) Mid and inner frontal hairs 1 : 1; comb with 10—12 scales .... *nigrinus* Eckst.
44. (1) Siphon with three or four pairs of hairs along the dorsal surface, detached teeth beyond hair-tuft .... *rusticus* Rossi.

In the above key the larva of *A. nearcticus* Dyar is omitted, but most probably it should be placed in the key in group No. 41. Having only a single larva of *nearcticus* at hand and no larvae of *sticticus* and *nigrinus* I am not able, from the literature, to find exact characters distinguishing these three species. As far as can be seen from the descriptions and figures published (Peus 1933, pp. 156—57; Martini 1931, p. 311) the outer frontal hairs in *sticticus* and *nigrinus* have 5 branches, whereas the outer frontal hairs in the single larva of *nearcticus*, at hand, have 3 branches. Also the anal gills seem to be shorter in *nearcticus* than in the two other species.

Subgenus *Ochlerotatus* Lynch Arribalzaga. 1891.

Proboscis conspicuously longer than the femur of the foreleg. Vertex ("occiput") with narrow scales; temporae with broad scales. Male: palpi longer than the proboscis; the ultimate and penultimate segment and the distal end of the long segment swollen and furnished with long hair-tufts. The hair-whorls of the male antennae not uniformly developed, most hairs projecting either from the dorsal or ventral side of the segments. Terminalia with typical claspettes. Basistyle at least with distinct basal lobes. Female: abdomen tapering, the eighth sternite small, cerci long, conspicuously protruding. Claws toothed. Larvae: mid frontal hairs more or less directly in front of the inner ones; a well developed hair-tuft projects on either side from about the middle of the siphon.

Martini (1931, p. 264) divides the subgenus *Ochlerotatus* in groups (globi): *Feltianus, Hyparcticus, Finlaya* and *Ochlerotatus* s. str., characterised by the male terminalia, *Feltianus* also by the broad flat scales at the anterior pronotal lobes. Edwards (1921, p. 293; 1932, p. 131 et seq.) considers *Finlaya* as a subgenus and remarks concerning the subgenus *Ochlerotatus* (1921, p. 296): "The palaearctic species are divisible (as adults) into three groups according to the markings of the tarsi. The first two of these groups appear to be natural assemblages of species, but the third, with dark tarsi, is less natural and shows more structural diversity. These groups may be known as the *dorsalis*-group, the *annulipes*-group and the *communis*-group; as mentioned below. *A. punctor*, though placed on account of coloration in the *communis*-group, shows signs of affinity with the *dorsalis*-group, while other members of the *communis*-group (such as *A. communis* itself) are probable more nearly related to the *annulipes*-group. The structure of the male hypopygium shows the isolated position of *A. rusticus* — — —."

This subgenus includes most of the mosquito species in our region. Of the total number known of 115 species, 20 have been found in Fennoscandia and Denmark. The *Ochlerotatus* species are typical spring breeders. The larvae of most species are bottom feeders. The *Ochlerotatus* passes the winter time in the egg stage.

In the key below on the groups of the subgenus *Ochlerotatus*, I have inserted *A. vexans*, in spite of the fact that this species belongs to another subgenus. As however the female of *vexans* only differs from *cantans* with narrow tarsal rings in minor characters of colour, I found it most practical to place these forms in the same key to avoid confusion.

Table 12.

Key to the male terminalia of *Ochlerotatus*.

1. (2) Basal lobe of basistyle bearing a row of flattened bristles or scales; claw of the diststyle long and s-shaped .... *rusticus* (Rossi)
2. (1) Basal lobe of basistyle otherwise; claw of diststyle straight.
3. (8) Basistyle with three spines; two on the basal lobe, backwardly directed, one more distally placed and inwardly directed (*Hyparcticus*).
4. (5) Basistyle swollen in the middle, where it has a large inwardly-directed hair-tuft .... *diantaeus* H. D. K.
5. (4) Basistyle not swollen in the middle, without hair-tuft in the middle.
6. (7) A distinct hair-tuft adjoining the apical lobe; on the basal lobe the two spines on the warty projection equal, stout and curved .... *intrudens* Dyar.
7. (6) No distinct hair-tuft adjoining the apical lobe; on the basal lobe one of the two spines on the warty projection distally faintly sclerotised, flattened and lanceolate, apically more or less curved; the other spine of ordinary form .... *pullatus* (Coq.)
8. (3) Basal lobe of the basistyle with at most two stout spines.
9. (12) Basal lobe with two spines; apical lobe ill-defined.
10. (11) Basal lobe of the basistyle noticeably constricted at the base, very prominent .... *dorsalis* (Meig.)
11. (10) Basal lobe of the basistyle not constricted at the base; much less prominent .... *caspius* (Pall.)
12. (9) Basal lobe with at most one spine; apical lobe nearly always well-marked
13. (18) Apical lobe reaching back to near middle of basistyle, apically clothed with very short, curved bristles; stem of claspette short and rather straight.

14. (15) Basal lobe not separated from the basistyle; stem of the claspette short and stout, mostly moderately curved; appendage of the claspette without wing, about three times as long as broad .... *punctor* (Kirby)
15. (14) Basal lobe separated from the basistyle in its apical portion; stem of the claspette rather slender and straight; appendage of the claspette winged, about twice as long as broad.
16. (17) Most prominent part of apical lobe is located distally; distal end of basal lobe slender and pointed.. *sticticus* (Meig.)
17. (16) Most prominent part of apical lobe is located basally; distal end of basal lobe broader and rounded.. *nigrinus* Eckst.
18. (13) Apical lobe not reaching so far back, and bearing longer bristles.
19. (20) Stem of the claspette rather stout, swollen in the middle; basal lobe of the basistyle with a stout sclerotised spine and short pubescence .... *flavescens* (Müll.)
20. (19) Stem of the claspette not swollen in the middle; spine of basal lobe when present mostly weaker and paler and generally accompanied by long bristles.
21. (24) Basal lobe small, without spine, but rugose area extends more than half the length of the basistyle.
22. (23) Stem of claspette rather stout, somewhat swollen towards apex .... *annulipes* (Meig.)
23. (22) Stem of claspette slender apically ...... *excrucians* (Walk.)
24. (21) Basal lobe larger, spine generally well-marked, rugose area not nearly reaching middle of basistyle (except in *cyprius*).
25. (30) Stem of the claspette comparatively short and not strongly curved.
26. (27) Appendage of the claspette with a long petiole and low wing; basal lobe of the basistyle rather small, not pointed .... *detritus* (Hal.)
27. (26) Appendage of the claspette without a long petiole; basal lobe of the basistyle produced and rather sharply pointed.
28. (29) Basal lobe much longer than broad; appendage of claspette extremely broad .... *cantans* (Meig.)
29. (28) Basal lobe scarcely longer than broad; appendage of claspette less broad .... *riparius* D. K.
30. (25) Stem of claspette longer and strongly curved.
31. (34) Basistyle without long hairs arching over the upper surface.
32. (33) Apical lobe of basistyle pointed, with hairs of moderate length; basal lobe prominent, with a long and straight, stout spine; appendage of claspette with a semilunary wing; phallosome distinctly narrowed towards apex, deeply incised .... *cyprius* Ludl.
33. (32) Apical lobe of basistyle short, mostly nude; basal lobe narrow, with a long apically curved spine; appendage of claspette with a short, basally broad wing; phallosome not narrowed towards apex, not deeply incised *nearcticus* Dyar.
34. (31) Basistyle with long hairs arching over the upper surface.
35. (36) Appendage of claspette with two slight ridges near the base .... *communis* (Deg.)

36. (35) Appendage of claspette with one ridge or wing.
37. (38) Phallosome and anal segment heavily sclerotised *nigripes* (Zett.)
38. (37) Phallosome and anal segment not unusually strongly sclerotised.
39. (40) Appendage of claspette long, petiolate with low wing; spine on basal lobe of basistyle conspicuously curved at apex; lobes of the ninth tergite with longer spines which curve outwards .... *leucomelas* (Meig.)
40. (39) Appendage of the claspette shorter, wing broader, not petiolate; spine on basal lobe of basistyle only slightly curved at apex; lobes of the ninth tergite with shorter spines which do not curve outwards ...... *cataphylla* Dyar.

Table 13.

Key to the groups of *Ochlerotatus* (and *A. vexans*).

1. (8) Tarsal segments with pale rings.
2. (3) The pale rings embracing both the basal and distal ends of the segments .... *dorsalis*-group.
3. (2) The pale rings at the base of the segments only.
4. (7) Tarsal pale rings very narrow.
5. (6) Mosquito of small or medium stature. Wings with dark scales only. Pale abdominal bands only basal, distinctly narrowed in the middle. Tarsal segments 4 and 5 at the fore-legs entirely dark .... *A. vexans* Meig.
6. (5) Big mosquito. Wings with light and dark scales mixed. Pale abdominal bands mostly basal as well as apical. The pale rings at the 4. tarsal segment of the fore-leg at least indicated by detached white scales .. *O. cantans* var.
7. (4) Tarsal pale rings broad; in some specimens about half the length of the segments in the hind leg .. *annulipes*-group.
8. (1) Tarsal segments, at least at the dorsal side, entirely dark.
9. (10) Scales on the posterior pronotum broad and flat *rusticus*-group.
10. (9) Upper scales on posterior pronotum conspicuously narrow and curved .... *communis*-group

1. *dorsalis*-group.

The *dorsalis*-group is, in our region, represented by the two species *dorsalis* Meig. and *caspius* Pall. only, but the authors are of very different opinions as to the species validity of these forms. Concerning details see below. I am myself inclined to agree with Edwards who considers the two as valid though very related species. In a paper by Dyar and Knab (1917, p. 122) the authors point out that the North-American species *curriei* Coq. has been established on a supposed difference in the teeth of the claws, but later investigations proved this to be a mistake; further the American species *lativittatus* Coq., *onondagensis* Felt and

Quaylei D. K. proved to be varieties of the same species. In his review of the *dorsalis*-group Martini (1931, p. 282) remarks that Dyar: "außer *dorsalis* noch die Arten *campestris* D. K., *melanimon* Dyar und *canadensis* Theob. aus Nordamerika aufführt, unter denen sich vielleicht noch unser *caspius* wiederfinden läßt. *Melanimon* wird von Matheson auch zu *dorsalis* gezogen". Some females of *campestris* from Canada, in our museum collection, determined by Dyar, Hearle resp. Twinn., did, however, not agree with any one of our two species. The thorax markings did not exhibit the distinct contrast of *dorsalis*, the median longitudinal stripe not being so dark and the pale sides having a yellowish tint. The wing scaling is dark and light sprinkled as in *caspius*, but the abdominal design is blackish brown and white as in *dorsalis*. The figure by Dyar (1928, Pl. XLVII, fig. 152) of the male terminalia exhibit quite another type of the basal lobe of the basistyle, and moreover the spine is missing. As it is, further investigations on the nearctic and palaearctic forms of this group are highly desirable.

Table 14.

A. Key to the females.

1. (2) Mesonotal scales fawn-coloured; the median third demarcated by a pair of longitudinal narrow white stripes. Wing with evenly mixed dark and light scales. Abdomen: dark areas of the tergites brown, pale areas yellowish with lateral white patches .... *caspius* Pall.
2. (1) Mesonotum with the median third dark brown, posteriorly more or less distinctly ornamented with a pair of narrow white lines. The two outer thirds of mesonotum ashy-white. Wing with basal parts of costa and radius, white scaled. Colouring of abdominal tergites blackish-brown and ashy-white .... *dorsalis* Meig.

B. *Terminalia.*

1. (2) Basal lobe of the basistyle noticeably constricted at the base; very prominent (Fig. 53 a) .... *dorsalis* Meig.
2. (1) Basal lobe of the basistyle not constricted at the base; much less prominent (Fig. 53 b) .... *caspius* Pall.

Aëdes (Ochlerotatus) dorsalis (Meig).

C. dorsalis Meig. (Syst. Beschr. *6*, p. 242) 1830
C. curriei Coq. (Can. Ent. *33*, p. 259) 1901
C. onondagensis Felt. (N. Y. State Mus. Bull. *79*, p. 278) 1904
C. lativittatus Coq. (Ent. News, *17*, p. 109) 1906
A. quaylei D. K. (J. N. Y. Ent. Soc. *14*, p. 191) 1906
Grabh. mediolineata Ludl. (Can. Ent. *39*, p. 129) 1907
Grabh. broquettii Theob. (Entom. *46*, p. 154) 1913
A. grahami Ludl. (Ins. Insc. Mens., *7*, p. 154) 1920
A. (O) melanimon Dyar (Ins. Insc. Mens., *12*, p. 126) 1924

Synonymical and systematical remarks.

In his last review (1932, p. 141) Edwards has placed *Culex maculiventris* Macq. as synonym with *O. caspius* Pall. but without further argumentation. I therefore hold with his previous interpretation (1921, p. 301) where he says, concerning *A. dorsalis:* "Rather contrary to expectation, Macquarts *C. maculiventris* proves to be this species and not *A. caspius,* according to the type female, which was sent me by M. Séguy."

In older literature there seems to be quite some confusion in the synonymy of *A. (O) dorsalis* Meig. and *A. (O) caspius* Pall. Older statements of distribution, which have not been controlled more recently, therefore must be looked upon with a certain reservation. However, Edwards has examined several type specimens and thereby contributed much to an elucidation of the matter. He i. a. says (1921, p. 301): "I have decided to adopt the name *dorsalis* for this species for two reasons. First I am indebted to M. Séguy for sending me a female from Meigen's collection labelled "*Culex dorsalis,* Berlin" probably in Meigen's own handwriting. As *C. dorsalis* was originally described from Berlin, it seems reasonable to accept this specimen as the actual type of the species. It is in good condition, and obviously *A. curriei,* not *A. caspius.* Secondly, from the description of Staeger and Letterstedt, as well as from some examples named by Staeger which were sent me by Dr. Wesenberg-Lund, it would seem that these writers based their conception of *C. dorsalis* mainly on *A. curriei.*"

Through the courtesy of Dr. K. Henriksen and Dr. S. L. Tuxen I have received for inspection the mosquitoes from Stæger's collection in the zoological museum at København. Among the 18 specimens labelled *O. dorsalis,* were 4 males and 10 females of *O. dorsalis,* further 3 females of *O. caspius* and one *Anopheles maculipennis.* One female labelled *A. vexans* also proved to be *O. dorsalis.*

Wesenberg-Lund (1920—21, p. 46) says regarding *O. curriei* Coq.: "This species is in my opinion indistinguishable in the imago-stage from *O. caspius.*" He considers *O. caspius* to be the common species in Denmark and he remarks (p. 47): "In more than twenty-five samples of mine, hatched in my laboratory, in the time from May to July I have never got more than about fifty *O. curriei* as compared with thousands of *O. caspius.*" However, among the 4 varieties of *O. caspius,* described by Wesenberg-Lund, I am inclined to consider number 3 and 4 as true *dorsalis.* I therefore suspect Wesenberg-Lunds *caspius* to be a mixture of specimens of the two rather near-related species.

In his monograph on the palaearctic mosquitoes, Martini (1931, pp. 282—285) discusses the *Aëdes dorsalis* problem. He has found many specimens which do not agree with Edwards' description of *dorsalis* and *caspius,* the colouring of the adult thorax and the position of the larval siphonal tuft being rather variable, and the range of variation is to some extent overlapping in the two forms. However, having pointed out the difficulties, he concludes: "Nach allen diesen Beobachtungen muss ich Edwards zustimmen, dass es sich bei "*dorsalis*" auct. um 2 gute Arten handelt, doch sind dieselben sowohl in der Larve wie in der Imago recht variable und wir haben eben auch hier wieder den bei Stechmücken so häufigen Fall, dass einzelne weibliche Stücke sich schlechterdings nicht mit sicherheit bestimmen lassen, weil sich die Variationskurven der einzelnen Merkmale für beide Arten überschneiden. Leider kann ich aber Edwards in dieser Trennung von *dorsalis* and *caspius* nicht bis ins einzelne folgen, weil mir die typische Form der einen Art eben die mit grauem Thorax und braunen Mittelstreifen zu sein scheint. Das "creamy" ist wohl keine Hauptsache bei der Unterscheidung, und die Mehrzahl der Stücke von *dorsalis* ist noch extremer in der Ausbreitung der hellen Schuppen als die von Edwards der Unterscheidung zugrunde gelegte Form. Die Namen will ich so belassen, wie sie Edwards nun gewält hat, trotz der Feststellung s. o."

Stackelberg (1937, p. 138) considers *caspius* und *dorsalis* as two forms (sub-species) of one species. Concerning *A.(O). caspius* he says: "A species which is very variable in the colouring. In the Palaearctic region the species is represented by two forms (sub-species). The typical form, *A. caspius caspius,* occurs in more southern, arid regions with saline waters. The other sub-species, *A. caspius dorsalis,* is characteristic of more northern and humid regions with freshwaters. In a median zone (in USSR i. a. in the Lower Volga distr.) intermedian forms have been found." [79] His description of the colouring of the abdominal tergites in the Russian specimens of *A. caspius caspius* do not agree with the Fennoscandian specimens I have seen, but in other characters they seem to be rather similar.

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[79] Translated from the Russian text.

The Danish and Fennoscandian specimens of *dorsalis* and *caspius* at hand, have, all of them, the typical colouring. Unfortunately Wesenberg-Lund's material has not been accessible.

Description.

F e m a l e. Front of h e a d with white narrow curved scales and white hairs forming a tuft between the eyes. Vertex ("occiput") in the middle with white narrow curved scales and yellowish-white upright forked scales; at the sides with two patches of dark brown, more delicate, narrow curved scales with golden reflections and with some dark or black upright forked scales. Temporae with flat white scales. Eyes bordered with black bristles. C l y p e u s blackish. P r o b o s c i s blackish-brown, in the middle more or less sprinkled with white scales, apex dark. A n t e n n a e. Tori dark brown with white scales dorsally and at the inner side. Flagellum dark brown with minute white-reflecting hairs and at the base of the segments bigger black hairs. First segment of flagellum with a lighter colouring. P a l p i (fig. 50 b) blackish brown, somewhat lighter at the apex. Some Finnish specimens have the palpi sprinkled with scattered white scales. T h o r a x. Anterior pronotal lobes blackish brown with white narrow curved scales and dark bristles with light reflections towards apex. Posterior pronotum with dark brown narrow curved scales in upper half and white ones in lower part. Mesonotum clothed with delicate narrow curved scales that form a broad median golden-brown or dark-brown band, posteriorly split into three narrow stripes, the median stripe reaching the antescutellar space. Sides of mesonotum ashy-white. In most specimens a lateral dark-brown stripe from the anterior pronotal lobe towards the root of the wing. S c u t e l l u m dark brown with light bristles and three patches of white narrow curved scales. P o s t n o t u m blackish brown. Pleurae blackish brown with white scales. W i n g. Scaling dark and white mixed at costa, radius$_1$ and the forked portions of Media and Cubitus. Basal parts of costa and radius$_1$ entirely white scaled. H a l t e r yellowish-grey with some white scales at the outer side of the globule. L e g s. Front side of femurae blackish brown, sprinkled with white scales. Basal part of mid and hind femurae light, and so is also back side of all femurae. Knee spot white, small. Front side of tibiae blackish brown and white sprinkled, with a white apical

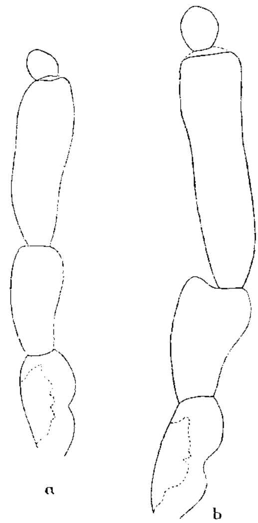

Fig. 50. Female palpi of *A. (O) caspius* Pall. (a) and *A. (O) dorsalis* Meig. (b). (Aut. del.)

patch. In many specimens the white scales predominate. Back side of tibiae light with dark apex. Tarsal segments. Fore-leg: segment 1 and 2 with basal and apical white ring, segment 3 with basal white ring only. The remainder dark scaled. Mid leg: segment 1—3 with basal and apical white rings. Hind leg: segment 1—4 with basal and apical white rings, segment 5 whitish. In some specimens the white scales at segment 1 tend to form a lateral white stripe, especially distinct in the hind leg. Abdomen (fig. 51) blackish brown with basal and apical white bands which connect in a median and two lateral longitudinal lines. The abdominal tergal colour pattern thus consists of two black patches on white ground in each segment. The first abdominal segment with a median patch of white scales and light bristles. On the seventh segment the two black patches are small; in one Finnish specimen they are represented by black points only, and in one Danish specimen the seventh abdominal tergite is entirely white. The colouring of the abdominal tergites is rather variable. Tip of abdomen pointed. Cerci long. Length of wing: 4 mm.

Male. Antennae. Tori blackish brown. Flagellum black and greyish ringed. Hair whorls grey with light

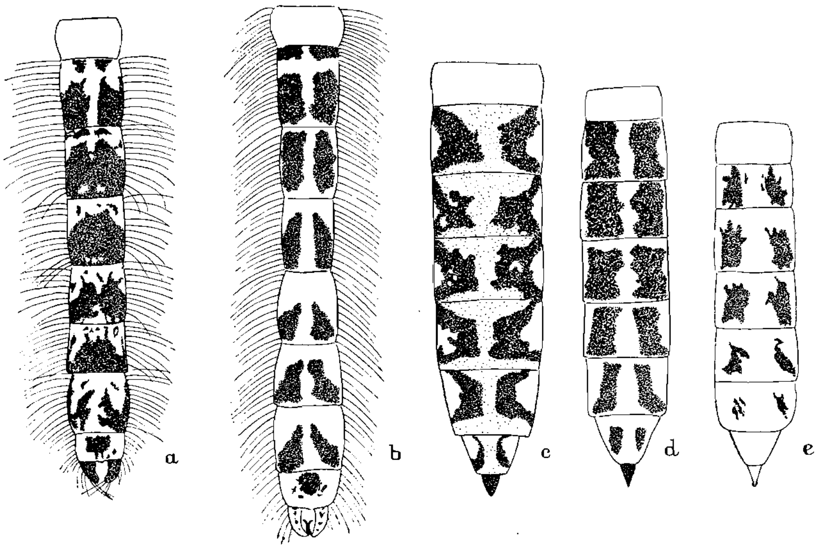

Fig. 51. Abdominal tergal markings. a—b, males, c—e, females a, c, *A. caspius* Pall.; b, d—e, *A. dorsalis* Meig. (Aut. del.)

reflections, in some specimens faintly fox-coloured. P a l p i exceed the proboscis by nearly the length of the last segment. Colouring dark brown. The long segment white at the base and in the distal half, a dark ring in the middle and dark scaling at the apex. Sides of segment 4 and base of the ultimate segment white. Hair-tufts long, dark brown with fox-coloured reflections, and situated at segment 4 and 5, but at apex only of segment 3.

T e r m i n a l i a (figs. 52, 53). Basistyle with ill-defined apical lobe. Basal lobe prominent, constricted at the base; it carries a dense mass of bristles and two stout spines. The upper spine is straight, the lower spine is conspicuously hooked. Stem of the claspette short and straight; near the apex it is distinctly narrowed and just at this point some bristles are inserted. Spine winged. Dististyle curved, with long claw. Proctiger with stout, sclerotised paraprocts. Lobes of the ninth tergite with 3—8 spines. Mean value for 3 specimens, counted for both lobes: 5,7.

L a r v a. According to Marshall (1938, p. 187) the larval distinctions separating *A. dorsalis* from *A. caspius*, in the

Fig. 52. *Aëdes (Ochlerotatus) dorsalis* (Meig.). Terminalia (total view). (Aut. del.)

4th instar are the position of the siphonal tuft, the number of the pecten teeth and the shape of the frontal hairs. The distance of the siphonal tuft from the base of the siphon (expressed as a percentage of the siphonal length) varies in *dorsalis* from 43 to 54 and in caspius from 55—62. The number of pecten teeth varies in *dorsalis* from 14 to 21 and in *caspius* from 20 to 26. In *dorsalis* the inner and mid frontal hairs are frequently bifid. In *caspius* one or the other of these hairs may occasionally be bifid, but never both of them.

I have only two Norwegian larvae which fully agree with the characters mentioned above. With some doubt I also include some larvae, from Fornebo (Ak 13). In this place multitudes of larvae were found in small pools near the sea-shore. Unfortunately only very few larvae were isolated for hatching, the remainder being preserved in alcohol. Two adults were hatched: a male and a female *A. dorsalis*. The larvae agree in most characters with the description of *dorsalis*, but in contradistinction to Marshall's description

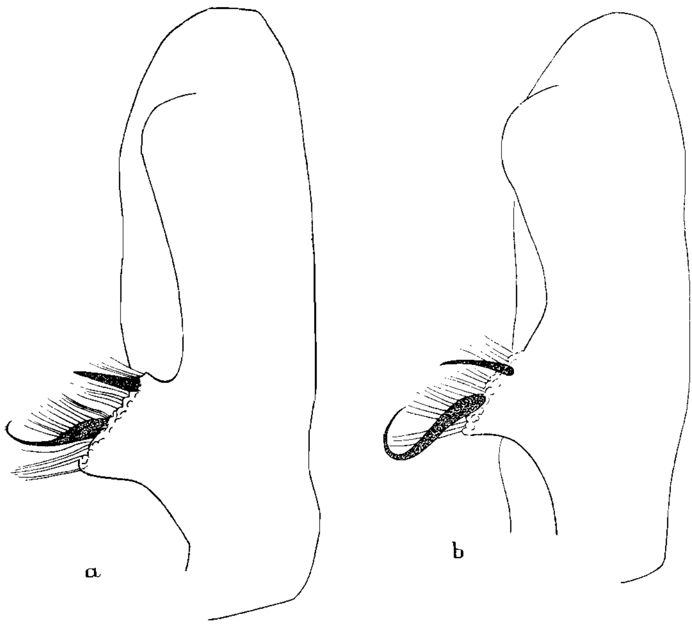

Fig. 53. Right basistyle with basal lobe of *A. (O) dorsalis* (a) and *A. (O) caspius* (b). (Aut. del.)

of the English *dorsalis,* these larvae have simple frontal hairs only. Details of the chaetotaxis is given below, but further investigations are needed. It must be emphasised that *A. caspius* has hitherto not been found in Norway.

Table 15.

Larval chaetotaxis of *A. dorsalis* Meig.

Number of branches in				Number of		Siphonal index
Frontal hairs			Siphonal tuft	Comb. scales	Pecten teeth	
outer	mid	inner				
5—8 6.6 (14)	1 1 (19)	1—2 1.2 (19)	5—8 5.9 (15)	19—27 23.8 (8)	16—19 17 (10)	21—25 23.5 (9)

The distance of tuft from the base of the siphon (per cent) is from 47 to 52. Mean value (eight specimens): 49,9.

Geographical distribution.

Denmark: 1. *Jylland:* Tipperne! ♂: 26. viii. 1946, ♀: 6. ix. 1946 (Sg. A.); Eastern coast, especially in the inner fjords (W-L). 2. *Sjælland:* Amager! ♂♀ (Stæger); Roskildefjord (W-L); *Laaland:* Southern coast at Guldborgsund (W-L); *Møen:* Ulfshale, meadow at the seashore! ♂ ♀: v. 1938 (H. Anthon).

Sweden: *Sk.* Lund and Lomma (Zett.); *Öl!* ♂ (Bhn); *Ög!* (Hagl).

Norway: *Ø:* 1. *Hvaler:* Island Kirkeøya, Brennesand: P: 13. iv. 1938 (♂ ♀) (LRN); Arekilen, ♀: 22. v. 1928 (LRN); Ørekroken, L: 14. iv. 1938 (♂) (LRN); Ak: 14. *Oslo:* Tøien botanical garden, ♂: 30. v. 1849, ♀: 6. vi. 1849 (Siebke); 12. *Bærum:* Snarøen, L: 29. iv. 1928 (LRN); 13. *Aker:* Fornebo, L: 2. v. 1937 (♂ ♀) (LRN); Bø: 1. *Hurum:* litle pond at the seashore at Sætre, L: 8. v. 1938 (LRN); VE: 24. *Stavern,* ♀ (Siebke).

Finland: *Ab(V):* Kuustö (Lundstr.); Uskela (Bonsd.); Eriksberg, Nådendal! ♂: 12. viii. 1939 (Tiensuu). *N(U):* Tvärminne (Frey); Helsingfors! ♀ (A.Palmén). *Kl(LK):* Kexholm (Tengstr.); *Om(KP):* Pedersøre! ♂: 26. vi. —5. viii., ♀: 16. vi. (Storå).

USSR: *LPom (Kpoc):* Sorokka! ♀ (J. Sahlb.)

Distribution outside Denmark and Fennoscandia.

According to Marshall (1938, p. 189) *A. dorsalis* is recorded from the following counties in England: Dorset, Essex, Norfolk and Westmorland. Burke (1946, p. 228) records the species from Cheshire. Séguy (1923, p. 130) records it from France: "Ille-et-Vilaine: St. Servan; Cotes- du Nord: Lamballe (J. Surcouf); Nantes (Peneau)." In Germany the species has been found at Berlin (Dahlem a. Zehlendorf) (Peus 1929 b, p. 7) and at Mellensee in Mark Brandenburg (Peus 1930 c, p. 670); it is also recorded from Warnemünde and Müritz, Markgrafenheide and at Danzig (Martini 1920, p. 134). Further eastwards it is recorded from Lithuania: Bialowies (Sack 1925, p. 263), from Poland (Tarwid 1938 a), from Austria: Hainfeld (Mik) (Edwards 1921, p. 302), from Hungary: Budapest (Kertész), Budafok (Bartko), Fehertelep (Ujhelyi), Torda (Biró), Keczel, Hild (Thalhammer), Neusiedler-See (Handlirsch) (Edwards 1921, p. 302) and from Bulgaria (Martini 1928, p. 22). Concerning the distribution in USSR Stackelberg (1937, p. 149) records: "Leningrad distr. (environs of Peterhoff: Montschadskiji, environs of Luga: Stackelberg!). Moskva distr. (Nikolskiji) and Voronesch distr. (environs of Voronesch: Schtschelkanzew); Ukraine: Ukrainskoje Polesje: Rybinskiji), environs of Dnepropetrovsk: Guzevitsch!); Donbass (Stalino: Kipritsch!); Southern coast of Crimea (Velitschenkevitsch 1931); North-Kaukasus (Pjatigorsk: Mess!); Dagestan (Enikalopov!); ?Aserbajidschan (Akundov 1931; the records most probably concern the typical form, which is missing in Akundov's list; ?Georgia (Kalandadse 1931);

Lower Volga distr. (environs of Saratov: Martini); Ural distr. (environs of Sverdlovsk: Kolosov, Slatouslav, Perm and Kugursk distr.: Mitrofanova 1929); Siberia: Irkutsk. (Edwards), Ussurijisk distr. (Alektorov 1931)." [80] Further records are: Kaukasus: Goratschevodskaja Levada, Goratschevodsk garden and Perekumok (Mess 1929). According to Petrischtscheva and Schubladze (1940) *A. dorsalis* is the dominating *Aëdes*-species in the Maritime Province of the Russian Far East. Further the species has been found in Mongolia ("Vallée près de la Kouré de Bandie, 1500 m" and "Bords du Tarim", Mission de Lacoste, Dr. du Chazaud, 1909) and in North China (Tinghai, C. Ford) (Edwards 1921, p. 302).

As to the distribution on the American continent, Dyar (1928, p. 201) remarks: "It is the dominant species of the western plains throughout southern Canada, from Manitoba to the Rockies, the Dakotas, to Utah, Nevada and California, east of the Sierras. It occurs also as a coastal inhabitant of salt pools, frequent on the Pacific coast, rare and local on the Atlantic and Gulf coast." Recent records are: Massachusetts (Tulloh 1939), Nebraska (Tate and Wirth 1942) and Utah (Don M. Rees 1942).

Biology.

In Norway larvae of *A. dorsalis* has been found in the Hvaler islands (Kirkeøya: Ø 1.) medio April; somewhere further to the north (Snarøen: Ak 12; Fornebo: A 13) they were caught ultimo April and in the first days of May. The hatching places were small pools near the sea-shore, in one place the pool was partly dried up and the bottom partly filled with decaying leaves. In some small pools near the sea-shore at Brennesand (southern coast of Kirkeøya) the percentage of salt in the water was: O,0749 % NaCl and the pH: 7,1. In these pools *A. dorsalis* was associated with larvae of *A. detritus, A. communis* and *A. punctor.* In a little pond near the sea-shore at Sætre (Bø 1) one larva of *dorsalis* was found associated with larvae of *Anopheles maculipennis* and *A. detritus.* The percentage of salt in the water was: 0.2721 % NaCl and the pH: 6.8. All the hatching waters in the Hvaler islands were in open-lying places exposed to the sun, but in Fornebu the pools were partly shaded. Adults, male and female, were found by Siebke in the botanical garden at Oslo, ultimo May resp. in the beginning of June. Most Norwegian localities are near the sea. From Sweden no dates have been accessible but in Finland males have been found from the beginning of July to August.

Martini (1920, pp. 134—35) has found the species in multitudes at Bohnsack ultimo August. He further remarks: "Es ist dies also eine sehr häufige und unter Umständen sehr lästige Form, die bis Anfang September fliegt und abends schwärmt. — — — Im Frühjahr 1918

[80] Translated from the Russian text.

beobachtete ich die Larven von März ab in Pfützen bei Usküb und später an vielen Stellen in Macedonien. Sie nehmen selbst sehr trübes, lehmiges Wasser an und fand sich in Regenpfützen selbst auf und an Wegen in denen ich sonst keine Stechmückenlarven beobachtete (*Branchipus*-pfützen). — — — Die Mücken waren später häufig im August in Usküb, ja die einzige dortige Mücke die schon im Hellen lästig wurde." From Swinemünde he records (1924, p. 441) that they are also entering houses: "Namentlich auch abends gegen ½ 8 Uhr (wenn es draußen kühler als im Zimmer wird). Gegen 10 Uhr kann man die Fenster wieder ohne Gefahr öffnen. Um ½ 5 Uhr folgt dann ein erneutes Eindringen."

Stackelberg (1937, p. 142) records from U S S R: "The larvae were occasionally found in enormous quantities in temporary waters (pools, ditches etc.) flooded in the spring or by rain-water, also in water with a poor vegetation on the bottom (Reingardt and Guzevitsch 1931). — — — The adults are chiefly found in meadows and disclose themselves as aggressive blood-suckers." [81]

From USA, Dyar and Knab (1917, pp. 124—25) record: "The stronghold of the species is in the western plains and the desert country of Utah, Nevada and eastern California; but it penetrates to all the coasts, having been taken on the coast of New England and on the Gulf of Mexico. It has been taken near Chicago, and is probably scattered through open country here and there, finding a local abundance in favourably situated tidal pools. It does not occur in forested country, which explains its rareness in the East. Salt marsh pools it may be noted, are not forested and hence the occasional occurrence of the species on the Atlantic seaboard. The species has as many generations in the year as the conditions warrant, although probably only part of the eggs hatch at each successive wetting. Dyar demonstrated this in Nevada, where he obtained as many as three sets of larvæ from one deposition of eggs." In his book on the mosquitoes of America, Dyar (1928, p. 201) remarks: "The larvæ occur in salty or alkaline pools whenever these become filled with water. — — — The adults occur in large numbers and are sufficiently annoying out of doors, especially just after dark; but they do not enter houses."

Aëdes (Ochlerotatus) caspius (Pallas.)

C. caspius Pall. (Reise versch. Prov. Russ. Reich, *1*, p. 475) .. 1771
C. punctatus Meig. (Klass. *1*, p. 5) 1804
? *C. siculus* Rob. Desv. (Mem. Soc. Hist. Nat., *3*, p. 406) 1827
C. maculiventris Macq. (Dipt. Exot. Suppl., *1*, p. 7) 1846
C. penicillaris Rond. (Bull. Soc. Ent. Ital., *4*, p. 31) 1872
C. pulchripalpis Theob. (nec. Rond.) (Mon. Cul., *2*, p. 16) 1901
Grabhamia subtilis Ed. et Et. Serg. (Bull. Mus. Paris, *11*, p. 240) 1905
Taeniorh. africanus Nev-Lem. (Arch. Par., *10*, p. 271) 1906
Mansonia arabica Giles (J. Trop. Med., *9*, p. 130) 1906
Grabh. willcocksi Theob. (Mon. Cul., *4*, p. 294) 1907
C. arabicus Becker (Denkschr. k. Akad. Wiss. Wien, *71*, p. 140) 1910
var. *longisquamosus* Theob. (Ann. Mus. Nat. Hung., *3*, p. 102) 1905
albineus Séguy (Ann. Soc. Ent. France, *42*, p. 260) *1923*
var. *hargreavesi* Edw. (Bull. Ent. Res., *10*, p. 130) 1920

[81] Translated from the Russian text.

Systematical and synonymical remarks.

The differentation of *A. dorsalis* and *A. caspius* is discussed under the first named species.

Description.

F e m a l e. H e a d. Front of head with golden bristles forming a tuft between the eyes. Vertex ("occiput") in the middle with whitish narrow curved scales, above with golden upright forked scales and golden or dark bristles. Eyes bordered with yellowish scales above and whitish ones below, and with a row of stout orbital bristles. Temporae with flat yellowish-white scales. C l y p e u s blackish brown. P r o b o s c i s chiefly dark at the base, light in the middle and dark brown at apex. Labellae blackish brown. A n t e n n a e. Tori yellowish brown, with many white scales on inner side. Flagellum. First segment yellowish brown, on inner side with white scales. The remainder of flagellum blackish brown with minute, white-reflecting hairs, and larger dark hairs at the base of the segments. P a l p i (fig. 50 a). The few slide preparations at hand indicate differences in the relative length of the segments in *caspius* and *dorsalis*. In *caspius* segment 2 is about ⅔ the length of segment 3, whereas segment 2 is about half the length of segment 3 in *dorsalis*. However, further investigation on a greater material is strongly needed. Scaling of palpi dark brown with black bristles and with scattered whitish scales which are agglomerated at the apex. T h o r a x. Anterior pronotal lobes with yellowish-white narrow curved scales and dark golden bristles. Mesonotum clothed with fawn-coloured narrow curved scales, the median third demarcated by a pair of longitudinal narrow white stripes. The colouring is lighter in the posterior part of mesonotum and in the praescutellar area it is nearly whitish. The bristles in the anterior part of mesonotum are dark brown, posteriorly they are golden. S c u t e l l u m with white and yellow narrow curved scales and golden bristles. P o s t n o t u m chestnut-brown. W i n g with evenly mixed dark and light scales. H a l t e r yellowish-brown with somewhat darker globule. L e g s. Femorae with mixed dark and light scales. In the fore- and mid-femorae the light scales predominate the basal third, in the hindleg the basal half is light scaled. Knee spot whitish, indistinct. Tibiae dark and light sprinkled, with apex light scaled. Tarsal segments. Fore-leg: segment 1 and 2 with basal and apical white ring, segment 3 with basal ring only, the remainder brown. Mid-leg: segment 1—3 with basal and apical white rings. Hind-leg: segment 1—4 with basal and apical white white rings, segment 5 whitish. The northern specimens agree well with the description of English *caspius* (Marshall). In one specimen, however, an apical white ring in the fourth segment of the mid-leg is indicated, as described by Martini from German specimens. A b d o m e n (fig. 51) ground colour brown, with yellowish-white basal and apical band, connected by a longitudinal stripe. Each segment with ashy-white lateral patches. Length of body: about 5 mm; length of wing: about 4 mm (W-L).

M a l e. P r o b o s c i s brown, more or less light scaled in the middle. A n t e n n a e. Torus brown. Flagellum brown and white ringed, the ultimate segments brown with minute white reflecting hairs . Hair-whorls light grey with a foxy tint. P a l p i exceed the proboscis by about half the length of the ultimate segment. The long segment light scaled with exception of base and apex. In the middle of this segment a dark ring. Segment 4 whitish in the basal half. Segment 5 with a basal white patch. A b d o m e n (fig. 51). The basal light hands are especially well developed. They are somewhat narrowed in the middle and widened laterally. In some specimens a longitudinal light median stripe is visible in the anterior and posterior segments.

T e r m i n a l i a (fig. 52, 53). The terminalia of *A. caspius* are very similar to those of *A. dorsalis.* The two may principally be differentiated by the shape of the basal lobe, the distal part of which in *caspius* runs gradually into the basistyle. The basal lobe therefore is not so prominent in this specis as is the case in *dorsalis.* In the slide-preparations at hand the lower spine at the basal lobe is somewhat longer and the apical part more conspicuously curved than in *dorsalis.* According to Marshall (1938, p. 187), the wing of the claspette is broader in *dorsalis* than in *caspius,* but owing to unhappy orientation of the claspettes in the preparations at hand, this character cannot be clearly seen. Lobes of the ninth tergite with 5—9 spines. Mean value of 2 specimens (both lobes counted): 6..8

L a r v a (fig. 54). Head broader than long. The stout antennae with spines, somewhat curved and faintly tapering from the insertion point of the antennal tuft. This is inserted about ⅔ from the base of the antennal shaft, of about half the length of the shaft and with about 9 hairs. Inner frontal hair behind the mid frontal hair. Dorsal

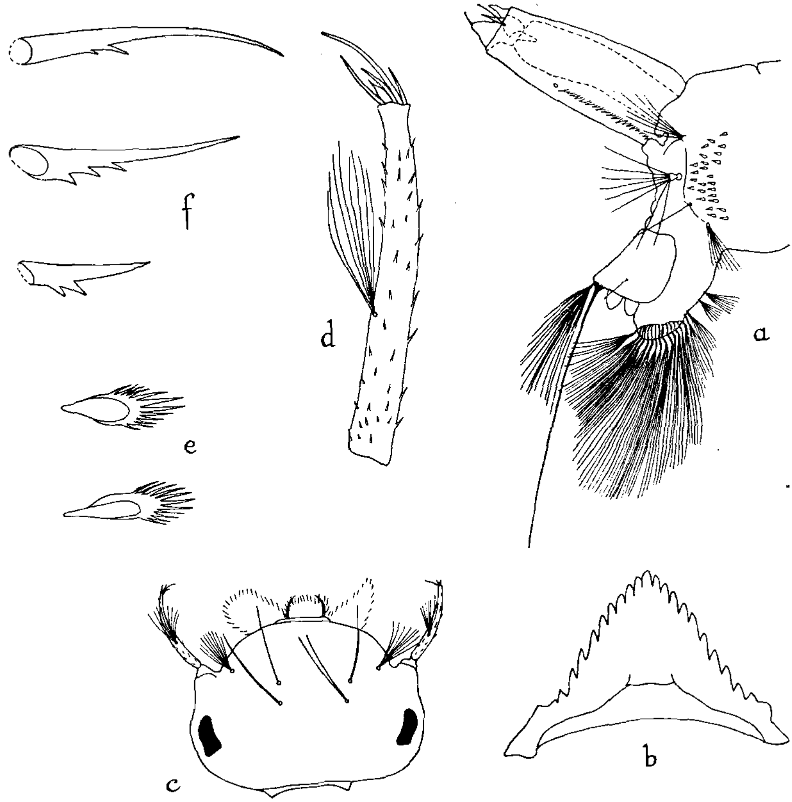

Fig. 54. Larva of *A. caspius* Pall. in 4th instar. a, terminal segments of larva; b, mentum; c, head of larva; d, antenna; e, comb-scales; f, pecten teeth. (Aut. del.)

prothoracic hair-formula about: 1,1,2; 1; 2; 1; 3; 1. Comb with about 22 rather acute scales. Siphonal index about: 2.2. Shape of siphon broad, gradually tapering towards apex. Pecten reaching about the middle of the siphon, with about 20 teeth. Siphonal tuft of about half the length of the siphon, with about 5 hairs and inserted within the distal half of the siphon. Saddle low with single saddle-hair. Gill-saddle index about: 0.37. Dorsal brush, with an inner pair of tufts with about 8 hairs and an outer pair of long stout hairs. Ventral brush with about 16 cratal and 2 precratal tufts. Gills short, bud-shaped.

Table 16.

Larval chaetotaxis of *A. (O) caspius* Pall.

Number of branches in			Number of		Siphonal index
Frontal hairs			Comb scales	Pecten teeth	
out.	mid.	inner			
7—9 8.1 (20)	1—2 1.0 (28)	1—2 1.4 (29)	19—25 22 (14)	18—24 20.8 (15)	19—25 2.2 (11)

The distance of tuft from the base of the siphon (per cent) is from 51 to 61. Mean value (13 specimens): 55.9.

As the Danish larvae at hand all have the siphonal tuft broken off, the number of hairs in the tuft is quoted from Wesenberg-Lund (1920—21, p. 42). According to Martini (1931, p. 272) the siphonal index is about: 3.1, and in this respect the Danish larvae of *caspius* agree better with the English specimens, which, according to Marshall (1938, p. 189), have a siphonal index from 1.8 to 2.3. The length of the anal gills seems to be rather variable in this species. Thus Martini points out that this larvae have anal gills of about the same length as the saddle, Kirkpatrick (1925, p. 83) records the saddle-gill-index for Egyptian larvae to about 0.3—0.5, and according to Marshall the index in English specimens is 0.4—0.7. In the few Danish larvae at hand where the gills were preserved, the index is below 0.4.

Geographical distribution.

Denmark: 1. *Jylland:* Tipperne! ♀; ♂: 26. viii.—6. ix. 1946 (Søg. A.); east coast, especially in the inner fjords (W-L). 2. *Sjælland:* Amager! ♀ (Stæger); Næstved! ♂: 27. vii. 1929 (P. N.); Roskildefjord (W-L); Jægerspris, Roskildefjord! ♂ ♀ LP: 29. vii. 1943 (H. Anthon); *Laaland:* Southern coast, coast at Guldborgsund (W-L).

Sweden: Hitherto not found (N!).

Norway: Hitherto not found (N!).

Finland: *A(Al):* Brändö, ♀ (Hellén); *Ab(V):* Kuustö (Lundstr.); Nystad! ♀ (Hellén); *N(U):* Tvärminne! ♂ ♀ (R. Frey); Jorvas! ♀ (R. Frey); Helsingfors, Sörnäs! ♀: 8. vii. 1921 (R. Frey).

Distribution outside Denmark and Fennoscandia.

In the British Isles *A. caspius* has been found in England as well as in Wales (Lang 1920, pp. 84—85). Most localities are coastal and Marshall (1938, p. 184) remarks: "In England, at any rate, the coastal districts in which *A. caspius* occurs are so numerous that a list of them would be of no scientific interest." Inland finds of this species are recorded from the counties: Essex, Kent, London, Middlesex, Surrey and Worcestershire. In Belgium *A. caspius* has been found in the downs at Blankenberghe (Litt.) (Goetghebuer 1925, p. 215). In France Séguy records it from the following localities: "Seine-et-Oise: Janville (J. Surcouf); Morbihan: La Trinité-sur-Mer (Surcouf, Mus. Paris); Loire-Inférieure; Hérault (Dr. Villeneuve); Charente-Inférieure: Saint Georges-de-Didonne (P. Lesne: Mus. Paris)." It is further recorded by Legendre (1937) from the salt marshes of Charante, and by Brumpt (1942) from Crau and Camargue (Bouches-du-Rhone). In Portugal the species is rather distributed and Braga (1931, p. 64) records it from several localities, Storå (1937) records it from the Island Gran Canaria. According to Peus (1929 b, pp. 6—7), *A. caspius* is recorded from the following places in Germany: "Prerow auf dem Darss, im Dünengelände von Zinnowitz (Usedom)", further: "in den Oederniederungen Schlesiens" (Peus 1930 c, p. 670) and in Spreewald (Peus, 1932, p. 138). Henkel (1936) records the species from Hildesheim in the province of Hannover, and Martini (1931, p. 283) points out that he has found typical *caspius* in inland freshwaters. Edwards (1921, p. 300) has examined specimens from: Austria: Wien (Handlirsch); Carniola (Loitsch); Hungary: Neusiedlersee (Handlirsch); Hortobagy (Kertész); Csepel (Bartko); Fehertelep (Ujhelyi); Iszak (Uhl); Torda (Biró); Italy: Mehadia, Livorno, Spalato (Mann); Roumania: Tultscha (Mann); Turkey: Konstantinople (Paris Mus.). It is also recorded by Lepsi (1935) from district of Chisinau in Bessarabia and by Bedia Salı (1938) from different localities in Turkey. Christophers (1929) records it from the Canaries. Waterston (1920—22, p. 133) records the species from Macedonia, on flat land, near the sea (Mikra, Vardar marshes). According to Stackelberg (1937, p. 140) the distribution in USSR is as follows: "Ukraine (Ukrainskoe Polesje: Ryninskiji, Dnepropetrovsk: Guzevitsch!); Lower Volga distr. (Martini); Crimea: southern coast (Velitschkevitsch!); North-Kaukasus: Azov (Schtschelkanovzev), Taganrog (Anger!); Kubanj (Dobrovolskiji!), Pjatigorsk (Mess!), Dagestan (Enikolopov!), Aserbajdschan (Guzevitsch, Akundov!); Grusin (Kalandadze 1931); Nakkraji and Armenia (Zaijzev 1935), Tadschikistan (Fedorov!), Usbekistan (Old-Bukara) (Montschadskiji!), Mirsatschul (Montschadskiji! Jacobson!)."[82] Further records are: Kirgisia: Oschsk distr., Narivansk distr., Dsjlalabdansk distr., Kysyl-Küjsk distr. (up to 3500 m above sea level) (Petrischtscheva 1940); Ferghana: Kokauda, Andisjan, Hakulbad, Sorov and Skobelev (Simanin 1929); Turkmenia (Petrischtscheva 1934); Murgabsk valley: Kuschka, cottage Morgunovskij, Tschimenibid in Kuschansk distr., Tachta-basar, Tachtabasarsk distr.: Karaul-chana, Gussein-ali; Erden, Tsch-kepri, Iolotanj, Sovchos Sandykatschi, Sultanbent Station, Merv and Bairma-ali (Simanin). Petrischtcheva (1936) records this species from the sandy dersert of Karakum. Edwards (1921, p. 300) has examined specimens from Asia Minor (Fregli,

[82] Translated from the Russian text.

Tskehir, Kara: Lendl) and from Palestine (Jerusalem: Goldberg), and, according to Waterston (1920—22, p. 133) it has also been found in Arabia, Bahrein Island in the Persian Gulf and in Rawal Pindi in Punjab. Further eastwards *A. caspius* has been recorded from S-W Mongolia (Söderblom; Edwards 1935, p. 2) and from the Gobi Desert (Cha Tcheou, Marais de Pa-Hou-lian: Dr. L. Vaillant) (Edwards 1921, p. 300). The species is also distributed in the desert regions of North Africa: Séguy (1923) records it from Biskra (Sergent) and Kirkpatrick (1925, p. 179) remarks as to its occurrence in Egypt: "A widespread and abundant species, very common throughout the Delta, the Wadi Tumilat, and the whole Canal Zone. Also in the Faiyum and known from the whole of the Nile Valley as far south as Aswan." He also records it from Sinai, and a somewhat paler variety from the oases of Kharga, Dakla and Siwa.

Biology.

A. caspius has hitherto not been recorded from Norway and Sweden. The Finnish specimens at hand, bear no other information on the labels than the locality-name.

Wesenberg-Lund (1920—21, p. 44 et seq.) has made close researches on this species in Denmark from which I quote: "For a long time it has been a well-known fact that countless mosquito-masses are a real plague to all suburbs of Copenhagen, especially those lying near Kalvebodstrand, the strait between Copenhagen and Amager; one of these suburbs, Valby, has given the mosquitoes of this district their name, they have been called the Valby mosquitoes. They appear almost every year, more especially at the beginning of August; — — — the whole country is extremely flat, the height over the sea level being only a few feet; formerly the sea often covered the whole area and after heavy showers, especially in spring, it is even nowadays changed into an almost inundated area which is difficult to cross. From the plain it is now separated by a dike along which a channel runs landwards. Between the dike and the sea numerous brackish water pools are to be found; on the other side scattered over the flat ground, countless small holes may be seen. After June the whole plain is commonly quite dry. — — — At certain periods they [the pools] contain thick layers of green algæ, and it is only in those pools, the bottom of which are covered with a layer of algæ in decomposition, that we find the huge masses of larvæ. — — — It was shown that *O. caspius* was often found in cellars etc. till the last part of November and even the beginning of December. In the last part of the winter it seemed as if the material everywhere died out. — — — Regarding it as almost certain that egg-laying processes have taken place in the last part of July and most probably also in September, there can be no doubt upon the point that *O. caspius* and most probably also *O. curriei,* if this species can be separated from *O. caspius,* both have two broods, the one hatched in the first half of June, the other in the last part of August. In summer and winter there is a resting period which is passed as eggs."

In a great material from Jægerspris at Roskildefjord, received through the courtesy of Dr. S. L. Tuxen, I found hundreds of larvae, in the fourth instar, pupae and adult males and females. The collecting-date of the material 29. v. 1943 agree well with the statements published by Wesenberg-Lund.

From the British Isles, Marshall (1938, p. 183) records: "*A. caspius* is primarily a seaside mosquito, but (unlike our other common salt-marsh species, *A. detritus)* it occasionally breeds in inland, non-salt waters. — — — Adults of *A. caspius* usually make their first appearance in April, and throughout the ensuing five or six months a number of additional broods are produced." Marshall also points out that, according to Piffard (1895) the species has been found in Suffolk in enormous masses; "Piffard also mentioned that the said species was known to the inhabitants of the district as the "N o r w a y M o s q u i t o"; a local tradition being to the effect of its having immigrated on a certain yacht which formerly plied between Aldeburgh and a Norwegian port".

As mentioned above, *A. caspius* has hitherto not been recorded from Norway. However, only scattered investigation has been carried out along the western coast of Norway, and possibly further researches may result in the location of the species somewhere.

Martini emphasises that (1931, p. 284) both *O. caspius* and *dorsalis* are among the species responsible for mosquito plagues. "Im ersten Frühjahr ist *caspius* auf den Wolgainseln äußerst häufig. Als ich 17. Mai die Insel zuerst besuchte, gehörte sie zu den lästigen, sofort, besonders in Gebüsch, stark angreifenden Arten. — — — Der Angriff erfolgte auch bei Tage sehr lebhaft. Abends erschienen *dorsalis* und *caspius* wiederholt in den Räumen der Wolgastation, also in der Stadt. — — — Die Wanderlust, welche die Art "*dorsalis*" auct. sonst kennzeichnet, z. B. nach Beobachtungen von Breßlau und Eckstein in Elsaß, zeigt sich also auch hier an der Wolga.

In Anatolien ist *caspius* sowohl unten nahe den Küsten, als auf der Hochebene bis über 1000 m eine Charakterform und eine der wichtigsten Beteiligten an der Mückenplage. — — — In den Gebieten völliger Sommerdürre wie der Anatolische Hochebene u. s. dürfte nur eine Brut vorkommen, im Frühjahr. — — — In der Steppe ist diese Art zweifellos einer der häufigsten Moskitos, und derjenige, an den man zuerst denken muß, wenn es sich um die Übertragung von Viehseuchen handelt."

As to the biology and ecology of *A. caspius* in U S S R, Stackelberg (1937, p. 138) remarks: "are among the distinctly heat-preferring species. The larvae are found in small waters, principally of temporary character (pools and similar places) which in common are more or less salty — — — but they also occur in freshwater. — — — The eggs are probably deposited on the surface of the water, but before hatching they must be exposed to desiccation for a shorter or longer time. When they, after this desiccation, again come in contact with water the larvae develop very rapidly (Kazanzev 1932). According to the climatological conditions (chiefly alternation of arid and rainy periods) the species produces one, two or even three generations in one year. The mosquitoes chiefly occur in open localities and in plains (meadows, steppes etc.) and they are among the most annoying species in places where they are abundant. They attack man outside houses. In daytime the mosquitoes chiefly rest in grass and bulrush. *Wucheria bancrofti* passes a part of its deveopment in *O. caspius*."[83]

Concerning the conditions in M a c e d o n i a, Waterston (1921—22, p. 133) records: "Next to the Anophelines this species was the most troublesome mosquito in hospitals and camps, especially those in lower levels. — — — The ova responded quickly to the spring rains and about a week after the first heavy fall multitudes of larvae were to be found in water-filled cracks. There may be, however, considerable intervals between the hatching of the eggs by parents of the same brood or even in the eggs of one female. One batch of eggs laid in October, 1917, hatched irregularly and produced imagines up to the end of June 1918."

Bali (1938, pp. 44—49) says that the specimens of this group found in different places in Turkey are all *A. caspius*. To be sure variations in the colouring of the adults were found, but the male terminalia as well as the larvae proved to be typical for *caspius*. As to the variations in the colouring the author i. a. remarks: "Die Variation ist auch wohl bei denen zu sehen, welche in demselben Brutwasser und von derselben Naturbedingungen beeinflußt waren. Da es aber von den Mücken aus verschiedenen Orten manchmal so deutlich möglich war, lichtere und dunklere Stücke zu unterscheiden, könnte man möglicherweise diese als eine neue Varietät annehmen. Die gelblich-weißen Mesonotalstreifen waren bei einigen Stücken sehr eng, während die Mehrzahl breitere Streifen hatte. Die Mesonotalen Farbenunterschiede können nicht von Klima und Jahreszeit abhängig sein, weil wir doch gesehen haben, daß das Material von demselben Brutplatz zu gleicher Zeit verschiedene Farbe hatte."

Interesting details concerning the biology and ecology of this species in Egypt, are published by Kirkpatrick (1925, p. 180): "Common throughout the year, but especially numerous in late autumn and winter, and at its minimum in June and July. It is essentially a cool weather species, and though able to breed continuously during the summer, it does so in far smaller numbers than in the winter, owing to the drying up of many of its breeding places. — — — Most commonly in borrow pits and other pools, usually those in which reeds are growing, often at the reedy sides of large areas of water. Very often in drains, either stagnant or slowly moving, and occasionally at the reedy sides of large fast-flowing canals and drains. Frequently in pools left in small stagnant irrigation channels. — — — Although the majority of times it is found in fresh or nearly freshwater yet it not infrequently occurs in water with a higher percentage of salt than the sea." Kirkpatrick has put up in a table the salinity of the water in different places where *A. caspius* has been found, with figures from 0.10 to 7.02. He further remarks: "The last figure is that of a single

[83] Translated from the Russian text.

breeding place in which the water had a salinity of 7.02 per cent, which so far as I am aware, constitutes a record for any mosquito larva, though possibly *A. mariæ* may be found to breed in water with a higher percentage of salt. — — — I have obtained sixteen readings of the pH concentration of the water in which this species breeds, all between: 7.9 and 8.9."

2. *annulipes*-group.

The *annulipes*-group is well characterized by the colour of the tarsal segments, but the differentation of the females is difficult and a revision of the group is highly desirable. Dyar (1920 c, pp. 106—107), in a review of the American species of this group, says i. e.: "The species are not separable in all cases on the coloration of the female adults; but the male hypopygium is characteristic. The larvae also show good characters. The basis of classification adopted is the male hypopygium. The larvae show different series of adaption. — — —" In his last review Edwards (1932, p. 136) defines the group as follows: "Group B. *(annulipes-group: Lepidoplatys).* Tarsi (at least of hind legs) with basal white rings on all segments. Lower mesepimeral bristles present. Male coxit with distinct apical lobe; basal lobe variable in development, usually with one spine. Larva with 5—6 ventral tufts on anal segment before the barred area, and with unpigmented gills. In some species the wing-scales are unusually broad, — — —. The group has a wide holarctic distribution, — — —." With two exceptions this definition fits well with the northern species; the broad wing-scales are absent and only 4 of our 6 species have a spine at the basal lobe of the basistyle.

In his key to the palaearctic species Edwards (1921, p. 297) makes use of the colour of the femurae for the differentiation of the females. However many northern specimens of *excrucians* are more or less dark coloured for which reason this criterion cannot be used. Having in vain searched for useful criterions for the differentiation of the females, I give below a provisional key, chiefly after Martini (1931, p. 232), for typical specimens from the southern Fennoscandia, but this key will not fit for varieties of *excrucians* from the high mountains and from localities in the far north. Further investigations with rearing of larvae from different localities are highly desirable, but as this will take years to complete, we must til then be content with a provisional key and the descriptions under the separate species.

Judging from the material at hand, most of these species have their distribution in the southern part of Fennoscandia. Zetterstedt (1840, p. 806) recorded *cantans* as common in Swedish Lappland, but of the three specimens from his collection that I have examined, the male is *excrucians* and the two females most probably belong to the same species. In Diptera Scandinavia (IX, p. 3462, 1850) Zetterstedt i .a. remarks about *cantans:* "in pratis et graminosis per totam Scandinaviam et Lapponias omnes"; in my opinion there is every indication that a confusion with *excrucians* has taken place. To be sure most *excrucians* from northern localities are conspicuously darker than those from southern Scandinavia, but as all males from northern Fennoscandia hitherto examined prove to be *excrucians,* we are for the present forced to consider also the females as belonging to the same species, At any rate it is a matter of fact that the distribution of *excrucians* extends far north in Fennoscandia.

Table 17.

Key to typical coloured females.

1.	(4)	Abdomen chiefly yellow or ochreus.	
2.	(3)	Thorax gold-yellow	*cyprius* Ludl.
3.	(2)	Thorax dark brown-golden (cupreous)	*flavescens* Müll.
4.	(1)	Abdomen in general chiefly dark scaled, if the light scales predominate they are whitish yellow.	
5.	(8)	Abdomen with rather distinct white bands.	
6.	(7)	The abdominal light basal bands rather narrow. Thorax dark cupreous, mostly with an aggregation of white scales forming a pair of lateral patches (or stripes) in the middle third	*cantans* Meig.
7.	(6)	The abdominal light basal bands interupted in the middle. Mesonotum with a median broad longitudinal band of bronzy hair-like scales and at the sides pale golden	*riparius* D. u. K.
8.	(5)	Abdomen mostly with broader ill-defined, yellowish-white bands and scattered light scales. Scutum at the sides light, grey or golden.	
9.	(10)	Mesonotum with pale golden longitudinal lines on dark golden ground	*excrucians* Walk.
10.	(9)	Mesonotum with a median broad longitudinal band of dark cupreous colour. Sides greyish yellow. .	*annulipes* Meig.

Aëdes (Ochlerotatus) cantans (Meig.).

Culex reptans Meig. (nec Linnaeus) (Klass. u. Beschr. *1*, p. 3) 1804
Culex cantans Meig. (Syst. Beschreib., *1*, p. 6) 1818
Culicada waterhousei Theob. (Ann. Mag. Nat. Hist. (7) *16* p. 674) 1905
Ochlerot. vexans Wesenberg-Lund (Kgl. D. Vid. Selsk. Skr. Nat. og Mat. Avd. (8) *7*, 1, p. 53) .... 1920—1
var. *subvexans* Martini (Ent. Mitt. *11*, p. 159) 1922

Synonymical remarks.

Concerning the synonymy of this species the authors are of very different opinion.

Edwards (1921, p. 304) has named the species *A. maculatus* and says: "This species has generally been known as *A. cantans,* though Meigen's description will apply as well or better to one of the other species of the group. For this reason Lang adopted the later name *waterhousi.* M. Séguy, however, informs me that males of this species are labelled *C. cantans* in Meigen's collection in Paris, and the identification of Theobald, de Meijere and others must therefore be regarded as correct. Meigen himself states that his *C. maculatus* was the male of *C. cantans,* and his statement must be accepted, since the type of *C. maculatus* no longer exists to prove or disprove it. Many of the earlier records of *C. cantans* apply no doubt to other species of the group.

Martini (1922 c, p. 118), in his review of the synonymy of the mosquitoes, is of another opinion: "Zu meiner früheren Auffassung, daß *cantans* Mg. = *variegatus* Schrank *(annulipes* Martini 1920) ist, führte mich Meigens Angabe einer Spur einer schwärzlichen abgesetzten Rückenlinie. Ich glaube jetzt doch, daß ich auf diese Bemerkung zu viel Wert gelegt habe und *cantans* Mg. der *cantans* der späteren Authoren ist, zumal ein entsprechendes Stück in der Sammlung Meigens noch vorhanden ist (Immerhin ist *cantans* in Meigens Icones pictae mit so ockergelben Beinen abgebildet, daß man die Abbildung kaum auf eine andere Art als *variegatus* beziehen kann) während zu Formen, welche *cantans, quartus* oder *excrucians* sein könnten, die Erklärung heißt 1. *C. taeniopus* ♂ ♀ 2. *C. annulipes* ♂ ♀ (*Cul. cantans* Var?).

Maculatus für *cantans* zu setzen, ist aber unmöglich, denn *maculatus* ist 1804 gleich *diversus* Theob., wie Meigens Vergleih mit *fasciatus (nemorosus)* beweißt. Was *maculatus* 1818 war, ist unsicher, die Beschreibung ist noch *diversus.* 1830 wird *maculatus* = *cantans* gesetzt. Ob mit recht im heutigen Sinne, ist nach der abgeänderten Beschreibung mindestens fraglich.

Wenn Edwards verlangt, man solle sich mit der Angabe von Meigen begnügen, daß *maculatus* das *cantans* ♂ sei, so bin ich der Meinung, daß die Wissenschaft Beweise, nicht Behauptungen will. Lassen wir trotzdem hin und wieder die Angabe eines Fachmannes one Beweis in einer Frage entscheiden, so nur in der Voraussetzung, daß er willens und in der Lage war, diese Entscheidung zu geben. Letzteres trifft aber offenbar nicht zu, da Meigen von der Begrenzung der heutigen Arten keine Ahnung haben konnte.

Auch 1818 wird erst *cantans* und dann *maculatus* gebracht. *Cantans* ist also auch der korrekte, nicht nur der gültige Name. Daß unter diesen Namen Meigen alle Farbenstufen verstanden hat, die wir jetzt auf *cantans, quartus* und *excrucians* verteilen, scheint sicher, da sowohl Stücke der erste, wie ein Stück der letzteren Art in der Sammlung Meigen sich unter dem Namen *cantans* befinden soll. "*Waterhousi*" hat keinerlei Wert oder Berechtigung. Der ältere Name ist *reptans* Mg. 1804, der aber als Homonym mit dem damals bei *Culex* stehenden *Simulium* wegfällt."

In Genera Insectorum, Fasc. 194 Edwards (1932, p. 139) placed the species under the name of *A. (O) maculatus* Meig., and this denomination is also found in the papers of Montschadsky (1936, p. 266) and Stackelberg (1937, p. 146). However, Marshall (1938, p. 107) again uses the name of *A. cantans* Meig. and remarks: "Regarding the names *cantans* and *maculatus* Dr. F. W. Edwards writes: "— — — Meigen in 1804 described from male specimens a *Culex maculatus* with dark legs and a *Culex reptans* (this name being homonym of *Culex reptans* Linnaeus) with white-ringed legs, in 1818 he placed *Culex reptans* as a synonym of *C. nemorosus,* a dark legged species, which in view of his original description was presumably an error; in 1830 he wrote: "*Culex maculatus* ist das Männchen von *cantans.*" On account of this last statement I revived the name *maculatus* for *cantans* in 1921, but the correctness of this procedure seems open to question because it is quite possible that Meigen in 1830 meant to write: "*Culex reptans* ist das Männchen von *cantans*", and thus to correct his error of 1818." In accordance with this suggestion the name *cantans* is used rather than *maculatus* in this book."

Description.

Female. Head. In front with yellowish-white narrow curved scales and hairs forming a tuft between the eyes. Vertex ("occiput") in the middle with narrow curved scales and scattered upright forked scales of the same colour. At the sides with yellowish narrow curved scales, with the exception of an oval brownish patch, the upright forked scales are blackish-brown. Eyes bordered with yellowish-white scales. Temporae with a patch of flat, black scales, surrounded by flat white scales. Clypeus blackish brown.

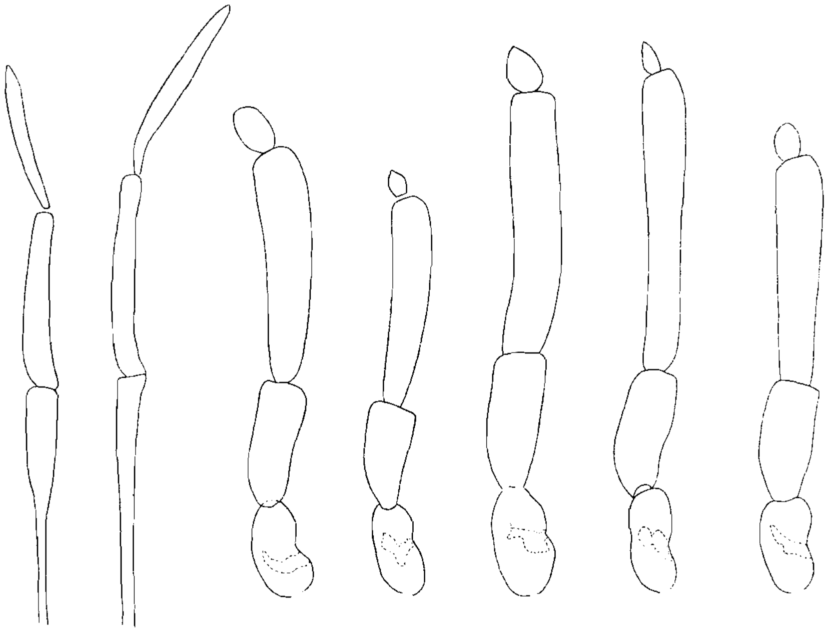

Fig. 55. Palpi of the *annulipes*-group.
a—b, males. a, *A. (O) excrucians* Walk.; b, *A. (O) cantans* Meig.: c—g, females; c, *A. (O) cantans* Meig.; d, *A. (O) excrucians* Walk.; e, *A. (O) annulipes* Meig.; f, *A. (O) flavescens* Müll.; g, *A. (O) cyprius* Ludl. (Aut. del.)

P r o b o s c i s blackish-brown, in the middle with more or less numerous scattered light scales. A n t e n n a e. Tori yellowish-brown or dark brown, with some white scales at the inner side. Flagellum dark brown, with minute white reflecting hairs and at the base of the segments with blackish brown bigger hairs. In light specimens the first segment in the flagellum, as well as the base of the second segment is yellowish-brown. P a l p i (fig. 55 c) of about ¼ the length of the proboscis. Colour dark brown with white and pale brown scales, which form pale spots at the base and distal end of segment 2 and at the apex af the palpi. Segment 3 about twice the length of segment 2 and of about the same thickness. Ultimate segment rather great, oval. T h o r ax. Anterior pronotal lobes with yellowish-white broad, narrow curved and lancet-formed scales. Posterior pronotum below with white narrow curved scales, above with dark chestnut-brown ones. Mesonotum with dark cupreous hair-like scales, which, at the lateral borders of the scutum and towards the antescutellar space are running into whitish narrow curved scales. In many specimens an aggregation of whitish scales form a pair of lateral patches within the middle third of mesonotum. In other specimens a pair of more or less distinct white stripes are running from these spots towards the antescutellar space which is mostly whitish scaled. Scutellum with yellowish-white narrow curved scales and bristles of the same colour. Postnotum brown. Pleurae blackish brown with patches of flat white scales and whitish hairs. Wing scaling blackish brown or dark brown, sprinkled with whitish scales. Halter brown with white scales at the globule. Legs. Front side of femurae blackish brown, more or less conspicuously sprinkled with whitish scales. In the hind-legs the light scales predominate at the basal ⅔ of femur. Back side of femurae lighter; mostly the apical part only dark scaled. Knee spot whitish. Tibiae blackish brown and whitish sprinkled, back side of tibiae lighter. Apex of hind-tibiae mostly dark scaled. Ground colour of tarsal segments blackish brown. The first segment more or less conspicuously with white scales. Segment 2, 3 and 4 with basal white rings in all legs. Segment 5 with basal white ring in mid and hind-leg only; however in one Norwegian specimen from Alnabru (Ak 13) some white scales are found at the base of segment 5 even in the fore-leg. The width of the white rings is rather variable. Claw formula: 1:1; 1:1; 1:1. Abdomen blackish brown with white basal bands, which are not narrowed in the middle. These bands are more or less distinctly separated from the basal lateral white patches. Mostly also segmental narrow apical white bands are found. The dark parts with scattered white scales. Venter blackish brown, with a broad basal white band and a more narrow apical white band. In some specimens the white scaling predominates. The first abdominal tergite with a bush of flat white scales. Hairs at the border of the abdominal segments yellowish brown. Cerci long. Length of body: 7—8 mm (W-L), length of wing: about 5 mm.

As to the variability of this species Martini (1931, p. 270) remarks: "Die Art ist recht variabel. Der Thorax zeigt meistens ein dunkles Reh- bis Kastanienbraun mit den beiden lichteren Flecken, doch verbreitet sich das Grau oder Gelbgrau manchmal über die ganzen seitlichen Teile des

Thorax. Das ist besonders beim ♂ der Fall. Die lichte Zeichnung kann fast reinweiß oder mehr gelb sein. Sie neigt eher zu einem nur wenig gelblichen Weiß, doch giebt es Ausnahmen. Sie kann ausnahmsweise auch ganz fehlen. An den Kopfseiten können die schwarzen Schuppen die weißlichen mehr oder weniger weitgehend verdrängen. Auf dem Abdomen kann die lichte Beschuppung mehr lebhaft hellbraun oder mehr weiß sein. Sie kann fast Verschwunden sein, nur durch bräunliche Borsten angedeutet, so daß das Abdomen von oben einfarbig schwarzbraun aussieht, oder kräftig entwickelt sein. Die eingestreuten hellen Schuppen können weißlicher oder bräunlicher, zahlreicher oder verschwindend wenig sein, und die helle Apikalbeschuppung kann kaum angedeutet oder kräftig sein. Auf den Flügeln kann die Einstreuung heller Schuppen gering oder sehr stark sein. Das gleiche gilt für die p. Extreme Varianten der ♂ lassen sich von *semicantans, quartus* und wohl selbst von *excrucians* nicht mit sicherheit unterschieden. Auch die weißen Ringe an den p sind sehr veränderlich. Sie können stärker ausgebildet sein, oder auch schwächer."

M a l e. A n t e n n a e shorter than the proboscis. Torus blackish brown. Flagellum of the same colour, but with light rings. Hair-whorls greyish brown or blackish brown with lighter reflections, in some specimens faintly fox-coloured. P r o b o s c i s dark brown, in the middle more or less distinctly sprinkled with yellowish-white scales. P a l p i (fig. 55 b) exceed the proboscis by about the length of the ultimate segment. The long segment gradually thickened towards apex. Segment 4 and 5 of about the same length. Colour blackish brown, on dorsal side with patches of white scales at the base of segment 2, 3, 4 and 5, mostly also towards the distal end of segment 3. Hair-tufts greyish brown, in some specimens with reddish-brown reflections. T h o r a x : the whitish, grey or yellowish-grey scaling more or less extended at the sides of mesonotum, leaving only a broad median stripe of dark fawn-coloured or chestnut-brown scaling. Length of wing: well over 5 mm. The abdominal white basal hands are connected with the lateral patches, which may extend towards the apex of the segments. The posterior abdominal segments with narrow apical bands.

T e r m i n a l i a (fig. 56). Basistyle with conspicuously extended basal lobe carrying numerous hairs. At the base of the basal lobe, a long, stout spine and several bristles. Dististyle somewhat curved, with straight claw. Stem of

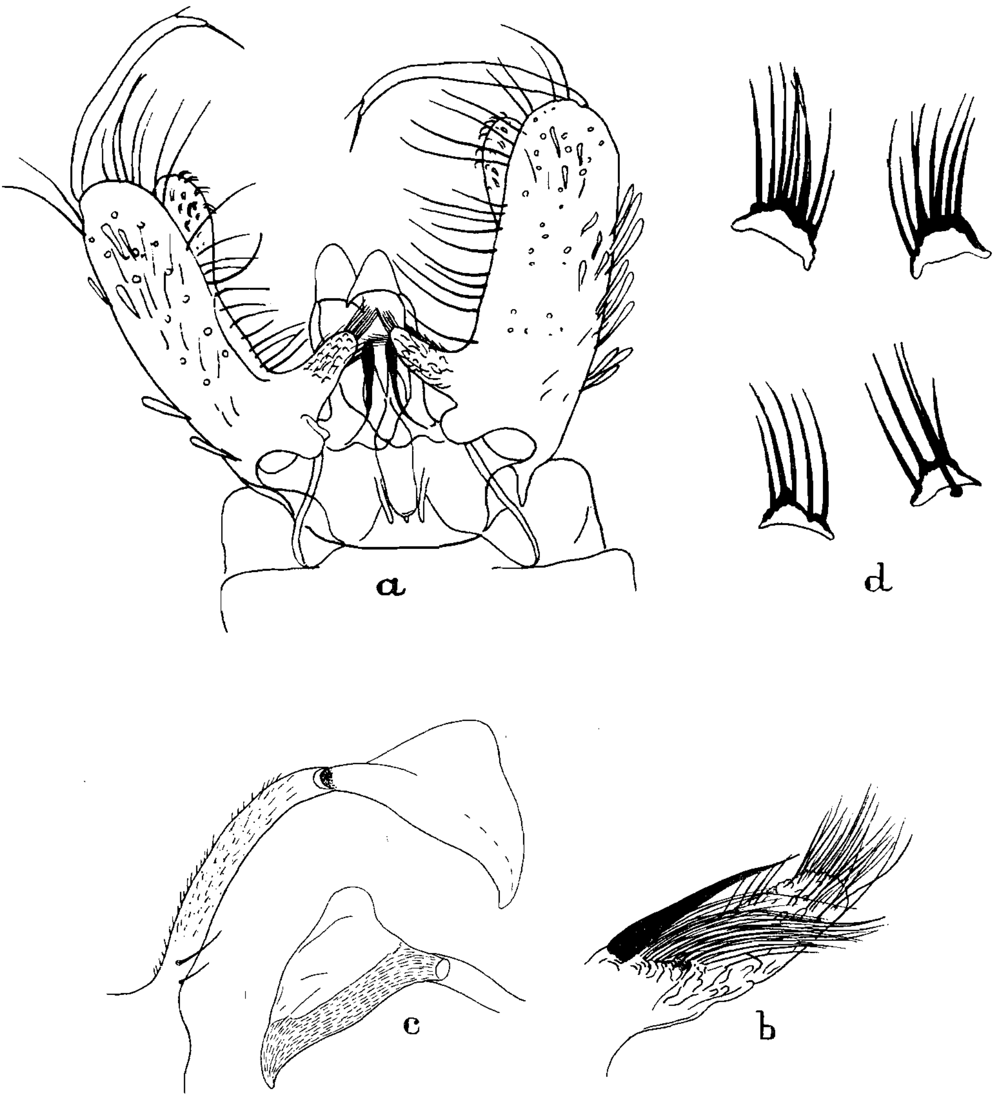

Fig. 56. *Aëdes (Ochlerotatus) cantans* Meig.
a, Terminalia (total view); b, basal lobe; c, claspette; d, lobes of the 9th tergite. (Aut. del.)

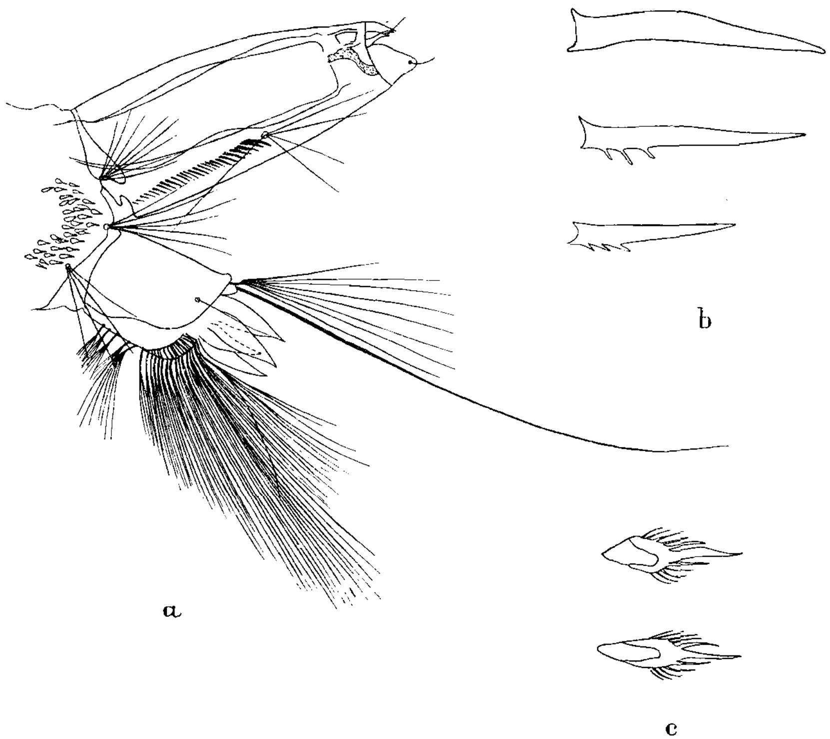

Fig. 57. Larva of *A. (O) cantans* Meig. in 4th instar.
a, Terminal segments of larva; b, pecten teeth; c, comb-scales.
(Aut. del.)

the claspette rather straight; appendage with a short petiole and with very broad wing. Proctiger with stout paraprocts. Lobes of the ninth tergite with 5—12 spines. Mean value of 20 specimens (both lobes counted): 7.0.

L a r v a (fig. 57). Head broader than long. Antenna rather short, slightly curved, distinctly spinose and somewhat tapering outside the antennal tuft. Mouth-brushes combed. Inner frontal hairs behind mid frontal hair. Dorsal prothoracic formula about: 3, 1, 1; 1; 1; 1; 3; 1. Comb with about 35 scales, which are broader at the base and tapering in a prominent median spine surrounded by stout bristles. Siphon rather broad, gradually tapering towards apex. Siphonal index about: 2.8. Pecten reaching about the middle of the siphon, with about 27 teeth. Siphonal tuft of about

⅓ the length of the siphon, inserted at about the middle of the siphon and with about 5 hairs. Saddle not encircling the anal segment. Dorsal brush with an inner pair of tufts with about 15 cratal and 5 precratal hairs. Anal gills mostly somewhat shorter than saddle.

Table 18.
Larval chaetotaxis of *A. (O) cantans* Meig.

Number of branches in				Number of		Siphonal index
Frontal hairs			Siphonal scales	Comb. tuft	Pecten teeth	
out	mid	inner				
6—11 6.9 (21)	2—3 2.1 (33)	3—4 3.1 (30)	4—7 5.5 (19)	28—48 35.6 (20)	21—33 27.6 (20)	2.4—3.1 2.8 (12)

Geographical distribution.

Denmark: 2. *Sjælland:* ♂ ♀ ("St": Stæger!); Tjustrup (W-L); Hillerød (W-L), *Møen:* Ulvshale! L: May 1939 (H. Anthon).

Sweden: *Sk:* ? (coll. Zett!); *Sm:* ♀ (Hagl!); *Öl:* Borgholms alvar, 6. vii. 1914 (Wahlgr);*Smd:* ♀ ("*O. maculatus* Mg. ♀ *cantans* Mg. *Waterhousi* Thb). F. W. Edwards det. 1920"); *Upl:* Holm! ♂ (Bhn).

Norway: *Ø: 1. Hvaler:* Kirkeøya, Arekilen, L: 27. v. 1928 (♂ ♀) (LRN); AK: *13. Aker:* Alnabru, L: 15. v. 1930 (♂ ♀) (LRN); *15. Lørenskog:* Lørenskog, L: 12. vi. 1929 (♀) (LRN); Bø: *2. Røyken:* Nærsnes, L: 15. v. 1938 (♂ ♀) (LRN); *4. Lier:* Gilhus, L: 8. v. 1938 (LRN); *13. Øvre Eiker:* Fiskumvannet, ♂ ♀: 3. vi. 1928 (LRN).

Finland: *Al(A):* ? Finnström (Frey). *Ab(V):* Karislojo (J. Sahlb., Hellén! Forsius!). *N(U):* Tvärminne Zool. Stat. (Frey); Tvärminne! ♂: 10.—14. vii., ♀: 11. vi.—17. viii. (Storå); Helsingfors (Frey); Helsinge! (Hellén); *Ka(EK):* Kymmene (Salmén). *Kl(LK):* ? Kexholm (Frey). *Ok(Kn):* ? Kajana (Hellén). *Ks(Ks):* Kuusamo (Frey).

Distribution outside Denmark and Fennoscandia.

According to Marshall (1938, p. 202), *A. cantans* has been recorded in England from the counties: Bucks, Essex, Hants, Herts, Hunts, Kent, Middlesex, Norfolk, Oxon, Shropshire, Suffolk, Surrey, Sussex and Yorks. In Belgium it has been found at "Destelbergen, Mont-

Saint-Amand, Vinderhaute, Melle, Waershoot, Eecloo (Fl.), Genval, Wesembeek (Tonnoir), Willebroeck (Jacobs) (Goetghebuer 1925, p. 215). In F r a n c e, Séguy (1923, p. 116) records it from: "Beauvais (Villeneuve). Fôret de Saint-Germain (Alluaud), Verrières, Femours (Surcouf), Rambouillet (Villeneuve, Séguy), Meudon, Vinsennes, Fontainebleu (Séguy), Bois-le-Roi, Val d'Aubray (Alluaud), Moyenne, Nièvre: Saint-Saulge (Séguy), Creuse: La Celle-Dunoise, Vienne, Antigny (Alluaud), Var: Cavalière (Clerc)." The specimens recorded by Brolemann (1919, pp. 78—79) under the name of *cantans*, are most probably *annulipes* Meig. According to Martini (1920, p. 125), *cantans* has been found in G e r m a n y in the environs of Hamburg, at Rostock and Danzig, and the same author remarks (1931, p. 271): "Sie ist offenbar in Süddeutschland häufiger als in Norden." Peus (1929 b, p. 7) records the species from: "Finkenkrug bei Berlin, Finkenkrug-Briselang, Grünewald, Nauener Wald (Mark), Plagefenn (Mark) Grumsin, Friedberg (Hessen), Usedom auf dem Darss, Prerow (Darss), Rostocker Heide und Unterspreewald bei Schlepzig." Eckstein (1919, p. 65) says: "Bis jetzt beobachtet in den Wäldern um Straßburg i. E., Rosheim, Brumath U—E., Galfingen, Reichweiler, Herlisheim O—E. Ebenso fand ich sie in den Wäldern bei Stuttgart." The same author (1920, p. 101) also found the species in Baden. Schneider (1914, pp. 29—32) records *cantans* from the environs of Bonn, and Edwards (1921, p. 304) records the species from Urdingen and Frankfurt a. d. Oder (Riedel). From S w i t z e r l a n d the species is recorded from: Bern (Bangerter 1926); Orbeebene, Kanton Waadt (Galli-Vall. u. Roch. d. J. 1908). Further eastwards *cantans* has been recorded from E s t l a n d : at the island Dagö and Pernau (Dampf 1924, p. 6), from L e t t l a n d : "bei Zarnikau, zwischen Uexküll und Oger, zwischen Anting und Caukciems am Kanger-See, bei Riga und bei Grobin" (Peus 1934, p.77), from P o l a n d (Tarwid 1935) and from L i t h u a n i a : Bialowies (Sack 1925, p. 263). As to the last mentioned find, Sack records the specimens under the name of *annulipes* Meig., but Martini (1928 c, p. 23) considers the specimens as *cantans*, which, in view of the locality, is most likely. *A. cantans* has also been recorded from A u s t r i a : Polzleinsdorff (Ujhelyi: Edwards 1921, p. 304), H u n g a r y : Balaton (Mihályi 1941), I t a l y : "Also females probably of this species from — — — Italy (Turin, Sangone: Coll. Bezzi)" (Edwards 1921, p. 304). According to Stackelberg (1937, p. 148) the distribution in U S S R is: "From the central and southern parts of Leningrad district (Stackelberg!), Moskva district: environs of Voronesch (Schtschelkanovzev), Ukrainskoe Polesje (Rybinskiji), Ukraine: Charkov distr. (Schokov), Dnepropetrovsk distr. (Guzevitsch!), Lower Volga distr. (Martini), Sverdlovsk distr. (Sverdlovsk: Kolosov 1928, Perm distr.: Mitrofanova 1929), Southern coast of Crimea (Velitschkevitsch 1931) and in North-Kaukasia (Pjatigorsk, Schelesnovodsk, Essentuki: Mess! 1929)." [84] Further Wnukowsky (1928, pp. 163—64) records the species from the following localities in the western part of Siberia: distr. of Tomsk: Tomsk, Ssokolowsky, Novo-Alekssandrowskoje, Schukowo, Tschulym, Rayon Norym: Permitino, (in Tomsk males as well as females have been caught, from the other localities females only are recorded).

[84] Translated from the Russian text.

Biology.

Concerning this species in Denmark, Wesenberg-Lund (1920—21, p. 49) remarks: "Everywhere in the forests of North-Seeland as well as in probably most of our Danish forests *O .cantans* is extremely common in July and August. It is a well marked forest mosquito which only rarely leaves the woodlands" and (p. 50): "There is undoubtedly only one generation in the course of the year. The larva is hatched in the middle part of April and the imagines about a month later; the life of the imago lasts about three months; the eggs are not ripe before two or three weeks after hatching; then the ponds dry out, and in summer (July—August) the eggs are laid on the dry bottom; here they hibernate; when in autumn the ponds get water again, this has no influence upon the hatching of the eggs. I have never found a single *O. cantans*-larva in autumn, the eggs must undoubtedly pass a freezing period before being hatched."

In Norway I have hitherto found single adults only of *A. (O) cantans,* especially in the woodland in Kirkeøya (Ø 1) and at the edge of the forested land at Fiskum (Bø 13). From other places larvae only have been found. Most localities have this in common that they are situated in forested country. In Kirkeøya (27. v.) masses of larvae in the last instar were found in a partly dried up pool, the bottom of which was covered with decaying leaves. The next day many of the larvae had cast their skin and changed into pupae. At Nærsnes (Bø 2) larvae were found in a pool in composite woodland of birches and alder, at about 5 m above sea level and 20—30 from the sea-shore. At Lørenskog (Ak 15) as well as at Alnabru (Ak 13) pupae and larvae were found in pools which were only partly shaded. Merely from two places the degree of pH has been quoted. Larvae of *A. (O)cantans* have been found associated with larvae of *Th. morsitans* and *A. (O) punctor.* In Finland male adults have been recorded on the 10.—14. vii. and females on the 11. vi.—17. viii., all from Tvärminne. Even the few records at hand indicate that *A. (O) cantans* occurs somewhat later in our region than in more southern places. Further investigation is required to settle the question if the partly shaded breeding-waters were exceptions only, or if the species in its northermost boundary of distribution may also breed outside the woodland.

As to the biology and ecology of this species in Germany Martini (1931, p. 270) says: "*Aëdes cantans* ist überwiegend ein Waldmoskito, dessen Larve teils in den mit Laub bedeckten Vertiefungen des Waldbodens im Frühjahrsregen oder Schneeschmelzwasser vorkommt, teils auch an Waldrändern und in lichten Wäldern auf mehr begrünten Gewässern, jedoch niemals ausserhalb des Waldes oder gar in völlig offenem Gelände. Sein Häufigster Genosse ist *A. nemorosus* Meig. *Cantans* tritt später auf. — — — Die Flugzeit liegt entsprechend ein wenig später als bei *nemorosus* Mg. und dauert länger, bis in den August." Peus (1929 b, p. 7) agrees with Martini concerning the site of the breeding-waters: "Alle Funde liegen im Walde, die Waldformation als solche ist bedeutungslos.". Interesting details have been published by Marshall (1938, p. 201): "As previously mentioned, both *A. cantans* and *A. annulipes* breed in temporary, non-salt pools; but whereas the latter species generally breeds in open or only partly shaded, situations, *A. cantans* almost always selects densely shaded ones. At Hayling Island, the removal of bushes and overhanging trees from around a prolific breeding place of *A. cantans* resulted in the entire disappearance of the larvae for a long period. When, however, the bushes were eventually allowed to grow again the water became re-infested with larvae."

Eckstein (1820 p. 100) represents the common opinion saying: "Sie gehören — — — zu denjenigen Arten der Aedinengruppe die im Laufe eines Sommers nur eine Generation hervorbringen." However, finds of *cantans*-larvae in late summer have provoked the question if occasionally more generations may develop in one year. Peus (1929 b, p. 7) discusses this problem: "Auffallend ist der Fund der erwachsenen Larven Ende August (Swinemünde). Er wirft die Frage auf, ob nicht, wie es ja auch bei anderen Arten (*dorsalis*- und *communis*-Gruppe) vorzukommen scheint, gelegentlich auch Bei *A. maculatus* eine Abweichung von der früher als Norm hingestellten einen Generation eintritt." He quotes the opinion of Dyar and Martini and he concludes: "Einwandfrei läßt sich die eventuelle Mehrzahl der Generationen wohl nur durch Zucht in Freilandskäfigen erweissen." In contradistinction to this Goetghebuer (1925, p. 214) says: "Il y a plusieurs generation par an; il n'est pas rare de rencontrer en septembre des adults fraichement eclos." More recently Marshall (1938, p. 200) has published detailed researches on these problems: "*A. cantans,* like *A. flavescens* and *A. annulipes* is a one-generation species. — — — Information regarding the biology of one-generation species is at present far from complete. Both field and laboratory investigations show that, when an "egg-sown" area of *A. cantans* is subject to intermittent flooding, only a certain proportion of the eggs hatch into larvae during each period of immersion. From this it follows that, when (as frequently must happen) premature drying-up of a breeding place of *A. cantans* destroys the existing larvae, unhatched eggs remain in situ ready to infest with larvae the next accumulation of water. Shute, for example, located (in Surrey) a number of woodland pools in which *A. cantans* was established and kept them under continuous observation throughout the spring and summer of the year 1929. He found that when breeding places which had dried out during periods of drought became subsequently flooded, first instar larvae of *A. cantans* appeared in the water soon after."

According to the literature *A. cantans* is an annoying bloodsucker. Thus Wesenberg-Lund (1920—21, p. 49) remarks: "More than ten yars ago I had observed that, at a time when *O. communis* had almost ceased to sting, another larger mosquito with white-banded tarsi appeared. The bite of this species *(O. cantans)* was much worse."

Martini (1931, p. 271): "Die Mücke ist sehr blutgierig. Sticht auch tags heftig im Walde." As to the conditions at Straßburg, Eckstein (1920, p. 340—1) records: "*Cantans* ist dort die häufigste Art; sie ist hier neben *vexans* der eigentliche Urheber der Recht großen Mückenplage.". Detailed investigations have also been published by Goetghebuer (1925, p. 214): "La ♀ pique énergiquement et est extrêmement aggressive. La piqûre est douloureuse, ses effets persistent souvent pendant plusieurs jours et se manifestent sous forme d'œdème parfois très prononcé, accompagné de démangeaisons. Par le grattage, la piqure peut déterminer un abcès ou un phlegmon."

Aëdes (Ochlerotatus) annulipes (Meig.).

C. annulipes Meig. (Syst. Beschreib., *6*, p. 241) 1830
A. (O). quartus Martini (Üb.Stechmücken, p. 128) 1920

Systematical remarks.

As to this species Edwards (1921, p. 305) says: "Meigen mentions the dark stripe in the middle of the mesonotum, the banded abdomen and pale femora, and I therefore have no doubt that the species is correctly identified. Zetterstedt, Ficalbi and others who have described the entirely yellow abdomen of the female probably had *A. lutescens* before them. In this species the abdomen almost always has distinct yellowish-white bands, which are situated mainly or entirely at the bases of the segments."

In the collection of the Naturhistoriska Riksmuseum in Stockholm I found a female with the label: "*O.? annulipes* Mg. F. W. Edwards det. 1920." As to this specimen Edwards (1921, p. 305) remarks: "A female from Sweden (Östergötland, Haglund) may be this species, but is perhaps more probably *A. excrucians.*" I have compared this female with German specimens of *annulipes* and Scandinavian *excrucians,* and I feel rather certain that it is *A. excrucians* Walk.

Description.

As no distinct female adults of this species from Denmark or Fennoscandia are at hand, and as Wesenberg-Lund's description (1920—21, pp.51—52) does not fully agree with the characters typical for *annulipes,* I here prefer to quote the description by Martini (1931, p. 324).

"Weibchen: Kopf: Hinterkopf in der Mitte gescheitelten blaßgoldenen Sichelschuppen und aufrechten blaßgoldenen Gabelschuppen, seitlich mit schwarzen flachen Schuppen und ebensolchen Gabelschuppen. Wangen mit einem Streifen flacher gelbweißer Schuppen, dann ein Fleck flacher schwarzer und dann wieder weißliche flache Schuppen. Tiefer im Nacken um das Hinterhauptloch blaßgoldene Sichelschuppen und ebensolche oder schwarze Gabelschuppen. Scheitel mit einem Busch blaßgoldener Sichelschuppen und goldener Haare. Augenrand oben von einem Breiten Streifen weißgoldener Sichelschuppen und der Reihe der schwarzen Orbitalschuppen begleitet. Die Augen schwarz mit kupfrigem Wiederschein. Rüssel gut so lang wie die f_1, an der Spitze nicht verdeckt, am Grunde schwarzbraun mit einigen helleren Schuppen, in der Mitte stehen diese so dicht, daß sie ein breites unscharfes helles Band um den Rüssel bilden, am Ende ist der Rüssel wieder fast rein dunkelbraun beschuppt. Dunkle Schuppen befinden sich besonders an den Seiten des Mittelstückes reinlich. Die Labellen dunkelbraun. Tori graubraun, mit einem Kranz schmutzig weißer Schuppchen. Geißel ziemlich hellbraun mit weißlichem Flaum und schwarzen Haaren. Clypeus schwarzbraun. Taster $\frac{1}{5}$ so lang wie der Rüssel. Beschuppung braunschwarz mit eingestreuten hellen Schuppen, besonders an der Spitze zu einem hellen Fleck zusammentreten und mit braunschwarzen Borsten. Lobi des Prothorax braun mit gelblichweißen Sichelschuppen und blaßgoldenen Borsten. Mesonotum braunhäutig mit feinen Sichelschuppen, die in der Mitte und forn mehr haarförmig, nach den Seiten und nach hinten etwas breiter werden. Diese Schuppen sind in einem mittleren Streifen mehr dunkelgolden bis kupfrig, an den seiten mehr blaßgolden bis grauweiß, weißlich auch vor dem Scutellum. Durch Reflex kann in dem mittleren dunkleren Streifen ein hellerer Medianstrich und können die Seitenwülste etwas dunkler erscheinen. Scutellum braun mit 3 Gruppen schmaler gelblichweißer Sichelschuppen und blaßgoldener Borsten. Mesophragma hellbraun mit dunkelbrauner Längskante. Pleuren dunkelbraun mit großen Flecken breiter, gelblichweißer, flacher Schuppen und weißlich schimmernden Borsten. Proepimeren nur in der untersten Ecke mit flachen weißen Schuppen, sonst mit ziemlich schmalen blaßgoldenen bis dunkelgoldenen Sichelschuppen. Flügel: Stamm der Gabel r_{2+3} ungefähr halb so groß wie die Gabel. Stamm der Gabel m_{1+2} etwas kürzer als der untere Gabelast. Die radiomediane Querader liegt um mehr als eigene Länge von der Mediocubitalen. Beschuppung der Flügel braunschwarz und gelblichweiß gemischt. Schwinger braun mit reichlicher blassen flachen Schüppchen um den Knopf und auf dem Stiel. f weißlich, oberseits in der Mitte stark dunkel gesprenkelt, mit braunschwarzem Subapikalring, und gelblichweißem Kniefleck, t unterseits überwiegend blaß beschuppt, oberseits dunkel, mit gelblichen Schuppen gesprenkelt, gegen die Spitze stärker verdunkelt. Erste Tarsenglieder ebenso, nur dunkler und mit einem weißlichen Basalfleck. Tarsalglieder 2—4 der p_1 mit weißem basalen Ring, der auch bei 5 angedeutet sein kann, im übrigen schwarz, unterseits etwas lichter, der p_2 und p_3 mit deutlichen weißen Ringen am Grunde der Glieder 2—5. Der Rest der Glieder schwarz. Klauenformel 1:1, 1:1, 1:1. Abdomen braunschwarz mit eingestreuten lichten Schuppen und blaßgelblichen Randborsten der Segmente. Basale weißlichgelbe Binden können vorhanden und in der Mitte erweitert sein, schmal oder recht breit. Apikal gelbliche Säume, wenigstens an den letzten Segmenten, vorhanden. An den Seiten weiße basale Seitenflecken. Unterseiten schwarz mit breiten, in der Mitte schmal getrennten, gelblichweißen Seitenflecken und ebensolchen Spitzensäumen. Das 1. Abdominalsegment mit einem Busch flacher Schuppen, die in der Mitte pechschwarz oder so mit lichten Säumen, weiter seitlich schmutzig gelblichweiß sind, und weißlichen Haaren. Das 8. Segment oberseits überwiegend hell beschuppt. Abdominalende spitz. Cerci lang. — — — Die Art ist ebenfalls sehr variabel. Vielfach ist die Thoraxzeichnung mehr rostbraun mit grauen Seiten, und diese Formen sind dann von helleren *Aëdes cantans* Meig. kaum zu trennen. Vielfach sind die Seitenteile mehr golden, und dann ergeben sich Schwierigkeiten inder Trennung von excrucians Walker. In letzteren Fällen um so mehr, als in goldenen Seiten oft auf den Seitenwülsten und in der Mitte der scapularen Area Felder rötlichbrauner Schuppen auftreten. Leicht kenntlich sind die Stücke mit weißgrauer Beschuppung der Seiten und reingoldener des Mittelstreifens. In einem Fall ist dies aber so breit wieder durch gelbgraue Schuppen geteilt, daß nur 2 schmale, reingoldene Linien auf gelblich weißgrauem Grunde bleiben. Die helle Beschuppung des Abdomens ist ebenfalls weißlicher oder gelblicher, stark entwickelt oder recht schwach. Jedoch nicht so schwach wie bei den extremen Stücken von *cantans*. Die Füße haben stärkere oder schwächere Ringe. Diese können am letzten Hintertarsenglied fast fehlen oder ungefähr ¾ des Gliedes einnehmen."

Concerning the differential characters of *A. annulipes* and *A. cantans,* Marshall (1938, p. 195) remarks: "Female adults of *A. annulipes* and *A. cantans* are distinguishable from one another by coloration; the ground colour of the abdominal tergites being dark brown in the former species and blackish-brown in the latter one. The abdominal bands and the leg rings (as well as the pale scales which are frequently scattered over the dark portions of the tergites) are yellowish in *A. annulipes* and white in *A. canans.* The wings of these two species are similarly contrasted in coloration; the dark scales being brown in each case, and the pale scales yellow in *A. annulipes* and white in *A. cantans*" and (p. 199): "The mesonotal coloration is also distinctive — that of *A. cantans* being dark brown, occasionally with an aggregation of pale scales forming a pair of lateral patches within the middle third, and that of *A. annulipes* being golden-brown, relieved by a more os less obvious, broad, median stripe of darker brown."

Male. Head. Antennae long. Torus dark brown. Flagellum brown and greyish ringed. Hair-Whorls fox-coloured, running to greyish towards the distal part of the hairs. Palpi exceed the proboscis by about the length of the ultimate segment. Colouring dark brown with whitish scaling at the base of segments 2 and 3 and at the apex of segment 3. Segments 4 and 5 with a dorsal patch of white

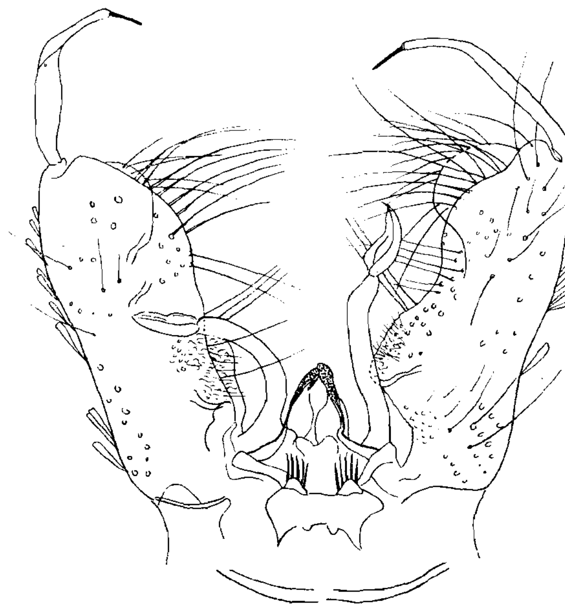

Fig. 58. *Aëdes (Ochlerotatus) annulipes.* Terminalia (total view). (Aut. del.)

scales at the base. Hair-tufts at the three ultimate segments long, grey with fox-coloured reflections in the basal part. Abdomen. Ground-colour brown. The segmental light basal bands distinct and broad.

Terminalia. (Fig. 58.) Basistyle with inconspicuous basal lobe and apical lobe of moderate size. Basal lobe with short hairs, apical lobe with rather long, curved hairs. Stem of the claspette rather thick and somewhat swollen towards apex. Appendage: a stout spine with a comparatively broad wing. Proctiger with distinctly sclerotised paraprocts. Lobes of the ninth tergite with 5 spines.

Larva. The larva of this species is very similar to that of *A. cantans.* Martini (1931, pp. 236 and 326) points out as differential characters of *annulipes* the greater siphonal index (3.0), the smaller number of pecten teeth (21) and the shape of the comb-scales. In *annulipes* the principal spine of the comb-scale is stouter than in *cantans,* but not so prominent as in *excrucians.* However, Marshall (1938, p. 197) *remarks:* "To separate the larva of *A. annulipes* and *A. cantans* from one another, is, however, by no means an easy matter. Various larval characteristics, notably the frontal hair formula, the character of the comb-scales, the number of pecten-teeth, the siphonal index and the gill-saddle index — have been said to provide specific indications; but the examination of large numbers of larvae of these two species, collected at Hayling Island and elsewhere, shows that none of the above-mentioned characters is of any value for purpose of differentiation, owing to the fact that the two ranges of variation which have to be contrasted in each case either coincide or very greatly overlap. In regard to the number of comb-scales however, the ranges of variation overlap to a less detrimental extent; the figures for the third and fourth instars respectively, being 35—44 and 31—44 in the case of *A. annulipes,* and 32—36 and 28 —38 in the case of *A. cantans.* When, in either of the said instars, the number of comb-scales happens to fall within both ranges, the larvae of the two species in question appear to be morphologically indistinguishable."

Geographical distribution.

Denmark: 2. *Sjælland:* Environs of Arresö (W—L) (?N!).

Sweden: *Sk:* Lund! ♂ (coll. Zetterstedt).

Distribution outside Denmark and Fennoscandia.

Concerning the general distribution of this species, Edwards (1921, p. 305) remarks: "It may be regarded as the western European representative of *A. excrucians,* though the ranges of the two species must overlap to some extent."

In England, *A. annulipes* is recorded from the counties: Berks, Cambs, Hants, Herts, Hunts, Norfolk, Shropshire, Surrey, Sussex, Warwickshire and Yorks (Marshall 1938, p. 189), in the Netherlands from Ghent (Edwards 1921, p. 305), in Belgium from: Melle, Vinderhaute (Fl.), Melsbroeck, Genval, Wesenbeck (Tonnoir) (Edw. 1921, p. 305). In Germany the species has been found at: "Hamburg, bei Travemünde, aus West- und Ost-Mecklenburg" (♂, Martini 1920, p. 129), "bei Warnemünde, in der Rostocker Heide". (Peus 1930 c, p. 671), "Berlin, Spreewald" (Peus 1929 b, p. 7), "am Ostaufer des Mellensees, Unterspreewald bei Schlepzig, Finkenkrug" (Peus 1930 c. p. 671), "aus der Bodensee-Gegend, aus Schwaben" (♂ ♀, Martini 1931, p. 326). Free city and Territory Danzig: "aus der Danziger Niederung, aus dem Kreis Danziger Höhe" (♀, Martini 1920, p. 129). It is also recorded from Poland (Tarwid 1935, 1938 a), Austria: Speising (Mik. t. Edwards 1921, p. 305) and from Hungary: Pressburg (Mik), Tultscha (Mann) (♂, Edw. 1921, p. 305), Balaton (Mihályi 1941). Further east it is recorded by Peus (1934 b, p. 77) from Letland: "Zarnikau, bei Anting am Kanger See, zwischen Anting und Caukciems, am Rande des Tirulmoores bei

Bienenhof (Riga)." As to the distribution in U S S R, Stackelberg (1937, p. 155) remarks: "recorded from Leningrad distr. (Montschadskiji), Voronesch distr. (environs of Voronesch: Schtschelkanozev) and Lower Volga distr. (environs of Saratov: Martini)" [85] Further Wnukowsky (1928, p. 164) records females from the western part of Sberia: District of Tomsk: Tomsk, Anastasievska, Moltschano and Tschulym.

Biology.

There are no records on the biology and ecology of this species, from Denmark and Sweden.

From Germany, Martini (1920, p. 129) records: "Die Art habe ich von lichten Erlengebüschen in der Nähe von Hamburg, aus lichtem Gehölz bei Travemünde, aus lichtem Kiefernwald, vor dem Erlen standen, der Danziger Niederung, an ähnlichen Stellen aus dem Kreis Danziger Höhe. Die Männchen flogen noch bis in den Juli, und waren in dieser Zeit bei weitem die Mehrzahl der von mir gefangenen *Aëdes*-Männchen mit geringelten Beinen." In accordance with this are the observations published by Peus (1932, p. 139): "*A. annulipes* Meig. erreicht trotz an sich größere Häufigkeit nicht die Hohe Abundanz von *A. maculatus*. Die Art ist in der Provinz Brandenburg allgemein typish für Erlenbruchwälder und ist auch im Spreewald an derartigen Formationen gebunden." As to the stages of development. Martini (1931, p. 326) says: "Die Larven traf ich bei Schwerin an verschiedenen Stellen in der Nähe von Wald oder Gebüsch an. Ihre Hauptplätze scheinen im Halbschatten zu liegen. — — — Die Larven kamen nur nach sehr langen Zeiten zum Atmen an die Oberfläche und hielten sich sonst tief unten zwischen dem Kraut in der Nähe des Grundes. Die Larven sind ungefähr mit den anderen der Gruppe gleichzeitig erwachsen." From the British Isles Marshall (1938, p. 198) records: "The females are in evidence from April to September, but the eggs laid by them do not hatch into larvae, until early in the following year. Locality records indicate that, in Britain, *A. annulipes* is a less common species than *A. cantans*. — — — *A. annulipes* (breeds) in open swamps or partially shaded, temporary, non-salt pools."

Aëdes (Ochlerotatus) riparius Dyar and Knab.

A. (O) riparius D. K. (J. N. Y. Ent. Soc., *15*, p. 213) 1907
A. (O) semicantans Martini (Sitzgber. u. Abh. naturf. Ges. Rostock. N. F., *7*, p. 205) 1920

Systematical and synonymical remarks.

It is with some hesitation that I quote this species under the name of *riparius*, as I have no American specimens for comparison. Edwards (1921, p.305) made the following remarks on *A. semicantans* Martini: "Resembles *A. maculatus* in coloration, being darker than the other four species of the group; the mesonotum has a more definite dark

[85] Translated from the Russian text.

median stripe than in *A. maculatus,* and the abdominal segments have distinct basal white bands, which are narrowed in the middle, but the two are not easily separated, except by characters of the male hypopygium and larva, which are perfectly distinct. The hind femora are largely pale on the outer side, and the tarsal rings are broader than in *A. maculatus.* One or two North American species resemble this rather closely, but I have not at present been able to identify *A. semicantans* definitely with any North American form. The larva is very distinct on account of the small number of scales in the comb of the eighth segment." However, in his last work, Edwards (1932, p. 139) has placed *semicantans* as a synonym of *A. riparius,* but without any comment.

Studying the literature at hand (Dyar 1928, p. 211, pl. L, fig. 163 and Matheson 1929, p. 122, pl. XV, fig. 6), I have the impression that the American adults of *A. riparius* do not fully agree in the coloration with the Norwegian specimens, but in the principal characters, i. e. the male terminalia and the comb of the larva, there is such conformity that I hold to the opinion of Edwards. Possibly further investigations may prove that the American and European specimens belong to different races of the same species.

Description.

Female. Front of head with golden bristles forming a tuft between the eyes. Vertex ("occiput") below with creamy narrow curved scales, which at the sides are replaced by darker or bronzy-brown ones; above with yellowish-white narrow curved scales intermingled with creamy upright forked scales, at the sides with black upright forked scales. Eyes bordered with yellowish-white narrow curved scales. Temporae with flat blackish scales, which posteriorly are replaced by whitish ones. Clypeus blackish brown. Proboscis blackish brown, in the middle lighter scales indicate a ring. Antennae. Tori dark leather-brown, darker at the inner side and with some light scales. Flagellum. The first segment and the base of the second segment leather-brown, the remainder blackish brown with minute white hairs and at the base of the segments bigger black hairs. Palpi blackish brown with light scales at the base and apex of the long segment. Thorax. Anterior pronotal lobes with white narrow curved scales and dark golden hair-like scales. Posterior pronotum above with light golden narrow curved scales, and with white ones at the lower corner. Mesonotum with a broad median stripe of cupreous, hair-like scales, blending into more light-golden scales at the sides. Anterior to the wing-root with cupreous scales. The antescutellar space with whitish narrow curved scales and long, dark bristles with pale golden reflections. Scutellum with golden narrow curved scales and pale golden bristles. Pleurae with patches of white scales. Scaling of the wings blackish, sprinkled with light scales. Halteres. Stem yellowish-white, sprinkled with darker scales, especially towards apex. Distinct sub-apical blackish-brown ring. Knee spot white, distinct. Tibiae at the front-side sprinkled with dark and light scales, towards apex dark. Back-side with a light longitudinal stripe. Tarsal segments. Colouring of first segment, in fore and mid-leg, as in tibiae; in hind-leg with a narrow white basal ring. Tarsal segments 2 and 3 in the fore-leg, 2—4 in the mid-leg and 2—5 in the hind-leg blackish with white basal ring. In one of the two specimens at hand, the tarsal segment 4 of the fore-leg has some white scales at the base. The length of the white rings at the tarsal segments 2—5 of the hind-leg are about: $\frac{2}{5}$, $\frac{1}{2}$, $\frac{1}{2}$, $\frac{1}{4}$. Abdomen blackish brown with a few, scattered white scales, the tergites with basal white bands, which are interrupted in the middle, and with extended lateral white patches. Segment 6—8 with apical white bands. Venter white and black sprinkled, with an indication of a longitudinal median black stripe and with white apical bands. Length of wing well over 4 mm.

The Norwegian specimens agree well with the description of Martini, but the American *riparius* have a somewhat different colouring. Thus neither Dyar (1928, p. 211) nor Matheson (1929, p. 122) mentions the interrupted abdominal basal bands, per contra both emphasise that the dark parts of the abdominal tergites are more or less sprinkled with light scales. Further the white tarsal rings seem to be somewhat broader in the American specimens than in the European *riparius*.

Male. Head. Vertex ("occiput") above with greyish scaling. Proboscis blackish brown or metallic, in the middle sprinkled with lighter scales. Antennae. Flagellum white ringed. Hair-whorls greyish brown with fox-coloured reflections. Palpi with whitish scales at the base, in the middle and towards apex of the long segment. Further a patch of white scales at the base of the penultimate segment. Mesonotum with a dark brown-golden median stripe, sides greyish. Abdomen. Tergites dark

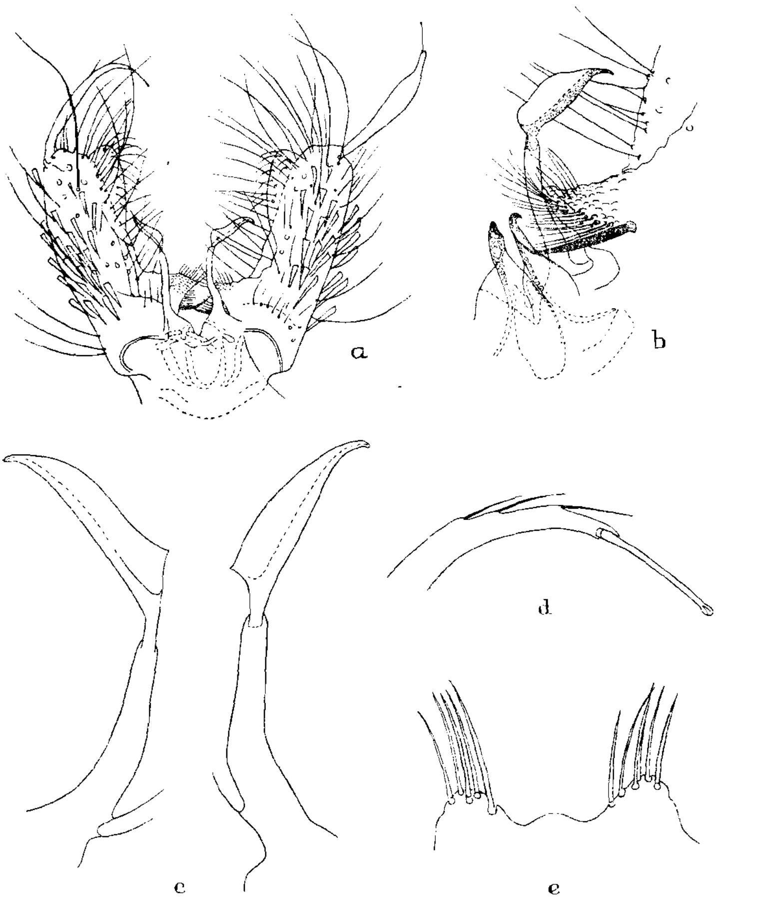

Fig. 59. *Aëdes (Ochlerotatus) riparius* D. K.
a, Terminalia (total view); b, terminalia (detail) with basal lobe, claspette; phallosome and paraprocts; c, claspette; d, tip of dististyle with claw; e, lobes of the 9th tergite. (Aut. del.)

metallic with white basal bands, which are narrowed in the middle. Scattered light scales on the dark ground.

T e r m i n a l i a (fig. 59). Basal lobe of the basistyle prominent, of about half the length of the basal lobe of *cantans;* basally with a stout spine and rather long bristles, apically with somewhat shorter hairs. Stem of the claspette faintly tapering towards apex, at the base with some bristles. Appendage with short petiole, rather long and curved at

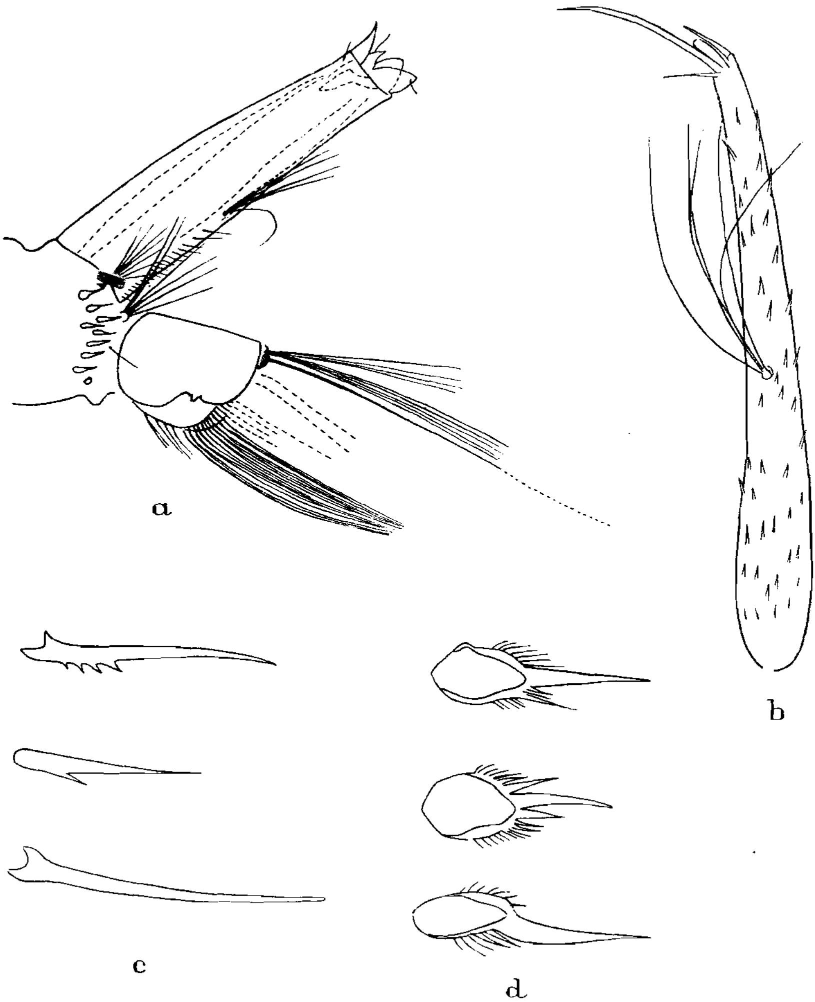

Fig. 60. Larva of *A. (O) riparius* D. K. in 4th instar. a, Terminal segments of larva; b, antenna; c, pecten teeth; d, combscales. (Aut. del.)

apex. Wing more narrow than in *cantans*. Diststyle somewhat widened in the middle. Proctiger with strongly sclerotised and apically hooked paraprocts. Lobes of the ninth tergite with 4—10 spines. Mean value of 9 specimens (both lobes counted): 6.9.

L a r v a (fig. 60). Head with rather short, strongly spinose antennae. Antennal tuft with 5 hairs, inserted outside the middle of the antennal shaft. Among the antennal apical bristles a stout spine. Frontal hairs: outer: 4, mid-fr.: 2, inn.fr.: 2; the inner frontal hair behind the mid-frontal hair. Comb with 8 stout scales in a row. Comb-scales with a stout median spine, on each side with one or two smaller spines and some bristles. Siphon faintly tapering. Siphonal index: 3.6. Pecten with 19—20 slender teeth, which basally extend into one or more denticles. However, the most distally-placed pecten-teeth have no denticles and are more widely separated than the rest. Siphonal tuft inserted within the basal half of the siphon, with 5 hairs of about 1/3 the length of the siphon. Saddle long. In the single larva at hand the annal gills are broken off, but according to Martini the length of the anal gills is well over 3/4 the length of the siphon.

Geographical distribution.

S w e d e n : *Sm:* ♂! (Bhn); *Vrm:* Rörbäcknes! L: 29. v. 1934 (LRN); *Dlr:* Ludvika! Brunnsvik! ♂: 2.—13. vi. ? ♀: 12. vi. 1928 (KHF).

N o r w a y : B ø : 13. *Øvre Eiker:* Fiskum. ♂ ♀ 3. vi. 1928 (LRN).

Distribution outside Denmark and Fennoscandia.

As to the distribution of this species, Edwards (1921, p. 305) remarks: "Northern Europe; apparently widely distributed, but local." He has examined male adults from: Hamburg (Martini), Berlin (Stobbe) and Posen(?) (Loew). Further Martini (1931, p. 77) records the species from G e r m a n y : "östlich Gr.-Müritz (L), Schwerin (L) und Ostpreussen, ♂ (Skwarra)." According to Edwards a male adult from coll. Winthem is probably from A u s t r i a. Peus (1934 b, p. 77) records it from L e t t l a n d : "hinter den Dünen bei Zarnikau, ♂, 8. vi. 1934" and Tarwid (1938 a—b) from P o l a n d. From USSR, Stackelberg (1937, p. 149) records: "In USSR recorded from Leningrad distr. (Peterhoff: Montschadskiji) and in Moskva distr. (Schingarev), Ukraine (Rybinsk), Sverdlovsk distr. (Sverdlovsk: Kolosov, environs of Perm: Mitrofanova 1929) and at the southern coast of Crimea (Velitschenkevitsch 1931). The records from Voronesch distr. (environs of Voronesch: Schtschelkanovzev 1928) relates to *A. (O) behningi* Mart."[86] Further reords are: Basin of Dnjepr: outlet of river Samara (Dolbeskin 1928). The species is also distributed in Canada and USA and, according to Dyar (1928, p. 211) it has been found in "Ontario, Manitoba, Saskatschewan, Alberta, Wisconsin, iMnnesota, North Dakota, Montana, Colorado." Recent records are: Michigan (Irwin 1941).

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[86] Translated from the Russian text.

Biology.

A single larva of *A. riparius* has been found in a pond at Rörbäcknes (*Vrm.* Sweden), but, unfortunately, no details have been put down. The few Norwegian and Swedish adults at hand were all caught in the first days of June, which may be taken as an indication that this is mating time in our region. This is, moreover, confirmed by observations from Lettland published by Peus (1934 b, p. 77).

As to the finds in Germany, Martini (1930, p. 331) says: "Die Larve hatte ich 1919 im Moor östlich Gr.-Müritz 2 mal, in stark verkrauteten Moorwässerns, nahe der Küste, nicht weit vom Ort gefangen. Ferner dort im Moor in Torfstichen, die nicht noch alt, wohl höchstens 2-jährig waren und als Vegetation nur in der Tiefe, von oben im Frühjahr unsichtbar, *Sphagnum* enthalten. — — — Unsere Art fand sich einzeln auf der Wasserfläche."

From U S A Dyar (1928, p. 202) records: "The larva occur in early spring pools on the prairie especially the shallow but large ones under aspens etc. The species is at home where the forest is breaking up into prairie, but extends somewhat into the forest and into the open grassy plains." Similar observations have been published by Matheson (1929, p. 122). In a paper on *Aëdes riparius* D. K., Dyar makes the following remarks concerning the nature of the breeding waters: "The pools have no connection whatsoever with the river, but are prairie pools."

Aëdes (Ochlerotatus) excrucians (Walker).

Culex excrucians Walk. (Ins. Saund., p. 429) 1856
C. abfitchii Felt. (Bull. N. Y. State Mus., *79*, p. 381) 1904
C. siphonalis Grossbeck (Can. Ent., *36*, p. 332) 1904
Aëdes sansoni D. K. (Can. Ent., *41*, p. 102) 1909
?Culicada surcoufi Theob. (Bull. Mus. Paris, *18*, p. 59) 1912
Aëdes euedes H. D. K. (Mosq. N. a. Cent. Am. a. W. I., *4*, p. 686) 1917
?A. aloponotum Dyar. (Ins. Insc. Mens., *5*, p. 98) 1917
A. excrucians dytes Martini. (Ent. Mitt., *2*, p. 164) 1922

Synonymical and systematical remarks.

On account of differences in the larvae, Martini (1922 d) proposed to separate the European *excrucians* from the American form, under the name of *excrucians* var. *dytes*. However, in his last review of the palaearctic mosquitoes (1931, p. 289), Martini does not maintain this separation, and Edwards (1932, p. 138) place *dytes* as synonymous with *excrucians*. Martini (1931) and Matheson (1929, p. 113) place *aloponotum* Dyar as synonymous with *excrucians*, but Edwards (1932, p. 138) has placed *aloponotum* as a separate species, however, with the remark: "(*?excrucians*, var.)". From the descriptions published by Dyar (1928, p. 201—203, pl. 48, fig. 156, 157) I have gained the impression that the two are closely related forms and I therefore hold to the opinion of Martini and Matheson.

As to the synonymy of this species Edwards (1921, p. 305—306) remarks: "*A. excrucians* is evidently one of the commonest species of the group on the European continent (it has been described by Martini as *A. abfitchii*), and it is therefore not surprising that it has frequently been determined either as *C. cantans* or as *C. annulipes.* I consider, however, that the evidence of the original descriptions and of the types in Meigen's collection in Paris is sufficient to allot these names to other species.

I learn from M. Séguy that the type male of *Culicada surcoufi* has been lost, so that there is now very little prospect of determining Theobald's species with certainty. A female which M. Séguy sent me for examination might have been either this species or *A. annulipes.* A female in Meigen's series of *C. cantans* in the Paris Museum is almost certainly *A. excrucians.*"

Concerning the variability of *excrucians,* Martini (1931, p. 290) says: "Auch diese Art ist variabel. Vor allem können das lichte Gold der Scutumseiten mehr oder weniger ausgebreitet und die gelbe Beschuppung auf dem Abdomen mehr oder weniger stark sein. Meist sind die basalen gelben oder weißlichgelben Bänder recht breit und nehmen oft ungefähr die Hälfte der Segmente ein. Bei extremen Stücken ist vom dunklen Grunde nur noch ein quer über jedes Segment subapikal verlaufender dunkler Streifen vorhanden. Die Farbe der hellen Schuppen kann einheitlich sein oder es können deutlich weißlichere in den apikalen und Basalbinden von mehr gelben, in den schwarzen Teilen eingestreuten, unterscheidbar scheinen. Manchmal erreichen die Basalbinden die Seitenflecken nicht, erscheinen also als mittlere Basalflecken. Auf den Seiten des Kopfes können auch beim ♀ Flecken dunklerer Schuppen auftreten, die den Augenrand nicht erreichen. Im Flügel können oft stark die dunklen Schuppen überwiegen. — — — Es sieht kaum ein männlicher Thorax aus wie der andere. In den Hypopygien aber konnte ich keine Unterschiede entdecken und ebensowenig deutliche Unterschiede an den Larven. Auffällig dunkel, besonders auch an den Beinen, waren Stücke von Hilleröd-Dänemark, ♂ und ♀. Thorax dunkel goldbraun mit schwacher hellgoldbrauner Zeichnung. Die lichten Schuppen am Abdomen und den Beinen sehr trübe. Besonders auffallend waren einige Stücke von Apfelbeck aus Jugoslavien, dadurch daß sie einen überwiegend schwarz und weissen Eindruck machten. Die dunklen Teilen des Abdomen sind fast rein dunkel beschuppt und helle Schuppen im wesentlichen auf sehr breite Basalbinden beschränkt und viel weniger gelblich als gewöhnlich. Die apikalen Binden fast verschwunden. Dieselben schärferen Gegensätze auch an den Tastern, die Fühler fast rein dunkelgrau, nur mit etwas rauchbraunen Anflug. Die Flügel mit verhälltnismässig wenigen hellen Schuppen. Dies Tier würde man zunächst nicht für einen *excrucians* halten, doch erlaubt das Hypopygium keine andere Deutung."

Description.

Female. Head in front with small golden narrow curved scales and pale golden bristles forming a tuft between the eyes. Vertex ("occiput") in the middle with pale golden narrow curved scales, at the sides blending into dark golden or cupreous ones. Vertex above with pale golden upright forked scales, at the sides with blackish brown upright forked scales. Temporae with flat golden scales, just behind the eyes mostly a patch of blackish brown scales. Eyes bordered with golden narrow curved scales and black bristles. Clypeus dark brown. Proboscis sprinkled with blackish brown and light scales; the light scales predominate in the middle of the proboscis, forming a more or less distinct light band. Labellae black. Antennae. Tori yellowish-brown or brown with rows of light scales, especially at the inner side. Flagellum. First segment yellowish brown with light scales. Second segment yellowish-brown at the case; the remainder of flagellum dark brown or blackish, with minute white hairs, and at the base of the segments bigger black hairs. Palpi (fig. 55 d) about ¼ the length of the proboscis. Segment 3 about twice the length of segment 2 and mostly distinctly narrower. Ultimate segment chiefly small, broad oval and tapering apically. Scaling blackish brown with scattered light scales, which may form a light patch at the apex of palpi. Bristles blackish, numerous and of moderate length. Thorax. Anterior pronotal lobes dark brown, above with golden narrow curved scales and bristles of the same colour, below with lancet-shaped, yellowish-white scales. Posterior pronotum above with golden cupreous narrow curved scales, below with yellowish-white ones. Mesonotum brown or blackish brown, in the middle with hair-like cupreous scales, laterally and posteriorly running into narrow curved scales of the same colour. A pair of fine golden lateral stripes may occur, or the golden scaling predominates the sides of mesonotum. The antescutellar space with golden scales. S c u t e l l u m brown with three patches of yellowish-white or golden narrow curved scales and pale golden bristles. P o s t n o t u m dark brown. P l e u r a e. The flat scales at the upper mesepisternum and at the sternopleura yellowish-white, the mesepimeral scale patch white. W i n g, with intermixed dark brown and yellowish-white scales. H a l t e r brown with yellowish-white stem and scales of the same colour at the globule. L e g s. Femurae yellowish, sprinkled with dark scales, especially distinct towards apex. Sub-apical dark ring mostly indistinct. Knee spot yellow, distinct. Tibiae at front side blackish brown and yellowish sprinkled, back-side lighter. The dark scales especially predominating at apex of tibiae. Tarsal segments. First segment brown and yellowish sprinkled, towards apex dark; dorsally with a narrow dark stripe, laterally and on ventral side chiefly light scaled. The white ring at the base of the first segment more or less distinct. Segment 2 and 3 in the fore-leg with conspicuous white ring, segment 4 and 5 generally entirely dark. In a few specimens at hand some white scales may be seen at the sides of the fourth segment. In mid-leg the tarsal segments 2—4 and in hind-leg the segments 2—5 dark brown with white ring at the base. In the tarsal segments of the hind-leg the basal white rings occupy about half the length of the segments. Claw formula: 1 : 1; 1 : 1; 1 : 1. A b d o m e n. First abdominal tergite with a bush of flat yellowish scales which laterally blend into whitish scales. Tergites blackish brown sprinkled with yellowish-white or yellow scales which form basal light hands. Segments basally with lateral patches of white scales. In segment 7 and mostly also in segment 8 the light scaling predominates. Abdomen pointed. Cerci rather long, dark brown sprinkled with yellowish-white scales. Venter blackish brown with yellowish-white apical bands widening at the sides, the anterior segments may also have basal bands of similar colour. Length of body about 6 mm. (W—L); length of wing about 5 mm.

In the northern specimens of *excrusians* the cupreous ground colour of thorax is darker than in the central-European specimens at hand. However, some specimens from Naturhistoriska Riksmuseum in Stockholm (labelled: "Haglund" and most probably from Östergötland) have the light yellow colouring of the Central European *excrucians,* and their abdomen is chiefly yellowish-white scaled. In the German *excrucians* the flat scales at the upper mesepisternum and at sternopleura are distinctly yellow whereas the scale-patch at mesepimer is white. These contrasts are not so conspicuous in the northern specimens although the scale-patches at the upper mesepisternum and at sternopleura have a tinge of yellowish. In most specimens from the southern Fennoscandia the contrasts in the colouring of the tarsalia are not so conspicuous.

However, specimens from Norwegian mountainous regions as well as from localities in the far north have a quite different colouring. Among the rather variable specimens at least two types may be separated. In one type the ground-colour of the thoracic scaling is light cupreous and the sides of thorax silver-white, thus leaving a broad median cupreous stripe only. In these specimens the pleural scales are distinctly white, and the light abdominal bands either yellowish-white or more or less sprinkled with whitish scales. Ground-colour of abdominal tergites nearly black. The dark scales predominate in the legs and the contrast is rather conspicuous in the tarsal colouring. In several respects these specimens call to memory the *excrucians* described from Jugoslavia by Martini.

In the other northern type the scaling of the thorax is distinctly darker, and the light colouring is reduced to a pair of lateral patches, as in *cantans*. However, the specimens may be differentiated by the more or less extended yellowish-white abdominal scaling and the yellowish scale-patches at the upper mesepisternum and at the sternopleura. In these northern *excrucians* the dark scaling predominates in the wings and the legs.

I have examined 6 specimens from the collection of Zetterstedt, sent me under the name of *cantans*. One male and one female were labelled "Lapponia", another female was labelled: "*C. cantans* Meig. ♀. Lapponia" in the hand-writing of Zetterstedt. A slide-preparation of the male terminalia proved that the spesimen is *A. excrucians* Walk., and I also consider the two females as *excrucians*. To be sure, the light scales at the abdominal tergites are sparsely represented, but the specimens fall within the range of variation described above. The colouring of the thorax and the tarsal segments also agree well with the northern *excrucians*. I therefore consider it right to strike the record "Lappland" for the species *A. cantans*. Further investigation is desirable to settle the distribution as well as the variation of the northern *excrucians*.

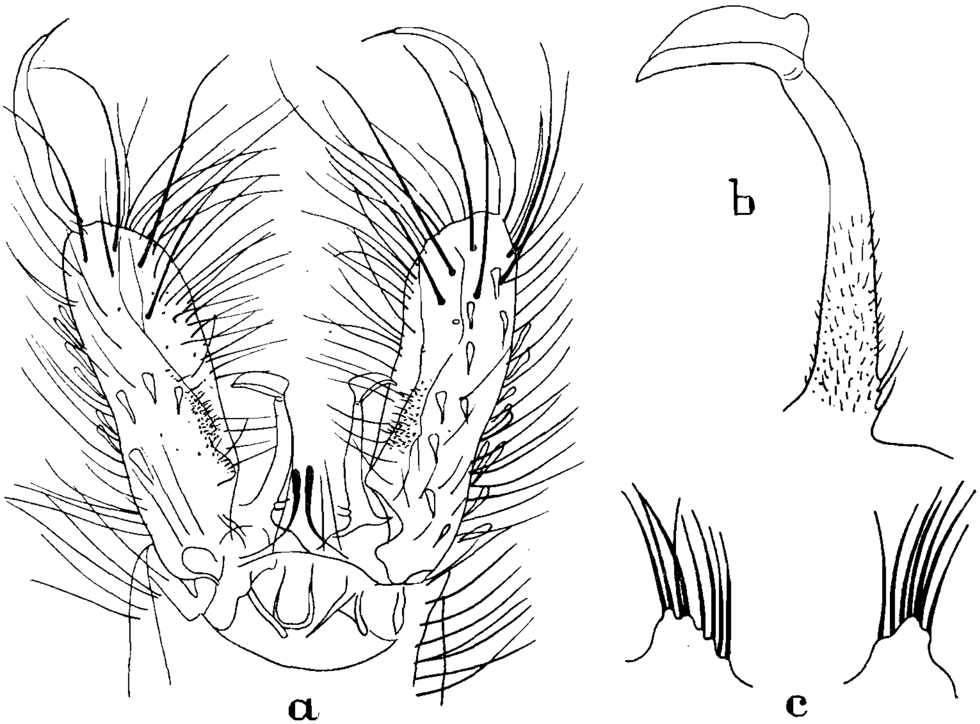

Fig. 61. *Aëdes (Ochlerotatus) excrucians* Walk.
a, Terminalia (total view); b, claspette; c, lobes of the 9th tergite.
(Aut. del.)

Male. Antennae. Tori dark brown. Flagellum dark and light ringed. Hair-whorls grey with fox-coloured reflections. The palpi exceed the proboscis with the ultimate and about one third of the penultimate segment. The long segment conspicuously swollen towards apex. Segment 5 about 4/5 the length of segment 4, which is distinctly broader than the ultimate segment. A more or less distinct ring of light scales at the base of segment 2 and at the joint of segment 2 and 3. Segment 3 chiefly light scaled at dorsal side, ventrally entirely light scaled, apex blackish brown. Ultimate and penultimate segments blackish brown, both with a patch of white scales at the base. Hair-tufts long, especially near apex of the long segment and at segment 4, with fox-coloured reflections.

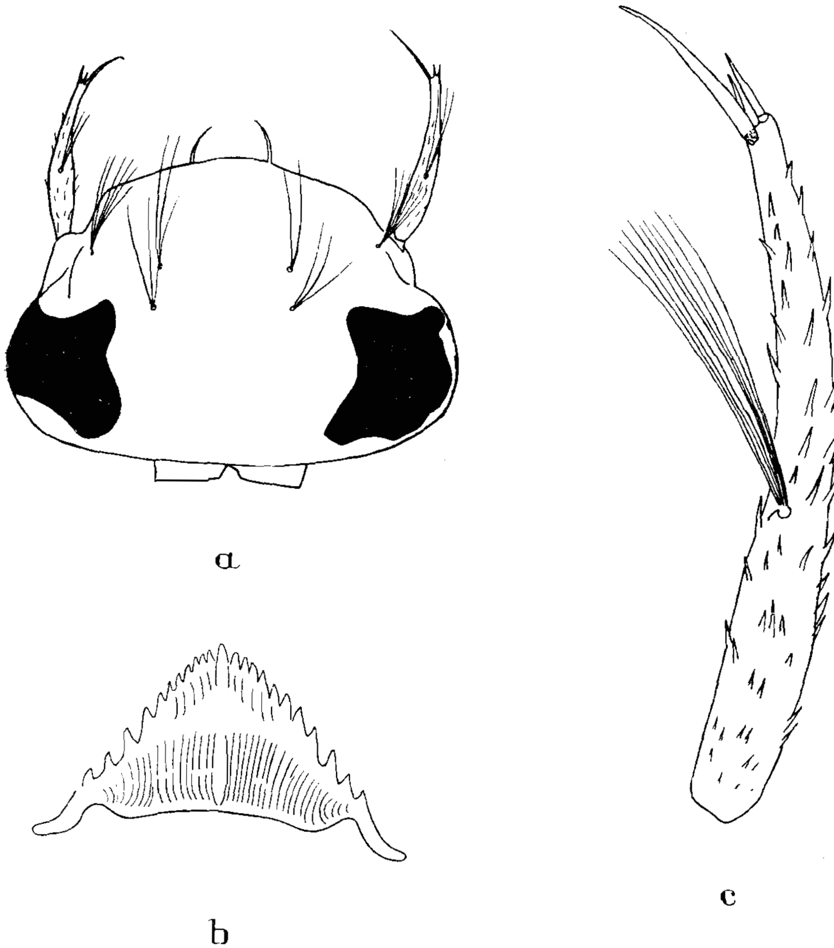

Fig. 62. Larva of *A. (O) excrucians* Walk. in 4th instar. a, Head; b, mentum; c, antenna. (Aut. del.)

T h o r a x with extended light golden scaling at the sides of scutum. A b d o m e n. The light basal bands connected with the lateral patches. Dark parts more or less sprinkled with yellowish-white scales. Lateral hairs at the abdominal segments with fox-coloured reflections.

According to Martini (1931, p. 290) the male palpi of the Central-European *excrucians* exceed the proboscis with about half the length of the ultimate segment. They there-

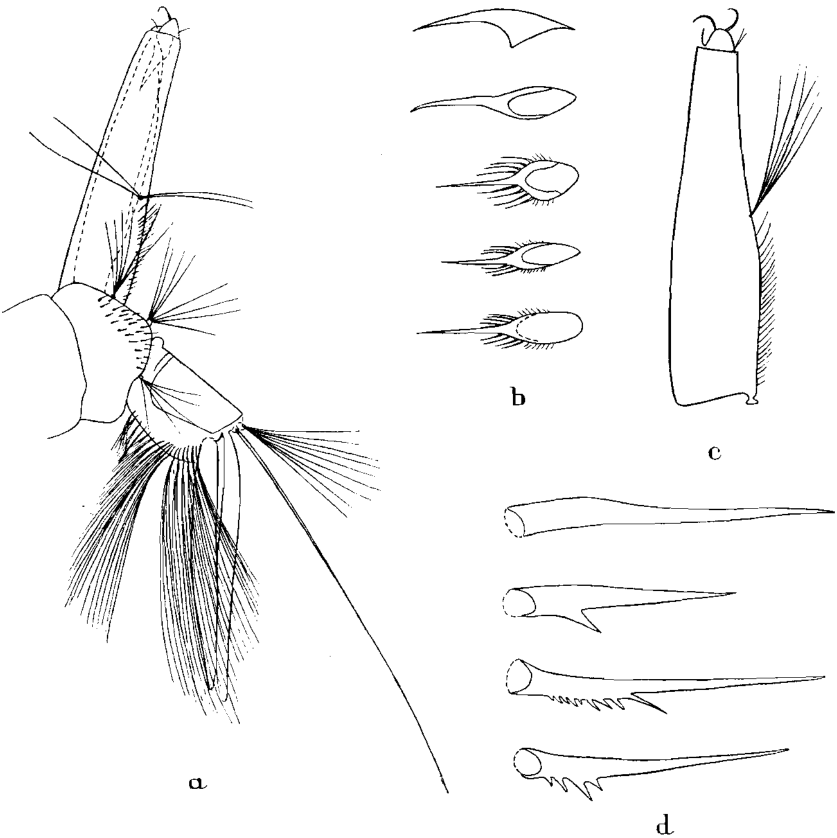

Fig. 63. Larva of *A. (O) excrucians* Walk. in 4th instar. a, Terminal segments of larva; b, comb-scales; c, siphon; d, pecten teeth. (Aut. del.)

fore seem to differ considerably in this character from the northern specimens.

T e r m i n a l i a (fig. 61). Basistyle with prominent apical lobe with rather long, somewhat curved hairs. Basal lobe represented by a long, rugose area clothed with short hairs. Dististyle somewhat curved and with a long, straight claw. Stem of the claspette distally curved and distinctly tapering. Appendage not petiolate, spine slightly curved and with a low wing. Lobes of the ninth tergite with 4—14 somewhat slender spines. Mean value of 30 specimens (both lobes

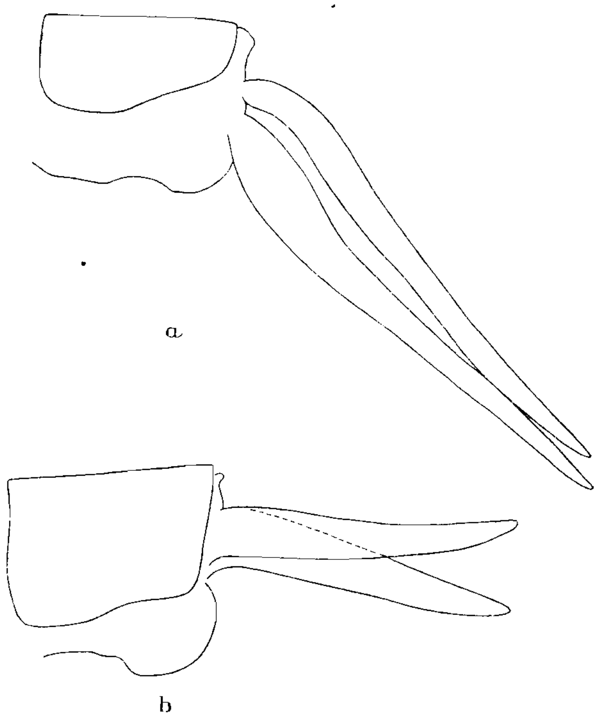

Fig. 64. Variable length of anal gills in larva of *A. (O) excrucians* Walk. (Aut. del.)

counted): 7.1. Proctiger with strongly sclerotised paraprocts.

L a r v a (figs. 62—63). Head broader than long. Antennae rather short, strongly spinose and faintly curved, tapering from the insertion point of antennal tuft. Tuft with about 9 hairs, inserted well over $1/3$ the length from the base of the antennal shaft, and of about half the length of the shaft. One of the bristles at the apex of the antenna, stout and long. Inner frontal hair behind the mid-frontal hair. Dorsal prothoracic hair-formula about: 2, 1,1; 1; 2; 1; 3; 2. Comb with about 30 scales, which are basally broad and tapering into a slender principal spine. At base of spine (and top of scale) there are spinules and fine hairs on either side. Siphonal index about 4.0. Siphon rather slender, distinctly tapering from the middle. Pecten not reaching the middle of siphon, with about 20 slender teeth with small denticles at the base. The most distally-placed pecten teeth are without denticles and are more widely separated than the remainder. Siphonal tuft with about 5 hairs, of about half the length of the siphon. The apical hair on the ventral valve stout and hook-shaped. Saddle not encircling the anal segment. Dorsal brush with an inner pair of tufts with about 9 hairs and an outer pair of long, stout hairs. Ventral brush with about 16 cratal and 6 precratal hairs. Anal gills of variable length (fig. 64), but generally of about the length of the saddle.

Table 19.

Larval chaetotaxis of *A. excrucians* Walker.

Number of branches in				Number of		Siphonal index
Frontal hairs			Siphonal tuft	Comb. scales	Pecten teeth	
out	mid	inner				
4—9 7.1 (46)	1—3 1.8 (75)	2—5 2.8 (69)	3—8 5.1 (50)	22—40 30.2 (41)	17—26 20.4 (64)	3.7—4.2 4.0 (13)

Geographical distribution.

Denmark: 2. *Sjælland:* København! ♂ ♀ (Stæg.); Hestehave, Hillerød, L: 16. iv., P: 8.—14. v., A: 15. v. (W-L); Tjustrup (W-L); Eremitagen (W-L).

Sweden: *Sk:* Ängelholm! ♀: 2. vi. 1915 (Ringdahl); *Sm:* Ekeberg, Visjön! ♀: 17. vii. 1940 (KHF); *Ög:* ♂ (P. Wahlb!); *Smd:* ♂. (Auriv!); Vrm: Degerfors, Kulbäckslid! ♀: 5. viii. 1940 (KHF); *Dlr:* Falun, Norslund! ♂: 5. vii. 1931 (Tjed.); Sundborn, Toxen! ♀ (Klefb.); Sundborn, Karlsby! ♂ (Tjed); Ludvika, Brunnsvik: Hillbo! ♀: 28. vi. 1921 (KHF); Ludvika, Brunnsvik, Stgn! ♀: 17. vi. 1919 (KHF); Ludvika, Brunnsvik, Trädgård! ♀: 2. vii. 1926 (KHF); Särna, Fulufjäll! ♀: 15. viii. 1927 (KHF); Idre, Töfsingspark! ♀: 3. viii. 1925 (KHF); *Jmt:* ?♀ (Zett!); *Lpl:* Jockmock, Mieskarjavnga! ♀: 21. vii. 1923 (KHF); "Lapponia"! ♂ ♀ (Zett.); Abisko, L. IV: 23. v. 1938, L. III: 30. v. 1938, L. IV: 4. vi., L. II and III: 2. vi. 1938 (A. Thieneman).

Norway: AK: *5. Ski:* Sværsvann, P: 1.vi.1930 (♂♀) (LRN); *11. Asker:* Arnestad farm (in cow-stable), ♀: 15. v. 1938 (LRN); HEs: *2. Vinger:* pond 1 km north of Kongsvinger, L: 12. vi. 1932 (LRN); *4. Brandval:* ditches at the highway about 8 km north of Kongvinger, L:12. vi. 1932 (LRN); *5. Sør-Odal:* creek, 11. vi. 1932 (LRN); *7. Grue:* ♀ (Siebke); Kongshaug farm, ditches, L: 12. vi. 1932 (LRN); H E n : *20. Trysil:* Lutnes farm, pond, L: 31. v. 1935 (LRN); Nybergsund, ♀: 7. vi. 1935 (LRN); Indbygda, ♀: 7. vii. 1934 (LRN); K. Sætre farm (in cow-stable), ♀: 17. vii. 1933 (LRN); Østby, ♀: 28. ix. 1934 (LRN); *21. Amot:* ♀ (Siebke); Strand farm at Ossjøen (in cow-stable), ♀: 27. vii. 1933 (LRN); *23. Ytre Rendal:* Storsjøen, in house, ♀: 6. vii. (LRN); environs of Holla outfarm, ♀: 21. vii. 1943 (LRN); L: 9. vii. 1944 (♀) (LRN), L: 3.—4. vii. 1945 (♂ ♀) (LRN);. Nøklebekken, ♀: 23. vii. 1943 (LRN); *28. Tynset:* pond: L: 24. vii. 1930 (LRN); *30. Engerdal;* Elvdal, ♀: 12. vii. 1931 (LRN); Sundet farm, in house, ♀: 5. vi. 1934 (LRN); O s : *25. Ringebu:* pond at highway, ♀: 26. viii. 1931 (LRN); O n : *37. Dovre:* ♀ (Siebke); Fokstuen, L: 23. v. 1937 (♂ ♀) (LRN); Domås, L: 24. v. 1937 (LRN); ♀: 25.—28. vii. 1930 (LRN); B ø : *2. Røyken:* Sundly, L: 8. v. 1938 (LRN); *13. Øvre Eiker:* Fiskumvann, P ♂♀: 3. vii. 1928 (LRN); B v : *22. Nes:* ♀ (Siebke); V e : *18. Nøtterøy:* ♀: 6. vii. 1927 (O. Sømme); A A i *30. Evje:* Hetså farm, L: 8. vi. 131 (LRN); S T y : *23. Osen:* Ramsøy, ♀: 16. vii. 1938 (S—R); N n v : *69. Andenes:* Andenes, ♂♀: 22.—26. vii. 1941 (S—R); T R y : *5. Bjarkøy:* Bjarkøy, ♀: 16. vi. 1936 (S—R); *16. Helgøy:* Hushattøy, ♀: 8. vii. 1935 (S—R); T R i : *28. Øverbygd:* Øverbygd, ♀: 26. vii. 1926 (S—R); Bjerkeng, ♀: 2. vii. 1927 (S—R); Raavann, ♀: 6. vii. 1922 (S—R); Frihetsli, ♂ : 27. vii. 1922 (S—R); *29. Balsfjord:* Fjeldfrøskvann, ♀: 30. v. 1927 (S—R).

F i n l a n d : *Al(A):* ?Föglö! ♀ (Forsius); *Ab(V):* ?Kuustö (Lundstr.); Eriksberg! ♂ (Bonsd., Edw. det.); Karislojo! ♀ (J. Sahlb. Forsius., Frey, Hellen), ♂ (J. Sahlb. Edw. det.); *N(U):* Tvärminne Zool. Stat! ♂♀ (Frey); Tvärminne, Långskär! ♀ (Frey); Tvärminne, Spikarna! ♀ (Frey); ?Kyrkslätt (Frey); *Ka(EK):* Kymmene! ?♀ (Sahlb.); *Ta(EH);* Messuby! ♂ (Frey, Edw. det.); Hattula! ♂ (Essen, Edw. det.) *Sk: (Kl.):* Valkjärvi (Frey); *Kb(PK):* ?Tohmojärvi (Mäklin); *Om(KP):* Jacobstad (J. Sahlb.); Pedersöre! ♂ : 28. vi. 1932, ♀: 26. vi.—3. vii. (Storå); *Li (InL):* Enare (J. Sahlb.); Ivalo!♀: 28. vi. 1929 (Håkan Lindb.); *Lps(Psl):* Petsamo, Hankilampi! ♀: 30. vii. 1929 (Storå).

U S S R : *Kola Peninsula: ImL:* Chibinä (Fridolin). (Stackelberg 1937 p. 155.)

Distribution outside Denmark and Fennoscandia.

Concerning the distribution in Germany, Martini (1931, p. 292) says: "Ich sah sie — — — in der Hamburger Gegend und östlich durch Mecklenburg nach Westpreussen, — — — aus Ostpreussen (Skwarra)." The species is recorded by Peus (1929 b, p. 7) from: "Darss (Vorpommern), Chorinchen (Mark) und Groß Raum (Ostpr.)," from Berlin (♂) (Edwards 1921, p. 306), from "Unterspreewald, Golmer Luch bei Werder a. Havel" (Peus 1930 c, 671), from "Oedergebiet bei Bellinchen" (Peus 1934 a, p. 39), "Richthof, Kreis Danziger Höhe (Martini 1920, p. 128), in der Bodensee-Gegend" (Martini 1931, p. 292). From France: Seine: Marais de Sucy it is recorded by Séguy (1923, p. 125), from Lettland: "bei Zarnikau, Wiesenniederung der Kl. Jegel bei Oger, bei Bienenhof (Riga), bei Anting, Düna-Aa-Kanal bei Riga" (Peus 1934 b, p. 77), from Estland: Dagö, 22. viii. (Dampf 1924, p. 6) and from Poland (Tarwid 1935, 1938 a—b). Edwards (1921, p. 306) records males from Austria from Hungary: Buda (Biró), Munkacs (Ujhelyi), Berecsacs (Kertesz), Balaton (Mihályi 1941), Martini (1931, p. 292) has examined specimens from Jugoslavia (Apfelbeck) and the high plateaus in Asia Minor (Turkey). As to the distribution of this species in USSR, Stackelberg (1937, p. 155) says: "In USSR recorded from — — — Leningrad distr. (Stackelberg!), Moskva distr. (Nikolskiji), Voronesch Distr. (environs of Voronesch: Schtschelkolnovzev 1928), Ukraine (Ukrainskoe-Polesje: Rybinskiji 1931, Dnepropetrovsk: Guzevitsch!), southern coast of Crimea (Velitschkevitsch 1931!), Sverdlovsk distr. (environs of Sverdlovsk: Kolozov, Perm env.: Mitrofanova 1929, Kungursk env.: Mitrofanova 1929), Lower Volga distr. (environs of Saratov: Martini), Siberia: Verkojansk, Jakutien (Roschnovskiji!), Sakalin (Labbé t. Edwards), Ussurijinsk region (Majke at Schkotova, Jakovlevka in Spassk region, Tigrovaja Sutschansk region: Stackelberg!)" [87] Further records are: Basin of Dnjepr: Ekaterinoslavsk distr. (Dolbeskin 1928); N. Kaukasus (Mess 1939). Vnukowsky (1928, p. 164) records females from district Tomsk: Ssokolovsky: Rayon Narym: Permittino. Edwards (1928, p. 2) has examined a female from Kamtchatka: Tchapina Nikkolke, but he remarks: "Too much damaged to name with certainty." He has also examined (1921, p. 306) males from Sachalin and concludes: "In addition I have seen many females which are probably this species, but cannot be determined with absolute certainty, including some from Siberia (Antsiferovo, 59° 10′, and Turuschansk, 65° 55′: Trybom). The species may therefore be assumed to have a continuous distribution over North Europe and North Asia; it is also known to be widely spread in North America. It appears to be absent from North-western Europe."

The distribution in USA is, according to Dyar (1928, p. 204): "Canadian Zone and northern United States to the Rockies, south to Colorado and north to the Yukon Valley." Recent records are: Maine (Bean 1946), Rhode Island (Knutson 1943), Massachusetts (Tulloch 1939), Nebraska (Tate and Wirth 1942); Utah (Don M. Rees 1942).

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[87] Translated from the Russian text.

Biology.

From Denmark, Wesenberg-Lund (1920—1921, p. 57 57—59) records: "In North-Seeland we often find, on the plains in the forests or in the outskirts of the wood, small ponds, the bottom of which is not decaying leaves, but grass; the ponds are always extremely shallow and dry up in May, often before other ponds are laid dry. They are almost dry from May to January, and the water these ponds contain is almost only melted snow; it disappears again in the course of one or two months. In these ponds, the true habitats of *Branchipus Grubii* and *Limnetis brachyura* we find the above-named grassy-green Culicin larvae which, when hatched, always give *O. excrucians.* — — — On a day with bright sunshine, standing near a pond with huge swarms of *O. communis*-larvae hanging down from the surface, I saw that below the layer of the perpendicularly hanging *O. communis*-larvae there was another layer of almost horizontally standing Culicin-larvae; they were larger and almost white; most of them rested on the bottom or got support from the fine leaves of *Hottonia.* These larvae were caught, isolated, and eight days later gave *O. excrucians.* — — — It may be pointed out, that the *O. excrucians*-larvae, in contrast to those of *O. communis,* almost always lie on the bottom, often on the dorsal side, or very often are found hanging down from water plants; they rarely come to the surface, brushing the bottom and the plants free from detritus. — — — The life history of the species is the same as for the other mosquito larvae in drying ponds. They are hatched immediately after the melting period, probably a little later than *O. communis,* they left the pond on 15/V; a few days afterwards the ponds were quite dry and did not get water before the spring. The mosquitoes have only one generation. — — Also as imagines the mosquitoes are rare; I have only found them in the vicinity of the ponds where they hatched." Wesenberg-Lund states that the larvae appear from medio March—April and the pupae about medio May.

In Norway, *A. excrucians* has been found from the southern-most parts of the land and to Balsfjord (about 69 degree of latitude) in the north. In Sweden it is found north to Lappland and in Finland even north to Petsamo (about 69° 30′ degree of latitude). In southern Norway the species has been found from the lowlands and up to the mountain regions (i. a. Fokstuen (On 37) at about 990 m above sea level). As indicated above the specimens from the mountain regions and from the northern parts of Fennoscandia seem to represent special colour-varieties. The breeding-waters are of variable character. Larvae have been found in shoal water at the border of the lake Fiskumvannet (Bø 13), in ponds, in flooded grassy areas, in ditches which most probably communicate with a nearby river in the flood season (i. a. the river Glomma in Østerdalen), and even in a creek of a river (Skarnes: HEs 5). Most breeding waters are in open areas, exposed to the sun, and only in one place I found larva in a partly shaded water. In the lowlands the degree of PH in these waters varied from 6.1 to 6.9 and the iron contents varied from Fe < 0.10 to 0.30. In the mountain regions larvae were found: at Fokstuen (On 37) in pools with mossy stones at the bottom or in ditches with grassy bottom; at the high plateau in the environs of Holla outfarm (HEn 23) most larvae were found in ponds and ditches at the border of a swampy area. The degree of pH in these mountainous localities varies from 4.8 to 5.9. In the swampy pond near Holla, mentioned above (Pl. VI), I made some observations which indicate that the larvae of the mountain-variety of *excrucians* have a preference for water of low temperature. The dirty yellowish-green *excrucians*-larvae were only found where the depth of the water was about one meter, whereas the blackish *punctor*-larvae were abundant at the shallow borders of the pond. I measured the temperature of the water in 1944 (at 6½ p. m.) and in 1945 (at 2 p. m.), both times in the first days of July and in bright sunshine. The temperature near the bottom was 10° C, but when placed in the heather, surrounding the pond, the thermometer showed 20° C. A lot of larvae were brought for hatching to the outfarm where I had my quarter, but many of them died in the following days. Most probably they could not bear the rather high temperature prevailing just in those days.

In other pools in the mountains valley I measured temperatures up to 27° C, and I therefore suppose that the pond mentioned above has some afflux from one of the many brooks running from the snowfields in the nearly high-mountain Sølen.

In Norway larvae of *A. (O) excrucians* have been found associated with larvae of *A. (O) communis, punctor, diantaeus* and *intrudens*.

Concerning the bloodsucking habits of *A. excrucians* I had excellent opportunity of making observations, when trouting in the beginning of July in streams and brooks in the mountain-plateau east of Ytre Rendal (HEn 23). The mosquitoes rarely attacked in open areas in bright sunshine,but in places, partly shaded by birches and brushwood they were very annoying. The predominant species in the high plateau in Rendal is *A. punctor,* but some *excrucians* were also frequently met with. In the afternoon the mosquitoes were flying just above the grass as long as the sun was burning, but an hour before sunset, as it grew somewhat cooler, the mosquitoes ascended and attacked immediately. After sunset it grew rather cool and the mosquitoes disappeared. However, in 1931 I suffered from the attack of masses of *A. excrucians* even in the night. It happened on a pine-barren in Elvdal (HEN 30), about 200 m from the river Trysilelven. Though midnight it was quite bright and rather sweltering, and the mosquitoes found their way into my motorcar and made any thought of sleeping impossible.

Several times *excrucians* have been found in houses, in Ytre Rendal (HEn 23) as well as in Trysil (HEn 20), especially after rain.

The sting of *excrucians* in these regions is not painful; several times when trouting, I did not at all notice the sting properly. Afterwards a comparatively small pustule was formed around the spot, but it disappeared in about an hour, leaving a small reddish spot which was still visible the next day. Just after the sting some itching was noticeable, but if one could abstain from scratching the itching soon disappeared.

As to the character of the breeding-waters Martini (1930, p. 291) remarks: "Ich selbst traf sie sowohl in Tümpeln nahe an der Ostsee, mit sicher nicht ganz süssem Wasser, als auch gelegentlich an Knicks in Gräben, in Teichen teilweise ausdauernden Charakters, zwischen Simsen usw. Vor allem aber schienen mir Ränder großer verlandender Gewässer im Walde ihr Hauptbrutplatz." Similar observations are published by Peus (1932, p. 139): "Obwohl ihr Optimum deutlich gleichfalls im Erlenbruchwald liegt, hält sie sich doch weniger streng als vorige Art (*annulipes*) an bewaldetes Gelände, so daß man die Larven auch in frei gelegenen Wegetationsreichen Wiesentümpeln antreffen kann." From USA Dyar (1928, p. 204) records: "The larvae occur by preference in the edges of grassy marches, when these are flooded in spring; occasionally also in early wood-pools. Emergence is somewhat late and adults are on the wing most of the summer, frequenting shade." Matheson (1929, p. 114) emphasises: "There is but one brood a season."

Concerning the bloodsucking habits of this species, Martini (1920, p. 128) says: "Die Art beträgt sich wie *cantans,* sticht tags, ist zudringlich und hält sich im Schutz dichten Gebüsches und Nadelholzdichtungen." In coincidence herewith Matheson remarks from USA: "The adults attacking at all times during the day in the shade and wooded areas."

Aëdes (Ochlerotatus) cyprius Ludlow.

Aëdes cyprius Ludl. (Ins. Insc. Mens., *7*, p. 158) 1920
A. freyi Edwards (♂ only) (Bull. Ent. Res., *21*, p. 306) 1921
A. lutescens Edw. (in part, nec. Fabr.) (Bull. Ent. Res., *21*, p. 306) 1921

Synonymical remarks.

The species is established by Ludlow on females from Wladiwostock and other localities in the Far East. The succeeding year Edwards described the male, under the name of *Aëdes freyi,* on specimens from Finland. However, according to Martini (1922 d, p. 163) and Stackelberg (1937, p. 151—152), the females ascribed by Edwards to the male *freyi,* are indeed *flavescens* Müll.

The species *C. flavus,* described by Motchulsky, is according to Edwards (1921, p. 307) synonymous with *A. lutescens* F. (= *flavescens* Müll.) and he remarks: "Although Motchulsky's diagnosis is very brief, I consider it highly probable that his *C. flavus* is our *A. lutescens.*" Martini (1922 c, p. 125) agrees in this point of view. However, in his last review (1932, p. 138), Edwards considers *flavus* as synonymous with *cyprius,* but Peus (1937, p. 242) remarks in his discussion of the synonymy of *cyprius: "Culex flavus* Motschulsky (1859, p. 503) aus dem Amurgebiet, von Edwards (1932, p. 138) zu *Aëdes cyprius* gestellt, beziehe ich mit Martini (1922 a, p. 125) auf *A. flavescens* Müller (= *lutescens* Fabr.); jedenfalls scheint mir die Diagnose Motschulsky's "Dilute fusco-testaceus, capite thoraceque subinfuscato, tarsis anticis fusco-annulatis offensichtlich gut auf letzteren Art, nicht aber auf *cyprius* zu passen".

Peus (1937, p. 243—51) also describes the larva and publishes biological and ecological observations.

Description.

F e m a l e. Front of h e a d with golden hairs forming a tuft between the eyes. Vertex ("occiput") in the middle with golden narrow curved scales and light upright forked scales, at the sides with narrow curved scales of the same colour as well as with blackish brown upright forked scales. Temporae with flat golden scales, intermingled with scattered black scales behind the eyes. Eyes bordered with golden scales and black bristles. C l y p e u s blackish brown. P r o b o s c i s distinctly longer than the fore-femurae; at the base sprinkled with dark scales, otherwise yellowish-white or yellow, dark at apex. Labellae dark brown. Antennae. Tori yellow with a row of yellowish-white or yellow scales and some black ones. Flagellum. First segment yellow, segment 2—4 yellowish-brown, the remainder brown clothed with minute white hairs, and at the base of segments bigger blackish-brown hairs. Palpi (fig. 55 g) not entirely ¼ the length of the proboscis. Scaling yellowish-white or yellow, sprinkled with black scales; at apex some white scales. Segment 3 of the same thickness as segment 2 and of about twice the length of the latter. Ultimate segment small and nearly circular. Thorax. Anterior pronotal lobes yellowish brown with golden narrow curved scales and golden bristles. Posterior pronotum with golden narrow curved scales and golden bristles. Integument of mesonotum yellowish brown, in some specimens with a blackish-brown patch at the anterior border of mesonotum and a dark median stripe running towards the scutellum, at each side with a shorter dark stripe. Mesonotum clothed with golden hair-like scales at the sides running into narrow curved scales of the same colour. Bristles of mesonotum golden or dark brown with golden reflections. Pleurae yellowish-brown with yellowish-white or yellow scales and bristles. Wing. Scaling yellow with scattered dark brown scales. In several specimens the basal fourth of costa entirely yellow. Halter yellow with scales of the same colour. Legs. Fore- and mid-femurae yellow sprinkled with blackish scales. Hind-femurae yellow with black scales predominating the apical third. Knee spot yellow, indistinct. Tibia yellow sprinkled with black scales, which predominate towards apex of mid- and hind-tibiae. Tarsal segments yellowish-white with black apex. The light basal ring at segment 4 in the fore- and mid-leg, occupies from one third to one half of the segment, in segment 5 the ring may be indicated only by some yellowish-white scales. Claw formula: 1 : 1, 1 : 1, 1 : 1. Abdomen clothed with broad yellow or orange-coloured scales intermingled with scattered black scales. In some specimens the dark scales are more predominating, especially at the sides of the anterior abdominal segments. The first abdominal tergite with some yellow and yellowish-white scales and with yellow hairs. The lateral hairs of the abdominal segments light yellow. Venter yellow with scattered black scales. In some specimens the dark scales form a more or less distinct longitudinal black stripe. Abdomen pointed. Length of wing about 5.5 mm.

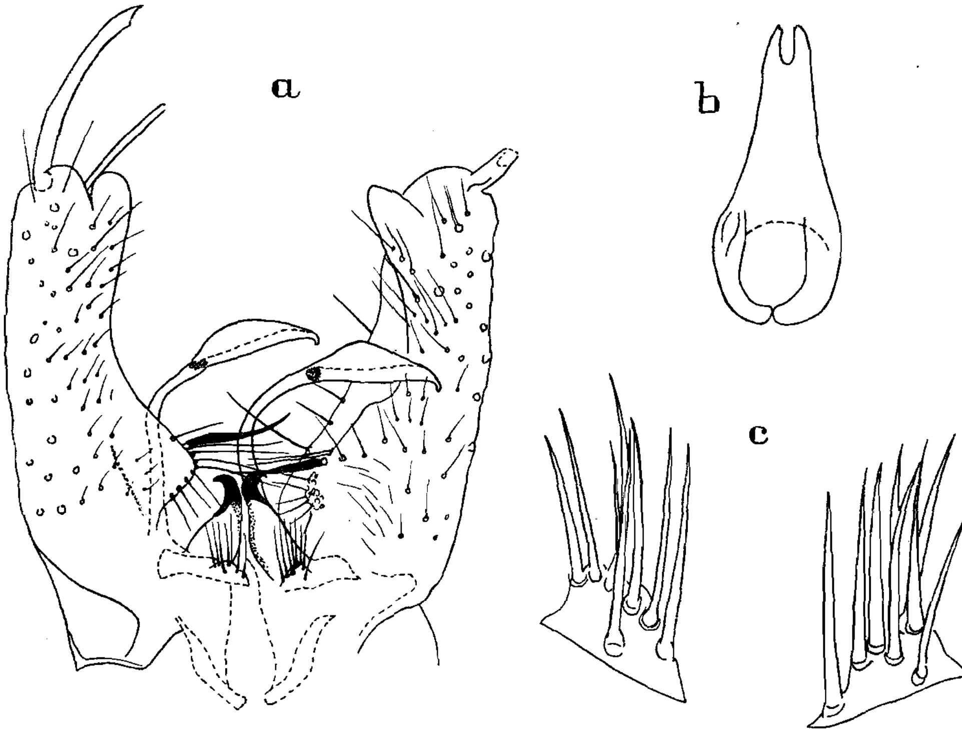


Fig. 65. *Aëdes (Ochlerotatus) cyprius* Ludl.
a, Terminalia (total view); b, phallosome; c, lobes of the 9th tergite. (Aut. del.)

The colouring of this species is rather variable. The light scales at proboscis, palpi and the scale-patches at the pleurae may be more or less whitish, and scaling of the abdomen either yellow or orange-coloured.

Male. Proboscis much longer than the fore-femurae, brown and yellow sprinkled, towards apex the dark scales are predominating. Antennae of about $3/5$ the length of the proboscis. Torus blackish brown, flagellum dark brown and light ringed. Hair-whorls yellowish with grey reflections towards apex of the hairs. Palpi exceed the proboscis by about one half of the ultimate segment. Segment 5 narrower and somewhat shorter than segment 4. The long segment with a broad yellow ring at the base and with two more or less indistinct rings beyond the middle. The light patches at segment 4 and 5 of a more whitish colour. Hair-tufts

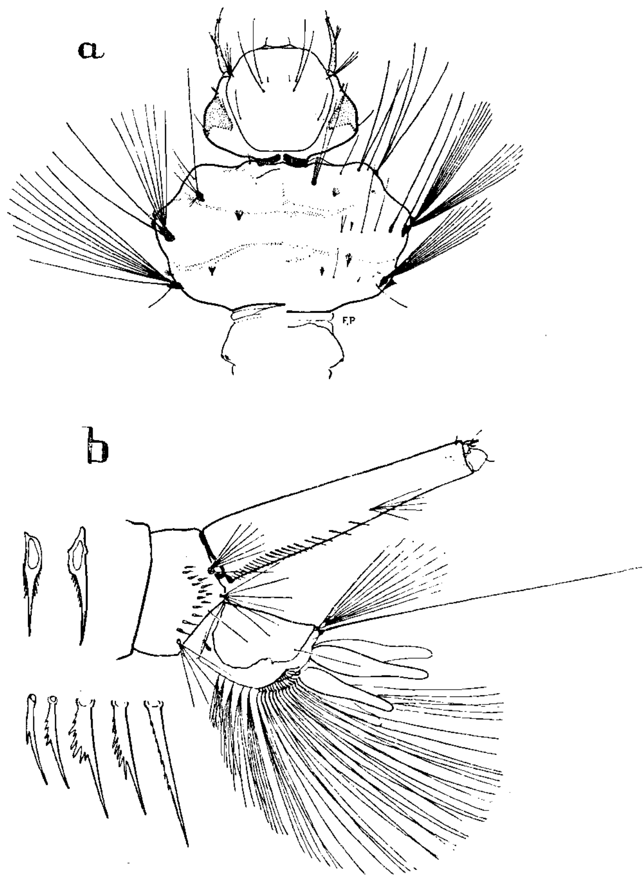


Fig. 66. Larva of *A. cyprius* Ludl. in 4th instar. a, head and thorax of larva, the right part of thorax in dorsal view, the left part in ventral view; b, terminal segments of larva, the figures left above: comb-scales, below: pecten teeth. The ventral brush has not been delineated in full. (After Peus 1937.)

greyish, basally with fox-coloured reflections. Thorax with light-golden scales. Abdomen with more sparse scaling than in the female. Tergites with basal yellow bands and in the posterior segment also with apical bands of the same colour. More or less extended brown lateral patches.

Terminalia (fig. 65). Basistyle long and slender. Apical lobe somewhat pointed and with hairs of moderate length. Basal lobe prominent, apically rounded, with a stout and long spine and some hairs. Stem of the claspette somewhat curved, slender and tapering. Appendage rather long, apically curved, not petiolate and with a broad wing. Dististyle curved and with a long straight claw. Proctiger with strongly sclerotised paraprocts. Lobes of the ninth tergite with 6—11 spines. The description is based on the single, somewhat defect Swedish specimen as well as on specimens from Lettland.

Owing to war condition I have not seen the type specimen. In his description Edwards quotes the number of spines on the lobes of the ninth tergite to 6. In the Swedish specimen the number is 8 and the Lettish specimens at hand have from 6—11 spines. Edwards (1921) and Martini (1931) point out that the spines are short, but in the specimens at hand the length of these spines did not differ from those in the other species of the cantans-group.

Larva (fig. 66). As no larvae of *A. cyprius* have been accessible I quote here, in a somewhat abbreviated form, the description of Peus (1937, pp. 244—246):

"Kopf. Antennen verhältnismäßig schwach und kurz, an der Basis mäßig angeschwollen, dann gleichmäßig — — — bis zur Spitze verjüngt. Schafthaar etwa in der Mitte — — — stehend, schwach entwickelt, mehrstrahlig. — Die großen Frontalhaare — — — kräftig, aber immer einfach, einstrahlig — — —. — — — Thorax. Die Art und Anordnung der Borsten bietet nichts Außergewöhnliches und ist aus der Abb. [Fig. 66] zu ersehen. Nur muß vermerkt werden daß das Prothorakalhaar "8" sehr viel dünner und bedeutend kürzer ausgebildet ist als bei allen übrigen Larven der *annulipes*-Gruppe, wenngleich es bei weitem nicht so dünn und kurz ist wie etwa bei der *A. cataphylla*-Larve; es hält in seiner Stärke und Länge etwa die Mitte zwischen *A. maculatus* Meig. und *A. cataphylla rostochiensis* Martini. — — — Abdomen. Striegelschuppen des VIII Segments (bei 20 beiderseitig ausgezählten Exemplaren) in der Zahl von 9—15 schwankend, überwiegend jedoch 11 oder 12. — — — Die Zähne sind meistens im unteren Teil des Striegels einreihig, im oberen Teil in unregelmäßiger Doppelreihe angeordnet. Ihre Form ist aus Abb. [66 b] ersichtlich. Atemrohr schlank, von der Basis zur Spitze ziemlich gleichmäßig verjüngt. Siphonal-Index im Durchschnitt 4.3 (schwankend von 4,07 bis 4,6 bei 20 gemessenen Exemplaren). Atemrohr nicht sehr kräftig, etwa 3—5 strahlig; es steht deutlich jenseits der Mitte, — — — Die beiden kleinen dorsalen Haare am Distalende des Atemrohrs verhältnismäßig kräftig in Form einer Kleinen starren Borste; bei allen anderen Larven der *annulipes*-Gruppe ist dies kleine Haar sehr viel feiner und dünner. Das apikale Haar der ventralen (großen) Atemrohrklappe gekrümmt aber schwach und dünn. Der Zahnkamm (Pecten) des Atemrohres im Durchschnitt aus 20 (17—25) Zähnen gebildet; die Zähne nehmen distalwärts an Länge zu — — — alle zeigen deutliche Nebenzähnelung, besonders die des mittleren' Drittels, während die letzten Zähne fast stets nur eine sehr schwache Nebenzähnelung besitzen. — — — Die letzten Kammzähne sind vom übrigen Kamm durch weitere Abstände abgetrennt und zwar in variierender Weise. — — — Die Form der Kammzähne zeigt die Abb. (Nebenfiguren). Analsegment. Sattel nicht geschlossen. Auf der Unterseite des Segments stehen 4—5 (bisweilen 6, selten einmal nur 3) Fächerborsten vor dem geschlossenen Ruderfächer. Analpapillen ("Kiemen") etwa so lang wie der Sattel oder das Analsegment. Die Larve von *A. cyprius* kennzeichnet sich also innerhalb der *annulipes*-Gruppe durch folgende Merkmale: Große Frontalhaare einfach; langes annähernd gleichmäßig verjüngtes Atemrohr; Atemrohrhaar jenseits der Mitte; die kleinen dorso-apicalen Haare des Atemrohrs recht kräftig, wenn auch sehr kurz; apikales gekrümmtes Haar auf der großen (ventralen) Atemrohrklappe dünn; die letzten Zähne des Atemrohrkammes weitab gestellt; Analpapillen etwa so lang wie das Analsegment. — — — Die Färbung im Leben ist obwohl die Art als Imago unsere hellste und daher auffälligste Stechmücke ist, merkwürdigerweise verhältnismäßig dunkel, nämlich durchaus grau, mit grünlichgelblich durchscheinendem Schimmer. Nur der Kopf ist satt ockergelb und sticht somit recht auffallend von dem übrigen Körper ab."

Geographical distribution.

Sweden: *Sk:* ♂ (Zett!); *Sm:* ♀ (Zett!); *Ög:* ♀ (P. Wg.).
Finland: *Ab(V):* Åbo! (E. J. Bonsd.): ♀ (det. Martini); *N(U):* H.fors!: ♀ (Palmén); H.fors!: ♀: 27. vi. 1940 (Nordman); *Kl(LK):* Parikkala!: ♀: (J. Sahlb.); *Kb(PK):* Tohmajärvi!: ♀: 26. vi.
USSR: *Karelia onegensis* Jalguba! ♀ (J. Sahlb., det. Martini).

Distribution outside Denmark and Fennoscandia.

According to Peus (1937, p. 242) the species is recorded from Germany: "bei Finkenkrug bei Berlin (coll. Oldenberg), Berlin-Pichselsberg (coll. Oldenberg), Berlin-Jungfernheide (coll. Lichtwardt)." In Lettland *cypreus* is recorded from: "Großen Kanger" northeast of Oger and at Anting (Peus 1934 b, p. 77) and at Libau (Peus 1937, p. 243). Peus further says: "In der Sammlung Sinentis (Riga) sah ich — — — Exemplare, offenbar aus Livland." As to the distribution in USSR Stackelberg (1937, p. 152) remarks: "From USSR it is, with certainty, recorded from Leningrad distr. (Stackelberg), Ukrainskoe-Polesje (Rybinskij). Lower Volga distr.: environs of Kusnezk (Martini), Sverdlovsk distr. (Mitrofanova 1929), W-Siberia (Omsk: Malaria Station!) and Ussurijisk distr. (Alektorov, Stackelberg!)." [88] However, the specimen from Jalguba, mentioned above indicates a distribution further to the north. The species is established on females from Selenga, Vladivostock, and Verkhne Udinsk.

Biology.

As to the biology of *A. cyprius* in Fennoscandia, very little is known. In the material of adults at hand, only two specimens from Finland are dated, both have been caught ultimo June.

Concerning the character of the breeding water, Peus (1937, p. 247—248) i. a. says: "Die Brutgewässer sind typische Überschwemmungs-Resttümpel in der Inundationszone der Kleinen Jägel. — — —

In den Vertieferung dieser freien wiesenartigen Inundationszone liegen die Überschwemmungs-Restgewässer eingebettet, die in zwei physiographisch und hydrologisch deutlich verschiedenen Typen ausgebildet sind. — — — Die Tümpel des anderen Typs sind dadurch charakterisiert, daß sich ihre Sohle von einer zunächst auch noch flachen Uferzone gegen die Mitte hin zu einem wannenartigen Becken vertieft; bei einem Längendurchmesser von meist etwa 8—10 m erreicht die Tümpelmitte eine durchschnittliche Tiefe von etwa 50—80 cm. Der Wasserstand sinkt zwar zum Sommer hin stark ab, so daß ihre Uferzone freigelegt wird, sie scheinen aber, — — — nicht ganz (oder doch wenigstens sehr viel später?) auszutrocknen. — — — Es ist nun bemerkenswert, daß sich die *cyprius*-Larven in ihrem Aufenthalt innerhalb des einzelnen Tümpels bei streng zonaler Abgrenzung allein auf die Mitte mit ihrer größerer Wassertiefe beschränken. — — — Da andere Gründe für das Fehlen der *cyprius*-Larven in der Uferzone nicht ersichtlich waren, liegt es nahe, *A. cyprius* entwicklungsbiologisch als eine Kaltwasserform oder doch wenigstens als eine Art, die ein tieferes Temperatur-Prädilektikum hat als ihre Verwandten, anzusehen."

Martini (1931, p. 294) sums up: "Die Mücke fliegt auf parkartigem Gelände, mit eingestreuten Busch- und Baumgruppen, auch an Wiesen- und Waldrändern und auf Lichtungen im Walde. Sie ist offenbar mehr als *A. variegatus* an den Busch gebunden." He as well as Peus (1937, p. 251) points out, that *A. cyprius* is very aggressive against man, and attacks even in bright sunshine.

Aëdes (Ochlerotatus) flavescens (Müller)

Culex flavescens Müll .(Faun. Ins. Friedrichsdalina, p. 87) .. 1764
C. lutescens Fabr. (Syst. Ent. p. 800) 1775
C. variegatus Schrank (Enum. Ins. Austr., p. 482) 1781
C. flavescens Fabr. (Syst. Antl., p. 35) 1805
C. bipunctatus Rob. -Desvoid. (Mem. Soc. Hist. Nat. Paris., *3*, p. 405) *1827*
C. flavescens Theob. (Mon. Cul. *1*, 410) 1901
C. arcanus Blanch. (Les Moust., p. 305) 1905
C. fletcheri Coquill. (U. S. Bur. Ent. Techn. Ser., *2*, p. 25) 1906

Synonymical and systematical remarks.

Concerning the synonymy of this species the opinion of the different authors are rather diverging. Edwards (1921, p. 307), quoting the species under the name of *A(O) lutescens* Fabr., says: "This being a common European species, is much likely to be Fabricius *C. lutescens* than the rare one which Theobald has redescribed as such. Fabricius emphasises the yellow costa and the yellow proboscis with a black tip, he does not mention the tarsi, the statement that they are dark being due to Meigen, who may have had

[88] Translated from the Russian text.

another species before him. Martini was of the same opinion regarding Fabricius species, but did not adopt the name; I consider the identification sufficiently probable for the name to be used. Zetterstedt, Ficalbi and Martini use the name *annulipes* Mg. for it, but this is certainly wrong, since the abdomen is never banded, as Meigen states is the case in *annulipes*." However, in his last review, in Genera Insectorum (1932) he quotes the species under the name of *flavescens* Müll. and places the names *flavescens* Fabr. and *lutescens* Fabr. as synonymous thereof.

Martini (1931, p. 337) quotes the species under the name of *A. variegatus* Schrank, and his argumentation for this is published in an earlier paper (Martini 1922 c, p. 109): "Inzwischen war im Norden *Culex lutescens* beschrieben. In der alten Literatur tritt zuerst *Culex flavescens* O. F. Müller 1764 (Fauna Insectorum Friedrichsdaliensis), Fabricius 1775, O. F. Müller 1776 auf, dann *lutescens* Fabr. 1781, darauf *lutescens* Fabr. 1794 endlich mit wörtlich gleicher Beschreibung und Fundort wie *lutescens* 1794 *Culex flavus* Fabr., zudem als synonym zitiert werden *flavescens* Fabr. 1775 und *lutescens* Meig. 1804. Da Müller und Fabricius so habe beieinander (Kopenhagen, Kiel) wirkten, und Fabricius auch durch seinen Verlag Beziehungen zu Kopenhagen hatte, kann an einem Gedankenaustausch zwischen beiden und an der Gleichheit ihrer *lutescens* kaum gezweifelt werden, zumal Fabricius habitat Hafniae schreibt. Auch Meigen hatte später Beziehungen zur Fabriciuschen Sammlung und alle wichtige Stücke derselben gesehen. Die gegebene Synonymie dürfte also richtig sein. Meigens Form, welche 1819 als *lutescens* mit ungefähr derselben Beschreibung wie *luteus* 1804 erscheint, dürfte nach der Größe (kleiner als *nemorosus* usw.) sicher nicht *variegatus* gewesen sein, und wenn Fabricius angiebt: "Statura praecedentis" (nämlich von *bifurcatus*, der wohl *pipiens* auct. ist) so spricht das für die gleiche Auffassung. Auch O. F. Müller setzt seinen *flavescens* 1776 mit *ciliaris* Linné gleich, also mit einer sehr kleinen Form. Diese Gleichsetzung, spricht ebenso sehr dagegen, daß *lutescens* = *variegatus* ist, wie dagegen, daß *ciliaris* = *cinereus* ist. Da heute wohl die Ansicht vorwiegt, daß *lutescens* bei Meigen, wie bei vielen späteren, helle Stücke von *pipiens* sind, muß man auch *lutescens* Fabr. = *flavescens* Müller für *pipiens* auct. halten." As to *variegatus* he further says: "Daß diese Art, welche von Zetterstedt bis Schiner und auch bei mir 1920 *annulipes* hieß, dieselbe Form ist, welche Meigen so nannte, habe ich oben gezeigt. Neuerdings hat Edwards den Namen *annulipes* aufgenommen für diejenige Art, welche *cantans* am nächsten *steht.* Obwohl nun *annulipes* mir an sich der gültige Name zu sein scheint, muß ich in Rücksicht auf die durch Edwards geschaffene Synonymie doch empfehlen, den Namen *variegatus* welcher den Nomenklaturregeln entspricht aufzunehmen."

In recent literature the species is quoted under the name of *A. (O) flavescens* Müller, by Dyar (1928), Edwards (1932) Stackelberg (1937) and Marshall (1938).

As to the differential characters of the female *flavescens* Müll. and *cyprius* Ludl., there has been some confusion in the descriptions by Edwards (1921, p. 307). Regarding the female *flavescens* Müll. (= *lutescens* (Fabr.) Edw.) he says: "Although this species seems to be subject to a good deal of variation, it may probably always be recognised by the predominately yellow-scaled costa and the mainly or entirely yellow-scaled abdomen. In the lightest specimens the proboscis is yellow-scaled except at the tip, where the scales are black; the palpi and wings are almost entirely yellow-scaled; the mesonotal scales are rather light yellow; the thoracic integument is reddish, with a black patch in front from which three black lines extend backwards; the abdominal scales are all yellow in the female, usually with a median line of dark ones in the male; the tarsi, though with the usual white rings at the bases of the joints, have the dark portions largely replaced by yellow except at the tips of the joints. In the darkest specimens the proboscis and palpi are almost antirely black-scaled, the wings are much darker, even the costa having a considerable sprinkling of dark scales; the mesonotal scales are rather deep brown, contrasting strongly with the white scales of the pleurae; the thoracic integument is nearly all black; the female abdomen has rather numerous dark scales at the sides; and the tarsi are darker. — — — It is possible that the two forms above described may represent distinct varieties, or even species, but they appear to intergrade, and males associated with both dark and light females have practically identical hypopygia, the only difference observed being that some (though not all) of the light specimens had a more or less definite hook to the membrane of the claspette appendage." As to the female *freyi* Edw. [= *cyprius* Ludl.] he i. a. remarks (Edwards 1921, p. 306): "The few examples I have seen are all more or less damaged and do not allow a very precise definition of the species on colour characters. Possibly the costa being yellow towards the base only instead of the greater part of its length might distinguish the female of *A. freyi* from that of *A. lutescens.*"

Martini (1922 d, p. 163) points out that Edwards has mixed up the females of the two species: "*Aëdes freyi* Edwards ist eindeutlich gekennzeichnet durch den männlichen Geschlechtsapparat. Mit solchen Männchen zusammen fliegen aber bei Finkenkrug die ganz gelben Weibchen, die Edwards *lutescens* nennt, während die dunkleren Weibchen von mir aus gleichen Larven wie mein *variegatus* Männchen gezogen sind. Bei Edwards haben sich also *variegatus* und *freyi* ihre Weiber getauscht; *freyi* Edwards muß also charactesiert werden: ♀ ganz goldgelb ,Füße schwarz und weißgelb geringelt, Hinterleib manchmal mit schwachen Andeutungen von dunkleren Querbinden. Beim Männchen treten die dunkleren Teile des Hinterleibes viel mehr hervor."

The material, deposited in the Naturhistoriska Riksmuseum at Stockholm, and named by Edwards: *A. lutescens,* at first gave me some difficulties, as I had overlooked the remarks by Martini, mentioned above. The specimens, one male (abdomen broken off) and 10 females were all more or less distinctly golden coloured, and especially some of the females well agreed with female *cyprius* from Lettland in our collection. As *cyprius* has hitherto not been recorded from Scandinavia I hesitated to establish the species from Sweden on these females only. However, some specimens from Zetterstedt's collection, sent me for examination, brought the question to a happy end. Among the specimens, labelled as *annulipes,* I found a male of *cyprius* Ludl. also two typical females of the same species. The third female was *flavescens.* Under these circumstances I have no more hesitation in considering the above mentioned females from Stockholm and also some females, labelled *annulipes,* from the zoological museum at Helsingfors as belonging to *A. cyprius* Ludl.

According to Martini (1931, p. 293, resp. 337) the female palpi are of about 1/5 the length of the proboscis in *cyprius* whereas they are about 1/6 in *flavescens.* I have examined some slide preparations of northern specimens as to this character, but I did not find distinct differences. However, the shape and relative length of the palpal segments exibit useful differential characters in the two species.

Among the specimens in Zetterstedt's collection, labelled "C. annulipes Meig.", were one male and two females of *cyprius* Ludl., one male of *annulipes* Meig. and one female of *flavescens* Müll. Even from Zetterstedt's description of "*annulipes* Meig.", in Diptera Scandinaviae (9, p. 3462—4) it is obvious that he had a mixture of species before him. I thus consider the footnote on page 3464: "Cul. aureus femina C. annulipedes oloim vendita fuit" as an indication on *cyprius*.

Description.

Female. Head. Vertex ("occiput") in the middle with pale golden narrow curved scales and some golden upright forked scales and many black upright forked scales. Temporae with flat yellowish-white scales, and a patch of black scales, which, in some specimens, may be reduced to scattered black scales. Clypeus blackish brown. Proboscis much longer than the fore-femurae, brown and yellowish-white sprinkled, darker at the base and the apex. Labellae blackish brown. Antennae. Tori yellowish-brown. Flagellum: 3—4 first segments yellowish-brown, the remainder blackish brown clothed with minute whitish hairs and bigger black hairs at the base for the segments. Palpi (fig. 55 f) of well ¼ the length of the proboscis; scaling brown intermingled with scattered yellowish-white scales, which are especially abundant at the apex of palpi. Segment 3 somewhat narrower and nearly three times as long as segment 2. Ultimate segment small, oval and tapering apically. Thorax. Anterior pronotal lobes above with golden brown narrow curved scales and bristles, below with yellowish-white scales. Posterior pronotum above with cupreous hair-like and narrow curved scales, below with white flat and narrow curved scales. Integument of mesonotum dark brown, clothed with small, hairlike, dark golden scales, which, at the antescutellar space run into pure golden scales. Bristles brown with golden reflections. Scutellum with 3 patches of golden scales and bristles. Postnotum yellowish brown or brown, in some specimens with a median, longitudinal dark stripe. Pleurae blackish brown with patches of flat white scales. Wing sprinkled with brown and yellowish-white scales; in some specimens the yellowish scales predominate at the anterior border of costa, in other specimens only the basal third of costa is yellow. Otherwise the dark scales predominate. Halter yellowish-brown with darker globule, which is clothed with dirty-white scales. Legs. Front side of femurae yellowish-white and blackish-brown sprinkled, in hind-leg the basal half of femur is more plain yellow. Back-side of femurae yellowish-white. Knee spot whitish. Tibiae in front yellowish-white and blackish-brown sprinkled, back-side lighter. The hind-tibia apically dark. The first tarsal segment light coloured, with dark apex. In front-leg the tarsal segments 2—4 with basal white rings. In some specimens some white scales may be seen at the base of segment 5. In mid- and hind-leg all segments have basal white rings. Claw formula: 1:1; 1:1; 1:1. A b d o m e n. First abdominal segment with a bush of broad yellowish-white scales and hairs of the same colour. Abdominal tergites in the northern specimens at hand chiefly yellow. Venter yellow with some blackish-brown scales forming a median longitudinal line. Abdomen pointed. Length of body: 7.5 mm. Length of wing: 6 mm (W-L).

The species differs from *cyprius* in the conspicuous darker coloring of head, palpi, thorax and wings, the flat white scales at the lower part of the posterior pronotum, the more whitish scales at the pleurae, as well as in the shape and relative length of the palpal segments.

M a l e. P r o b o s c i s yellow, labellae dark brown. A n t e n n a e shorter than the proboscis. Torus brown. Flagellum brown and white ringed. Hair-whorls long, fox-coloured, running into greyish towards the apex of the hairs. P a l p i exceed the proboscis by about 4/5 the length of the ultimate segment. Ultimate segment distinctly narrower than the penultimate segment. Ground-colour dark brown, sprinkled with yellowish-white scales which form two distinct rings on the long segment. At segment 4 and 5 plain white scales especially at the bases of the segments. Hair-tufts long, yellow with a tint of fox-colour. T h o r a x in the single Danish specimen, the anterior part has a broad median stripe of dark brown-golden scales. The sides of mesonotum and the antescutellar space light golden. In some Finnish specimens thorax is more greyish-white scaled, with an indistinct median golden stripe. W i n g. The light scaling at costa is more whitish. A b d o m e n. Tergites whitish or yellowish-white scaled with a dark median stripe and narrow lateral stripes of the same colour.

T e r m i n a l i a (fig. 67). Basistyle with prominent apical lobe which is rounded and bears numerous curved hairs of moderate length. Basal lobe broad, slightly elevated and with many fine hairs. At the base of the basal lobe a stout spine, and some long bristles. Dististyle somewhat curved and with a long, straight claw. Stem of the claspette rather stout and somewhat swollen in the middle. Appendage

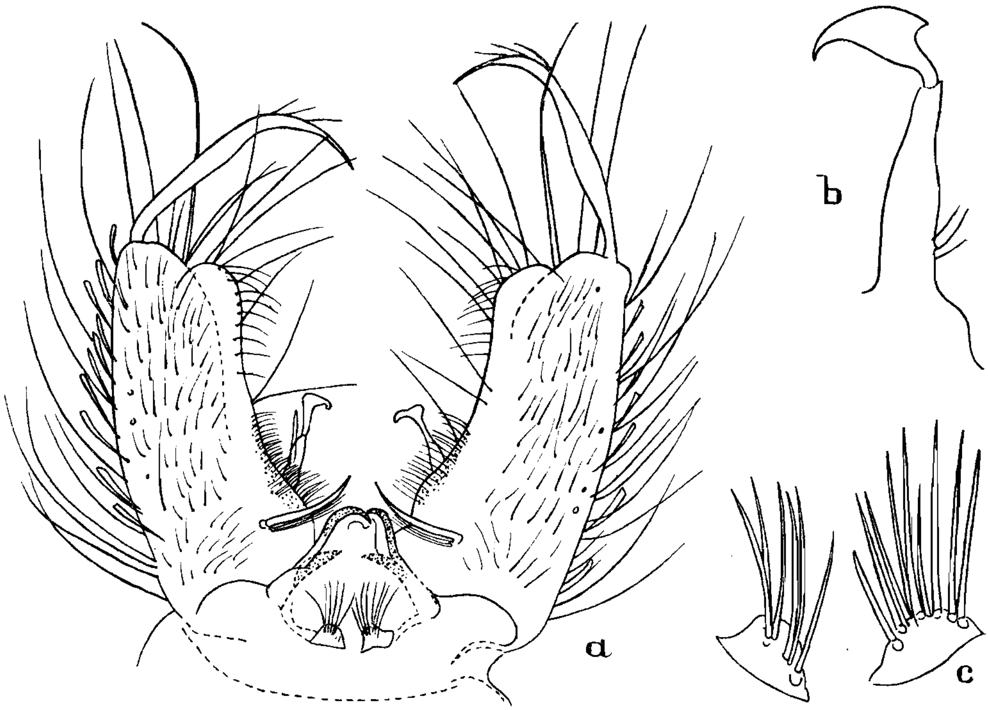


Fig. 67. *Aëdes (Ochlerotatus) flavescens* Müll.
a, Terminalia (total view); b, claspette; c. lobes of the 9th tergite.
(Aut. del.)

petiolate with a rather broad wing, which is angularly expanded at the middle of the spine. Proctiger with rather strongly sclerotised paraprocts. Lobes of the ninth tergite with 5—11 long spines. Mean value of 6 specimens (counted for both lobes): 7.3.

Larva. According to Martini (1931, p. 236) the character which differentiates the larva of *A. flavescens* from that of *A. annulipes* and *A. cantans* is the somewhat isolated postion of the distal pecten teeth. However Marshall (1938, p. 192) remarks on this matter: "Unfortunately moreover, the "spacing-out" of the distal pecten-teeth in *A. flavescens* is far from being an invariable characteristic. Of a large number of larvae of this species, collected on the Essex coast in 1935, no fewer than 42 per cent were found to have the last two pecten-teeth as close-set as those forming the remainder of the pesten. When this is the case, the larva of *A. flavescens* appears to differ from that of *A. annulipes* or *A. cantans* only in having 1) the siphonal index higher, 2) the gill-saddle index lower, 3) the saddle-hair distinctly longer, 4) the comb-scales usually less numerous, and 5) the median bristle of comb-scale rather more conspicuous." He puts the figures in a table and concludes: "It will be noted that none of the above means of differentiating is particularly satisfactory, since the respective ranges of variation are either separated by a very small interval or else actually overlap. Borderline cases in which the larvae of the three species in question are difficult, if not impossible, to distinguish from one another are therefore by no means uncommon."

Geographical distribution.

Denmark: 1. *Jylland:* Tipperne! ♂: 6. ix. 1946, ♀: 13. ix. 1946 (Søg. A.); 2. *Sjælland:* Tjustrup Sø, 15. vi. —1. viii. (W-L); Arresø, 21. v.—20. vi. (W-L); *Amager!* ♀ (Staeg); Knudshoved peninsula, vi. (W-L). *Møen:* Ulvshale. ♂ ♀: v. 1938 (Anthon); *Laaland:* Aalholm, Maribo, vi. (W-L); *Falster:* (W-L).

Sweden: *Sk:* ♀ (Bhn)! *Vg:* ♀ (Zett!); *Upl:* Stockholm! ♀: 30. vii. (Tullgren).

Finland: *Ab(V):* Kuustö! ♂ (Lundstr. leg., Edw. det.); Eriksberg! ♂: (E. J. Bonsd. leg. Edw. det.); Runsala! ♂: 17. x. 1923 (R. Frey).

Distribution outside Denmark and Fennoscandia.

Concerning the general geographical distribution of this species, Edwards (1921, p. 307) remarks: "Europe, except the west; Siberia, extending in a slightly modified form into North-America." In England *A. flavescens* Müll. has only been found twice in the southeast viz. in the counties Essex and Kent (Marshall 1938, p. 194). It is also recorded from France (Marshall 1938, p. 194). In Germany it is recorded from Cuxhaven, from Danzig and at Warnemünde (Martini 1920, p. 122), further "a. d. Schmergower Bruch a. d. Havel" (Peus 1930 c, p. 671), at Berlin (Edwards 1921, p. 307), in Spreewald (Peus 1932, p. 140), in "dem Odergebiete bei Belinchen" (Peus 1934 a, p. 39) and at Radoj (Edwards 1921, p. 307) also from the Free City and Territory Danzig (Martini 1920, p. 122). In Austria the species has been found at Mödling, Michelstettin, Sterize, Styria and Weyshi Steiermark (Edwards 1921, p. 307), in Hungary at Pressburg, Jaszenova, Kovakspatak, Budapest, Balaton (Michályi 1941) and

Munkacs. Further eastwards it is recorded from L e t t l a n d: "Bienenhof bei Riga (♀), Wiesenniederung der Kl. Jegel bei Oger (♂)" (Peus 1934 b, p. 77) and P o l a n d (Tarwid 1938 b). Concerning the distribution in U S S R, Stackelberg (1937, p. 153—54) records: "Leningrad distr. (Peterhof: Montschadskiji), Voronesch Distr. (environs of Voronesch: Schtschelkanovzev 1928), Ukraine (Ukrainskoe Polesje: Rybinskiji, Dnepropetrovsk: Guzevitsch!), North Kaukasus (Mineralnye Vody, Kumagorsk: Mess!), Georgia (Kalandadze 1931), Sverdlovsk distr. (Uktus at Sverdlovsk: Jacobson!), Lower Volga distr. (Martini), Kasachstan (environs of Alma-ata: Lisova), Kirgisia (Kattykul: Suschkin!), S i b e r i a (Omsk: Maljzev!), Nazimovo at Jenisei (Edwards)" [83] Austen further records the species from Archangel and Edwards records males from Nikulina: 60° 25′ and from K a m t s c h a t k a (Bolsherjetsk, ♀: 20. vii. 1917). From western Siberia Wnukovsky (1928, p. 164) records the species from the district of Tomsk: Ssokolowsky, Markelowo (♀), and, according to Edwards (1921, p. 308), *A. flavescens* has been recorded from A s i a M i n o r: Seraj-Koj (♀).

As to the distribution in C a n a d a and U S A, Dyar (1928, p. 207) says: "Ontario to Albany River at Hudson Bay, Manitoba, Saskatchewan, Alberta, Minnesota, North Dakota, Montana, Alaska (Anchorage)." In a previous paper (Dyar 1923, pp. 92—94) he had published detailed records of the distribution, and he concludes: "The distribution is thus seen to be very wide in the north reaching from Alaska to Hudson Bay, but more restricted to the central plains southwards. The species probably occurs at least in South Dakota, but I have no material from there." Recent records are: Michigan (Irwin 1941); Utah (Don M. Rees 1942).

Biology.

On this species in D e n m a r k, Wesenberg-Lund (1920—21, p. 65) i. a. says: "From these observations, we are able to state that the home of *O. lutescens* seems to be the open meadows bordering our lakes and sea-shores, they do not dwell in forests, the outskirts of which is the natural home of *O. excrucians*, only on very warm days do they now and then seek them. There is unquestionably regularly only one single generation, hatched in the latter part of May and on the wing the whole summer, attacking cattle and horses more than men. Curiously enough, this species, which has not hitherto been described in our country, is perhaps the one which forms the greatest swarms, standing in clouds over the meadows; the males disappear before the last part of June, and the females begin to throw their numerous single eggs over the vast plains, then dry, but inundated before January, at all events in the following spring." Wesenberg-Lund found newly hatched larvae about medio April and once he also found greater larvae ultimo August.

[83] Translated from the Russian text.

He is, however, of the opinion that these larvae derive from eggs which have been retarded in their development and he supposes that the species has only one single generation in Denmark. Otherwise only scattered dates are at hand. Anthon has found males and females in the month of May in Møen. From Sweden a single female has been found near Stockholm ultimo July. Remarkable is the find of a male at Rundala (F i n l a n d) medio September, but I also hold this for a retarded specimen of the summer generation.

As to the character of the breeding waters, Martini (1930, p. 339) remarks: "Die gleichen Stellen (offenen, im Frühjahr überschwemmten Wiesen) habe ich selbst als Brutplätze beobachten können. Besonders hinter den Dünen auf den Weiden an der Ostsee entwickelt sie sich als eine der charakteristischen Mückenformen in großer Menge. Aber auch in ausdauernden Teichen habe ich sie nicht selten getroffen, an diejenigen Stellen, die nur im Frühjahr als eine ausgedehnte Verbreitung des Teiches unter Wasser treten, resp. wo das Wasser in Zusammenhang mit dem Teich in Gras und Kraut steht. — — — Die Larve ist oft sehr stark bewachsen mit Algen und anderen Mikroorganismen und erscheint manchmal durch diesen Aufwuchs deutlich grün. Sie ist vielleicht die Späteste ihrer Gruppe." In accordance herewith Peus (1932, p. 140) remarks: "*A. lutescens* (F) Edw. ist als typischer Bewohner frei gelegener, unbeschatteter Sumpfwiesen durch die entsprechenden Formationen des Ober- und Unterspreewaldes verbreitet." Similar observation from U S A has been published by Matheson (1929, p. 122): "It breeds in early spring pools and flooded meadows of the prairies. There is but one brood a season, the adults living till late in the season." In contradistinction to this, Dyar (1919, p. 27) emphasises: "This species has been considered peculiar to the prairies; but it occurs in the forest as well", and the same author (1928, p. 207): "Interior grassy plains, but straying into the lighter forest and the less arid prairie; — — — the larvæ occur in the larger and deeper early spring pools."

Wesenberg-Lund (1920—21, pp. 154—55) once had the opportunity to study the mating process of this species, and as his detailed observations most probably are unique, I take liberty in quoting them here: "On 15. vi. I was standing on the southern coast of Lolland near Aalholm Castle, on a little hill covered with trees and lying in a vast fen, covered with reeds. Below the trees the ground was covered with more than one meter high nettles. It was near sunset at seven o'clock. The weather was calm; Tp. 20° C; the day had been very warm. Enormous masses of *O. fletcheri* were sitting in the reeds; as soon as I came down upon the little patch, hundreds of females rushed upon me. Studying the nettles I then saw that most of the leaves of the nettles either on the edges or on their tips carried males of mosquitoes undoubtedly *O. fletcheri.* The mosquitoes hung on the edges of the leaves by means of the two first pair of legs, the hindlegs were astraddle in the air and were now and then moved in cirkles; the females almost always sat under the leaves. When I now moved the nettles with my walking stick, both sexes arose, and to my great satisfaction I saw that if they touched each other during the flight, pairing immediately took place. — — — More than once I saw a male during the dance touch the hindlegs of the female, stetched out into the air. At the very same moment the female released its hold [from the edges of the leaves], and the mating process took place; but I also very often saw a female voluntarily release its hold and make her away into the swarm of dancing males. The pairing was always begun and accomplished during flight; it lasted only from 50 to 70 seconds; the position during the act was vertical, and in this position the insects floated up and down, the line from the highest to the lowest point being only half a meter; — — — in the vertical position the sexes were placed face to face. Immediately after the two sexes had found each other, they danced some seconds up and down, grasping each others fore and middle legs; the hindlegs were stretched straight out into the air; then I saw the hindlegs being carried inwards, forming a bow with each other; immediately after this the tips of the abdomens were brought against each other, and the pairing took place. Still flying the two sexes released their holds, and both male and female hovered alone in the air; immediately after I have seen the male seize another female and pair with her. — — — At 8.30 the phenomenon abated, and at nine o'clock I saw no more dancing pairs."

Dyar (1923 c) has seen males and females under somewhat similar conditions at Barneville, Minnesota and he concludes: "No matings were observed, but there seems to be no doubt that the males were behaving with us in the same manner as observed in Denmark."

A. flavescens seems to be a very annoying bloodsucker.

From Germany, Martini (1924, p. 3442) records: "*Aëdes variegatus* war dagegen 1921 hinter den Dünen bei Müritz die vorherschende Art im August und griff mit Dunkelwerden recht lebhaft an; auch in Hamburger Marschländern stellte sie mit *Aëdes leucomelas* zusammen die Hauptschuldige an der Mückenplage im Frühjahr dar", and the same author (1930, p. 339): "Sie lebt ganz überwiegend im offenen Gelände und ist also ausgesprochen abendlich, wenn sie bei feuchter Luft, besonders nach Regen auch gelegentlich einmal im Felde tags in größerer Menge angreifen kann."

3. *communis*-group.

The *communis*-group is no doubt characterised by the dark colour of the tarsal segment, but, as pointed out by Edwards (see above) the group is somewhat heterogeneous in other respects.

Edwards is of the opinion that *A. (O.) punctor* shows signs of affinity with the *dorsalis*-group, but in my opinion also the two species *A. (O.) sticticus* and *A. (O.) nigrinus* show conspicuous signs of affinity with this group. In all these species the rather straight stem of the claspette has the little break with setae. And further the basal lobes are of just the same type. Concerning this point one might nearly be tempted to draw up a line of development from *caspius,* through *dorsalis* and *nigrinus* to *sticticus.*

The sub-group (Globus) *Hyparcticus,* established by Martini (1931, p. 264) and embracing the three species *diantaeus, intrudens* and *pullatus* in our region, is well defined by the male genital organs. However the larvae of these species have no joint criterions by which they can be distinguished from the remainder of the subgenus.

The isolated position of *A. rusticus* brought Martini (1931, p. 264) to establish a new sub-group (Globus) *Feltianus* for this species and some related forms. In his last review Edwards (1932, p. 137) bestowed the rank of a group on these species, and I am inclined to agree with his point of view.

Among the larvae in the *communis*-group two species, viz. *A. (O.) punctor* and *A. (O.) nigripes* have a complete sclerotized ring, encircling the anal segment whereas the rest have a saddle only.

Table 20.

Key to females of the *communis* and *rusticus* group.

1. (24) Posterior pronotal scales, at any rate in upper part, narrow curved (never black coloured). Meron and metepisternum devoid of scales.
2. (7) Wing sprinkled with pale scales at costa, subcosta, radius and media. Lower mesepimeral bristle present.
3. (4) Hypostigmal scale-patch absent. First segment of flagellum devoid of scales. Dark parts of abdominal tergites more or less sprinkled with light scales. Colour of scutum uniformly dark, brown-golden. In some specimens light lateral stripes may be found at posterior part of mesonotum (fig. 68, above) .. *detritus* Hal.
4. (3) Hypostigmal scale-patch present and connected with the parastigmal patch (fig. 68, centre). First segment

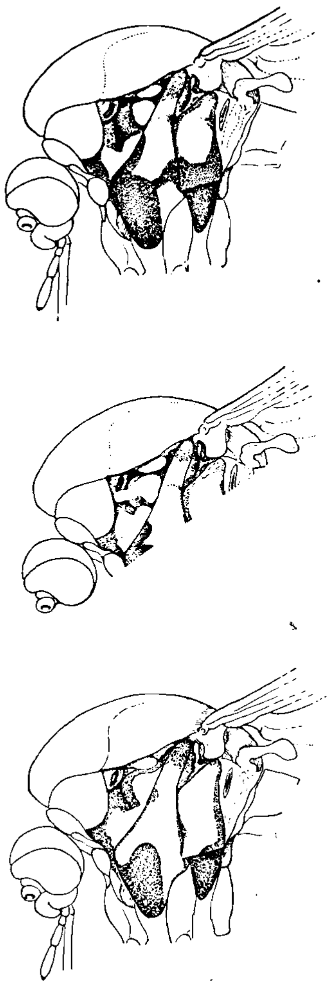


Fig. 68.

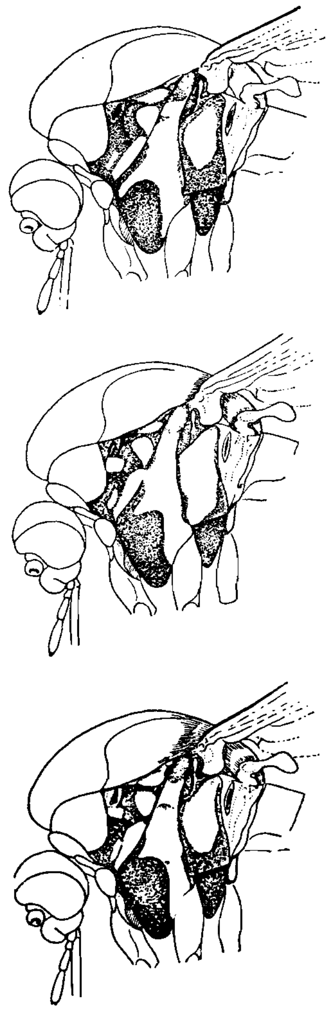


Fig. 69.

Fig. 68. Above: *A. detritus* Hal.; center: *A. cataphylla* Dyar; below: *A. communis* Deg. (After Peus 1933.)

Fig. 69. Above: *A. sticticus* Meig.; center: *A. pullatus* Coq.; below: *A. (O) intrudens* Dyar. (After Peus 1933.)

of flagellum with white scales at ventral side. Dark parts of abdominal tergites uniformly dark.

5. (6) Proboscis sprinkled with ligth scales, by preference in the median part .... *leucomelas* (Meig.)

6. (5) Proboscis uniformly dark .... *cataphylla Dyar.*

7. (2) Wing venetation with dark scaling with the exception of white scales at the base of costa and some other veins. In *nigrinus* the white scaling predominates at subcosta.

8. (11) Mesonotum with a coat of long blackish hairs and bristles; propleurae and fore-coxae with long bristles. Front-side of fore-femurae more or less conspicuously white sprinkled.

9. (10) Bigger, more hairy species; length of wing about 5 mm. Scale-patch on the ventral mesepisternum (sternopleuron) reaches the upper frontal border .... *nigripes* Zett.

10. (9) Smaller, less hairy species; length of wing about 3.5 mm. Scale-patch on the ventral mesepisternum (sternopleuron) does not reach the upper frontal border .... *nearcticus* Dyar

11. (8) Mesonotum, propleurae and fore-coxae with hairs and bristles of normal length. On front-side of fore-femurae the dark scales predominate.

12. (19) Scale-patch at the ventral mesepisternum (sternopleuron) reaches the frontal border. Hypostigmal scale-patch absent.

13. (16) Scale-patch at the mesepimeron reaches the ventral border. Lower mesepimeral bristles present. Front side of hindtibiae dark, rarely with scattered light scales. Tori dorsaly white, at inner side with black scaling.

14. (15) Basis of costa (especially at inner side), occasionally also radius with almost white scales (either entirely whitish or conspicuously sprinkled with light scales), further analis with some white scales at the base. Abdominal tergites with white basal bands which are not conspicuously narrowed in the middle (fig. 68, below) .... *communis* Deg.

15. (14) Base of costa and radius uniformly dark, rarely a few white scales at the very base of costa. Abdominal tergites with white basal bands which are conspicuously narrowed in the middle .... *punctor* Kirby

16. (13) Scale-patch at the mesepimeron does not reach the ventral border. Lower mesepimeral bristles absent. Front side of hind tibiae with predominating white scaling, mostly forming a narrow longitudinal white stripe. Tori white scaled dorsally and at inner side, scales narrow and detached.

17. (18) Segment 1—3 of the flagellum of the same length as the remainder. First segment swollen and, at least at the base, yellow. Tori yellowish-brown, at least at outer side. Light upright forked scales at the head. Wing-veins uniformly dark. Mesonotum whitish with two broad, bronzy-brown, longitudinal bands in the middle, as well as two shorter lateral bands in the posterior part of mesonotum. Dark parts of abdominal tergites bronzy-

brown, with white basal bands conspicuously narrowed in the middle (fig. 69, above) .... *sticticus* Meig.

18. (17) Segment 1—3 of the flagellum conspicuously shorter than the remainder first segment swollen. Tori and first segment of flagellum entirely black. Upright forked scales at the head partially black, by preference towards the sides of vertex. Ground colour of mesonotum variable, from greyish to golden brown. Longitudinal bands as in *sticticus*, but in dark specimens the colour pattern is somewhat blurred. Dark parts of abdominal tergites black. White basal bands not narrowed in the middle *nigrinus* Eckst.

19. (12) Scale-patch at the ventral mesepisternum (sternopleuron) does not reach the frontal border. Hypostigmal scale-patch absent in *diantaeus* only.

20. (21) Scale-patch at the mesepimeron reaches the ventral border. Lower mesepimeral bristles present. Hypostigmal scale-patch present. The base of costa, subcosta and analis with light scales. Mesonotum with yellowish-brown scales, on the lateral margins and around the antellar space shading to yellowish-white. In the middle two bare, black longitudinal lines lying close together and a shorter sublateral black stripe on each side of the antescutellar space. Bristles blackish brown, shading to more or less golden, especially above the wing root (fig. 69, centre) .... *pullatus* Cocq.

21. (20) Scale-patch at the mesepimeron does not reach the ventral border. Lower mesepimeral bristles absent.

22. (23) Hypostigmal scale-patch present. Base of costa, subcosta and analis occasionally with a few white scales. Mesonotum with bronzy golden scales shading to whitish at the lateral margins, above wing-root and at the antescutellar space. Bristles above wing-root blackish (fig. 69, below) .... *intrudens* Dyar.

23. (22) Hypostigmal scale-patch absent. Mesonotum with pale golden or whitish scales. Two median, longitudinal, bronzy-brown stripes faintly divided by a narrow golden line. In some specimens the two stripes are fused. At either side of the antescutellar space is a shorter lateral dark stripe. Bristles above wing-root pale golden *diantaeus* H. D. K.

24. (1) Posterior pronotal scales broad and flat, in upper part blackish brown. Caudal part of meron and ventral part of mesepisternum with a white scale-patch. Hypostigmal scale-patch present and connected with parastigmal patch. Scale-patch at the ventral mesepisternum (sternopleuron) reaches the frontal border, that at the mesepimeron reaches the ventral border. Lower mesepimeral bristles present .... *rusticus* Rossi.

Aëdes (Ochlerotatus) detritus Haliday).

C. detritus Hal. (Ent. Mag., *1*, p. 151) 1833
C. salinus Fic. (Bull. Soc. Ent. Ital., *28*, p. 29) 1896
C. terriei Theob. (Mon. Cul., *3*, 193) 1903

Description.

Female. Head. Vertex ("occiput") with dark yellow-white narrow curved scales. Numerous blackish brown upright forked scales above and on the nape. Temporae with broad, flat white scales with a yellow tint. Eyes bordered with black bristles. Clypeus black. Proboscis blackish brown sprinkled with yellow scales, principally on the basal part. Antennae. Torus laterally yellow, darker on the inner side, with some dirty white scales. Flagellum blackish brown with black hairs and covered with minute white hairs. Palpi (fig. 70 l) about one fifth the length of the proboscis. Segment 3 about half the length of segm. 4, and well over two times as long as it is broad. Segment 4 slender, about four times as long as broad. Ultimate segment circular, small; about ⅓ the width of the penultimate. Colour of palpi dark brown, sprinkled with whitish scales. Apically more white scales. Thorax. Anterior pronotal lobes above with dark golden scales, below with dirty-whitish ones. Posterior pronotum with dark golden narrow curved scales, a few dirty-white ones at the posterior lower corner. Mesonotum with dark brown bristles with golden reflections, by preference stout above the wing root. In the middle of mesonotum fine hair-like narrow curved scales of a dark golden colour, on the sides the scales are mixed with broader ones. Antescutellar space with lighter scales. Scutellum with yellow scales and long, golden bristles. Pleurae and coxae with broad flat dirty-white scales with a yellowish tint. Wing venetation dark brown, sprinkled with yellowish white scales. Halteres brown with whitish scales on stem and globule. Legs. Femurae dark brown sprinkled with yellow scales, these dominate the basal part of fore femurae. Knee spots yellowish. Tibiae and tarsal segments dark brown, sprinkled with yellow scales. Abdomen. Tergites blackish brown with basal dirty-white bands with a yellowish tint. The dark part more or less sprinkled with yellow scales. Venter whitish scaled, in many specimens with a median row of black spots. Length of body: about 5.5 mm (W-L); length of wing: about 3.5 mm.

Male. Head. Antennae rather more than half the length of the proboscis. Torus blackish brown. Flagellum blackish brown and whitish ringed, the last segments covered with minute white hairs. Hair-whorls grey with dirty yellow reflections. Proboscis rather long, tall, blackish brown with an indication of lighter scales. Palpi exceed the

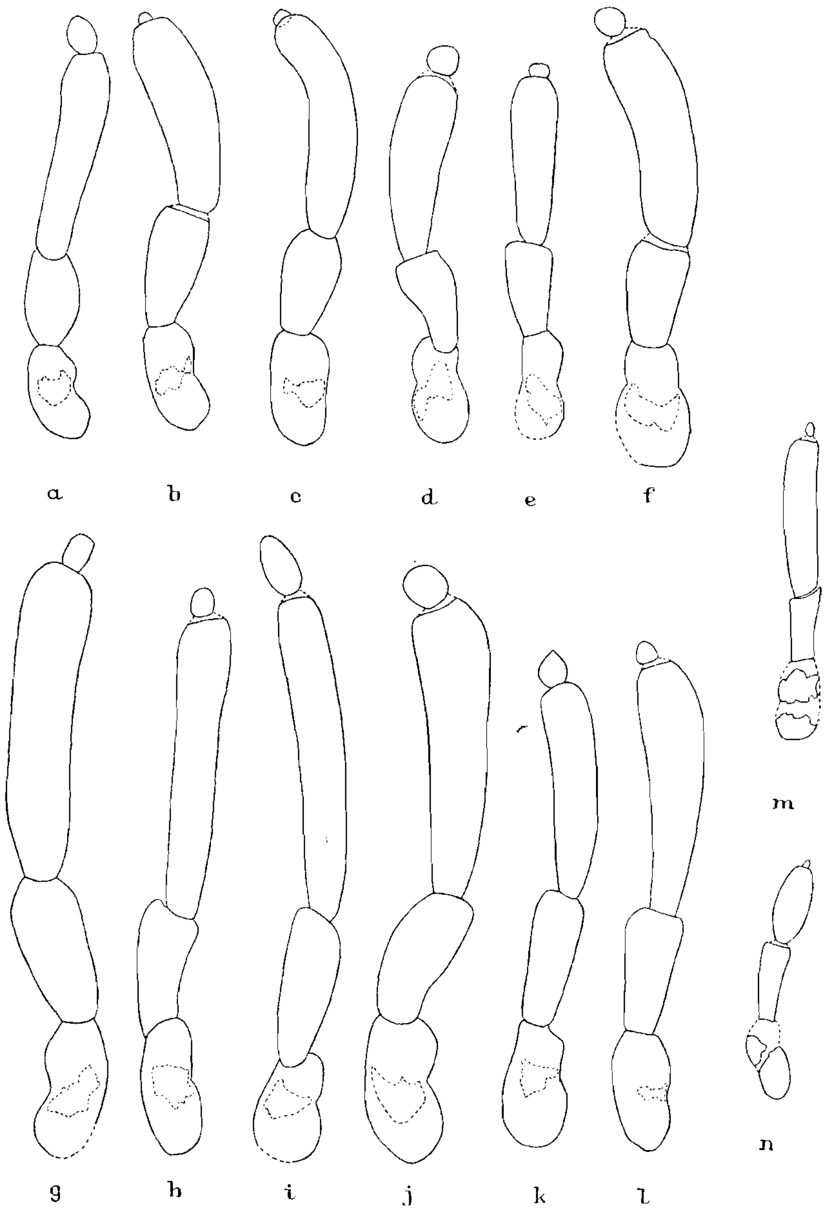


Fig. 70. Palpi of the *communis* group and of *A. cinereus*. Female: a, *sticticus*; b, *nigrinus*; c, *leucomelas*; d, *cataphylla*; e, *intrudens*; f, *nearcticus*; g, *pullatus*; h, *communis*; i, *punctor;* j, *nigripes*; k, *diantaeus*; l, *detritus*; m, *A. cinereus*. Male: n, *cinereus*. All drawn to the same scale. (Aut. del.)

proboscis about ¼ the length of the ultimate segment. Segment 5 a little shorter than segment 4, somewhat taller and tapering apically. Colour dark brown, sprinkled with lighter scales, which in some specimens form patches, found at segment 4, and apically at the long segment. Thorax with dark brown-golden narrow curved scales which have a lighter tint at the antescutellar space. Abdomen blackish brown with yellowish white basal bands and sprinkled with yellowish-white scales on the dark ground. Lateral hairs with dark golden reflections. Length of body: about 6.5 mm (W-L); length of wing about: 4 mm.

Terminalia (figs. 71—72). Basistyle about three times as long as wide, with distinct apical and basal lobes. Apical lobe with a few scattered long hairs. Basal lobe small with a long, apically curved, spine accompanied by some long hairs. Dististyle curved, tapering in the apical half and with a long claw. The stem of the claspette not strongly curved. Appendage of the claspette with a long stem and a low wing. Proctiger with strongly sclerotized, hookshaped paraprocts. Lobes of the ninth tergite with 3—8 moderate long spines each. Average value of 24 specimens: 4,8 spines per lobe.

Larva (fig. 73). Head broader than long. Antennae short, spinose and slightly curved. Antennal tuft of about half the length of the shaft, with about 7 hairs and inserted nearly in the middle of the shaft. Inner frontal hairs behind the mid frontal hairs. Hair formule $^2/_2$ or $^2/_3$. Dorsal prothoracic hair-formula: 2,1,1; 1; 1; 3; 1. The hairs No. 1, 2, 4 and 8 slender, the remainder stout. Comb with about 62 blunt scales in a triangular patch. Siphonal index about 2.0. Siphon broad, slightly tapering in the distal half. Pecten with about 23 teeth, which are furnished with basal denticles. Siphonal tuft with about 8 hairs and inserted approximately in the middle of the siphon. The distance of the hair-tuft from the base is from about 44 % to about 49 % of the siphonal length. Mean value of 11 specimens about 46 %. Saddle low, not reaching half down the sides of the anal segment. Saddle-hair long, simple. Dorsal brush with an inner pair of tufts with about 9 hairs and an outer pair of long stout hairs. Ventral brush with about 16 cratal and 2—3 pre-cratal tufts. Anal gills short, globular.

Compared with German larvae (Martini 1931, p. 329) the siphonal index and the number of the comb scales are greater

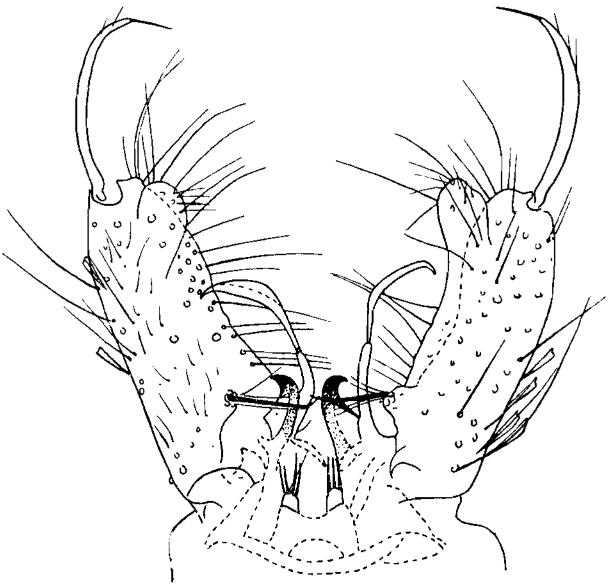
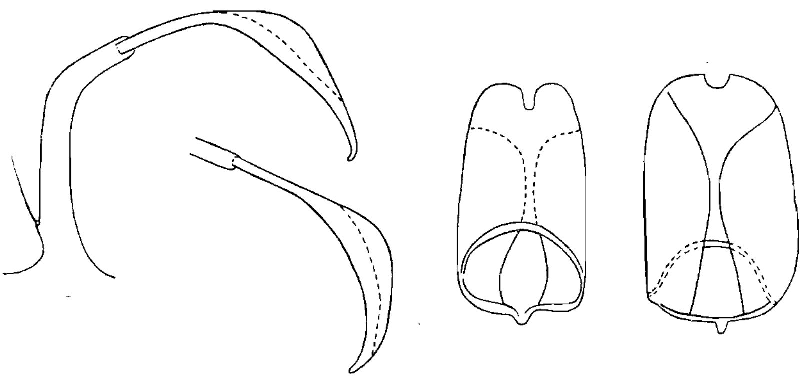


Fig. 71. *Aëdes (Ochlerotatus) detritus* (Hall.)
Terminalia (total view). (Aut. del.)



a b

Fig. 72. *Aëdes (Ochlerotatus) detritus* (Hall.).
a, claspettes; b, sclerotised parts of phallosome. (Aut. del.)

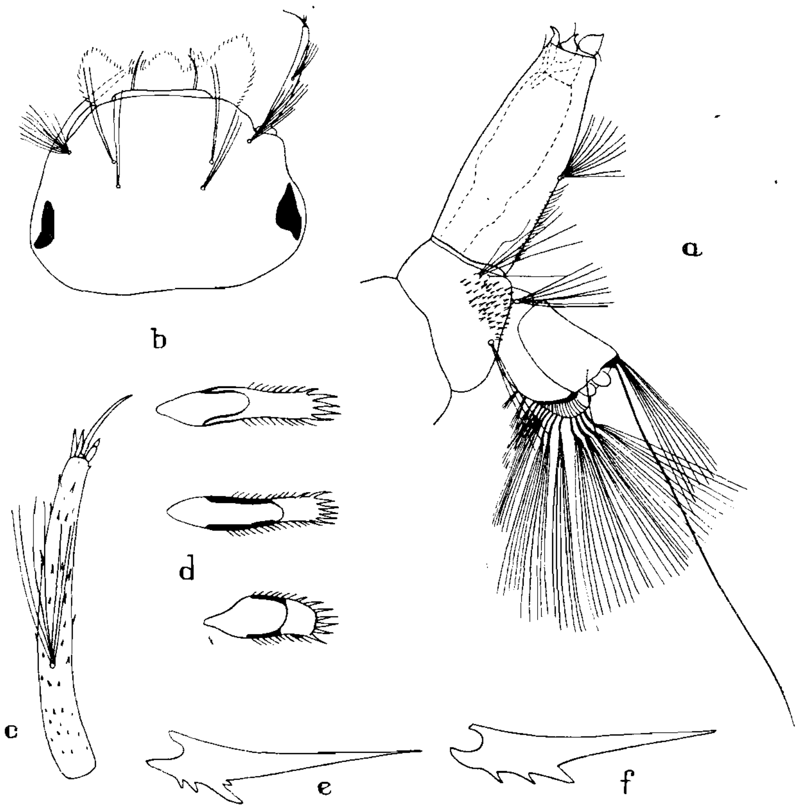


Fig. 73. Larva of *A. (O) detritus* (Hal.) in 4th instar.
a, Terminal segments of larva; b, head of larva; c, antenna; d, comb-scales; e—f, pecten teeth. (Aut. del.)

in the Norwegian larvae. The range of variation in the comb scales is greater than in English specimens (Marshall 1938, p. 173).

Table 21.
Larval chaetotaxis of *A (O) detritus* Hal.

Number of branches in				Number of		Siphonal index
Frontal hairs			Siponal Tuft	Comb scales	Pecten teeth	
out.	mid	inner				
7—10 6.8 (18)	2—3 2.0 (27)	2—3 2,7 (26)	6—10 8 15	45—76 62.3 (12)	19—27 22.9 (18)	2.6—3.5 3.0 (17)

Geographical distribution.

Denmark: 2. *Sjælland:* Roskilde Fjord, viii. (W-L); Amager, viii. (W-L); *Laaland:* Guldborgsund, 20. vii. 1920 (W-L); *Falster:* Guldborgsund, 20. vii. 1920 (W-L).

Norway: Ø: *1. Hvaler:* Kirkeøya: Prestesand, L: 13. iv. 1938 (♂♀) (LRN); Brennesand, L: 13. iv. 1938 (♂♀) (LRN); Hellekilen, L: 13. iv. 1938 (♀) (LRN); Bø: *1. Hurum:* near Kongsdelene Chapel, L: 8. v. 1938 (♂) (LRN); at Sætre, L: 8. v. 1938 (♂) (LRN); Fi: *11. Karasjok:* ? ♀, at Jiesj-Javre, 3. vii. 1924 (S-R).

The single female specimen, probably of this species, from Finnmark, has raised many intricate problems. The specimen was caught near the lake Jiesj-javre by Mr. Soot-Ryen of the Norwegian Finmark-Expedition 1924, and he emphatically assures me that a confusion of labels is out of question. In 1927 I worked out the mosquito-material from this expedition in the Tropical Institute at Hamburg, and without hesitation I considered the specimen as *A (O) detritus* Hal. A comparison with the material of *detritus* in the institute brought out no distinct differences, and Prof. Martini, who controlled my identifications, agreed with my point of view concerning this specimen. To be sure, in my little paper on the Finmark *Culicidae* (Natvig 1929 a) I pointed out the strangeness of the finding place about 40 km. from the seashore, but a closer study of the Fennoscandian mosquitoes, has now convinced me that the find is quite outside the range of distribution of this species. As will be seen from the accompanying map (fig. 139) *A. detritus* has been recorded in our region from Denmark and the southeastern Norway: hitherto it has neither been found in Sweden, nor in Finland, nor in the northern European part of USSR. Now and again I have compared the specimen with material from southern Norway, and I could find only the following small differences. The light scales of the wing-veins are more distinctly whitish than in the southern specimens. The white scaling is predominating on the under side of costa and subcosta in the specimen from Jiesj-javrre, whereas the dark scales predominate in the southern specimens. Further the legs are somewhat more distinctly white-speckled in the Jiesj-javrre specimen and the abdominal sternites are white-scaled, without the median black spots. However, further research is urgently needed in this matter.

Distribution outside Denmark and Fennoscandia.

On the general geographical distribution of *A. detritus,* Edwards (1921, p. 310) says: "European coasts, from Ireland and France to Denmark and Macedonia; also coast of North Africa, Suez Canal and Palestine.". According to Marshall (1938, p. 176) the British records are: England: "*A. detritus* has been recorded from all the counties of the south coast, as well as from all those of the east coast except Durham and Lincoln-shire. It also occurs in estuarine marshes in Somerset and Westmorland." Wales: Carnarvon and Merionethshire. Burke (1946) records the species from Cheshire. Scotland: Argyllshire, Buteshire, Dunbartonshire and East Lothian. From Belgium Goetghebuer (1925, p. 215) records: "Bas-fonds du Zwyn à Knocke s/m (Litt), 9." In France the species has been recorded (Séguy 1923, p. 148—9) from: "Morbihan: La Trinite-sur Mer (Surcouf), Loire-Inférieure (Larousse, Penau), Var: Hyères (Lesne), Nîmes et Var: Cavalière (Villeneuve), Sardaigne: marais salants de Cagliari (Ficalbi)." Further Brumpt (1942) records it from Crau and Camargue and Roubaud (1943) from the Rhone delta. As to the occurrence of *A. detritus* in Portugal, Braga (1931, p. 72) says: "Abundante com o *A. caspius,* em algumas regioes do nosso litoral. Caminhal (Braga) Leca da Palmeira, VII (Braga); Aveiro, VII (Braga); Alcácer do Sal (M. Sarmento)." From the Canarian Islands the species is recorded by Christophers (1929) and Storå (1937, p. 20) records a ♀ from Tafira, 23. iii. From Germany Martini (1931, p. 329) records: "In Deutschland ist sie in Müritz, Markgrafenheide, Warnemunde häufig, ebenso auf dem Privall bei Lübeck — — —. Auch in Inlandssalzgebieten — — — so — — — an den Salzwassern von Oldersloe." Hungary: Balaton (Mihályi 1941). From Italy it has been described by Ficalbi under the name of *Culex salinus* (Martini 1920, p. 116) and Martini (1928c, p. 38) also records a find from Seria. From Macedonia Séguy (1923, p. 148—9) records it from: "Batch et Brod (Le Fauncheur), Zeitenlik, près Lalonique (Rivet), Mityléne, Loutra (Landrieu)" and Waterstone (1921—2, p. 134) records it from Galiko river and Karabouroun. Concerning its occurrence in Asia Minor Martini (1931, p. 329) remarks: "In Anatolien nicht nur an der Küste, sondern auch häufig bei Aidin." From North Africa it is recorded by Séguy (1923, p. 148) from Tunis and from Egypt it is recorded by Kirkpatrick (1925, p. 206) from the following places: Canal Zone, Delta, Mariut. Coast, Baharia Oasis and Eiwa. As to the distribution in USSR Stackelberg (1937, p. 165) says: "From USSR recorded from the Lower Volga distr.: Eljton, Altana (Martini: *A. (O) salinus* Fic.), Turkmenia (Petrischtscheva 1936), Tadschikistan (Petrischtsch 1936), Usbekistan (Bukara: Montshadskiji!) Ukraine (Polesje: Rybinskiji 1930) and Dnjepr distr. (Dolbesdikin). The two last mentioned records have to be controlled." [90] Wnukowsky (1928, p. 164) records females from: Distr. Tomsk: Nowo-Aleksandrowkoje, 26. vii., and from Rayon Narym: Permitino, 29. vii. and Bolschaja Paschnia, 22. vii., and Edwards (1921, p. 310) records a male from Kashgar, Chinese Turkestan and male and females from Etsingol, S-W Mongolia (1935, p. 2).

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[90] Translated from the Russian text.

Biology.

Hitherto the only records of *A. detritus* in southern Norway are from Hvaler Islands and from coastal localities on the Oslo-fjord. In Kirkeøya, Hvaler (Ø 1) larvae have been found about medio April and at Sætre and Kongsdelene chapel (Bø 1) larvae were caught 8. v. The hydrogen-ion-concentration of the breeding waters varies from pH: 5.9 to pH: > 7.6. The salinity of the water varies from 0.0749 % NaCl up to 0. 835 % NaCl. The last mentioned figure is from a pool with seaweed near the sea-shore at Kirkeøya. The larvae of *A. detritus* have been found associated with larvae of *A. communis, dorsalis, leucomelas, punctor* and *Anopheles maculipennis (messeae* and *typicus);* concerning detais see table 2, p. 60. The single find of an adult female *detritus* near Jiesj-javrre has been discussed above.

From Denmark Wesenberg-Lund (1920—21, p. 69) records: "It seems that the species in our country has only one generation, the imagines appearing very late; owing to this it has nearly been overlooked".

According to Marshall (1937, p. 173) *A. detritus*, in Britain is essentially a "seaside" mosquito. — — — The eggs — are deposited amidst the vegetation of coastal marshes and are able to remain in a dry condition for at least one year, and probably much longer, without their viability being affected. Whenever a resting place of the eggs becomes flooded — — a certain proportion of them hatch into larvae. — — — Hence, in areas which are subject to alternate flooding and drying, fresh stocks of larvae are periodically produced." The species has been found in one inland water — in Droitwich (Worcestershire) where extensive salt deposits exist.

From Germany Martini (1920, p. 116) records: "Diese Art ist unsere hauptsächliche Salzwiesenart, die besonders in ganz offenen Wiesengelände in kleinen Tümpeln und stehenden Gräben sich im ersten Frühjahr in ungeheuren Scharen entwickelt." In accordance herewith Goetghebuer (1925, p. 215) remarks from Belgium: "Espèce propre au littoral. La larve vit dans l'eau saumâtre des mares dans les bas-fonds des dunes" and Séguy (1923, p. 149) from France: "Espèce spéciale aux régions littorales, commune dans le voisinage des marais salants." As to the occurrence of *A. detritus* in inland localities, Martini (1928, p. 38) says: "Im Inland wahrscheinlich an vielen Salzstellen, in Europa und Asien, vermutlich durch das ganze Salzwüstengebiet." This supposition is confirmed by a find of adult male and females at Etsin-gol, S-W. Mongolia, 8. vi. 1929 (Edwards 1935, p. 2). On these specimens Edwards remarks: "The male is lighter in tint than British examples of the species, but the hypopygium agrees." From Egypt Kirkpatrick (1925, p. 182) states that larvae of *A. detritus* are found in "salt pools, either with or without water plants, and stagnant salt drains". The salinity of the breeding waters varies from 0.83 % to 5.20 %. Kirkpatrick further says: "In every case *A. detritus* has been found in company with *A. caspius,* and once also with *Culex pusillus,* but with no other species."

According to Marshall (1938, p. 176): "*A. detritus* adults are vicious and persistent biters, and since — — — they — — — also have a flight range of at least four miles, their capacity for causing widespread annoyance undoubtedly exceeds that of any other British species.". From E g y p t Kirkpatrick (1925, p. 182) records: "This species bites readily by day and in the evening. I do not know whether it enters houses."

The seasonal prevalence of this species in E g y p t is from February to May, but two records in January and one each in June and July are also quoted.

Aëdes (Ochlerotatus) cataphylla Dyar.

A. cataphylla Dyar (Insec. Insc. Mens., *4*, p. 86) 1916
A. prodotes Dyar (Insec. Insc. Mens., *5*, p. 118) 1917
(W-L: D. Vid. Selsk. Skr. (8), 7, p. 81) ....(1921)
var. *rostochiensis* Martini (Üb. Stechmück., p. 246) 1920

Synonymical and systematical remarks.

The synonymy above is in accordance with Edwards (1932, p. 143). In 1920 Martini established a new species: *Aëdes rostochiensis,* differing from *A. cataphylla* Dyar in characters of the male terminalia. On this species, Dyar (1922 b, p. 70), in a paper on "The mosquitoes of the Palaearctic and Nearctic regions", remarks: "Further there are two species representing *cataphylla* and *impiger,* the former called *cataphylla* var. *rostochiensis* Mart. I have some examples of this by the kindness of Dr. Martini and do not trace any resemblance in the thoracic markings to those of *cataphylla,* with which I am familiar by the personal collection of hundreds of examples. I therefore think that the species should be *A. rostochiensis* Mart., representing our *cataphylla* in Europe, but specifically distinct". However, Edwards (1921, p. 310) says: "None of the old European names seem to be applicable to this species, but I am satisfied that it is specifically identical with the western North American *A. prodotes* Dyar (which Dyar now recognises to be the same as his previously described *A. cataphylla*)." Martini (1928, p. 36) maintains his previous opinion and remarks: "Edwards möchte die nordamerikanische *A. cataphylla* für artgleich mit dieser form [*A. rostochiensis!*] halten. Meiner Meinung nach sind Unterschiede in den Lobi der neunten Tergiten beim Männchen vorhanden, welche das nicht erlauben. Immerhin stehen sich beide Arten außerordentlich nahe." As will be seen from the description below of the Norwegian material, the range of variation in the number of spines on the lobes of the ninth tergites in the near-related species *cataphylla* and *leucomelas* overlap to some extent. In my opinion the value of this character for diagnostical purpose therefore is rather questionable, and I am inclined to agree with Edwards that *cataphylla Dyar* and *rostochiensis* Mart. are specifically identical.

Description.

Female. Front of head with some golden bristles forming a little tuft between the eyes. Vertex ("occiput") in the middle with whitish and yellow narrow curved and upright forked scales, intermingled with some dark brown upright forked scales. On the sides of vertex a patch of brown narrow curved scales. Temporae with dirty-white broad, flat scales. Clypeus blackish brown. Proboscis dark brown. Labellae black. Antennae. Torus ochreous, inner side dark with some dirty-white scales. Flagellum. First segment ochreous, the remainder dark brown with a coating of minute white hairs all over, and at the base of the segments, bigger hairs. Palpi (fig. 70 d) about one fifth the length of the proboscis, with dark brown scales blended with some dirty-white ones. Segm. 3 about half the length of segm. 4, about twice as long as broad. Segm. 4 amply three times as long as broad. Ultimate segment circular, about half the width of the penultimate. Thorax. Anterior pronotal lobes blackish brown, dorsally with dirty-white narrow curved scales, ventrally with some broad, flat scales of the same colour. Posterior pronotum with golden narrow curved scales, dirty-white ones at the posterior lower corner. In some specimens all the scales are more or less whitish. Mesonotum blackish brown clothed with golden narrow curved scales, those on the sides being paler. One brown golden stripe on either side of the middle line. Mesonotum with dark brown bristles, those at the wing root golden. Scutellum and antescutellar space with white narrow curved scales. Postnotum blackish brown. Pleurae and coxae dark brown with patches of dirty-white, broad, flat scales. Bristles with golden reflections. Wing venation dark brown, sprinkled with dirty-white scales. In the few specimens at hand the white scales on the wing venation are more scanty in this species than in *A. leucomelas.* The light scales predominate at the base of costa and on the subcostal vein. Halteres with luteous stem and dark globule, clothed with greyish scales. Legs. Femurae and tibiae with pale scales on under side, dorsal side dark brown sprinkled with white scales. The first tarsal segment with many white scales, in particular on the hind legs. Abdomen. Tergites dark brown with broad basal segmental white bands. Venter white scaled. Length of body: 5.5 mm (W-L); length of wing: about 3.5 mm.

Some variation in the colouring may be found also in this species. Thus Edwards (1921, p. 310) remarks: "The American specimens, however, are on the average smaller, and the mesonotal scaling is rather different from the usual European type, being rather darker in the middle and with more numerous white scales at the sides. Nevertheless the Norwegian specimens in the British Museum have the sides of the mesonotum even whiter than the American specimens I have examined." I have a female of this type from Ytre Rendal (HEn 23). In another, somewhat damaged specimen (probably of the same species) the dark longitudinal bands on the mesonotum are missing. In one specimen from Denmark the eighth abdominal segment is clothed with white scales nearly all over.

Male. Head. Proboscis dark, longer than the fore femurae. Antennae about 2/3 the length of the proboscis. Hair-whorls with brown reflections. Palpi exceed the proboscis about half the length of the ultimate segment. The long segment dark brown, more or less conspicuously sprinkled with white scales, which in the distal half form a ring; apex dark. Segment 4 with white scales basally, segment 5 dark. Ultimate segment about 4/5 the length of the penultimate. Hair-tufts at the distal end of the long segment and at segment 4 long, at segment 5 short. Thorax dirty-golden scaled; the sides of the mesonotum may be more or less whitish scaled. Abdomen black with basal white bands occupying about 1/8 the length of the segments. At segment 8 the white scaling predominates. Length of wing: well 4 mm.

Terminalia of *A. (O) cataphylla* very similar to those of *A. leucomelas* (see description p. 297 and fig. 80, 81 f—g), however the appendage of the claspette is shorter and the wing is broader and not petiolate. Lobes of the ninth tergite with 4—13 spines, that are mostly somewhat shorter than those of *leucomelas*. Average value of 12 specimens: 6.7 spines per lobe.

Larva (fig. 74). Head broader than long. Antennae short, straight and spinose. Antennal tuft well half the length of the shaft, inserted about the middle of the shaft and without 4 hairs. One of the bristles of apex of antenna

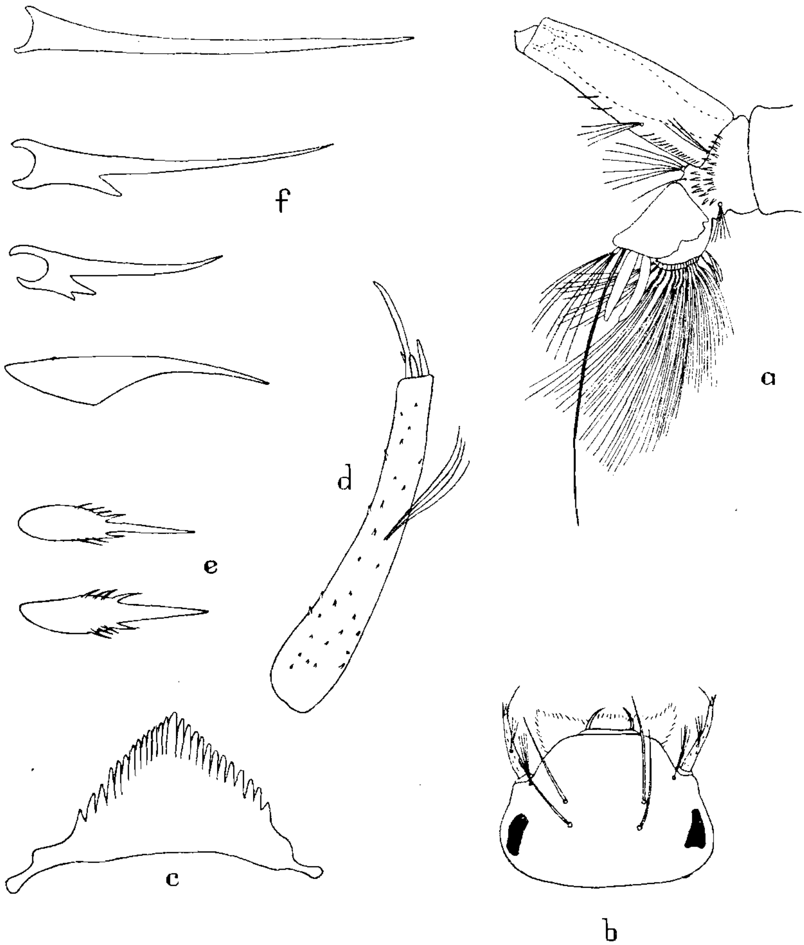

Fig. 74. Larva of *A. (O) cataphylla* Dyar in 4th instar.
a, Terminal segments of larva; b, head of larva; c, mentum; d, antenna; e, comb-scales; f, pecten teeth. (Aut. del.)

long. Inner frontal hairs behind the mid frontal hairs, both simple. Comb scales about 25, in a triangular patch. Scales pointed, with some denticles at the base of the median spine, two of which are greater than the remainder. Siphonal index about 3. Siphon slightly tapering beyond hair-tuft. Tuft inserted about the middle of the siphon, with about 4 hairs of nearly $1/8$ the length of the siphon. Pecten with about 16 teeth, the two apical ones widely detached and inserted conspicuously beyond the tuft. Anal segment longer than wide. Saddle reaching well half down the sides of the anal segment. Dorsal brush with an outer pair of long, stout single hairs and an inner pair of tufts, with about 8 hairs. Ventral brush with about 18 cratal and 1 precratal tufts. Anal gills somewhat shorter than saddle.

Martini (1931, p. 273—74) states that the number of comb scales is about 30 and the pecten teeth are about 18 + 2—4. Wesenberg-Lund (1920—21, p. 82) records the number of comb scales to about 25 and the pecten teeth to about 20. As will be seen from the table below, the corresponding figures for the Norwegian material are generally somewhat lower.

Table 22.

Larval chaetotaxis of *A. (O) cataphylla* Dyar.

Number of branches in					Number of		
Frontal hairs			Antennal tuft	Siphonal tuft	Comb scales	Pecten teeth	Siphonal index
out.	mid.	inner					
4—5 4.5 (4)	1 (6)	1 (4)	3—5 4.3 (4)	3—5 4.2 (5)	25—28 26 (3)	14—19 16 (9)	3 (2)

Geographical distribution.

Denmark: *2. Sjælland:* Hestehave near Hillerød (W-L); Hareskov! ♂: 1. vii. 1935 (Esb. Petersen); Eremitage plain about 15 km from København (W-L); København! ♀: (Stæg.). *3. Bornholm:* Blykobbe! ♂: 28. v. 1931 (*P.* Nielsen).

Sweden: *Sm:* ♂ (Bhn!); *Upl:* Hlm! ♂: (Bhn); Experimentalfältet! ♀ 3. vi. (Lampa); *Dlr:* Floda, Syrholn! ♀: 31. v. 1934 (B. Tjed.); »Dlc.«!, ♀: (Bhn).

Norway: Ø: »Smaalenene (Collett)« (Edw. 1921, p. 310—11); AK: *12. Bærum:* Snarøya, L: 29. lv. 1928 (LRN); *13. Aker:* Bygdøy, L: 8. v. 1928 (LRN); Bø: *4. Lier,* L: 19. v. 1938 (♂) (LRN); HEn: *20. Trysil:* Indbygda, L: 31. vi. 1935 (♂) (LRN); Vestby, L: 8. vii. 1934 (♂) (LRN); Nybergsund, L: 31. v. 1935 (LRN); *23. Ytre Rendal:* Solbakken, Storsjøen, ♀: 20. vii. 1939 (LRN); ? Holla outfarm, ♀: 21. vii. 1943 (LRN); STi: *41. Trondhjem,* ♀: vii. 1844 (Siebke).

Finland: *Al (A):* Finnström! ♂: (R. Frey); Sund! ♂: (Forsius, Frey); *Ab (V):* Karislojo! ♂: (J. Sahlberg); Karuna! ♂: 29. iv. 1934 (Storå); *N (U):* Helsinge! ♂: (Federley); Helsingfors (Frey); Tvärminne Zool. Stat! ♂: 10. vi. 1920 Frey); Esbo! ♀: (Hellén); *Ta(EH);* Hattula! ♂: 1907 (L: v. Essen); *Ks (Ks):* Kuusamo! ♂: (R. Frey).

Distribution outside Denmark and Fennoscandia.

On the distribution in Germany Martini (1931, p. 274) records: "Diese Art habe ich als Larve bei Warnemünde gefunden, ferner bei Schelferwerder und an anderen Plätzen bei Schwerin und bei Müritz und Graal — — —. Die *"nemorosus"* mit rostigem Anflug waren mir dagegen schon längst gut bekannt, vor allem aus der Danziger Gegend. — — — Neuerdings giebt sie Vogel von Würtemberg an." Further Edwards (1921, p. 311) records the species from Frankfurt—Oder (Riedel) und Berlin (Oldenberg). Hungary: Balaton (Mihályi 1941). From Estland it is recorded from "Jööpre-Hochmoor, Hochfläche westlich von Lavasaarbach, 4. ix" (Dampf, 1924, p. 6), further from Lettland: Illjen (Kurland), ♂: 23. v. 1924 (Peus 1934 b, p. 77) and Poland (Tarwid 1935, 1938 a). As to the distribution in USSR Stackelberg (1937, p. 167) says: "From USSR recorded from Severnyi Kraji (environs Arkangelsk: Birulja!), Leningrad (environs Peterhoff: Montsch.!, environs Luga: Stackelb.!), Moskva (Moskva: Nikolskiji, Rjasanj: material from Malaria Station), Voronesch distr. (environs Voronesch: Schtschelk.), Ukraine (Polesje: Rybinsk, Dnepropetrovsk distr.: Dolbeschkin), southern coast of Crimea (Velitschkevitsch!), North Kaukasus (Pjatigorsk, Schelesnovodsk, Essentuki: Mess/), Lower Volga distr. (Martini), Sverdlovsk distr. (Sverdlovsk: Kolosov, Perm distr.: Mitrofanova, Kungursk distr.), Siberia: Omsk(!), Jeniseisk (Trybom t. Edw.), Barnaul (Simanin.)," [91] Wnukowsky (1928, p. 164) records the species from West-Siberia: Tomsk distr.: Ssokolovsky, ♀: 1. viii.; Rayon Narym: Permitino, ♀: 29. vii. Further Edwards (1921, p. 311) records *cataphylla* from Austria (Prater: Mann) but he remarks: "This specimen was insufficiently examined and may have been *A. salinellus.*" According to Dyar (1923 d, pp. 64—5) the distribution of *A. cataphylla* in the American continent is: Northern Rocky Mountains to Alaska, and Sierras of California. The records are: Alaska: Camp 327, Alaska Engineering Comm., July 13, 1921; Camp 334, Alaska Eng. Comm., July 9, 1921; Sevard, July 24, 1921; Healy, July 7, 1921; Hurricane, July 15, 1921; Inspiration Point, July 28, 1919; Skagway, June 24, 1919; Canada (Dyar 1921 b, p. 102): *Alberta:* Banff, July 7, 1918; Laggan, July 11, 1918; Lake Minnewanka, July 22, 1918; Lake Louise, July 11, 1918; *British Columbia;* Field Aug. 15, 1906; Mt. Cheam, Aug. 7; White pass, July 28, 1919; Atlin, July 22, 1919; *Yukon Territory:* Carcross, June 26, 1919; Whitehorse, June 26, 1919; Tahkeena River, July 19, 1919; Byer's Camp, July 6, 191; Big Salmon, July 15, 1919; Carmack's July 14, 1919; Horse Falls, July 13, 1919; Knudson's Camp, July 6, 1919; Tantalus Mine, July 6, 1919; Selkirk, July 13, 1919; Dawson, July 7, 1919. USA: (Dyar 1923 d, pp. 64—5) *California:* Fallen Leaf Lake,

[91] Translated from the Russian text.

June 20, 1916; Tahoe City, June 18, 1920; Summit Placer County, June 20, 1920; Little Truckee River, May 6, 1921; *Montana:* Bozeman, May 7, 1907. However, Matheson (1930, p. 292) remarks: "This species according to Dyar, is restricted to the Rocky Mountains, from Colorado north to the Yukon. In the collection (Museum of the Illinois State Natural History Survey) there is one male taken at Mt. Carmel, Ill. on June 30, 1906. This would indicate a much wider range for the species than given by Dyar."

Biology.

In Norway larvae of this species have been found from the seashore and up to about 620 m above sea-level. The breeding-waters are pools, waterfilled ditches and flooded meadows. The larvae seem to tolerate rather polluted water, then at Nybergsund (Hen 20) a cabbage-pile was situated at the edge of the breeding-pool. The larvae have been found associated with larvae of *A (O) dorsalis, leucomelas, communis, diantaeus, intrudens, punctor* and *Theob. bergrothi.* For details see table 2, p. 60. No Norwegian male adults have been found in the field, but females have been found in July. In Sweden females have been found ultimo May and in Finland males have been found from 29. iv. to 10. vi. From Denmark Wesenberg-Lund (1920—21, p. 85) records that larvae of this species were found in "the *Hydrophantes*-ponds in Hestehave near Hillerød". In April "the many ponds in the Eremitage-plain in the Royal Deer Park about 15 kilom. from Copenhagen — — — teemed with *O. prodotes* larvæ". He further says: "The species is hatched very early before *O. communis* — — —. As far as I have hitherto observed, it seems that the species prefers temporary ponds on plains, not overshadowed by trees, or ponds lying on the outskirts of forests. — — — The species has unquestionably only one generation in the course of the year, lying almost the whole years as eggs; all ponds in which the species is found are commonly dry from June to March".

According to Martini (1931, p. 274) the larvae, in Germany, are found "in Gräben und Wasserlöchern am Waldrande". Concerning USSR Martini (1928 c, p. 36) records from the Lower Volga district: "Die Fangplätze lagen ebenfalls im Waldgebiet und daher ausschlieslich auf der Bergseite, sowohl die der Larven als die der Imagines. Erstere fand ich in mehreren Brutplätzen in einzelnen Stücken, fast in Reinkultur dagegen und in großer Menge in einem kleinen Wasserloch an einem Nordhang, über dem nur noch dünne Reste eines Platanenwäldchens standen." According to Stackelberg (1937, p. 167) the larvae have been found associated with larvae of *A. caspius dorsalis* Mg. and *A. meigenanus* Dyar [= *punctor* Kirby]. From the American continent Dyar (1928, p. 191) states: "The larvae occur in the earliest spring pools, mixed in smaller proportion with those of *impiger*. They favor grassy pools along river-banks, and sometimes occur in very large numbers." He further records (Dyar, p. 102); "The females bite both by day and night. The males swarm high over spaces between bushes or small trees in open country."

Aëdes (Ochlerotatus) leucomelas (Meig.?).

C. leucomelas Meig. (?) (Klass. p. 3) 1804
A. salinellus Edw. (Ent. Tidskr., *42*, p. 52) 1921
A. terriei Martini (nec. Theob.). (Üb. Stechmück., p. 112) 1920

Synonymical and systematical remarks.

On the synonymy of this species Edwards (1921, p. 311) says: "I am not satisfied that any older name can be applied to this species. The type of *C. terriei* is certainly nothing but a normal, if rather small, female of *A. detritus,* which is common in the locality where *C. terriei* was taken. It is quite possible that *A. salinellus* may eventually be found to be the same as some known American species, but at present I have not been able to identify it with any such; it may be the European representative of *A. impiger* (= *decticus* H. D. K.), which has the male palpi all black and fewer bristles on the ninth tergite. The name *salinellus* was suggested partly because of the strong resemblance to *A. detritus (salinus),* and partly because the first specimens sent me by Dr. Wesenberg-Lund were reared from brackish water." In 1922 c (p. 115) Martini remarks on this species: "Aus Meigens Arbeit 1804 aber, die mir erst in letzterer Zeit zugänglich wäre, sehe ich, daß die Art ihm schon bekannt war; es ist *leucomelas*. Diese Art ist durch die schwarzen Füße, die weißgefleckten männlichen Taster, die geringere Größe *diversus* (*maculatus* Mg. 1804) gegenüber, so zuverlässig wiederzuerkennen wie nur irgendeine Meigensche Art". In conformity to this Edwards, in his last monograph (1932, p. 144) altered the synonymy as indicated above.

Description.

F e m a l e. H e a d with golden bristles forming a little tuft between the eyes. Vertex ("occiput") with golden narrow curved scales and upright forked scales. Laterally dark brown upright forked scales. Temporae with creamy broad flat scales. C l y p e u s blackish brown. P r o b o s c i s blackish brow sprinkled with white scales with a yellowish tint, by preference in the basal part. Labellae black. On the under side of the proboscis the light scales predominate. A n t e n n a e. Tori brownish yellow with a row of whitish scales. Flagellum. First segment basally yellow, the other blackish brown with setae of the same colour and minute white hairs. Palpi dark brown sprinkled with lighter scales (fig. 70 c) about one fifth the length of the proboscis. Segm. 3 less than half the length of segm. 4, twice as long as it is broad. Segm. 4 about four times as long as broad. Ultimate segment circular, its width about ¼ of the penultimate. Thorax. Anterior pronotal lobes blackish brown with yellowish bristles and narrow curved scales. Posterior pronotum with light golden or whitish narrow curved scales. Mesonotum clothed with dirty-golden, narrow curved scales, the sides of the mesonotum lighter. In some specimens black lines may be seen on either side of the somewhat darker median region. The antescutellar space with more whitish scales. Bristles on the median part of mesonotum dark brown, golden on the lateral regions. Scutellum dark brown with yellowish white scales and golden bristles. Postnotum brown. Pleurae and coxae brown with patches of white broad, flat scales. Bristles with golden reflections. Wing venation dark brown, sprinkled with yellowish white scales; these predominate on the subcostal vein. Halteres with luteous stem and dark globule with whitish scales. Legs. Under side of femurae yellowish white, dorsal side dark brown, sprinkled with light scales. A subapical dark ring on middle- and hind femurae. Knee spot yellowish white. Tibiae dark brown. Tarsal segments dark and light sprinkled. Abdomen. Tergites blackish brown with broad white basal bands. In some specimens the dark parts may be more or less sprinkled with light scales in the last segments, and also apical narrow white bands may be seen here. Venter clothed with whitish scales. Length of body: 5.5 mm (W-L); length of wing: about 3.5 mm!

Male. Head. Proboscis longer than the fore-femurae, above sprinkled with white scales which are aggregated especially at the base and in the middle, below the proboscis has a lighter scaling. Labellae blackish brown. Palpi exceed the proboscis about half the length of the ultimate segment. Ultimate segment about ⅔ the length of segment 4. Base and apex of the long segment with brown scaling, otherwise the scaling is yellowish white, as is also the case with the basal part of segment 4. Ultimate segment blackish brown. Thorax dirty-golden scaled, at the sides of the mesonotum and at the antescutellar space more or less whitish. Length of wing: about 4 mm!

Fig. 75. *Aëdes (Ochlerotatus) leucomelas* Meig. Terminalia (total view). (Aut. del.)

Terminalia: (figs. 75, 76). Basistyle rather slender, with conspicuously projecting apical lobe with single hairs of moderate length. Basal lobe comparatively small, rounded, with a long, apically conspicuously curved spine accompanied by 2—3 long hairs of similar shape, and some shorter hairs. Lobes of the ninth tergite with 6—17, laterally curved long spines each. Average value of 28 specimens: 11,3 spines per lobe. Stem of the claspette strongly curved, tapering apically. Appendage with very long and petiolate low wing.

The terminalia of *A. leucomelas* Meig. and *A. cataphylla* Dyar are very similar and the only criterion hitherto used for differentiation have been the spines on the lobes of the ninth tergite. Concerning *cataphylla* Edwards remarks (1921, p. 299): "Lobes of the ninth tergite with about six short straight bristles" and for *salinellus* [= *leucomelas* Meig.!]: "Lobes of the ninth tergite with about twelve longer bristles which curve outwards." As to the British *leucomelas* Marshall (1938, p. 177) records twelve spines and Martini (1931, p. 273) records for *leucomelas* about 14 and for his *rostochiensis* [= *cataphylla!*] about 7 spines in specimens from Central-Europe. Consulting the American literature we find by Dyar (1928, p. 190) for *cataphylla:* "seven or eight rather long spines" whereas Matheson (1929,

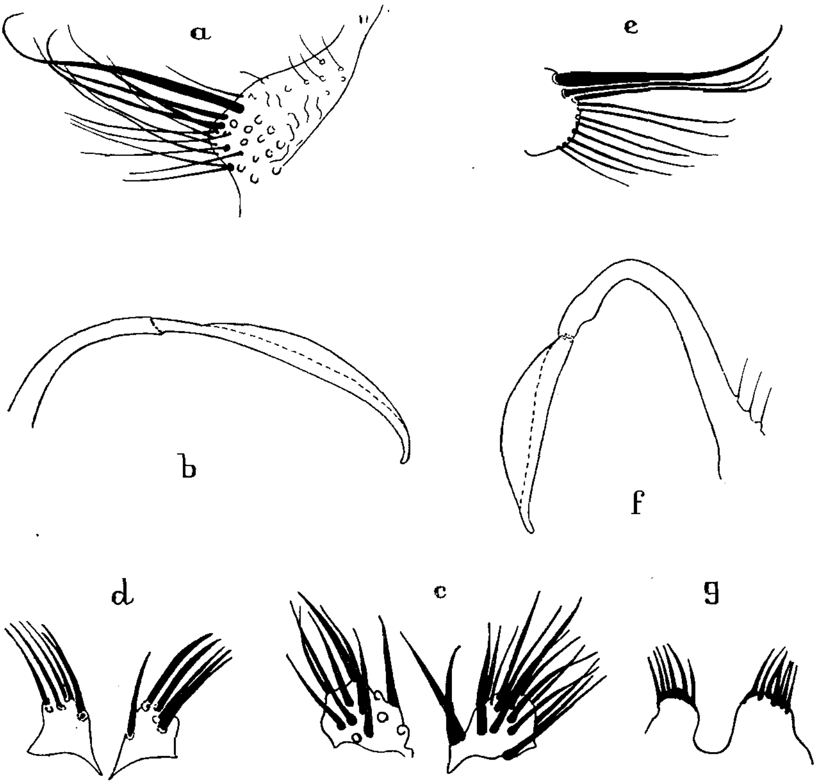

Fig. 76. Terminalia of *A. (O) leucomelas* Meig. and *A. (O) cataphylla* Dyar.
A. (O) leucomelas. a, basal lobe; b, claspette; c—d, lobes of the 9th tergite; *A. (O) cataphylla.* e, basal lobe; f, claspette; g, lobes of the 9th tergite. (Aut. del.)

p. 151) only says: "each [lobe!] bears a row of stout short spines". As will be seen there are differences both in shape and number of the spines!

Some years ago I investigated a great Norwegian material of *A. communis* De Geer on the number of spines on the lobes of the ninth tergite. It proved that this criterion shows great variability which is not geographically determined. Similar investigations on northern *leucomelas* gave figures in part lying between the numbers hitherto recorded as typical for *leucomelas* and for *cataphylla*. As I obtained the same result investigating a single population where both larvae as well as exuviae were at hand, I am of the opinion that the number of spines on the ninth tergite can not be used for differentiation of the two species *leucomelas* and *cataphylla*.

Most probably however other criterions may be useful, viz. the shape of the appendage of the claspette. In *leucomelas* the spine of the appendage is very long and the wing low and petiolate, whereas the spine in *cataphylla* is of moderate length and the wing broader and not petiolate. Concerning the basal lobe I have the impression that it is apically more pointed in *leucomelas* than in *cataphylla,* but further investigation must prove if this also holds good in a greater material. As it is, the spine at the basal lobe is conspicuously curved at the apex in *leucomelas* whereas it is only slightly curved in *cataphylla.* I have not succeeded in finding other criterions for differentiation. Concerning the variability of the spines on the lobes of the ninth tergite as well as the correlation of the spines on the left and the right lobe, see the table below. The material demonstrated is from a single population.

Table 23.

Correlation of the number of spines on the lobes of the ninth tergite in *A. (O) leucomelas* Meig.

Left lobe

	6	7	8	9	10	11	12	13	14	15	16	17	Specimens
Right lobe 6	1												1
7													
8													
9			1		1								2
10				1	1	1							3
11			1	1				1					3
12						1	1						2
13						1	3						4
14							2	1					3
15									1				1
16													
17								1					1
Specimens	1		2	2	2	3	6	3	1				20

Larva (fig. 77). Head broader than long. Antennae of well half the length of the head, slightly curved and with a few spines. Shaft faintly tapering from the insertion point of the antennal tuft. Tuft with about 4 hairs, inserted in

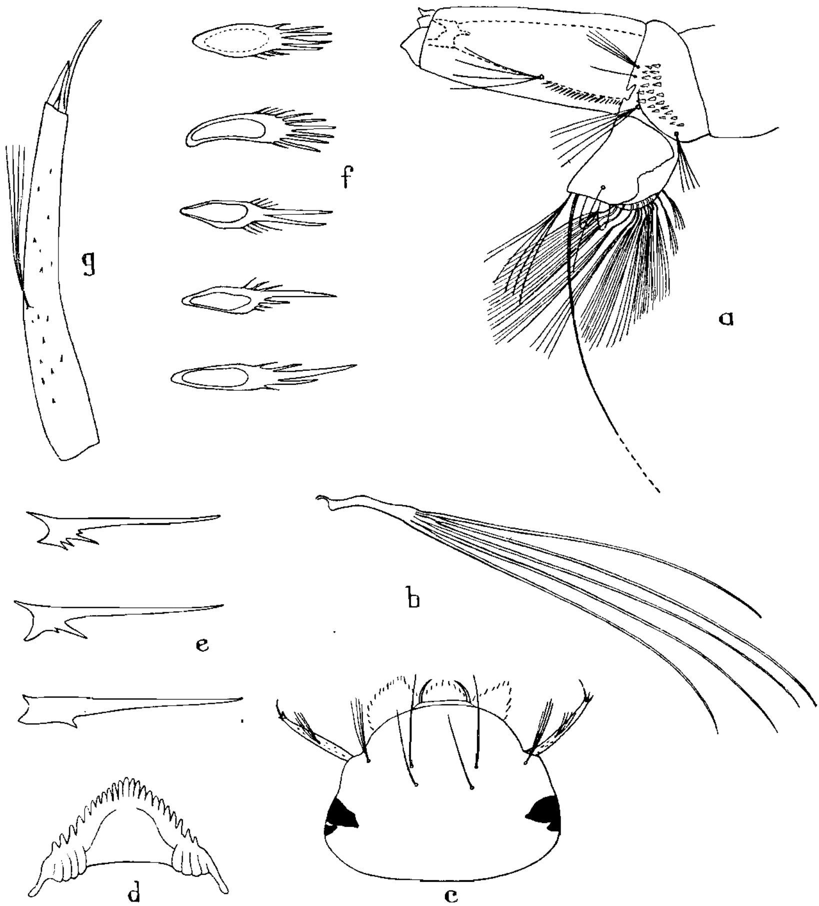

Fig. 77. Larva of *A. (O) leucomelas* Meig. in 4th instar. a, Terminal segments of larva; b, tufted hair from ventral brush; c, head of larva; d, mentum; e, pecten teeth; f, comb-scales; g, antenna. (Aut. del.)

the basal half of the antennal shaft and of about half the length of the shaft. Hairs of inner mouth-brushes with well developed comb. Inner frontal hairs behind the mid frontal hairs, all single. Dorsal prothoracic hair formula: 2, 1; 1; 1; 2; 1; 3; 1. Comb with about 24 scales in a triangular patch. The dorsal scales less pointed and the ventral scales distinctly pointed with a strong median spine. Siphonal index rather variable, from 2.2 to 4.2 Pecten reaching about

⅓ from the base of the siphon, with about 20 teeth, which are furnished with small basal denticles. Siphonal tuft with about 5 hairs, inserted just above the end of the pecten. Siphon tapering from about the insertion point of tuft. Anal segment longer than wide. Saddle extending well down half the sides of anal segment. Ventral edge of saddle somewhat incised. Saddlehair long, simple. Dorsal brush with an inner pair of tufts with about 5 hairs and an outer pair of long, stout single hairs. Ventral brush with about 15 cratal and one pre-cratal tufts. The tufts with rather long stem. Anal gills short, tapering.

Table 24.

Larval chaetotaxis of *A. (O) leucomelas* Meig.

Number of branches in				Number of		Siphonal Index
Frontal hairs			Siphonal tuft	Comb. scales	Pecten teeth	
out.	mid.	inner				
3—6 4.5 (41)	1 (35)	1 (39)	3—7 4.7 (35)	18—29 24 (25)	15—24 20.1 (39)	2.2—4.2 3.1 (22)

Compared with German larvae (Martini 1931, p. 301) the figures for the Norwegian larvae are in general somewhat higher, and also the range of variation.

Geographical distribution.

Denmark: *2. Sjælland:* Amager (W-L 1920—21, p. 197).
Sweden: *Sk:* Hälsingborg! ♀: 10. vii. (O. Ringdahl).
Norway: Ø: *1. Hvaler:* Kirkeøya, ♀: 12. vi. 1934 (LRN); L: 13. iv. 1938 (♂♀) (LRN); AK: *13. Aker:* Bygdøy, L: 6. v. 1928 (♀) (LRN).
Finland: *N(U):* Munksnäs! ♂ (Storå).

Distribution outside Denmark and Fennoscandia.

On the general distribution of this species Edwards (1921, p. 311) remarks: "I have seen males from England (Nottinghamshire, *Carr*); Denmark (*Wesenberg-Lund*); Germany (Berlin, *Oldenberg, Lichtwardt;* Kiel *Wiedemann*); Austria (Vienna, *Pokorny*); Hungary (Budapest, *Kertész;* Bethlen, *Ujhelyi;* Pöstyén, *Lichtwardt*). Also some small females, probably of this species from south Russia (Waloniki, *Velitschkovsky*)." Further record from Hungary: Balaton (Mihályi 1941). As to England Marshall (1938, p. 177) notes only "a single male specimen having been collected near Nottingham (Carr, 1919)". From Germany Martini (1920, p. 114) records the species from: "Danzig, Westerplatte, Bohnsack, Bankbau bei Danzig, Warnemünde, Müritz, Schwerin i. M., Israelshof bei Lübeck, Cuxhaven, Altengamme bei Hamburg, Dartfort, Kent;" it is also recorded from Poland (Tarwid 1938 a). As to USSR Stackelberg (1937, p. 169) says: "Recorded from Leningrad distr. (environs Luga: Stackelberg), Tartar-Rep. (Kazan: Malinina), Voronesch distr. (environs Voronesch: Schtschelkanovzev), Ukraine (Polesje: Rybinsk, environs Dnepropetrovsk: Gutzevitz.), Lower Volga (Samara, environs Sarativ: Martini)." [92]

Further records are: Basin of Dnjepr: Penkovka, river Samara (at outlet and at Orlovschina) (Dolbeskin 1928).

Biology.

In Norway larvae of this species have been found in openlying pools and waterfilled ditches at Bygdøy (AK 13), in the first days of May, also in small pools on grassy ground at Kirkeøya (Ø 1) medio April. The percentage of salt in the water was: 0.0749 % NaCl and the pH: 7.1. In another small pool, with sea-weed near the sea-shore, in the same locality, the percentage of salt in the water was 0.835 % NaCl and the pH: 7.6. The larvae were found associated with larvae of *A. detritus, cataphylla,* and *punctor.* A female adult was found in a cow-stable at Kirkeøya (Ø 1) 12. vi. 1934. Further details concerning the biology of *A. leucomelas* have not been accessible from Fennoscandia.

From Germany Martini (1931, p. 301) records: "Die Larven leben meist in nächster Nähe des Waldrandes oder von Gebüsch, an Stellen wo noch abgefallenes Laub den Boden der Wasserlachen bedeckt, unter einzeln stehenden Bäumen usw. — — — Im Inland stimmen die Fangplätze in Südost-Russland gut dazu. Hier ist es das Vorgelände des Waldes und die Umgebung einiger Gebüsche, wo ich die ♂ reichlich fing. Der Boden ist vielfach, wenn auch nur in geringem Masse salzhaltig. Wesentlich anders sind die Verhältnisse im Ramper-Moor bei Schwerin, wo nur eine starke Kalkbildung in einem *Carex*-Moor vorliegt. — — — *A. leucomelas* gehört zu den ersten Arten der Culiciden, wenn sie nicht die erste ist, die bei uns sich verpuppt." Peus (1929 b, p. 8) discusses different finds of *A. leucomelas* and he concludes: "Vermutlich ist also *A. salinellus* zwar halophil, scheint aber von den Salzstellen in die Umgebung auszustrahlen und vermag sich dort zu halten, auch wenn die Salzwässer, etwa durch Melioration (Bredow) bereits verschwunden sind."

Aëdes (Ochlerotatus) nigripes (Zett.)

C. nigripes Zetterstedt. (Ins Lapp., p. 807) 1838
A. innuitus D. K. (Ins Insc. Mens.,*5*, p. 166).................. 1917
A. alpinus Dyar (nec. Linné) Ins. Insc. Mens., *8*, p. 53) 1920
A. alpinus Edw. pp. (nec. Linné) (Bull. Ent. Res., *12*, p. 309) .. 1921

[92] Translated from the Russian text.

Synonymical remarks.

This species was described by Zetterstedt (1840) on specimens from Greenland, but unfortunately later misinterpretations of an older description by Linnaeus of *Culex alpinus* from Lapland, has caused confusion in the nomenclature. I have recently (Natvig 1945) pointed out that *Culex alpinus* was described as a species with white ringed legs, and it is therefore n o t indentical with *Aëdes nigripes* (Zett.). For details I refer to the above named paper.

The first description of the larva was published by Dyar (1919b, p. 33c) as *Aëdes* n.sp. Twinn (1927, p. 47) depicted the larva and remarked (*l. c.* p. 49): "There is some doubt as to whether the larvae which Dyar described as *Aëdes nearcticus* actually belong to the same species as the adults which he described under the name, for he states (1. p. 32), that the larvae were, — — — "taken from a pond, Bernard Harbour, Northwest Territories, June 28, 1915 (Fritz Johansen), not isolated, but present in dominating numbers, so that they doubtless belong to the abundant species, *nearcticus.*" The remainder of the larvae in the collection he briefly described as *Aëdes* n.sp., and they subsequently proved to be *Aëdes alpinus* L. In view of this, therefore, it is quite possible that Dyar in describing *nearcticus* associated the wrong larvae with the adults, in which case the latter are undoubtedly *alpinus.*". I do not agree with Twinn in this point as Dyar's description of the male adult and the larva of *A. nearcticus* are in coincidence with later descriptions of this species. As to the female adults however probably some confusion has taken place, as pointed out below in my remarks concerning *A. nearcticus.*

In 1920—21 Wesenberg-Lund published a detailed description of the larva on specimens from Greenland. At that time one mosquito species only, viz. *A. nigripes* Zett., was quoted from Greenland, and this most probebly has given occasion to the unhappy confusion made by Martini (1931) in his monograph on the palaearctic mosquitoes (Lindner) Martini here (p. 311, fig. 350) describes and depicts the larva of *A. nearcticus* under the name *A. nigripes* Zett. I have at hand the complete material collected in Greenland of Danish and Norwegian expeditions, and both *A. nigripes* as well as *A. nearcticus* are represented from several localities. Details will be published in a paper in preparation on the Greenland mosquitoes.

Description.

Female. Head with numerous dark brown bristles forming a conspicuous tuft between the eyes. Vertex (»occiput«) in front with browngolden narrow curved scales, some whitish ones in the middle line and between the eyes, above with dark brown upright forked scales. Temporae with broad with flat white scales, blended with some darker ones. Clypeus black. Proboscis brown, labellae blackish brown. Antennae. Torus black with white scaling. Flagellum blackish brown, the first segment ventrally with white scales, the remainder clothed with minute white hairs and bigger black hairs at the base of the segments. Palpi (fig. 70 j) nearly one fifth the length of the proboscis. Segm. 3 about half the length of segm. 4, over twice as long as it is broad. Segm. 4 long and slender, nearly five times as long as broad. Ultimate segment great, circular, about half the width of the penultimate. Colour of palpi dark brown, in some specimens with scattered lighter scales. Thorax dorsally with a dense coat of long, blackish-brown hairs with bronzy reflections. Anterior pronotal lobes black with white narrow curved scales and blackish-brown bristles. Posterior pronotum with bronzy-brown narrow curved scales, posterior lower corner with a few white scales. Mesonotum with dark bronzy-brown scales, the lateral margins and the antescutellar space may have a more or less pronounced lighter scaling, in some specimens even quite whitish. Scutellum black with dark bronzy-brown or whitish narrow curved scales and black bristles. Postnotum black. Pleurae and coxae with patches of white and brown broad flat scales; bristles long and dense, mostly pale but also black bristles may occur. Wing venation black; the base of costa, radius and analis more or less pronounced white scaled. Halteres with brown stem and blackish globule, this clothed with greyish scales. Legs. Fore side of femurae and tibiae dark brown, sprinkled with white scales. In the fore femurae the white scaling prodominates. Back side of legs with dirty white scaling. Knee spots dark grey, indistinct. Tarsal segments dark brown; some paler scales may be found on under side of first segment. Abdomen. Tergites dark brown with white basal bands. Venter whitish scaled, in some specimens the scales at the apical border of the segments may be pale brown, thus indicating faint apical bands. Cerci broad, black. Wing length: nearly 5 mm.

Fig. 78. Male palpi of *A. (O) communis* (a) and *A. (O) nigripes* (b). Both drawn to the same scale. (Aut. del.)

M a l e : H e a d with numerous black bristles forming a conspicuous tuft between the eyes. Vertex (»occiput«) in the middle with a few light narrow curved scales, above with numerous black upright forked scales. Temporae with broad flat scales. C l y p e u s black. Proboscis rather long, dark brown, labellae blackish brown. A n t e n n a e about half the length of the proboscis. Torus black. Flagellum blackish brown and grey ringed. Hair-whorls blackish brown. The last two segments clothed with minute white hairs. P a l p i (fig. 78) about $^5/_6$ the length of the proboscis, dark brown; hairtufts on segment 3.4 and 5 long, blackish brown with bronzy reflections. Ultimate segment slightly shorter than the penultimate and both apically a little tapering. But the long segment is again conspicuously swollen at its distal end. T h o r a x dorsally coated with long and dense, blackish brown hairs that apically have a bronzy tint. Mesonotum in the middle thinly clothed with dark golden narrow curved scales; the lateral margins and the antescutellar space with

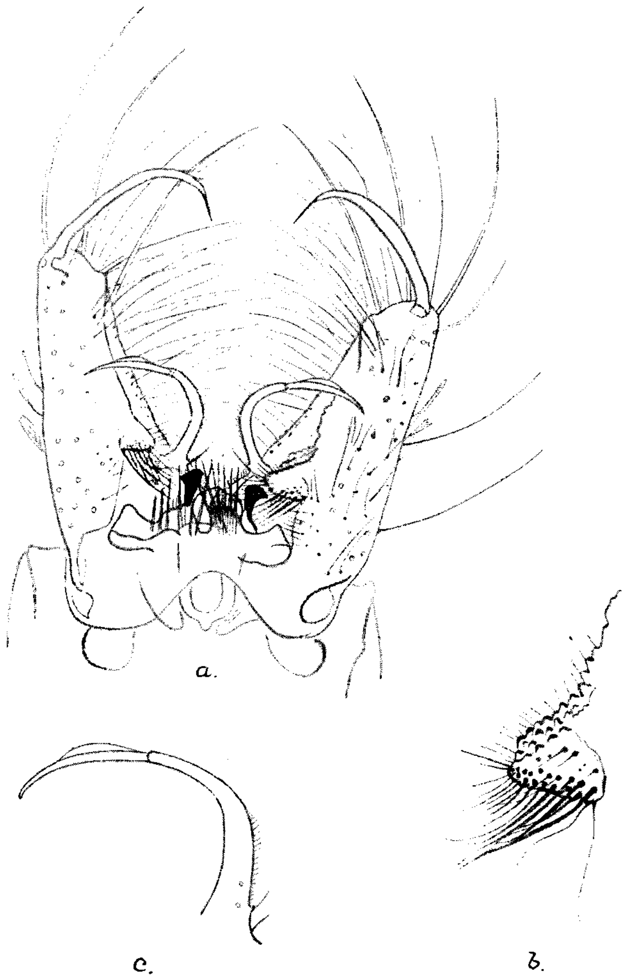

Fig. 79. *Aëdes (Ochlerotatus) nigripes* Zett.
a, Terminalia (total view); b, basal lobe; c. claspette.
(After Natvig 1929.)

somewhat greater white narrow curved scales. Scutellum black, with three patches of white narrow curved scales and long black bristles. Postnotum black. Pleurae black with patches of white and brown broad, flat scales and blackish bristles with bronzy reflections. Wing venation with dark brown scales; costa and subcosta basally with

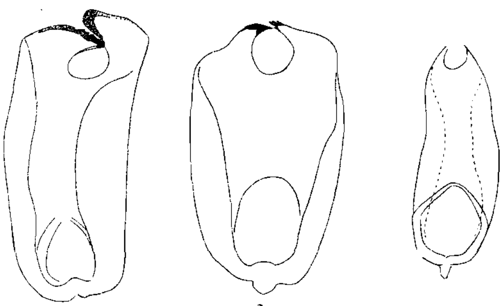

Fig. 80. Sclerotised parts of phallosome.
a—b, *A. (O) nigripes;* c, *A. (O) nearcticus.*

some white scales. H a l t e r e s with dark brown stem and blackish globule. L e g s dark brown. C o x a e dorsally with white broad flat scales, below with bronzy-brown ones, bristles on propleurae and fore-coxae very long and dense. Femurae and tibiae sprinkled with some light scales. The under-side of first tarsal segment with some lighter scales. A b d o m e n. Tergites with dark brown scaling and segmental narrow basal white bands. Venter greyish scaled. The segments with apical and lateral long black hairs. Wing length: about 5 mm.

T e r m i n a l i a (figs. 79, 80).

Basistyle conical, not entirely so long as broad. Apical lobe small, not prominent, with a few short hairs. Basal lobe rounded, with several rows of long hairs, the lateral dorsal one in the first row being the stoutest. The stoutness of this hair is rather varying in different specimens, but it does not form a spine. Dististyle curved, pointed in the distal half. Claw long. Stem of the claspette curved. Appendage: spine stout and pointed, wing sickle-formed. Phallosome cylinderformed, fused basally and dorsally, open at the ventral side. Apically the cylinder is very broad and deeply incised, the points bent inwardly like a pair of forceps. They are strongly sclerotized and furnished with conspicuous small teeth. Proctiger with stout hookformed paraprocts. Lobes of the ninth tergites with many stout spines, probably amounting to 10—20. The exact number of spines can hardly be fixed as the lobes are partly covered by the spines of the eighth segment. In this species the terminalia are most strongly sclerotized.

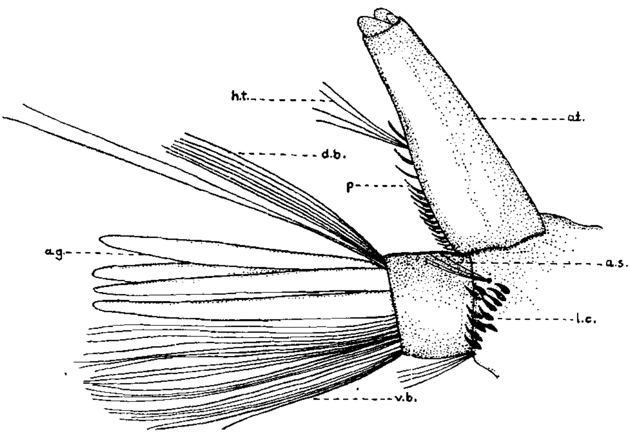

Fig. 81. Terminal abdominal segments of larva of *Aëdes nigripes* Zett. a.g. anal gills; a.s. anal segment; a.t. siphon; d.b. dorsal brush; h.t. hair tuft; l.c. comb; p. pecten; v.b. ventral brush. (After Twinn 1927).

Larva (fig. 81). As I have no Fennoscandian larvae of *A. nigripes* at hand, I here quote, in part, the description by Wesenberg-Lund (1920—21, p. 79), based on specimens from Greenland.

"Head rounded; wider than long, a notch at insertion of antennae; front margin arcuate. Antennae short; antennal tuft small, with only a few hairs; on apex four hairs, one long, and a digit. Anteantennal tuft multiple; lower and upper frontal tuft both concisting of one single feeble hair. Eyes large. Thorax subquadratic, angled at hairtufts; hair-formulae of frontal border: 3231441323; hair one after tuft four very short. Lateral hairs in multiple tufts and some single strong hairs. Abdominal segments broad; the first of them much shorter than the last. Lateral hairs on the first segment four; on the second three, on the third to seventh two. On fourth to seventh segment subdorsal hairs single in two series. Tufts of eighth segment in common arrangement: lateral comb consisting of about twenty scales arranged over a little triangular area; scales formed as sharp strong thorns without any lateral thorns or hairs. Sipho short, straight, tapering at front only about two and a half times longer than broad. Pecten long consisting of about fifteen thorns; the last of them out of line at greater distance from each other; most of them with a short basal tooth. A tuft of hairs between end of pecten and apex. Anal segment broader than long ringed by the dorsal plate; dorsal tuft rather feeble but with two strong hairs; ventral brush consisting of about eighteen rays, every ray carrying from seven to ten hairs; no hairtufts before the barred area; anal gills extremely long, acute and equal."

Geographical distribution.

Sweden: *Lu. Lpm.:* "Sarek-Geb. Tjåres in der Birkenregion; ♂: 8. vii 1907" (Poppius, Lundstr. Frey, 1917, p. 676); *T. Lpm.:* Abisko! ♂: 16. v. 1918 (Ringdahl), 12. vii. 1939 (Krogerus), "pond immediately south of railroad 12. vii.") (Edwards 1931, p. 33); *Dlr:* ?Särna, Fulufjäll, Njuveskär! ♀: 8. vii. 1927 (KHF).
Norway: *Fi: 9. Alta:* Romsdal, ♂: 30. vi. 1924 (S-R); Jotkajavrre, ♂: 9. vii. 1924 (S-R).
Finland: *Lps (PsL):* Vaitolahti (Petsamo.)! ♂ (Hellén).
USSR: *Lv.(VL):* Lapponia Varsugae: ?Kuzomen! ♂ (R. Frey); *Lt. (TL):* Lapponia tulomensis: Murmansk, ♀Edwards, 1921, p. 39).

Only two of the above mentioned finds need discussion viz. the female from Fulufjäll and the male from Kuzomen. It is with some doubt that I refer the female from Fulufjäll to *A. nigripes;* this species having been recorded only from the northernmost parts of the old and new world. However, the dense coat of long black hairs on mesonotum, pro-pleurae and fore-coxae, did scarcely permit any other interpretation. The femurae are partly denuded, but several white scales indicate a predominating white scaling. As to the male from Kuzomen the terminalia have been cut off but the size of the specimen agrees well with *nigripes.* It bears a label: "*O. ?alpinus* L. det. F. W. Edwards 1920".

Distribution outside Fennoscandia.

A. nigripes is a circumpolar species, occurring in the northernmost parts of the Nearctic and Palaearctic regions. It is thus recorded from Greenland (W-Gr. Hale Carpenter 1937, p. 413, 1938, p. 544; E-Gr.: Brændegaard a. Henriksen 1935, p. 11; W- a. E-Gr.: Kai Henriksen 1939, p. 67; A. D. Jensen 1928, p. 73), and a detailed review will be published later, in connection with a revision of the great material of Greenland-mosquitoes at hand, which is collected by Danish and Norwegian expeditions. In Svalbard the species is recorded from W-Spitsbergen (Hale Carpenter 1937, p. 413; Holmgren 1869, p. 37). As to USSR Stackelberg (1937, p. 98—9) says: "From USSR recorded from Murmansk (Carment and Siberia. These dates which are based solely on female adults ought to be controlled." [93] However, Edwards (1921, p. 309) declares that he has seen females from Murmansk; Lundström (1915) records a female from Krinka and male and females from Tschisha, Kanin Tundra (25. vi.); Kiseleva (1936) records the species from the Taimyr Peninsula and further eastwards it is recorded from: "Lena-Mündung, Halbinsel Bykow, 10. vii. (28. vii.) 1902" (Lundström 1915). A very curious

[93] Translated from the Russian text.

record is found in Séguy: "Hist. Nat. des Moustiques de France" (1923, p. 317): "4 exemplaires ♀ provenant de Fontainebleau, juin 1869 (collection Dufour > Laboulbène: Mus. Paris)". In a footnote the author remarks: "L'etiquette de ce moustique dans la collection Dufour > Laboulbène est de la main d'un correspondant de L. Dufour et porte l'indication suivante "Fbl. Juin 69" abbrevation de Fontainebleau emploée souvent ailleurs par le même correspondant. Les moustiques de cette boîte n'ont pas été deplacés depuis la mort de L. Dufour et l'hypothese d'un erreur ou d'un changement d'étiquette est peu vraisemblable." However, as *A. nigripes* Zett. is a typical arctic species I fully agree with Edwards (1921, p. 309) who, concerning this record, declares: "In regard to this last there must have been some mistake in labelling." As to the distribution in the American Continent Dyar (1923 d, p. 84) records the following localities from Alaska: Konganevik, Cramden Bay, July 4, 1914 (F. Johansen); Collison Point, July 22, 1914 (F. Johansen) and the same author (Dyar 1928, p. 182) briefly remarks: "Arctic coast of Alaska and Canadian Northwest Territory."

Biology.

Only few dates on the biology of *A. nigripes* in Fennoscandia have been obtainable. In pursuance of the date labels on the specimens at hand males have been caught from 15. v. to 12. vii. in Sweden. Thienemann (1938, p. 39) records: "Abiskogebiet: Kleiner Tümpel am mittleren Kårsavagge-See 21. vi. 1936. Larve (IV. Stadium) Puppe; am oberen Kårsavagge-See 1 ♂ gekätschert 15. vii. 1937. Früherer Fund: Teich an der Eisenbahn bei Abisko 12. vii. (Edwards 1931, p. 33). Auch aus der Birkenregion des Sarekgebirges bekannt) (2 ♂ 8. vii.) (Lundström, S. 676)". In Norway males have been caught from 30. vi. to 9. vii.

According to Ad. S. Jensen 1928, p. 73) *A. nigripes* occurs in enormous masses on the west-coast of Greenland, where the mosquitoes are very annoying especially on hot and calm days. The sting is rather painful, causing tumidity and insufferable itching. In Kristianshaab district the mosquito-plague certainly reaches its climax whereas it is considerably diminished at Upernivik. The mosquitoes also attack the reinder herds which, seeking the snow-fields or depressions below the highest peaks, try to get rid of their tormentors. The mosquito-larvae and pupae are common in all pools in the summer; the adults occur from medio June to August. Also from the east-coast of Greenland, especially from Angmagssalik, these insects are reported to be rather troublesome.

Kiseleva (1936) records *A. nigripes* to be the most frequent species in the western portion of the Taimyr Peninsula, where it attacked man and both living and dead reindeer. Females of this and some other species (in order of frequency: *A. nearcticus, punctor, communis* and *Th. alascaensis)* caused such annoyance during their flight period, which in 1929 lasted from 18th July to 2nd August, when snow fell, that the inhabitants remained indoors. There was only one generation a year.

From the American Continent Dyar (1928, p. 182) records: "The larvae occur in early spring pools from melting ice and snow."

Aëdes (Ochlerotatus) nearcticus Dyar.

A. (O) nearcticus Dyar (Rept. Can. Arct. Exp., *3*, C. p. 22) 1919
A. (O) parvulus Edw. (Bull. Ent. Res., *12*, (3), p. 314) 1922
A. alpinus Twinn (nec. Linnaeus) (Can. Ent., *59*, p. 48) 1927

Synonymical remarks.

As to the nomenclature of this species there has been some confusion in the literature. *Aëdes nearcticus* was described by Dyar (1919, p. 32 c) on material collected by the Canadian Arctic Expedition from Bernhard Harbour, North-west Territories.

In his monograph on the palaearctic mosquitoes Edwards (1921, p. 309) placed *Aëdes nearcticus* Dyar as a synonym of *A. alpinus* (Linn.). At the same time he (*l. c.* p. 314) described a new species, *Aëdes parvulus* from Kittilä in Finland, where he remarked: "*A. parvulus* has the appearance of a small, less hirsute race of *A. alpinus,* and perhaps it really is so, but the less strongly chitinised hypopygium, the absence of a spine on the basal lobes of the side-pieces, the slightly shorter male palpi, and the less speckled femora seem to be sufficient to distinguish it specifically." He also depicted the male genitalia (l. c. p. 301, fig. f), which however fitted well with Dyar's description of *nearcticus* (1919). In the first instance Dyar probably considered *A. parvulus* as a distinct species then in his publication "The mosquitoes of Canada" (1921b, p. 111) he says, referring to *A. nearcticus*, "The species is closely allied to *innuitus* Dyar and Knab of Greenland and *alpinus* Linnaeus (= *nigripes* Zetterstedt) of Scandinavia. The three may prove to be one species, but the genitalia of the European form is undescribed". However, in his next paper Dyar (1922, p. 74) placed *A. parvulus* Edw. as synonymous with *Aëdes nearcticus.* According to this, Edwards (1926) stated that he had compared Canadian specimens of *nearcticus* with *parvulus* and with the same result as mentioned by Dyar.

Twinn (1927, p. 48, fig. 2) depicted the male terminalia of *A. nearcticus* under the name: *Aëdes alpinus* L. (*nearcticus* Dyar) and he remarked: "The adults are identical with Dyar's *Aëdes nearcticus,* the type specimens of which are in the Canadian National Collections. According to Edwards, *A. nearcticus* Dyar is synonymous with *A. alpinus* L. Dyar, however, maintains the authenticity of *nearcticus* based on the following slight differences in the male genitalia; — — and on differences of structure in the larvae of *alpinus* and *nearcticus.*"

Further Hearle (1927), in a publication on *A. nearcticus,* placed *A. parvulus* as synonymous with this species. In his opinion: "there is no character of the hypopygium by which this species can be separated from *Aëdes alpinus.*" In a foot-note C. H. Curran made the following remarks: "On pp. 47—49 of this volume C. R. Twinn published an article in which he unfortunately indicated that *A. nearcticus* Dyar is a synonym of *A. alpinus* L. The synonymy should have been given with a query. The holotype of *nearcticus* is an adult male in the Canadian National Collection and a comparison of the genitalia of the two species shows differences which may be considered as of specific value."

In a little paper on the mosquitoes collected by the Norwegian Finmark Expedition I described (Natvig 1928, p. 244—29) and depicted the male genitalia of *A. nigripes* Zett. as well as *A. nearcticus* Dyar. As to the problem *nearcticus-parvulus* I further remarked: "Die Unterschiede im Bau des Hypopygiums bei *A. nigripes* Zett. und *nearcticus* Dyar habe ich oben gegeben, dazu muß ich bemerken, daß es sehr wahrscheinlich ist, daß sich unter den jetzt als Synonymen angesehenen Namen *nearcticus* und *parvulus* zwei sehr nahestehenden Arten befinden. Bei mein Exemplar von *nearcticus* war die Palpen so lang wie der Rüssel und Edwards giebt für *parvulus* an (1921), daß die Palpen kürzer sind. Ebenso wird hervorgehoben das Fehler des Dornes am Basallappen, der mit vielen langen Haaren bestetzt ist. Die amerikanischen Authoren geben an, daß bei *nearcticus* der Basallappen meist ohne Dorn ist. Mein Exemplar hat wie die Zeichnung zeigt einen ausgeprägten Dorn am Basallappen, der nur mit 4 langen und einigen kurzen Haaren versehen ist. Die Frage *nearcticus-parvulus* bedarf scheinbar eine nähere Prüfung."

This view was further accentuated by Martini (1931) in his monograph on the palaearctic mosquitoes, where he described *A. nigripes. A. nearcticus* and *A. parvulus* as three distinct species. Here he depicts the terminalia of *A. parvulus* Edw. and in the description he compares this species with *A. nigripes* Zett. Concluding he says: "Ich fühle mich ziemlich sicher, daß das finnische Stück im Hypopygium von *nearcticus* ausreichend verschieden ist, auch im Bau der Taster und des Hypopygiums, um als besonders Art gelten zu müssen."

I have now at hand a greater material of *A. nigripes* as well as *A. nearcticus* and a closer investigation of these specimens has convinced me of the fact that the male

A. parvulus described and depicted by Edwards (1921) and Martini (1928) is synonymous with *A. nearcticus* Dyar. To be sure, I have not actually seen the male type specimen, [93b] but there is no essential character in which *A.* parvulus differs from the figures of *nearcticus* given by Edwards and Martini. The thickness of the spine on the basal lobe is a variable character, and I possess Canadian males with palps of variable length.

However, as to the female of *A. nearcticus,* the criterions given for differentiation of this species and *A. nigripes* Zett. are rather vague. In the original description of *nearcticus* by Dyar (1919b) nothing is said about this matter. Dyar (1923 d, p. 8) describes *A. alpinus* L. as "a rather large black mosquito, with long hairy vestiture, especially conspicuous on under side of thorax" and *A. nearcticus* as "a medium-sized black mosquito, much like *alpinus,* rather smaller, the legs less white speckled." Matheson (1929, pp. 144—147) gives i. a. the following details: *A. nearcticus* Dyar: "Length 4.5 mm; wing 4 mm. — — — Abdomen; venter white scaled, the apices of the segments more or less black scaled." As to *A. alpinus* L. his description i, a. reads: "Length 6.5 mm; wing 5 mm. — — — Abdomen; — — venter white scaled."

I have at hand Zetterstedt's type specimens of *A. nigripes,* the female of which is a large well preserved specimen with length of wing about 5.5 mm. The abdominal sternites are white scaled with narrow bands of dark scales. As this colouring of the abdominal sternites thus may occur in both *nigripes* and *nearcticus,* I consider the character of no specific value.

In searching for differential criterions I also examined the two species as to the scaling of the pleurae, a character used with advantage by Peus in the classification of the *communis*-group. As far as I can see we here have the most useful and distinct character for differentiation. In *A. nigripes* the scale patch on the ventral mesepisternum (sternopleuron) reaches the upper frontal border, whereas in *nearcticus* the scale patch on the ventral mesepisternum did not reach the upper frontal border (see Natvig N. E. T. 7(5) 1946).

Among other material of *A. nearcticus,* received from prof. Matheson, Ithaca, N. Y., were also two specimens from Dyar's original material from the Canadian Arctic Expedi-

[93b] see addenda.

tion. They were labelled "W. of Konganevik (Camdin Bay), Alasca. July 4. 1914 (F. J.)" and both were marked "Paratype". These specimens, however, coincide with *A. nigripes* in the size as well as in the scaling on the mesepisternum. That Dyar himself questioned whether this material really belonged to the species *nearcticus* is apparent from the original text which reads as follows (1919 b, p. 32 c): "A p p a r e n t l y [93c] the same species from the following localities: — — — Konganevik, Camden Bay — — —." In my opinion the label "Paratype", in this case is misleading.

From the Zoological Museum at Helsingfors I received, before the war, Edward's original material of *A. parvulus* (female paratypes). A comparative investigation of these specimens with females of *nearcticus*, proved that *parvulus* coincides with *nearcticus* in the scaling on mesepisternum. Unfortunately the specimens were partly denuded.

Description.

F e m a l e. H e a d in front with blackish brown bristles forming a conspicuous tuft between the eyes. Vertex ("occiput"), in the middle with pale golden narrow curved scales, on each side with a patch of dark brown scales, above with dirty yellow upright forked scales. Temporae with pale brown, broad flat scales, more or less blended with dirty white ones. In some specimens a patch of dark brown scales may be seen just behind the horizontal middle-line of the eye. Rows of dark brown bristles are bordering the eyes. C l y p e u s blackish brown. P r o b o s c i s dark brown, A n t e n n a e. Torus black with dirty-white flat scales. Flagellum. First segment with some flat white scales at the ventral side, the rest of flagellum blackish brown, the segments clothed with minute white hairs, bigger dark hairs at the base of the segments. P a l p i (fig. 70 f) blackish brown, well over one fourth the length of the proboscis. General appearance somewhat stouter than the palpi of *nigripes*. Segment 3 nearly twice as long as it is broad, about half the length of segment 4. This about three times as long as broad. Ultimate segment circular, about half the width of the penultimate. T h o r a x. Anterior pronotal lobes black with yellowish white, narrow curved scales and pale golden bristles. Posterior pronotum with dirty-yellowish narrow, curved scales. Dorsal part of thorax with long,

93c Emphasized here.

blackish brown hairs. Mesonotum clothed with dark bronzy-brown, narrow, curved scales; the lateral margins of the antescutellar space with somewhat lighter scaling. Pleurae and coxae with patches of broad, flat white scales with a more or less pronounced yellowish tint. Bristles on propleurae pale golden, on fore-coxae dark brown, all long. Wing venation blackish brown, basal part of costa, radius and analis with white scaling. Halteres with luteous stem and blackish brown globule, the latter with some greyish scales. Legs. Front side of femurae dark brown, more or less conspicuously sprinkled with white scales. These predominate in fore and hind femurae. Back side of femurae with whitish scaling. Knee spots grey, indistinct. Tibiae dark brown, white sprinkled. Tarsal segments dark brown. Abdomen. Tergites blackish brown with broad, basal, segmental white bands. Cerci black. Venter white scaled, in some specimens the segments have faint dark apical bands. Wing length: about 3.5 mm.

I have compared females of *A. (O) nearcticus* from Banff, Alberta with Norwegian specimens from Fokstuen, Dovre (On 37), but no essential differences can be found. In the Canadian specimens the lateral upright forked scales are darker, the scaling on the lateral margins of the mesonotum is more or less white speckled and the white scaling on the fore-femurae are less pronounced as compared with the Norwegian specimens. However, having only a limited material at hand, I am, for the present, inclined to consider these small differences as individual variations only.

Male. Head with numerous blackish brown bristles forming a conspicuous tuft between the eyes. Vertex ("occiput") in front with a few light narrow, curved scales, on the sides with broad, flat, white scales. Clypeus black. Proboscis blackish brown, labellae black. Antennae. Torus black. In the single Norwegian male specimen at hand the remainder of the antennae and the palpi are broken off. Thorax dorsally with long and dense dark brown hairs which apically have bronzy reflections. Integument blackish brown. Anterior pronotal lobes with dirty-white, narrow, curved scales and black bristles. Posterior pronotum with bronzy-brown, narrow, curved scales blended with dirty-white ones. Mesonotum in the middle scantily clothed with small bronzy-brown, narrow, curved scales. The lateral margins and the antescutellar space with somewhat bigger, dirty-white, narrow, curved scales. Scutellum blackish brown with dirty-white, narrow, curved scales, and long black

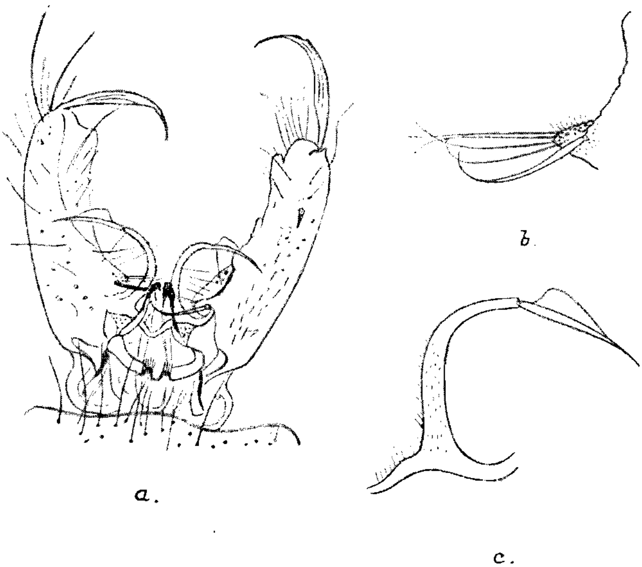

Fig. 82. *Aëdes (Ochlerotatus) nearcticus* Dyar.
a, Terminalia (total view); b, basal lobe; c, claspette.
(After Natvig 1929.)

bristles. Postnotum black. Pleurae with patches of broad, flat, white scales. Coxae with dirty-white flat scales and long black bristles. Wing venation dark brown. Halteres with dark brown stem and blackish brown globule. Legs. Ground colour dark brown. Femurae and tibiae sprinkled with dirty-white scales. Tarsal segments dark brown. Abdomen. Tergites blackish brown with segmental narrow, basal, white bands. Venter whitish. The segments with rather long apical and lateral hairs.

Terminalia (figs. 80, 82). Basistyle about three times as long as broad. Apical lobe short, rounded and mostly nude. Basal lobe narrow, rather pointed, with a long basal spine which is apically somewhat curved. The spine apparently is rather variable. Thus a specimen from Finmark (fig. 9) has a quite stout spine which conspicuously differs from the hairs, while, in another specimen from Swedish Lappland the spine at the basal lobe is slender and does not differ much from the hairs. Dististyle curved, with a thickening in the middle an a long claw. Stem of the claspette curved, apically somewhat tapering. Appendage long and

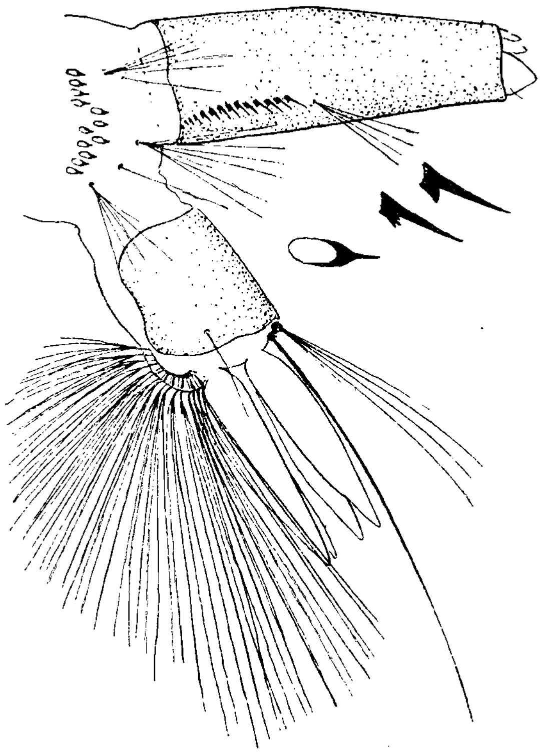

Fig. 83. Larva of *A. nearcticus* Dyar in 4th instar. Terminal segments; pecten teeth (above right) and comb-scales (below right). (After Martini 1931).

pointed. Wing basally very broad, apically tapering and converging with the spine about ⅔ from its base. The two sclerites of the phallosome form a long, slender cylinder; they are fused basally and on the dorsal side. Ventrally the cylinder is widely open and apically it is not conspicuously incised. It is here furnished with minute teeth. Lobes of the ninth tergite with 6—7 spines. Proctiger with hook-formed paraprocts.

L a r v a (fig. 83). As no Fennoscandian larvae of this species are at hand, I here quote the original description by Dyar (1919, p. 32 c):

"Head rounded, wider than long; antennae small, uniform, with sparse spicules, the tuft situated near the middle, composed of three short hairs. Head hairs single, at least the lower pair are so, the upper pair are broken in all the specimens; ante-antennal tuft in fours. Body with the skin glabrous; tracheæ thick and uniform, narrowing only in the end of the airtube, where there is a short closing apparatus. Air-tube short, about two and a half times as long as the basal width, tapering outwardly; pecten of 11 to 16 teeth, usually about 14, the single tooth finely pointed and with a rounded branch, followed closely by a three- to four-haired tuft. Lateral comb of the eighth segment of ten to fourteen scales in a patch, the single scale elongate conical from an oval base, width long central thorn and few small lateral spinules. Anal segment with a dorsal plate reaching to about the middle of the side, its edge even but bulging a little posteriorly; barred area preceded by one or two hair tufts, the area situated posteriorly; dorsal hairs a long hair and three-haired tuft on each side."

I have at hand a slide preparation of a single exuvium from Banff, Alberta, 1. vii. 1924, determined by Hearle (No. E—26). In this specimen the antennal tuft has 4 hairs, the outer frontal hairs 3; the mid frontal hairs and the inner frontal hairs are simple. The comb consists of 12 scales, the pecten of 5 small and 9 larger teeth. The siphonal tuft consists of 7 hairs. The apical, dorsal, hair is short and stout. Anal gills very long. Otherwise the specimen agrees well with the description above. As to the anal gills Martini (1931, p. 311) says: "Kiemen ungefähr von 1½' facher Sattenlänge" whereas Matheson (1929, p. 145) remarks: "Anal gills very long and stout, at least four times as long as anal segment." Obviously the character is variable also in this species.

Geographical distribution.

S w e d e n : Swedish Lappland! ♂ (Poppius) (? Sarek, vii. 1907) *T.Lpm:* Abisko, LP: 6.—8. vi. 1938 (Thienemann).

N o r w a y : O n : *37. Dovre:* Fokstuen, P: 25. v. 1937 (♂♀) (LRN); S T i : *32. Ålen* Riasten, ♀: 6. vii. 1925 (LRN); *37. Tydal:* Skarpdalen, ♀: 15. viii. 1925 (LRN); T R y : *14. Tromsøysund:* Fagernes, Ramfjord, ♀: 29. vi. 1921 (S-R); F i : 9. *Alta:* Njalganasj, ♀: 1. vii. 1924 (S-R); Jotkajavrre, ♂: 1. vii. 1924, ♀: 1. vii. 1924 (S-R).

F i n l a n d : *Ab(V):* Karislojo! ♀. (J. Sahlberg); *Lkem. (KemL):* Kittilä! ♀ (N. Sahlb.); *Ok(Kn):* Suomussalmi! ♀ (Hellén); *Lps(Psl):* Petsamo. Nautsi! ♀: 25. vi. 1928 (Kanervo).

U S S R : *Lp(Pol):* Lapponia ponojensis: Ponoj! ♀ (R. Frey).

Distribution outside Fennoscandia.

The single Palearctic record of *A. nearcticus* outside Fennoscandia is from the Asiatic part of U S S R, from the Taimyr Peninsula (Kiseleva 1936), but probably a revision of the older material would bring out also other Siberian localities. The records from the A m e r i c a n C o n t i n e n t are: A l a s k a : Konganevik, Cramden Bay, July 4, 1914 (F. Johansen) (Dyar 1923 d, p. 84); C a n a d a : *Northwest Territories:* Bernhard Harbour, July 9, 1916 (F. Johansen); Dolphin and Union Strait, July 14, 1916 (F. Johansen); Young Point, July 18, 1916

(F. Johansen); Vape Bathurst, July 26, 1916 (F. Johansen); *Youkon Territory:* Herschel Island, July 26, 1916 (F. Johansen) (Dyar 1921 b, p. 111). From the districts farther eastwards in the *Northwest Territories* Kai Henriksen (1937, p. 24) records females from Danish Island 23. vii.—1. viii. 1922, Baker Lake 22. vii. 1922, Eskimo Point 30. vi. 1922 and Churchill 20. vii. 193. U S A : Rocky-Mountains to Banff, Alberta, and the Glacier National Park, Montana. (Dyar 1928, p. 197).

In a little paper on the mosquitoes from the 2nd "Fram"-expedition (1898—1902) I described (Natvig 1930, pp. 358—59) two specimens from Ellesmere Land as *Aëdes* n. sp.? Comparing them with *A. lazarensis* Dyar I pointed out that they differed from this species especially by the clothing of longer and somewhat darker hairs. I have now compared them with the Greenland mosquitoes and find that both specimens are *A. nearcticus* Dyar. These specimens, from Winter-Harbour, 27. vii. 1899 and Cap Rutherford, 26. vii. 1899, both places at about 78° 50′ degree of latitude, represent most probably the northernmost finds of *A. nearcticus,* if not even the northernmost finds of any mosquito hitherto known.

Biology.

The only N o r w e g i a n dates are from Fokstuen (On 37) where pupae of this species were found ultimo May in a shallow pool (pl. III) with grassy bottom. The pool was situated in the Fokstu-swamp, near the brooklet Foksåa. Many mosquito-pupae were found here associated with larvae of *A. communis* and *A. punctor.* The hydrogen-ion-concentration was pH: 5.9.

A single N o r w e g i a n male, caught in freeland, is from Jotkajavrre (Fi 9) 1. vii.; females have been found, in N o r - w a y from 29. vi. to 15. viii., in F i n l a n d at Petsamo (Lps) 25. vi.

From U S S R Kiseleva (1936) records that, in the western part of the Taimyr Peninsula, this species was second to *A. nigripes* only in frequency, and in the flight period the females were very annoying.

From arctic A m e r i c a Dyar (1928, p. 197) records: "The present species breeds with *communis* and *pullatus,* but at higher elevations the admixture of these species in the pools is less. N e a r c t i c u s adults occur in the higher passes in large numbers in midsummer. The distribution is not downwards."

Aëdes (Ochlerotatus) communis (Deg.).

C. communis Deg. (Memoires, *6,* p. 316) 1776
? *C. fasciatus* Meig. (Klass., *1,* p. 4) 1804
C. nemorosus Meig. (Syst. Beschr., *1,* p. 4) 1818
? *C. sylvaticus* Meig. (Syst. Beschr., *1,* p. 6) 1818
C. obscurus Meig. (Abb. Zweifl. Ins. Pl. 2, fig. 2) 1830
C. lazarensis Felt a. Young. (Science, n.s., *30,* p. 312) 1904
C. borealis Ludl. (Can. Ent., *43,* p. 178) 1911
C. nemorosa diplolineata Schneid. (Verh. Nat. Ver. Bonn, *70,* p. 37) 1913

A. tahoensis Dyar (Ins. Insec. Mens., *4*, p. 82) 1916
A. altiusculus Dyar (Ins. Insc. Mens., *5*, p. 100) 1917
A. mazamae Dyar (Ins. Insc Mens., *8*, p. 166) 1920
A. (O) palmeni Edw. (Ent. Tidskr., *42*, p. 52) 1921
? *A. prolixus* Dyar (Ins. Insc Mens., *10*, p. 2) 1922
? *A. peary* Dyar a. Shannon (J. Wash. Acad. Sci., *15*, p. 78) 1925

Synonymical remarks.

Edwards (1921, p. 315) has examined several of the above named type specimens and he has published his remarks, which I find important to quote in part here. "This is one of a group of species which can only be satisfactorily distinguished by the structure of the male hypopygium. — — *A. communis* is — — — no doubt the species which has most frequently been identified as Meigens *C. nemorosus* This, together with the fact that a male of the species is included in Meigen's series of *C. nemorosus* in the Paris Museum, will definitely settle this name; although Meigen's description (Brownish-yellow thorax etc.) does not agree. Degeer's description of the adult and larva of *C. communis,* however, is quite sufficiently detailed for identification, and I have therefore adopted this name for the species. — — — I have examined the type of Meigen's *Aëdes obscurus,* — — — The hypopygium is apparently identical with that of *A. communis,* and the short palpi (if they were not merely broken) were therefore probably an individual abnormity similar to those which I have recorded as occurring in *A. punctor.* — — Meigen's *C. sylvaticus (fasciatus,* 1804) is impossible to determine from the description, and I see no particular justification for Martini's suggestion that it is *Culex apicalis;* since the type does not exist it will be as well to accept Meigen's statement (Syst. Beschreib., 6, p. 241) that it is only his *C. nemorosus.*

The American forms *A. lazarensis* and *A. tahoensis,* and probably also *A. pionips,* differ in such minute details that they can hardly be ranked as more than varieties of *A. communis,* but it is interesting to note that the hypopygium of the Alaskan *tahoensis* is the more nearly identical with European *communis* in regard to the exact position of the spines on the basal lobe of the side-piece, the only point in which Dyar has indicated distinctions between the American forms. I had intended to describe a new species, *A. palmeni,* on account of some differences which I thought I perceived in the male hypopygium in two specimens from Finland. On a re-examination I failed to verify these differences, but meanwhile, unfortunately, I had published the name *palmeni* in my key to the Swedish species." In his last review of the Culicidae Edwards (1932, p. 145) considers *A. pionips* as a different species and the synonymy above is quoted in coincidence with this paper.

Description.

Female. Head with golden bristles forming a little tuft between the eyes which are bordered by dark brown bristles. Vertex ("occiput") with golden, narrow curved scales, numerous yellow upright forked scales above and on the nape. Temporae with white, broad flat scales of a yellowish tint. Clypeus dark brown. Proboscis blackish brown, in some specimens basally with some lighter scales at the under side. Labellae black. Antennae. Tori yellow or brown, with some dirty-white scales. Flagellum: first segment brown, the others blackish brown, clothed with minute white hairs and bigger black hairs at the base of segments. Palpi (fig. 70 h) dark brown, more or less sprinkled with whitish scales, and long and slender, about one fifth the length of the proboscis. Segment 3 hardly one half the length of segment 4, nearly three times as long as broad. Ultimate segment rounded, nearly half the width of the penultimate. Thorax. Anterior pronotal lobes with white or yellowish, narrow curved scales and darker bristles with golden reflections. Posterior pronotum with dirty-yellow or more or less whitish narrow curved scales; bristles mostly dark with golden reflections. Mesonotum clothed with dirty-golden, narrow, curved scales. A bronzy brown stripe on either side of the median line and a shorter similar stripe on each side of the antescutellar space, which is clothed with pale yellow or whitish, narrow, curved scales. Bristles on the sides of the mesonotum and above the wing root brown with golden reflections. Scutellum with dirty-yellow, narrow, curved scales and golden bristles. Postnotum blackish brown, Propleurae with dirty-golden, narrow, curved scales, more or less blended with whitish ones in the lower and caudal part. Pleurae and coxae with patches of broad, flat white or yellowish scales and pale golden bristles. Wing venation dark brown with dirty-white patches at the base of costa, subcosta and radius. In some specimens single whitish scales may be found also at the base of the other veins. Halteres with luteous stem and darker globule, the latter more or less clothed with greyish scales. L e g s. Front side of femurae dark brown, more or less sprinkled with dirty-white scales, in particular in the basal half of femur. In the hind femurae the light scales predominate. The apical end of femur mostly dark. Back side of femurae yellowish white. Knee spots conspicuous, dirty-white. Tibiae dark brown, sprinkled with dirty-white scales. Tarsi with dark brown scales; on the under side of first segment more or less blended with whitish ones. A b d o m e n blackish brown; each segment with basal dirty-white bands, mostly not, or indistinctly constricted in the middle. Venter greyish white. Cerci long, black. Length of body 6 mm. (W-L) Wing length: about 4.5 mm.

A. communis varies considerably. In some specimens the dark brown areas on mesonotum are very extended, only leaving lines of golden scales between and along the outer sides of the typical dark longitudinal stripes. Golden scales are also bordering the short dark stripes at the antescutellar space and are found on the sides of the mesonotum. The dark lines may be more or less blurred and the ground scaling may be greyish. According to Martini (1931, p. 305) this is the matter in specimens, stored for a long time in the collections.

M a l e. H e a d : antennae almost ⅔ the length of the proboscis. Torus blackish brown, flagellum brown and whitish grey ringed, the ultimate and penultimate segments blackish brown with minute whitish hairs. Hairwhorls greyish brown with more or less conspicuous foxcoloured reflections. Length of p a l p i (fig. 78) exceeding the proboscis by about one third of the ultimate segment. In other respects the palpi are very like those of *O. punctor* Kirby. T h o r a x: Mesonotum with two long median stripes and laterally two shorter ones in cupreous brown, the sides of the mesonotum clothed with greyish yellow scales. Bristles dirty golden. A b d o m e n. Scales at dorsum blackish brown, segments with basal white bands. Segment eight whitish scaled. Gonostyle dark. Venter clothed with whitish scales. Apically the segments may have a dark spot. Wing length: 5 mm.

T e r m i n a l i a (figs. 84, 85). Basistyle about four times as long as broad. Apical lobe prominent, apically rounded and with a few inwardly directed hairs. Basal lobe of median size with a stout, apically curved spine and with some hairs. The inner border of the basal lobe with a row of upright, curved, claw-like spines which are very characteristic for this species. Stem of the claspette slender, somewhat curved and faintly tapering. Appendage with a double very low

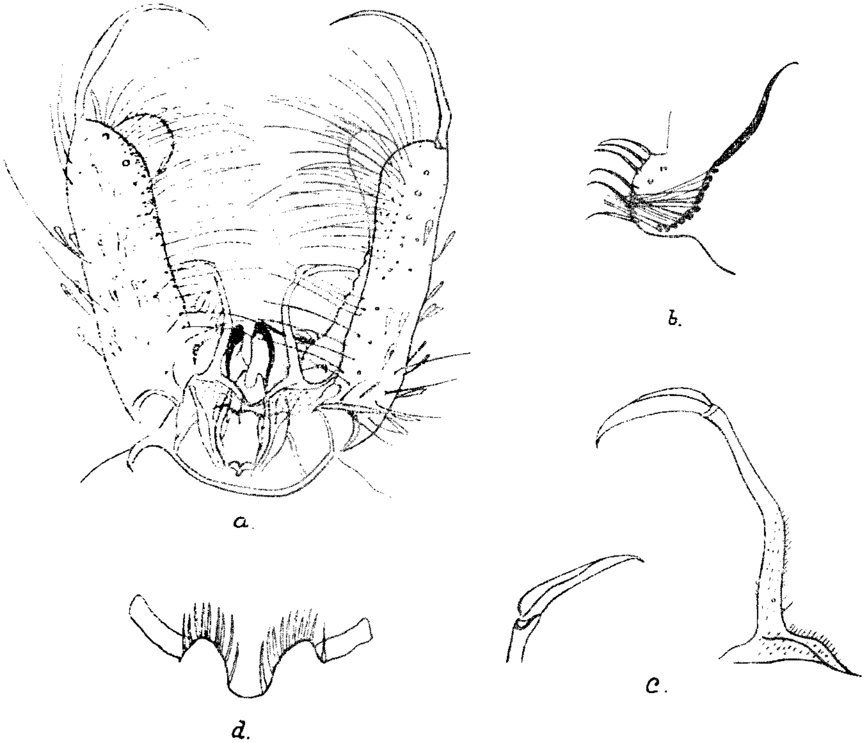

Fig. 84. *Aëdes (Ochlerotatus) communis* Deg.
a, Terminalia (total view); b, basal lobe; c, claspette; d, lobes of the 9th tergite. (After Natvig 1929.)

wing. Dististyle curved, apically pointed, with a moderately long claw. The form of the lobes of the ninth tergite as well as the number of spines are very variable. The lobe may either be narrow, projecting from the caudal border of the segment, or it may be broad and attached to the caudal border. In some specimens divided lobes my also occur. Concerning the spines two types may be distinguished. In most specimens the spines are arranged at the border of the lobes, either just distally or both at the distal and proximal border. Some specimens have the spines spread over the entire lobe, on the border as well as on the dorsal and ventral side, like a pin-cushion. Other differences are not to be seen in these types of terminalia. The number of spines at the lobes of the ninth tergites varies between 2

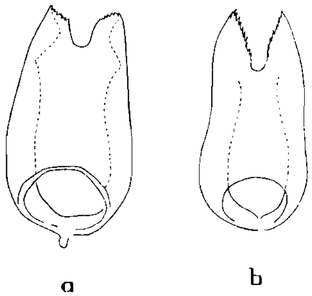

Fig. 85. Sclerotised parts of phallosome.
a, *A. (O) communis;* b, *A. (O) punctor.* (Aut. del.)

and 13. The mean value of 269 specimens (counted for both lobes): 6.8 The number of spines on both lobes are not always congruent; a difference of 0—6 may occur (mean value: 1.2). Concerning the correlation of the number of spines on the two lobes see table 25. A comparison of material from different localities demonstrates that these variations are not geographically determined, for even within a single population (52/53) extreme variants may be found (see table 26). The two sclerites of the phallosome form a cylinder which is dorsally fused and open at the ventral side with exception of a narrow basal ring. Apically the cylinder is furnished with minute teeth. Proctiger with strongly sclerotized paraprocts.

L a r v a (fig. 86). Head rounded, broader than long. Antennae rather short, spinose, slightly curved and faintly tapering from the insertion point of tuft towards apex of antennal shaft. Tuft with about 6 hairs, inserted at about $^2/_5$ the length from the base of the antennal shaft, and of about half the length of the shaft. Inner mouth-brushes with conspicuous combs. Inner frontal hairs behind the mid-frontal hairs. Frontal hair-formula about $^1/_1$. Dorsal prothoracic hair-formula about 2, 1, 2; 1; 3; 1; 3; 1. Hairs Nos. 1, 2, 4 and 8 faint, the remainder stout hairs. Lateral comb of the abdominal segment with about 60 scales arranged in a triangular patch. Each scale blunt with an apical row of small teeth. Siphonal index about 2.3. Siphon faintly tapering towards apex. Pecten reaching well one third the length from the base of the siphon, with about 20 teeth. The teeth with some basal denticles. Siphonal tuft with about 7 hairs, inserted beyond the pecten and beneath the middle

Table 25.

Correlation of the number of spines on the lobes of the ninth tergite in *A. (O) communis* (Deg.)

Left lobe

	Number of spines	2	3	4	5	6	7	8	9	10	11	12	13	Specimens examined
Right lobe	2													
	3	1	1	1		1								4
	4	2	4	14	3	2	1							26
	5	1	1	13	12	5	3							35
	6		1	9	23	20	2	2						57
	7			1	9	23	17	4	2	1				57
	8			1	2	4	21	9	5	1	1			44
	9					3	8	5	2					18
	10						5	2	3		2			12
	11				1	1		1	2	2			1	8
	12									1	2	1		4
	13								2	1				3
Specimens examined		4	7	39	50	59	57	23	16	6	5	1	1	268

Table 26.

Correlation of the number of spines on the lobes of the ninth tergite in a single population (52/35) of *A. (O.) communis* (Deg.).

Left lobe

	Number of spines	2	3	4	5	6	7	8	9	10	11	12	13	Specimens examined
Right lobe	2													
	3	1												1
	4	2	1	2										5
	5			4	2	1								7
	6			2	7	2		2						13
	7					6	7	1						14
	8						5	2	1					8
	9						3		2					5
	10						1				1			2
	11												1	1
	12													
	13								1					1
Specimens examined		3	1	8	9	9	16	5	4		1		1	57

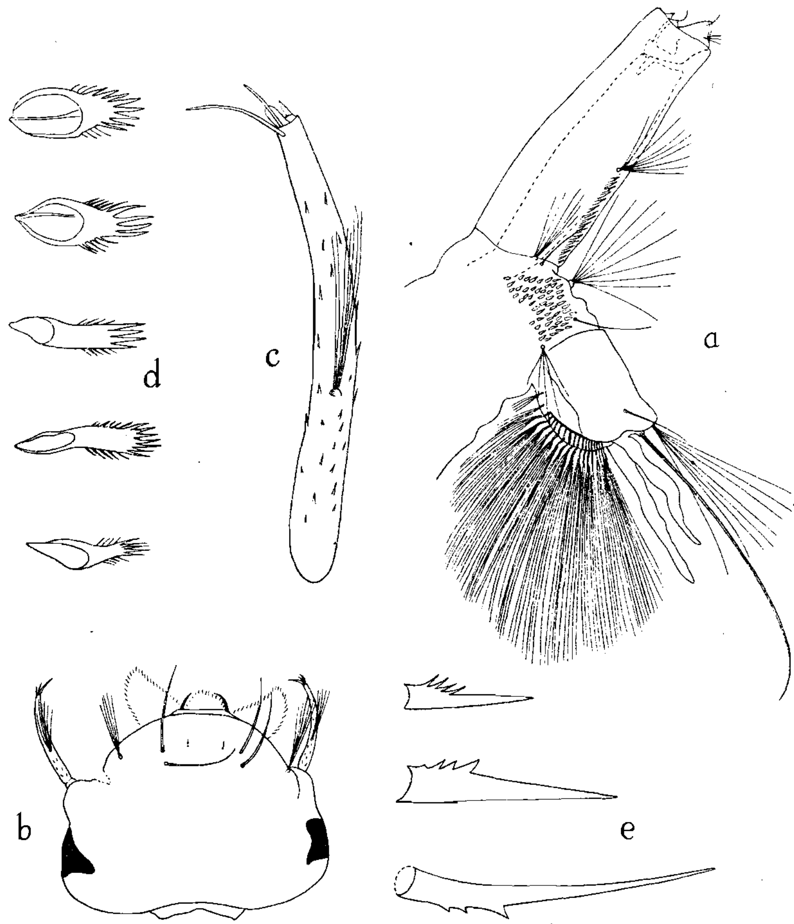

Fig. 86. Larva of *A. communis* Deg. in 4th instar. a, terminal segments of larva; b, head of larva; c, antenna; d, comb-scales; e, pecten teeth. (Aut. del.)

of the siphon. Dorsal hair stout, somewhat below the apex of siphon. Saddle reaching about two thirds down the sides of the anal segment. Saddle-hair of moderate length, mostly single. Dorsal brush with an inner pair of tufts with about 8 hairs and an outer pair of long, stout hairs. Ventral brush with about 19 cratal and 2 pre-cratal hairs. Anal gills long, pointed.

Table 27.

Larval chaetotaxis of *A. (O.) communis* Deg.

Number of branches in				Number of		Siphonal index
Frontal hairs			Siphonal tuft	Comb scales	Pecten teeth	
out.	mid.	inner				
4—10 6.1 (230)	1—2 1.0 (331)	1—2 1.1 (327)	4—10 6.8 (140)	40—113 61.9 (127)	15—26 20.6 (196)	2.2—3.6 2.8 (70)

Comparing the Norwegian material with the descriptions of larvae from Denmark, Germany and U. S. A., some differences in the chaetotaxy are noticeable. According to Matheson (1929, p. 118) the siphonal index in American specimens are slightly more than 2, whereas the index varies from 2—3 in European material. Further the number of comb-scales is noticeably high in Norwegian Larvae.

Geographical distribution.

Denmark: *1. Jylland:* Gjessø Savverk, Silkeborg! ♂: 19. v. 1935 (P. Nielsen); *2. Sjælland:* Gripsskov (W-L); environs of Hillerød (W-L).

Sweden: "*Sk.-Lpl.*" (Wahlgr., 1922, p. 260); *Dlr.:* Falun. Kv. 46! ♂: 23. vi. 1935 (Tjed.); Falun. Norslund! ♂: 11. vi. 1931, ♀: 5. vi.—26. vii (Tjed.); Ludvika. Norsvik! ♀: 18. vi. 1924 (Fd.; Ludvika. Brunnsvik! ♀: 26. vi 1926 (KHF); Lima! ♀: 25. v. 1926 (Tjed.); Sundborn. Karlsbyn! ♂: 15. vii. 1941 (B. Tjed.); Floda. Sundviken; ♀: 1. vi. 1934 (Tjed.); Särna. Fulufjäll! ♀: 6. viii. 1924 (KHF); *Jmt.:* Snasahögarna! ♀: 31. vii. 1932 (O. Ringd.); *Vb.:* Degersfors. Kulbäckslid! ♀: 16. viii. 1940 (J. Forslund); *Lu. Lpm.:* Sarek, "Särkokhütte, 6. vii., Pårte, 10. vii., Rapadalen beim Pelatjåkko 14. viii." (Lundstr. 1917, p. 676); *T. Lpm.:* Abisko! ♂: 12.—18. vii. 1939 (Krogerus!); ♀: 20. vi.—20. vii. (Krogerus! Ringdahl!); ♂♀: 1. vii 1937, Lp: 30. vi.—8. vi 1938, ♂♀: 4. vi 1938 (Thienemann 1938, pp. 309—10); Nuolja! ♀: 12. vii. 1918 (Ringd.); Tjuonjatjåkko! ♀: 17. vii. 1918 (Ringd.).

Norway: *Ö: 1. Hvaler:* Kirkeøya, at Arekilen, L: 27. vi. 1928 (♂♀) (LRN); Skjærhalden; L: 27. v. 1928 (♂), L: 13. iv. 1938 (♂♀) (LRN); Prestesand, L: 13. iv. 1938 (♀)

(LRN); *AK: 12. Bærum:* Fornebo, L: 2. v. 1937 (♂♀) (LRN); Snarøen, L: 29. iv. 1928 (LRN); *13. Aker:* Bygdøy, L: 28. v. 1928 (♀) (LRN); at Sognsvannet, L: 9. v. 1937 (♂♀) (LRN); Alnabru, L: 15. v. 1930 (♂♀) (LRN); *14. Oslo:* ♀ "Kristiania" (Siebke); *30. Ullensaker:* Granli, L: 3. vi. 1929 (♂) (LRN); *HEn: 20. Trysil:* at highway Elverum—Nybergsund, L: 30. v. 1935 (♂♀) (LRN); Nybergsund, L: 27. v. 1934 (♂♀) (LRN); at highway Nybergsund—Indbygda, L: 27. v. 1934 (♂♀) (LRN); Indbygda, L: 31. v. 1935 (♂♀) (LRN); near the brooklet Langtjernbekken, ♀: 15. viii. 1935 (LRN); Rekkenskjæret, Vestby, ♀: 20. vi. 1935 (on cattle) (O. Skj.); Våråholla, ♀: 16. vi. 1935 (on cattle) (O. Skj.); Vestby, ♀: 2. vii. 1939 (on horse) (P. Bk.); Grønoset, L: 31. v. 1935 (♀) (LRN); Korsberget, ♀: 28. vi. 1934 (O. Skj.); Talåssetra outfarm, Vestby, ♀: 2. vii. 1934 (O. Skj.); Nesvoldberget, ♀: 2. vii. 1934 (on cattle) (O. Skj.); Bustad, ♀: 22. vi. 1934 (on man) (O. Skj.); Langtjernåsen, ♀: 10. vi. 1934 (in cow-stable) (O. Skj.); Grønoset, ♀: 12. vi. 1934 (on man) (O. Skj.), L: 31. v. 1935 (LRN); Østby, ♀: 6. viii. 1934 (O. Skj.); Kneiten, ♀: 19. vi. 1935 (in cow-stable) (O. Skj.); Ljørdalen, ♀: 25. vi. 1935 (in cow-stable) (O. Skj.); Skjeggmuruvatn, Drevdalen, ♀: 18. vii. 1935 (O. Skj.); *23. Ytre Rendal:* at the lake Storsjøen, L: 3. vii. 1928 (♂) (LRN); ♀: 30. vi.—29. vii. (LRN); Lomtjern, LP: 24. vii. 1929 (♂) (LRN); at the brooklet Valsjøbekken, L: 6. vii. 1928 (♂) (LRN); Viken, Storsjøen, L: 4. vii. 1935 (♂) (LRN); at the brooklet Renåen, ♀: 7. vii. 1944, at the brook Renåen in Mistervalley, ♀: 28. vii. 1935 (LRN); Holla outfarm, ♀: 21. vii. 1943, LP: 8. vii. 1944 (LRN); at the brooklet Nøkkelåbekken, ♀: 23. vii. 1934 (LRN); ridge s. of the mountain massif Sølen, LP: 9. vii. 1944 (♀) (LRN); *30. Engerdal:* ♀: 4. vii. 1935 (on horse) (LRN); Os: *26. Sør-Fron:* Hundtorp farm, ♀: 26. viii. 1931 (in cow-stable) (LRN); *37. Dovre:* ♀ (Siebke); Fokstua, LP: 23. v. 1937 (♂♀) (LRN); Dombås, L: 24. v. 1937 (♂♀) (LRN); Bv.: *25. Ål:* ♀: *Djup* (on grouse chicken) (Bernhoft—Osa); Bø: *1. Hurum:* at Kongsdelene chapel, L: 8. v. 1938 (♂) (LRN); *2. Røyken:* Værpen, L: 8. v. 1938 (♂) (LRN); *13. Øvre Eiker:* at the lake Fiskumvannet, L: 3. vi. 1938 (♂♀) (LRN); TEy: *4. Porsgrunn,* ♀: 6. vii. 1930 (LRN); AAy: *10. Arendal,* Jovatn, ♀: 7. vii. 1930 (LRN); VAy: *4. Kristiansund,* L: 7. vii. 1930 (LRN); *10. Mandal,* L: 28. v. 1929 (♂) (LRN); STi:

24. Opdal: Kongsvold, ♂: 1. viii. 1873 (Siebke); *41. Trondheim;* Bymarka, L: 4. vii. 1939 (R. Brekke); NTi : *35. Ogndal:* Heimen, Indherad, ♀: 5. vii. 1930 (LRN); T R y : *14. Tromsøysund:* Prestvatn, ♀: 26. vii. 1924 (S-R); T R i : *25. Bardu:* Altavatn (Poppius); *26. Malangen :* Skjåvikør! ♂ : 26. vii. 1943 (S-R); *27. Målselv:* Rundhaug, L: 18. vi. 1938 (J. Smo); Maukstua, L: 2. vii. 1938 (J. Smo); *28. Øverbygd:* Frihetsli, ♀: 12. vii. 1922 (S-R); Råvatn, ♀: 2. viii. 1942 (S-R); *29. Balsfjord:* Sagelvatn, ♀: 29. vi. 1922 (S-R); Fjellfrøskvatn, ♀: 22. vii. 1926 (S-R); Lille Rundvatn, ♀: 19. vii. 1943 (S-R); *31. Storfjord:* Signaldalen, ♀: 21. vii. 1921 (S-R); F i : *9. Alta: Bossekop,* ♀: 29. vi.—22. vii. 1924 (S-R); Jotkajavrre, ♂ : 4.—6. vii 1924, ♀: 30. vi.—16. viii. 1924 (S-R); Romsdal, ♂♀: 30. vi. 1924, (S-R); *11. Karasjok,* ♀: 9. viii. 9. viii. 1924 (S-R); Bojobæske, ♀: 16. vii. 1924 (S-R); F n : *12. Kistrand:* Vuorjegaissa, ♀: 29. vii. 1924 (S-R).

F i n l a n d: *Al(A)* ?Hammarlund (Frey); Saltvik, Finnstr.! ♀ (Frey); *Ab(V):* Åbo! ♀ (E. J. Bonsd.); Kuustö (Lundstr.); Karislojo! ♂ (Krogerus); *N(U):* Tvärminne Zool. Stat! ♂ : 19. v.—5. vi. 1935, ♀: 22. v.—9. vi. 1940 (Storå); Kyrkslätt (Frey); Helsingfors! ♂ : 13. vi. 1940 (Tiensuu); *Ik(Kk):* Terijoki! ♀ (Hellén); Metsäpirti! ♂ (Krogerus); *Ta(EH):* Hattula (Wegelius); *Kl(LK):* Kexholm (Hellén); *Sb.PS):* ?Kuopio (Frey); *Om(KP):* Nykarleby! ♂ : 25. vi.—13. vi. (Storå); Pedersöre! ♂ : 16.—27. vi. 1933 (Storå), ♀: 15. vi. 1933 (Storå); *Ok (Kn):* ?Suomussalmi (Hellén); ?Säräisniemi (Wuorentaus); *Le(EnL):* Kilpisjärvi! ♀ (Hellén); *Li(InL):* Ivalo! ♀: 16.—19. vi. 1928 (Kanervo); Utsjoki! ♀ (Hellén); ?Enare (Mäklin); *Lps(PsL):* Petsamo, Hankilampi. ♀: 23. vii. 1928 (Kanervo); Nautsi! ♀: 26. vi. 1928 (Kanervo); Kiddjaure! ♀: 28. vii. 1929 (Storå); Trifona. ♂ : 7. vii. 1929, ♀: 17. vii. 1929 (Storå); Petsamo! ♀: 23. vi.—18. vii. 1929 (Storå); Waido-guba! ♀: 13. vii. 1927 (Levander).

U S S R : *Kola Peninsula:* Kibiny (Chibinä): Fridolin, (Stackelberg, 1937, p. 174); Seitjaur (Palmén); Solovez Islands (Birulja) (Stackelberg 1937, p. 174).

Distribution outside Denmark and Fennoscandia.

As to the distribution of *(A.(O) communis* Edwards (1921, p. 316) remarks: "Europe, except west and south, and probably across Siberia to Alaska and Canada."

In E n g l a n d the species has been found on one occasion only, near Strelley in the county of Notts (Marshall 1938, p. 169). In B e lgium it is recorded from: "Diepenbeek (Camp.); Hockai (Subalp.) 5—7." (Goetghebuer, 1925, p. 216). From France Séguy (1923, p. 144) records the following finds: "Environs de Paris: Forêt de Saint-Germain (P. Lesne), Meudon (Séguy), Bois-Colombes (Le Cerf), Forêt de Marly, Nemours (Surcouf), Samois-sur-Seine (Séguy).". Further Eckstein (1918, p. 68) records it from Strassbourg. In Germany *A. communis* has been recorded from: Hamburg, Rostocker Heide, Danzig, Lübeck, Schwerin i. M. (Martini 1920, p. 107); further from Darss (Vorpommern), Berlin, Finkenkrug, Brieselang, Gross Raum (Ostpr.) (Peus, 1929b, p. 9), Stuttgart (Vogel, 1929, p. 269) and from the environs of Bonn (Schneider, 1914, p. 38). From Switzerland the species is recorded from: Bern (Bangerter 1926); Kanton Waadt, Kanton Freiburg, Kanton Wallis, Kanton Bern, environs of Lausanne (Galli-Vall. 1917). Ficalbi (1896, p. 275) records it from Italy. Further eastwards it is recorded from Estland from: "Dagö (Im Zimmer), 22. viii. Päskülla-Moor bei Nömme, 28. viii., Jööpre-Hochmoor bei Pernau, 4. ix., Uchten bei Wesenberg, 13. ix., Varudi-Hochmoor bei Port Kunda, 14. ix.", (Dampf, 1924, p. 6), from Lettland: "Erlenbrücher bei Anting am Kanger-See, ♂: 16.—17. vi. 1934, Betula nana-Hochmoor am "Gr. Kanger", ♂: 10. vi. 1934, Libau, ♀: 8. v. 1899 (Peus, 1934, p. 78), from Lithuania: Bialowies, v.—viii. (Sack, 1925, p. 263) and from Poland (Tarwid 1938 a—b). Edwards (1921, p. 316) records males from the following places in Austria: Admont, Steiermark (Strobl); Richenau and Linz (Mik); Dornbach (Handlirsch). Further Séguy (1923, p. 144) records the species from Poland, Martini (1938, p. 22) from Roumania (Mihályi 1941): Hungary: Balaton, Martini (1931, p. 308) from Jugoslavia: Dobropolje and Séguy (1923 p. 44) from Syria: Beirut (Gadeau de Kerville). According to Stackelberg (1937, p. 174) the species is recorded from USSR from the following places: "Leningrad distr. (Montsch., Stackelberg!), Voronesch distr. (environs of Voronesch: Schtschelk. *A. nemorosus* Meig.), Ukraine (Polesje: Rybinsk, environs of Kiev: Rybinskiji and Dneprostroi distr.: Dolbeschkin!), Lover Volga distr. (Martini), southern coast of Crimea (Velitschkevitsch!), Sverdlov distr. (environs of Sverdlovsk: Kolosov, Mitrofanova!), Perm distr.: (Mitrof.!), Siberia (Eniseijsk: t. Edwards), Ussurijskij Kraj (Tigrovaja, Sutschan river: Stackelb.!)".[94] From West-Siberia it is recorded from Tomsk distr.: Tomsk, ♀: 3.—23. vii, Ssokolowsky, ♀: 1. viii, Nowo-Alekssandrowskoje, ♀: 27. vii., Tschulym, ♀: 29. vi.—28. vii.; Rayon Narym: "Wosnessensky, ♀: 11. viii. (Wnukowsky, 1928, p. 164), further it is recorded from the places Ust-Jansk and Kasatschje on the river Jana (Lundström 1915) and from the Taimyr Peninsula (Kiseleva 1936). Previously (Natvig 1933, pp.7—8) some females of this species have been recorded (in the Report of the Norwegian North Polar Expedition with the "Maud") from "Maud"-Harbour, Cap Tsjeljuskin, July-Aug. 1919. It also occurs in Kamtschatka. From this locality Edwards (1928 a, p. 2) records *A. punctor* Kirby from Tchapina and remarks: "Some of the females may perhaps belong to *A. communis* Deg." By the courtesy of Dr. Malaise I have received for inspection the pinned specimens, deposited in Naturhistoriska Riksmuseum, Stockholm, and I consider at least two females as true *communis*, the white scaling at the base of costa and subcosta being conspicuous.

In the American continent *A. communis* has a widespread distribution. According to Dyar (1923 d, p. 65) the species (*A. lazarensis*

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[94] Translated from the Russian text.

Felt a. Young) has been recorded in Alaska from: Eagle; Healy, June 27, 1921; Camp 334, Alaska Engineering Comm., June 21, 1921; Camp 327, A. E. C., June 12, 1921; Pitchfork Falls, July, 1919, Skagway, July 8, 1919; in Canada (Dyar 1921 b, p. 99: *A. lazarensis*) from *Ontario* Ottawa; Height of Land, June 21, 1918; Osnaburg, June 21, 1918; Fort Hope, June 27, 1918; White River, June 25, 1907; Nipigon, June 26, 1918; Dryden, July 1, 1918; Kenora, July 2, 1918; *Alberta:* Red Deer, July 30, 1918; Lochearn, Aug. 5, 1918; Lamoral, Aug. 6, 1918; Banff, July 8, 1918; Lagan, July 11, 1918; *British Columbia:* Glacier, July 28, 1916; Kalso, June 11, 1903; Prince George, May 9, 1919; Terrace, Aug. 12, 1919; Salvus, May 27, 1919; Kwinitsa, May 24, 1919; U. S. A. (Dyar 1923 d, pp. 65—8: *A. lazarensis, altiusculus, mazamae, tahoensis*): *Montana:* Belton, June 23, 1921; Glacier Park, July 3, 1921; *New Hampshire:* Mount Washington; White Mountains; Dublin, May; *New York:* Elisabethtown, June 11, 1904; Plattsburg, April 20, 1905; *Washington:* Mount Rainier, Aug. 4, 1906, Indian Henry's Long mire Springs, June 25, 1917; *Oregon:* Crater Lake, July 30, 1920, Prospect, May 24, 1921; Engineers Camp, above Whiskey Creek, May 24, 1921; *California:* Yosemite Valley, Mariposa County, May, 1907; Fallen Leaf Lake, El Dorado County, June 24, 1916; Lake Tahoe, Placer County, June 22, 1920; Summit, Placer County, June 15, 1920; Gold Lake, Sierra County, June 26, 1920; Bear Lake, Plumas County, June 24, 1920. Recent records are: Maine (Bean 1946) Massachusetts (Tulloch 1939), Michigan (Irwin 1941); Utah (Don M. Rees 1942).

Biology.

A. communis Deg. is, second to *A. punctor* Kirby, the most common mosquito in Fennoscandia. It has been found from the southernmost parts of the Scandinavian Peninsula (Skåne in Sweden and Kristiansand in Norway) up to about the 70th degree of latitude in the north. Hitherto the species has not been recorded from the western part of southern Norway, but in Sweden it occurs eastwards to the Baltic Sea. In Finland it has been found from Helsingfors in the south up to Petsamo in the north. *A. communis* is by preference a woodland mosquito, but it has been found also in other localities, from pools at the seashore and up to the mountainous regions (i. a. at Fokstua (On 37) at 990 m above sea level). In southern Norway no males have been found in freeland, but male specimens have been bred from the second part of May to ultimo July. In the northernmost county Finmark) males have been caught from 4. vii. to 26. vii, and females from 29. vi. to 2. viii. The finds at hand indicate that in mountainous regions and northern localities the imagines appear from one to two months later than in southern localities. In Sweden males have been found from 25. v. to 18. vii., females from 1. vi. to 16. viii, and in Finland males have been caught from 19. v. to 7. vii., and females from 22. v. to 23. vii. Full grown larvae have been found, in southern Norway, from 13. iv., and in northern Norway (Målselv) from 18. vi. to 2. vii. Most breeding waters are more or less in shade of trees, but, especially in mountainous regions, quite exposed breeding waters are found with larvae of this species. The bottom of most breeding waters are covered with decaying leaves or pine-needles, but also pools with muddy or stony bottom may be inhabited by larvae of *A. communis*. Near the railway at Fokstua (O 37) larvae were found in small and deep pools with stony bottom, the stones being covered with mosses and lichens. These pools (pl. IV) were mostly lined with dwarf-birches (*Betula nana*) which probably partly shaded the water. A single larva of *A. communis* was found in a pool near the sea-shore at Kirkeøya, Hvaler (Ø 1.), where the salinity of the water was 0.0749 % NaCl. The degree of pH in 18 breeding-waters investigated varies from pH 4.5 up to pH 7.5. For details see table 2 (p. 60). Larvae of *A. communis* have been found in Norway associated with (in order of frequency): *A. punctor* (16), *excrucians* (9), *diantaeus* (5), *detritus* (2), *T. morsitans* (2), *A. intrudens* (1), *cataphylla* (1), *dorsalis* (1), *nearcticus* (1). *A. cinereus* (1) and *C. pipieus* (1). *A. communis* is a very annoying and persistent biter attacking both man and beast. In the lowlands the mosquitoes attack by preference at night or, by daytime, in shady places but in dusky weather even in open land. However, in the mountains I have been attacked by this species in the afternoon even in bright sunshine. *A. communis* has also repeatedly been found in cow stables and in houses.

As to the biology of *A. communis* in Denmark Wesenberg-Lund (1920—21, pp. 75—76) sums up: "The eggs are hatched in midwinter or in very early spring; many of them do not hatch before April; owing to the rising tp. the latest hatched overtake the first, and in the two first weeks of May the mosquitoes are hatched. The mating process takes place shortly after hatching, but the craving for blood does not appear before June, often not till the latter part of June. The eggs are laid singly, and often in the same pools in which the imagines are hatched, but these pools are now dry, and the eggs are deposited upon dry bottom from July—August to December—January and do not hatch before a freezing period; the males probably die off shortly after the mating process." Concerning the bloodsucking habits of this species he further remarks: "As an exclusive forest mosquito it hardly ever goes out of the forest; according to my experience, the attack is always worst in the biggest and darkest part; here in the deep shade the attack on a sunny day at noon is just as severe as in the evening. In late spring and early summer man and cattle are almost exclusively injured by this single species."

According to the literature, the biology of *A. communis* in Central Europe in general coincides with that in Denmark. Peus (1932, p. 140) remarks on this species: "Streng an den Wald gebunden" and Séguy (1923, p. 144) records from France: "Habite surtout les bois et les forêts, apparait des mois de mai et disparait en aout." Martini (1931, pp. 306—7) points out the tenacity of life of the larvae and pupae: "Sehr vichtig ist es, daß die Larve ein oberflächliches Austrocknen ihrer Brutgewässer überdauern kann. — — — Unter den trockenen oberflächlichen Blättern lagen bald Blätterschichten, die ganz naß waren, und hier zwischen die Blätter gelagert, fanden sich Unmengen von *nemorosus*-Larven und Puppen — — — Davon, daß Puppen, welche mit Larven durcheinander feucht in feucthter Kammer auf einem Kupfersieb lagen, durchaus regelrecht schlüpften, konnte ich mich durch 2 Tage im Versuch überzeugen." Martini (1931, p. 308) also records imagines from Dobropolje (Jugoslavia) caught at 1500 m above sea level.

From U. S. A. Matheson (1929, p. 11) remarks on this species: "It is said to remain in the shade and bites whenever opportunity offers, though it attacks most firecely just after dark. The species is single brooded, the adults living till late in the season (August). The larval habitat is normally early spring pools filled with melting snows, though I have taken them in swamps and marshes. The adults appear very early, the latter part of April (Central New York)."

Aëdes (Ochlerotatus) punctor (Kirby).

C. punctor Kirby (Faun. Bor.-Am., *4*, p. 309) 1837
C. provocans Walk. (List. Dipt. Brit. Mus., *1*, p. 7) 1848
C. fusculus Zett. (Dipt. Scand., *9*, p. 3459) 1850
C. auroides Felt. (N. Y. State Mus. Bull. 971, p. 448) 1905
Culic. nemorosa f. *haplolineata* Schneid. f. *alineata* Schneid. (Verh. Nat. Ver. Bonn, *70*, p. 37) 1913
A. nemorosus Lang. (nec. Meig.?). (Handb. Brit. Mosq. p. 91) 1920
A. sylvae Martini (nec. Theob.). (Üb. Stechmück. p. 108) 1920
A. meigenanus Dyar (Insec. Insc. Mens., *9*, p. 72) 1921
A. punctodes Dyar (Ins. Insc. Mens., *10*, p. 2) 1922
?*A. labradoriensis* Dyar a. Shannon (J. Wash. Acad. Sci., *15*, p. 78) 1925

Synonymical remarks.

Concerning the synonymy Edwards (1921, p. 313) says: "I have rejected the name *nemorosus* for this species, because there appear to be no examples of it so named in Meigen's collection in Paris, while there is a male of *A. communis;* the name *nemorosus* has been used to cover so many species that there would be little advantage in retaining it. The present species is possibly Meigen's *C. sylvaticus,* but this is doubtful. While admitting that there are minute differences in larva and adult as well as some distinction in breeding habits, between *A. punctor* and the European form, I cannot believe these are sufficient to justify the maintenance of the two as distinct species. The European form should perhaps be known as *A. punctor* var. *meigenanus.* The hypopygium is identical in the two forms, and also in two or three other American forms which are regarded by Dyar as distinct species. The relationship of all these forms appears to require closer investigation." However, Dyar (1922 b, p. 69) remarks: "In regard to *punctor,* we have a number of very close species in America, from which the European form seems specifically detatched. I am therefore not inclined to depart from my position previously discussed (Ins. Insc. Mens., IX, 72, 1921) and consider that the European form should be called *Aëdes meigenanus,* and that *punctor* is its American representative."

As quoted below (see *A. geniculatus* Oliv. p. 392) the two males of *C. fusculus* in Zetterstedt's collection at Lund proved to be *A. punctor.* Edwards in the description of *A. geniculatus* (1921, p. 320) i. a. says: "Zetterstedt must also have included with these males rubbed females of other species, as one which was sent me by Dr. Bengtson in 1912 was an *Ochlerotatus* near *O. cataphylla."* I have inspected two females of *C. fusculus* from Zetterstedt's collection. Both were rather rubbed and nothing can be said but this that they are most probably species of the *communis*-group.

Description.

Female: head with dark brown bristles, those in front with golden reflections and forming a small tuft projecting between the eyes. Vertex ("occiput") with golden, narrow, curved scales, numerous dark golden, upright, forked scales above and on the nape. Temporae with broad, flat scales of a creamy tint. Proboscis blackish brown. Clypeus black. Antennae: Torus laterally brown, on the blackish inner side with some yellowish-white scales. Flagellum blackish-brown with bigger black hairs at the base of the segments and a coating of minute whitish hairs. Palpi (fig. 70 i) blackish brown, about one fourth the length of the proboscis, and of a long and slender appearance. Segm. 3 about half the length of segm. 4, about 2.5 times as long as broad. Segm. 4 well over four times as long as broad. Ultimate segment oblong, great; nearly half the width and well over $\frac{1}{4}$ the length of the penultimate. Colour of palpi blackish brown. Thorax. Anterior pronotal lobes with yellow and whitish narrow curved scales. In some specimens the scales at the lower posterior corner are more or less whitish. Bristles golden. Mesonotum blackish brown. In the common type the sides are clothed with yellow, narrow, curved scales, and in the middle of the mesonotum there is a broad longitudinal band of bronzy scales. In some specimens the scales on the sides have a pronounced ochreous tint, in others they are more greyish. The longitudinal band may be undivided or it is represented by two dark bands, divided either by a narrow or a broader stripe of yellow scales. The longitudinal band may also be absent altogether. On the posterior part of mesonotum the scales on either side may be darkened thus forming two short lateral stripes. The antescutellar space yellowish. Long golden bristles on the sides of mesonotum and above the wing root. Scutellum with three groups of yellow, narrow curved scales and long yellow bristles. Postnotum brown. Propleurae clothed with bronzy narrow curved scales and some whitish ones ventrally. Pleurae and coxae with broad flat whitish scales, more or less with a yellowish tint. Bristles on pleurae and coxae with golden reflections. Wing venation blackish brown scaled; in some specimens single whitish scales may be found just at the base of costa. Halteres: stem brown, with whitish scales on the globule. Legs: Front side of femurae in fore- and middle leg: basally creamy, apically dark brown; hind leg: yellow with the most distal part brown. Knee spots conspicuous, creamy. Tibiae and tarsi blackish brown without white scales. The back side of femurae and tibiae whitish, also some light scales on under side of first tarsal segments. Abdomen blackish brown, the segments with creamy basal bands conspicuously contracted or even interrupted in the middle. Venter whitish, mostly with a dark median line. Length of body: 5.5—6.5 mm (W-L); Wing length: about 5 mm.

As emphasised by Edwards this species is a variable one, and therefore in many specimens difficult to distinguish with certainty from its allies. He further says (1921, *12* (3), p. 313): "The absence of a definite speckling of pale scales on the femora and tibiae, and the creamy tint of the abdominal bands — those on the last few segments being rather conspicuously narrowed in the middle — are, taken together, the best means of distinguishing the female." As the

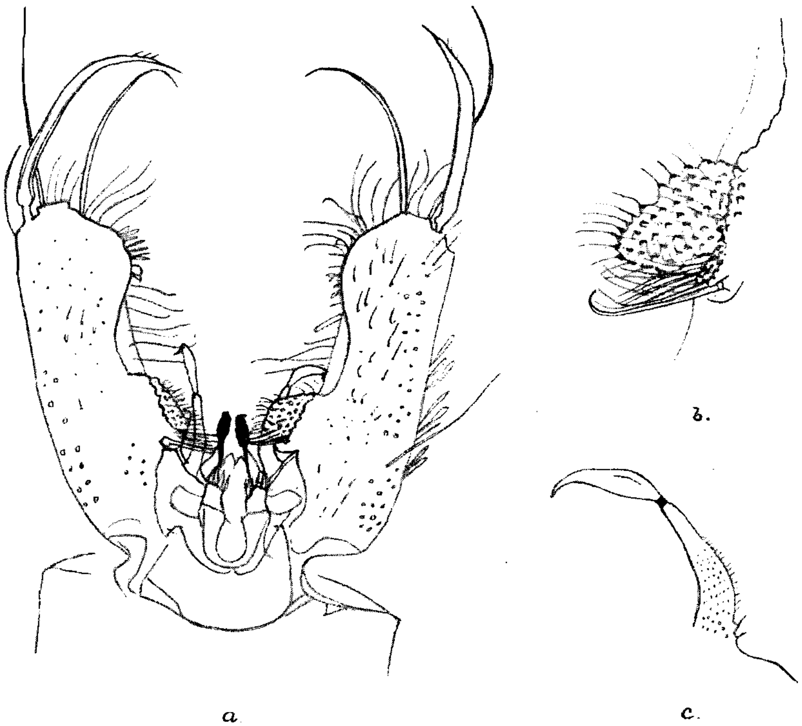

Fig. 87. *Aëdes (Ochlerotatus) punctor* Kirby.
a, Terminalia (total view); b, basal lobe; c. claspette.
(After Natvig 1929.)

abdominal bands may be somewhat contracted also in specimens of *communis* I use the colouring of the wing scales for the differentiation in doubtful cases. If conspicuous rows of white scales are found on the basal part of costa and subcosta I consider the specimen as *communis,* if these parts are dark or only single light scales are found just at the base of costa, the specimen is determined as *punctor.* However a closer examination of these subtile criterions on reared material would be highly desirable.

M a l e. H e a d : antennae about ⅔ the length of the proboscis. Torus blackish brown, flagellum dark and white ringed, the ultimate and penultimate segments dark with fox-coloured reflections. Hairwhorls dark grey with fox-coloured reflections. P r o b o s c i s long, dark brown. P a l p i clothed with blackish brown, bronzy reflecting scales.

Length of palpi somewhat variable, but mostly exceeding the proboscis by one third of the ultimate segment. The long segment apically swollen, the fourth (penultimate) segment basally broader than apically, the ultimate segment nearly of the same length, blunt and apically somewhat swollen. The hair tufts on segment 3 and 4 long, on the ultimate segment of medium length, colour dark brown, basally with fox-coloured reflections. Thorax. Integument blackish brown. Mesonotum with a more or less well defined dark median stripe, consisting of scattered, dark golden, narrow, almost hair-like scales; laterally and on the antescutellar space the scales are broader and more whitish yellow. Bristles with golden reflections. Abdomen. Scales at dorsum blackish brown, segments with basal white bands, more or less contracted in the middle. Venter whitish with a dark median line. Wing length: 4.5 mm.

Terminalia (figs. 85, 87). Basistyle about three times as long as broad. Apical lobe rounded, with many short, broad and curved hairs. Basal lobe stout, may have several breaks; with an apically curved spine and many long hairs. Stem of the claspette short and stout, mostly moderately curved. Appendage hookformed, somewhat thickened in the middle and without wing. Dististyle curved, with a

Table 28.

Correlation of the number of spines on the two lobes of the ninth tergite in *A. (O.) punctor* (Kirby).

Left lobe

	2	3	4	5	6	7	8	9	10	11	12	Specimens examined
Right lobe 2												
3	2	1										3
4		1	2	1	3							7
5		2	6	12	3	5						28
6			4	4	12	7	2	1	1			31
7				2	6	8	3					19
8					2	10	10	1		1		24
9					3	3	1	2		1		11
10							2	3	1			6
11								2		1		3
12										1		1
Specimens examined	2	4	12	19	29	33	18	9	2	5		133

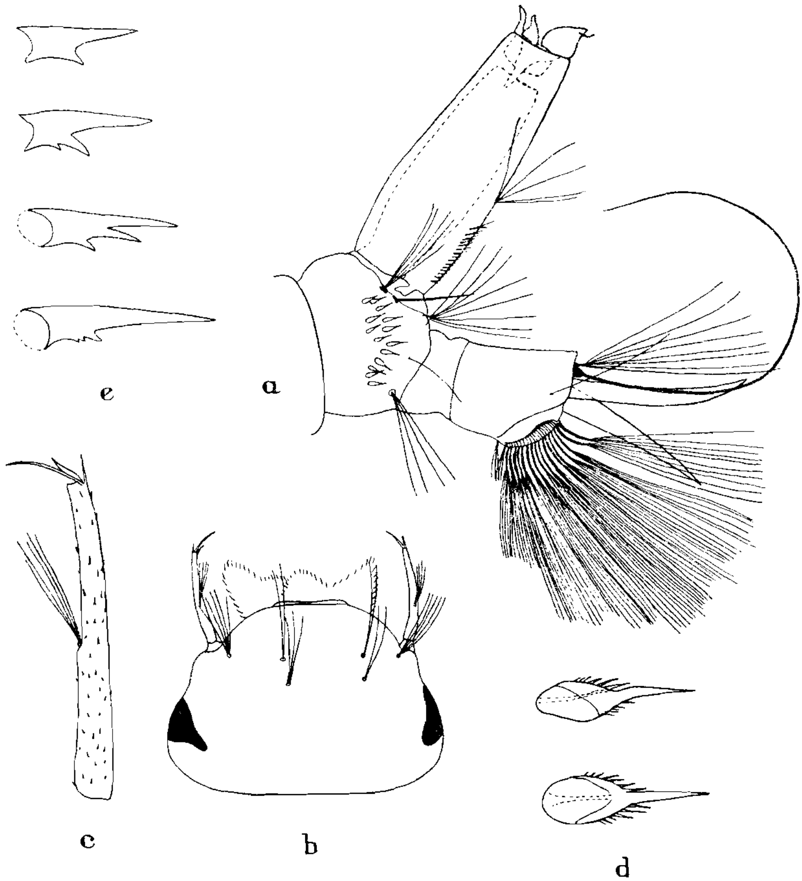

Fig. 88. Larva of *A. (O) punctor* Kirby in 4th instar.
a, Terminal segments of larva; b, head of larva; c, antenna; d, comb-scales; e, pecten teeth. (Aut. del.)

moderately long claw. Proctiger with stout hookformed paraprocts.

In accordance with *A. (O.) communis* the form of the lobes of the ninth tergite and the number of spines are varying in *A. (O.) punctor*. The number of spines on each of the lobes varies from 2—12. Mean value of 133 specimens (counted for both lobes) : 6.6. A difference of 0—4 in the number of spines on the two lobes may be found. (Mean value: 1.0). Concerning the correlation of spines on the two lobes the table number 28 will give information.

L a r v a (fig. 88). Head broader than long. Antennae short, slightly curved and spinose, faintly tapering from the insertion point of the antennal tuft. Latter inserted about $\frac{2}{5}$ from the base of the antennal shaft, of about half the length of the shaft and with about 5 hairs. Hairs of inner mouth-brushes with well developed comb. Inner frontal hairs behind the mid frontal hairs. Frontal hair-formula about $^{2}/_{2}$. Dorsal prothoracic hair-formula about: 2, 1, 2; 1; 2; 1; 3; 2. Of these, hair No. four is a faint hair, the remainder long and stout hairs. Comb with 6—21 scales arranged in a double row, each scale with a long median spine with one or more basal denticles and minute bristles on either side. Siphonal index about 2.6. Siphon slightly tapering from about the insertion point of siphonal tuft. Siphonal tuft within the middle of the siphon and with about 5 hairs. Pecten reaching about $\frac{2}{5}$ the length from the base of the siphon, with about 18 teeth, these with few basal denticles. Anal segment longer than wide, encircled by the saddle. Saddle-hair long, single. Dorsal brush with an inner pair of tufts with about 8 hairs, and an outer pair of long, stout hairs. Ventral brush with about 17 cratal and 2 precratal tufts. Anal gills of varying length. As to the variability in the larval chaetotaxy see table below.

T a b l e 2 9.

Larval chaetotaxis of *A. (O.) punctor* Kirby.

Number of branches in				Number of		Siphonal index
Frontal hairs			Siphonal tuft	Comb scales	Pecten teeth	
out.	mid.	inner				
2—8 5.2 (120)	1—3 1.8 (178)	1—3 1.8 (171)	3—9 13.3 (91)	6—21 13.3 (94)	11—25 17.7 (119)	2.0—3.5 2.6 (29)

Compared with the chaetotaxis of larvae from B r i t a i n (Marshall 1938, p. 101) and G e r m a n y (Martini 1923 a, p. 560) the ranges of variation is somewhat wider in the N o r w e g i a n material. This is especially distinct concerning the number of comb scales and the siphonal index. Of the eight specimens with number of comb-scales below 10, four are from Fokstua in the Dovre mountains (On 37), two from Målselv (TRi 28), and the remaining two are from lowland localities in southern Norway. As to the siphonal index, 7 specimens from Målselv have an average siphonal index of 2.2, whereas the remaining 22 larvae from southern Norway have an average siphonal index of 2.8. Unfortunately the bulk of the slide preparations are made from exuviae, mostly a few specimens from each locality, and the material at hand does not permit closer research as to possible variability of populations from different parts of Norway.

Geographical distribution.

Denmark: *1. Jylland:* Tipperne! ♂: 14.—17. vi. 1940 (in house) (Søg. A.); Lystrup Aa (s. of Silkeborg)! ♀: 16. ix. 1929 (P. Nielsen); *2. Sjælland:* Tisvilde forest (P. Kryger t. W-L); environs of København! ♂ (Stæg.). Wesenberg-Lund (1920—21, p. 81) remarks concerning the occurrence of this species in Denmark: "Of *O. punctor,* — — I have only seen one single specimen, brought me by Mr. Kryger from Tisvilde forest, near the shores of the Kattegat."

Sweden: *Sk:* (t. Wahlgren 1922, p. 260); *SM:* Ekeberga, Visjön! ♀: 13. vii. 1940 (KHF); *Upl:* Stockholm! ♀ (Tlgn); *Dlr:* Falun, Kv. Trädgård! ♂ (B. Tjed.); Falun, Norslund! ♂: 7. vii. 1933, ♀: 5.—29. vi. 1933 (B. Tjed.); Ludvika. Norrvik! ♀: 18. vi. 1923 (KHF); Ludvika. Brunnsvik! ♀: 10.—27. vi., (in house): 17. vi. 1924 (KHF); Ludvika. Ställviksberg! ♂: 31. vii. 1928 (KHF); Lima. Rostberget! ♀: 24. vii. 1933 (B. Tjed.); Orsa, Frykås! ♀: 6. —11. vi. 1933 (B. Tjed.); Hedemora. Ringselle! ♂ (B. Tjed.); Idre. Töfsingpark! ♂: 16. vii. 1926, ♀: 2. viii. 1925 (KHF); Töfsingdal! ♀: 2. viii. 1925 (KHF); Idre! ♀: 11. viii. 1921 (KHF); Idre. Nippfjäll! ♀: 29. vi. 1929 (KHF); Idre. Säsjön! ♀: 7. viii. 1925 (KHF); Särna. Fulufjället! ♀: 5. viii. 1927 (KHF); *Jmt:* Gäddede! ♀: 9. x. 1914 (O. Rg.); Undersåker! ♀: viii. 1916 (O. Rg.); Enafors! ♀: 7. viii. 1930 (O. Rg.); Åreskutan! ♂ (Zett.) ("*C. fusculus* Zett. ♂ var a et b"); *Vb:* Degerfors, Svartberget! ♀: 22. vii. 1935 (KHF); Degerfors. Kulbäckslid! ♀: 2.—5. viii. 1940 (KHF); *Lu.Lpm:* Gällivare. Kallajaure! ♀: 27. viii. 1923 (KHF); *T.Lpm:* Nuolja! ♂: 12. vii. 1918 (O. Rg.); Abisko! ♂: 11. vii. 1922 (O. Rg.), Caltatjärn, 12. vii. 1930 (Edwards 1931, p. 33); at lake Katterjaure, L. P. ♂♀, in swamp-pool, L.P: 23. v. 1938, ♂♀: 4. vi. 1938 (A. Thienemann 1938, pp. 309—10).

N o r w a y : Ø: *1. Hvaler:* Kirkeøya: at Arekilen, L: 17. v. 1928 (♂♀) (LRN), Ørekroken, L: 14. iv. 1938 (♀) (LRN), Hellekilen, L: 16. iv. 1938 (♀) (LRN); A K : *11. Asker:* at Holmen farm, P: 15. v. 1931 (♂♀) (LRN); *12. Bærum:* Fornebu, L: 2. v. 1937 (♀) (LRN); Snarøya, L: iv. 1928 (♂♀) (LRN); *13. Aker:* Bygdøy, L: 6. v. 1928 (♂♀) (LRN); at lake Østensjøvannet, L: 13. v. 1928 (♂) (LRN); Alnabru, L: 15. v. 1930 (♂♀) (LRN); at lake Sognsvannet, L: 15. v. 1937 (♀) (LRN); *14. Oslo:* Tøyen, ♀ (Siebke); *23. Fet:* ♀ (Siebke); *30. Ullensaker:* Granli, L: 2. vi. 1929 (♂♀) (LRN); at lake Hersjøen, L: 5. vi. 1929 (♂) (LRN); s. of lake Transjøen, L: 5. vi. 1929 (♂) (LRN); *31. Nes:* Vormnes farm (in cowstable), ♀: 16. ix. 1934 (LRN); H E s : *12. Romedal:* ♀: 18. viii. 1931 (LRN); H E n : *20. Trysil:* at highway Elverum-Nybergsund, L: 30. v. 1935 (♂♀) (LRN); Indbygda, L: 27. v. 1934 (♂♀) (LRN); 2 km east of Nybergsund, L: 27. v. 1934 (♂♀) (LRN); Vestby (in house), ♀: 31. vii. 1933 (LRN); Bakken farm (in cow stable), ♀: 2. vii. 1934 (O. Skjerven); Varåholla farm (on cattle), ♀: 19. vi. 1935 (O.Skj.); Livollen outfarm (on cattle), ♀: 30. vii. 1933 (LRN); N. Jerpen outfarm, ♀: 30. vii. 1933 (LRN); Rekkenskjæret farm (on cattle), ♀: 20. vi. 1935 (O.Skj.); Talåssetra outfarm, ♀: 2. vii. 1934 (O.Skj.); Galåsen farm, ♀: 9. vii. 1934 (O.Skj.); at the brooklet Slåttmyrbekken, ♀: 22. viii. 1934 (LRN); Bustad farm, ♀: 20. vi. 1934 (O. Skj.); Kneiten farm (in cow stable) ♀: 19. vi. 1935 (O. Skj.); at the brooklet Langtjernbekken, ♀: 15. vii. 1935 (LRN); at the lake Skjeggmuruvatn, Drevdalen, ♀: 18. vii. 1935 (O. Skj.); Nyhus outfarm (on cattle), ♀: 5. vii. 1934 (O. Skj.); Flermoen farm (on cattle), ♀: 4. vii. 1935 (O. Skj.); Grønoset farm, ♀: 12. vi. 1934, (in hog-cote): 15. vii. 1934 (O. Skj.); at Lutnes farm, L: 31. v. 1935 (♀) (LRN); *21. Åmot:* Rena, ♀: 19. viii. 1931, (in cow stable): 18. vii. 1935 (LRN); *22. Stor-Elvdal:* 30 km n. of Rena, ♀: 18. vii. 1935 (LRN); *23. Ytre Rendal:* at the lake Storsjøen, L: 9. vii. 1928, ♀: 11. vii. 1928 (LRN); Solbakken, Storsjøen, ♀: 22. vii.—12. viii. (LRN), (in house): 20. vii.—25. viii. (LRN); Flenøya farm (in house): ♀: 28. viii. 1942 (LRN); at the brook Renåen, L: 18. vi. 1944 (♂♀), ♀: 7. vii.—12. viii. (LRN); at the brooklet Sagbekken, L: 15. vi. 1944 (LRN); at the lakelet Lomtjern, P: 30. vii. 1929 (♂) (LRN); at the mountain lake S. Rensjøen, ♀: 10. vii. 1931 (LRN);

Storvelta at the river-valley of Flena, ♀: 14. viii. 1944 (LRN); Akre farm, ♀: 26. vii. 1931 (LRN); at Holla outfarm, ♀: 9. vii. 1944 (LRN); at the mountain brook Grøna, ♀: 9. vii. 1944 (LRN); at the brooklet Nøkkelåbekken, ♀: 30. vii. 1935 (LRN); ridge s. of the mountain massif Sølen, L: 10. vii. 1944 (♂♀) (LRN); *28. Tynset:* Tynset, ♀: 24. vii. 1930 (LRN); *30. Engerdal:* Elvdal, ♀: 15. vii. 1931 (LRN); Myrstad farm, ♀: 12. vii. 1934 (LRN); Karl Sætre farm, ♀: 17. vii. 1933 (LRN); O s : *25. Ringebu:* near the highway, ♀: 26. viii. 1931 (LRN); O n : *36. Lesja:* Lesjaskogen (on *Accipiter nisus* (L) juv.), ♀: 19. vii. 1939 (Yngv. Hagen); *37. Dovre:* Fokstua, L: 23. v. 1937 (♂♀) (LRN); Dombås, L: 24. v. 1937 (♂♀) (LRN); B ø : *1. Hurum:* at Kongsdelene chapel, L: 8. v. 1938 ♂♀) (LRN); Verpen, L: 8. v. 1938 (♂♀) (LRN); *2. Røyken:* Nærsnes, L: 15. v. 1938 (♀) (LRN); *5. Hole:* at the lake Tyrifjorden, L: 4. vi. 1930 (♂♀); *13. Øvre Eiker:* Fiskum, ♀: 3. vi. 1928 (LRN); B v : *18. Rollag;* Rollag, ♂♀: 18. vi. 1932 (LRN); *26. Hol:* Ustaoset, ♂♀: 15. vii. 1928 (T. Qpr.); V e : *9. Borre:* Ra farm, ♀: 31. viii. 1930 (LRN); *15. Stokke:* ♀: 3. vii. 1930 (LRN); *16. Sem:* Rakås farm, ♀: 31. viii. 1930 (LRN); T E t : *13. Drangedal:* Luggens farm (in cow house), ♀: 14. ix. 1931 (LRN); V A y : *1. Tveit:* at Kraage Boen, ♀: 3. vi. 1931 (LRN); *4. Kristiansand,* L: 23. vi. 1929 (♂♀) (LRN); *10. Mandal:* L: 28. v. 1929 (♂♀) (LRN); R y : *15. Høyland:* at Lura, L: 5. vi. 1931 LRN; at the lake Lutsi-vann, L: 5. vi. 1931 (♂) (LRN); *20. Hetland:* at the lake Mosvannet, L: 5. vi. 1931 (♂) (LRN) 25. viii. 1931 (O. M.); R i : *49. Forsand:* Berge in Høgsfjord, L: 19. viii. 1931 (O. M.); Meling in Høgsfjord, ♀: 12. viii. 1931 (O. M.); H O y : *18. Fana:* at the lake Tveitevatn, L. P.: 10. vii. 1929 (♂♀) (LRN); *22. Bergen:* Starefos, ♂ : 22. vi. 1937 (N. Knab.); *24. Åsane:* Eidsvåg v. Bergen. ♂ : 7. vii. 1935 (J. Knab); *29. Herdla:* Herla. ♂ : 3. vii. 1935 (J. Knab.); M R y : *25. Molde:* ♂ : 8. vi. 1935 (S-R); *48. Aure:* Ertvåg, ♂♀: 24. v. 1946 (Johs. Dahl); M R i : *60. Grytten:* Halsa Hotell (in house), ♀: 22. viii. 1931 (LRN); S T i : *37. Tydal:* Ramsjøen; ♀: 18. viii. 1923 (LRN); *41. Trondheim:* Bymarka, L: 4. vi. 1939 (R. Brk.); N T y : *35. Ogndal:* "Heimen", ♀: 5. vii. 1930 (LRN); N s i : *32. Nord-Rana:* Grønli, Rødvasdal, ♀: 19. vii. 1926 (S-R); N n ø : *39. Sørfold:* Røsvik, ♀: 9. vii. 1923 (S-R); N n v: *62. Hadsel:* Sommerhus, ♂ : 22. vi. 1936 (S-R); Melbu, ♀: 20. vi.

1938 (S-R); *69. Andenes,* ♀: 28. vii. 1941 (S-R); T R y : *9. Tranøy:* Granvik, ♂♀: 18. vii. 1943 (S-R); *14. Tromsøysund:* Prestvtn, ♀: 4. vii.—20. viii. (S-R); *16. Vannøy:* Vannøy, ♀: 30. vi. 1925 (S-R); Måkeskjær, ♀: 22. vii. 1934 (S-R); Hushattøy, ♀: 29. vii. 1928 (S-R); *17. Karlsøy:* Nordfugløy, ♀: 29. vii. 1928 (S-R); T R i : *29. Målselv:* Rundhaug, L: 18. vi. 1938 (J. Sandm.); "Maukstua", L: 2. vii. 1938 (J. Sandm.); at the lake Store Sagelvann, L: 17. vii. 1938 (J. Sandm.); at the lake Aurevatn, L: 17. vii. 1938 (J. Sandm.); *28. Øverbygd:* Bjørkeng farm, ♀: 7. vii. 1922 (S-R); at the lake Carac-Javrre, ♀: 14. vii. 1928 (S-R); Frihetsli farm, ♂: 23. vii. 1914 (B. Poppius); Dividal, ♀: 10. vii. 1922 (S-R); Råvatn, ♀: 6. vii. 1922 (S-R); *29. Balsfjord:* Langvtn, ♀: 15. vii. 1943 (S-R); Sagelvtn, ♀: 29. i. 1922 (S-R); Fjellfrøskvatn, ♀: 8. vii. 1922 (S-R); F v i : *8. Kjelvik:* Repvåg, ♀: 3. viii. 1926 (S-R); F i : *9. Alta:* Bossekop, ♂♀: 29. vi. 1924 (S-R); Jotkajavrre, ♂: 1. vii.—24. vii., ♀: 4. vii.—15. viii. 1924 (S-R); *11. Karasjok:* ♂♀: 10. vii. 1924 (S-R); Bojobæske, ♂: 16. v., ♀: 16. vii.1924 (S-R); F n : *12. Kistrand:* Fæstningsstuen, ♂: 30. vii., ♀: 2. viii. 1924 (S-R); F ø : *23. Sør-Varanger:* Kjelmøy; ♂: 30. vi. 1927 (S-R); Jarfjordbotn, ♀: 7. vii. 1937 (S-R).

F i n l a n d : *Al(A):* Finström (Frey); *Ab(V):* Karislojo (J. Sahlb., Frey); *N(U): Tvärminne* Zool. Stat! ♂: 26. v. 1936, ♀: 28. vi. 1935 (Storå), (Levander, B. Poppius, Frey); Helsingfors (Hellén, Frey); Helsinge! ♀ (Hellén); Snappertuna! ♂ ♀: 17. vi. 1931 (Klingstedt); Esbo! ♀ (Hellén); *Ka(EK):* Viborg (Pipping); *Ta(EH):* Hattula (Essen); *Om(KP): Terijärvi!* ♀: 11. vii. 1938 (Storå); Pedersöre! ♂: 27. vi. 1932 (Storå); *Ks(Ks):* Kuusamo (Frey); *Li (InL):* Enare! ♀: 23. vi. 1856; Utsjoki (J. Sahlb.).

U S S R : *Kola peninsula:* Chibinä (Fridolin) (Stackelberg 1937, p. 172).

Distribution outside Denmark and Fennoscandia.

According to Marshall (1938, p. 163): "This species is so widely distributed in Britain that a list of the various localities in which it has been found would be of little interest." It is found in the counties: E n g l a n d : Bucks, Dorset, Essex, Glos., Hants, Herts, Middlesex, Notts., Shropshire, Somerset, Surrey, Sussex, Warwickshire, Westmorland, Yorks; W a l e s : Merionethshire; S c o t l a n d : Aberdeenshire, Inverness-shire, Lanarkshire, Midlothian, Morayshire, Perthshire, Ross and Cromarty, Sutherland. Martini (1931, p. 323) mentions the species as very common in the Netherlands. From Belgium it is recorded by Goetghebuer (1925, p. 216) from: "Mont-Saint-Amand, Destelbergen, Melle, Waerschoot, Bellem (Fl.); Heide (Camp.); La Panne (Jacobs); Forêt de Soignes, Melsbroeck (Brux.) (Tonnoir), Ethe (Jur.), 4—8." From France Séguy (1923, p. 147) records: "Env. de Paris: Nemours, Chaville (Surcouf: Mus. Paris), Forêt de Marly (Lesne: Mus. Paris), Gray (André: Mus. Paris). — — — Cette espèce plus rare aux environs de Paris que *l'A. communis* a encore été rencontrée à Vélizy: mai, St. — Nomla-Bretèche: juin (Surcouf), Ardennes: Vendresse (Benoist). M. P. Lesne a trouvé cette espèce, avec *l'Ecculex vexans* Meigen et *l'Aedes dorsovittatus* Vill. sur les bords Rhin, a Chalampé et au bois de Borne, pres Beaune (aout)." From Germany *A. punctor* has been recorded from: Hamburg, Wohldorf (Martini 1931, p. 323); Rostock, Danzig (Martini 1920, p. 110); "Velener Moor (Westfalen), Münster i. Westf., Berlin, Grünewald, Finkenkrug, Darss (Vorpommern), Usedom, bei Swinemünde, Schwendlunder Hochmoor (Ostpr.), Forst Gross Raum (Ostpr.)," (Peus 1929 b, p. 9); "Luchsee (Mark Brandenburg), Pechsee (b. Berlin), bei Grumsin (Angermünde), bei Ribnitz Mecklenb.), Brocken (Harz)," (Peus 1930 c, p. 672); Oberspreewald, Unterspreewald (Peus 1932, p. 140); "b. Stuttgart, a. d. Straße Heimerdingen—Hammingen," (Vogel, 1929, p. 269); "Schwemminger Moor (Schwarzwald), b. Baumgarten (östl. Friedrichshafen a. B.), zwischen Rohr u. Sindelfingen (Stuttgart), Kirnbachtal bei Großsachsenheim" (Vogel, 1933, p. 181); zwischen Waldenburg u. Kupfer (Vogel 1940, p. 107). From Switzerland the species is recorded from: Bern (Bangerter 1926). According to Edwards (1921, p. 314) the species has been recorded from Hungary: Munkacs (Ujnelyi), "also females, probably of this species" from Austria: Hammern (Mik), Tyrol: Landro (Mann). Further eastwards it is recorded from Estland: Jööpre-Hochmoor (Dampf, 1924, p. 6) and from Lettland: "bei Zarnikau, zwischen Uexküll u. Oger, am "Gr. Kanger, bei Bienenhof (Riga), Anting am Kanger-See, Grobin, N. Bartan" (Peus 1934, pp. 77—78) and from Poland (Tarwid 1938 b). From USSR Stackelberg (1937, p. 172) records the following finds: "Leningrad distr. (Stackelberg!), Voronesch distr. (Schtsch!), Ukraine (Polesje: Rybinsk, Dnepropetrovsk distr.: Dolbeschkin!), Lower Volga distr. Kuznezk distr., Martini), N. Caucasus (Schelesnovodsk, Mess!) and Sverdlovsk distr. (environs Sverdlovsk: Kolosov, Perm distr.: Mitrofanova), Siberia: Ob (Finsch t. Edw.), Jenisei (Jeniseisk, Anziferovo, Nazimovo, Tutkansk: Trybomt. Edw.), Ussurijiskij Kraj (Jakovlevska, Spask distr.: Schtak.!), Kamtschatka (Kap Afrika: Starokadomskiji!)." [95] Edwards (1925) records these finds from Kamtschatka: Petropavlovsk, Klutchi, and Kiseleva (1936) records the species from the western part of the Taimyr Peninsula. As to the distribution in the American Continent Dyar (1928, p. 180) remarks: "Canadian forest region from the Atlantic to Rocky Mountains, northern States, Maine, New Hampshire, Vermont, northern New York, Michigan, Minnesota, Rocky Mountains to Colorado and Yukon Territory, upper Yukon Valley." Recent records are: Massachusetts (Tulloch 1939); Utah (Don M. Rees 1942).

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[95] Translated from the Russian text.

Biology.

A. punctor is the most common and widespread mosquito in Fennoscandia. It has been found from the southernmost parts of the Scandinavian Peninsula (Skåne in Sweden and Mandal in Norway) up to about the 70th degree of latitude in the north, and it occurs from the west coast of Norway in the west to the Baltic Sea in the east. In Finland the species has been found from Helsingfors in the south up to Enare in the north. Though *A. punctor* obviously prefers moorland, it has been found also in many other localities, from pools and ponds near the sea-shore and even in islands far out in the sea up to the mountainous regions (i.a. at Fokstua (On. 37) at 990 m above sea level). In Sweden males have been found from 4. vi. to 31. vii., females from 23. v. to 9. x., in Norway males are found from 8. vi to 30. vii. and females from 3. vi. to 16. ix. and in Finland males have been found from 26. v. to 27. vi. and females from 26. v. to 11. vii. However, in the southern Norway, nearly full grown larvae have been found medio April and from these larvae males and females were bred on the 25. iv. The freeland finds indicate that in mountainous regions and northern localities the first imagines develop about a month later than in more southern localities.

The breeding waters are of varying character. Larvae have been found in pools, small ponds, lakelets and water-filled ditches, in some cases even in flooded grassy areas. Most breeding waters are found along swampy areas, the waters being lined by *Sphagnum* moss and the bottom often covered by decaying leaves or pine neddles. In a burnt-out field in the pinewood at Storsjøen in Ytre Rendal (HEn 23), larvae were found living in small and deep holes in the ground, lying about 15 m from the banks of the brook Renåen. Most probably the water in these holes communicates, in spring time, with the brook. When investigated (15. vi. 1944) the surface of the water in the holes stood about 50 cm below the ground level, and obviously no sunbeam would reach these waters which held a temperature of 12° C while the air temperature was 21° C. Most breeding-waters were partly shaded, but larvae of *A. punctor* were found even in some open-lying waters. On the ridge south of the Sølen massif in Ytre Rendal (HEn 23) small pools were found (9. vii. 1944) between stones, surrounded by Reindeer moss, Sphagnum and heather. One of the pools with a diameter of about 15 cm (pl. VII), teemed with larvae.

The temperature in most of these pools were about 17—18° C but in one pool, probably communicating with a nearly brooklet, the temperature was 12° C. When placed in the heather, the thermometer showed 25° C. The degree of pH in 19 breeding-waters investigated varies from 4.8 up to 7.6. However the larvae of *A. punctor* obviously prefer waters with a degree of pH below 6.0, and only in two waters the degree of pH was above 7.0.

Larvae of *A. punctor* have been found associated with larvae of *T. bergrothi, T. morsitans, A. (O) dorsalis, cantans, excrucians, detritus, cataphylla, leucomelas, communis, sticticus, nearcticus, C(N.) apicalis* and *C. pipiens; communis* being the predominant companion of the *punctor* larvae.

A. punctor is probably the most persistent biter of the Fennoscandian mosquitoes and in many localities this species is very annoying. In the lowlands this mosquito mostly attacks in the evening and in the night or, in shaded places by day, but in swampy areas in the high mountains I have been attacked by hundreds, even on hot days, in bright sunshine. In mountainous regions *A. punctor* is very often found in houses, cow-stables and hog-pens and cause great annoyance both to man and beasts, especially at night.

In its broad features the biology and ecology of *A. punctor* abroad coincide with conditions in Fennoscandia. From B r i t a i n Marshall (1938, pp. 161—3) records: "*A punctor* breeds almost exclusively in districts characterized by a sandy or gravelly soil; the larvae occurring in temporary collections of waters located either in open heaths or in woods where pine or birch trees predominate. In most cases the water in which the larvae are found is of a more or less acid nature and the pools are often lined with decaying leaves or with sphagnum moss." However, in England *A. punctor* passes the winter in the larval stage. Marshall tabulates finds from Dec. 14. to Aug. 1: and concludes: "It will be noted that arvae of *A. punctor* have been collected in all four instars, not only in December, but also in each of the first six months of the year. The females of this species attack human beings fiercely and persistently. — — —Harold — — — has frequently observed *A. punctor* biting indoors." From G e r m a n y Martini states: "Diese Mücke liebt die mehr moorigen Gelände; hier kommt ihre Larve teils in ziemlich scattigen Gewässern, teils in mehr oder weniger offen gelegenen Gräben und Torfstichen vor, zwischen Graß, über *Sphagnum,* über altem Laub und Nadels usw. — — — In so großen Frühjahrswässern wie *nemorosus* und *cantans* Mg. fand ich sie seltener. Die Larve braucht offenbar zum verlassen des Eies etwas mehr Wärme als *nemorosus.*" As to the preference of this species towards moorland Peus (1929b, p. 9) remarks: "Schon früher bezeichnete ich den *A. meigenanus* auf Grund der Martinischen Angaben und der Funde in Velener Moor als "tyrphophil", d. h. Hochmoore bevorzuged. Sie ist die einzige auf reinen Hochmooren überhaupt heimische Stechmücke, wenngleich sie nicht an diesen Lebensraum gebunden ist." As to the occurrence in France Séguy (1923, p. 147) states: "*L'O punctor* a une dispersion preque aussi étendu que *l'O. communis,* avec lequel on le rencontre de mai à août. Semble répandu dans tout la France, mais moins commun que *l'O. communis*." From the American Continent Dyar (1928, p. 180) records: "The larvae come in early spring pools filled with snow water, and seem to prefer the very cold ones containing much moss."

Aëdes (Ochlerotatus) sticticus (Meig.).

Culex sticticus Meig. (Syst. Beschr., *7,* p. 1) 1838
C. concinnus Steph. (Ill. Brit. Ent. Suppl., p. 19) 1846
C. nigripes var. *sylvae* Theob. (Monogr. Cul., *2,* p. 96) 1901
C. hirsuteron Theob. (Monogr. Cul., *2,* p. 98) 1901
Culicada sylvae Theob. (Mon. Cul., *3,* p. 194) 1903
C. aestivalis Dyar. (J. N. Y. Ent. Soc., *12,* p. 245) 1904
C. pretans Grossbeck. (Ent. News, *15,* p. 332) 1904
Culic. lateralis Eckst. (Centr. Bl. Bakt. I. Abt. Orig., *82,* p. 66) 1918
Aëdes gonimus D. K. (Ins. Ins. Mens., *5,* p. 165) 1918
Culex nemorosus var. *dorsovittatus* Villeneuve (Bull. Soc. Ent. France, p. 57) 1919
A. vinnipegensis Dyar. (Ins. Ins. Mens., *7,* p. 34) 1919
Ochletrot. dorsovittatus Séguy. (Bull. Mus. Paris, *26,* p. 408) 1920
C. sticticus Séguy. (Bull. Soc. Ent. France, p. 226) 1920
A. sticticus Edw. (Bull. Ent. Res., *12,* p. 311) 1921
A. dorsovittatus Séguy. (Hist. Nat. Moustiques de France, p. 141) 1923
A. sticticus Séguy (Moust. de l'Afrique Min., p. 134) 1924
A. sticticus Edw. (Riv. Malariol. n. s., *5,* p. 85)............. 1926
A. sticticus Stackelb. (Akad. Sci. de l'USSR, *1,* p. 105) 1929
A. paradiantaeus Apfelbeck (Konowia, *8,* p. 290) 1929
A. lateralis Martini (Lindner: Flieg. Pal. Reg., *11—12,* p. 296) 1931

Synonymical and systematical remarks.

The synonymy above is, by preference in accordance with Peus (1933, *12* (½), pp. 153—58) who published a special research on the matter. As, however, *Aëdes hirsuteron* has been considered to be synonymous with *A. sticticus* by several recent authors, I have, with some doubt, included this name in the synonym list, as well as *A. gonimus* D. K.

Edwards (1921, p. 312), who did not differentiate the two species *sticticus* and *nigrinus,* remarks concerning the synonymy: "Since there may be two allied species here, and since there has been difference of opinion as to the interpretation of Meigan's *C. lateralis,* Theobald using the name for *A. geniculatus,* it does not seem advisable to adopt this earlier name for the species; the type of *C. lateralis* being no longer in existence, it seems best to follow Theobald in adopting Ficalbi's suggestion that it is the same as *C. albopunctatus* Rond. (*A. geniculatus*). Of *C. sticticus* there is a female in good condition in Meigen's collection in Paris, and Séguy reports that the hind tibiae have a distinct pale stripe on the outer side. The name *sticticus* may therefore be used without further question. I have examined the types of *C. concinnus* and *C. sylvae* and cotypes of *C. dorsovittatus*, and have no doubt as to their identity. Séguy's figure of the typopygium of *O. lesnei* represents a structure apparently identical with that of *A. sticticus*, his other figure of *O. dorsovittatus* being rather inaccurate, besides showing the same structure in a different position. Specimens of *A. sticticus* were collected by M. Lesne in the same locality and at the same time as the type of *O. lesnei*, and I cannot help thinking, that Séguy has confused two different species in his description: the tarsi of *O. lesnei* are said to have pale rings."

As to the name of *Culex lateralis*, Peus (1933, *12*(½), p. 156) says: "Da die Deutung des Meigen'schen *Culex lateralis* (1818), dessen Type nicht mehr existiert (vgl. Edwards 1921, p. 312), seit jeher unsicher ist, halte ich es nunmehr für zweckmässig und unbedenklich, d i e s e n N a m e n i n Z u k u n f t g a n z f a l l e n z u l a s s e n."

He further remarks: "Während bereits Eckstein erkannt hat, dass hier zwei verschiedene Arten, die er als "*Culicada lateralis* Meigen" und "*Culicada nigrina* n. sp." bezeichnet, vorliegen, kannte Edwards nur e i n e Art, "*Aëdes sticticus* (Meigen)". Später folgt Martini der Auffassung Ecksteins, bleibt für die eine Art bei der Benennung "*lateralis* Meigen", während er die andere als "*sticticus* Meigen" bezeichnet, in die er den Eckstein'schen *nigrinus* als Synonym einbezieht.

Während mir der "*Aëdes lateralis*" (sensu Eckstein, Martini) als durchaus häufige, in Deutschland weit verbreitete Art schon länger bekannt war, hatte ich erst im Sommer 1932 Gelegenheit auch den *Aëdes nigrinus* Eckstein in allen Entwicklungsstadien einzusammeln, und zwar in den Wiesenniederungen der Wechnitz bei Weinheim a. d. Bergstrasse (Hessen). Ein Vergleich beider Arten, die mir nunmehr in größeren Serien vorlagen, ergab die oben genannten Artcharactere, zugleich aber stießen mir angesichts des im Gegensatz zu "lateralis" sehr beschränkten Verbreitungsgebietes von *nigrinus* in Deutschland Zweifel an der Richtigkeit der üblichen Benennung und Synonymie auf. Herr Dr. E. Séguy hatte die dankenswerte Liebenswürdigkeit, mehrere ihm von jeder Art übersandte Exemplare und eine Gegenüberstellung der ermittelten Trennungsmerkmale mit der im Pariser Museum befindlichen Type von *Aëdes sticticus* (Meig.) zu vergleichen. Das Ergebnis war das erwartete: "— — — Votre *Aëdes lateralis* correspond exactement au *sticticus* de Meigen type — — — C'est le *dorsovittatus* de Villeneuve — —. Je ne connais pas votre *Aëdes sticticus.*[95b] J'ai seulement deux exemplaires de Fontainebleu Bellecroix qui correspondent aux votres." In a recent paper by Gjullin (1946) the author i.a. remarks on this species: "*Aëdes gonimus* Dyar and Knab, which was based on four female specimens from Kerrville Tex., was found to have typical *A. sticticus* characters and has been included here. *A. hirsuteron,* which was described by Theobald in 1902, has been considered to be a synonym of *A. sticticus* Meigen by several recent authors. *A. aldrichi* Dyar and Knab was synonymyzed with *A. lateralis* Meigen by Edwards in 1932. Examination of North American specimens of *A. lateralis* and *A. sticticus* in the U. S. National Museum, showed them to be the same species, but the true name of this species was somewhat in doubt, because type specimens were not available for comparison."

It is with some doubt that I here include the names of the American species as synonyms of *sticticus,* as Edwards (1932) did not differentiate the two species *A. sticticus* (Meig.) and *A. nigrinus Eckstein.* A revision of the American species and a comparison with typical specimens of *sticticus* and *nigrinus* is therefore very much needed.

Description.

Female. Head with pale yellow bristles forming a tuft between the eyes. Vertex ("Occiput") with white narrow curwed and upright forked scales with a yellowish tint. Some brown bristles bordering the eyes. Temporae with white flat, broad scales. Clypeus dark brown. Proboscis black; labellae black. Antennae. Torus luteous, inner side somewhat darker, with single white scales. Flagellum. First segment luteous, the remainder dark brown, clothed with minute white hairs and long black hairs at the bases of the segments. Palpi dark brown (fig. 70 a), somewhat more slender than the palpi of *nigrinus.* Segm. 3 about $2/5$ the length of segm. 4. Segm. 4 slender, its width not $1/4$ of its length. Ultimate segm. somewhat oblong, well over $1/5$ the length and about half the width of the penultimate. Thorax. Anterior pronotal lobes dark brown with white narrow curved scales. Posterior pronotum clothed with white narrow curved scales. Mesonotum black; in the middle

95b "Im Sinne von Martini (in Lindner)."

Fig. 89. *Aëdes (Ochlerotatus) sticticus* Meig. Terminalia (total view). (Aut. del.)

clothed with fine hair-like bronzy-brown scales, the sides with bigger, white narrow curved scales. Fine, more or less conspicuous white lines divides the bronzy-brown area into two broad, longitudinal bands as well as two shorter lateral bands in the posterior part of mesonotum. Bristles on the sides of the mesonotum and above wing-root pale golden. Scutellum with white narrow curved scales and pale golden bristles. Postnotum dark brown. Pleurae and coxae with white broad, flat scales and pale bristles. Wing venation blackish brown with some white scales at the base of costa. Halteres with luteous stem and darker globule clothed with some whitish scales. Legs. Fore side of fore- and middle femurae dark brown sprinkled with some white scales, hind femurae yellowish-white with dark brown apex. Knee spots white. Tibiae apically and basally dark brown, sprinkled with white scales forming, especially on the outer side of the hind leg, a white stripe. Tarsal segments brown with paler scales on the outside. Abdomen. Tergites black with white basal bands conspicuously narrowed in the middle. Venter white scaled. Wing: length: well over 3.5 mm.

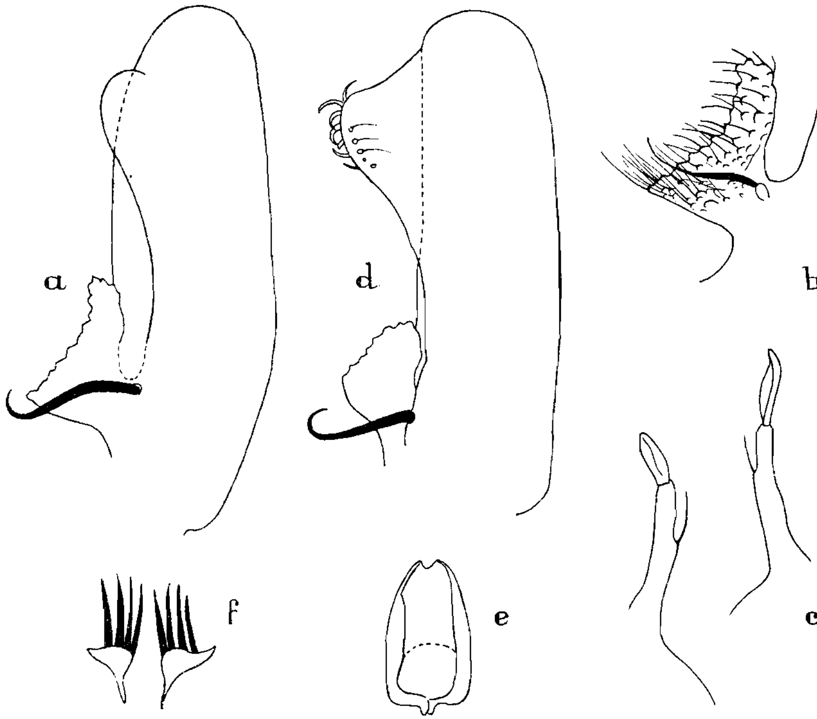

Fig. 90. Terminalia of *A. (O) sticticus* Meig. and *A. (O) nigrinus* Eckst. *A. (O) sticticus.* a, basistyle with apical- and basal lobe; b, basal lobe; c, claspettes. *A. (O) nigrinus.* d, basistyle with apical- and basal lobe; e, sclerotised parts of phallosome; f, lobes of the 9th tergite. (Aut. del.)

M a l e. H e a d. A n t e n n a e. Torus black Flagellum dark brown and white ringed with minute white hairs on the ultimate segments. Hair-whorls greyish brown with yellowish reflections. P r o b o s c i s with metallic colour, apically slightly distended. P a l p i with metallic colour, exceed the proboscis by about the length of the ultimate segment (recorded from a pinned specimen). T h o r a x with two median longitudinal dark lines, divided only by a narrow lighter stripe. Laterally two shorter dark stripes. The white line at the outside of the hind tibiae is narrow but distinct.

T e r m i n a l i a (figs. 89, 90). Basistyle well over three times as long as broad. Apical lobe with short, broad and curved hairs. Basal lobe prominent and rather projecting,

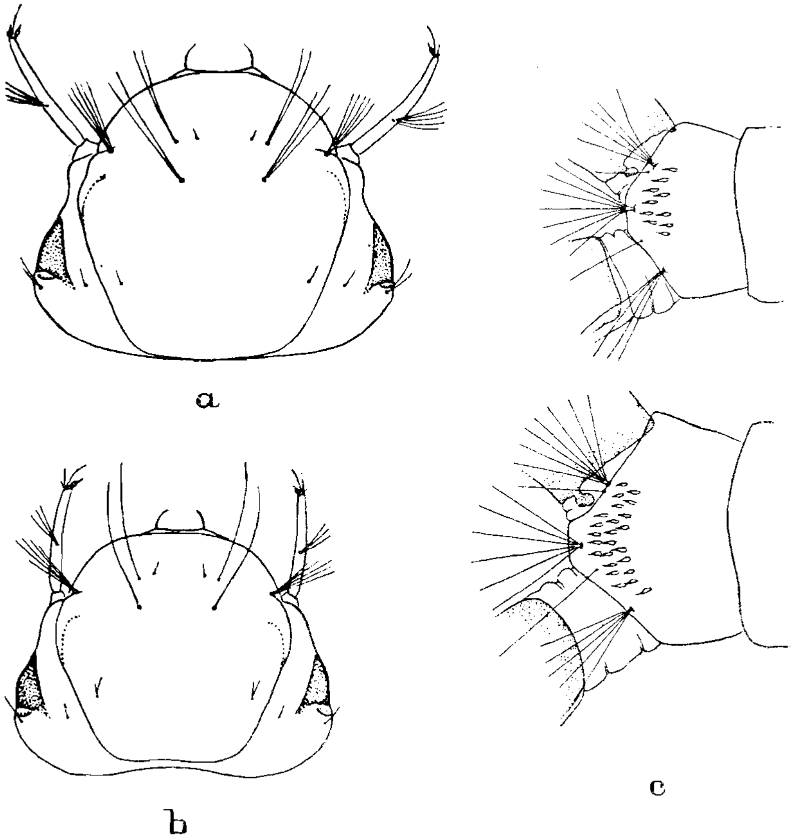

Fig. 91. Larval character of *A. sticticus* (Meig.) and *A. nigrinus* Eckst. *A. sticticus*, a, head; c (below), comb; *A. nigrinus*, b, head; c (above), comb. (After Peus 1933.)

uniformly covered with short hairs and basally with a stout spine. Diststyle slender, tapering in the distal third and with a long claw. Stem of the claspette rather slender, somewhat curved. Above the middle of the stem with a break and two hairs. Phallosome cylindrical, ventrally open, but fused on the dorsal side of the base. Lobes of the ninth tergite with three spines of median length.

L a r v a (fig. 91). As hitherto no larvae of this species have been found in our region, I here quote Peus (1933, *12* (1/5), p. 157) who says:

"Bei den Larven sind die gemeinsamen Merkmale, durch die sie sich von ihren Verwandten trennen, von Edwards und Martini fixiert worden. Untereinander lassen sich die beiden Arten auf Grund meiner Sammlungspräparate (142 *sticticus-*, 51 *nigrinus*-Larven) leicht durch die Ausbildung der Frontalhaare unterscheiden, die bei *sticticus* 2—3-strahlig, bei *nigrinus* sämtlich einfach sind. Nur bei einer *sticticus*-Larve ist eins dieser Haare einfach, und nur bei einer *nigrinus*-Larve eins dieser Haare gespalten. Weiterhin sind die Zahl und die Form der Striegelschuppen für jede Art typisch: *sticticus* besitzt eine größere Zahl von Schuppen, durchschnittlich 20—24 (18—27). Bei *nigrinus* beträgt die Zahl der Striegelschuppen durchschnittlich nur 10—12 (oft auch mehr, bis 15, selbst 17); die einzelnen Schuppen sind bei dieser Art schlanker, der Enddorn ist länger ausgezogen. Den übrigen von Martini angeführten Charakteren (Kiemenlänge, Stellung des Atemrohrhaares, Breite des Sattels) kann ich keine Bedeutung beimessen, da sie in meinen Serien eine zu große, sich jeweils überschneidende Variabilität zeigen."

Geographical distribution.

Sweden: *Dlr.:* ?Sundborn, Karlsbyn! ♀: 10.—15. vi. 1941 (Tjed).

Norway: *AK: 15. Lørenskog:* near Lørenskog railway station; P: 2. vi. 1919 (♂ ♀) (LRN).

Distribution outside Denmark and Fennoscandia.

Edwards (1921, p. 318) mentions different places where this species occurred, but, as indicated above, he did not differentiate the two species *sticticus* and *nigrinus*. However, as these species are rare and little known, I find it of interest to quote Edwards, who records the species, mostly females, from: "Scotland (Stephen's type; also Aberfoyle,; *Carter);* England (New Forest, Theobald's types) France (Melun, *Debreuil;* Bois de Lutterbach, Bois de Borne, Chalampe, *(P. Lesne);* Germany (Lüben, Rados, Halle, *Loew;* Bonn, *Schneider*; Berlin, *Lichtwardt*); Denmark (Jutland, *Wesenberg-Lund*); Austria (Linz, Kahlenberg, Aigen, *Mik*; Dornbach, *Handlirsch*; Prater, *Pokorny*; Styria, *Mann*); Hungary (Szovata, *Csiki*); Siberia (Asinovo, 61° 25' *Trybom*). A long series collected by Dr. K. Kertesz at Fuzine and Jasenak (Croatia) shows very little variation." The species is further recorded from: Belgium: "Destelbergen (Fl.); Heide (Camp.), 3—5", (Goetghebuer 1925, p. 126) and from W. Siberia: "Rayon Turuchansk: Nischne-Inbatskoje, 13. vii. (♀), (Wnukowsky (1928, p. 164).

Of the finds recorded above, I consider the specimens from Denmark as *nigrinus,* and I fully agree with Peus (1933, *12*(½), p. 157—8) who remarks: "Die in der Literatur bisher niedergelegten Daten über die geographische Verbreitung von *sticticus* and *nigrinus* in Europa sind revisionsbedürftig." He further adds: "Weitaus die meisten Angaben dürften sich auf *sticticus* beziehen, der nach meinen Erfahrungen in Deutschland eine weit verbreitete, stellenweise, so z. B. in den Inundationsgebieten größeren Flüsse, wie Oder, Spree (Spreewald.), Rhein usw., im Massenentwicklung auftretende Art ist."

According to the above mentioned I consider, at any rate, the following records as certain: England: the counties Hants and Westmorland; Scotland: the county Pertshire (Marshall 1938, p. 166); Germany: "Unterspreewald bei Schlepzig, ♀: 22. vi. 1928; Oberspreewald (Forst Straupitz), ♀: 11. viii. 1928; — — — Finkenkrug (Berlin), ♀: 10. vi. 1928; Breslau, in den gesamten Auwäldern der Oderniederungen ober- und unterhalb der Stadt (Strachate, Ransern, Masselwitz, Oswitz, Kosel, Waldvorwerk) — — — (1928). — — — In den reinen wiesengebieten (Weistritz, Ohle, Lohe, Weide) (Peus 1929 b (¾), p. 8); Frankfurt (Sack) (Martini 1931, p. 297); France: "Environs de Mulhouse; Bois de Lutterbach; bords du Rhin: Chalampé, août (P. Lesne). Lyon (Dr. Villeneuve); Creuse: La Celle-Dunoise (Alluaud)", (Séguy 1923, p. 141); Elsas (Eckstein) (Martini 1931, p. 297); Poland (Tarwid 1938 a—b); Bosnia: environs of Sarajevo; Sarajevsko polje; at Pale (about 900 m above sea level) (Apfelbeck 1929, *8*, p. 292); USSR: "Recorded from Voronesh district (environs of Voronesch: Schtschak), Ukraine (Polesje: Rybinsk and Dnepropetrovsk distr.: Reingard and Guzevitsch!), and also from Siberia: Osinovo at Jenisej, 61° 25′ (Trybom t. Edw.); the last mentioned record ought to be confirmed." [96] (Stackelberg 1937, p. 172).

On the distribution of this species (*A. hirsuteron* Theob.) in the American continent Matheson (1929, p. 138) says: "This species is widely distributed over the eastern United States and Canada, west to the Rocky Moutains." As quoted above, *A. gonimus* D. K. has been recorded from Kerrville, Texas. Recent records of *A. sticticus* are: Maine (Bean 1946); Michigan (Irwin 1941), Missouri (Adams and Gordon 1943), Lousiana and South Carolina (Bradley, Fritz, Perry 1944).

Biology.

Three pupa of *sticticus* were found in a partly shaded pond near Lørenskog railway station. The water was to some extent covered with *Lemna;* degree of pH: 5.9.

The few observations on the biology and ecology of this species outside Fennoscandia are here quoted from Peus, who says (1929 b, ¾), p. 8—9): "Die Art ist als charakteristisch für die leichten Auwälder und Wiesen — zumal wenn letztere mit *Salix*gebüschen durchsetzt sind — im Inundationsgebiet der großen Flüsse anzusehen"; (1932, ¾ u. 5, p. 184): "Typisch für die Auwald mit seiner mäßigen Beschattung sind vor allem die zwei Arten *Aëdes lateralis* und *Aëdes vexans*. Sie strahlen zwar auch in lichte Stellen des Erlenhochwaldes, wie in das freie Wiesengelände hinein, besitzen im Auwald aber deutlich ihr Optimum. Ihre Massenentfaltung, verbunden mit der Erzeugung mehrerer Generationen im Sommer, stellt sie in der erste Reihe der Plageerreger — — —"; (1933, ½, p. 158): "Oekologish hat *sticticus* sein Optimum in halbbeschattetem Gelände (Auwälder.), *nigricus* anscheinend in unbeschattetem, freiem Wiesenland.".

Aëdes (Ochlerotatus) nigrinus (Eckstein).

Culicida nigrina Eckst. (Centr. Bl. Bakt. I. abt. Orig. *82*, p. 67) 1918
O. sticticus var. *concinnus* W-L. (D. Vid. Selsk. Skr. Nat. Math. Afh., VIII, *7*, p. 92) 1920
A. sticticus Martini (Lindn. Flieg. Pal. Reg., *11—12*, p. 334) .. 1931

[96] Translated from the Russian text.

Synonymical and systematical remarks.

The synonymy above is according to Peus (1933 (½), p. 155), however Wesenberg-Lund's *sticticus* var. *concinnus* is placed here, as I am of the opinion that his description agrees with the species *nigrinus* Eckst. Peus remarks on this matter:

"Welche Art Wesenberg-Lund (Danske Vid. Selsk. Skrift., Nat. og Mat. Afh., 8 Række, VII, p. 92, 1921) in seinem "*sticticus* (Meig.) var. *concinnus* Steph." vor sich gehabt hat, kann ich nicht sicher entscheiden. Auch über die wahrscheinliche Identität des nearktischen *Aëdes aldrichi* Dyar u. Knab mit unserem *sticticus* oder über die weniger wahrscheinliche Identität des nearktischen *A. hirsuteron* Theobald mit unserem *nigrinus* muß ich mich, da ich nordamerikanische Exemplare nicht habe einsehen können, eines Urteils enthalten." As mentioned before, the documentary material of Wesenberg-Lund has not been accessible, but from his publication (1920, pp. 92—93) I got the impression that his *O. sticticus* (Meig.) var. *concinnus* Steph. most probably is *A. nigrinus* Eckst. His remark: "Hind tibia with a very characteristic white stripe on the outer side" makes it obvious that he had in hand one of the two species *sticticus* Meig. or *nigrinus* Eckstein. Further the description of the antennae: "— — — the joints subequal, — — — second joint a little larger; — — — tori — — — black — —" suits very well with *nigrinus*.

In the museum collection we have one male and four females of *A. hirsuteron* Theob. I have made slide preparation of the male genitalia, but the exact form of the basal lobe can not be diagnosticated with certainty. The females correspond with *sticticus* in colour and form of the antennae as well as in the colour of the wing scales, but the scales on the posterior pronotum are bronzy brown as in *nigrinus*. I therefore can not consider the American form as synonymous with the European *sticticus*. Most probably we have to do with local races, but the problem can not be settled until more material has been brought together and the geographical distribution fixed.

Description.

F e m a l e. H e a d with some pale golden bristles forming a little tuft between the eyes. Vertex ("occiput") with yellowish-white narrow curved scales and dirty-white upright forked scales in the middle, black upright forked scales on the sides. Rows of black bristles bordering the eyes.

Temporae with a great patch of black flat broad scales in front, dirty-white scales with a yellowish tint behind. Clypeus black. Proboscis and labellae black. Antennae. Torus black with single white scales. Flagellum black with a coating of minute white hairs and larger black hairs at the bases of the segments. Palpi (fig. 70 b) about one fifth the length of the proboscis, general appearance stout. Segm. 3 well over half the length of segm. 4, nearly half as broad as long. Segm. 4 well over three times as long as broad. Ultimate segm. minute, about $1/6$ the width of the penultimate. Palpi with blackish brown scaling. Thorax. Anterior pronotal lobes black, with white narrow curved scales and dark, golden reflecting bristles. Posterior pronotum with bronzy-brown narrow curved scales, caudal part white scaled. Mesonotum black, in the middle clothed with fine hair-like, dark bronzy-brown scales, the sides with bigger, greyish narrow curved scales. A fine, more or less conspicuous white line divides the bronzy-brown area into two, broad longitudinal bands. Bristles on the sides of mesonotum with golden reflections. Scutellum and antescutellar area with white narrow curved scales and pale golden bristles. Postnotum black. Pleurae and coxae with patches of white broad flat scales; bristles pale golden. Wing venation blackish-brown with white scales at the base of costa, radius and media. In subcosta the white scaling is predominating. Halteres with brown stem and darker globule, clothed with white scales. Legs. Fore side of fore and middle femurae blackish brown, sprinkled with white scales, hind femurae whitish scaled with subapical black ring. Back side of femurae greyish. Knee spots white, conspicuous. Tibiae basally and apically dark brown, with a white longitudinal stripe on the outer side. This is very pronounced in the hind leg. Abdomen black. The tergites with broad white basal bands. Venter white scaled. In some specimens the apical part of the sternites black. Wing: length: about 3.5 mm.

Male. Head. Vertex ("occiput") with black upright forked scales and many black bristles; middle of vertex with white narrow curved scales. Temporae with flat white scales. Antennae: Torus black, flagellum black with minute white hairs at the ultimate segments. Hairwhorls blackish. Palpi: Hair-tufts at the apex of the long segment long, at segment 4 and 5 short. Thorax in the specimens at hand partly denuded. Integument black. Mesonotum in the middle with two longitudinal lines of blackish-brown hair-like scales, at the sides with pale golden narrow curved scales and black bristles. Bristles above the wing-root pale golden. S c u t e l l u m with patches of pale golden narrow curved scales and bristles of the same colour. A b d o m en blackish-brown, with basal white bands somewhat narrowed in the middle. Venter blackish brown; a great patch of white scales on each side of the middle line. Lateral hairs pale golden, long.

T e r m i n a l i a (fig. 90). The terminalia of *A. (O.) nigrinus* are very similar to those of *A. (O.) sticticus.* A useful differential diagnosis has been elaborated by Peus (1933, p. 153 et seq.). As he has remarked, the differences are subtile, but if one has good slide preparations for comparison they are well noticeable. In the total shape the terminalia of *nigrinus* are somewhat more compact than those of *sticticus.* In *sticticus* the most prominent part of the apical lobe is located distally, while this projection of the apical lobe lies basally in *nigrinus.* The basal lobe has the typical neckformed constriction in both species, but the distal end of the lobe is more slender and pointed in *sticticus* whereas it is broader and rounder in *nigrinus.* In the Norwegian specimens of *nigrinus* the lobes of the ninth tergite have 4 spines of moderate length.

L a r v a (fig. 91). Concerning the differential characters of *A. sticticus* and *A. nigrinus,* see p. 353.

Geographical distribution.

D e n m a r k : *1. Jylland:* Linding at Varde (Kryger leg.) (W-L).

N o r w a y : O n : *32. Sel:* Laurgård, ♀: 8. vii. 1870 (Siebke); V A y : *1. Tveit:* Krågeboen, P: 3. vi. 1931 (♀) (LRN); H E n : *23. Ytre Rendal:* Solbakken, ♀: 15. vii. 1936 (LRN); Renåen, P: 15. vi. 1944 (♂♀) (LRN); Renåen, ♀: 7. vii. 1944 (LRN).

F i n l a n d : *EnL:* Kilpisjärvi! ♀: 11. vii. 1929 (R. Frey).

Distribution outside Denmark and Fennoscandia.

Concerning the distribution of *A. nigrinus,* Peus (1933, *12* (½), p. 158) says: "Sollte den Angaben Wesenberg-Lund's (a. a. O.) nicht unser *nigrinus* zugrunde liegen, so scheint letzterer eine südwesteuropäsche Art zu sein, die in Deutschland nicht über das obere Rheingebiet hinausreicht." As will be seen from the records above, this did not agree with the recent investigations. On the contrary I have the impression that *nigrinus* ranges farther north in our region than *sticticus.* However, the two are among the rarest species in Fennoscandia, and very little is known as to their actual distribution. Further investigation is strongly needed in this matter. The scattered records from places outside our region are: Germany: Weinheim, Hessen, ♂ ♀: 23. vii. 1932 (F. Peus) (coll. Z. M. Oslo) France: Environs of Strasbourg: "Auf den Wiesen bei Wolfsheim und Oberschäffolsheim" (Eckstein 1918, *82*, p. 68); Fontainebleau Bellecroix (Séguy), (Peus 1933, *12* (½), p. 155); Poland (Tarwid 1935, 1938 a); USSR: "From USSR only recorded from Leningrad distr. (Jukki: Stackelberg!)" (Stackelberg 1937, p. 172).[97]

Biology.

A pupa of *A. nigrinus* has been found at Krågeboen (VAy 1) in the first days of June in a partly shaded pond near the highway. *Sphagnum* at the border of the pond, pH: 5.5. In the same pond were found: *Corethra* sp., *Notonecta* sp., red Chironomid — larvae, Hydracnids. In Ytre Rendal (HEn 23) pupae were found medio June in an open-lying pool in a grassy area near the little brook Renåen, pH: 5.9.

On this species, Eckstein (1918, *82*, p. 68) says: "Sie legt ihre Eier einzeln auf feuchten Boden ab, überwintert als Ei und vermag mehreren Generationen im Jahr zu erzeugen. Sticht empfindlich und ist für die Ortschaften Wolfsheim, Oberschäffolsheim und Achenheim zusammen mit *vexans* eine wahre Plage." From USSR, Stackelberg (1937, p. 172) records: "The species is characteristic of open meadows."[98]

Aëdes (Ochlerotatus diantaeus) H. D K.

A. diantaeus H. D. K. (Mosq. N. a. C. Am., *4*, p. 758) 1917
A. serus Martini (Üb. Stechmücken, p. 96) 1920

Description.

Female. Front of head with pale golden bristles forming a little tuft between the eyes. Vertex ("occiput") with pale golden, narrow curved scales, above with yellow upright forked scales. Temporae with yellowish-white broad flat scales. Eyes bordered with dark brown bristles. Clypeus blackish brown. Proboscis black, labellae black. Antennae. Torus dark brown. Flagellum. Basal part of first segment brown, the remainder of flagellum blackish-brown clothed with minute white hairs, longer black hairs at the base of the segments. Palpi (fig. 70 k) dark brown, nearly one fift the length of the proboscis long and slender. Segm. 3 about ⅔ the length of segment 4 and about three times as long as broad. Segm. 4 five times as long as broad.

[97] Translated from the Russian text.
[98] Translated from the Russian text.

Fig. 92. *Aëdes (Ochlerotatus) diantaeus* H. D. K. (Terminalia (total view). (Aut. del.)

Ultimate segm. somewhat oblong, about 1/8 the length and 1/2 the width of the penultimate. Thorax. Anterior pronotal lobes blackish brown clothed with pale yellow, narrow curved scales and pale golden bristles. Posterior pronotum with pale yellow or whitish, narrow curved scales. Mesonotum blackish brown clothed with pale golden or whitish, narrow curved scales. Two median, longitudinal, bronzy-brown stripes of nearly hair-like, narrow curved scales. These stripes are faintly divided by a narrow line of golden scales or they may be fused. At either side of the antescutellar space is a shorter lateral dark stripe. Bristles pale golden. Scutellum blackish brown with golden, narrow curved scales and golden bristles. Postnotum blackish brown. Pleurae and coxae blackish brown with patches of white, broad, flat scales and pale golden bristles. Wing venation dark brown. Halteres with yellowish-brown stem and brown globule, the latter with some dirty-white scales. Legs. Front side of fore- and middle femurae dark brown, basally with dirty-white scaling; back side pale yellowish. The dark scaling is embracing the hind femurae

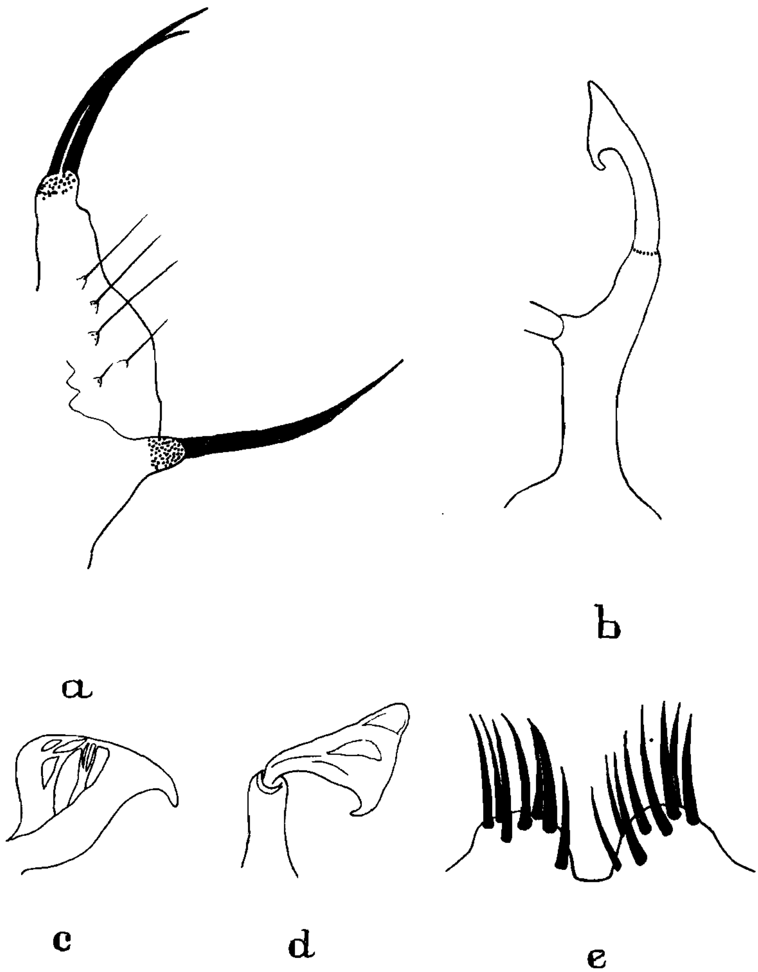

Fig. 93. *Aëdes (Ochlerotatus) diantaeus* H. D. K.
a, basal lobe; b, claspette; c—d, spine with wing; e, lobes of the 9th tergite. (Aut. del.)

apically while the yellowish scaling predominates the basal part. Knee spots dirty white. Tibiae and tarsal segments dark brown. A b d o m e n. Tergites blackish brown with basal white bands, very narrowed or even disappearing in the middle and widening laterally, then forming lateral white spots. The sternites basally greyish scaled, apically with

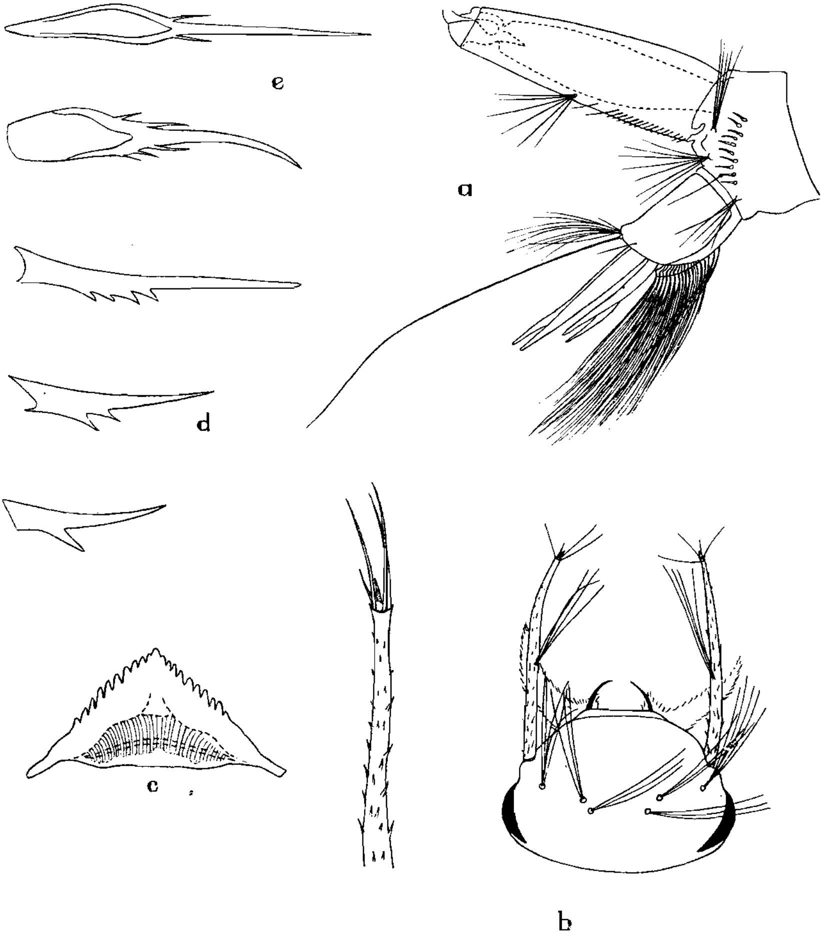

Fig. 94. Larva of *A. (O) diantaeus* H. D. K. in 4th instar.
a, Terminal segments of larval; b, head and tip of antenna; c, mentum, d, pecten teeth; e, comb-scales. (Aut. del.)

dark bands. Cerci long, black. Length of body: about 5.5 mm (W-L). Wing length: 4.5 mm.

M a l e. H e a d. A n t e n n a e. Torus blackish brown; flagellum brown and grey ringed. Ultimate segments blackish brown with minute white hairs. Hairwhorls long, greyish brown with yellowish reflections. P r o b o s c i s dark brown. P a l p i metallic, slightly longer than the proboscis. The long segment distally somewhat thickened, also the last two segments swollen. The ultimate segment somewhat more slender and about $4/5$ the length of the penultimate. Hair-tufts with dark metallic reflections, at the end of the long segment and at segment 4 they are long, at the ultimate segment short. T h o r a x in the middle with two longitudinal, broad dark brown lines, at the sides with golden or more whitish, narrow curved scales. A b d o m e n dark metallic, with white lateral patches which may be connected through narrow basal bands. Venter whitish scaled with dark triangles at the caudal border of the segments. Wing length: 4 mm.

T e r m i n a l i a (figs. 92, 93). Basistyle nearly three times as long as broad, somewhat swollen in the apical third and with a dense tuft of very long hairs. Apical lobe stout and projecting, with ventrally directed hairs. Basal lobe broad, at the caudal angle with a prominent conical pedestal bearing two curved spines and at the basal angle with a warty projection bearing one stout curved spine. Stem of the claspette basally broad tapering distally. In the middle of the stem there are two small projections, each bearing a seta. Appendage with short petiole and very broad wing. Dististyle basally somewhat swollen, tapering distally, with long claw. Proctiger with stout hookformed paraprocts. Lobes of the ninth tergite with 5—14 stout spines of median length. Mean value of 8 specimens (counted for both sides): 9.9. The number of spines in the northern specimens seems to be somewhat greater than in specimens from more southern latitudes. Martini (1931, p. 275) gives no details in the description, but from his figure I have counted 5—6 spines and Stackelberg (1937, p. 170) figures 5 spines on each lobe. Concerning American specimens Matheson records 4—5 spines and Dyar "about six".

L a r v a (fig. 94). Head broader than long. Antennae conspicuously longer than head, spinose, rather straight. Antennal tuft of about $2/3$ the length of the shaft, with 4—6 hairs and inserted about $3/5$ the length from the base of the antennal shaft. Bristles at apex of antennae very long, sensory appendages of moderate length. Inner frontal hairs somewhat behind the mid frontal hairs. Hair-formula about 3 or 4. Dorsal prothoracic hair-formula about 1, 1, 2; 1; 1; 1; 2; 1. Comb-scales 9—14, scales long and pointed, with some denticles at the base of the median spine. Siphonal index about 3.3. Siphon slightly tapering from the middle. Pecten with about 18 teeth, the last ones detached. Siphonal tuft with about 7 hairs, inserted at about the middle of the siphon. Anal segment longer than wide. Saddle reaching $^7/_8$ down the sides of the anal segment. Saddle-hair single. Dorsal brush with an outer pair of long, stout single hairs and an inner pair of tufts with about 9 hairs. Ventral brush with about 3 shorter precratal tufts and about 20 long cratal tufts. Dorsal annal gills longer than saddle, ventral pair of about the same length as saddle.

Table 30.

Larval chaetotaxis of *A. (O) diantaeus* H. D. K.

Number of branches in				Number of			Instar
Frontal hairs			Siphonal tuft	Comb. scales	Pecten teeth	Siphonal index	
out.	mid.	inner					
3—5 4 (5)	2—3 2.2 (5)	2—3 2.8 (5)	6—8 7 (4)	8—11 10 (4)	15—18 16.2 (5)		III
5—6 5.4 (12)	3 (11)	3—4 3.5 (11)	6—9 7.1 (6)	9—14 12 (16)	15—20 17.9 (20)	2.8—3.8 3.3 (8)	IV

Geographical distribution.

Denmark: *2. Sjælland:* Stenholtsvang at Hillerød (W-L); Grib forest (W-L).

Sweden: hitherto not found (N!)

Norway: AK: *12. Bærum:* Fornebo L: 2. v. 1937 (♀) (LRN); *30. Ullensaker:* Granli L: 2. vi. 1929 (♂♀) (LRN); HEn: *23. Ytre Rendal:* Renåen: ♂♀: 10. vii. 1928 (LRN); *20. Trysil:* Indbygda, L: 31. v. 1935 (LRN); Lutnes, L: 31. v. 1935 (LRN); Grønoset, L: 31. v. 1935 (LRN); Bø: *5. Hole:* pond at Tyrifjorden, L: 30. v. 1930 (♂♀) (LRN); TRy: *13. Hillesøy:* Kvaløy, Nordfjord, ♂: 16. ix. 1942 (S-R); TRi: *26. Malangen:* Skjåvikør, ♂: 14. viii. 1941, 18. vii. 1942 (S-R); *29. Balsfjord:* Fjeldfrøskvann, ♂: 23. vii. 1926 (S-R).

Finland: *Ab(V):* Kuustö (Lundstr.); Lojo! ♀ (Storå); *N(U):* Snappert! ♂: 17. vi. 31 (Klingstedt); *Om(KP):* Larsmo! ♂: 16. vi. 1933 (Storå); Pedersöre! ♂: 10.—15. vi. 1933, ♀: 18. vi. 1933 (Storå); *Ob(PP):* ?Kiiminki (Frey); *Ks(Ks):* ?Kuusamo (Frey).

Distribution outside Denmark and Fennoscandia.

On the distribution of this rare species in Germany, Martini (1931, p. 276) says: "Ich habe *diantaeus* an verschiedenen Orten Norddeutschlands von Hamburg ostwärts gefunden. Auch in Material aus Ostpreussen — — — ist er sehr häufig, in Dänemark offenbar häufiger als bei Hamburg." Further it is recorded by Peus (1929 b, p. 8) from Finkenkrug at Berlin, L: 27. iv. 1928, and (Peus 1930 c, p. 674) from Forst Grumsin at Angermünde, L: 28. iv. 1929. From Lettland, Peus records: "Erlen-Calla-Sumpf bei Anting, ♂: 16. vi. 1934." As to the distribution in USSR Stackelberg (1937, 169) says: "Recorded from Leningrad distr. (environs Peterhof: Montschadskiji., environs Luga: Stackelberg), Ukraine (Polesje: Rybinsk distr. Kiev), Sverdlovsk distr. (environs Perm: Mitrofanova.) and from Usurijsk Kraj (Alektorov 1931)." [69] Further Wnukowsky (1928, p. 164) records finds from W-Siberia: Tomsk distr.: Tomsk, ♀: 5. vii, Ssokolovsky, ♀: 1. viii., Novo-Aleksandrovskoje, ♀: 27. vii. Rayon Narym: Parabel, ♀: 21. vi., Bolschaja Paschina, ♀: 22. vii.; Rayon Turuchansk: Nischne-Inbatskoje, ♀: 13. vii. The distribution in the American continent is according to Dyar (1928, p. 174) "Canadian forest region from New Hampshire and Ontario to British Columbia — — —" and Matheson (1929, p. 136) says: "The species is rare and local throughout the northeastern United States south to New York, west through Canada to British Columbia and south along the Rocky Mountains to Wyoming." Recent records are: Maine (Bean 1946), Massachusetts (Tulloch 1939), Michigan (Irwin 1941).

Biology.

On the biology of this species in Denmark, Wesenberg-Lund (1920—21, pp. 91—92) says: "I have found this peculiar mosquito only in one locality in the little bog of Stenholtsvang near Hillerød. In the sample 23. v. 1919, in which I found the larva of *A. cinereus* I found, among the numerous *O. cantans* larvæ, a remarkable red brown larva with very long antennæ, almost as long as those of *C. morsitans,* but almost straight, not elegantly curved as in this species. — — — In the time from 25. v. to 5. vi. the pond was visited almost every day; the larva was rare, and I never got more than about fifty specimens. — — — By 5. vi. the pond was almost dried up and got very little water till October. — — — I had quite given up finding the imago in nature, when suddenly on 29. ix. 1919 I found it in another part of Grip forest. — — — In the winter 1919—20 up to June 1920 the pond was visited regularly; — — — On 5. v. the first halfgrown *O. diantaeus* larvæ appeared in the samples; by 25. v. all were pupæ." In Norway most breeding waters are situated in woodland, more or less shaded, but in one place (HEn 20: Lutnes, Trysil) some

[69] Translated from the Russian text.

larvæ were found in an open lying pond in a field. The larva were, in most places, found associated with larvae of *A. (O) communis,* in three places they were also associated with larvae of *A. (O) intrudens* and in one place they were associated with larvae of *communis* (multitudes), as well as a few *excrucians, cataphylla* and *intrudens.* Males have been found in the time from 10. vii. (HEn 23: Ytre Rendal) till 16. ix. (TRy 13: Hillesøy). In Finland males have been found medio June.

As to the finds in Germany, Peus (1929 b, p. 8) records: "Auch mein Fund stammt aus altem, feuchtem Mischwaldgebiet. In Finkenkrug (Berlin) fanden sich — — — Larven in einem temporären Frühjahrstümpel vergesellschaftet mit zahlreichen *communis,* mehreren *maculatus, meigenanus* und einigen *intrudens.* Sie waren erst erwachsen, als die *communis* schlüpften", and from Angermünde Peus (1930 c, p. 674) says: "Die Larven fanden sich einzeln in typischen Schmelzwassertümpeln in Gesellschaft von *A. communis* (massenhaft) und *A. maculatus.* Die Bodenschicht dieser vegetationslosen flachen Tümpel bestand lediglich aus toten Buchenblättern." According to Dyar (1928, p. 174), *A. diantaeus* seems to be rare also in the American continent: "The species is rare and local, frequenting the darkest woods. The males do not swarm in the usual manner, but fly singly where the females are biting. Matings may readily be observed. The adults fly both by day and night in dark forest."

Aëdes Ochlerotatus intrudens Dyar.

A. intrudens Dyar (Ins. Insc., 7, p. 23) 1919

Description.

Female. Front of head with some pale golden bristles forming a little tuft between the eyes. Vertex ("occiput") in the middle with pale golden or yellowish-white, narrow curved scales, above with yellow, upright forked scales. Temporae with white, broad, flat scales of a more or less pronounced yellowish tint. Eyes bordered by a row of black bristles. Clypeus blackish brown. Proboscis blackish brown, labellae black. Antennae. Torus yellow, inner side darker; with few light scales. Flagellum. First segment yellowish, the remainder blackish brown, clothed with minute white hairs, longer black hairs at the base of the segments. Palpi (fig. 70 e) about fifth the length of the proboscis; colour of palpi dark brown, sprinkled with dirty-white scales. Segm. 3 a little more than half the length of segm. 4, nearly half as broad as long. Segm. 4 well over four times as long as broad. Ultimate segm. small, circular. Thorax. Anterior pronotal lobes blackish-brown with

Fig. 95. *Aëdes (Ochlerotatus) intrudens* Dyar. Terminalia (total view). (Aut. del.)

yellowish-white, narrow, curved scales and dark golden bristles. Posterior pronotum with yellowish-brown, narrow, curved scales; in the posterior lower corner with white scaling. Mesonotum clothed with bronzy golden narrow curved scales shading to whitish at the lateral margins, above wing-root and at the antescutellar space. Scutellum with pale yellowish scales and bristles with golden reflections. Postnotum blackish brown. Pleurae and coxae with patches of dirty-white, broad, flat scales and bristles with golden reflections. Wing venation blackish brown, occasionally with a few white scales at the base of costa, radius and analis. Halteres with pale yellowish stem and darker globule, the latter clothed with dirty-white scales. Legs. Fore-side of femurae blackish brown, sprinkled with some dirty-white scales, back side yellowish. In the hind femurae the dark scaling is embracing apically while the basal part is entirely whitish. Knee spots conspicuously white. Tibiae dark brown, sprinkled with light scales which predominate the back side. Tarsal segments dark brown on dorsal side, the first segments ventrally more or less with light scaling.

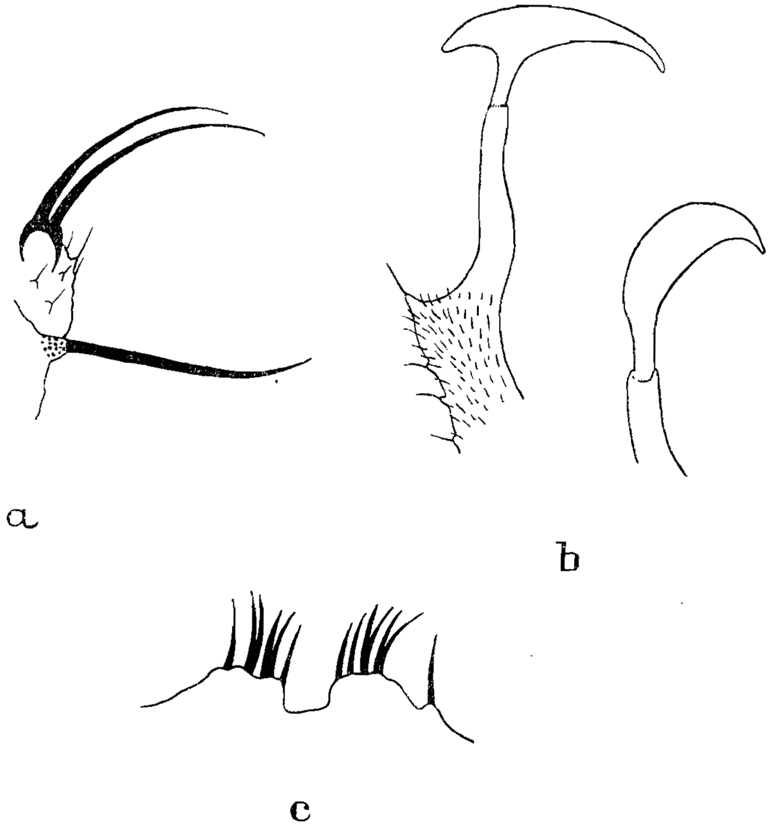

Fig. 96. Terminalia of *A. (O) intrudens* Dyar.
a, basal lobe; b, claspettes; c, lobes of the 9th tergite. (Aut. del.)

Abdomen blackish brown with basal broad, white bands somewhat widening laterally. Venter with dirty-white scaling. Bristles golden. Wing length: about 4 mm!

Male. Head: Antennae about the length of the proboscis. Torus blackish brown, flagellum brown and grey ringed. Hairwhorls with bronzy reflections. Proboscis long, blackish brown. Palpi exceed the proboscis more or less by the ultimate segment. The long segment slender, apically swollen, the two last segments about equally stout. The ultimate segment rather $\frac{5}{6}$ the length of the penultimate segment. Both Palpi and hair-tufts dark with bronzy reflections. Thorax Integument blackish brown, mesonotum with two

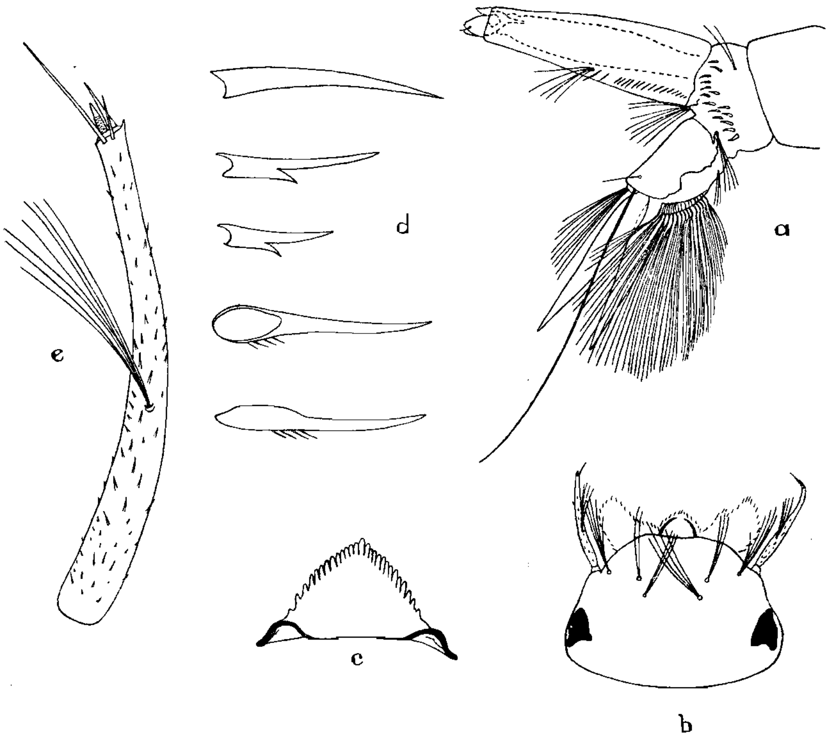

Fig. 97. Larva of *A. (O) intrudens* Dyar in 4th instar.
a, Terminal segments of larva; b, head; c, mentum; d, comb-scales (below) pecten teeth (above); e, antenna. (Aut. del.)

black stripes in the median line, surrounded on either side by bronzy brown, narrow curved scales. Bristles on the sides of mesonotum and on scutellum with golden reflections. Abdomen blackish brown. The segments with white basal bands, somewhat widened laterally. Wing length: 4.5 mm!

Terminalia (figs. 95, 96). Basistyle rather three times as long as wide; apically beneath the apical lobe an area covered with a dense tuft of long hairs. Apical lobe distinct, rounded apically, on inner side with some stout, inwardly directed hairs. Basal lobe represented on one side by a small warty projection bearing a stout, apically somewhat curved spine and on the other by two equal, stout and curved spines on a conical pedestal. Stem of the claspette very broad in the basal half, hirsute and with a seta on a projecting angle, outwardly slender and somewhat tapering. Appendage: petiolate, curved and with a somewhat long and low wing. Diststyle with a basal conspicuous thickening and with a long claw. Proctiger with stout hookformed paraprocts. Phallosome a short and stout cylinder, conspicuously constricted before the apex. Lobes of the ninth tergite with 3—7 stout, short spines. Mean value of 14 specimens (counted for both sides): 4.9.

As to the American *intrudens* Matheson (1929, p. 125) remarks that the lobes bear 4—5 spines while Dyar (1928, p. 173) says: "about eight spines". It therefore seems to be no reliable difference between the European and American specimens.

L a r v a (fig. 97). Head broader than long. Antennae shorter than head, conspicuously spinose, rather straight and slightly tapering from the insertion point of antennal tuft. Tuft of about ½ the length of the antennal shaft, with about 7 hairs and inserted well ⅛ the length from the base of the shaft. One long bristle at the tip of antenna. Inner frontal hairs somewhat behind the mid frontal hairs. Hair-formula about ¾. Dorsal prothoracic hair-formula about 2, 1, 1; 1; 1; 1; 2; 1. Comb-scales 12—17, scales long and pointed, with a few fine hairs near the base. Siphonal index about 3.2. Siphon slightly tapering from the middle. Pecten reaching the middle of the siphon, with about 19 teeth, the last ones somewhat detached. Pecten teeth with one basal denticle, the detached teeth simple. Siphonal tuft with about 7 hairs, inserted about the middle of the tube. In most specimens the tuft is inserted distally to the last pecten teeth, but rarely one of the pecten teeth stands beyond the insertion point of the tuft. Anal segment longer than wide; saddle reaching down to about the midline of the segment, the ventral border conspicuously incised.

T a b l e 31.
Larval chaetotaxis of *A (O) intrudens* Dyar.

Number of branches in				Number of		Siphonal index
Frontal hairs			Siphonal tuft	Comb. scales	Pecten teeth	
out.	mid.	inner				
5—9 7.3 (24)	2—4 3.1 (27)	3—5 4.2 (23)	6—10 7.6 (24)	12—17 14.9 (19)	15—22 19 (25)	28.—3.5 3.2 (4)

Saddle-hair simple. Dorsal brush with an outer pair of long, stout single hairs and an inner pair of tufts with about 8 hairs. Ventral brush with 1—2 precratal tufts and about 17 cratal tufts. Anal gills conspicuously longer than saddle.

Remarkable is the great variability in the chaetotaxis of the Norwegian larvae, further the figures for the average values are somewhat higher than those published by Martini (1931, p. 295).

Geographical distribution.

Denmark: Hitherto not found (N!)

Sweden: *Vrm:* customhouse north of Långfloen at Klarälven! ♀: 12. vi. 1934 (Skjerven); *Dlr:* Särna, Fulufjell! ♀: 18. vii. 1918 (KHF); Falun, Norslund! ♀: 22.—29. vi. 1931 (Tjed.); Venjan, Brintbodar! ♀: 18. vii. 1933 (Tjed.) Sundborn, Karlsbyn! ♀: 21. vi. 1941 (Tjed.).

Norway: AK: *11. Asker:* Holmen farm, ♀: 30. vii. 1930 (LRN); *13. Bygdøy:* L: 24. v. 1928 (LRN); *30. Ullensaker:* Granli, L: 2. vi. 1929 (♂♀) (LRN); HEs: *11. Elverum:* pond at the highway Elverum-Indbygda, L: 27. v. 1934 (♂), 30. v. 1935 (♂♀) (LRN); HEn: *20. Trysil:* Indbygda; L: 31. v. 1935 (♂♀) ♀: 7. vii. 1934 (LRN); Nybergsund, L: 31. v. 1935 (♂♀) (LRN); Sætre farm, ♀: 17. vii. 1933 (Skjerven); Lutnes farm, L: 31. v. 1935 (♂) (LRN); Kneiten farm, ♀: 19. vi. 1935 (Skjerven); Vestby L: 8. vii. 1934 (♀) (LRN); *23. Ytre Rendal:* Solbakken, Storsjøen, ♀: 6. vii. 1931, 22. vii. 1934, 20. vii. 1939, 19. vii. 1941 (LRN); Renåen, ♀: 10. vii. 1928 (LRN); *30. Engerdal:* Myrstad farm, ♀: 5. vii. 1934 (LRN); STi: *37. Tydal:* Skarpdalen, ♀: 2. viii. 1923 (LRN); TRy: *14. Tromsøysund:* ? Ramfjord, Fagernes, ♀: 29. vi. 1921 (S-R); TRi: *27. Målselv:* Frihetsli, ♀: 29. vi. 1914 (B. Poppius).

Finland: Karislojo! ♀: (Hellén, Linnaniemi); *N(U):* Esbo! ♀: (Hellén); *Li(InL):* Enare, ♀: 25. vi. 1930 (Frey) (det. F. W. Edwards).

Distribution outside Denmark and Fennoscandia.

Only scattered records are published on this species. From Germany: Peus (1929, p. 9) records: "Ostdeutschland (Posen?) (ex. coll. Loew): ♂; Ostpreußen (Groß Raum): ♂;" Finkenberg-Brieselang (at Berlin): L: 22. iv. 1928; further at Dannenberg (Bez. Lünenberg), L: 5. vi. 1929 (Peus 1930 c, p. 673); Unterspreewald (Peus 1932, p. 140). From Lettland it is recorded from "Erlen-Calla Sumpf bei Anting, ♂: 16. vi. 1934 (Peus 1934 b, p. 78) and Tarwid (1935, 1938 a) records it from P o l a n d. As to the distribution in U S S R Stackelberg (1937, p. 177) says: "Recorded from Leningrad distr. (Peterhoff: Montsch. 1936), Voronesch distr. (environs Voronesch: Schtschelkanovzev), Ukraine (Dnepropetrovsk: Reingardt and Guzevitsch!), Lower Volga (environs Saratov: Martini) and at the southern counterforts of Ural (Perm distr.: Karitonov)." [100] According to Dyar (1928, p. 173) the the distribution in the A m e r i c a n C o n t i n e n t is: "Forested Canadian Zone from Atlantic to the Rockies, Rocky Mountains from Colorado to Alberta and British Columbia (Skeena River)." The same author (Dyar 1923 d, p. 54) records the following finds from U S A: "*New York:* Karner, 19. iii. 1904, Elisabethtown, 23. iv. 1905; *Massachusetts:* West Springfield, 13. iv. 1905, Longmeadow, 16. iv. 1905; *New Hampshire:* Dublin, 23. v. 1910; *Montana:* Whitefish, 16. vi. 1921." Further Irwin (1943) records it from *Michigan:* Chebogyan county. Recent records are: Maine (Bean 1946), Rhode Island (Knutson 1943); Utah (Don M. Rees 1942).

Biology.

In N o r w a y larvae of this species have been found from 24. v. to 8. vii. The last mentioned find was in Vestby (HEn 20), 571 m above sea level. Breeding waters are: small, shallow pools and waterfilled ditches mostly at the border of pine woodland. In some places the bottom of the waters was covered with decaying pine-needles. The larvae seem to tolerate rather polluted water. In one place, Nyberg-sund (HEn 20), the little breeding pond was just at the edge of a cabbage pile. The larvae have been found associated with larvae of *A. excrucians, cataphylla, communis, diantaeus* and *A. cinereus*. For details see table 2, p. 60. No N o r w e g i a n males have been found in the field, females have been found from 19. vi. to 2. viii. In S w e d e n females have been found from 21. vi. to 18. vii., in F i n l a n d the only dated specimen has been found 25. vi. In N o r w a y females have been caught in woodland, in dwellings (Engerdal, Trysil, Tydal, Ytre Rendal), in cow-stables (Asker, Trysil) as well as in hog-cotes (Trysil). In Trysil I have been attacked by females in woodland, on a sunny day.

Concerning the biology of this species in G e r m a n y, Peus (1932, p. 140) records: "Diese bis vor wenigen Jahren äußerst selten in Europa gehaltene Art gehört im Spreewald zu den dominierenden, sehr charakteristischen Stechmücken. — — — In den geschlossenen Wäldern (hauptsächlich Erlenhochwald) des Unterspreewaldes ist sie außerordentlich häufig. Die typischen Entwicklungsgewässer sind die flachen, seichten, vegetationslosen Wasserlachen mit totem Laub am Grunde, die auf den frühjährlichen Grundwasseranstieg zurückgehen. — — — Die Weibchen sind sehr angriffslustig und stechen auch am Tage bei hellem Sonnenschein (naturgemäß nur im Walde)."

[100] Translated from the Russian text.

The only biological record from U S S R is published by Martini (1928 c, p. 44): "Von dieser Art wurde einzige Larve in dem Walde bei Poliwanowka in einer Schneeschmelztümpel gefangen, in dem zugleich *A. nemorosus, rostochiensis* und *cantans*-Larven lebten, am 12. Mai."

From U S A Dyar (1928, p. 173) records: "The larvae breed very early in cold snow-pools and wet meadows, the summer and following winter being passed in the egg state on the ground. The adults are fond of entering houses and can be found in such places until July, when there is no sign of adults out of doors. This is in contradistinction to the habits of other forest mosquitoes, which generally shun interiors." On the other hand, Matheson (1929, p. 126) remarks: "Dyar states that this species readily invades houses but I have never taken them in houses though I have found them abundantly in wooded areas throughout the season."

Aëdes (Ochlerotatus) pullatus (Coquillet).

C. pullatus Coq. (Proc. Ent. Soc. Wash., *6*, p. 168) 1904
A. acrophilus Dyar (Ins. Insc. Mens., 5, p. 127) 1917
C. jugorum Villeneuve. (B ull. Soc. Ent. France, 1919, p. 59) .. 1919
A. gallii Martini. (Arch. Schiffs-Trop. Hyg., *24*, Beih., *1*, p. 110) 1920
A. metalepticus Dyar. (Ins. Insc. Mens., *8*, p. 51) 1920
A. seguyi Apfelbeck. (Konowia, *8*, p. 288) 1929

Systematical and Synonymical remarks.

As to this species, Edwards (1921, p. 316) remarks: "I have not seen the types, but an Italian male of *A. metalepticus* sent by Prof. Bezzi is practically identical in structure with an American male of *A. pullatus* in the British Museum; the distinctions given by Dyar must be due either to individual variation or to differences in mounting. The only differences observable in the Italian specimen were that the stem of the claspette was slightly stouter, slightly more angulated, and with a more distinct bristle arising from the angle; the main spine of the basal lobe was somewhat stouter, and the pale scales of the thorax whiter. These differences taken together may possibly indicate a variable distinction. Dyar suggested that C. jugorum might be the same as *A. metalepticus*, and this is almost certainly the case — —" (See further the discussion under: terminalia).

Description.

Female. Front of head with some golden bristles forming a little tuft between the eyes . Vertex ("occiput") with brown-golden narrow, curved scales and upright forked scales, the last mentioned flanked by blackish ones. Temporae with yellowish-white broad, flat scales. Eyes bordered by yellowish-white narrow, curved scales and blackish brown bristles. C l y p e u s blackish brown. P r o b o s c i s conspicuously longer than femurae of fore-leg, black; labellae black. A n t e n n a e. Torus black with rows of white, broad flat scales on the dorsal and inner side. Flagellum blackish brown, clothed with minute white hairs, longer black hairs at the base of the segments. P a l p i (fig. 70 g) dark brown or blackish brown about one fourth the length of the proboscis. Segm. 3 nearly half the length of segm. 4, over twice as long as broad. Segm. 4 about five times as long as broad. Ultimate segm. oblong, its length about $1/8$, its width nearly $1/2$ of segm. 4. T h o r a x. Anterior pronotal lobes blackish-brown with yellowish-white narrow curved scales, and dark bristles with golden reflections. Posterior pronotum with yellowish-white narrow curved scales. Mesonotum black, clothed with yellowish-brown narrow curved scales, on the lateral margins and around the antescutellar space shading to yellowish-white. In the middle two bare, close, black longitudinal lines and a shorter sublateral black stripe on each side of the antescutellar space each sparsely clothed with hair-like bronzy-brown scales. The numerous bristles on the scutum are mostly blackish brown, in other specimens they may be more or less golden, especially above the wing root. S c u t e l l u m with yellowish narrow curved scales and dark golden bristles. P o s t n o t u m blackish brown. P r o p l e u r a e with yellowish-white narrow curved scales. P l e u r a e and c o x a e with patches of white, broad, flat scales of a yellowish tint, and pale golden bristles. Wing venation blackish brown with conspicuous white scaling at the base of costa and radius; white scales may also be found at the base of analis. H a l t e r e s with luteous stem and darker globule, the latter with dirty-white scales. L e g s. Front side of femurae dorsally dark brown, ventrally yellowish-white. The dark parts sparsely blended with light scales. In the hind legs the dark scaling is embracing the femur apically while the light scales predominate the basal part. Back side of femurae yellowish-white. Knee spots dirty-white. Tibiae dark brown sprinkled white scales. First tarsal segment dorsally dark brown, ventrally more or less sprinkled with light scales; the last segments with a uniform dark brown colour. A b d o m e n. Tergites blackish brown with basal yellowish-white bands, laterally somewhat widening. Venter white scaled. Cerci long, black. Wing length: 4.5 mm.

The colouring of this species is subject to great variation. In some specimens the palpi may be sprinkled with dirty-white scales. The mesonotum may be more or less ochreous and the light scaling on the sides of mesonotum may be white. In one specimen the median part of mesonotum is dark brown, blended with a few brown-golden scales along the lateral margins, while the sides of the mesonotum are conspicuously white; further the legs are sprinkled more than usually with white scales.

Concerning the variability of this species Martini (1931, p. 320) remarks: "Variabilität zeigt die deutlichere oder weniger deutliche dunkle Streifung des Scutum. Die scheitelnde Mittellinie ist bei den Saratower Stücken schlecht ausgeprägt, während sie bei Stücken aus Jugoslawien ungewöhnlich deutlich ist, ebenso stark wie die Linien über den Seitenwülsten. Die lichte Beschuppung der Flügel bei den Saratower Stücken ist sehr ausgedehnt, sie greift hier stark an der c und r entlang und nimmt auch einen großen Teil des cu ein. Dagegen ist sie bei den jugoslawischen Stücken wenig deutlich. Die männlichen Taster sind dagegen gerade bei den Saratower Stücken besonders dunkel. In einer anderen Serie aus Jugoslawien tritt die scheitelnde Linie auf dem Thorax kaum hervor. Amerikanische Stücke stehen in der starken Ausprägung der scheitelnden Linie und der Bechränkung der weißlichen Beschuppung auf die Basis c, r und an den *Gallii* der ersten jugoslawischen Serie sehr nahe, ebenso in dem weißlicheren Ton der Beschuppung. Wir können danach vielleicht eine Gebirgsrasse der mehr kontinentalen Gebirge von Balkan bis zu den Rocky Mountains (*pullatus*), eine Rasse der dem maritimen Klima angehörigen Gebirge (*Gallii*) und eine Rasse der Steppen unterscheiden." As the above mentioned Norwegian variations are all from islands and coastal localities, I have the feeling that further researches are strongly needed till the question concerning geographical races in this species can be settled.

Male. Antennae. Torus blackish-brown. Flagellum black and white ringed. Ultimate segment blackish-brown with minute white hairs. Hairwhorls long, black greyish-brown reflecting. Proboscis long, slender. Palpi about the length of the proboscis. The long segment gradually thickened towards the apex. Segment 4 apically a little tapering. Ultimate segment scarcely more slender than segment 4 and about the same length. Hair-tufts at segment 5 of mean length, at segment 4 and apically at the

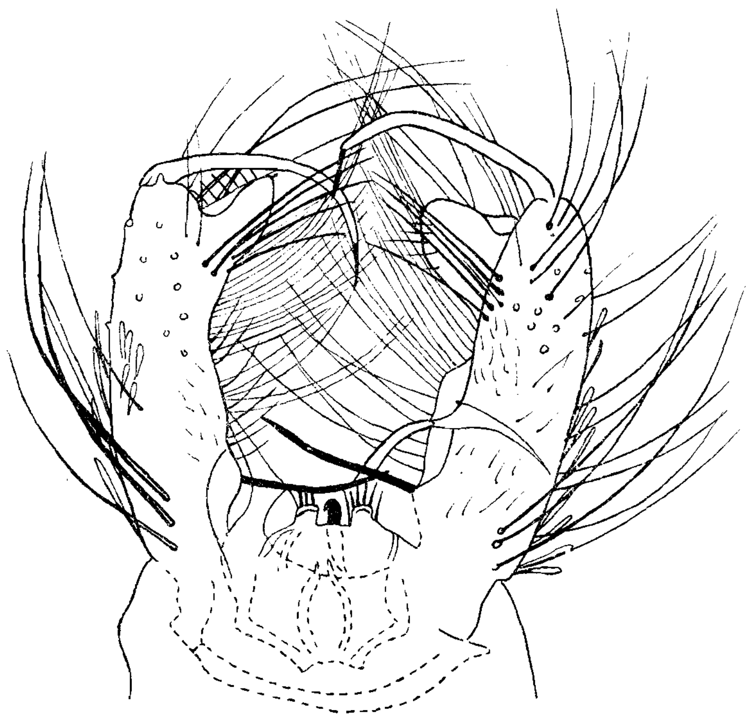

Fig. 98. *Aëdes (Ochlerotatus) pullatus* Cocq.
Terminalia (total view). (Aut. del.)

long segment long, dark brown. Colour of the palpi similar. Some light spots in the basal part of segment 3 and at segment 4. Thorax somewhat denuded in the specimens at hand. Integument blackish brown. Scaling at the sides of thorax and at the antescutellar space white. Stout setae at the sides of the thorax and at the scutellum. Abdomen. Scaling meallic with white basal bands widening laterally. Venter of similar colour with broad white basal bands conspicuously widening laterally. Hairs at the caudal and lateral borders of the segments with yellowish grey reflections. Wing length: 4.5 mm.

Terminalia (figs. 98, 99). Basistyle well over three times as long as broad, with conspicuously projecting apical lobe that carries ventrally directed hairs; along the inner border of the ventral flap a row of long setae. Basal lobe small, at the dorsal side with a stout apically curved spine,

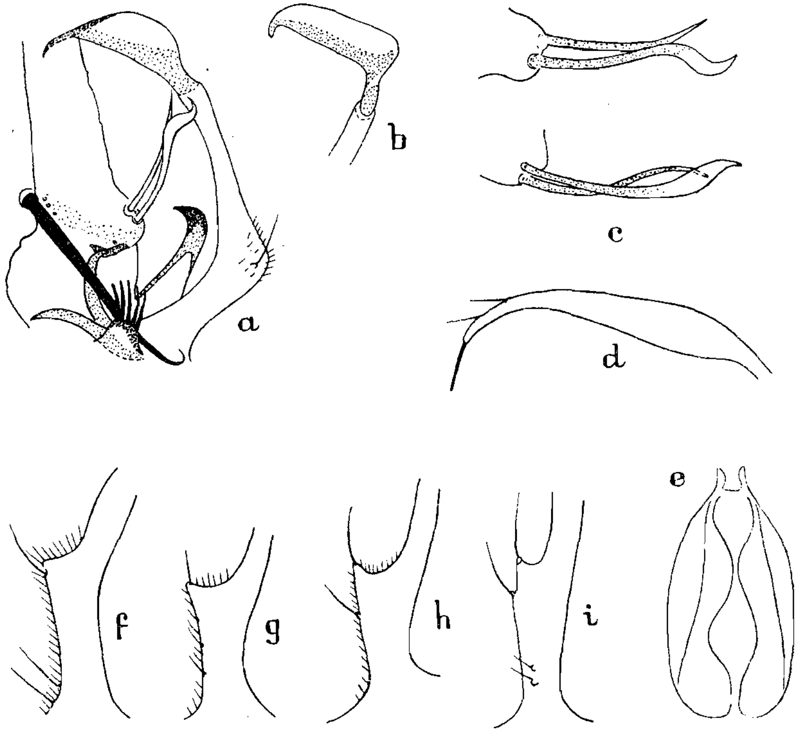

Fig. 99. Terminalia of the *Hyparcticus*-group.
A. (O) pullatus, a, basal part of basistyle with basal lobe, claspette, paraproct and lobe of the 9th tergite; b, tip of claspette with spine; c, warty projection of the basal lobe with the unequal spines; d, dististyle; e, sclerotised parts of phallosome; basal part of claspette; f, *pullatus;* g—h, *intrudens;* i, *diantaeus.* (Aut. del.)

at the ventral side with a small warty projection bearing two unequal spines, one of ordinary form, the other distally faintly sclerotized, flat and lanceolate, apically more or less curved. Stem of the claspette broad and the base, below the middle with a projecting angle and tapering distally. The angle is furnished with a seta. Appendage: a petiolated hook with rather broad, apically tapering wing. Dististyle curved, rather slender, with long claw. Proctiger with stout hookformed paraprocts and faint epiprocts. Phallosome of the usual *Hyparcticus*-type. Lobes of the ninth tergite with 5—2 short, stout spines. Mean value of 4 specimen (counted for both sides): 5.8.

As it is, the descriptions of the terminalia of this species do not coincide by all authors. Apfelbeck (1930, p. 288) remarks concerning *A. séguy:* "Dem *A.(O.) pullatus (jugorum* Villen., *Gallii* Martini) zunächststehend, — — — von dieser Art jedoch hauptsächlich durch den ♂-Genitalapparat — — — differierend." However the figure subjoined is rather schematic and gives few details, but in a note Apfelbeck refers to the description of the terminalia of *A. jugorum* Villen. in the handbook of Séguy (1923, p. 139, 126—127). Here the form of the spines on the basal lobe corresponds with those from northern specimens, as is also the case by Martini (1920, p. 110, fig. 35), but no details are mentioned in the text. In his last monograph Martini (1931, p. 320, fig. 360) remarks: "Sinneslappen zu einem kleinen, 2 einwärts gebogene Dornen tragenden Höcker zurückgebildet" and the subjoined figure demonstrates two equal spines of ordinary form. This is also the matter by Matheson (1929, pl. XIII, fig. 6) and by Dyar (1928, pl. XXXVIII, fig. 125). If these figures have been carefully drawn there must be great variations in the terminalia in this species.

In the above mentioned figures by Séguy (1923, fig. 126—127) a distally directed tuft of long hairs is delineated on the basistyle. As to this detail Edwards (1921, p. 316) remarks: "— — — but Séguy's figure of the hypopygium of a specimen (not the type) of *C. jugorum* shows a distinct apical hairtuft on the sidepiece, as in *A. intrudens.* The Verestorony example that I have examined have an aggregation of hairs in this position, almost suggesting a tuft, and Séguy may have exaggerated the appearance of a tuft in his specimen, or the species may be somewhat variable. Both Séguy's and Kertesz's specimens agree with Bezzi's except in this one point. As remarked by Villeneuve, there are long dense hairs arching over the upper (sternal) surface of the hypopygium, as in *A. rusticus, A. cataphylla,* and some others." Also Peus (1929 c, p. 122) comments this point concerning the specimens from Harz: "Ich kann nicht finden, daß distalwärts die Borsten dichter stehen, wie es aus Séguy's Figur hervorzugehen scheint." He emphasises the variability of the claspette in this species and he points out that the shape of the stem of the claspette can not be used for differentiation of the species of *Hyparcticus.*

Larva (fig. 100). As no Fennoscandian larva of this species has been accessible I here quote the description by Dyar (1928, p. 171):

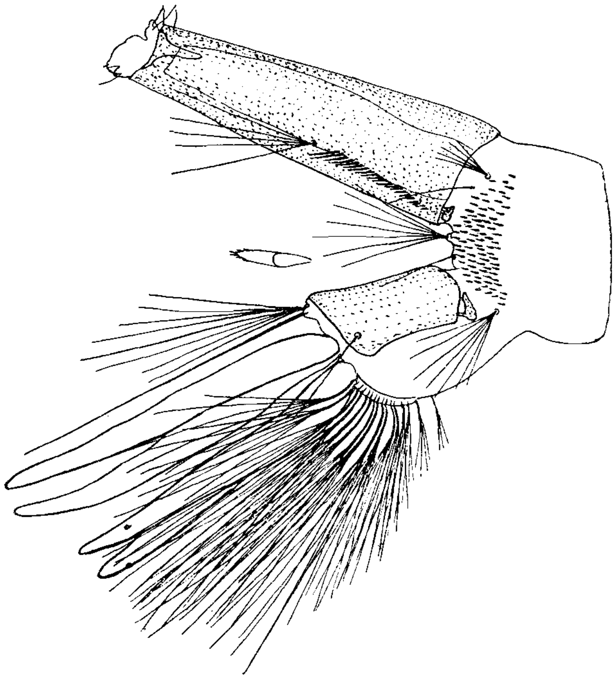

Fig. 100. Larva of *A. pullatus* Coq. in 4th instar. Terminal segments and comb-scale. (After Martini 1931.)

"Head rounded, bulging at the sides; antennae moderate, sparsely spined, with a tuft at the middle. Head-hairs upper in eight, lower in four or there about, antennal tuft multiple. Lateral comb of the eighth segment of many scales in a large triangular patch. Airtube over three times as long as wide, the pecten reaching the basal third; a multiple hair-tuft about the middle. Anal segment with a dorsal plate reaching well down the sides, excavate on the margin; ventral brush posterior; dorsal tuft as long hair and brush on each side; lateral hair single, small. Anal gills nearly twice as long as the segment, pointed."

Geographical distribution.

Sweden: *T.Lpm.:* Kiruna (Lichtwardt) (Edwards 1921, p. 316); environs Abisko, L. P: 15. vi.—3. vii 1937; I: 3. vii. 1937 (Thienemann, 1938, pp. 308—9).

Norway: NTv: *4. Namsos* ♂ (S-R); Nnv: *69. Andenes:* Andenes, ♂: 22. vii. 1941, ♀: 24. vii. 1941 (S-R); TRv: *9. Tranøy:* Granvik, ♂: 10. vii. 1943, ♀ 11.—24. vii. 1943 (S-R); *13. Hillesøy:* Hillesøy, ♀: 11.—14. vii.

1928 (S-R); *16. Helgøy:* Hushattøy, ♀: 9. vii. 1935 (S-R); Måkeskjær, ♀: 20. vii. 1934 (S-R); Torsvåg, ♂: 22. vi. 1925 (S-R); *17. Karlsøy:* Vannøy, ♂: 30. vi. 1925, ♀: 29. vi.—17. vii. 1925 (S-R); F ø : *23. Sør-Varanger:* Pasvikhavn, ♂: 1. vii. 1937 (S-R).

F i n l a n d : Hitherto not found (N!).

U R S S : *Kola Peninsula (Lapponia Imandrae):* Kibiny (Stackelberg 1937, p. 175).

Distribution outside Fennoscandia.

A. pullatus has a very interesting geographical distribution, being a typical exponent of the boreo-alpine group of animals. In G e r m a n y the species is recorded by Peus (1930 c, p. 672—3) from Brocken in Harz, L: 5. v., L. P: 5. vii.; further by Martini (1931, p. 321) from Schwarzwald. According to Gallii Valerio it is found in S w i t z e r l a n d in lake Rogneda in Veltin (2390 m above sea level). Concerning the distribution in F r a n c e (Séguy (1923, p. 141) records: "Col du Lautaret (Hautes-Alpes), sur le bord de la route qui decend vers Briancon a 2100 m d'altitude environ. On rencontre aussi des adultes a Premols (900 m) et autour du lac Luitel (1000 m) dans le massif de Belladonne, au Mont Seneppi (1755 m) près de la Muse, a la Grave (Hautes-Alpes), 1525 m, au pied du Lautaret (E. Hesse)" Broleman (1918, p. 427) records the species from "Vallée du Gave de Pau: Haute vallée (Haute-Pyrénées) am Gedre (1000 m)" Dyar (1920 (8), p. 4—6) mentions the following localities from I t a l y : "Alps, province Sondrino, Italy as follows: M. Meriglio, 18000 m, 17. vii. 1900; Scais, 1500 m, 19. vii. 1901; Venina, 1600 m, 8. viii. 1903; Chiareggio, 1700 m, 9. viii. 1903, Campo Moro, 2000 m, viii. 1903 (M. Vezzi)." Edwards (1921, p. 316) records males from the T r a n s y l v a n i a n A l p s (Verestorony) as well as from B a l k a n (Vermosa, 1200 m, Greuse) and Apfelbeck (1929, p. 289) described the species, under the name of *A. séguyi* from the environs of Sarajevo. In U S S R the species is recorded by Martini (1928 c, p. 44) from Saratow. As to this find he remarks: "Der neue Fund deutet auf eine Brücke zwischen den nordamerikanischen und den westeuropäischen Funden." It is very probable that this interpretation is correct. Thus males and females of *pullatus* are recorded by Edwards (1928 a, p. 2) from Petropavlovsk (vii.—viii.) in K a m t c h a t k a, a find missed by Martini. From the A m e r i c a n c o n t i n e n t the following records have been published: A l a s k a : (Dyar 1923 d, p. 53): Camp 327, Alaska Engineering Comm. vii. 1921; Seward, 25. vii. 1921; Anchorage, 21. vii. 1921; Skagway, 17. vii. 1919; C a n a d a : (Dyar 1921 b, p. 90): *Alberta:* Lake Louise, 11. vii. 1918; Banff, 14. vii. 1918; *British Columbia:* Kalso, 2. vii. 1903; Kwinitsa, 29. v. 1919; Bennett, 28. vii. 1919; Atlin, 23. vii. 1919; *Yukon Territory:* Carcross, 21. vii. 1919; Whitehorse, 27. vi. 1919; Tahkeena River, 19. vii. 1919; Hootalinqua, 15. vii. 1919; Tantalus Mine, 6. vii. 1919; Big Salmon, 15. vii. 1919; Carmack, 7. vii. 1919; Dawson, 7. vii. 1919; U S A (Dyar 1923 d, p. 53): *Idaho:* Julietta, 21. iv. 1889; *Montana:* Whitefish, 16. vi. 1921; *Colorado:* Aspen, vii. 1922; Buena Vista, 3. vii 1917; Estes Park Village, 24. vi. 1924. Recent records are: Michigan (Irwin 1941); Utah (Don M. Rees, 1942).

Biology.

From Norway no biological records have hitherto been available on this species. According to the material to hand males have been found from 22. vi to 22. vii, females from 29. vi to 20. vii. However, the character of the finding places of *A. pullatus* in Norway are rather remarkable. This species, which in Central Europe occurs in mountainous regions and in southern Europe even in very high altitudes, has, in northern Norway, a coastal distribution. Most finds are from more or less mountainous islands, in some cases even from islands far out in the sea. A detailed discussion on the interesting distribution of *A. pullatus* in Fennoscandia and the problems connected herewith will be found in chapter 10.

Concerning the finds in Sweden Thienemann (1938, p. 308—9) says: "Abiskogebiet: Im austrocknen befindlicher Graben in der Zwergbirkenheide bei Abisko, 15. vi. 1936 Larve (IV Stadium); Teich am mittleren Kårsavagge-See, 21. vi. 1936 Larven (IV Stadium), Puppenexuvie; Ufer des mittleren Kårsavagge-Sees. Larven 21. vi. 1936 (II u. III Stadium, quelliger Graben in der Zwergbirkenheide bei Abisko 3. vii. 1937 Larven (IV Stadium), Puppenexvien, Imagines."

From the Kola Peninsula Stackelberg (1937, p. 75) records that according to investigations in Kibiny (Chibinä) by Fridolin (1936) the larva of this species breeds in oblong narrow turf-pools of moderate depth. As a rule the pools are situated in the narrow peatbogs along rivers and on the first terrace which is not innundated in the flood season. The bottom of the pools is covered with peat-mud or stones and also with leaves of heather an *Betula nana*. The water here is comparatively cold which may be explained by the existence of affluxes of permanent or temporary character, further by communication of the pools with the river or underground moraine-waters. In the northern parts of USSR the species probably has only one brood in the season and appears later than other species.

According to Dyar (1928, p. 171—2) the ecology of *A. pullatus* in the American continent agrees with the conditions in Europe: "The larvae hatch from over-wintering eggs in the cold snow-pools in spring in the mountains. The species ranges from sea-level to 10 000 feet, reaching as high altitudes as even the strictly alpine forms. The larvae are slow in development, being found last in the pools after other mosquito inhabitants have tranformed and flown."

4. *rusticus*-group.

The *rusticus*-group is characterized by several conspicuous characters distinguishing it from the other species of the subgenus *Ochlerotatus*.

The female palpi are long. The posterior pronotal scales are all broad and flat. The shift of the posterior cross-vein is less than unity. Male terminalia: Basistyle with strong apical lobe; basal lobe protruding, narrow at the base and expanded distally where it carries a number of flattened, lanceolate spines. Dististyle with s-shaped claw. Claspette with the stem narrowed in the middle and somewhat swollen distally. Appendage pear-shaped, the wing with several transverse ridges and pointed apically.

Larval siphon with several pairs of long dorsal hairs.

Edwards (1932, p. 147) records 6 species belonging to this group, five of which are Palaearctic and one Nearctic. One species only extends into the southernmost part of our region.

Aëdes (Ochlerotatus) rusticus (Rossi).

C. rusticus Rossi (Fauna Etrusca, *2*, p. 503) 1790
? ? *C. maculatus* Meig. (Klass., *1*, p. 4) 1804
? *C. musicus* Leach. (Zool. Journ., *2*, p. 293) 1825
C. pungens Rob.-Desv. (Mem. Soc. Hist. Nat. Paris, *3*, p. 407) 1827
C. quadratimaculatus Macq. (Suites a Buffon, *1*, p. 34) 1834
C. diversus Theob. (Mon. Cul., *2*, p. 73) 1901
C. nemorosus var. *luteovittatus* Theob. (Mon. Cul., *2*, p. 85) .. 1901
var. *subtrichurus* Martini (Arch. Schiffs- u. Trop. Hyg., *3*, p. 386) 1927

Synonymical and systematical remarks.

The synonymy above is in accordance with Edwards (1932, p. 147). However, Martini (1931, p. 277) still uses the name of *diversus* Theob. for this species, and the argumentation we find in his previous paper (1922, pp. 108—9, 117) where he, i. a., says: "Rossis Culiciden fasse ich folgendermassen auf: — — — *C. rusticus* = *Anopheles* unserer Nomenclatur des Rostrum porrectum, longitudine dimidii corporis, pedes fusci, postici longissimi scheint mir jeden Zweifel auszuschließen. Die Beschreibung des Thorax läßt sich durchaus verstehen, die Worte Abdomen segmentis omnibus utrinque nigro maculatis beziehen sich wohl auf die dunklen Flecke die man bei frischen Stücken infolge der helleren Reflexe auf den Tergiten der Hinterleibsringel oft deutlich getrennt zu sehen bekommt. (Noch besser zeigt sich die Fleckung an Spiritusmaterial). Der Fundplatz und die Größe passen ebenfalls gut. Was in der Beschreibung Rossis auf *diversus* Theob. Schließen läßt, ist mir durchaus unerfindlich. — — — *A. diversus.* Die unter diesem Name allgemein bekannte Mücke nennt man jetzt vielfach *rusticus.* Ich habe aber erst unter sehr vielen Stücken ein einziges gesehen, dessen Hinterleib leidlich auf Rossis Beschreibung passen würde. Versuche durch größere Wärme hellere passendere Stücke zu erzielen, scheiterten an der Empfindlichkeit der Art gegen hohe Temperaturen. Auch der Fangort Rossis paßt nach meinen Beobachtungen gar nicht zu *diversus* und ich habe oben dargelegt, warum ich in Rossis *rusticus Anopheles* sehe. Meine frühere Vermutung, daß *rusticus dorsalis* sein könnte, die sich auf Rondanis Auffassung stützte sowie das *nigripes* Zett. = *diversus* sein könnte, wozu mich die Größenangabe veranlaßt hatte, scheinen mir doch nicht ausreichend begründet, nachdem ich die Originalbeschreibung von Rossi gelesen und ferner gefunden habe, daß Zetterstedt 1850 die Größe von *nigripes* nur auf 2½—3 Linien angibt. Oben wurde gezeigt, daß *maculatus* Mg. 1804 der älteste Name für diese Art ist."

As mentioned above I have at hand the type specimens of *A. nigripes* (Zetterstedt) from Greenland, and this species has no resemblance at all to the much larger *A. rusticus* Rossi. The same objection has previously been put forward by Séguy (1923, p. 153).

Edwards (1921, p. 308) mentions an interesting variation (female) with the abdomen almost entirely yellowish scaled. This specimen is from Szeged in Hungary. He further remarks: "A similar specimen from Budapest has been described by Theobald (Mon. Cul. IV, p. 344) as *Culex lutescens,* but, as stated above, I prefer to use Fabricius' name in another sense. Walker (List. Dipt. Brit. Mus. I, p. 8) queries *C. musicus* as the same as *C. quadrimaculatus.* The synonymy indicated may be correct, but the specimens are no longer in existence."

Description.

Female. Head with some pale golden bristles forming a little tuft between the eyes. Vertex ("occiput") in front with yellowish narrow curved scales, above in the middle with pale golden, upright forked scales, on the sides with a few dark ones. Temporae with yellow broad, flat scales. Eyes bordered with yellowish-white narrow curved scales and dark brown bristles. Clypeus blackish brown. Proboscis dark brown with scattered yellowish-white scales in the basal half. Antennae. Torus blackish brown, densely clothed with yellowish-white scales. Flagellum dark brown, the first segment with yellowish-white scales at the inner side. The remainder clothed with minute white hairs, with greater black hairs at the base of the segments. Palpi rather long, about 1/4 the length of the proboscis; colour dark brown, sprinkled with yellowish-white scales. Thorax. Anterior pronotal lobes black, above with blackish brown scales and black bristles, below with yellowish-white broad, flat scales and pale golden bristles. Posterior pronotum above with comparatively broad, flat blackish-brown scales; below with broad flat white scales. Mesonotum in the middle with two longitudinal dark golden lines, at either side of the antescutellar space with a similar shorter line, all surrounded by pale golden narrow, curved scales. The lateral margins of mesonotum with dark brown bristles, those above the wing-root pale golden with darker apex. Scutellum black with patches of pale golden narrow curved scales and long bristles. Postnotum blackish brown. Pleurae and coxae with dense patches of white broad, flat scales and pale golden bristles. Wing venation dark brown, sprinkled with yellowish scales, in particular at the base of costa, radius and analis and along the subcosta. The shift of the posterior cross-vein is less than unity. Halteres with luteous stem and darker globule, the last clothed with dirty-white scales. Legs. Femurae yellowish white with dark brown scaling embracing apically. Knee spot yellowish white, conspicuous. Tibiae dark brown and whitish sprinkled. First tarsal segment with many pale scales, the remainder dark brown. Abdomen. First abdominal segment with two patches of whitish scales and with golden bristles. The remainder of the tergites dark brown with yellowish-white basal bands and a median stripe of the same colour, increasing caudally. Venter whitish, eighth sternite dark brown, yellowish-white sprinkled. Cerci long and broad, dark brown with scattered light scales. Length of body: 7 mm (W-L). Wing length: about 6 mm.

Male. Proboscis dark brown with a bluish tinge, ventral side with white scaling at the basal part. Antennae. Torus black. Flagellum black and greyish ringed, two ultimate segments blackish brown with a coating of minute white hairs. Hair-whorls dark grey, lighter towards the tip of the hairs. Palpi exceeding the proboscis by about the length of the ultimate segment. The apex of the long segment and the last two segments swollen. Colouring. The long segment whitish with dark apex and a dark ring in the middle, the white parts with scattered dark scales. Segment 4 white with lateral borders of dark scales. Ultimate segment with a patch of white scales at the base, otherwise dark. The dark scales with more or less distinct bluish reflections. Hair-tufts fox-coloured changing into greyish towards the tip of the hairs. The thorax of the two specimens at hand is partly denuded. Integument black, with yellowish narrow curved scales. Abdomen. Tergites dark brown with yellowish basal bands. Segment 2 with an indistinct longitudinal median yellow stripe. Segment 8 yellowish-white. The base of the basistyle with yellowish-white scaling. Dense rows of golden yellow hairs form an arch over the claspettes. Lateral hairs of abdomen fox-coloured. Abdominal sternites white scaled. Length of wing about 6.5 mm.

Terminalia (fig. 101). Basistyle distinctly curved, well over three times as long as wide. Apical lobe strong, with several short, broad and curved hairs. Basal lobe protruding, narrow at the base and expanded distally where it carries some short spines and at apex a cluster of long, flattened, lanceolate spines. Dististyle curved and with a long, s-shaped claw. Claspette conspicuously curved, the stem narrowed in the middle and somewhat swollen distally. Appendage pear-shaped, the wing with several transverse ridges and pointed apically. The basistyle is very hairy as well as the eighth tergite which carries a row of long, caudally directed hairs that form a dome covering proctiger, basal lobes and the claspettes. Lobes of the ninth tergite with 5—6 short spines. Paraprocts with strongly sclerotised apical hooks.

Larva (fig. 102) I have only a few slide preparations of the anal segments of Danish larvae at hand, but as the most distinguishing characters are found just on the siphon, I complete the description of these preparations by a quotation from Wesenberg-Lunds (1920—1, pp. 85—6) description of Danish larvae.

"Head rounded, wider than long, narrowed before the eyes; a notch at insertion of antennae; front margin arcuate. Antennae extremely short, straight, spinose; antennal tuft small, inserted almost in the middle of the antennae; at the apex two small hairs a long hair and a digit; anteantennal tuft multiple, lower frontal tuft triple, upper double; epi-

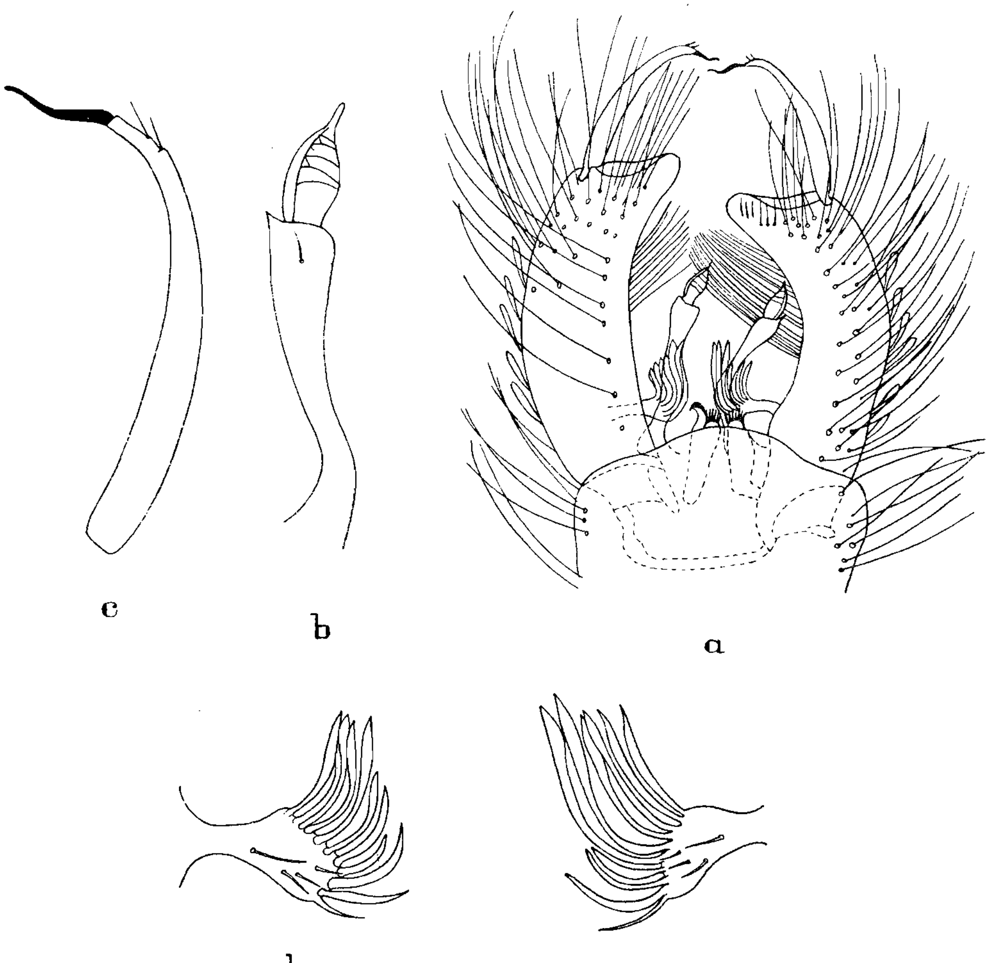

Fig. 101. *Aëdes (Ochlerotatus) rusticus* Rossi.
a, Terminalia (total view); b, claspette; c, dististyle; d—e, basal lobes.
(Aut. del.)

stome with a very characteristic coloration of the head integument. Eyes well developed.

Thorax much wider than long, rounded; hair formula of frontal border 5141331415 or 4131331314; hair 1 after median tuft 3 short, lateral hairs highly developed; most of them in large multiple tufts, some of them single.

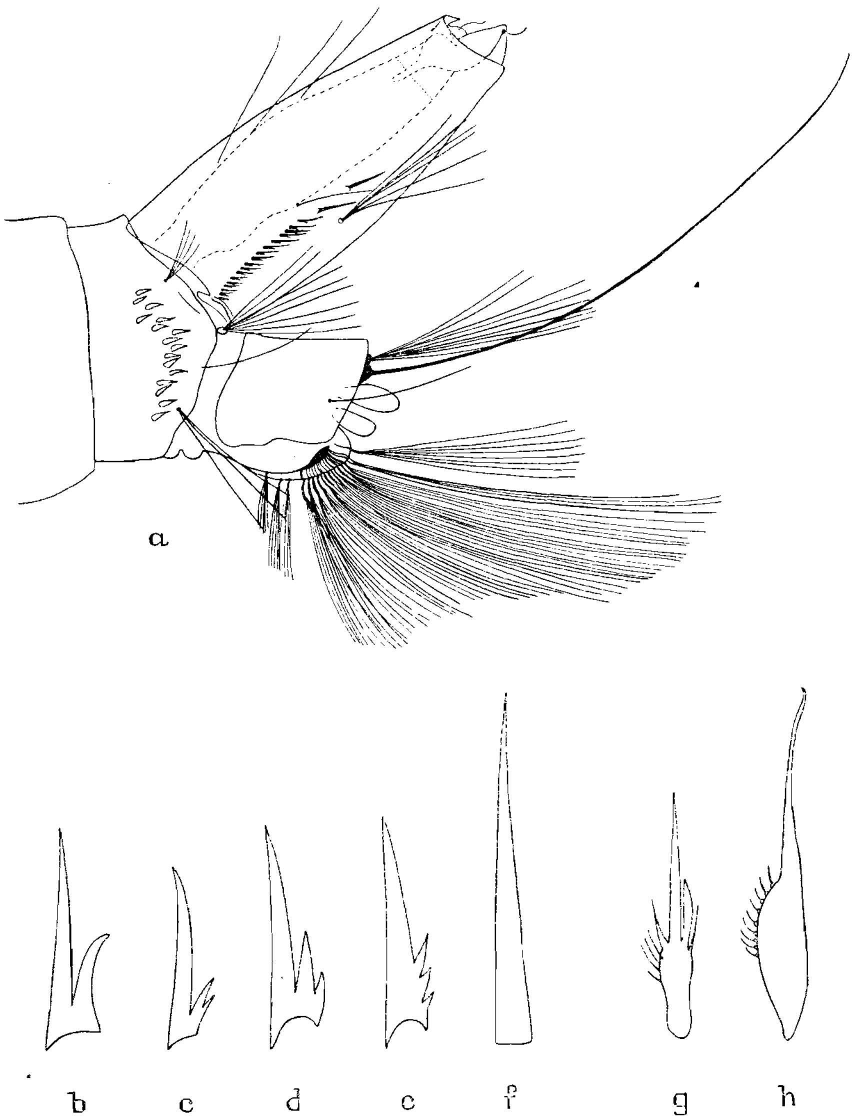

Fig. 102. Larva of *A. (O) rusticus* Rossi in 4th instar.
a, Terminal segments of larva; b—f, pecten teeth; g—h, comb-scales.
(Aut. del.)

Abdomen moderate, the first segments much shorter than the last; lateral hair-tufts on segment one and two multiple. on segment three to six double; a pair of subdorsal hairs on segment one to six, largest on segment four to six."

Comb with 12—16 elongated scales, which are furnished with a long median spine, some submedian denticles and laterally fringed with fine hairs. Siphonal index about: 3.4. (The depicted specimen probably somewhat pressed by the slide cover.) Siphon slightly tapering in the distal 2/3 of the total length. Ventral tuft inserted at about 2/5 the length from the base, with 6 hairs of well over 2/5 the length of the siphon. Pecten with about 23 close-set, stout teeth and 2—3 widely-spaced narrower teeth, 1—2 of which are situated distally to the ventral tuft. The close-set teeth are mostly furnished with several basal denticles, the distal, widely-spaced teeth without denticles. A secondary small tuft is inserted on the inner side of the pecten and somewhat nearer to the base of the siphon than the main hair-tuft. Siphon in about the middle with 3 pairs of long dorsal hairs; the regular dorsal hair, near the apex of the siphon, minute. The apical hair in the ventral valve slender and hookshaped. Anal segment with saddle reaching well over 3/4 down the sides; saddle-hair long, single. Dorsal brush with an inner pair of tufts with about 9 hairs and an outer pair of long, stout hairs. Ventral brush with about 16 cratal and 3—4 pre-cratal tufts. Anal gills short.

Geographical distribution.

Denmark': *1. Jylland:* Errested: Vesterskov! (north of Haderslev) ♂♀: 24. v. 1936 (P. Nielsen); *2. Sjælland:* Hillerød (W-L); Suserup (W-L); Ermelunden! L: 28. v. 1922 (I. P. Kryger); vicinity of København! ♀ (Stæg.); Amager (W-L). *Møen:* Ulvshale! L: 2. iv. 1938 (H. Anton); Klosterskov! L: iv. 1938 (H. Anthon).

Distribution outside Denmark.

According to Marshall (1938, pp. 157—8) *A. rusticus* is recorded from: Scotland from the county: Ross and Cromarty, from England from the counties: Beds, Cambs, Glos, Hants, Herts, Kent, Norfolk, Notts, Oxford, Surrey and Sussex, from Wales from Glamorgan. From Belgium it is recorded by Goetghebuer (1925, p. 215) from: "Mont-Saint-Amand, Melle, Destelbergen, Waerschoot, Oosracker, Vinderhaute (Fl.), Forêt de Soignes (Tonnoir) Brux.), 4—6." From France Séguy (1923, p. 151) records the following finds: "Dans les environs de Paris! — — Rennes (E. Hesse); Jura: Montsous-Vaudry

(P. Lesne: Mus. Paris); Allier; Albi (Dr. Villeneuve); — —." Brolemann (1919, p. 72) records it from: "Mayenne, près de la gare de Neuilly-Saint?Ouen and Eckstein (1920, p. 342) from Strassbourg. From Portugal Braga (1931, p. 69) records the species from "Amares, Setembro de 1928 (Braga). Leça da Palmeira, Agosto de 1926 (Braga)." It is further recorded from Algier (Surcouf (Séguy, 1923, p. 151). In Germany *A. rusticus* is recorded by Martini (1920, p. 100) from "Hamburg — — —, bei Roevershagen bei Rostock i. M. bei Müritz, — — — von Hela." Peus (1929 b, p. 8) records the species from Finkenkrug, Berlin), L: 20. v. 1928 and at Friedberg (Hessen), L: 30. v. 1928, Vogel (1933, p. 182) records it at Ludwigsburg (Württemberg) and Eckstein (1920, p. 342) from Mannheim. Hungary: Balaton (Mihàlyi 1941). As to the distribution in Italy, Ficalbi (1896, p. 270) remarks: "Questa specie è stata catturata da Rossi in Toscana nel Pisano" and Edwards (1920, p. 308) records finds from Taranto (Hargreaves) and Livorno (Mann), and further Waterston (1921—2, p. 134) records it from Macedonia.

Biology.

Concerning the biology and ecology of *A. rusticus* in Denmark, Wesenberg-Lund (1920—1, pp. 87—8) says: "Its life-history may be summed up as follows: The imagines are hatched in May and may probably lay their eggs on the dried bottom of forest ponds, rarely in ponds in meadows, without trees around. The eggs are hatched in autumn when the ponds get water again. Before winter they are full grown, and as such they winter, living under the ice exactly like *C. morsitans*. In the first days of May they pupate, and the mosquitoes appear in the first part of the same month."

As to Britain Marshall (1938, p. 157) remarks that *A. rusticus* "is without doubt a one-generation species — — — The majority of the adults appear in April and May, and are rarely met with after the middle of July — — — So far as known, the first instar larvae never make their appearance before October; the delay in the hatching of the eggs being supposedly due to their having been deposited in situations lying above the autumn water levels. First instar larvae have been collected during the months of October to June inclusive. All four instars of *A. rusticus* are usually to be found before the end of December, but pupation has never been known to occur until late in the following March. The larvae are to be found, for the most parts, in ditches or woodland pools, which are bordered with deciduous hedges or trees; such pools being usually bottomed with dead leaves, upon the larvae feed."

Martini (1931, pp. 279—80) says: "Ich fing sie im Juni, Juli, besonders an Knicks und in lichtem Walde. Sie sticht stark zu allen Tageseiten im Schatten der Knicks und Gebüsche. Fundplätze der Larven sind besonders Gräben an Waldrändern und Wasser in lichten Gebüschen mit überwiegend grassigem Grunde, schwach fließende Wasser in Schonungen mit Vergißmeinnicht und ähnliche Stellen. Sie verschwindet mit dem dichteren Schluß des Gebüschs und erscheint neu, wo durch Wegnahme der stärkeren Büsche dem Licht guter Zugang zum Wasser geshaffen ist. Einzelne Stücke habe ich auch in ganz offenen Teichen gefangen — — —. Es ist auffällig, daß sich die Art geradezu mit *lutescens* mischt. — — — Im Süden (Kleinasien) kommt *A. diversus* besonders an Büschen in offenem Wisengelände vor."

Séguy (1923, p. 151) indicates the hibernation of the females in France: "Les œufs sont pondus isolement dans les fossés herbeux, des le mois de mars, par les femelles ayant hiverné. — — — Wesenberg-Lund, l. c. 25 (1920) affirme que la larve de cette espece passe l'hiver; cependant j'ai capturé au mois de mars des larves au premier âge qui portaient encore l'appareil d'eclosion cephalique." However, it is not mentioned if this statement is based on actual finds of hibernating females.

Subgenus *Finlaya* Theobald. 1903.

The male is well characterised by the terminalia; further the proboscis is somewhat longer than the palps. The female is recognised by the short and blunt cerci and the broad sternite of the eighth abdominal segment. The last mentioned characteristic we also find in *Aëdes cinereus.*

The larva of *A. (F.) geniculatus* is the only northern species of which, in the later instar, the antennal tuft consists of a simple hair. Furthermore the larva is recognised by the peculiar stellate hairs, which are present both on thorax and abdomen.

The nearly cosmopolitan subgenus attains its greatest development in the oriental region; it is absent from southern South America and perhaps Madagascar. Of the 92 species known only one species extends into the southern part of Fennoscandia.

Aëdes (Finlaya) geniculatus (Olivier).

Culex geniculatus Oliv. (Encycl. Meth. Hist. Nat. Ins., *6,* 134) . . 1791
Culex equinus Meig. (Klass. d. Zweifl. Ins., *1,* p. 3) 1804
Culex ornatus Meig. (Syst. Beschr. europ. zweifl. Ins., *1,* p. 5) 1818
? *Culex lateralis* Meig. (Syst. Beschr., *1,* p. 5) 1818
Culex guttatus Meig. (Syst. Beschr., *6,* p. 241) 1830
Culex guttatus Curtis. (Brit. Ent., p. 537) 1834
Culex albopunctatus Rondani. (Bull. Soc. Ent. Ital., *6,* p. 31) . . 1872

Synonymical remarks.

The synonymy above is quoted from Edwards (1932), but as the authors are of divergent opinions I find a review of the matter desirable.

Edwards (1913, p. 107), in a paper on this species, also treats the synonymy and he remarks i. a.: "*Culex geniculatus* was described by Olivier in 1791 (Encycl. Méthod. VI. p. 134) in the following terms: "Culex thorace cinereo nigro lineato, pedibus fuscis, geniculis albis. Il est de la grandeur du Cousin commun. Les antennae sont obscures. La trompe est noire, un peu plus longue que la moitie du corps. La tête est cendrée. Le corselet est cendré, avec deux lignes longitudinales noirâtres, presque réunis, au milieu du dos, et une autre courte de chaque coté. L'abdomen est obscur, avec le bord des anneaux blanchâtre. Les pattes sont noirâtres avec la base des cuisses et le genou blancs. Les aîles sont transparentes avec les nervures et le bord intérieur ciliés. Il se trouve aux environs de Paris, dans les endroits humides." — — — The object of the present note is to suggest that there is no connection between *C. geniculatus* and *C. hortensis,* but that *C. geniculatus* is really the species which was subsequently described by Meigen as *C. lateralis* (Syst. Beschr., *1,* p. 5, 1818). It will be noticed that Olivier, in describing the abdomen, says it is "obscur, avec le bord (not: "le bord posterieur") des anneaux blanchâtre". In this sentence the impression given is distinctly that the lateral rather than the apical portion of each segment is whitish, at least the words will easily bear this interpretation. Now there are but two North European gnats having an abdomen coloured thus, *Aëdes cinereus* and *Ochlerotatus lateralis.* The former need not be considered as Olivier's description of the thorax of this insect will not apply to it. *O. lateralis,* however, answers perfectly to the description, specimens in first-rate condition show very clearly the two long and two short black lines (of scales) on the thorax, the ground colour of the thoracic scaling being whitish-grey, and the head-scales of the same colour; the tips of the femora, too, are conspicuously white, even to the naked eye, while the basal half of the hind femora is more uniformly and more evidently whitish in this species than in any other British gnat. Olivier's statement that his species is of the size of the common gnat is true of *O. lateralis,* though specimens are often found rather larger than *C. pipiens. C. hortensis,* however, is consistently and considerably smaller than the average *C. pipiens;* moreover, it seems to be a purely mediterranean species, having been recorded only from Italy, Palestine and Algeria. — —."

Eckstein records the species under the name *Culicada ornata* and says (1919, p. 66): "Die Rückseite des Hinterleibes variiert sehr in der Zeichnung. Oft haben alle Hinterleibssegmente weisse Querbinden, meist sind diese aber an den hinteren Segmenten in der Mitte durchbrochen, so daß dort nur dreiseitige weisse Flecke zu sehen sind. — — — Sehr characteristisch für die Art dagegen, immer vorhanden, und bei keiner unserer anderen Stechmückenarten in dem Masse ausgebildet sind die glänzend silberweissen Schuppenringe an allen Knien, wodurch *Cul. ornata* leicht und mit Sicherheit, namentlich frishe Exemplare, von ähnlichen Arten *(lateralis, nemorosa, nigrina)* unterschieden werden kann.". He is of the opinion that *lateralis* is a distinct species, and recapitulating he remarks: "*Lateralis* ist eine Art für sich und ebenso *Ornata* und *Nemorosa.* Diese Arten lassen sich, um es noch einmal zu sagen, schon im Larvenstadium mit Sicherheit voneinander trennen."

Wesenberg-Lund (1920/21, p. 94) gives a detailed description of the Danish *geniculatus,* from which I quote: "Mesonotum black, covered with bright bronzy or snow-white scales. — — — pleurae black with eight or nine distinct large patches of snow-white scales. — — — Abdomen. — — — Each segment with lateral snow-white spots, — — — knees snow-white — —." In his comment on the synonymy of this species he says i. a.: "*C. ornatus* (Hoffmgg.) Meigen has always been a very doubtful species, and it is now very difficult to understand what the earlier authors really meant by this species; the type-species does not exist anywhere any longer — —."

Martini (1931) uses the name *ornatus* Meig. and the argumentation we find in his paper on the nomenclature of the mosquitoes (1922 c, p. 109): "Bei Olivier glaube ich die Tiere folgendermassen zu erkennen: — — — *C. geniculatus* sind die *Aëdes* der *nemorosus*-Gruppe. Olivier sagt von geniculatus "Schenkel und Knie sind weiß", sie sind also offenbar von gleicher Farbe; hätte er *ornatus* vor sich gehabt, so hätte er wohl wie Séguy das auffallende "Silberweisse" der Knie der "blassen" Färbung der Schenkel gegenübergestellt. Die Bezeichnung des Mittelrückens als "cendre" mit zwei langen und zwei kurzen schwärzlichen Streifen, die Bezeichnung der dunklen Teile des Hinterleibes in der Diagnose als fuscus und der hellen als weißliche Binden entsprechen *nemorosus,* nicht aber *ornatus.* Für die *nemorosus*-Gruppe stimmt auch die Angabe "feuchte Plätze", während der doch im ganzen nicht häufige *ornatus* an solche gerade nicht gebunden ist. Zur Not würden die ganzen Angaben auch auf einzelne *hortensis* passen — — —."

To be sure, the few northern *geniculatus* at hand, have all very distinct white spots on the knees, but they differ conspicuously from the snow-white patches on the pleurae and the abdominal lateral spots. The colour of the knee-spots have a yellowish tint differing only in the gradation from the more yellowish-white colour of the femorae. Per contra the lateral patches on the thorax and the abdominal segments are snow-white, with a faint bluish tint, thus having a "cold" colour. However some German specimens of *geniculatus* in our collection have the knee-spots more conspicuously white than is the case with the northern specimens. This criterion is evidently fairly variable. In the descriptions of Meigen (1818, p. 5) I find an indication of this variability. In the diagnosis of *Cul. ornatus* the author says: "Legs brown with snow-white knees", and in the following description he further remarks: "Femura pale yellow, back blackish brown, knee white", but as to *Cul. lateralis* he says: "Knee pale", and now these forms are considered as synonyms of the same species. In my opinion the most characteristic criterion for this species is the snow-white patches on the pleurae and further the snow-white lateral spots on the abdominal segments. Altogether I find Edwards interpretation the most convincing.

In 1921 Edwards quoted *Culex fusculus* Zett. as synonymous with *A. geniculatus* Oliv. and made the following remarks (l. c. p. 320): "Mr. J. E. Collin has kindly examined for me the two males of *C. fusculus* in Zetterstedt's collection at Lund, and from his notes and accompanying sketch of the claspette there can be no doubt that *C. fusculus* is *A. geniculatus*." In his great monograph (1932) the synonym *C. fusculus* is omitted, and as it would be of interest to clear up this problem I received, through the courtesy of prof. Kemner in Lund, the two males for inspection. Slide preparations of the terminalia were made and an investigation proved that the two specimens were *A. punctor* Kirby.

Description.

F e m a l e. H e a d. Vertex ("occiput") in the middle with yellowish white, broad curved scales and upright forked scales. On the sides with two patches of blackish brown upright forked scales and bristles. Temporae with yellowish white broad, flat scales. C l y p e u s black. P r o b o s c i s and palpi dark metallic with bluish reflection. A n t e n n a e. Torus blackish brown, flagellum of the same colour. The segments with a basal narrow white ring and clothed with minute white hairs. Hair-whorls black. P a l p i (fig. 103)

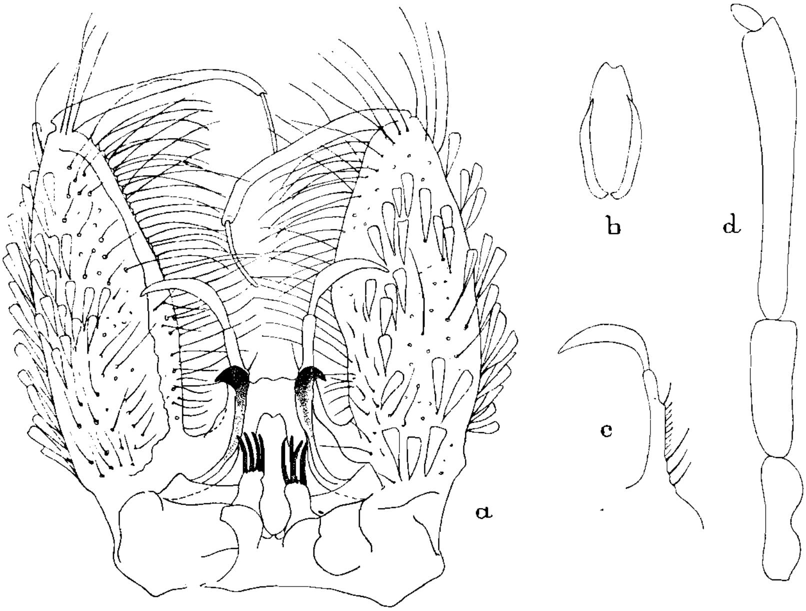

Fig. 103. *Aëdes (Finlaya) geniculatus* Oliv.
a, Terminalia (total view); b, sclerotised parts of phallosome; c, claspette; d, femal palp. (Aut. del.)

about 1/5 the length of the proboscis. Segment 2 about half the length of segment 3. The ultimate segment oval. Thorax. Anterior pronotal lobes blackish brown with broad white curved scales and bristles with light reflection. Posterior pronotum with broad flat white scales. Mesonotum black with hairlike dark metallic or blackish brown scales and yellowish white narrow curved scales. The dark scales form two broad longitudinal, median lines divided by a narrow yellowish white stripe. Bristles dark, above wing root lighter. Scutellum blackish brown with yellowish-white narrow curved scales and light bristles. Postnotum blackish brown. Pleurae blackish brown with patches of snow-white broad flat scales. Wing with uniformly dark scales. The shift of the posterior cross-vein about 2.0. Halteres yellowish grey with a dark globule clothed with small white scales. Legs. The fore- and middle femorae purplish black with yellowish white bases. The better basal half of the under side is of the same colour. Hind femorae yellowish white with the outer third dark. Knee spots white. Tibia

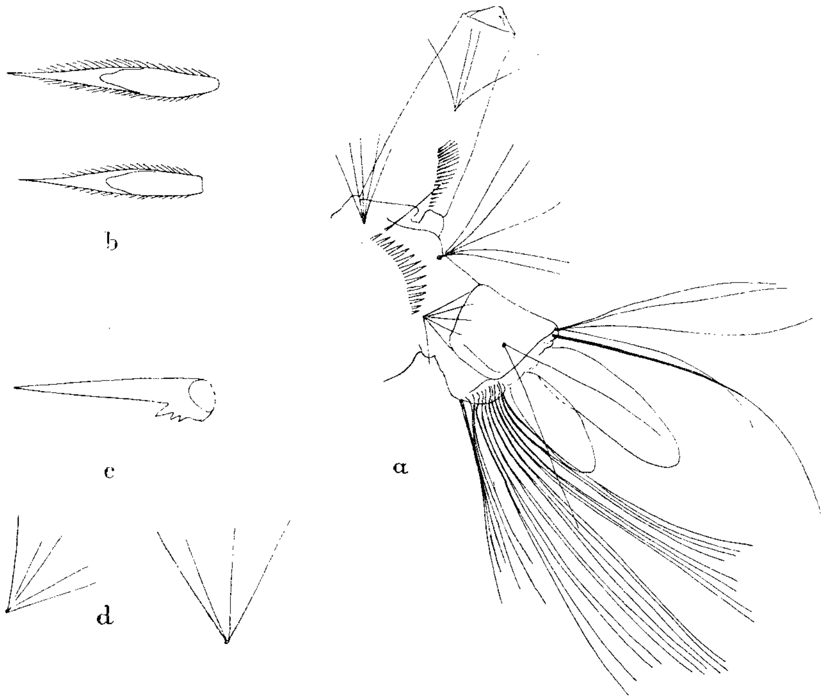

Fig. 104. Larva of *A. (F) geniculatus* Oliv. in 4th instar. a, Terminal segments of larva; b, comb-scales; c, pecten teeth; d—e, stellate hairs. (Aut. del.)

and tarsi dark metallic. Claw formula: 1 : 1; 1 : 1; 0 : 0. Abdomen dorsally clothed with violet brown or dark metallic scales, the segments laterally with patches of snow-white scales. Venter with basal white bands. Cerci comparatively blunt.

Male. Antennae shorter than the proboscis, the segments black and white ringed, the ultimate long segments black. Hair tufts black with light metallic reflection. Palpi nearly of the same length as the proboscis, black. The ultimate segments not distinctly swollen. Thorax. The white markings even more distinct than in the female. Abdomen with greater white patches than in the female; the eighth segment white. Dark parts of abdomen metallic.

Terminalia (fig. 103). Basistyle without basal and apical lobes. Dististyle slender with a long claw. Stem of

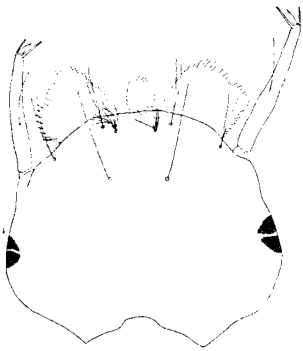

Fig. 105. Larva of *A. (F) geniculatus* Oliv. in 4th instar. Head of larva. (Aut. del.)

the claspette not curved, rather short, appendage hookformed. Proctiger with stout hookformed paraprocts.

L a r v a (fig. 104, 105). Head slightly broader than it is long. Antennae smooth; antennal tuft reduced to a single hair. The mid frontal hair with two branches, the inner frontal hair unbranched. Unfortunately the hairs on the frontal border of prothorax are more or less broken off in the few specimens at hand. As to the Danish larvae Wesenberg-Lund (1920—1, p. 94—5) says: "Hair formula at frontal border 21022012. Between 2 and 0 a very small hairtuft. Lateral hairs long, many single, the others in multiple tufts. Two series of smaller tufts with one single or a few hairs between the median and posterior tufts." According to Martini (1931, p. 315) the prothoracal hair formula is: 2, 1, 2; 3; 2,1,2; 3 up to 4, 1, 3; 5; 2, 1, 3; 8. Comb with about 14. scales, arranged in a single row. The scales are of a rather pointed shape and have fine lateral hairs. Siphonal index about 2,0. Pecten with 17—18 teeth, each with a few basal denticles. Siphonal tuft with 4 to 5 branches. Saddle-hair very long, with two branches. Ventral brush consisting of about 9 cratal and 1 to 2 precratal tufts, all with few branches. Anal gills exceptionally broad; the dorsal pair about twice as long as the saddle, the ventral pair slightly longer than the saddle. A characteristic criterion for this species is the presence of the peculiar "stellate hairs" on thorax and abdomen. According to the literature some characters seem to be more or less variable. Thus Wesenberg-Lund quotes 10 to 12 teeth in the Pecten, Martini says:

"ungefähr 15-zähnig" and according to Marshall the number varies between 15 and 19 in British specimens. As to the number of comb-scales Wesenberg-Lund and Martini quote about 12 and Marshall 11 to 16.

Table 32.

Larval chaetotaxis of *A. geniculatus* Oliv.

	Frontal hairs			Number of comb scales	Number of pecten teeth	Siphonal index
	out.	midd.	inn.			
instar III	2	1	1	11—13	13—15	
instar IV	2—3	2	1	14	17—18	2.0—2.2

Geographical distribution.

Denmark': *2. Sjælland:* Hillerød (W-L), Lillerød! ♂♂: Mai 1939. (Anthon), Uggeløse Skov! ♀: 14. viii. 1938. (Anthon). Dragsholm (W-L), Tisvilde (s.w. of Vejby) W-L), Suserup (s. of Sorø)! ♂♀: 27. vii. 1919 (W-L).

Sweden: *Sk:* ♂ (Boheman!).

Norway: VAy: *10. Mandal:* Mandal. (L): 21. v. 1929 (LRN).

Finland: Hitherto not found in Finland (N!).

As to the northern limit of this species Edwards (1921, p. 320) remarks: "The most northerly record I have is Scania Sweden (Boheman)." However the Norwegian locality Mandal lies about two degrees latitude north of Skåne.

Distribution outside Denmark and Fennoscandia.

According to Marshall (1938, p. 153) *A. geniculatus* has been found in the British Isles in the following counties: Bucks, Cambs, Cheshire, Cornwall, Devon, Essex, Glos, Hants, Herts, Kent, Lancs, Middlesex, Oxon, Shropshire, Somerset, Surrey and Sussex. From the Netherlands the species is recorded by Theobald (Séguy 1923, p. 112), and concerning its distribution in Belgium Goetghebuer (1925, p. 214) has published the following details: "Gand, Laethem, Saint-Martin (Fl.); Heverlée (Bequaert); Tervueren, Stockel, Forêt de Soignes (Tonnoir); Mont-Saint-Guibert (Brux); Lamorteau (Jur.), V—IX. In France the species is widely distributed (Séguy 1923, pp. 11—12): "Bourg-la Reine (Langeron); Forêt de Saint-Germain (Alluaud); Nemours, Chaville (Surcouf: Mus. Paris); Meuden (Séguy: Mus. Paris); Rambouillet (Dr. Villeneuve); Fontainebleau (Séguy Mus. Paris); Marne: Verrières, Villers-Daucourt (Cordier); Gray

(Coll. André: Mus. Paris); Saint-Sulpice-Lauriere (Alluaud); Pau (Brolemann); Perpignan (Weiss: Mus. Paris); Corse: Corte, Vizzavona (Maindron: Mus. Paris); Sartène (Le Cerf)." Callot (1939) records it from Soury (Seine-et-Oise) and Roubaud and Colas-Belcour (1941) from the city of Paris and Eckstein (1920, p. 341) from Strassbourg. From Switzerland the species is recorded from: Bern (Bangerter 1926) and environs of Lausanne (Galli-Vall. u. Roch. d. J. 1913). Further south it has been found in Spain: Tabarda (Lauffer) (Séguy 1923, p. 112) and from Portugal it is recorded from: Povoa de Lanhoso, X, (Braga) and from Fornos de Algodress, V, (Braga), (Braga 1931, p. 58). As to the distribution in Germany, the species has been published by Peus (1929 b, p. 10) from the following localities: "Welbecker Tiergarten (bei Münster i. W.), 1. iv.; Natrup-Hagen i. W. (Habichtswald), 3. iv.; Spreewald ("Buchenhain" b. Schlepzig), 22. vi.; Dubrow (Mark Brandenb.), 25. iii.; Chorin (Mark Brandenb.), 29. iv.; and Usedom, 23.—24. viii."; Martini (1920, p. 143) records it from Danzig (L: iv., viii.), Schneider (1924, pp. 42—43) mentions it from Bonn. According to Martini (1920, p. 143) *A. geniculatus* is recorded from Dalmatia and Italy (Séguy 1923, p. 112). Further eastwards the species is recorded from Austria (Schiner 1864, p. 629); Lithuania: Bialowies (Sack 1925, p. 264); Hungary: Balaton (Mihályi 1941); Jugoslavia (Pavisic 1938), Bulgaria (Martini 1928, p. 22) and Macedonia(Waterston 1922, p. 132). Concerning the distribution in USSR Stackelberg (1937, pp. 186—88) records: "From the Tartary Rep. (Volkova!); Voronejsch distr. (Schtschelkonozev!); Ukraine (Karkov distr.: Schachov, environs of Kiev, Schitomir, Korosten Rybinskiji! Dnepropetrovsk: Guzevitsch!); Lower Volga (environs of Saratov: Martini); southern coast of Crimea (Velitschkevitsch!); Kaukasus (Kuban, river Psekons: Dobrovolskiji! Pjatigorsk: Mess!); Transkaukasia: Grusia (Kalandadse 1931); Armenia (Mirsajan!); Abchasia, Aserbaidschan (Guzevitsch!); Turkmenia (Kara-Kalinsk distr.: Petrischtscheva 1934, 1936)" [101] Further records are: Basin of Dnjepr: Samara forest, Orlovschina, Penjchovka (Dolbeskin 1928); Kaukasus: Sjelesnovodsk, Essentuki, Podkumje (Mess 1929), Sotschi distr. (Baschkareva 1931). According to Krivenko (1941) it has been found at Kachétie (Rss de Georgie). The species is also recorded from Asia Minor: Brussa (Mann) (Edwards 1921, p. 320) and Algeria: Boghari (Surcouf: Mus. Paris) (Séguy 1923, p. 112).

Biology.

Wesenberg-Lund found the larva in old tree holes in Denmark and made close investigations on the biology of the species. He says (1920—21, p. 101) i. a.: "Having had the holes under regular observation for about two years, I feel quite sure that we have only one or two generations the whole year round. In 1918 many of the holes were ice-covered during the last days of March; they were filled with water during the first days of April and in the time from April the first to about April the fifteenth very many larvae

[101] Translated from the Russian text!

in the first stage were found in the holes. In the first weeks of May many of the holes were almost dried up; the larvæ only grew very slowly, lying between the moist leaves at the bottom of the holes, but without any water and the larvæ grew more quickly, but no pupæ were observed before the first days of July; in the course of July all the pupæ were hatched, owing to the extremely rainy summer the holes almost always held water. From the last days of July no larvæ could be observed in the holes. In 1919 and 1920 I found a few halfgrown larvæ in several holes in October—November. In December the holes were frozen, and when they thawed in 1919 in March and in 1920 in February, they never contained larvæ; I take it for granted that the larvæ from the autumn have died out in the course of the winter. — — — The eggs are laid in July—August and are to be found on the sides of the holes, commonly a little above the water rim. Most probably the eggs are laid at different times and by different females; under specially favourable conditions e. g. in wet summers, in which the eggs are reached by the water rim at a very early date, it may possibly occur that some of these eggs are hatched in the very summer in which they are laid, but I feel quite sure that the main part hibernate as eggs, and are not hatched before the next year, commonly in March—April." In Norway I found a single larvæ in a tree hole at Mandal on the 21st of May 1929; the hole contained very little water and the bottom was covered with old leaves.

According to Marshall (1938, p. 153) *A. geniculatus* has been found in British Isles in holes in beeches, oaks, ashes, chestnuts and elms. He further says: "An apparently unique case of *A. geniculatus* breeding in an open pool, in company with *Aëdes cinereus,* has been recorded by Harold."[102] However, the existence of larvae outside tree holes, evidently may occur in other places also, as Stackelberg (1937, pp. 186—88) reports from USSR: "The larvae are living in water in tree holes (oak, hazel, beech, ash a. o.), also below roots, more rarely in ditches and pools (Mess.)."[103] Further Callot (1939) reports from Souzy (Seine-et-Oise) that larvae were found in large numbers and on several occasions in pools in rocks in a thick wood of beeches and oaks. The water was contaminated with decomposing leaves and resembled in colour and appearance that found in tree-holes. As to the conditions in Germany Peus (1929 b, p. 10) says: "Am häufigsten finden sich die Baumhöhlengewässer in Buchen" but Pavisic (1938) points out that the choice of a breeding place appears to depend more on the type of the hole than on the species of tree. In a paper on

[102] Harold, C. H. H. (1926): Studies in mosquito bionomics. (J. Royal Army Med. Corps. 47, pp. 81—94).
[103] Translated from the Russian text.

the larvae of the *Psychodidae* Feuerborn (1923 b, p. 203) gives some interesting information on the nature of tree holes containing water. He i. a. says: "Wo sich Ast- oder anderen Höhlungen oder Gabelungen alter Bäume (Besonders Buchen) Räume gebildet haben, die das am Stamm herabfließende Regenwasser längere Zeit zu halten vermögen, findet man in diesen "Tümpelchen" besonders wenn mehr oder weniger Fallaub, morsche Holzteile usw. hiergeraten, eine Lebewelt ganz besonderer Art, eine kleine geschlossene Biocoenose, deren Vertreter anscheinend durchweg stenotop an solche "Baumhöhlen" gebunden sind, und die vielleicht mit dem Namen "Fauna dendrolimnetica" gekennzeichnet werden kann. In der Regel nimmt das Wasser in diesen Höhlen bei längerem Stehen eine braune bis schwärzliche Färbung und einem fauligen, stankenden Geruch an, ein Anzeichen, daß die Zerzetzungsvorgänge an den wasserbedeckten Pflanzenteilen saprogenen Chrakter tragen, worauf auch das häufige Vorkommen von *Eristalis-Larven* hindeutet. Allerdings bedarf es wohl noch einer genaueren Analyse der durchaus eigenartigen Verhältnisse die hier vorliegen." — — —

An analysis of some of the problems suggested by Feuerborn we find in a paper Keilin (1932, pp. 280—82) on the fauna in a horsechestnut tree hole, where the author i. a. says: "It is important to mention here that the relationship between the mosquito fauna and the pH of water, which is so often discussed in entomological literature. was first pointed out by MacGregor in connection with the fauna of tree holes. Having found larvae of *Anopheles plumbeus, Aëdes geniculatus* and *Orthopodomyia pulchripalpis,* in the very acid water (pH: 4.4) of a beech tree reservoir in Epping Forest, he concluded that the water of tree holes is usually acid and that the larvae of the above three species are adapted to the acid water. Later (1929), referring to my observations on the horse chestnut fauna, he wrote: "Keilin (1927) has reported the discovery of water in a horse-chestnut tree hole at Cambridge having a pH of 9.1. This high pH index is certainly abnormal." This conclusion is not supported by my observations, as it is hardly possible to describe a pH of water which for more than ten years remains at about the same level, namely between 9 and 9.3 as "abnormal". Moreover, throughout this time the water always contained numerous larvae and pupae in all stages of development of the above-mentioned three species of mosquitoes. The fact that the same three species have been found by MacGregor in a beech tree with very acid water shows only that these mosquito larvae can live equally well in water of pH ranging between 4.4 and 9.3, in other words, that the pH of water has no direct effect on the mosquito larvae."

As to the stages of development Marshall (1938, p. 153) i. a. remarks on the conditions in the British Isles: "Both field and laboratory observations indicate that *A. geniculatus* deposits the eggs on the sides of the cavities — successive "instalments" of eggs being lodged at different heights above the water level. When, during rainy periods, water rises in the cavities, those of the eggs which become submerged — or, more probably, only a certain proportion of them hatch into larvae. — — — Larvae of *A. geniculatus* have been collected in every month of the year, but they are able to survive only brief periods of frost." Concerning North-Germany, Martini (1931, p. 315) has made corresponding observations with those of Wesenberg-Lund from Denmark: "Die Eier des gleichen Jahres lassen sich meist nicht zur Entwicklung bringen." According to Mac Gregor (1932, pp. 183

—84) the temperature is of deciding influence for the development of this species. He thus i. a. says: "During the cold winter months the larvae are far more torpid than the overwintering larvae of the other British mosquitoes, yet large numbers of eggs laid in autumn habitually hatch in December or somewhat later. Despite this fact laboratory experiments have proved that neither the larvae (at any stage) nor the ova can withstand freezing, even when the temperature of the surrounding ice is maintained at 30—32 F." In a paper by Eckstein (1920, pp. 101—15), the author emphasises: *"Culicada ornata,* die Höhlenbrüterin, ist in ihrer Vermehrung abhängig von üblichen Regenfällen, die mit heißen trockenen Tagen abwechslen müssen, um eine möglichst große Anzahl von Generationen hervorzubringen." Also a paper by Stackelberg (1937, pp. 186—88) with information from U S S R indicates that the species, in more southern degrees of latitude, appears in several generations. "Hibernate as larva or egg. Adults are to be found the entire hot period of the year. May also emerge in winter time in a mild climate (South-Crimea). They are intrusive bloodsuckers and on hot days they may be very annoying in the forest (Zoizev 1935). They are also often met with in houses." [104] The last mentioned observations are confirmed by Martini (1931, p. 315): "Die Mücke ist im Walde oft zudringlich und blutdürstig auch bei Tage."

Of special interest is the following information, published by Marshall (1938, p. 153): "The extremely important fact that *A. geniculatus* is able to "carry" yellow fever — a disease for long believed to be transmittable exclusively by the (non-British) species *Aëdes aegypti* — has recently been established." [105]

Subgenus *Aëdes* Meigen. 1818.

This subgenus is characterized by the following criterions. Head. Vertex ("occiput") with narrow curved scales in a narrow median line, otherwise with flat broad scales. Proboscis about the length of the front femurae. Palpi in both sexes very short. Lower mesepimeral bristles absent. Male terminalia characterized by the peculiar form of the subapically inserted dististyle being unequally bifurcated and without claw. The longer and slender branch has a fish-tail shaped apex, and the shorter and somewhat broader branch carries several spines on its distal half (figs. 106, 107).

The authors are of diverging opinions concerning the interpretation of the terminalia of *A. cinereus.* Martini (1931, p. 242) says: "Valven ohne Claspette mit Apikal- und Basallappen. Der Sinneslappen ist zu einem kleinen behaar-

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[104] Translated from the Russian text.

[105] Roubaud, E., Colas-Belcour, J. and Stefanopoulo, G. J. (1937): Transmission de la fièvre jaune par un moustique palearctic repandu dans la region parisienne, *l'Aëdes geniculatus* Oliv. (C. R. Acad. Sci. Fr. *205,* pp. 182—83).

ten Feld reduziert, von dessen Proximalteil ein spitzer Fortsatz ausgeht." Studying slide preparations of northern specimens I can not see any apical lobe on the basistyle, and both Dyar (1918) and Edwards (1921) records only the basal lobe. Matheson (1929, p. 107) says: "Apical lobe absent". In the above mentioned paper by Dyar, the author emphasises that the claspettes are absent. He uses the term claspette for the typical organ only, i. e. a more or less slender stem supporting a flattened appendage which is mostly winged. This interpretation we find also in the papers by Martini (1931) and Edwards (1932), but Marshall (1938) uses the denomination claspette in a wider sense. He gives (1938, pp. 146—47) a detailed description of the organ (in the present paper termed the claspettoid) which is bilobed with one shorter and one longer and slender branch, both terminating in spines. In fig. 106 two types are delineated, one with few terminal spines and one with many spines. The female is characterized by the dark red-brown colour. The abdominal lateral white spots are hardly noticeable from above. The wings are dark scaled, the shift of the posterior cross-vein being about 2. *Aëdes cinereus* differs from the rather similar-looking *Culex* species by the protruding cerci and by the absent pulvilli.

The subgenus *Aëdes,* including 36 species, is principally distributed in the oriental region, few species occur in Australia but none are found in Africa, Madagascar or tropical America. Two species are distributed in the northern temperate zone, but only one is found in our region.

Aëdes (Aëdes) cinereus Meigen.

? *C. ciliaris* L. (Syst. Nat. *1,* (2) p. 1002)	1767
A. cinereus Meig. (Syst. Beschreib. *1,* p. 13)	1818
C. rufus Glimmerthal (Bull. Soc. Imp. Nat. Moscou, *18,* p. 295)	1845
C. nigritulus Zett. (Dipt. Scand., p. 3469)	1850
A. leucopygus Eysell (Abh. Ver. Nat. Kassel, *48,* p. 285)	1903
var. *fuscus* Osten-Sacken (Bull. U. S. Geol. a. Geograph. Surv. of the Territ., *3,* p. 191)	1877
C. pallidohirta Grosbeck (Can. Ent. *37,* p. 359)	1905
C. pallidocephala Theob. (error) (Mon. Cul. *5,* p. 612)	1910
var. *hemitelus* Dyar. (Ins. Insc. Mens., *12,* p. 179)	1924

Synonymical remarks.

The synonymy above is quoted from Edwards (1932) but some remarks may be added.

As to *Culex ciliaris* Linnaeus, the type specimens evidently do not exist, but the original description strongly indicates that this species is the same as *A. cinereus,* and I agree with Edwards in his synonymy. However, Martini (1922 c, p. 108) is of a different opinion. He says: "1767 tritt zu *pipiens ciliaris,* eine dunkel braungelbe (fusco-testaceus) Art, um die Hälfte kleiner als *pipiens* bräunlichem Hinterleib. Man hat in ihr *A. cinereus* sehen wollen. Mit mehr recht, scheint mir, kann man an den nicht wesentlich größeren *C. pipiens* auct. denken, besonders wenn uter den *Ochlerotatus=pipiens* L. der große *meigenanus* vorgewogen hat. Es würde dann hier die erste Trennung von *Ochlerotatus* und *Culex* im modernen Sinne vorliegen; ersteren würde *pipiens* letzteren *ciliaris* entsprechen." As it would be of special interest to see the opinion of the great Swedish entomologist Zetterstedt, I asked prof. N. A. Kemner if it were possible to send me for inspection some of the mosquitoes from his famous collection, deposited in the museum at Lund. Through his courtesy I received, among others, specimens of *C. ciliaris* and *C. nigritulus.*

Three specimens, pinned on the same entomological pin, are labelled "*C. ciliaris* Linn. Wadstena" in the handwriting of Zetterstedt. These specimens are all *A. cinereus,* as shown by the short proboscis, the reddish brown colour of the thorax and the wing-venation, the shift of the posterior cross-vein being about 2.0. The fourth specimen, sent me as *cinereus,* is labelled "Smol." (Småland), in the handwriting of Zetterstedt. However, it did not coincide with the other in the wing-venation, and traces of abdominal white basal bands are visible. I esteem it a species of the *communis*-group.

I have inspected two specimens of *C. nigritulus,* from the same collection, both labelled "Lapp. Lul." (Lapponia Lulensis) in the handwriting of Zetterstedt. According to the original description (Zetterstedt, 1850, p. 3459) they have been caught at Qvickjok. One specimen is *A. cinereus,* but the other one has the proboscis distinctly longer than the femur of the fore-leg, and the wing-venation differs from *cinereus.* Also in this specimen traces of abdominal white basal bands are visible, and it most probably is a species of the *communis*-group.

The original description of the American *Aëdes fuscus* Osten-Sacken (1877, p. 191) reads as follows:

"*Aëdes fuscus* n. sp. ♀♀ — Brown; thorax clothed with a short, appressed brownish-golden tomentum; abdomen with whitish-yellow narrow bands at the segments; venter whitish-yellow. Antennae black, proboscis and legs brownish, with a metallic reflection, femora paler on the under side; pleura under the root of the wings with a spot clothed with whitish scales. Long. corp. 3—4 mm. Hab.-Cambridge, Mass., in May."

As to this species, Dyar (1924 c, p. 179) remarks: "In the monograph (Howard, Dyar and Knab, Mosc. N. and Cent. Am. and W. I., IV, 729, 1917), we treated the American form of this species as *Aëdes fuscus* O. S., but called attention in a footnote to its identity with the European *Aëdes cinereus Meigen.* This synonymy has been followed since, but nevertheless, the two forms are not identical. In the European specimens examined by me, at least in the females, the broad scales on the head practically meet vertically, whereas in the American form there is a very distinct channel of narrow scales reaching through to the vertex. The American form, therefore, may be called *Aëdes cinereus fuscus* O. A."

In the same paper the author describes a new form from mountains of California: "*Aëdes cinereus hemiteleus*, new race. The channel of narrow scales on the vertex of head is wider than in *cinereus fuscus;* the mesonotum is bronzy brown, with two longitudinal black lines and posterior short side stripes; the abdominal bands are variable, often well developed, the lateral widenings touching, but not forming an even lateral band; venter frequently with a more or less distinct median dark band."

Specimens from Ottawa, in our collection, agree with the above description of *A. cinereus fuscus* O. S.; in the colouring of the thorax they coincide with the dark Norwegian specimens. As mentioned below, light coloured northern specimens have the dark lines on the thorax, as mentioned above, for *A. cinereus hemiteleus.*

Concluding these remarks I would draw the attention to some inexactitudes in the bibliographical records concerning this species. In the literature (Dyar 1924; Edwards 1932; Kertesz 1902) the original description of *Aëdes fuscus* O. S. is quoted from: "Bull. U. S. Geol. Survey, III (1877)," but the third volume in this series was published in 1855 and the description mentioned is not to be found here. I had some trouble in this matter til I discovered that the said paper is published in: "Bull, of the U. S. Geol. and Geograph. Survey of the Territories", the so-called "Hayden-Series".

Description.

F e m a l e. H e a d. Front of vertex ("occiput') in the middle with golden narrow curved scales, above with golden or dark golden upright forked scales, at the sides with brown-golden broad flat scales. Temporae with white or yellowish-white flat scales. Hairs golden. Eyes bordered with yellowish-white or golden narrow curved scales. C l y p e u s blackish brown. P r o b o s c i s distinctly swollen towards the apex, of about the same length as the front femorae, dark brown somewhat lighter in the middle. A n t e n n a e. Tori, in light specimens, yellowish, dark brown at the inner side; in dark specimens the tori are dark brown all over. Flagellum blackish brown, first segment yellowish at the base. P a l p i (fig. 70 m) very short, about 1/6 the length of the proboscis. T h o r a x. Anterior pronotal lobes and posterior pronotum brown with brown-golden narrow curved scales and dark brown bristles. Mesonotum reddish brown or dark brown; in light coloured specimens two longitudinal approximated dark lines and two shorter, lateral stripes are visible. Scales hair-like, brown-golden; at the sides and towards the antescutellar space passing into narrow curved scales. Bristles stout, blackish brown, with golden reflections. S c u t e l l u m with pale golden narrow curved scales and blackish brown, golden reflecting, bristles. P o s t - n otum yellowish-brown or brown. W i n g. Stem of the fork $_{2+3}$ of about half the length of the fork. Stem of the fork m_{1+2} of about the same length as the posterior branch of the fork. The shift of the posterior cross-vein about 2.0. L e g s. Femorae pale yellowish, dorsal side brown or blackish brown, especially towards apex. Front femorae somewhat darker. Tibiae brown, at ventral side somewhat lighter. Knee spot indistinct. Tarsal segments dark brown. Front and middle claws of female toothed. A b d o m e n brown with cupreous reflections or dull blackish; with dirty-white lateral spots, forming a more or less continuous border which, in many specimens, is hardly visible from above. In some specimens the apical border of the 7th segment is somewhat lighter coloured. Apex of abdomen pointed. Cerci of moderate length. Length of wing about: 3.5 mm.

M a l e. A n t e n n a e long. Torus dark brown. Flagellum brown and dirty-white ringed. Hair-whorls long, greyish brown. P r o b o s c i s in coincidence with that of the female. P a l p i see fig. 70 n. Thorax darker than in the female, more greyish-brown. Abdomen in the male more

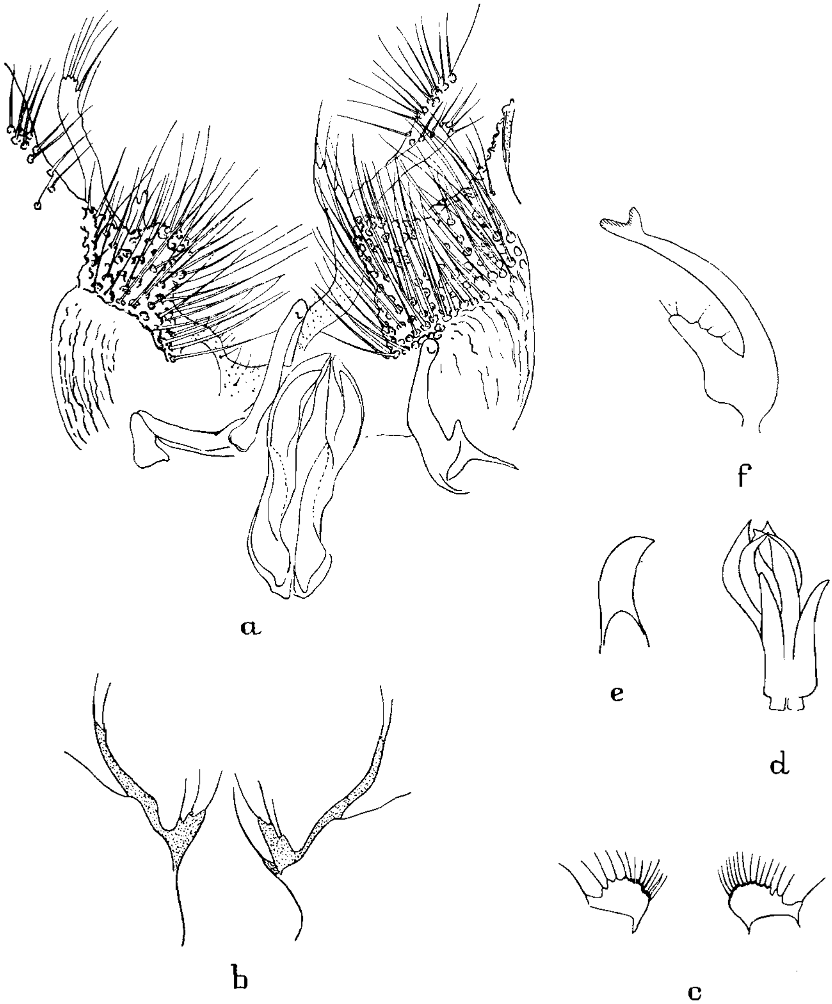

Fig. 106. *Aëdes cinereus* Meig.
a, basal part of terminalia with basal lobes, claspettoids, paraprocts and sclerotised parts of phallosome; b, claspettoids with few apical setae; c, lobes of the 9th tergite; d, sclerotised parts of the phallosome; e, paraproct (side-view); f, dististyle. (Aut. del.)

conspicuously haired than in the female. Length of wing about: 3.5 mm.

T e r m i n a l i a (figs. 106, 107). Basistyle twice as long as broad. Basal lobe large, rugose and densely setose. Disti-

Fig. 107. *Aëdes cinereus* Meig.
Terminalia (total view). (Aut. del.)

style inserted subapically upon the basistyle, bifurcate with one longer and one shorter branch. The longer branch is furcate at the tip and of a fishtail like appearance, the shorter branch is apically rounded and bears several setae. Claspettoid unequally bifurcate, with a longer rod-like branch bearing 2—6 long apical setae, and a shorter branch bearing 1 apical and 2—3 subapical setae, Proctiger with straight paraprocts. Sclerites of the phallosome consisting of two distinct halves, somewhat expanded distally, where they are split into one shorter and 2(3) longer claw-like processes.

Larva (figs. 108, 109). Head. Distinctly broader than long. Antennae of about the length of the head, spinose, slightly curved and tapering towards apex. Antennal tuft inserted about $\frac{2}{5}$ from the base of the antennal shaft. Tuft is of about $\frac{2}{3}$ the length of the shaft and with about 5 hairs. Sensory appendages and setae at apex rather short. Mouth-brushes not combed. The three frontal hairs of the same side are approximately in line with one another. Abdomen. Lateral hairs of the 3rd to 5th abdominal segment simple. Comb with about 14 scales

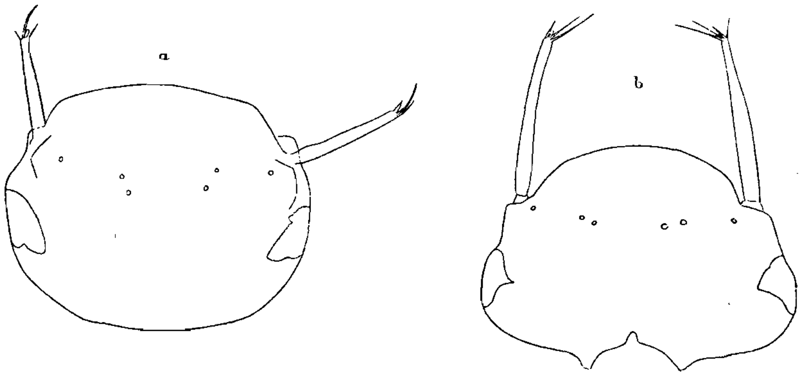

Fig. 108. Head of larva of *A. vexans* Meig. (a) and *A. cinereus* Meig. (b). (Aut. del.)

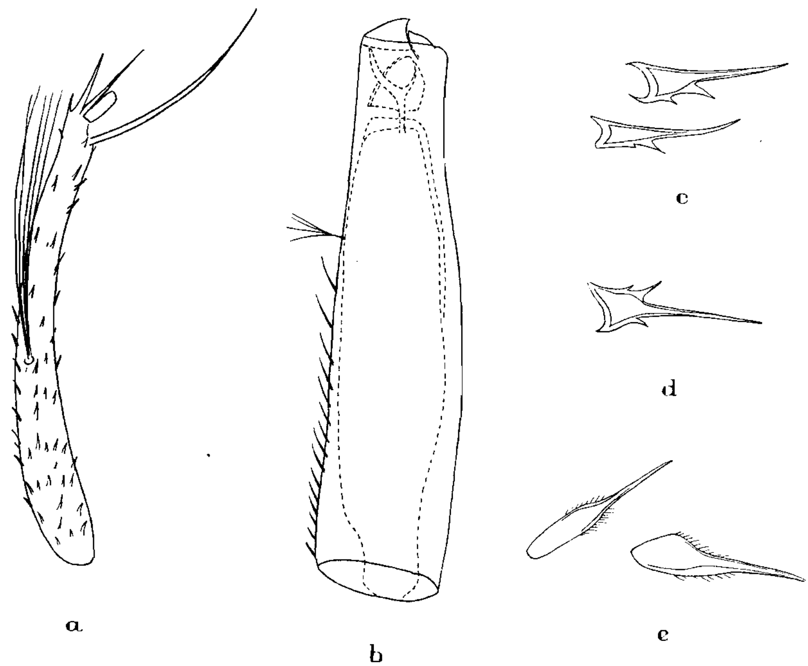

Fig. 109. Larva of *A. cinereus* Meig. in 4th instar.
a, antenna; b, siphon; c—d, pecten teeth; e, comb-scales. (Aut. del.)

arranged in a partly double row. Comb-scales with a broader basal part fringed with fine hairs and tapering in a long spine. Siphonal index: 3.8 Siphon faintly tapering towards apex. Pecten reaching well over the middle of the siphon, with about 14 teeth, of which one or two are detached. All teeth of the same shape. Siphonal tuft small, with 4—5 hairs and inserted at about $\frac{3}{5}$ the length from the base. Saddle of annal segment longer than high. Saddle-hair with two branches. Dorsal brush with an inner pair of tufts with about 7 hairs and an outer pair of long stout hairs. Ventral brush with about 8 cratal and 3 precratal hairs of moderate length. Annal gills long and tapering.

The larva of *Aëdes cinereus* differs from all other *Aëdes* larvae in the character of the mouth-brushes, which are composed of simple hairs only. In other *Aëdes*-larvae, at least the median brushes are furnished with comb-like teeth apically. In the Norwegian specimens at hand the dorsal protoracic hairs are damaged, but according to Martini (1931, p. 242) the prothoracic hair-formula is: 5, 1, 1; 2; 1; 1; 3; 2. In *A. cinereus* as well as in *vexans* one or two of the distal teeth in the pecten are detached. Whereas these detached teeth are of the same shape as the remainder in *cinereus,* they are plain (without denticles) and somewhat curved in *vexans.* Marshall (1938, p. 148) records, for English *cinereus,* a siphonal index of about 3, whereas, according to Martini, the siphonal index for German specimens is about 4. The few Norwegian larvae at hand thus nearly coincide with the German larvae concerning this character. In the single Norwegian larva, where the gills are relatively well preserved, the gill-saddle index is 2.3.

Table 33.

Larval chaetotaxis of *Aëdes (Aëdes) cinereus* Meig.

Number of brances in				Number of	
Frontal hairs			Siphonal tuft	Comb. scales	Pecten teeth
out.	mid.	inner			
6—13 9.5 (4)	4—5 4.3 (8)	3—6 4.9 (8)	4—5 4.3 (7)	10—14 11.8 (12)	13—16 15.1 (12)

Geographical distribution.

Denmark: *2. Sjælland:* North-Sjelland, 3. v.—2. vi. (W-L); Lyngby, 1. vi. 1918 (W-L); environs of København! ♂♀ (Stæg.). *Laaland:* vii. 1920 (W-L).

Sweden: *Sk:* Brunnsby, Mölle Mosse! ♀: 12. vii. 1938 (Tjed.). *Sm:* ♀ (Bhn); Ekeberga, Visjön! ♀: 13. vii. 1940 (KHF). *Ög:* ♀, (Hagl! P. Wg!). *Upl:* Hlm (Holmiæ)! ♀(Bhn); Nacka at Stockholm (Wahlb. Zett.). *Dlr:* Falun, Pilsundet! ♀: 24. vii. 1931 (Tjed.); Falun, Norslund! ♀: 5. vii. 1931 (Tjed.); Falun, Hökviken! ♀: 19. ix. 1926 (Tjed.); Falun, Östanforsan! ♀: 28. ix. 1928 (Tjed.); Ludvika, Brunnsvik! ♂: 10. vi. 1926, ♀: 12.—24. vi. 1920, 30. vii. 1924, 2. ix. 1924 (KHF); Sundborn, Karlsbyn! ♀: 6. vii. 1941 (Tjed.). *Ly.Lpm:* Lp. interm! ♀ (Bhn); *Lu.Lpm:* "Lapponia Lulensi! (ad Quickjock)" (Zett), ♀: (= *C. nigritulus*)!

Norway: Ø: *1. Hvaler:* pool at the border of Arekilen, L. P.: 24. v. 1928, (♂) (LRN). HEs: *12. Romedal:* ♀: 19. viii. 1931 (LRN). HEn: *20. Trysil:* pond south of Plassen, L: 31. v. 1935 (LRN). Os: *25. Ringebu:* flooded meadow, ♀: 29. vii. 1930, ♀: 26. viii. 1931 (LRN). Bø: *13. Øvre Eiker:* pond at Darbu, L: 3. vi. 1928 (♂♀) (LRN). TEy: *7. Bamble:* pool at Hullvann, L: 5. vi. 1930 (♂) (LRN). AAy: *14. Fjære:* Little pond at Grimstad, P: 5. vi. 1930 (♂♀) (LRN). VAi: *34. Hægeland:* pond at Høivold Hotel, L: 8. vi. 1931 (LRN). TRi: *27. Målselv:* Rundhaug, L: 19. vi. 1938 (Sandmo).

Finland: *Al(A):* Finnström! ♀. (R. Frey). *Ab(V):* Uskela (Bonsd.). Karislojo (Krogerus, J. Sahlb. Forsius); Lojo! ♂ (Storå). *N(U):* Tvärminne! ♂: 18. vi. 1935 (Storå); Kyrkslätt (Frey). *Ta(EH):* Sysmä! ♀ (Hellén); Messuby (Frey). *Ka(EK):* Kivikoski, Rajala! ♀, (Adelung). *Kb(PK):* Juuka! ♀: 24. vi. 1940 (Krogerus).

Distribution outside Denmark and Fennoscandia.

According to Marshall (1938, p. 149) *A. cinereus* has been found in Britain in the following counties: England: Cambs, Hants, Herts, Hunts, Middlesex, Norfolk, Suffolk, Surrey, Warwickshire; Wales: Glamorganshire; Scotland: Argyllshire, Pertshire. The species has also been recorded from Clackmannanshire, Midlothian, Oxon and Dorset. De Meijere (1911, p. 148) records it from the Netherlands; Goetghebuer (1925, p. 214) from Belgium: Destelbergen, Eecloo, Helle, Vinderhaute, Bellem (Fl.); Gemval (Brux.)

(Tonnoir); Virton (Jur.), V—VII. Séguy (1923, p. 104) remarks: "Toute la France — — — Luxembourg", Eckstein (1920, p. 342) records it from Strassburg and Brolemann (1919, p. 66) from Basses-Pyrenées. In Germany *A. cinereus* is among the most common and most widely distributed species (Peus 1929 b, p. 11). Thus Martini (1920 a, p. 94) records it from Rostocker Heide, the environs of Hamburg and from Danzig, Peus (1929 b, p. 11) from: "Dahlem, Grünewald, Finkenkrug, Bresslau, Usedom, Zinnowitz, Swinemünde, Chorinchen und Plagefenn (Mark), Grumsin, Darss (Vorpommern)", Schneider (1914, p. 25) from the environs of Bonn and Eysell (1902) from "Habichtswald oberhalb Wilhelmshöhe (Kassel) und Mannheim". From Switzerland it is recorded from Bern (Bangerter 1926). Further eastwards *A. cinereus* is recorded from Estland: Dorpat (Dampf 1924), from Lettland: "Bienenhof (Riga), zwischen Uexküll und Oger und bei Abanshof" (Peus 1934, p. 78) and from Poland (Tarwid 1935, 1938 a—b). According to Schiner (1864) the species is rare in Austria; it has also been found in Hungary: Balaton (Mihályi 1941) and Italy: Sondrino (Bezzi t. Edwards 1921, p. 324). According to Stackelberg (1937, p. 192) the species has been recorded from the following localities in USSR: "District of Leningrad: Environs of Peterhoff (Montschadskiji), Sablino (Stackelberg!), distr. of Moscow (Nikolskiji!) and distr. of Voronesch (environs of Voronesch: Schtschelkanovzev), Lower Volga distr. (Martini), Sverdlovsk distr. (environs of Sverdlovsk: Kolosov!), North Kaukasus (Kubanj: Dobrovolskiji!), Kasakstan (Almaata: Olsofjev!), Siberia: Omsk (Granö t. Edw.), (Jenisejsk), Torchansk (Trybom t. Edw.), Blagoweschinsk at Amor (Popov!), Udinsk at Amor (Maslov!)." [106] Further Wnukovsky (1928, p. 164) records the species from the following places in the distr. of Tomsk: Nowoalekssandrowskoje, Schukowo and Tschulym; in all places found ultimo July. In the American continent the subspecies *Aëdes cinereus fuscus* O. S. has a wide distribution from the Canadian forested region to Arkansas in the south. In the Californian mountains, at about the 7 000 feet level, a special modification, *A. cinereus* hemiteteus, occurs. (Dyar 1924 c, p. 179, Dyar 1928, p. 239). Recent records are: Maine (Bean 1946), Rhode Island (Knutson 1943), Massachusetts (Tulloch 1939), Michigan (Irwin 1941). Utah (Don M. Rees 1942).

Biology.

Only in one place, a flooded meadow at Ringebu (Os 25) I have found species in number, ultimo July 1930 and ultimo August 1931. Near the highway were several, partly shaded pools. I visited the place in the afternoon but the sun was still shining. As I bent down to examine one of the pools for *Anopheles* larvae, I was attacked by the small *Aëdes cinereus*. Once more I have been attacked by this species under similar conditions. In August 1931 I was resting in my motor-car in Romedal (HEs 12); it was bright sunshine but the motor-car was placed in the shadow. A female *cinereus*

[106] Translated from the Russian text.

entered through the open window and immediately attacked my hand.

Larvae have been found in the time 25. v.—8. vi, partly in ditches at the border of lakes (Arekilen, Ö 1), partly in open-lying pools and ponds. To be sure, I have not actually found the larva of *A. cinereus* in Ringebu, but I am convinced that the pools near the highway are the breeding-places. The degree of pH in this place was: 6.5 (26. viii.). Larvae of *A. cinereus* have been found associated with larvae of *A. (O) communis, intrudens* and *Anopheles maculipennis*. The Norwegian finds indicate that *A. cinereus* has only one generation, which seems to be confirmed by the dates on the labels of the Finnish (24. vi.) and Swedish (12. vi.—28. ix.) adults.

As to the conditions in D e n m a r k, Wesenberg-Lund (1920—21, pp. 38—39) remarks: "The life-history of *A. cinereus* is in our country most probably as follows: Males and females die off before autumn; the males most probably already in June—July; the larva stage is extremely short, only from eight to ten days; the pupa-stage lasting normally only a few days; the species hibernates only as egg; the eggs are hatched rather late, not before the last part of May; the pools, in which they are hatched, are dried up a fortnight later; the eggs must therefore be laid upon dry land and undoubtedly singly; most likely there is not time for more than one generation; this generation has only one brood, and this brood lives for three or four months." Wesenberg-Lund also made some observations on the bloodsucking of this mosquito and he says: "The sting was almost imperceptible and they had great difficulty in getting blood, the skin being too thick; afterwards, as my hands had got more than fifty punctures, it was covered with a common purple colour and rather aching."

As pointed out by Martini, this little mosquito is rather inconspicuous and it has therefore been estimated a rare species. He further says: "Sie ist aber in geeigneten Gegenden sehr häufig und kommt in solchen Mengen vor, daß sie eine schwere Plage werden kann. Allerdings bleibt sie am Tage gern tief im Kraut verborgen. — — — Bei regnerischem Wetter zeigt sie sich etwas stärker. Erst Abends kommt sie höher, um in der Zeit des Dunkelwerdens ganz hoch anzufliegen."

As to the habitat Peus (1932, p. 141) emphasises: "Diese kleine, aber recht aggressive Mücke — — hat ihr Optium in den lichten, nicht alzu geschlossenen Walddistrikten, in den Auwäldern und dem nur mit zerstreutem Weidengebüsch bestandenen Wiesengelände." Lang (1920, p. 80) says: "The general situations indicated in the British records sugest that it is mainly a river haunting species", which agree with the observations published by Martini from the Lower Volga. In contradistinction to this, Wesenberg-Lund (1920—21, p. 39) remarks: "It may be found in the forests, along the shores of larger ponds and upon the open plains; I have never seen any special predilection for river valleys."

Concerning the bloodsucking habits Twinn (1931, p. 6) reports from Canada: "This small woodland species inflicts a rather painful bite, attacking both during daytime and at dusk", but King, Bradley and McNeel (1939, p. 48) say: "This is a comparative rare northern species that has been recorded from Arkansas, where it was said to be abundant but a nonbiter."

Eysell (1902) emphasises the peculiar resting position of *A. cinereus* If resting on a vertical surface, the mosquito raises its hindlegs distinctly above the abdomen, and often it rests on the forelegs and one mid-leg only.

Subgenus *Aëdimorphus* Theobald 1903. (*Ecculex* Felt. 1904.)

This subgenus is well characterized by the peculiar male terminalia. Edwards (1921, p. 322) also points out that the male palps generally are not longer than the proboscis, but this does not fit in with the northern *vexans*. According to Peus (1929 b, p. 11) the length of the male palps is very variable, at least in German Specimens, and he figures (l. c.) four specimens where the palps, in part, are conspicuously longer than the proboscis. I made some slide preparations of Canadian specimens in our collection, where the male palps exceed the proboscis with approximately the length of the ultimate segment. The female, in most cases, is recognised by the shape of the basal abdominal whitish bands which are distinctly narrowed in the middle and have the distal margin laterally curved to meet the margins of the tergites. They thus form B-shaped figures and are flanked by detached lateral stripes. *A. vexans* may further be distinguished from the other northern ringed-leg species by the uniformly dark scaled wings and by the absence of white rings on the fourth and fifth tarsal segment of the fore-leg.

The subgenus *Aëdimorphus,* with 54 species, habitates the Ethiopian, Oriental and Australian region, and only one, widely distributed, species extends into our region.

Aëdes (Aëdimorphus) vexans Meigen.

A. vexans Meig. (Syst. Beschr. *6,* p. 241) 1830
? *C. parvus* Macquart (Suites à Buffon, *1,* p. 36) 1834
C. articulatus Rondani (Bull. Soc. Ent. Ital., *4,* p. 30) 1872
C. malariae Grassi (Atti Acc. Lincei, *7,* p. 168) 1898

C. nocturnus Theob. (Mon. Cul. *3*, p. 159) 1903
? *C. arabiensis* Patton (J. Bombay Nat. Hist. Soc., *16*, p. 663) 1905
C. sylvestris Theob. (Mon. Cul. *1*, p. 406) 1901
C. montcalmi Blanchard (Les Moust. p. 307) 1905
Culicada minuta Theob. (Mon. Cul. *4*, p. 338) 1907
? *Culicada eruthrosops* Theob. (Mon. Cul. *5*, p. 299) 1910
C. nocturnus var *niger* Theob. (Nova Caledonia, *1*, p. 164) 1913
Aëdes euochrus H. D. K. (Mosq. N. C. Am. *4*, p. 716) 1917
var. *nipponi* Theob. (Mon. Cul. *4*, p. 337) (*Culicada*) 1907

Systematical remarks.

Edwards (1921, p. 332) says: "Two varieties occur in the Palaeactic region: the typical form, in which the abdomen has only the emarginate white bands on a dark ground; and the variety *nipponi*, Theobald, in which the abdominal segments have, in addition to the bands, a median whitish patch."

Concerning the shape of the phallosome, the opinion of the authors diverge. Martini (1931, p. 261) says: "Unter allen *Aëdes*-Arten der paläarktischen Region, ist es am schwierigsten, dieser eine Stellung anzuweissen. Während sie sich im Hypopygium solchen Formen wie *A (Stegomyia) Galloisi* Yamada nähert, läßt sie doch die dort starke Faltenbildung am Distalende des Penisskleriten vermissen." Felt (1904, p. 391 c), in his diagnosis of the subgenus summarily remarks: "Harpagones terminated by three long curved spines." Brolemann (1920, p. 53) depicts the phallosome and emphasises as to its shape: "Lorsqu'on regarde le cylindre par la pointe, on voit que la partie apicale de ses parois chitinisées est coupée de plis obliques festonnent sa silhouette; mais il n'existe aucun prolongement distinct et on doit par conséquent considérer l'organe comme du type simple, du même type que dans les genres precedents", (*Culicada, Theobaldia*). However, as far as I can see from the slide preparations at hand, (2 Canadian and 1 Danish), the sclerites of the phallosome is slit apically in several curved teeth, namely, on each side, a greater apical tooth, accompanied by 2—3 smaller lateral ones. Thus the phallosome of *A. vexans* occupies an intermedian place between the phallosome of *A. cinereus*, which is apically slit into several claw-like teeth, and the broader type of the phallosome in the *Stegomyia*-species with its richer formations of apical folds.

According to Martini (1931, p. 260), *A. vexans* is rather variable. Thus the white rings on the tarsal segments may be very narrow or they are even wanting, as in specimens from the lower Volga district. In other specimens they may occupy the basal third of the segments. The light scaling on the abdominal tergites may be pure white or light brown, and more or less conspicuous.

In the northern specimens the dark parts of the abdominal tergites are metallic, but according to Martini these parts have steel-coloured reflections in newly-hatched specimens. No essential differences can be found in the genitalia of Canadian and Danish *vexans*.

Description.

Female. Front of head with some golden hairs forming a tuft between the eyes. Vertex ("occiput"), in the middle with yellowish-white narrow curved scales and yellowish or dark brown upright forked scales; on the sides, in front with a patch of dark flat scales, behind and on the temporae with broad, flat whitish scales. Eyes bordered with a row of black bristles. Clypeus blackish brown. Proboscis somewhat longer than the fore-femurae; dorsal side, apically blackish-brown, at the base and the middle more or less light scaled; under side with many light scales. Antennae. Tori yellowish-brown or dark brown, on inner side with some white scales. Flagellum. First segment yellow or yellowish-brown at the base and with brown apex. Some white scales may occur at the first segment. Remainder of flagellum dark brown, clothed with minute white hairs, and bigger dark brown hairs at the base of the segments. Palpi short, about 1/8 the length of the proboscis. Scaling blackish brown, with some white scales apically. With long, blackish-brown bristles. Thorax. Anterior pronotal lobes with whitish narrow curved scales and bristles. Posterior pronotum blackish brown, clothed with cupreous narrow curved scales and whitish scales at the posterior border; in the Norwegian specimens the white scales are more predominating than in the Canadian ones. Mesonotum with cupreous, hair-like scales which are shading into lighter narrow curved scales at the lateral border and at the antescutellar space. In the two Swedish females the anterior border of the mesonotum is clothed with lighter scales, extending backwards into a short stripe on each side. These stripes are distinctly yellowish in one of the specimens. Scutellum with yellowish-white narrow curved scales and golden bristles. Wing. Stem of the fork r_{2+3} about 2/5—3/5 as long as the fork. Stem of the fork m_{1+2} of about the same length as the posterior branch of the fork. Shift of the cross vein m-cu about: 1.0. Scaling of the wings dark brown. H a l t e r e s pale brown with darker globule. L e g s. Femora of fore and midd leg: base and ventral side yellowish-white, dorsal side and apex dark; femur of hind leg more plain dark white scattered light scales. Knee spot dirty white. Tibia dark brown on dorsal side; on ventral side often lighter with a small light spot at the base and apex. Tarsal segments dark brown, in the fore leg with basal white rings at the segments 1—3, in the mid-leg with white basal rings at the segments 1—3 (rarely: 1—4), in the hind-leg with basal white rings at all segments. A b - d o m e n. Ground colour metallic, with basal white bands which are conspicuously narrowed in the middle and flanked by detached lateral spots. In one of the Norwegian specimens the bands merge into the lateral spots. Venter whitish scaled. Cerci long. Length of wing about: 3.8 mm.

M a l e. A n t e n n a e. Torus dark brown. Flagellum whitish and dark-brown ringed. Hair-whorls glossing dark greyish brown. P a l p i exceed the proboscis by about the length of the ultimate segment, which is tapering towards the apex. White ring at the base of the third, fourth and fifth segment. Hairs-tufts dark brown, especially long at the third and fourth segment.

T e r m i n a l i a (fig. 110). Basistyle slender, without basal and apical lobe. Dististyle broad, somewhat widening towards the divided apex. One shorter arm bears a stout spine, the other, longer arm with a comb-like structure of small setae distally. Claspettoid with a short, stout stem ornamented with a dense crown of long hairs at the apex. Sclerites of the phallosome small, with broad lateral wings in the basal half and distally with a row of strongly curved teeth. Proctiger with faintly sclerotised paraprocts which are distally furnished with some blunt teeth. Lobes of the ninth tergite widely separated and with few setae.

L a r v a (fig. 111). Head somewhat broader than long. Antennae of about half the length of the head, with few spines and faintly tapering towards the apex, which is furnished with two sensory appendages and three setae. Antennal tuft inserted about 1/3 from the base of the antennal shaft, of well over half the length of the shaft and with about 6 hairs. Inner mouth-brushes stout, curved and apically combed. Inner frontal hairs somewhat behind the mid frontal hairs. Abdomen. Comb with about 11 narrow

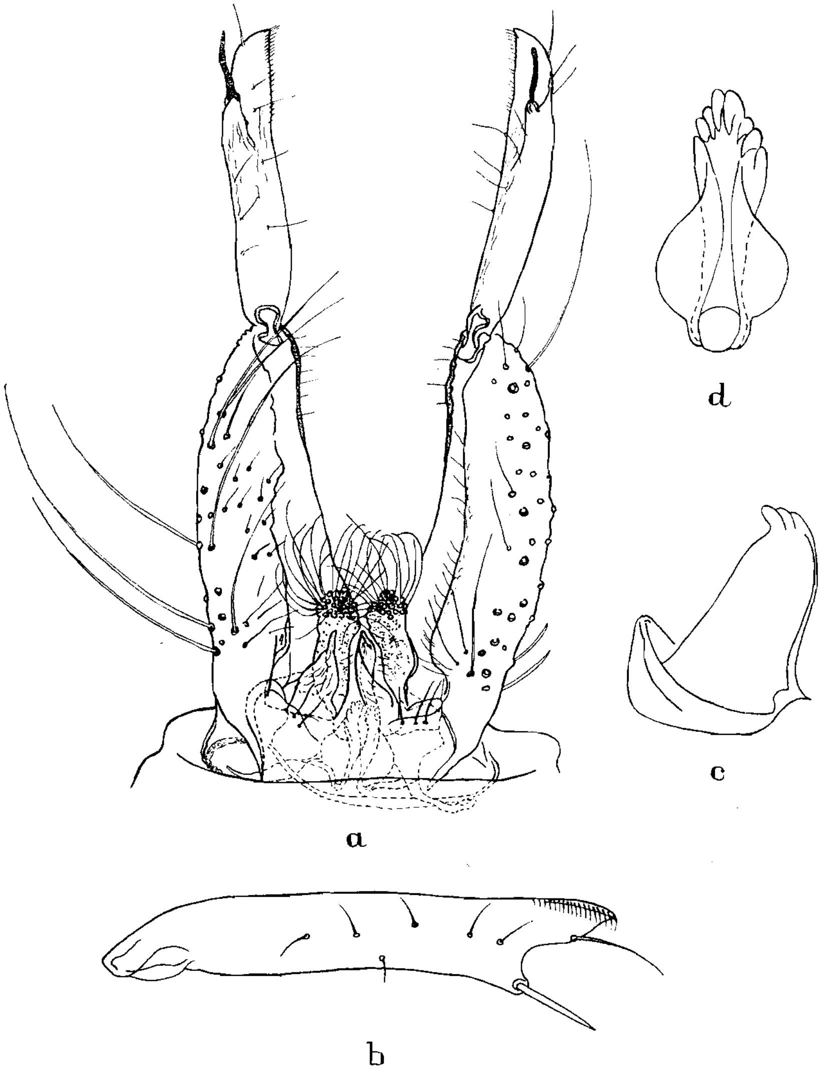

Fig. 110. *Aëdimorphus vexans* Meig.
a, Terminalia (total view); b, diststyle (side view); c, paraproct (side-view); d, sclerotised parts of phallosome. (Aut. del.)

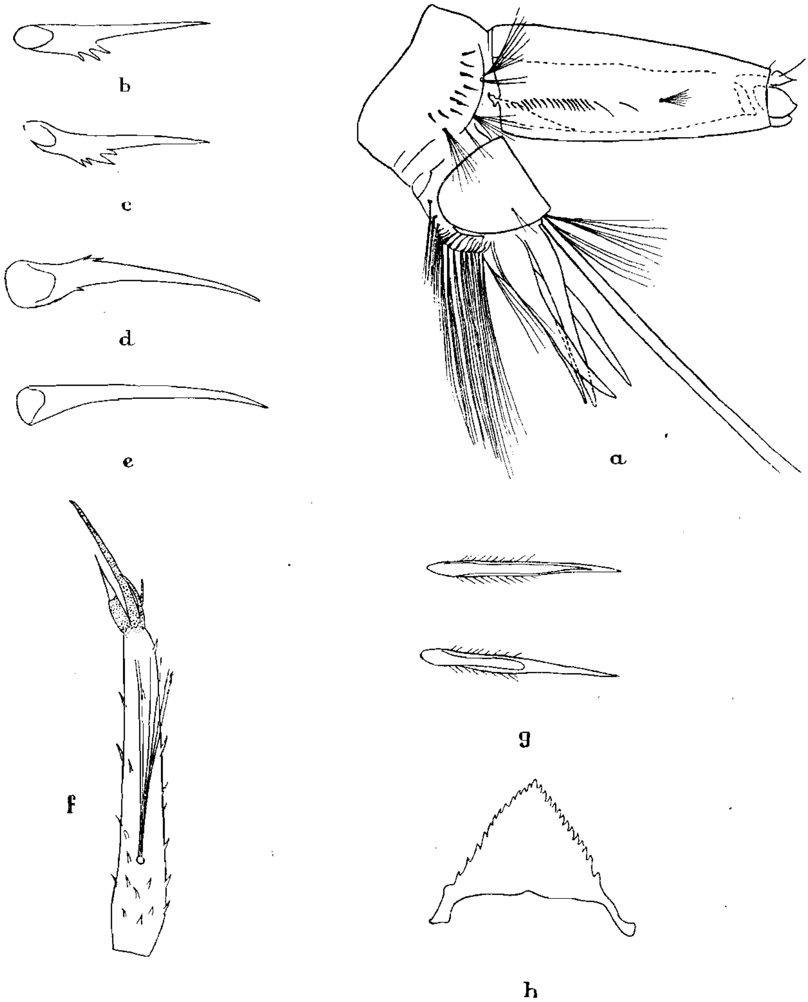

Fig. 111. Larva of *Aëdimorph. vexans* Meig. in 4th instar. a, Terminal segments of larva; b—e, pecten teeth; f, antenna; g, comb-scales; h, mentum. (Aut. del.)

scales which are fringed with fine hairs in the basal half. Comb-scales nearly in a row. Siphon apically somewhat tapering. Siphonal index: 2.6. Pecten reaching about the middle of the siphon, with about 18 teeth of which the two distal ones are detached and somewhat larger than the others. The teeth are furnished with some basal denticles, but the detached teeth are mainly without denticles. In one Danish larva, however, one of the detached teeth has two minute dorsal, and one ventral denticle. Siphonal tuft small, with about 5 hairs and inserted at about ⅔ the length from the base of the siphon. Saddle of anal segment of about the same length as height. Dorsal brush, with an inner pair of tufts with about 6 hairs and an outer pair of long stouter hairs. Ventral brush with about 11 cratal and 3 precratal tufts. Anal gills tapering.

Table 34.

Larval chaetotaxy of *Aëdes (Aëdimorphus) vexans* Meig.

Number of branches in				Number of		Siphonal index
Frontal hairs			Siphonal tuft	Comb scales	Pecten teeth	
outer	mid.	inner				
8—9	3	4—5	5—7 5.6 (5)	10—12 11 (4)	15—21 18 (6)	3.5—4.3 3.8 (4)

According to Martini (1930, p. 260) the frontal hair formula is: 1—3 or 1—4 and Marshall (1938, p. 205) records as to English specimens: 1—3 or 2—4.

Geographical distribution.

Denmark: 2. *Sjælland:* Dyrehaven at København! ♂♀: 28. vii. 1938 (Anthon).

Sweden: *Sk:* Råå! ♂: 14. viii. 1918 (O. Ringdahl); Brunnby, Lerhamn! ♀: 9. vii. 1938. (Tjed.). *Öl!:* ♀, (Bohem.); Vickleby 29. vi. 1908 (Wahlg.).

Norway: *Os: 25. Ringebu:* meadow near the river Laagen, ♀: 26. viii. 1931 (LRN).

Finland: *N(U):* Helsingfors (Frey); Tvärminne zoolog. Station (Levander).

USSR: Southern Karelia, X. (Olenev, 1936).

Distribution outside Denmark and Fennoscandia.

Concerning the general distribution of *A. vexans*, Edwards (1921, p. 323) says: "Apart from the domestic species (*Culex pipiens, C. fatigans* and *Aëdes argenteus*), this species is the most widely spread of all mosquitoes, occurring practically throughout the Palaearctic. Oriental and Nearctic regions. Possibly it may have had its origin in tropical Africa, where there are a number of related forms, but if so its apparent absence from that region at the present time is remarkable." In Great Britain *A. vexans* has only rarely been found, and Marshall (1938, p. 206) records seven scattered finds in all from southern England and Wales. In one place, Finchley (London) in September 1927, the species appeared very abundantly, but Marshall remarks: "It is perhaps reasonable to suggest that the accidental importation of "dry-laid" eggs from the Continent — — — cannot be regarded as altogether impossible." It is further recorded from the Netherlands, (Séguy, 1923, p. 115), Belgium: Gand (Fl.); Genval (Brux) (Tonnoir), (Goetghebuer, 1925, p. 214); "commun dans le centre et le sud de la France", (Séguy, 1923, p. 115); Strasburg (Eckstein, 1920, p. 342). Brolemann (1919, p. 66) records it from Basses-Pyrénées; Séguy (1923, p. 115) from Spain: Salines de San Fernando (Czerny), Elche (Strobl) and Madrid (Arias), and Braga (1931, p. 61) from Portugal. In Germany the species has been found: "bei Hamburg, in der Rostocker Heide bei Gral, in der Gegend von Danzig" (Martini, 1920, p. 138); at Hildesheim in the province of Hannover (Henkel, 1936); "bei Bonn in der Siegniederung und in dem Mündungsgebiet der Sieg" (Schneider 1914, p. 32); "die Hauptentwicklungsgebiete liegen in den Oderniederungen und besonders in der Loheniederung" (Peus 1929 b, p. 10); further it is found in Berlin-Dahlem, Tiefwerder at Spandau, at "Faulen See", Usedom, Swinemünde, Zinnowitz, Breslau (Peus 1929 b, p. 10) and at Mannheim (Eckstein, 1920, p. 342). From Switzerland the species is recorded from Bern (Bangerter 1926). In Italy it is recorded from Susa, Sondrino, Macerata, Chivasso: Bazzi (Edv. 1921, p. 323). In the eastern part of Europe the species has been found in Lettland (Peus, 1934 b, p. 78), in Estland at Pernau (Dampf, 1924), in Lithuania: Bialowies (Sack, 1925, p. 264) and in Poland (Tarwid 1938 a—b); further south: in Austria (Schiner 1864) and Hungary: Balaton (Mihályi 1941). As to USSR, Stackelberg (1937, p. 190) records the following finds: "Distr. of Leningrad (environs of Peterhoff: Montschadijii, environs of Luga: Stackb!). Distr. of Moskva (Nokolskiji), Distr. of Voronesch (environs of Voronesch: Schtschelkanovzev!) Ukraina (Korob: Tischtschenko! Karkov: Tischtschenki! Dnepropetrovsk: Guzevitsch!). Distr. of Lower Volga. (Environs of Saratow: Martini.) Southern coast of Crimea (environs of Jalta: Velitschkevitsch!); N. Kaukasus (Kubanj: Dobrovolskiji!), Dagestan, Transkaukasia (Georgia, Armenia, Azarbersjan); Kasakstan (environs of Alma-ata: Olufjev!); South-Siberia (Minusinsk: Koschantschikov!); Turkmenia (Aschabad: Ahnger t. Edw.); Usbekistan (Taschkent, Mirzatschul: Montschadskiji!)."[107] Further records are: Kaukasus: Maschuk, Sjelesnivodsk (Mess 1929), Sotschi distr. (Baschkareva 1931); Ferghana: Andisjan (Simanin 1929); Kirgisia: Issyk- Kulsk valley (Petrischtscheva 1940). Guzevitsch (1937) records *A. vexans* as very abundant in the Russian Far East, chiefly in the Province of Ussuri. Here the species was also taken on man in houses. Waterston (1922, p. 133) records *vexans* from Macedonia. According to Edwards (1921, p. 323) the species has also been found in Asia Minor (Konia: Naday). Iran (Enzeli: Buxton), Aden (Kazan Chand: Barraud) and in Corea (Yamada). Henning (1941, p. 35) records the species from Formosa, Sundar Rao (1942) from Assam and Edwards (1928, p. 46) remarks as to its distribution in the Pacific:

[107] Translated from the Russian text!

"It occurs on many other Pacific islands, including the New Hebrides, New Caledonia, Fiji and Tonga, but there are no certain records from farther east than Samoa."

Also in the American Continent *A. vexans* has a wide distribution. As to Canada, Twinn (1926 b, p. 88) remarks: "This species is one of the most widespread and troublesome mosquitoes of the Quebec woodlands" and (1931, p. 8) "The species — — — may be considered as the paramount rainpool mosquito of eastern Canada." Mc Lintock (1944) records it as one of the principal species in the Greater Winnipeg area. Concerning its distribution in USA Dyar (1928, pp. 237—8) says: "The species is not found in the forested Canadian Zone, but inhabits all the country south of that to the Mexican border. It does not occur in the American tropics." Among other places it is reported from the Lower Columbia River valley (Stage, Gjullin and Yates, 1937); Minneapolis—St. Paul, Minn. (Riley and Chalgren, 1939); Colorado (James, 1942); Arkansas (Horsfall 1936); New Orleans, Louisiana (Dozier, 1936). Further King, Bradley and Mc Neel (1939, p. 46) remark: "It is seldom abundant in the extreme south and the writers have taken only occasional specimens in Florida." Recent records are: Maine (Bean 1946), Rhode Island (Knutson 1943), Massachusetts (Tulloch 1939), Michigan (Irvin 1941), Missouri (Gurney 1943), Nebraska (Tate and Wirth 1942) and Colorado (Lasky 1946), Utah (Don M. Rees 1942).

Biology.

There are no detailed accounts on the biology and ecology of this species in Denmark and Fennoscandia. However, the scattered finds indicate that the species has its northern limit of distribution in the southern part of Fennoscandia. Concerning the northernmost find in Scandinavia, Ringebu (Os 25) in Norway, I am somewhat in doubt whether *A. vexans* develops in this place, or if the specimens have been carried by wind or in some other way. The place, a meadow near the river Laagen, is most probably flooded in spring, and in several, partly shaded, pools near the highway, larvae of *Anopheles maculipennis* have been found. Adults of *Aëdes cinereus* have also been caught near the pools in 1930 and 1931, but only once I found 2 females of *A. vexans*. The two finds of males, 28. vii (Denmark) and 14. viii. (Sweden), give some indication as to the hatching time of the adults in our region. However, further investigation as to the area of distribution in Scandinavia is greatly needed.

According to Martini (1931, p. 261) the species may have several generations if the conditions are favourable: "So in Überschwemmungsgebieten mancher Flüsse oder auf Rieselwiesen, wo sie nach der Unterwassersetzung im Frühjahr, in Sommer und, wenn eine dritte Rieselung erfolgt, in Herbst, in großen Larvenmengen auftreten kann. In vielen Gebieten dürfte sie im wesentlichen einbrütig sein. So in den Hochwassergebieten der Schweitz (Hurther 1926), auch in den Hochwassergebieten Anatoliens, wo sie im Märtz in großer Menge vorhanden ist in den Hochwassern der Flüsse und später mehr oder weniger verschwindet." Concerning the conditions in the Lower Volga district Martini 1928 c, p. 56) remarks: "Wenn auch die Fangplätze der Imagines an recht verschiedenen Stellen lagen, — — — ist doch die Wolga erst das Hauptgebiet dieser Mücke. Auf den Wolgawiesen und Inseln ist sie ganz ungeheuer häufig und bei weitem die Vorherschende Mückenart überhaupt. — — — Im ganzen fand ich sie aber fern von der Wolga nie häufig, auch nicht an Steppenflüssen und Teichen."

In a paper on the mosquito fauna at Straßburg Eckstein (1920, p. 100) says, concerning *A. vexans:* "Die Aedinen, die ihre Eier an den Rand temporärer Tümpel aufs Trockene ablegen, bedürfen zum Ausschlüpfen derselben eines Anstiegen des Grundwassers. — — — Steigt das Wasser während der Wintermonate, so schlüpfen die Eier im allgemeinen nicht aus." From Eastern Canada, Twinn (1931, pp. 9—10) reports: "The most favored breeding places of *A. vexans* Mgn., are shallow, transient water bodies exposed to the sun. — — — The winter is passed by *A. vexans* Mgn., in the egg stage. — — — Temperature undoubtedly is an important factor in the hatching of the eggs. We have found newly hatched larvae in mid-June (1929) in warm rain pools in scrubby woodland, which for nearly two months, in April and May, had been under cold river floodwaters — — —." The problem concerning the hatching of the eggs has been investigated more recently. Thus Gjullin, Yates and Stage (1939) remark: "Experiments carried out — — — demonstrated that only 2 percent of the eggs of *A. vexans* hatched when they were flooded in the laboratory with tap-water or with water from the river. The eggs required the stimulus provided by leaves and grass. The substances causing the stimulus were found to include six amino acids." In the most recent paper by Gjullin, Hegarty and Bollen (1941), the authors give the following very interesting details: "It is shown that a reduction of the dissolved oxygen from about 7 to below 3 parts per million in the medium in which the eggs of *Aëdes vexans* are immersed will cause them to hatch. — — — The stimulus causing the eggs — — — to hatch in nature may be the reduction of dissolved oxygen by organic material, bacteria and other organisms in the water. When temporary floods cause hatching in nature, the newly hatched larvae are normally found only in shallow water. It is only in such water that a reduction of dissolved oxygen can occur, as deep or running water should not normally contain enough bacteria or organic matter." An important discovery as to the resistence of this species in favourable places is published by Strong (1938 and 1940), who in the last paper says that: "Eggs of *A. vexans* would remain viable in the soil for at least 6 years", and in the most recent paper on this problem, Annand (1941) i. a. says: "Studies in the north-western States showed that eggs of *A. vexans* — — — will remain viable in the soil for at least 7 years, although after 5 years less than 1 per cent as many eggs hatched as previously."

The migratory habits of *A. vexans have* repeatedly been recorded from different places. Martini (1931, p. 262) says: "Sie wandert ziemlich weit" and Twinn (1931, p. 8) records: "At Ottawa it invades the city from outside points two to three miles distant. Hearle, in Western Canada, reports that species probably can migrate ten miles with ease." From experiments carried out in Illinois, with mosquitoes dusted with aniline dyes, Clarke (1943) reports: "Six females and nine males of *A. vexans* were taken 14 miles from the starting area. This proves that, contrary to expectation, the males fly as far as the females."

However, the distribution of this species not only takes place by active migration, but the mosquitoes may also be dispersed by wind. In a paper on the insects of Samoa, Buxton (1935, p. 43—4), i. a. remarks: "The carriage of insects over great distance by wind, and in particular by the current of the upper air, may be of great importance; it is now becoming possible to investigate it, and a considerable body of facts already exists. — — — The mosquito, *Aëdes vexans*, occurs in the Palaearctic and Nearctic Regions, including many places which are quite cold; it is also known from a number of parts of Asia and it extends eastwards as far as Samoa; it is even known to occur on some Polynesian atolls. Wherever it occurs it tends to breed in shallow, temporary pools, and to disappear from a locality after existing for a generation or two; there is no reason for thinking that it is introduced by man, and it seems likely that it owes its wide and erratic distribution to winds." This point of view has been stated by experiments. Thus Glick (1939) reports from research on the aerial distribution of Arthropods carried out in north-eastern Louisiana and in northern Mexico, by means of screens smeared with an adhesive and attached to aeroplanes, that, among other insects, also 4 specimens of *A. vexans* were taken at 5000 feet. One of these mosquitoes was alive when removed from the screen. According to Pemberton (1944), all aircraft stopping at Honolulu on their way across the Pacific were inspected for insects. Among the insects taken, were dead specimens of *A. vexans*.

From most parts of its area of distribution the records coincide that *A. vexans* is a persistent biter which causes serious annoyance both to man and beast. Such records are i. a. published from England (Marshall, 1938, p. 206), Germany (Eckstein, 1920, p. 347; Martini, 1931, pp. 261—2; Peus, 1929 b, p. 10, 1932, p. 184) Switzerland (Hurter, 1926, p. 32—3); France (Séguy, 1925, p. 68); USSR (Guzewitsch, 1937; Martini, 1928 c, p. 56); Canada (Twinn, 1926 a, p. 88); USA (Dyar, 1928, p. 238; King, Bradley and McNeel, 1939, p. 46; Matheson, 1928, p. 109) and Fiji (Lever, 1943). Dyar (1928, p. 238) emphasises that in USA *A. vexans* is an outdoor species, not entering houses, but from the Province of Ussuri, USSR, Guzewitsch (1937) records that the species was also taken on man in houses. An idea of the enormous number in which this species occurs in favourable places may be had from a paper on the mosquitoes in Canada, published by Twinn (1931, pp. 9—10); "The numbers of larvae and pupa that occur in the breeding places varies markedly, but it is not unusual to find, in shallow pools, as many as (approximately) 5000, 10 000, and 20 000 to the square foot of water surface." From Luzern (Switzerland) Hurter (1926, p. 32—3) estimates the number to approximately 10 000 per square meter of water surface.

Genus *Culex* Linnaeus 1758.

As remarked by Edwards (1921, p. 328) this genus is sharply distinguished by the possession of distinct pulvilli; they may be clearly seen in the hind-legs of the male as well as on all the feet in the female (fig. 6).

The eyes are narrowly separated or even touching above the antennae. Proboscis not or scarcely longer than front femorae. Palpi of male long, slender and with the last

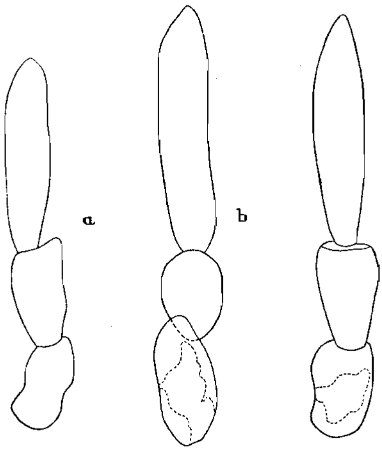

Fig. 112. Female palpi of *Culex*.
a, *C. apicalis;* b, *C. pipiens;* c, *C. torrentium.* (Aut. del.)

two segments directed upwards (pl. XII). Female palpi short. I have examined slide-preparations of female palpi of the northern species of *Culex*. They did not exhibit any distinct characters that could be of use for differential purpose. However, slight differences in the shape and relative length of the segments exist (fig. 112), and possibly these may be of systematic importance, but further investigation on a larger material is needed to settle the question. Spiracular and postspiracular bristles absent. Wing. Stem of the fork r_{2+3} shorter than the fork itself. Legs. Hind-tibia mostly without tibial scraper. Tarsi dark. First tarsal segment of hind-leg as long as, or longer than, the tibia. Female abdomen blunt, cerci short and broad.

Male terminalia. Basistyle without scales, but with a subapical lobe bearing spines and appendages of varying shape.

Larva. Head broad, antennae long, more or less conspicuously curved. Sub-apical bristles somewhat removed from the tip of the shaft. Antennal tuft large, inserted well beyond the middle of the antennal shaft. Siphon long and slender, with several pairs of ventral tufts.

The genus *Culex* is divided in several subgenera, two of which are represented in our region,, viz. *Neoculex* (with one species) and *Culex* (with three species). The subgenera are founded principally on the shape of the male terminalia, but in our fauna, with its limited number of species, also other characters may be useful for differential purpose.

As emphasised by Freeborn (see chapter: External Anatomy) the phallosome is always rotated from its normal position in the microscopic mount.

The differentiation of the female *Culex* and the larvae is a rather difficult task. On this matter Martini (1931, p. 342) remarks: "Die Bestimmung der *Culex*-Arten ist schwierig, sowohl der Larven als der Weibchen. In unserer verhälltnismässig *Culex*-armen paläarktischen Region ist noch leidlich durchzukommen, in den tropischen Gebieten dagegen mit ihrer reichen *Culex*-Fauna nicht mehr. Das geht so weit, daß Dyar an der Möglichkeit, überhaupt eine Bestimmungstabelle der *Culex*-Species für die Weibchen zu geben, verzweifelt, und seine Übersicht, nur bis zu Art-Gruppen führt, die teilweise systematische Einheiten sind, teilweise auch nur zufällige Gruppen äußerer Ähnlichkeit. Dies Vorgehen is ausserordentlich dankenswert, das es mit wissenschaftlicher Offenheit die wirkliche Sachlage anerkennt." Matheson (1929, p. 160), dealing with the differentiation of the subgenerae, says i. a.: "It is impossible to recognize these sub-genera in the females with any degree of certainty."

Keys to the subgenera of *Culex*.

Table 35.

A. *Females.*

1. (2) Pale bands of abdominal tergites apical ...... subg. *Neoculex*
2. (1) Pale hands of abdominal tergites basal .... subg. *Culex*

B. *Male terminalia.*

1. (2) Subapical lobe of basistyle bearing spines and two long, distally curved blades. Phallosome simple, with one pair of plates, distally connected by a narrow bridge. Paraprocts with an apical transverse comb of short, stout and blunt teeth (fig. 114) .... subg. *Neoculex*
2. (1) Subapical lobe of basistyle bearing spines, a spatulate blade, a leaf-like appendage and other processes. Phallosome more complicated, apically split into a complex of lobes of various shape. Paraprocts at the base with a more or less protruding arm; at the distal tip with a cluster of spines, the "crown" (fig. 121) ...... subg. *Culex*

C. *Larvae.*

1. (2) Siphon distally expanded. Siphonal index mostly exceeding 6.0 (fig. 115) .... subg. *Neoculex*
2. (1) Siphon not distally expanded. Siphonal index mostly not exceeding 6.0 (fig. 119) .... subg. *Culex*

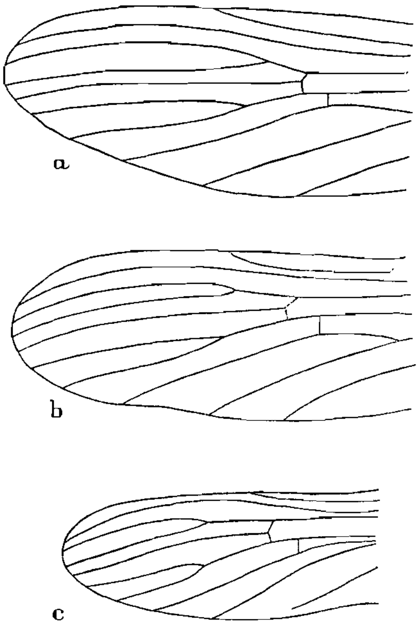

Fig. 113. Wing venation of *Culex*.
a, *C. pipiens;* b, *C. torrentium;* c, *C. apicalis.* (Orig.)

Subgenus *Neoculex* Dyar 1905.

According to Martini (1931, p. 343) this subgenus must be considered as an old group, which is indicated by the tibial scraper on the hind-leg, the transverse comb of teeth at the tip of the paraprocts and the simple structure of the phallosome.

The female of the single species in our region may be recognised by the apical pale bands on the abdominal tergites. In the wing the stem of the fork r_{2+3} is shorter than the fork itself, but the relative length of the stem is conspicuously longer than in the northern species of the subgenus *Culex* (fig. 113 c).

In all 23 species are known, 6 of which habitate the palaearctic region, the remainder are distributed in the African, Oriental and Australian regions. Only one species, *Neoculex apicalis* Adams, has been found in Denmark and Fennoscandia.

Culex (Neoculex) apicalis Adams.

C. apicalis Adams (Kans. Univ. Sci. Bull. *2*, p. 26) 1903
C. sergenti Theob. (Mon. Cul., *3*, p. 218) 1903
C. saxatilis Grossbeck. (Can. Ent., *37*, p. 360) 1905
C. frickii Ludl. (Can. Ent., *38*, p. 132) 1906
C. territans H. D. K. (nec. Walker), (Mosq. N. a. C. Am., *3*, p. 293) 1915
C. pyrenaicus Brolem. (Ann. Soc. Ent. France, *87*, p. 427) 1919
var. *judaicus* Edw. (Riv. Malar., *5*, p. 631) 1926

Synonymical remarks.

Concerning the synonymy of this species there has been rather great confusion in the literature. On this matter Matheson (1929, p. 162) remarks: "This species has long been known in literature as *territans* Walker (1856). *C. territans* Walker is another species identical with *restuans* Theobald (1901). This species was described by Adams (1903) as *apicalis* and as *saxatilis* by Grossbeck (1905) Owing to the doubt that *apicalis* Adams was antedated by *apicalis* Theobald (1903), Dyar (1917 d) referred this species to *saxatilis* Grossbeck. Theobald (1910) changed his *apicalis* to *neoapicalis*. Dyar (1920) considered *testaceus* Van der Wulp (1867) to be the correct name but Edwards (1925) shows that *C. testaceus* Van der Wulp is a synonym of *T. perturbans* Walk."

Description.

Female. Proboscis somewhat swollen at apex. Wing. Stem of the fork r_{2+3} of about half the length of the fork itself. Stem of the fork m_{1+2} of about $2/3$ the length of the fork. Shift of posterior cross-vein well over 1.5. Hind-legs with tibial scraper. Abdomen with apical white bands.

Male. Terminalia. Basistyle pear-shaped. Subapical lobe bearing spines and two long, distally curved blades. Dististyle swollen at the base, tapering. Claw somewhat expanded at the tip. Paraprocts broad, with an apical transverse comb of short, stout and blunt teeth. Phallosome formed of one pair of plates, which apically bear a row of stout, short spines (fig. 114).

Larva (figs. 115, 116, 117). Head much broader than long. Antennae of about the same length as the head, strongly spinose, especially around the insertion point of the antennal tuft. Tuft with about 24 hairs, of about $2/3$ the

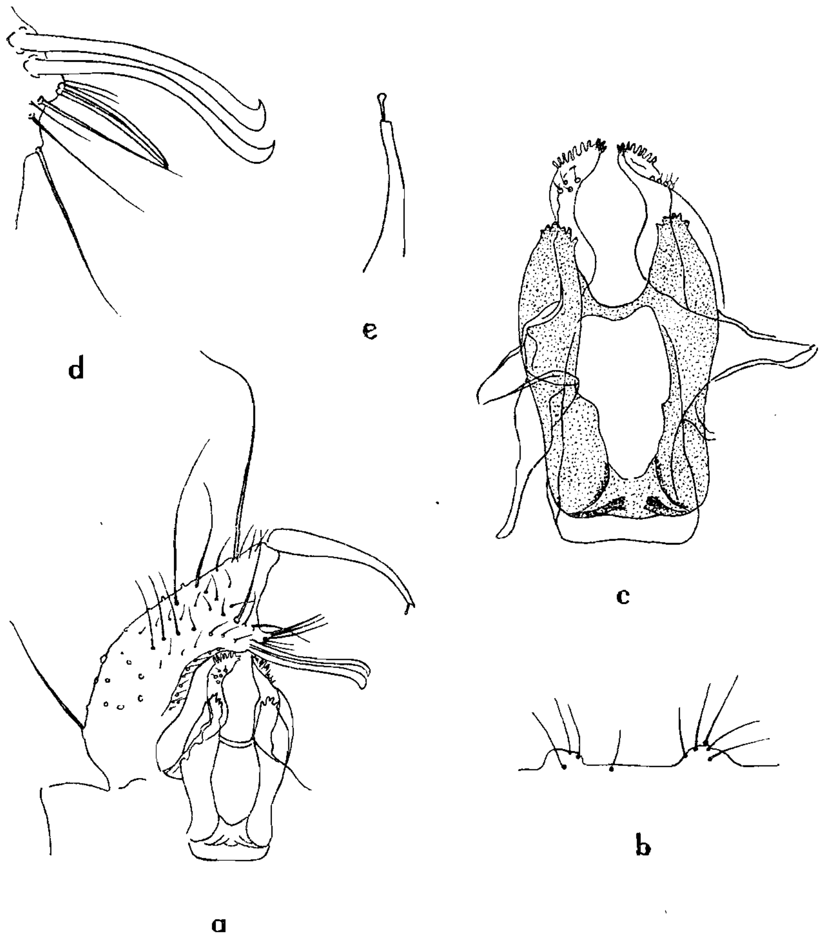

Fig. 114. *Culex (Neoculex) apicalis* Adams.
a, Terminalia (total view); b, lobes of the 8th tergites; c, sclerotised parts of phallosome (dotted) and paraprocts; d, subapical lobe with spines and blades; e, tip of dististyle. (Aut. del.)

length of the antennal shaft. At apex of shaft 1 short and 3 long bristles and one sensory appendage. Two of the bristles conspicuously subapical. The inner frontal hair, with two branches, nearly behind the mid frontal hair. Dorsal prothoracic formula about: 1, 1, 3; 1; 1; 3; 2. Comb with 41—64 rather slender scales, with fine hairs at the tip. Siphon somewhat narrowed above the base and expanded at

Fig. 115. Larvae of *Culex (Neoculex) apicalis* Adams.
Terminal segments of larvae. a, second instar; b, third instar; c, fourth instar. (Aut. del.)

the apex. Siphonal index 5.8—8.1 (mean value of 28 specimens: 6.8). Pecten with 14—21 teeth, which bear one or two denticles; extends about one third from the base of the siphon. Siphonal tufts with 1—4 hairs; on one side 4 tufts, on the other side 5 tufts. Dorsal hair at apex of siphon, short and spine-like. Saddle encircles the anal segment.

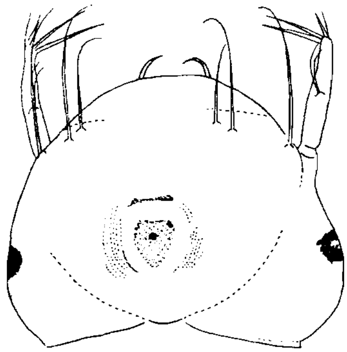

Fig. 116. *Culex (Neoculex) apicalis* Adams.
Head of first instar larva (with egg-breaker). (Aut. del.)

Saddle-hair chiefly with two branches. Dorsal brush with an outer pair of long stout hairs and an inner brush with 4 shorter branches. Ventral brush with about 14 hairs. Anal gills of about the length of the saddle.

Concerning the first instar larva, Marshall (1938, p. 257) remarks that no information is to be obtained. Among larvae of this species, I have also found one specimen in the first instar, the head of which is delineated below (fig. 116).

Table 36.

Larval chaetotaxis of *Neoculex apicalis* Adams.

Number of branches in										Number of	
	Frontal hairs			Siphonal tufts						Pecten teeth	Comb scales
Instar	out.	mid.	inner	I	II	III	IV	V			
I	1	1	1								
II	2	1	1	1	1—2	1—2	1	1		7—8	22—24
III	3—4 3.7 (13)	1	1—2 1.7	1—2 1.7 (11)	1—3 2.0 (9)	1—2 1.7 (9)	1—2 1.6 (9)	2—3 2.2 (6)		8—13 10.9 (10)	31—49 42.7 (3)
IV	5—9 6.2 (41)	1	2	1—4 2.5 (48)	2—4 2.9 (40)	2—4 2.8 (44)	2—4 2.6 (46)	2—4 2.4 (31)		14—21 16.6 (37)	41—64 48.8 (17)

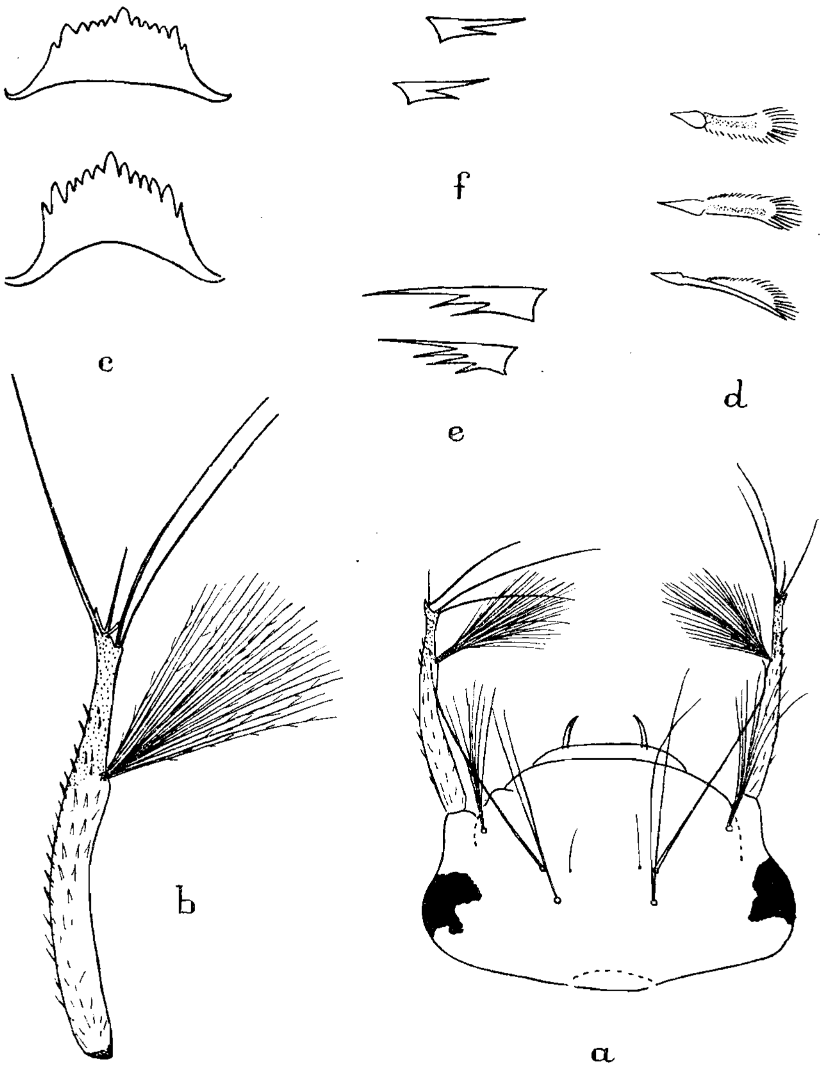

Fig. 117. Larva of *Culex (Neoculex) apicalis* Adams.
a, head; b, antenna; c, mentum; d, comb-scales; e—f, pecten teeth.
(Aut. del.)

Unfortunately the position in the slide mount of this specimen did not permit a clear view of details in pecten, comb and chaetotaxis. As far as I can see the antennal tuft consists of two hairs.

Neither Marshall nor Martini has published details concerning the different larval instars of *Neoculex apicalis.* I possess larvae in all instars of this species, caught in a swamp-pool in forested land at Lerang in Högsfjord (Ri 49) by O. Meidell medio August. Only two specimens in the second instar, eight specimens in the third instar and 29 in the fourth instar are at hand. Possibly further investigation on a greater material may change details in the range of variation.

Comparing the Norwegian larvae with the description of larvae from other countries, the greater range of variation in the northern larvae becomes evident. The siphonal indexes of Norwegian *Neoculex apicalis* and *Culex pipiens* overlap to some extent and they are therefore of limited value for differential purpose. According to Martini (1931, p. 352) the siphonal index in German specimens is about 7,1, in English specimens it exceeds 6.0 (Marshall 1938, p. 243), and from USA, Dyar (1928, p. 392) records an index of 9.0. In a similar way the number of siphonal tufts is a rather variable character. Martini records 6 tufts on one side and 7 on the other side, in the Portuguese specimen, depicted by Braga (1931, p. 42) the siphon bears 7 tufts, whereas Dyar points out that the number is 4 in American larvae, which agree with the English specimen, depicted by Marshall. Most Norwegian larvae have 4 siphonal tufts on one side and 5 tufts on the other side, but specimens with 5 : 5 also occur.

In my opinion the best differential characters are the shape of the siphon and the shape and number of branches in the frontal hairs. A very good character is pointed out by Marshall (1938, p. 256), viz. the presence of numerous minute spicules covering the exterior of the larva in the later instars. With the magnification used (Seitz: Comp.-Ok.: 6; Obj.: 8.0 mm. Apert. 0.65) the spicules are clearly visible in third and fourth instar larvae, but in the smaller larvae I have not been able to see the spicules.

Geographical distribution.

Denmark: 2. *Sjælland:* Frederiksborg, viii.—ix. (W-L).
Sweden: ?According to Martini (1931, p. 352) the species has been found in wells in Sweden, but no localities are recorded. I have hitherto not seen specimens from Sweden, and I can not confirm the above.
Norway: Ø: *1. Hvaler:* Kirkeøya, L: 28. v. 1928 (LRN); AK: *11. Aker:* Alnabru, L: 15. v. 1930 (LRN); *12. Bærum:* Langåra, L: 19. vi. 1928 (♂) (LRN); TEy: *7. Bamle:* pond near the church at Bamble, L: 28. vi. 1930 (LRN); AAy: *6. Øiestad:* rock-pool at Flødevigen, L: 20. vi. 1930 (♂) (LRN); VAy: *3. Oddernes:* at Kristiansand S, L: 18. vi. 1930 (♂) (LRN); Ry: *22. Høle:* Ims, L: 15. viii. 1931 (OM); Ri: *49. Forsand:* Lerang at Høgsfjord, L: 9. viii. 1931 (OM); *HOy 18. Fana:* Kloppedalsvann, L: 10. vii. 1929 (♂♀) (LRN); MRi: *60. Grytten:* near Romsdalshorn, L: 22. viii. 1931 (♂♀) (LRN).
Finland: *Ab(V):* Kuustö (Lundstr.).

Distribution outside Denmark and Fennoscandia.

According to Marshall (1938, p. 257), *Neoculex apicalis* Adams is extremely rare in Britain. In England the species has been recorded from the counties Berks and Hants, and in Scotland from the counties Elgin and Inverness-shire. In France it is recorded by Séguy (1923, p. 82) from Meudon, Villejuif, Marly (Séguy); Rambouillet (Villeneuve, Séguy); Lamballe, 3. iv. (Surcouf); Creuse, Ambazac, La Celle-Dunoise (Alluaud). From Portugal, the species is recorded by Braga (1931, p. 43) from Chaves, x.— 1926 (Braga); Moledo vi. 1925 (Braga); Arredores do Porto, v. 1928 (T. Gonçalves). In Germany *apicalis* has been found in the environs of Bonn (Schneider 1914, p. 45) at Mannheim and Strassburg (Eckstein 1920, p. 342) and in the environs of Hamburg (Martini 1920, p. 159). From Switzerland *Neocul. apicalis* is recorded from Bern (Bangerter 1926). Further it is recorded by Tarwid (1938 a) from Poland, by Edwards (1921, p. 336) from Italy: Gorizia (Mik) and Austria: Wippach (Handlirsch). Hungary: Balaton (Mihályi 1941). Christophers (1929) records it from the Canaries. Waterston (1921—2, p. 135) records the species from different localities in Macedonia. As to the distribution in USSR, Stackelberg (1937, pp. 222—3) remarks: "From Leningrad distr.: environs of Peterhoff (Montschadskiji!), Sablino (Stackelberg); Moskva distr. (Nikolskiji); Ukraine: Ukrainskoe Polesje (Rybinskiji), Dnepropetrovsk (Guzevitsch!); Crimea: environs of Jalta (Velitschkevitsch!); North-Kaukasus: environs of Novotscherkask (Schtschelkanovzev), Pjatigorsk (Mess!); Transkaukasia: Georgia (Kalandadse 1931), Aserhajdjan; Sverdlovsk distr. (Mitrofanova 1929) and Lower Volga distr. (Martini)."[108] Fur-

[108] Translated from the Russian text.

ther records are: Basin of Dnjepr: Jazeva (Dolbeskin 1928); Ferghana: Kakand, Skobelev, Andisjan and Kakulabad (Simanin 1929). Further Edwards (1921, p. 336) records the species from Transkaspia: Amudaria (C. Ahnger) and from Tunis: Tamerza (Langeron). Concerning the distribution in North-Africa he further says: "Occurs — — — apparently also in North-Africa, though I have seen only females from there (including Theobald's type of *C. sergenti*) and I am not absolutely certain of their identity." Charrier (1924) records the species from Tanger.

As to the distribution in the American continent, Twinn (1931, p. 11) records *Neoculex apicalis* Adams from eastern Canada and says: "It is a moderately common species although not very abundant." From USA the species is i. a. recorded from Michigan (Irwin 1943), Rhode Island (Knutson 1943), California (Kelley 1942), and in several paper Dyar (1907, 1916, 1917 a—c, 1919, 1929) records it from different localities from Seattle in the north to California in the south. Recent records are: Maine (Bean 1946), Rhode Island (Knutson 1943), Missouri (Adams a. Gordon 1943, Gurney 1943), Indiana (Christensen a. Harmston 1944) and Colorado (Lasky 1946).

Biology.

In Norway I have not found adults in the field, and all adults at hand are bred from larvae. The breeding waters are of rather different character. At Alnabru (AK 11) larvae were found in a partly shaded pool, at Lerang (Ri 49) in a swamp-pool (with *Sphagnum*) in woodland, otherwise in open land, either at the edge of swamp-pools (Ims, Ry 22), Kloppedalsvann (HOy 18)) or in more arid regions (Feset, TEy 7), Kristiansand (VAy 3)). Larvae have also been found in rock-pools: near the sea-shore at Flødevigen (AAy 6), in the islands Langåra (AK 12) and Kirkeøya (Ø 1), all in the Oslo-fjord. Especially the find in a little rock-pool near the sea-shore in Kirkeøya is remarkable (pl. X), the breeding pool being without any vegetation and exposed to direct sunlight. Unfortunately I had no opportunity to examine salinity and pH in 1928, and when I revisited the place in 1934, the rock-pools were all dried upp. At Romsdalshorn (MRi 60) the degree of pH was 5.5, and also the breeding-water at Lerang (Ri 49), with *Sphagnum*-vegetation, indicates a lower degree of pH. In Norway larvae of this species have been found from ultimo May to medio August. At Lerang, Meidell found larvae in all instars at the 9th of August. The Norwegian finds indicate that the larvae prefer open-situated breeding-waters. Larvae of *C. apicalis* have been found associated with larvae of *T. bergrothi, morsitans, A. punctor, C. pipiens.*

Concerning the character of the breeding waters, Martini (1931, p. 352) remarks: "In den wärmeren Ländern ist er eine ausgesprochene Kaltwasserform. In Norddeutschland kommt er in offenen Gräben mit quelliger Umgebung und mässig schattigen Wasserlöchern und an Gebüschen vor. Oft in verkrauteten Wasserlöchern und Teichrändern. In Schweden und Deutschland tritt er als Quellform auf." Further Schneider (1914, p. 47) says: "Sie leben in den reichlich mit Pflanzben versehenen Uferzonen größerer Tümpel, aber auch in kleineren von nur 1 m Durchmesser. Gewöhnlich finden sie sich in reinem klaren Wasser in Gesellschaft der *Anopheles*-Larven; nur einmal habe ich sie in einer kleinen, von organischen Zerfallsprodukten stark getrübten Pfütze gefunden, zusammen mit *Theob. annulata* und *C. pipiens.*" From Canada, Twinn (1931, p. 11) reports: "We have found the larvae associated with *Anopheles* larvae, in shallow water along the margins of swamps and lakes, particularly where there is a good growth of *Typha* and other aquatic plants. They were also collected — — — — in clean water in a barrel beneath the eaves of a woodland cottage." Similar records are published from U S A by Dyar (1917 d, p. 173), who adds: "In the west the species becomes restricted to mountainous forested areas, avoiding the open plains." A somewhat unusual breeding-place is recorded by Kelley (1942), who found larvae in flower containers in cemeteries in Almeda county in California.

Schneider (1914, p. 46) and Twinn (1931, p. 11) point out that the females hibernate in sheltered places. Most authors (i. a. Dyar 1917 d, p. 173; King Bradley a. McNeel 1939, p. 39; Matheson 1929, p. 164; Schneider 1929, p. 164) agree that *Neoculex apicalis* do not attack man or hematherms. However, Herman (1938) records from experiments, in which attempts were made to transmit avian malaria by means of different species of mosquitoes, that at least one female *apicalis* sucked on the blood of a canary. According to Martini (1931, p. 352), Shannon has observed the species sucking blood from the frog, *Rana catesbeiana,* and Desportes (1942) records *apicalis* stinging *Rana esculenta* in nature.

Subgenus *Culex* Linnaeus 1758.

In the female sex the species of this subgenus may be distinguished by the wing venation, the stem of the fork r_{2+3} being extremely short. The tibial scraper in the hindlegs is absent, and in all species in our region the abdominal tergites have light basal bands. Otherwise characters as mentioned for the genus.

In the male terminalia the phallosome, is apically split into a complex of lobes of various shape. Paraprocts at the base with a more or less protruding lateral arm; at the distal tip the paraprocts are ornamented with a cluster of spines, the "crown".

Larvae with siphon not expanded distally. Siphonal index mostly not exceeding 6.0. As pointed out by Marshall (1938, p. 250) the siphonal index of *C. molestus* Forskål is very low, and in accordance with this, I consider three Norwegian larvae, with indexes from 4.13 to 4.36 as belonging to this species. However, as no breeding from Norwegian larva has been carried out, further studies on this matter are greatly needed.

As to the larvae of *C. torrentium* Martini, I have not been able to find, in the Norwegian material, distinct characters differentiating this species from *pipiens* L.

According to Edwards (1932, pp. 200—12) the subgenus includes 107 distinct species and 10 species of uncertain position. The bulk of these species are distributed in the tropics, in the Old World as well as in the New World, and only two species, one with two subspecies, have been found in Fennoscandia.

Table 37.

Keys to the species of the subgenus *Culex*.

A. *Females*.

1. (2) Stem of the fork r_{2+3} of about ¼—⅓ the length of the fork itself. Radio-medial cross-vein placed about twice its length distally to the medio-cubital cross-vein *torrentium* Martini.
2. (1) Stem of the fork r_{2+3} of about ⅕—⅙ the length of the fork itself. Radio-medial cross-vein placed about 1½ its length distally to the medio-cubital cross-vein.
3. (4) Colouring dark brown and white. Abdominal pale bands on fourth and (usually) adjoining tergites constricted laterally. Sternites ornamented with distinct patches of dark scales in the median line and usually also on the sides. Kneespots are distinct and white, and tip of tibia has a white patch .... *p. pipiens* L.
4. (3) Colouring yellowish-brown and dirty white. Abdominal pale bands straight and parallel. Sternites either entirely pale-scaled or with a few dark scales in the median line Knee-spot and white patch at tip of tibiae absent *p. molestus* Forskål.

B. *Male terminalia*.

1. (2) Phallosome a paired structure, each half with three prominent processes. Dorsal process (3) broad, tubular and truncate; not exceeding the crown. Basal arm of paraproct a small process (fig. 118) *p. pipiens* L. *p. molestus* Forskål.
2. (1) Dorsal process of phallosome apically pointed (3), exceeding the crown. Basal arm of paraproct a prominent, dorsoventrally curved process, encircling the penis (fig. 121) *torrentium* Martini.

C. *Larvae*.

1. (2) Average value of siphonal index 5.3 .... *p. pipiens* L.
2. (1) Average value of siphonal index 4.2 ...... *p. molestus* Forskål.

(The larva of *torrentium* is omitted.)

Culex (Culex) pipiens pipiens Linnaeus.

C. pipiens L. (Syst. Nat. Ed. X, p. 602) 1758
? *C. fasciatus* Müll. (Fauna Insect. Friedrichsdal, p. 87) 1764
C. trifurcatus Fabr. (Ent. Syst., *4*, p. 401) 1794
? *C. luteus* Meig. (Klass. u. Beschr. d. bek. eur. Zweifl. Ins.) .. 1804
? *C. bicolor* Meig. (Syst. Beschr., *1*, p. 9) 1818
? *C. rufus* Meig. (Syst. Beschr., *1*, p. 7) 1818
? *C. meridionalis* Leach. (Zool. Journ., *2*, p. 209) 1825
C. marginalis Steph. (Zool. Journ. *1*, p. 455) 1825
? *C. calcitrans* Rob. Desvoid. (Mem. Soc. Hist. Nat. *3*, p. 409) 1827
? *C. thoracicus* Rob.-Desvoid. (Menm. Soc. Hist. Nat. *3*, p. 409) 1827
? *C. consobrinus* Rob.-Desvoid. (Mem. Soc. Hist. Nat. *3*, p. 408 1827
? *C. pallipes* Waltl. (Reise Tyrol etc. *2*, p. 110) 1835
C. pallipes Macq. (Dipt. exot. nouv. ou peu conn, *1*, p. 38) 1838
? *C. rufinus* Rigot (Expl. Sci. Tunis. Dipt. 7) 1888
C. agilis Bigot (Ann. Soc. Ent. France (6) *9*, Bull. 112) 1889
C. phytophagus Fic. (Bull. Ent. Soc. Ital., *21*, p. 126) 1890
C. melanorhinus Giles (Gnats or Mosq., p. 342) 1900
C. nigritulus Theob. (nec. Zett.) (Mon. Cul., *1*, p. 140) 1901
C. zombaensis Theob. (Mon. Cul., *2*, p. 143) 1901
C. varioannulatus Theob. (Mon. Cul. *3*, p. 198) 1903
C. azoriensis Theob. (Mon. Cul., *3*, p. 210) 1903
C. longifurcatus Becker (Mitt. Zool. Mus., *2*, p. 68) 1904
C. quasimodestus Theob. (Ann. Mus. Nat. Hung., *3*, p. 98) 1905
C. quasigiarti Theob. (Mon. Cul., *5*, p. 374) 1910
C. pipiens var. *doliorum* Edw. (Ent. *45*, p. 263) 1912
var. *pallens* Coquill. (Proc. US Nat. Mus. *21*, p. 303) 1889
C. ozakaensis Theob. (Mon. Cul., *4*, p. 439) 1907
C. comitatus D. K. (Proc. Ent. Soc., *9*, p. 35) 1909

Synonymical remarks.

The above synonymy is quoted from Edwards (1932, pp. 209—10), however, with the following modifications.

The synonyms *C. bifurcatus* L. and *vulgaris* L. are omitted as discussed below. Further the synonyms *C. molestus* Forskål, *domesticus* Germar and *haematophagus* Ficalbi are transferred to the race *C. p. molestus* Forskål.

As to the synonymy, Edwards (1921, p. 347) remarks: "It is impossible to say what species were actually intended by most of the old descriptions, but I think it probable that the names *C. bicolor* M., *C. pallipes* M., *C. thoracicus* R—D., *C. calcitrans* R—D., and perhaps also *C. luteus* Mg., were based on more or less rubbed specimens of this species. From the habits indicated by Forskål and Germar for *C. molestus* and *C. domesticus* it seems probable that this species was intended, *C. fatigans* being excluded owing to its now apparently established absence from Europe and Egypt. The description of *C. pallipes* Waltl. was evidently supplied by Meigen, and amplified by him in 1838. The British

Museum possesses a copy of Meigen's Abbildung eur. zweifl. Ins., hand-coloured by the author, in which the figure of *C. rufus* evidently represents *C. pipiens,* though the venation is shown in a conventional manner. In his diagnosis of *C. meridionalis,* Leach says "abdomine segmentis omnibus postice griseo marginatis", but as he makes a similar statement regarding his *C. nicaënsis* and *C. musicus,* it seems probable that by "postice" he meant "basally". Ficalbi's description of *C. phytophagus,* especially as regards the male palpi and abdominal bands, shows that he had *C. pipiens,* not *C. laticinctus* or *C. univittatus,* before him. I have examined the types of *C. marginalis, C. agilis, C. vario-annulatus,* and *C. azoriensis,* and find them to be *C. pipiens.* Dr. Dyar informs me that he has examined Coquillett's type of *C. pallens,* and that it is *C. pipiens.* The species has frequently been referred to as *C. ciliaris* L., but I think probably incorrectly."

In a paper "On the identity of *Culex pipiens* Linnæus", Dyar and Knab (1909) i. a. say (p. 30): "The family *Culicidae,* comprising the mosquitoes, is based upon the genus *Culex* of Linneus, of which the generally recognized type is *Culex pipiens* Linneus. The genus and species date from the beginning of bionomical nomenclature, the tenth edition of the Systema Naturae." The authors quote in extenso the part of Syst. Nat. covering *Culex,* making their remarks on each species mentioned, and they continue (p. 31): "Of the others, *bifurcatus* has been recognized as a mosquito, an European species of *Anopheles,* but very little is said about it, and it was obviously subordinated in Linnæus' conception of the group. — — — The next point to be determined is the identity of *Culex pipiens.* Linnæus obviously intended the term to cover all mosquitoes known to him, directly or indirectly, except the *Anopheles,* with long palpi in the female, which he separates under the name *Culex bifurcatus.*" The authors also discuss the names *Culex vulgaris* and *Culex alpinus,* first published in Flor. Lapp. 364, 1737. Linnaeus referred these species as synonyms of *pipiens* in the second edition of the Fauna Suecica, 1761, but the description reappeared in the second edition of Flora Lapponica 1792. In the case of Linnaeus, Dyar and Knab hold that these names should be accepted as valid, in spite of the fact that they first appeared as synonyms. They conclude: "Of these species, *Culex vulgaris* is apparently a *Simulium,* but *Culex alpinus* is a mosquito, and judging from its place of occurrence, an *Aëdes* in the broader sense."

The next paper dealing with these problems is Martini's investigation on the nomenclature of the mosquitoes of Central-Europe. The author here i. a. says (1922, p. 107): "In der Fauna Suecica und Systema Naturae kann man die Beschreibung der Bifurcation entweder auf Labellen und in ihrer Mitte die Stechborsten beziehen, und dann ist mit der Beschreibung überhaupt nichts anzufangen, oder auf die angezogenen Figuren von Reaumur. Dann bezieht sich "gegabelt" auf die männlichen Taster. Beachtlich ist, daß die typischen *Anopheles*-Figuren von R. bei L. nicht zitiert sind. — — — — Die Figuren Tafel 40. Fig. 1 u. 2 von Reaumur sind nach der Tafelerklärung von demselben Tier wie Taf. 41, Fig. 2 u. 3, und bei diesen muß es sich nach Ausweise der Taster wohl um ein *Culex*-wahrscheinlich *pipiens*-Männchen gehandelt haben. Jedenfalls ist Reaumur die Beziehung der Geschlechter nur teilweise klar gewesen, er sieht die absperrenden Enden männlicher Taster als gegabelte Rüssel an und führt die abgebildete Mücke als besondere Art auf, ohne sie zu benennen. Linné benennt sie dann *bifurcatus*. Bei ihm ist 1758 das Culiciden-Weibchen *C. pipiens* und das Männchen *C. bifurcatus*. Dadurch erklährt sich auch, daß bifurcatus nicht stechen soll, was sonst wohl niemand, der unsere heutige Art diesen Namens in der Natur gefangen hat, annehmen wird." As to the older names, *Culex vulgaris* and *C. alpinus*, Martini remarks: "Das im Bereiche seines *pipiens* Unterschiede vorkommt, war Linné schon bekannt; er erwähnt es bei *alpinus*, betohnt aber, daß es doch nur e i n e Art sei. So ist 1758 synonym *alpinus* L. = *pipiens* L. = *bifurcatus* L. = *communis* L. und wohl auch *vulgaris*."

As to the name *Culex* vulgaris L., I have recently (Natvig 1945) pointed out that the interpretation of Dyar and Knab is in contradistinction to the description of Linnaeus. It is quite clear that Linnaeus had a mosquito before him, and most probably it has been an *Aëdes* of the *communis*-group. *Culex alpinus* L. is described as a species with white ringed legs. It is therefore n o t identical with *Aëdes nigripes* (Zett.), as hitherto supposed by most American authors.

When Edwards and Martini consider *Culex bifurcatus* L. as synonymous with *Culex pipiens* L., they most likely base their conception on the tenth edition of Systema Naturae and second edition of Fauna Suecica. Comparing different editions of these works I recognised that the text in the first edition of Fauna Suecica, 1746, has been altered in later editions. In the first edition of this work No. 1115 is "*Culex fuscus, rostro bifurco*" and in the description is subjoined:

"Culice sequente duplo major." The next No. 1116, is "*Culex cinereus, abdomine annulis fuscis octo*". However, in the second edition of Fauna Suecica (1761), the succession of these species is changed, and as the third species is now *Culex pulicarius*, the remarks concerning the size of *Culex bifurcatus* has got quite another meaning. The same succession of the species, as in the second edition of Fauna Suecica, is found in Systema Naturae, Ed. X (1758). According to these facts, I do not consider *Culex bifurcatus* L. as synonymous with *Culex pipiens* L.

Walker, in his list of Diptera of the British Museum, quotes some specimens of *C. pipiens* L. from northern Norway (Alta, Finmark), but he emphatically remarks (1948, pp. 6—8): "If, as Mr. Haliday has supposed, this species is the *Culex pipiens* of Linnaeus, that name, by which it is described in Zetterstedt's work, must be transferred to it, and the *pipiens* of more southern entomologists must receive a new denomination." Ficalbi (1890 a. 1896) directed attention to the contradictory character of the information concerning the biting propensities of *Culex pipiens*. He points out that many authors, i. a. Meigen, Schiner and Rondani, as a matter of course, designate the common house-mosquito as *Culex pipiens* L., whereas Haliday and Westwood express their doubt as to the identity of the *Culex pipiens* Linnaeus from the North and the species described under this name by Meigen. Ficalbi has examined specimens, designated as *Culex pipiens* L., from the far north and they did not agree with the Italian specimens. He emphasises (1890, p. 126) that, at any rate, two species are found in Italy, which hitherto have been mingled together by the authors under the name of *Culex pipiens*. The common, haematophagous, species he designates *Culex pipiens* and the other, phytophagous, he describes under the name of *Culex phytophagus*. In the differential diagnosis he points out the throughout pale colouring and the scarcely noticeable kneespots of the haematophagous species, in contradistiction to the darker colouring and the distinct knee-spots of the phytophagous species. As to the male palpi, he (1896, pp. 276—8) remarks, concerning *C. phytophagus:* "I palpi nel maschio (che superano la proboscide con l'estremità del penultimo e con tutto l'ultimo articolo)," and as to *C. pipiens:* "I palpi del maschio sono molto pelosi; piu lunghi della proboscide."

As stated by Marshall (1938, p. 236), Ficalbi was in error when he applied the specific name of *pipiens* to a man-biting *Culex*. Marshall further says: "Ficalbi's proposal to recognise a new species of *Culex* aroused surprisingly little interest, although it received subsequent support from the observation of other workers. — — — Observations of the second group of facts commenced to be assembled as recently as 1929, when Roubaud,[109] de Boissezon [110] and Huff [111] independently referred to strains of *C. pipiens* which behaved in an abnormal manner — notably in being able to mate in small cages and to lay fertile eggs without having a previous meal of blood. To designate these two biological features Roubaud introduced the adjectives stenogamous and autogenous respectively. He also introduced the adjectives eurygamous and anatogeneous to denote, respectively, the absence of the above-specified peculiarities."

The most recent paper dealing with the problem of the identity of *Culex pipiens* Linnaeus, was published by Marshall and Staley in 1937. I shall here quote some passages (from Marshall 1938, p. 239) from this paper: "In our opinion, the information acquired, during the last few years, regarding autogenous and anautogenous strains of *Culex* fully establishes the validity of the theory — advanced by Ficalbi — that two distinct species have been confused under the name *pipiens*. If this be admitted, we have then to decide: a) which of the two species is entitled to the specific name of *pipiens*. — — — In the tenth edition of the Systema Naturae, published in 1758, Linnaeus referred to this mosquito as *Culex pipiens*, and gave references to descriptions and illustrations by Réaumur and others, but in 1761 he revived his earlier name *alpinus*. As pointed out by Dyar and Knab (1909) the name *pipiens* became thereby restricted to the insects described by the author quoted by Linnaeus. Linnaeus for instance, referred to pls. 43—44 in the fourth volume of Réaumur's Histoire des Insectes, published in 1738. Figs. 2—8 of pl. 44 illustrate egg-rafts and detached eggs, the latter having the terminal "corolla" typical of the genus *Culex*. Figs. 2—3 of pl. 43 show fullgrown larvae; the siphon in each figure having the multiple hair-tufts diag-

[109] Roubaud, E. (1929): "Cycle autogéne d'attente et générations hivernales suractives inapparentes chez le moustique commun, *Culex pipiens* L. (C. R. Acad. Sci. Fr. 188 (10), 735—8).

[110a] de Boissezon, P. (1929): Remarques sur le condition de la reproduction chez *Culex pipiens* L. pendant la periode hivernale. (Bull. Soc. Path. exit. *22* (7) 549—53).

[110b] de Boissezon, P. (1929): Experiences au sujet de la maturation des œufs chez les Culicides. (Bull. Soc. Path. exot. *22* (8), 683—9).

[111] Huff, C. G. (1929): Ovulation Requirements of *Culex pipiens* L. (Biol. Bull., *56* (5), 347—350).

nostic of *Culex* and the slender proportions characteristic of anautogenous strains. Pl. 40 of the same volume is of special importance. Fig. 3 of this plate shows the terminal segments of a male palp of the Culex type, and figs. 6 and 10 show the venter of a female and male adult respectively. In each of the last-mentioned figures the sternites are ornamented with conspicuous, dark median patches which are characteristic of anautogenous strains. This fact appears clearly to indicate that the name *Culex pipiens* belongs to the man-ignoring, dark-coloured, ventrally-spotted species and not (as Ficalbi considered) to the man-biting, light-coloured, ventrally-unspotted one."

Jobling (1938) uses the name *C. pipiens pipiens* L. for the anautogenous form and *C. pipiens molestus* Forsk. for the autogenous form, and he treats them as subspecies.

Description.

Female. Front of head with some golden bristles forming a tuft between the eyes. Vertex ("occiput") with golden narrow curved scales; in the middle with yellow upright forked scales, at the sides with dark brown ones. Eyes bordered with whitish narrow curved scales. Temporae with flat yellowish-white scales Clypeus blackish brown. Proboscis blackish brown, not swollen at apex. Antennae. Tori yellowish-brown. Flagellum with first segment yellowish brown at the base, the remainder dark brown. Flagellum of about the same length as the proboscis. Palpi (fig. 112 b) of about $\frac{1}{8}$ the length of the proboscis, dark brown. Thorax. Anterior pronotal lobes and posterior pronotum brown with golden narrow curved scales and bristles. Mesonotum with dark golden or cupreous narrow curved scales and brown bristles. Abdomen. Integument pale brown or yellowish. Scaling dark brown with yellowish-white basal bands. On the fourth and (usually) adjoining tergites the pale bands are constricted laterally, and often also centrally. Venter yellowish-white with patches of dark scales in the median line and mostly also on the sides. Wing. Stem of the fork r_{2+3} of about $\frac{1}{5}$—$\frac{1}{6}$ the length of the fork itself. Radio-medial cross-vein placed about $1\frac{1}{2}$ its length distally to the medio-cubital cross-vein. Legs. Front side of femurae dark brown, back side yellowish or whitish. Apex of femur dark. Knee spot yellowish-white, distinct. Tibiae dark brown with a patch of white scales at apex. Tarsal segments dark brown. Length of wing about 4.5 mm.

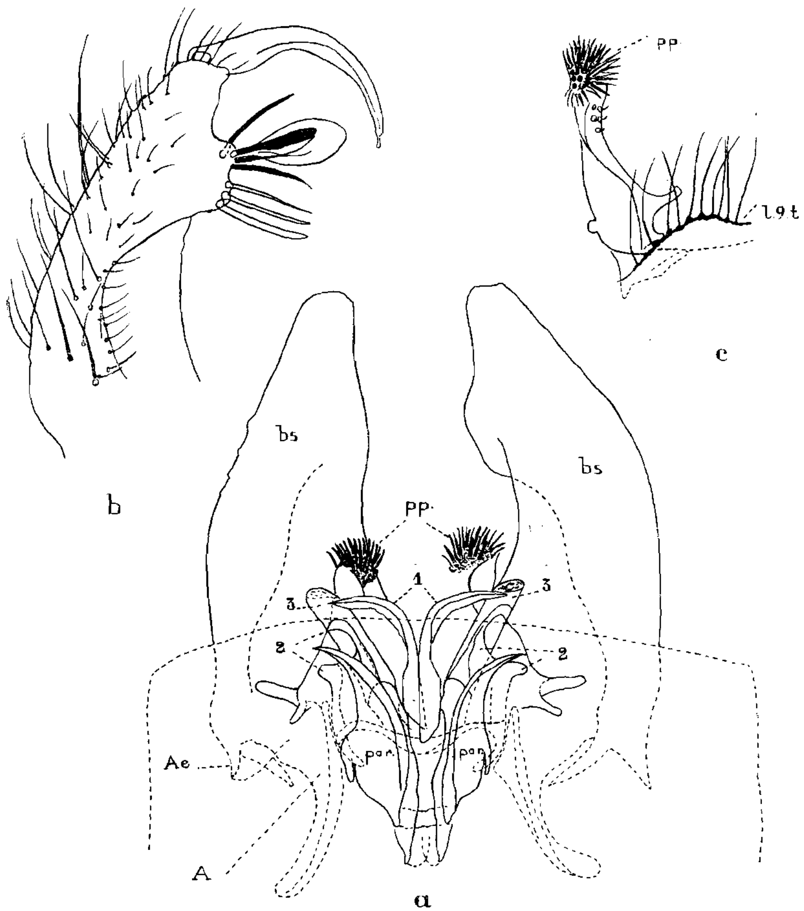

Fig. 118. *Culex pipiens* L.
a, Terminalia, total view (the diststyles omitted in this figure); b, basistyle with subapical obe and diststyle; c, lobe of the 9th tergite and paraproct.. Legend: A, apodeme of the side piece; Ae, external apodeme; bs, basistyle; par, paramere; pp, paraprocts; 1, 2, 3, ventral median and dorsal sclerites of phallosome. (Aut. del.)

Male. Colouring somewhat lighter than that of the female. Palpi dark brown with basal patches of yellowish-white scales on the ventral side of the two ultimate segments. Length of wing about 4 mm.

Terminalia (fig. 118). Basistyle about twice as long as broad, tapering towards apex. Subapical lobe prominent,

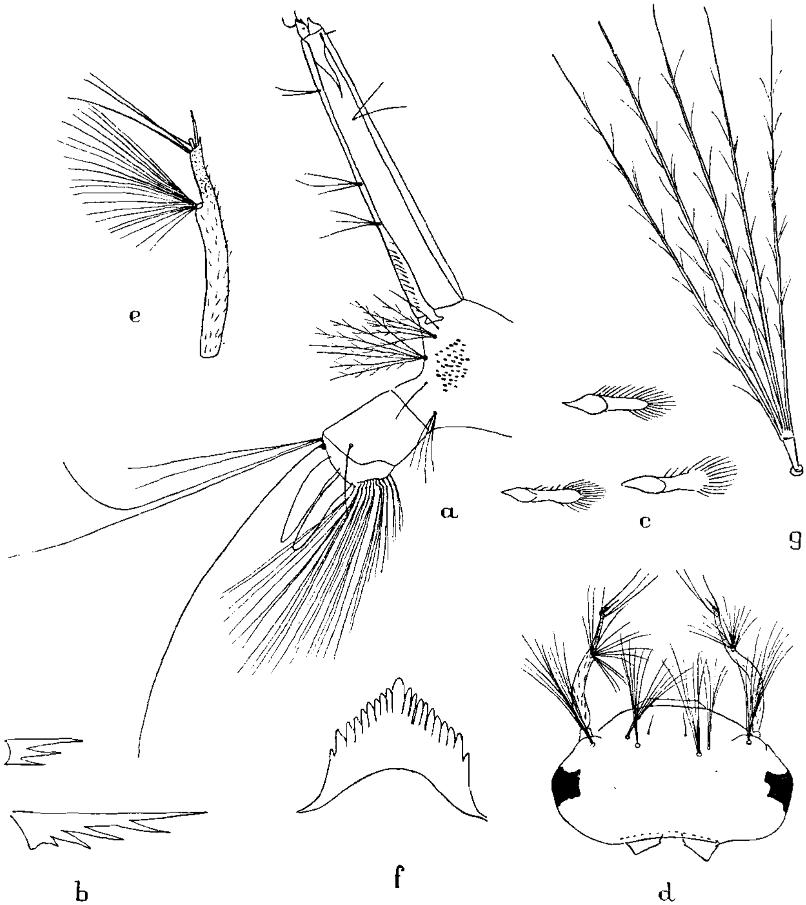

Fig. 119. Larva of *C. pipiens* L. in 4th instar.
A, Terminal segments of larva; B, pecten teeth; C, comb-scales; D, head of larva; E, antenna; F, mentum; G, frontal hair. (Aut. del.)

bearing, in the proximal part, three rod-like appendages, the third of which being more slender than the other two. Further distally are two bristles, one style, a leaf-like appendage and a long bristle. Diststyle short and curved, somewhat expanded at the base. Claw narrowed at the base. Phallosome a paired structure, each half with three prominent processes. Dorsal process (3) broad, tubular and truncate, not exceeding the crown. Paraprocts distally orna-

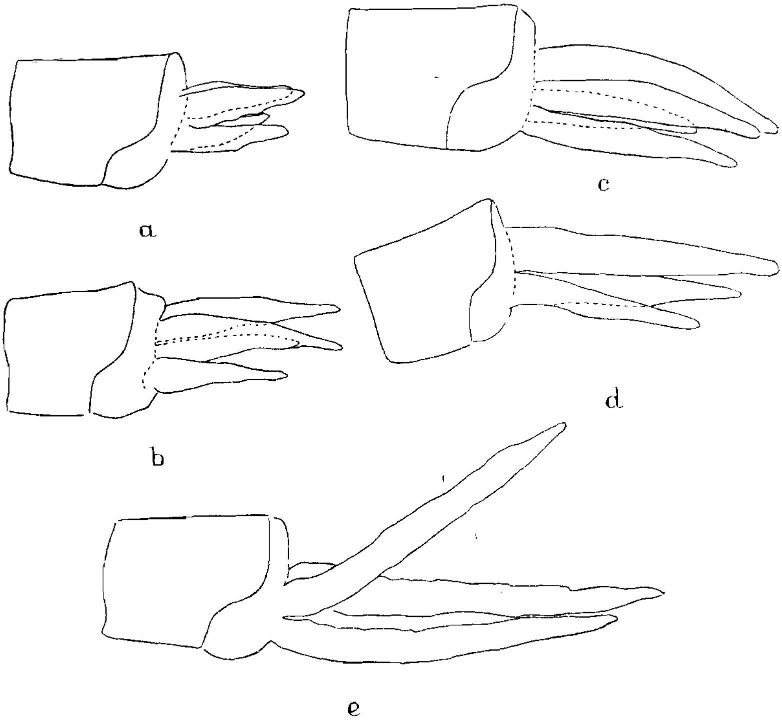

Fig. 120. Anal segment with papillae (anal gills) of *C. pipiens* L. A, island Kvaløy, Romsdalsfjord; B, pool at sea-shore, island Kirkeøya, Hvaler; C, lake Østensjøvann, Aker; D, swamppool, Stokka; E, pool near the lake Storsjøen, Ytre Rendal. (Aut. del.)

mented with a cluster of spines, the "crown", at the base with a small process. Lobes of the ninth tergite widely separated, with long bristles.

L a r v a (figs. 119, 120). Head conspicuously broader than long Antennae curved, strongly spinose in the basal two thirds; tapering from the insertion point of the tuft. Antennal tuft inserted about ⅔ from the base of the shaft, of about ¾ the length of the shaft and with 20—22 hairs. Sensory appendage and bristles at apex of antenna somewhat separated. Inner frontal hair oblique to the middle one. Dorsal prothoracic hairs formula about: 1, 1, 1; 2; 1, 1, 2; 2. Siphonal index: 4.5—6.2. Mean value (counted on 38 specimens): 5.3. Siphon slightly tapering. Pecten of about the length of the siphon, with 12—18 teeth, which are furnished with denticles. Siphonal tufts 4 : 4 or 4 : 5, infrequently 5 : 5, the tuft with 1—4 hairs. Saddle encircling the anal segment, with a single or double saddle-hair. Dorsal brush with an outer pair of long stout hairs and an inner pair of tufts with about two hairs. Ventral brush with about 12 tufts. Annal gills tapering, of varying length.

Concerning details in the chaetotaxy, see table below. However, it may be emphasised that a few larva, with low siphonal index, are separated under *C. pipiens molestus* Forskål. As it has been impossible to differentiate the larvae of *C. pipiens* Linnaeus and *C. torrentium* Martini, all larvae are counted as *C. pipiens* L.

Table 38.

Larval chaetotaxis of *Culex pipiens* Linnaeus.

Number of branches in									Number of	
Frontal hairs			Siphonal tufts						Pecten teeth	Comb scales
out.	mid.	inner	I	II	III	IV	V			
6—12 8.4 (55)	2—7 4.5 (47)	4—8 5.4 (46)	1—4 2.6 (38)	1—4 2.4 (38)	1—3 2.3 (40)	1—2 2.2 (40)	2—3 2.3 (7)		12—18 15 (47)	28—60 41 (43)

Geographical distribution.

Denmark: 1. *Jylland:* Tipperne! ♂: 6.—20. ix. 1946, ♀: 20. viii.—20. ix. 1946 (Søg. A.) 2. *Sjælland:* Environs of København! ♂♀ (Stæg.); Hillerød, Tjustrup lake at Sorø, v.—ix. (W-L); 3. *Bornholm* (P. Johns.).

Sweden: *Sk:* Sövestad, Krageholm! ♂: 12. viii. 1936 (B. Tjed.); Bjäresjö, Lilleskog! ♀: 16. viii. 1936 (B. Tjed.); Ystad, Anderslust! ♀: 9. viii., ♂: 14. viii. 1936 (B. Tjed.); Lund! (Zett.); *Hall:* Ö. Karup, Eskildstorp! ♂: 30. vii. 1939 (B. Tjed.); *Ög:* ♀ (Hagl.!); *Vg:* ♀!; *Upl:* Ent. Anst. Exp. fält! ♂: 14. ix., ♀: 12. viii. 1901; *Dlr.:* Falun, Norslund! ♀: 23. v.—18. vii., ♂: 11. vi. (B. Tjed.); Falun, Høkviken! ♂: 19. ix. 1926 (B. Tjed.); Falun, Kv. 46! ♀: 15. v., ♂: 21. viii. (B. Tjed.); Falun, Kv. Trädgården! ♂: 22. ix—12. x. (B. Tjed); St. Tuna, N. Romma! ♀: 29. ix. 1940 (B. Tjed.); Floda, Syrholm! ♀: 2. viii.—3. x., ♂: 2. ix. (T. Tjed.); Floda, Sångån! ♂: 28. ix. 1938 (T. Tjed.).

Norway: Ø: *1. Hvaler:* Kirkeøya, L: 13. iv. 1938 (LRN); Kirkeøya, Oreviken, L: 11. v. 1934 (♂) (LRN); *12. Halden,* ♂: viii. 1862 (Siebke); AK: *6. Ås:* N. E. Neset, L: 30. viii. 1931 (♀) (LRN); *7. Frogn:* Drøbak, L: 5. vi. 1932 (LRN); *13. Aker:* Østensjøvannet, L: v. 1928 (LRN); Østensjø farm (cellar), ♀: 28. ix. 1934 (LRN); Lille Tøien, L: 11. vi. 1929 (LRN); *14. Oslo:* Tøien Bot. Garden, ♀: 4. vii., 29. vii. 1851 (Siebke); *30. Ullensaker:* Bakke farm, ♀: 24. vii. 1930 (LRN), ♂♀: 21. viii. 1931 (LRN); pond s. Barntjern, L: 4. x. 1931 (♀) (LRN); *32. Eidsvoll:* at Eidsvoll Bath, ♀: 15. viii. 1930 (LRN); VE: *16. Sem:* Kruke farm (cow-stable), ♀: 31. viii. 1930 (LRN); Blixekilen, Åsgårdstrand, L: 29. v. 1938 (LRN); Ry: *18. Madla:* Malleforen, L: 18. viii. 1931 (OM); *20. Hetland:* Lindøy, L: vii. 1930 (♂) (OM); Mosevannet, L: 22. viii. 1931 (OM), L: 5. vi. 1931 (♀) (LRN); waterfilled ditch near Mosevannet, L: 5. vi. 1931 (OM); Stokke, L: 15. viii. 1931 (OM); Lille Stokkevann. L: 15. vi. 1931 (OM); swamp pool at Foros, L: 25. viii. 1931 (OM); *21. Stavanger:* ♂: 8. ix. 1931 (OM); Kiellandsmyren, L: 7. viii. 1931 (OM); *22. Høle:* swamp pool, Bersagel, Høgsfjord, L: 15. viii. 1931 (OM); Ri: *49. Forsand,* L: waterfilled ditch, Lerang, Høgsfjord (OM); HOy: *18. Fana:* swamp pool, Minde, L: 26. vi. 1932 (LRN); HEn: *23. Ytre Rendal:* Solbakken, Storsjøen, ♂: 4. vii. 1935 (LRN); ♀: 30. vii. 1930 (LRN); Viken, Storsjøen, L: 4. vii. 1935 (♂♀) (LRN); *25. Sollia:* Degerud, ♀: 28. viii. 1928 (S-R); MRy: *23. Veøy:* Karlsøy, Romsdalsfjord, L: 16. viii. 1929; MRi: *60. Grytten:* Halsa, ♂♀: 22. viii. 1931 (LRN).

Finland: *Ab(V):* Kuustö! ♂ (Lundstr.); Karislojo! ♂ (Hellén); Nådendal! ♂: 3. ix. 1937 (Tiensuu). *N(U):* Tvärminne zool. stat! ♀: 23. vii. 1920 (Levander, Frey.); ♀: 15. vii.—31. viii, ♂: 15. vii.—3. ix (Storå.); Tvärminne, Långskär! ♂ (Frey); Tvärminne, Spikarna! ♂ (Frey); Helsingfors! ♂: 10. 1920 (Frey), ♀: 15. ix. (Nylander, Lundstr.); *OM (KP):* Larsmo! ♂: 15. viii. (Storå); Pedersøre! ♂: 5. viii.—9. ix. (Storå); Nykarleby! ♂: 12. x. 1938 (Storå).

Stackelberg (1937, p. 247) emphasises that *C. pipiens* is not found in the arctic zone, and in accordance with this Soot-Ryen states (1939, p. 67) that this species has hitherto not been found in the northern part of Norway. As will be seen from above list of places, this agrees with the result of the examination of the Fennoscandian material at hand. As, however, several records of *C. pipiens* from northern localities are found in older literature, a discussion of these statements is necessary.

In Fauna Suecica, Linnaeus says, on the distribution of *C. pipiens:* "Culex ipse in sylvis praesertim Lapponia, nec non rarius in alpibus, ubi major est, hed una eademque species." As stated above, the species-differentiation of Linnaeus is not in accordance with modern systematics and his records concerning finds of *C. pipiens* in Lappland must be excluded from the account. Zetterstedt, in Diptera Scandinaviae (1850, p. 3455), i. a. says: "In Lapponia praesertim abundans, in alpes quoque adscendens." Dr. K. H. Forslund (1929, pp. 185—6), who published a revision of the *Trichoptera* in coll. Zetterstedt, remarks that some caution must be applied regarding the statements on distribution published by Zetterstedt. Chiefly the specimens, which most likely are not from Lappland, are without locality labels. Forslund therefore emphasises that only specimens bearing locality-labels are reliable. Through the courtesy of prof. dr. Kemner in Lund, I received for inspection all specimens in coll. Zetterstedt of *C. pipiens* bearing locality-labels, in all 6 specimens including one male. Two females are furnished with small black card-boards and handwritten labels: "Lapp." (according to B. Tjeder 1940: Umeå Lapmark 1832). Three females bear purple card-boards, one of which also has a handwritten label: "*C. pipiens* Linn. ♀ Lund. Scan." The purple card-boards indicate: Lund and environments (B. Tjed.). The male bears a handwritten label: *C. pipiens* ♂ Wittangi." The females from Lapland are rather denuded. However, the wing-venation is characteristic of *Ochlerotatus* and a few white scales on some tarsal segments indicate that the specimens belong to the *annulipes*-group, most probably *A. excrucians* Walk. According to an examination of the male genitalia, this specimen proved to be *A. communis* Deg. Thus also Zetterstedt's statement of *C. pipiens* from Lappland must be excluded from the account.

Holmgren (1883, p. 178), Jacobson (1898) and Økland (1928, p. 103) records the species from Novaja Semlja and Waigatsch. As the specimens in question have not been accessible, I must refrain from taking these statements into consideration. Further Ménétries (1851, p. 68) records *C. pipiens* from the Taimyr-river, Boganida, Udskoj-Ostrog, but also here further investigations are strongly needed.

Distribution outside Denmark and Fennoscandia.

Acording to Edwards (1921b, p. 347) *C. pipiens* is distributed throughout the palaearctic region, but, as stated by Marshall (1938, p. 248), *C. molestus* Forsk. had not been distinguished when this statement was made. Marshall also points out that the form occurring in China and Japan is slightly different from that in Europe. Among other places, *C. pipiens* L. has been recorded from: Switzerland: Bern (Bangerter 1926); Orbeebene, Kanton Waadt (Galli-Vall. u. Roch. d. J. 1908); Poland (Tarwid 1934, 1938 a—b); Dalmatia (Bezzi 1911, p. 14); Hungary: Balaton (Mihályi 1941), Spain: Malaga, Madeira, Teneriffe (Theob. 1910, p. 381); Gran Canaria (Storå 1937, p. 2; Germer and Behrens 1942); Azores (Theob. l. c. pp. 361—2); Malta, Crete, Algeria (Theob. l. c., pp. 381—2); Tangier (Charrier 1924); Tunis: Sfax (Theob. l. c., pp. 303); Egypt (Kirkpatrick 1925, p. 13); Odessa (Prendel 1940); Tiflis (Kalandadze a. Tairova 1939); Caucasus: Sotschi distr. (Baschkareva 1931), Kryschina, Sjelesnovodsk (Mess 1929); S. coast of Crimea: Aluschta (Velitschkevitsch 1931); Ferghana: Kokanda, Skobelev, Andisjan, Hakulbad (Simanin 1929); Turkmenia (Petrischtscheva 1934); N. Kirgisia: Issyk-Kuljsh-valley (up to 1500 m above sea level), S. Kirgisia: along Pamir highway (up to about 3500 m above sea level), "At about 2000—2500 m above sea level this species is the predominating one." Manchuria (Ono 1939); The Maritime Province of the Russian Far East (Petrischtscheva a. Shubladze 1940); Eritrea (Lewis 1943); Etiopia (Hopkins 1936, pp. 207—8), East and South-Africa and Madagaskar (Edwards 1921 b, p. 347). As to the distribution in the American continent, Dyar (1928, p. 383) gives the following information: "Eastern North America from the thirty-eighth parallel of north latitude to southern Canada; Pacific Coast, California to British Columbia; South America south of the thirty-ninth parallel of south latitude." However, Wanamaker, Chamberlain and Carpenter (1944) remark: "The ranges of distribution in USA of *Culex pipiens* L. and *C. fatigans* Wied. overlap in a transitional zone of varying depth. Considerable confusion regarding the limits of their distribution has arisen from the fact that they cannot be distinguished except by examination of the male genitalia. The range of *C. pipiens* was found in 1942 to include parts of Georgia, South Carolina and Alabama. — — — The presence of *C. pipiens* in northern Missisippi was estabished." Other recent records are: Maine (Bean 1946), Rhode Island (Knutson 1943), Massachusetts (Tulloch 1939), Michigan (Irwin 1941), Missouri (Adams and Gordon 1943), Nebraska (Tate and Wirth 1942), Colorado (Lasky 1946), Utah (Don M. Rees, 1942), and South Carolina (Bradley, Fritz, Perry 1944).

Biology.

Larvae of *Culex pipiens* L. have been found in Norway from the beginning of May till the first days of September. The breeding waters are of different character: waterfilled ditches, pools filled with rain-water, flooded areas, swamp-pools and larger ponds. Chiefly the larvae have been found in clear water, in some cases in ponds, more or less covered with *Lemna*, but larvae have also been found in rather polluted waters. The few investigation of the hydrogen-ion-concentration gave figures from pH: 5.5 up to pH: 7.4. In a swamp pool at Minde (HOy 18) the hardness of the water was 1.15. Larvae of *C. pipiens* have been found associated with larvae of *T. annulata, bergrothi, A. (O) communis, punctor* and *C. (N) apicalis.*

Culex pipiens L. has been found in southern Norway from the sea-shore and up to 250 m above sea level. The breeding waters lie partly in open areas, partly more or less shaded.

From Denmark, Wesenberg-Lund (1920—1, p. 129) points out that larvae of *C. pipiens* L. may be found in highly polluted water: "But also in the dunghill pools, where the sides of the pools are real dunghills, we often find the brown, nasty fluid almost filled with mosquito larvae."

As demonstrated in the figures (fig. 120) the anal gills of the larva of *Culex pipiens* L. are rather variable in length; the larvae with the short gills are mostly from coastal localities and the specimen with the very long gills is from an inland locality.

Concerning the number of generations in Denmark, Wesenberg-Lund (1920—1, p. 128) says: "It is very difficult to make clear how many generations are produced in the course of a summer. The common opinion is that the number of generations is very large; I for my part regard this supposition as quite wrong. I do not think that it exceeds three or rarely four." According to the dates on the labels of the Fennoscandian material at hand, m a l e s have been caught: in S w e d e n from medio June to ultimo September, in N o r w a y from the beginning of July to the first days of September, and in F i n l a n d from medio July to medio October. In my opinion these dates indicate that *Culex pipiens* L. has at least three generations during the summer in Fennoscandia.

In southern Norway I found females of *Culex pipiens* L. ultimo September in the cellar of the residential house at Østensjø farm (Ak 13). The mosquitoes were found, associated with *Anopheles maculipennis,* under the ceiling and on the upper part of the wall; they were rather vivacious and changed their resting place when hit by the light of my electric lamp. In Denmark, Wesenberg-Lund has made detailed investigations on the hibernation of *Culex pipiens*: "In November I have often found the females in number in summer houses, arbours etc., but during winter they commonly disappear from localities of this nature. The females hibernate in deep sheltered, frostless cellars; hitherto, as far as I know we have never in winter found the mosquitoes in nature. As long as the temperature is above zero, the mosquitoes are able to fly when a light is brought near them; they hang down from walls and ceilings often in such huge masses that these are covered with them; the hibernating localities in our houses must always be dark, rather moist; and without any draught at all; it is not necessary that they are frostless; if the temperature falls below zero, they fly deeper into the cellars; during severe winter they often retreat to places of such a sheltered nature that it is difficult to find them. — — — If mosquitoes are taken in from the deep dark cellars, brought into the light and kept at temperatures about 15 C they almost always die; probably owing to want of food. Most probably they are not able to keep their metabolism at a point as slow as necessary, if food supply is to be wholly denied."

On the blood-sucking habits of *Culex pipiens* he further remarks (Wesenberg-Lund 1920—1, p. 146): "During the whole summer and late autumn not a single *C. pipiens* has done me the honour to puncture my skin. As mentioned later on, I have never found a blood-filled mosquito in the cellars, and the few I have seen I have caught on evenings in spring and summer months. Only during winter, when the mosquitoes arrived in the rooms, have I been the object of their attacks; when I have heard that people have been attacked in their rooms by mosquitoes in winter, and I have been able to examine them, it has almost always been shown that the trouble was caused by *C. pipiens.*" As pointed out below (see *C. pipiens molestus* Forsk.), the investigators have arrived at very diverging results as to the man-biting habits of *C. pipiens,* but this is due to the confusion of the two subspecies *C. pipiens pipiens* Linnaeus and *C. pipiens molestus* Forskål.

Taken all in all the character of the breeding water of *C. pipiens* in places outside Fennoscandia agree with those found in our region, but some variations are found. From Germany, Martini (1931 a, p. 379) points out that the breeding waters rarely are found in open places. Marshall (1938, p. 247) i. a. remarks: "Of all British species of mosquitoes, *C. pipiens* is undoubtedly the least fastidious in the selection of breeding places. — — — The larvae infest water of all degrees of salinity up to half that of seawater." According to Kirkpatrick (1925, pp. 194—5), *C. pipiens* is very common in artificial cisterns and tanks in Egypt, it is also abundant in cess-pools, in household utensils in which water has been left, in borrow pits and pools of all types. It is mainly a fresh water species, but in thirteen places the percentage of salt was over 1.0. The hydrogen-ion-concentration of the breeding waters showed figures from pH 7.2 to pH 8.9. From Middlesex county, New Jersey, J. B. Schmitt (1942) records that eggs of *C. pipiens* placed in water from abandoned clay pits, either did not hatch or gave rise to larvae that died on the first day. The pH of the water in these pits ranged from 3.3 to 4.7. Hopkins (1936, p. 208) points out that *C. pipiens* is rarer in artificial cisterns in Ethiopia, than in natural water. He has occasionally found larvae in waterfilled leaves of bananas lying on the ground. Records from USA and Canada (Dyar 1928, p. 383; Twinn 1931, p. 12) agree that the larvae occur largely in the water of artificial receptacles In Alameda county, California, larvae of *C. pipiens* have even been found in waterfilled flower containers in cemeteries (Kelley 1942). From different places it is recorded (Twinn 1925/26, p. 89; Martini 1931, p. 379; Peus 1932, p. 141) that larvae of *C. pipiens* may be found in rather polluted waters. On this matter, Hurter (1926, p. 20) remarks: "Wenn auch die Scheidung der Gewässer in reine und verschmutzte mit menschlichen Begriffen arbeitet, so ist es doch eine Tatsache, daß die Arten dermassen an Reinheitsstufen angepaßt sind, daß in vielen Fällen eine reine Auslese eintritt Unsere Arten (Schweiz) lassen sich in folgende Reihe entsprechend der zunehmenden Verschmutzung des Brutwassers stellen: |*Culex, vexans, annulipes, Anopheles maculipennis, bifurcatus, Culex pipiens.* Die Rangordnung ist aber nur in Bezug auf das Maximum der ertragenen Verschmutzung richtig, denn gerade *Culex pipiens* und *Anopheles bifurcatus* brüten auch in den reinsten Wässern, und die übrigen kommen auch nebeneinander vor. Deshalb ist hier die Verschmutzung unter die Ausscheidenden, negativen Faktoren eingestellt."

Studies of the development of *Culex pipiens,* at varying and constant temperatures, carried out by Headlee (1942), demonstrated that the mosquito is a temperate species developing at 56° F (= 13.33° C), but not above 87° F (= 30.55° C). Jobling (1938) records: "Experiments in which both subspecies (*C. p. pipiens* and *C. p. molestus)* were breeding in many different solutions of sodium chloride showed that *C. p. molestus* can resist higher concentrations of salts in water than *C. p. pipiens,* and seemed to indicate that reduction in length of the anal papillae is proportional to the concentration of salts in the water. It is known that osmotic pressure increases with temperature, and further experiments proved that the temperature of the water affects the length of the anal papillae through the modification of the osmotic pressure and also showed that equal differences of temperature produce equal variations in the papillae irrespective of the concentrations of salts in solution. Long anal papillae in larvae of *C. p. pipiens* caught in nature were more often found in the spring generation (and sometimes also in those collected in the autumn) probably because of the much lower salt content of the water owing to the more frequent rains. The length of the papillae in larvae from very polluted water was the same as that of the papillae of larvae bred in 0.25 or 0.5 per cent concentrations of sodium chloride."

As to the number of generations in the summer, Eckstein (1920 a, p. 95) records 5 generations in Elsass, and Hecht (1933, p. 78) remarks: "Ich glaube, wir können in Norddeutschland mit 3 Generationen jährlich rechnen, in Jahren mit warmen Sommer wohl mit 4 Generationen." On the hibernation, Martini (1931, p. 377) says: "*C. pipiens* durchwintert als erwachsenes ♀ in den nördlichen Teilen seines Verbreitungsgebietes, in die wärmeren geht die Entwicklung das ganze Jahr weiter." From U S S R Stackelberg (1937, p. 248) points out that *Culex pipiens* is found not only in cellars etc., but also in caves (i. a. at Sablino in the environs of Leningrad). On the seasonal prevalence in Egypt, Kirkpatrick (1925, p. 194) says: "So numerous throughout the year that it is difficult to say when it attains its maximum."

Very little is known concerning the migration habits of this species, but from experiments, carried out in Illinois, with mosquitoes dusted with aniline dyes in the breeding area, Clarke (1943) records that 10 females and 2 males were caught 14 miles from the starting point.

Culex (Culex) pipiens molestus Forskål.

C. molestus Forsk. (Descriptiones Animalium, p. 85) 1775
C. domesticus Germar (Reise in Dalmatien, p. 290, No. 498) .. 1817
C. pipiens Ficalbi (Bull. Soc. Ent. Ital, *21*) 1890
C. haematophagus Fic. (Bull. Soc. Ent. Ital., *25*) 1893
C. pipiens var. *autogenicus* Roubaud (Ann. Sci. Nat. Zool., *16*) 1933

Synonymical remarks.

In 1775 Forskål described a new mosquito from Egypt: "*Culex molestus,* antennis pilis verticillatis; rostro cinereo, apice nigro crassiusculo; dorso fusco, fuscilis sex pallidis. Descr. Magnitude et fascies Culicis vulg. pipientis. — — — Rosettae, Kahirae et Alexandriae immensa copia, nocte incommodus dormientibus et vix arcendus nisi cortina bene clausa." According to Marshall and Staley 1937 (cit. Marshall 1938, pp. 240—1): "Germers description of *C. domesticus* obviously refers to a *Culex* which (in Dalmatia) is abundant in houses, bites only at night, and is more bloodthirsty than the common mosquito." Ficalbi's investigation on the man-biting *Culex* in Italy (1890) has been quoted above (see *C. pipiens),* but as he was in doubt as to whether the man-biting Culex of South Europe was the same as the species from Lapland described by Linnaeus, he subsequently (1893) proposed the name of *C. haematophagus* to the man-biting species in Italy. In 1933 Roubaud proposed the name *C. pipiens autogenicus* for an urban, homodynamic, stenogamic and autogenous race of *C. pipiens.* Marshall and Staley (1937) pointed out that the name of *Culex molestus* Forskål has to be used for the autogenous form, which they consider a different species. Marshall (1938) agrees with this interpretation. Jobling (1938) emphasises that: "The autogenous and anautogenous forms of *Culex pipiens* can interbreed, and are believed to do so in nature." He therefore treats them as subspecies and he uses the name *C. pipiens pipiens* L. for the anautogenous form and *C. pipiens molestus* Forsk. for the autogenous form, and this synonymy is also used by Callot and Dao Van Ty (1943). However, Roubaud (1944), points out that the name *C. molestus* Forsk. was originally proposed for å form of *C. pipiens* that attacked man in the Nile Delta. He disapproves of the application of this or any other early name to the European autogenous form, since such synonymy can take no account of the physiological differences between the biotypes and must depend solely on indefinite colour characters and on readiness to attack man. The latter criterion is inadequate for differentiation, since some of the non-autogenous forms — — —feed on man quite readily." In this paper I hold to the interpretation of Jobling (1938), though I am aware of the fact that further investigations are strongly needed to clear up the complex of forms of the *pipiens*-group, indicated in several recent publications (Callot and Dao Van Ty 1943, Richards jr. 1941, Roubaud 1939).

Description.

As already pointed out by Ficalbi (1890), *Culex p. molestus* Forsk. is differentiated from *C. p. pipiens* L. by the conspicuous lighter colour and the absence of white knee-spots and white spots on the apex of the tibiae. In the male *molestus* the palpi exceed the proboscis by a part of the ultimate segment. The female adults are distinguished by the uniform width of the pale abdominal bands on the tergites and by the absence of conspicuous dark patches on the venter.

Male terminalia. According to Marshall (1938, p. 249) the average number of hairs on the lobes of the ninth tergite, differ in *C. p. pipiens* L. and *C. p. molestus* Forsk. Even in different English strains of *molestus* the average number of these hairs varies.

Larvae. Marshall (1938, p. 249) points out that the larvae of *C. pipiens pipiens* L. and *C. p. molestus* Forsk. may be differentiated by the average siphonal index. In English specimens the average siphonal index of *C. p. pipiens* is about 5.0, whereas the highest average index of *C. p. molestus* is 4.3. Three Norwegian specimens with an average siphonal index about 4.2, I have, with some doubt, determined as *C. p. molestus* Forsk. However, as they are all from freeland material, further investigations on the larvae of Norwegian *Culex pipiens* are badly needed.

Geographical distribution.

Denmark: 2. *Sjælland:* ♀ (W-L., 1920—1, p. 146).
Sweden: *Upl:* Stockholm, ♀: xii. 1934 (K. H. F.).
Norway: AK: *?13.* Aker: Østensjø, L: vi. 1928 (LRN); *14. Oslo:* Kroghstøtten hospital, ♀: 5. x. 1933 (E. Onsum); AAy: *? 10. Arendal:* Flødevigen, L: 7. vi. 1930 (LRN); RY: *? 20. Hetland:* Mosvann, *L:* 5. vii. 1931 (LRN).

Distribution outside Denmark and Fennoscandia.

According to Weyer (1937 a, p. 66) *Culex p. molestus* Forsk. (the autogen race of *C. pipiens*) is hitherto recorded from England, the Netherlands, France, Germany (Hamburg, Bonn, Elberfeld), Hungary, Malta and Greece. Marshall (1938, p. 255) further points out that specimens from Egypt are in the collections of the British Museum. However, biological records of several investigators (i. a. Eckstein 1938; Hecht 1933 c, p. 11—2; Kon, Dobrosmuislov and Ginzburg 1942; Peus 1930 b, p. 410—4; Prell 1919; Savitzkii 1938; Stackelberg 1937, p. 248) strongly indicate that the subspecies has a wider distribution in Europe. Roubaud (1933) points out that there are doubtless other races of *Culex pipiens,* and he describes a non-autogenous, stenogamic race from Algeria (*C. pipiens berbericus*). Callot and Dao Van Ty (1943) have reared and studied three strains that are stenogamic but non-autogenous. They conclude that there must be at least three if not four biological races in France. Jobling (1938) points out: "*C. p. molestus* is most common in the Mediterranean parts of the Palearctic region. Its distribution is local in central Europe and it is probably not present in Scandinavia." As to Africa, Hopkins (1936, p. 208) says: "Since both the autogenous and anautogenous forms — — — would appear to occur in East Africa, it is possible that the range of variation and of breeding places may, to some extent, be divided between the two forms, but the point has not been investigated."

Biological observations by Twinn (1926 a, p. 89; 1926 b, p. 110; 1927, p. 2) indicate that *C. p. molestus* occurs in Canada. However,, according to Richards jr. (1941): "It has been found that genetically distinct strains of *Culex pipiens* L., similar to those observed in Europe occur in the eastern USA. The author points out that the situation in USA differs from that in England, as the American autogenous strain does not agree in structural characters with the description of *C. p. molestus* Forsk. The American anautogenous strain does not shun human blood."

Biology.

As to the biology and ecology of *C. p. molestus* there are only scattered observations from our region.

Concerning Denmark, Wesenberg-Lund (1920—1, p. 146) remarks: "Only during winter, when the mosquitoes arrived in the rooms, have I been the object of their attacks; when I have heard that people have been attacked in their rooms by mosquitoes in winter, and I have been able to examine them, it has almost always been shown, that the trouble was caused by *C. pipiens.*"

From Sweden I received January 1935, from Dr. K. H. Forslund, some *Culex* for identification, with the report that they had been very annoying in the city of Stockholm. To be sure, the specimens sent me where rather denuded, but the wing venation was typical for *C. pipiens.* On account of the man-biting habits of this *Culex* I considered them as

C. p. molestus Forsk. The matter has been published by Forslund (1941, p. 191).

In Norway, *C. molestus* has been positively established. In the first days of October 1933 I received from the director of Kroghstøtten hospital in Oslo some specimens of *Culex* for identification. The director, Dr. Onsum, informed me in an accompanying letter that the mosquitoes had been rather annoying to the patients and staff. The specimens suited well with the description of *C. p. molestus* Forsk., and by a subsequent precipitin-test in the Tropical Institute at Hamburg the content of the stomach of two specimens proved to be human blood.

From Germany F. Weyer (1937 a, p. 66) records: "Bei uns in Hamburg war es in Kinderkrankenhaus, dessen Bewohner im wahrsten Sinne des Wartes bis aufs Blut von den Mücken gepeinigt worden sind." Further F. Peus (1930 b, p. 412) remarks: "In einem großen Krankenhaus (in Bochum, Ruhrkohlenbezirk) trat in allen Krankenzimmern während des ganzen Winters 1928/29 eine starke Belästigung durch *C. pipiens* auf." According to Prell (1919) a mosquito-plague in Stuttgart was due to *"C. pipiens"*. From USSR Kon, Dobrosmuislov and Ginzburg (1942) report that the workmen in the underground railway of Moscow were attacked by *C. pipiens,* and Savitzkii (1938) records that *C. pipiens* caused considerable annoyance in February 1937 in the building of a large public swimming bath in Kiev. On the conditions in Egypt, Kirkpatrick (1925, p. 144) says: *"Culex pipiens,* — — — is most active at night. It will however bite also by day, especially in a somewhat darkened rom. It frequently bites one's ankles, when one is sitting at a desk or table with the feet in comparative darkness, even though the rest of the room is brilliantly illuminated. It also appears to bite rather more frequently by day in cool weather possibly owing to restricted activity by night." As mentioned above several observations published indicate that *C. p. molestus* probably occurs in Canada. Thus Twinn (1927, p. 2) i. a. remarks: "At Montreal, this species attacks man freely, particularly at night, night workers on the railway which runs through the swamp, and residents in sections of the city in the vicinity of the swamp abundantly testifying to its bloodthirsty habits. One of the most annoying features of *Culex pipiens* is its habit of entering dwellings, at which it exhibits considerable ability."

Culex (Culex) torrentium Martini.

C. torrentium Martini (Int. Rev. Hydrobiol., *12,* p. 336) 1924
? C. pavlovsky Schingarev (Russ. J. Trop. Med., *6,* 52)....... 1928
C. exilis Martini (Flieg. Pal. Reg. *11* u. *12,* p. 386) 1937

Synonymical and systematical remarks.

This species was established by Martini in 1924, but in his monograph (1931), he points out that the name of *exilis* Dyar is the correct one. He further remarks (1937, p. 387): "Edwards weist auf die nahen Beziehungen dieser Art zu *vagans* Wied., dem Neuseeländer *pervigilans* und dem afrikanishen *trifilatus* Edw. hin. Ich muß sagen, daß nach dem Bilde von Barraud zwischen dem Hypopygium von *vagans* und *torrentium* kaum ein greifbarer Unterschied ist, und wenn ich den *torrentium* in einem Stück auch aus Kleinasien belegt habe, andererseits *vagans* bis nach Kaschmir und im westlichen Himalaja, ist eigentlich kein Grund geographischer Art einzusehen, warum *vagans* nicht bis in die Gebiete kontinentalen Klimas nahe am Mittelmeer vordringen sollte. Man möchte daher *torrentium* für die westliche Rasse von *vagans* halten, wenn nicht in der Zeichnung doch erhebliche Unterschiede beständen. Zwecks Aufklärung dieser Frage habe ich *C. torrentium* an Barraud und nach Washington gesandt Von Barraud erhielt ich die Nachricht, daß *C. torrentium* und *C. vagans* verschieden seien, aus Washington schrieb mir W. de C. Ravenel, daß *C. torrentium* mit *C. exilis* Dyar gleich sei. Danach sind auch *exilis* und *vagans* verschieden."

However, Edwards (1932, p. 210—1) considers *C. exilis* Dyar as synonymous with *C. vagans* Wiedm. and he places *C. torrentium* Martini as an independent species. As it may be assumed that this prominent investigator and connoisseur of the mosquitoes had the best opportunity for comparative investigations, I here hold to the interpretation of Edwards.

In his description of the adult *C. torrentium* Martini (1924 b, p. 335) says: "Die Art wird durch ihre reiner weissen Binden und schwärzeren Farben der dunkelgefärbten Teile sofort als verschieden von *C. pipiens* erkannt." However, the Norwegian *C. pipiens* are rather variable in the colouring, and dark specimens occur which are hard to differentiate from specimens of *C. torrentium* Martini. In such difficult cases I have used the wing-venation for the differentiation of the females of the two species.

Description.

In the female the stem of the fork r_{2+3} is about ¼—⅓ the length of the fork itself. The radio-medial cross-vein is placed nearly twice its length distally to the medio-cubital cross-vein. The males are differentiated by the terminalia. Martini points out that the male palpi in *C. torrentium* are dark brown, without the light patches which are found at the palpi in *pipiens* and *fatigans*. However, the light patches on the male palpi are found in Norwegian specimens of

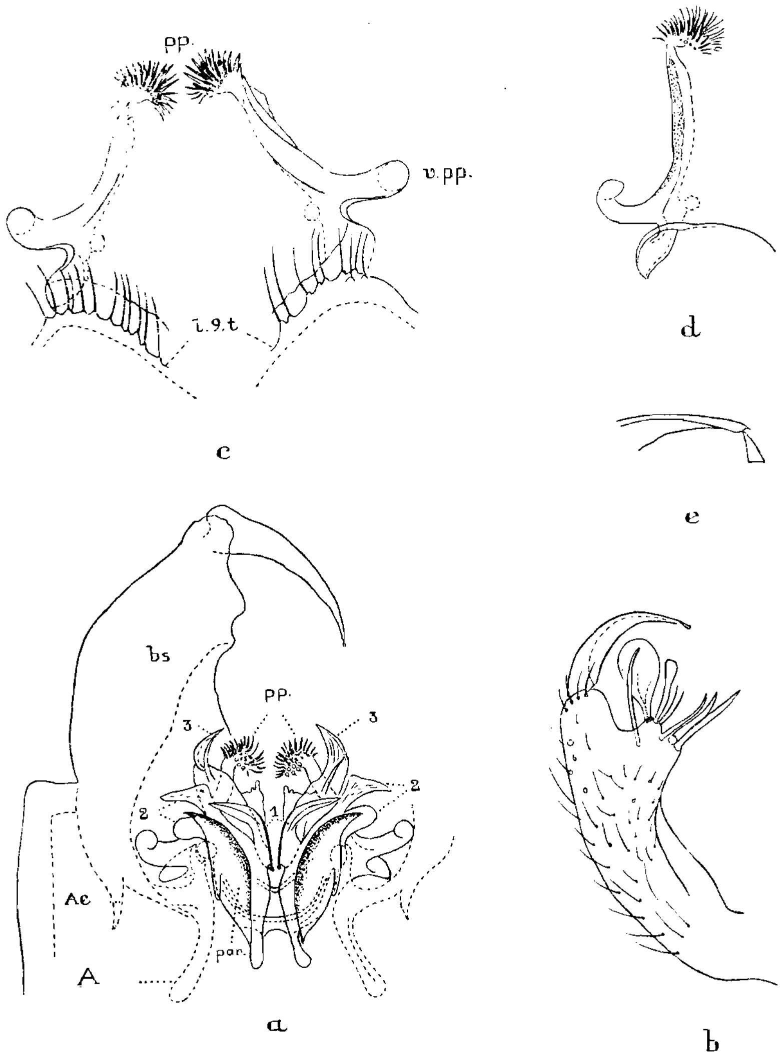

Fig. 121. *Culex torrentium* Martini.
A, Terminalia (total view); B, basistyle; C, paraprocts articulating with the lobes of the 9th tergite; paraproct (side view); e, tip of dististyle: Lettering of figures as in fig. 118. (Aut. del.)

C. torrentium, thus indicating differences between the northern and the Central European specimens.

Male terminalia (fig. 121). Basistyle and subapical lobe with appendages very similar to those of *C. pipiens.* Diststyle short and curved, expanded at the base. Claw narrowed at the base, swollen at apex. Sclerites of the phallosome a paired structure, each half with three prominent processes. Dorsal process (3) exceeding the crown, apically with a broad, tapering wing; median process (2) with a small rounded knob and more distally with a broad, tapering and laterally directed wing; ventral process (1) short, narrowed and curved. The semilunar parameres (pm) strongly sclerotised at the inner border. Paraprocts distally with a cluster of spines, the "crown". The basal arm of the paraproct, situated at the outer side of the stem, is a prominent, dorso-ventrally curved process, encircling the penis. At the inner side of the stem, opposite the basal arm, is a knob, which probably articulates with the penis sclerites. Lobes of the ninth tergite faintly sclerotised.

Larva. The larva of *C. torrentium* is first described by Martini (1924 b, p. 337), who (1931, p. 387) gives several differential characters.

In *C. torrentium* Martini the antennal tuft is of about ⅔ the length of the antennal shaft and with about 20 hairs; (in *C. pipiens* L. the antennal tuft is of about ¾ the length of the shaft and with about 22 hairs). Sensory appendage and bristles at apex of antenna close together. Subapical bristles of about the same length as the apical bristles; (in *pipiens* the subapical bristles exceed the apical bristle somewhat). Inner frontal hairs beside the mid frontal hairs; frontal hair formula about 5/5. (In *pipiens* inner frontal hair stands oblique to the mid frontal hairs; frontal hair formula about 4/4.) Siphonal index about 6—7 (in *pipiens* well over 5.0). Ventral brush with about 11 tufts, anal gills of about twice the length of the saddle (*pipiens:* ventral brush with about 12 tufts, anal gills of varying length). In his description of the larva of *C. pipiens,* Martini (1931, p. 380) remarks: "Die längeren Rohre fand ich vor allem bei Larven aus relativ reinem Wasser im Freien. Diese Larven sind von denen von *C. exilis* Dyar [= *torrentium* Martini] wohl nicht zu unterscheiden." As mentioned above I have not succeeded in obtaining pure strains of *C. torrentium* Martini, and I therefore can not differentiate the larvae of *C. torrentium* and *C. pipiens.*

Geographical distribution.

Denmark: Hitherto not found (N!)

Sweden: *Sk:* Ystad, Anderslust! ♀: 8. viii. 1936 (B. Tjed.); *Ög:* ♀ (Hagl!); *Vg:* ♀ (coll. Växtsk. Anst. Exp. fält!); *Upl:* Hlm., ♂♀ (Lmp!); Växtsk. Anst. Exp. Fält! ♀: 8.—13. viii., ♂: 13. viii.

Norway: AK: *32. Eidsvoll:* Eidsvoll Bath, L: 15. viii. 1930 (♀) (LRN); HEn: *23. Ytre Rendal:* Solbakken, Storsjøen, ♂♀: 30. vii. 1930, L: 20. vii. 1939 (♂♀), Sandodden, L: 4. vii. 1935; Viken, P: 4. vii. 1935 (♂♀) (LRN); Nnø: *39. Sørfold:* Røsvik, ♂♀: 3. vii. 1923 (S-R).

Finland: *Ab(V):* Kuustø! ♂ (Lundstr.); Lojo! ♂ (Krogerus); *N(U):* Esbo! ♀ (Frey); Tvärminne! ♀: 15.—22. vii. 1935, ♂: 13. vii.—13. viii. (Storå); Helsinge! ♂ (Hellén); *Ta(EH):* Teisko! ♂ (Frey); *OM(KP):* Larsmo! ♀: 12. viii. 1933 (Storå); Pedersöre! ♂♀: 15. viii. 1933 (Storå).

Distribution outside Denmark and Fennoscandia.

As to the distribution of *C. torrentium,* Martini (1931, p. 387) remarks: "Bisher gefunden in Thüringen, im Gouvernement Saratow und der Wolga-Sowjet-Republik. Ferner ist wohl *C. Pawlovskii* Schingarew, gefunden bei Tomsk, die gleiche Art. Ein Exemplar habe ich ferner, das Izmet etikettiert ist, also aus dem Norden von Kleinasien stammt, von Dr. Medjid. Neuerdings stellte ich sie fest in Material von Königsberg (Skwarra) und Isingtau (Horn)." It is also recorded from Poland (Tarwid 1934, 1938 a). Stackelberg (1937, pp. 239—40) says that the species is widely distributed and fairly common in some places in USSR. Hitherto recorded from: "Leningrad distr.: Peterhof (Montschadskiji!), environs of Luga (Stackelberg!); Sverdlovsk distr. (Kolozov!); Lower Volga distr. (Martini); southern coast of Crimea (Velitschkevitsch!); N. Kaukasus: Essentuki, Pjatigorsk (Mess!); W. Sibir: Tomsk (*C. pavlovskyi* Sching.) and Ussurjsk dstr.: Kamen-Rybalov (Stackelberg!); Tirgovaja, Sutschan mines (Stackelberg!)." Under "critical remarks," Stackelberg adds: "Under this species must be included information on finds of *C. laticinctus* Edw. from Ural (Kolosov), N. Kaukasus (Mess 1929) and southern coast of Crimea (Velitschkevitsch 1931)." [112]

Biology.

The only adults caught (♂♀), are from Ytre Rendal (HEn 23), collected ultimo July and further a male and two females from Røsvik (Nnø 39). In Sweden ♂♀ have been found medio August and in Finland from medio July to medio August. How many generations may develop in the course of the summer in our region is not known. In Norway larvae have been found, associated with larvae of *Anopheles maculipennis* in a pond near Eidsvoll Bath (Ak 32), and in Ytre Rendal (HEn 23), associated with larvae of *Anopheles maculipennis, T. bergrothi,* and *C. pipiens.* In Eidsvoll the breeding water was a permanent pond, and in Ytre Rendal larvae were caught on a flooded meadow, and in a great pool,

[112] Translated from the Russian text.

which communicates with the lake Storsjøen in spring time. The hydrogen-ion-concentration in the last mentioned pool was pH: 7.4. A find in Ytre Rendal in 1939, indicates that larvae of *C. torrentium* may sustain even highly polluted water. In a pailful of liquid manure, intended for the vegetable garden, masses of *Eristalis*-larvae and also several mosquito-pupae were found. From the pupae males and females of *C. torrentium* were hatched.

As to the ecology of this species in more southern places, Martini (1931, p. 387) remarks: "Die Larven wurden zuerst in Strudellöchern von Felsen im Schwarzabett nicht weit von Salzburg gefunden, wo v. d. Brelje sie zuerst bemerkt und gezüchtet hatte. Die Annahme, daß sie nur an solchen Plätzen vorkämen, bestätigte sich nicht. In Südostrussland war sie nach meinen Beobachtungen die häufigste der *Culex*-Arten im Freien, die in klarem Wasser, zwischen Gras, in alten Brunnen, in Überschwemmungspfützen der Steppendörfer usw. sehr gemein war, gewissermassen der *C. pipiens* in den natürlichen Gewässern vertrat. Danach ist vielleicht der Fundplatz im Schwarzatal einer an der westlichen Grenze der Art — — — Die Larven waren schon im Mai und bis in den September häufig."

Chapter 10.

Composition of the culicine fauna of Denmark and Fennoscandia and problems connected herewith.

The area considered in this treatise is that of Denmark and Fennoscandia, a region used in 1939 in a catalogue of northern Coleoptera (Victor Hansen, Hellén, etc.). As to the conception Fennoscandia, we find the following definition, from a geological point of view, in W. Ramsay (1931, *2*, p. 140): "The greatest area of archaean rocks in the Fennosarmatic block and even in Europe constitutes Fennoscandia. With this name Wilhelm Ramsy has designated the, from many points of view, well bounded and characteristic natural territory, comprising Norway, Sweden, Finland, The Kola Peninsula and the Russian Karelia. The rock basement of Fennoscandia is mostly Precambrian, consisting principally of massive and crystalline schistose rocks of igneus origin, partly including minor areas of highly altered sediments." Further Lindroth (1941, p. 431) remarks: "Fennoscandia als biogeographischer Begriff umfaßt Scandinavien, Finland (vor d. J. 1940) und die russischen Teile von Karelien, und Lappland (östl. bis zum Onega-See und dem Fluß Wyg)."

Topographically the Scandinavian Peninsula is characterised by the mountainous chain extending north-south. In the north this chain principally extends along the frontier between Norway and Sweden, in the south the mountainous area is merely confined to Norway.

Norway, representing the western part of the Peninsula, has its longitudinal direction Sw—NE. The distance from the southernmost point (Lindesnes) to the northernmost (Nordkyn) is about 1756 km (more than 13 degrees of latitude). The southern part of Norway is about 400 km broad; north of the Trondheimsfjord the width rarely exceeds 100 km. Norway is a mountainous country, the coast being indented by many fjords and the land-mass furrowed by deep valleys. In Southern Norway the watershed lies about 100—150 km from the coast with peaks above 2000 m in and around Jotunheimen. In northern Norway the highest mountainous areas are found chiefly along the Swedish frontier. The principal lowlands are in the areas surrounding the Oslofjord and northwards to the lake Mjøsa, in the southwestern Norway (Jæren) and in the districts neighbouring the Trondheimsfjord. Owing to the Gulf-Stream, the mountainous chains and the great extension N—S of the land, there are rather conspicuous contrasts in the climate in different parts of Norway. In western Norway north to Finmark a coastal climate prevails, whereas the southeastern Norway and the inner parts of Finmark are characterised by a continental climate. The average temperature (1874—1933) in Bergen was: January: ÷1.4° C, July: + 14.4° C; Oslo: January: ÷ 3.8° C, July: + 17.4° C; Røros: January: ÷ 10.4° C, July: + 11.3° C; Karasjok: January: ÷ 14.8° C, July: + 12.9° C. The chilly foliiferous trees are merely distributed in lower regions around the Oslofjord and along the south and west coast north to the the 60th degree of northern latitude. The predominating coniferous woodlands (fig. 122) extend up to about 1000 m above sea level in southeastern Norway, the timber line decreasing towards the westcoast and in northern Norway. The upper belt of the woodland is characterised by birchwoods (*Betula odorata*) and the line of woods are found in about 1100 m above sea level in the central mountains, decreasing to about 500 m at the west coast and downwards to 100 m or less at the coast of Finmarken.

Sweden, covering the eastern part of the Scandinavian Peninsula, may be divided into four principal regions, viz. the North-Swedish Highland, the Central-Swedish Lowland, the South-Swedish Hill-Land and Skåne. The North-Swedish Highland is a terraced high-plateau descend-

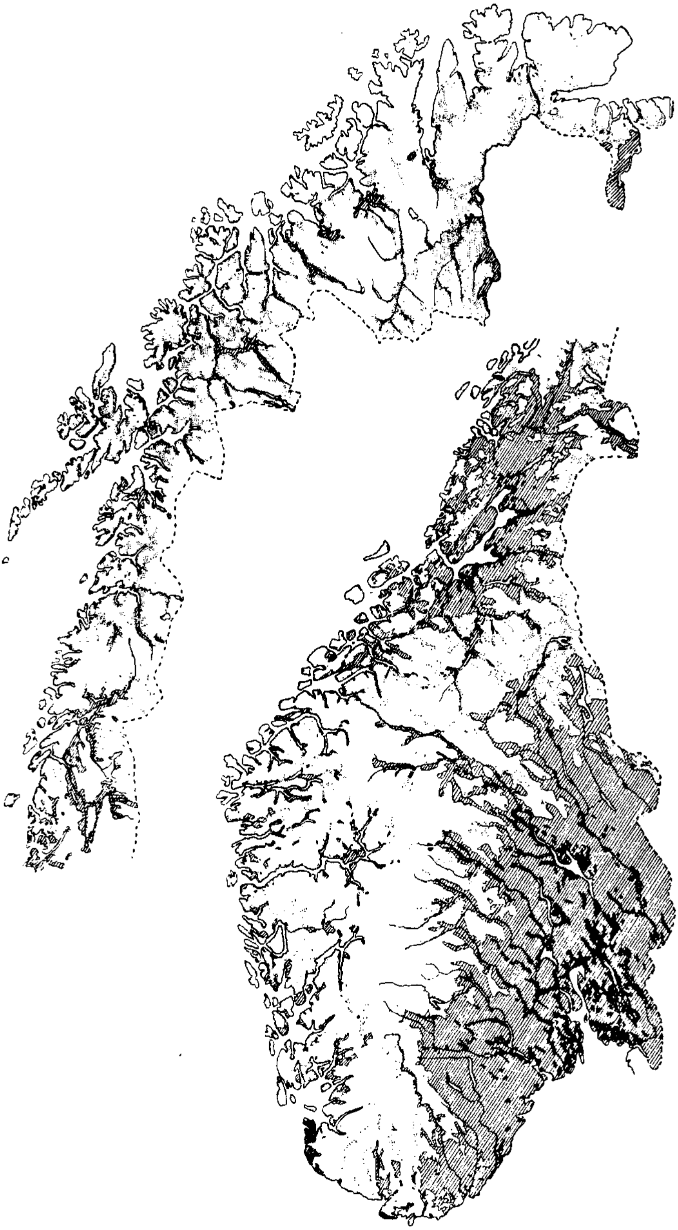

Fig. 122. The distribution of woodland in Norway.
Shaded: coniferous forest, dotted: foliferous forest, black: agricultural field, white: barren mountains and untilled area (After S. Johnsen 1928).

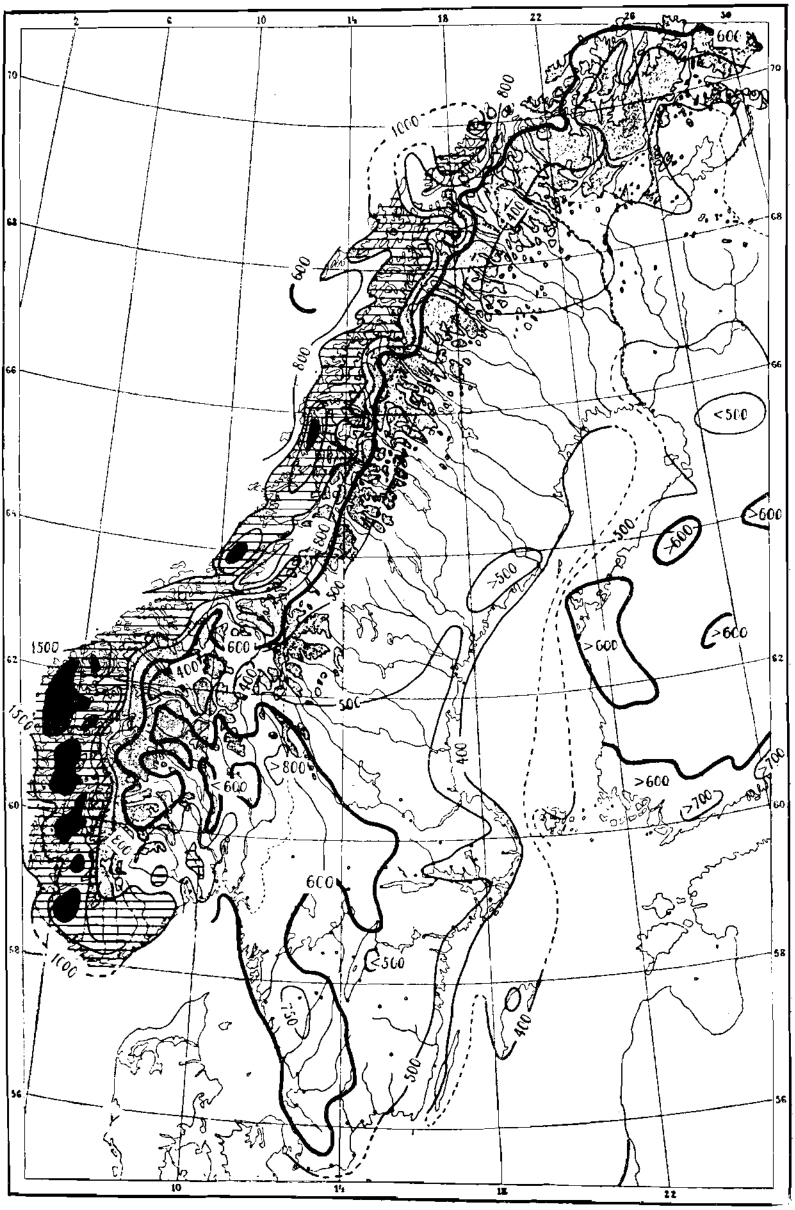

Fig. 123. The average annual precipitation (mean value of many years). The figures indicate millimeters per year. The 600 mm line is drawn heavier than the others, shaded area with 1000—2000 mm, black area with more than 2000 mm. In certain localities immediately south of 60, immediately south of 61 and immediately north of 61 northern latitude the precipitation exceeds 3000 mm per annum. After H. E. Hamberg, Mohn and Atlas över Finland.
(After Ekman 1922).

ing towards the Baltic Sea. Near the Norwegian frontier are mountainous chains with peaks from 1200 m (Dalarna) up to about 2000 m above sea level (Lappland). The line of woods, which in the south is about 1000 m, descends northwards to about 600 m above sea level. The Central-Swedish Lowland, characterised by the great lakes, extends between Skagerak and the Baltic Sea. The South-Swedish Hill-Land embraces the woodland plateau of Småland with heights up to about 370 m above sea level. Skåne is a plain partly covered with fertile glacial deposits. In Sweden about 56 % of the land is woodland, mostly coniferous woods, and about 9 % is cultivated areas. The climate is, with the exception of the south-western coast, of a continental type. The mean temperature decreases rather regularly from south to north. The average precipitation in Scandinavia will be seen from the adjoining map (fig. 123). In post-glacial time (the *Ancylus* time) the southern part of Sweden has been connected with Denmark and North-Germany which event obviously placed its stamp on the South-Scandinavian biota.

Finland is an old peneplain, rarely exceeding 200 m in height, which forms a plateau mostly covered with glacial deposits. The plateau consists of broken ground with lower hills and eskars, intermingled with a multitude (about 35 000) of lakes. Mountainous areas are situated in the north with the highest peaks (about 1300 m) near the north-western frontier. About two thirds of the area is woodland, predominated by pinewoods. Pine-swamps and treeless bogs are rather extensive (about 31 % of the land). In the northernmost part of Finland, along the Arctic Sea, tundra-regions with moss-vegetation are found. The climate is of continental type with rather cold winters. The average temperature in Helsingfors: February: ÷ 6.9° C, July: + 17.1° C, in the region of the lake Inari (Enare): February: ÷ 13.8° C, July: about + 12° C. The precipitation of the year amounts in Helsingfors to 704 mm.

Geologically Denmark, as well as North-Germany, the Netherlands, Belgium and southwestern England, appertains to a great sedimental area, the rock basements of which, in our region, are solely exposed in Bornholm. In the rest of the Danish Islands and in Jylland the older layers have not been investigated. The greater part of the land is covered with glacial deposits which rest on cretaceous and tertiary formations. However, in some places cretaceous formations are exposed (i. a. Møens Klint). Generally the ground is rather broken, with an average height of about 30 m and with hills up to 173 m above sea level (north of Horsens). About 70 % of the land is cultivated area, and only 8 % consists of woods, mostly foliferous trees. Along the western coast of Jylland is a narrow strip of downs and the original type of vegetations in West-Jylland is the heath (Hede). Moor-land may be found in the river-valleys. The average temperature in July is: + 16.1° C., in February: ÷ 0.06° C. The mean precipitation 1921—25 was 623 mm, but it varies to some extent in different years.

Though the Fennoscandian mosquito-fauna is not by far sufficiently traced as to the geographical distribution of many species, we have reason to suppose that the bulk of species to be found in this area, are now known. In a treatise "Die Skandinavische Käferfauna als Ergebnis der letzten Vereisung" Lindroth (1939, *1*, pp. 242—43) makes some reflections on the trustworthiness of zoogeographical investigations, which I find of interest to quote here.

"Die Zuverlässigkeit jeder tiergeographischen Untersuchung ist von der Genauigkeit des Kartenbildes abhängig. Das w a h r e Verbreitungsbild einer Art werden wir niemals erhalten. Aber die Karte muß wenigstens "glaubwürdig" sein. Als ein Zeugnis davon, daß dies Stadium erreicht ist, mag gelten, wenn alle neu einlaufenden Funde sich organisch in das frühere Kartenbild einreihen lassen, ohne es zu "zerstören".

I fully agree with Lindroth in his point of view, though the culicidologists hardly may obtain such multitudes of finds as the coleopterologists use in their geographical researches. I think, however, when some caution is used, that a preliminary analysis of the composition of the Scandinavian mosquito-fauna and the main lines concerning the possible way of immigration of its components, should already now be allowable.

As a starting point for further consideration I give below a review of the species actually found in this area.

The table below gives the positive fact that these species have been found in the different countries of the region, but, in consideration of the few systematic investigations on mosquitoes carried out in our region, the table does not permit negative conclusions for all species. Most probably further investigation will enlarge the range of distribution for some species, and, as remarked by Marshall (1928, p. 216), concerning *Theob. subochrea* in England, the finds hitherto "possibly indicate the distribution of mosquito-

Table 39.

The species of *Culicini* hitherto found in Denmark and Fennoscandia.

		Denmark	Sweden	Norway	Finland	USSR
1	*Theobaldia (Theobaldia) alascaensis* Ludl.	-	×	×	×	-
2	» » *anulata* Schrank.	×	×	×	-	-
3	» » *subochrea* Edw. .	×	-	×	×	-
4	» » *bergrothi* Edw. . .	-	×	×	×	×
5	« *(Culicella) morsitans* Theob. . . .	×	×	×	×	-
6	» » *fumipennis* Steph.	×	×	×	-	-
7	*Taeniorhynchus richiardii* Fic.	×	×	-	×	-
8	*Aëdes (Ochlerotatus) dorsalis* Meig.	×	×	×	×	×
9	» » *caspius* Pall.	×	-	-	×	-
10	» » *cantans* Meig	×	×	×	×	-
11	» » *annulipes* Meig.	×	×	-	-	-
12	» » *riparius* D. K.	-	×	×	-	-
13	» » *excrucians* Walk. . . .	×	×	×	×	×
14	» » *cyprius* Ludl.	-	×	-	×	×
15	» » *flavescens* Müll.	×	×	-	×	-
16	» » *detritus* Hal.	×	-	×	-	-
17	» » *cataphylla* Dyar. . . .	×	×	×	×	-
18	» » *leucomelas* Meig. . . .	×	×	×	×	-
19	» » *communis* Deg.	×	×	×	×	×
20	» » *punctor* Kirby	×	×	×	×	×
21	» » *sticticus* Meig.	-	×	×	-	-
22	» » *nigrinus* Eckst.	×	-	×	×	-
23	» » *diantaetus* H.D.K . . .	×	-	×	×	-
24	» » *intrudens* Dyar.	-	×	×	×	-
25	» » *pullatus* Coq.	-	×	×	-	×
26	» » *nigripes* Zett.	-	×	×	×	×
27	» » *nearcticus* Dyar. . . .	-	×	×	×	×
28	» » *rusticus* Rossi.	×	-	-	-	-
29	» *(Finlaya) geniculatus* Oliv.	×	×	×	-	-
30	» *(Aëdimorphus) vexans* Meig.	×	×	×	×	×
31	» *(Aëdes) cinereus* Meig,.	×	×	×	×	-
32	*Culex (Neoculex) apicalis* Adams	×	×	×	×	-
33	» *(Culex) pipiens* L.	×	×	×	×	-
34	» » *molestus* Forskål	×	×	×	-	-
35	» » *torrentium* Martini	-	×	×	×	-
		25	29	29	25	10

collectors rather than that of the species in question." However, a closer consideration of these problems will be given in connection with the discussion below on the geographical distribution of the northern Culicines.

As to the systematics of the mosquitoes concerned I refer to chapter 9 for details. I consider the existence of a species in the region beyond doubt where male adults have been found, in most species also where larvae in the fourth instar are recorded. The few exceptions are mentioned in the systematical part of this paper. In most species even finds of well preserved and typical female adults may prove the existence of a species in a locality. However, I have, with few exceptions, discarded all more or less denuded specimens, even from interesting localities. The systematics of the mosquitoes brings the investigator enough problems, and I held it of no value to increase the difficulties by introducing in the literature several obviously doubtful determinations.

In order to ensure the reader a possibility of control, I have, in the geographical part of this paper, recorded all stages actually found for each locality from Denmark and Fennoscandia. Doubtful finds are specially marked, in some cases, also discussed.

As could be expected the subgenus *Ochlerotatus* is the predominating group within our area and also the genus *Theobaldia* is represented by several species. Per contra the genus *Culex* and the subgenera *Aëdes, Aedimorphus, Finlaya and Taeniorhynchus,* which have their principal distribution in subtropic and tropic regions, are each, in Denmark and Fennoscandia, represented solely by few or even a single species. With the rather wide extension of many species characteristic of the boreal region (woodland and taiga-zone) it is not surprising that no endemic species is found within the Fennoscandian area. It should then be *Theobaldia bergrothi* Edw., but a record from Udinsk, gouv. Irkutsk, indicates that this species extends further eastwards.

It would be hazardous to deny the possibility of future finds of new species in Denmark and Fennoscandia, but as a base for further consideration of this problem I have below tabulated the number of species hitherto found in our region and the adjacent areas.

Of the 55 species found in the European part of U S S R the following 17 species have a distinct southern distribution: Uranotaenia unguilata, *Allotheobaldia longiareolata, Theobaldia setivalva, Orthopodomyia pulchripalpis, Ochlerotatus duplex, pulchritarsis, mariae, behningi, subdiversus, refiki, Stegomyia creticus, aegypti, Aëdes rossicus, Culex modestus, hortensis, mimeticus, theileri.* As to *Theobaldia glaphyroptera* I suspect this species is confused with *Th.*

Table 40.

Species of *Culicini* found in Denmark-Fennoscandia and adjacent areas.

	Europ. part. of USSR	Denmark Fenno-scandia	Germany	Britain
Uranctaenia unguilata Edw.	×	-	-	-
Allotheobald. longiareolata Mcq.	×	-	-	-
Theobald. glaphyroptera Schin.	×	-	×	-
» *alascaensis* Ludl.	×	×	×	×
» *annulata* Schrnk.	×	×	×	×
» *subochrea* Edw.	×	×	×	×
» *bergrothi* Edw.	×	×	-	-
» *morsitans* Theob.	×	×	×	×
» *fumipennis* Steph.	×	×	×	×
» *litorea* Shute	-	-	-	×
» *ochroptera* Peus.	×	-	-	-
» *setivalva* Masl. (in lit)	×	-	-	-
» *silvestris* Shing.	×	-	-	-
Orthopodomyia pulchripalpis Rd.	×	-	-	×
Taeniorhynchus richiardii Fic.	×	×	×	×
Aëdes (Ochlerotatus) dorsalis Meig.	×	×	×	×
» » *caspius* Pall.	×	×	×	×
» » *duplex* Mart.	×	-	-	-
» » *pulchritarsis* Rond.	×	-	-	-
» » *mariae* Serg.	×	-	-	-
» » *cantans* Meig.	×	×	×	×
» » *annulipes* Meig.	×	×	×	×
» » *riparius* D.K.	×	×	×	-
» » *behningi* Mart.	×	-	-	-
» » *excrucians* Walk.	×	×	×	-
» » *cyprius* Ludl.	×	×	×	-
» » *flavescens* Müll.	×	×	×	×
» » *detritus* Hal.	×	×	×	×
Aëdes (Ochlerotatus) cataphylla Dyar.	×	×	×	-
» » *leucomelas* Meig.	×	×	×	×
» » *nigripes* Zett.	×	×	-	-
» » *nearcticus* Dyar.	×	×	-	-
» » *communis* Deg.	×	×	×	×
» » *punctor* Kirby	×	×	×	×
» » *sticticus* Meig.	×	×	×	×
» » *nigrinus* Eckst.	×	×	×	-
» *diantaeus* H.D.K.	×	×	×	-
« » *intrudens* Dyar.	×	×	×	-
» » *pullatus* Coq.	×	×	×	-
» » *rusticus* Rossi	×	×	×	×
» » *subdiversus* Mart.	×	-	-	-
» » *refiki* Med.	×	-	×	-
» (*Finlaya*) *geniculatus* Oliv.	×	×	×	×

(Table 40 continued.)

	Europ. part of USSR	Denmark Fenno-scandia	Germany	Britain
Aëdes (*Stegomyia*) *creticus* Edw.	×	-	-	-
» » *aegypti* L.	×	-	-	-
» (*Aëdimorphus*) *vexans* Meig.	×	×	×	×
» (*Aëdes*) *cinereus* Meig.	×	×	×	×
» » *rossicus* D. G M.	×	-	-	-
Cul. (*Barraudius*) *modestus* Fic.	×	-	-	-
» (*Neoculex*) *apicalis* Adams.	×	×	×	×
» » *hortensis* Fic.	×	-	×	-
» (*Culex*) *mimeticus* Noe.	×	-	-	-
» » *theileri* Theob.	×	-	-	-
» » *torrentium* Mart.	×	×	×	-
» » *pipiens pipiens* L.	×	×	×	×
» » » *molestus* Forsk.	×	×	×	×
	55(54?)	35	35	25

bergrothi. However, *Th. ochroptera,* found in Letland and east Germany and *Th. silvestris,* found in the Moskva distr., may possibly in future be found in the easternmost part of Fennoscandia.

Of the 35 species found in Germany, two, viz. *Ochlerotatus refiki* and *Culex hortensis,* are southern species which extend into the southern part of the land.

The 25 British Culicines include two species, *Th. litorea* and *Orthopodomyia pulchripalpis* which are not found in Denmark and Fennoscandia. *Th. litorea* is hitherto solely recorded from Britain and *Orthopodomyia pulchripalpis* has a western and southern distribution in Europe.

According to the above possibly few new species could be expected to be found within our region.

The classic work on the geographical distribution of the Scandinavian fauna is that of Ekman (1922): "Djurvärldens utbredelse på Skandinaviska halvön" [113] where the area is divided into three principal regions, viz. the Arctic region, the Archiboreal region and the South-

[113] The distribution of animals in the Scandinavian peninsula.

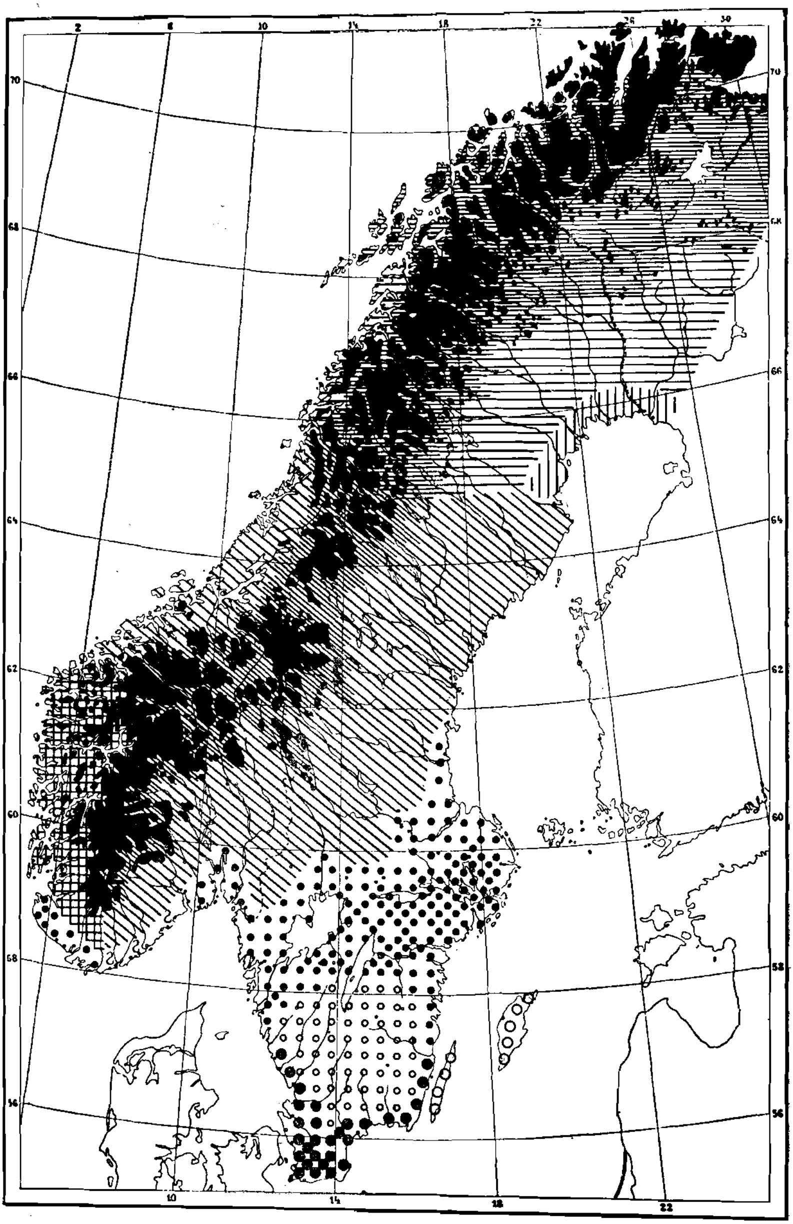

Fig. 124. The zoogeographical regions of Scandinavia. The arctic region (the mountain region) black. The archiboreal region shaded or (the Norwegian Vestlandet) chequered, the various subregions in various direction. Heavy shading indicates the subarctic regions. The south-Scandinavian region indicated by filled or open rings, the subregions with different rings. — — — The distribution of the coastal fauna is not marked on this map. (After Ekman 1922).

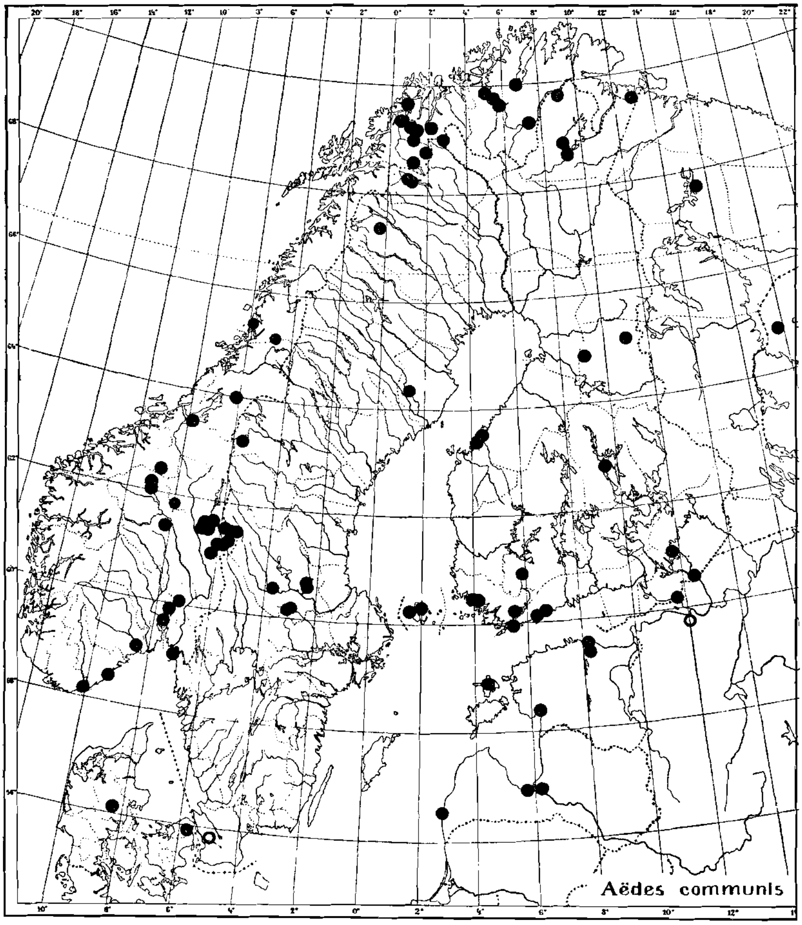

Fig. 125. The distribution of *Aëdes communis* Deg. in Fennoscandia and adjacent areas. When many localities are close together only some of them are mapped. Open rings indicate (older) finds where the exact locality is not recorded. (Aut. del.).

Scandinavian region, each embracing further subregions (fig. 124).

As still wide areas are a terra incognita as to mosquito investigations some caution has to be used in grouping the culicines according to Ekman's divisions. This is especially true concerning the central mountain region of southern Norway as well as an area in northern Norway ranging

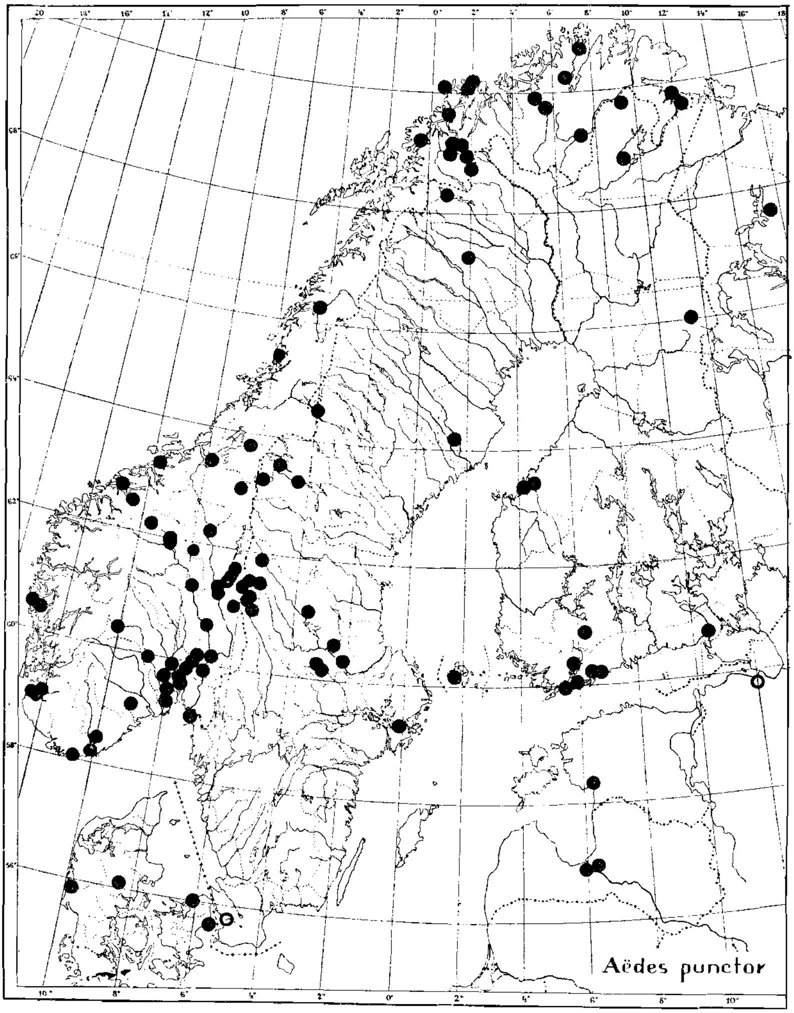

Fig. 126. The distribution of *Aëdes punctor* Kirby. Legend as in fig. 125. (Aut. del.)

from about 64 to about 68 degrees of northern latitude. Also from the corresponding area in Sweden very few records are hitherto known. The relative short time of development of most culicines mostly compels repeated observations in each locality. The specimens commonly caught are females which have to be identified principally with the aid of colour pat-

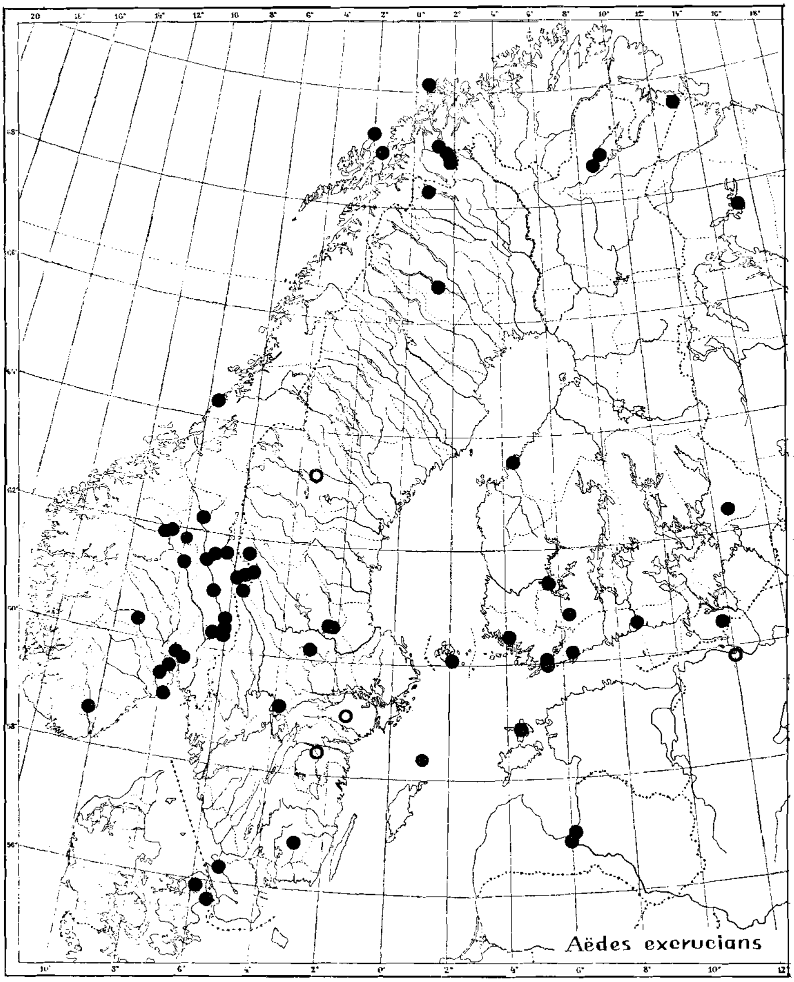

Fig. 127. The distribution of *Aëdes excrucians* Walk. Legend as in fig. 125. (Aut. del.)

tern in the scaling. The state of preservation of the specimens therefore is a matter of the utmost importance for geographical studies in mosquitoes. The culicidologist evidently has to face difficulties which are unknown to the student of *coleoptera* and several other groups of insects. In many cases, however, a study of the general distribution of the species will be an aid in the interpretation of the Fennoscandian culicine records

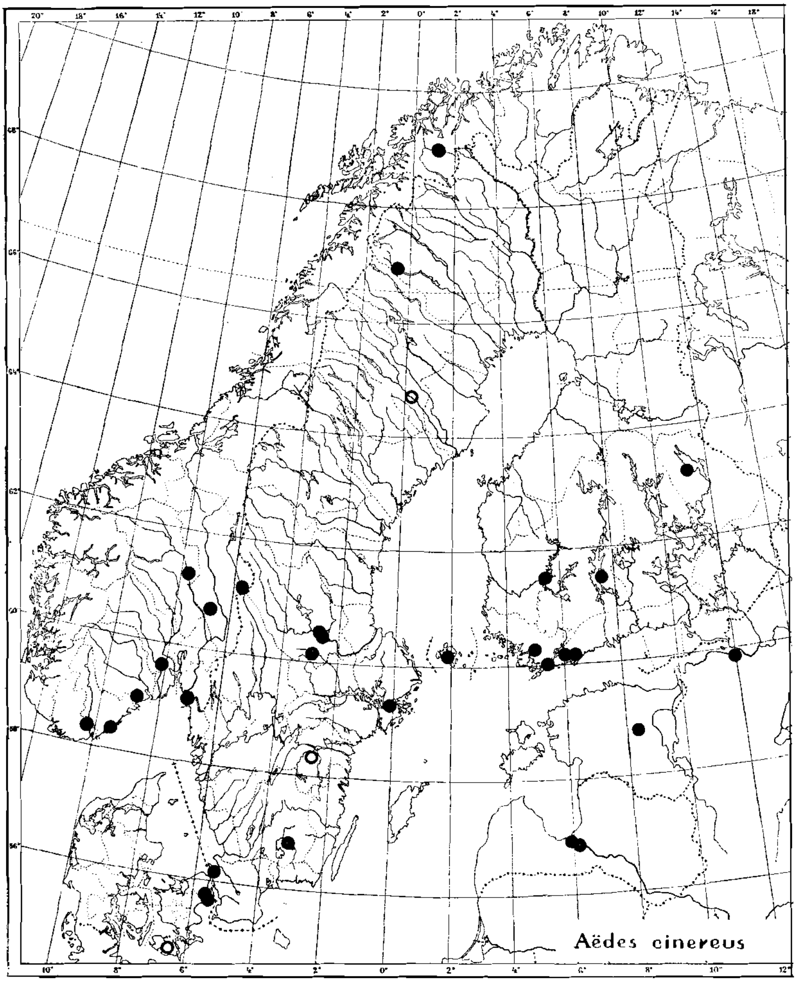

Fig. 128. The distribution of *Aëdes cinereus* Meig.
Legend as in fig. 125. (Aut. del.)

The tentative grouping of the Danish and Fennoscandian culicines below is arranged according to Ekman (1922). However, allowing for the difficulties mentioned, I prefer to make use solely of his principal geographical divisions. In some species the utterly few records at hand do not at all permit any conclusions as to the type of distribution.

1. Species ranging from Skåne to Finmark.

This group consists of the three species *Aëdes communis* (fig. 125), *punctor* (fig. 126) and *excrucians* (fig. 127) which, all of them, are widely distributed. In Europe *A. communis* is recorded south to France, Switzerland, Hungary, Jugoslavia and Crimea. In Siberia it ranges from the Taimyr peninsula in the north to Tomsk-Jeniseijsk in the south and eastwards to Kamtschatka and the Ussuri distr. *A. punctor* is recorded south to France, Switzerland, Hungary and Crimea, further through Siberia from Taimyr to Jeniseijsk and eastwards to Kamtschatka-Ussuri distr. *A. excrucians* ranges in Europe south to France, Jugoslavia, Hungary and N. Kaukasus, in Siberia eastwards to the Ussuri distr. and Sakhalin. In our region the three species are found from sea level up to mountainous regions, and *A. communis,* which in Central Europe is recorded as a distinct woodland species, occurs in Scandinavia, in mountainous regions and in the far north, also in open land. All species occur in Denmark and in Finland they are distributed from the Finnish Gulf up to the Arctic sea.

I am somewhat in doubt whether *A. cinereus* (fig. 128) has to be included in this group or not. In Norway the species has been found up to Målselv (about 69°). This is the northernmost record hitherto known from Europe where the species occurs south to France (Basses-Pyrenées), Germany (Mannheim), Austria, Hungary and USSR (Kaukasus). In Siberia it is i. a. recorded from Omsk-Jenisejsk east to Blagoweschinsk at Amur. *A. cinereus* seems to prefer light woodland and even open plains. In Norway it has been found up to about 270 m above sea level.

2. The northerly advanced southern species.

The species within this group, which goes farthest to the north, is *Culex torrentum* (fig. 129). In Norway it is found north to Sørfold (about 67°), which is the northernmost find in Europe hitherto known. According to Martini (1931, p. 387) Schwarzburg in Thüringen is to be considered the westernmost find in Europe. Eastwards the species is recorded in USSR from Leningrad south to Crimea and N. Kaukasus. Martini (l. c.) also records a find in Asia Minor. In Siberia the species is recorded from Tomsk east to the Ussuri district.

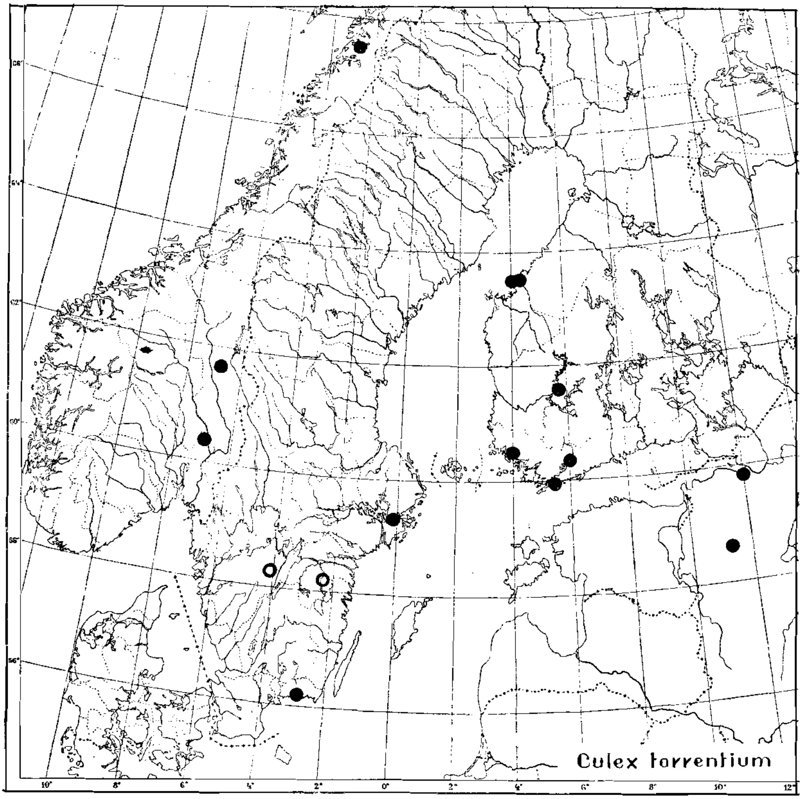

Fig. 129. The distribution of *Culex torrentium* Martini. Legend as in fig. 125. (Aut. del.)

Other species belonging to the group are *Theobaldia annulata* (fig. 130, above), *subochrea* (fig. 130, below), *Aëdes cataphylla* (fig. 131, above), *vexans* (fig. 132, above), *Neoculex apicalis* (fig. 133, above) and *Culex pipiens pipiens* (fig. 133, below). Of these species *A. cataphylla* is recorded north to Archangelsk in the European USSR, the others extend farthest to the north in Fennoscandia. In Norway *A. cataphylla* has been found up to 620 m above sea level, *Th. annulata* and *subochrea* up to 520 m, *A. vexans, C. pipiens* and *C. torrentium* up to about 270 m above sea level.

3. The true South-Scandinavian species. In this group I have included 15 species viz. *Th. morsitans* (fig. 134, above), *fumipennis* (fig. 134, below), *Taeniorhyn-*

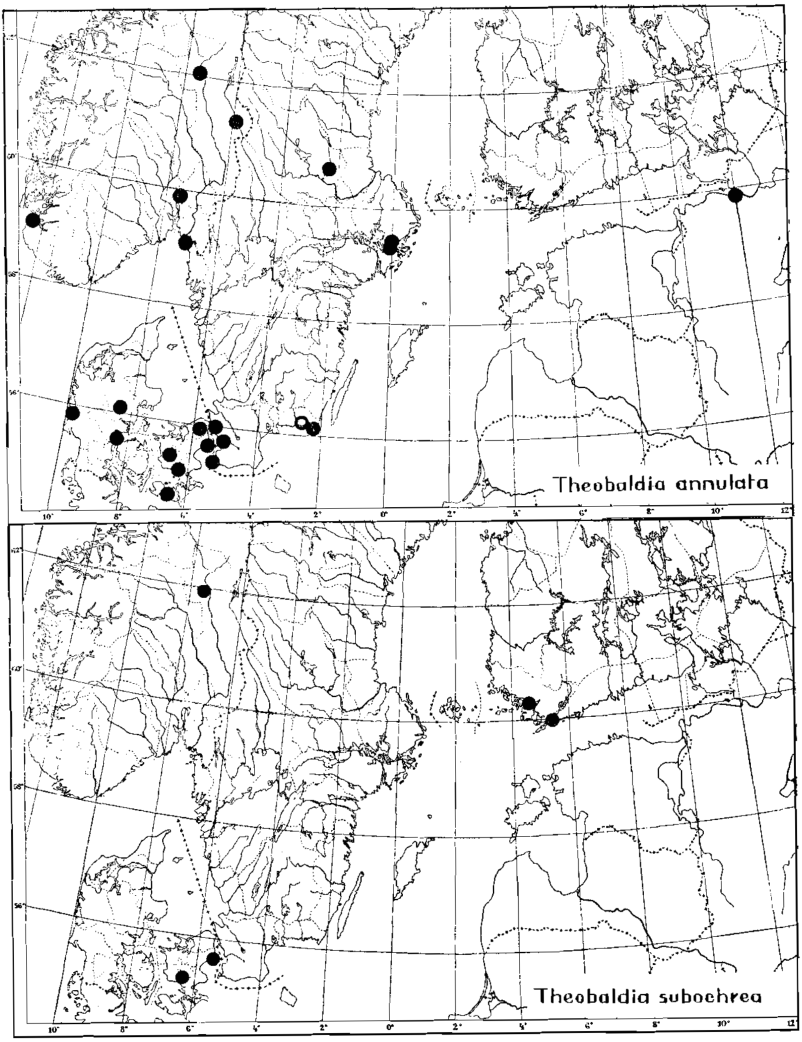

Fig. 130. The distribution of *Theobaldia annulata* Schranck (above) and *Th. subochrea* Edw. (below). Legend as in fig. 125. (Aut. del.)

chus richiardii (fig. 135), *A. dorsalis* (fig. 136), *caspius* (fig. 137, above), *cantans* (fig. 137, below), *annulipes* (fig. 138, above), *riparius* (fig. 138, below), *cyprius* (fig. 139, above right), *flavescens* (fig. 139 below), *detritus* (fig. 139, above left), *leucomelas* (fig. 131, below), *rusticus* (fig. 140 above

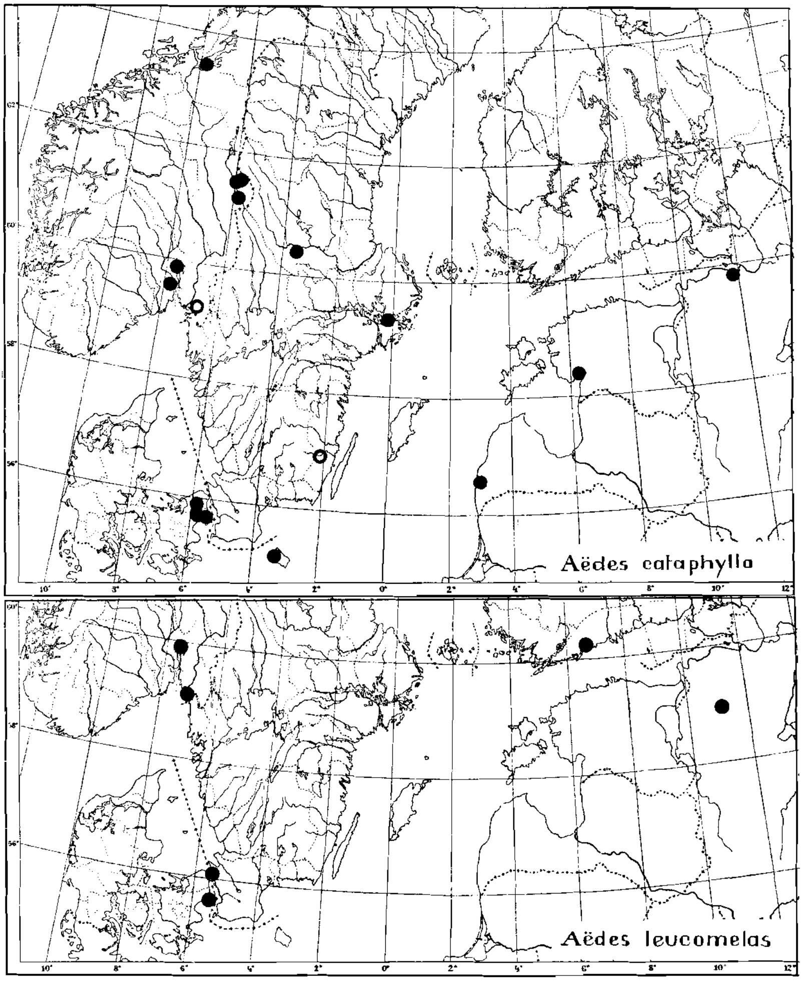

Fig. 131. The distribution of *Aëdes cataphylla* Dyar (above) and *Aëdes leucomelas* Meig. (below). Legend as in fig. 125. (Aut. del.)

left), *geniculatus* (fig. 132 below left) and *Culex pipiens molestus* (fig. 132, below right).

A. rusticus extends north to Denmark but is hitherto not found in Fennoscandia. In Europe it has a western and southern distribution. It is i. a. found in England, Belgium, France south to Portugal, Italy, Hungary, Bulgaria, Macedonia, Algeria and Palestine. The other spe-

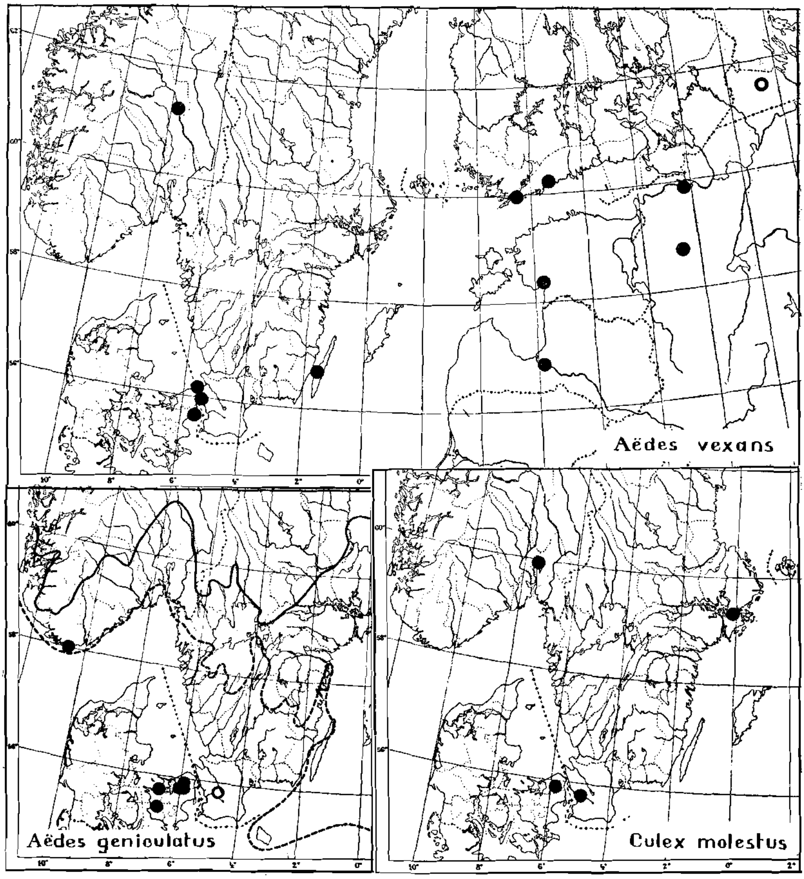

Fig. 132. The distribution of *Aëdes vexans* Meig. (above), *Aëdes geniculatus* Oliv. (below, left) and *Culex molestus* Forskål (below, right). In the map of *A. geniculatus* the northern boundaries of oak (bold line) and beech (broken line) are indicated. Legend otherwise as in fig. 125. (Aut. del.)

cies extend into the South-Scandinavian region, *A. cantans* and *dorsalis* somewhat farther to the north in Finland. Concerning two of these species some remarks may be justified. As will be seen from chapter 9, a find of *A. detritus* from the northernmost Norway is discussed. However, I find this record, quite outside the range of distribution of the species, so dubious that it is omitted in the map (fig. 139, above left) until further investigation at the place may settle the problem. As previously pointed out a closer examination

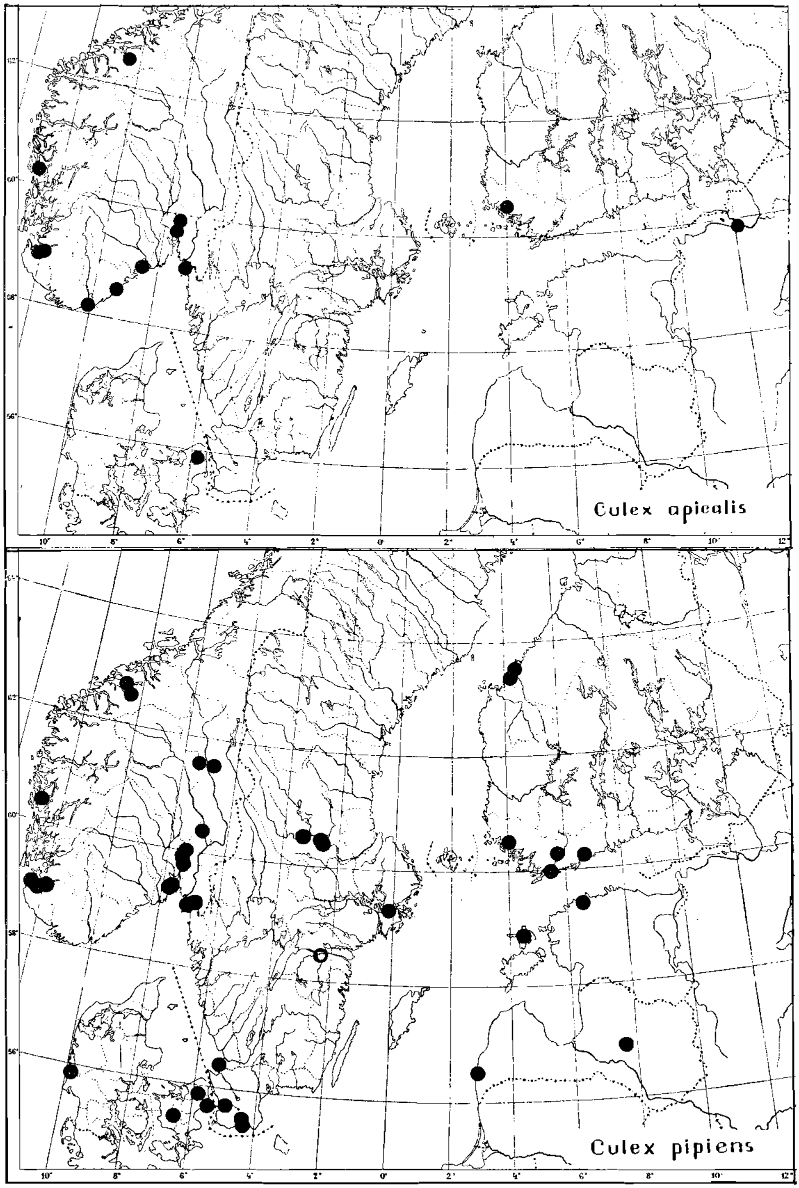

Fig. 133. The distribution of *Culex apicalis* Adams (above) and *Culex pipiens* L. (below). Legend as in fig. 125. (Aut. del.)

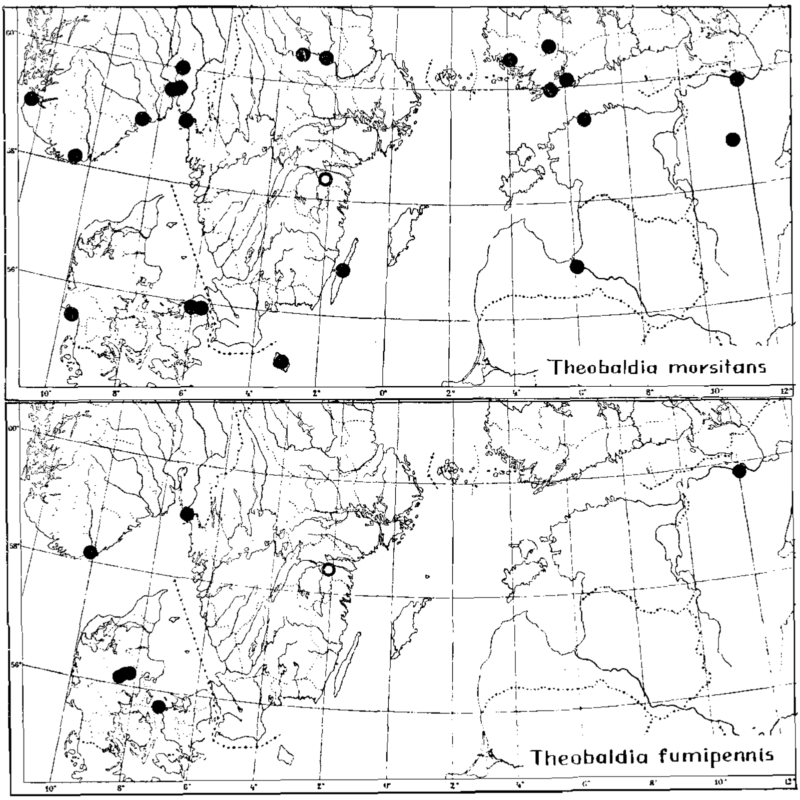

Fig. 134. The distribution of *Theobaldia morsitans* Theob. (above) and *Th. fumipennis* Steph. (below). Legend as in fig. 125. (Aut. del.)

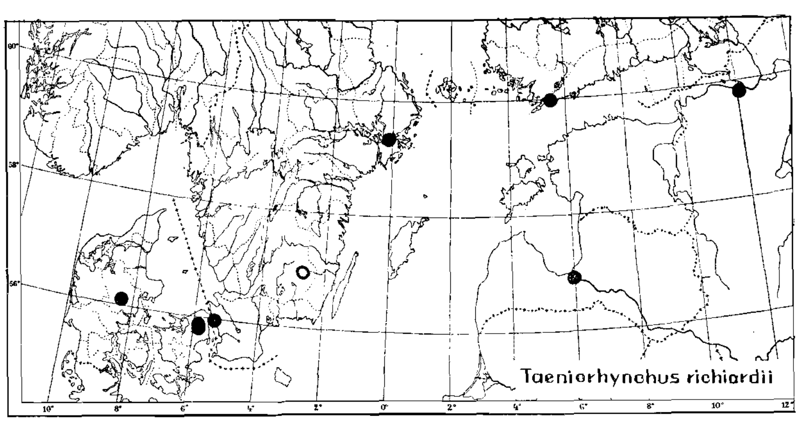

Fig. 135. The distribution of *Taeniorhynchus richiardii* Fic. Legend as fig. 125. (Aut. del.)

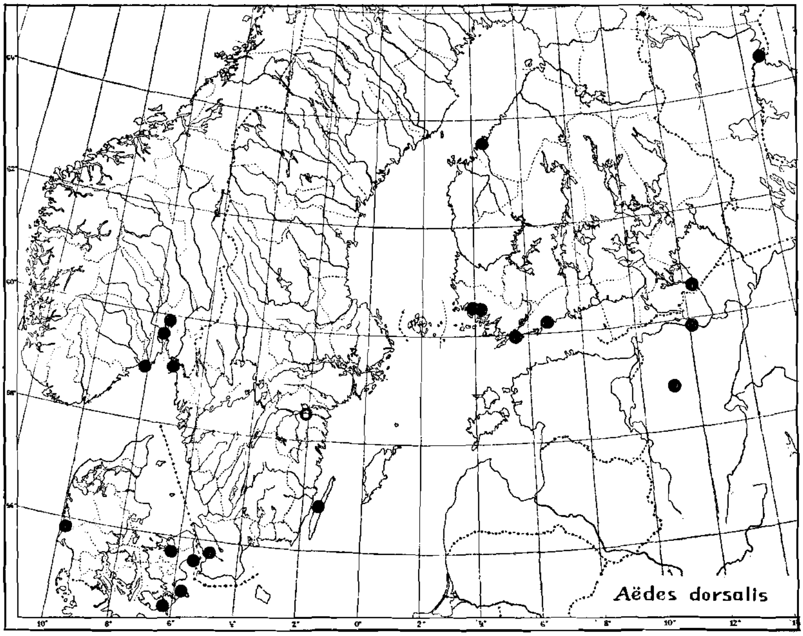

Fig. 136. The distribution of *Aëdes dorsalis* Meig. Legend as in fig. 125. (Aut. del.)

of several *A. "cantans"* from northern localities has proved the specimens to be *A. excrucians.* During a visit to Helsingfors August 1947, I had opportunity to examine the collection of *Culicidae* in the Zoological Museum there. The specimens of *A. cantans* from the two northermost Finnish localities (Kajana a. Kuusamo) were both somewhat denuded females, the identity of which I consider rather doubtful. In the map illustrating the distribution of the arboreal species *Aëdes (Finlaya) geniculata,* I have indicated the northern borderline of beech and oak, two of the principal trees in which the larvae breed.

4. The archiboreal species.

In this group I have included the four species *Theobaldia alascaensis* (fig. 141), *bergrothi* (fig. 142), *Aëdes diantaeus* (fig. 143) and *intrudens* (fig. 144) which have all of them a distinctly northern distribution in Europe.

Th. alascaensis is recorded from the northern England,

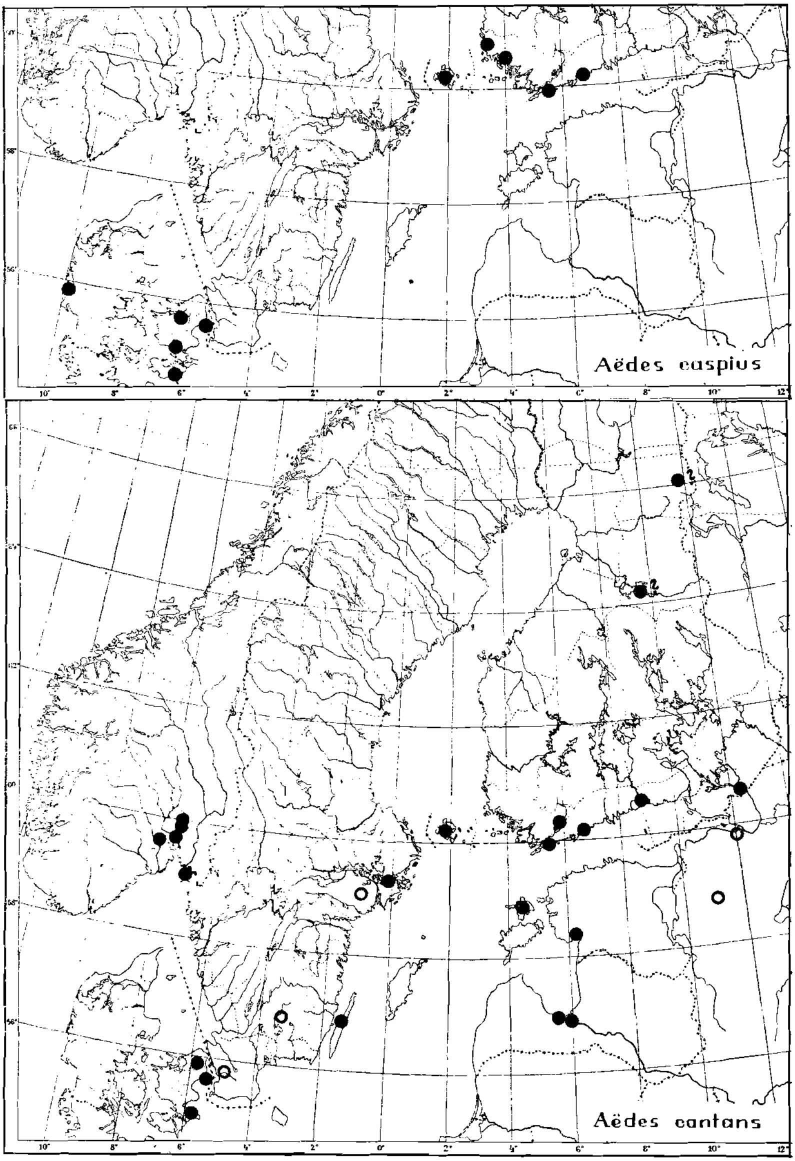

Fig. 137. The distribution of *Aëdes caspius* Pall. (above) and *Aëdes cantans* Meig. (below). Legend as in fig. 125. (Aut. del.)

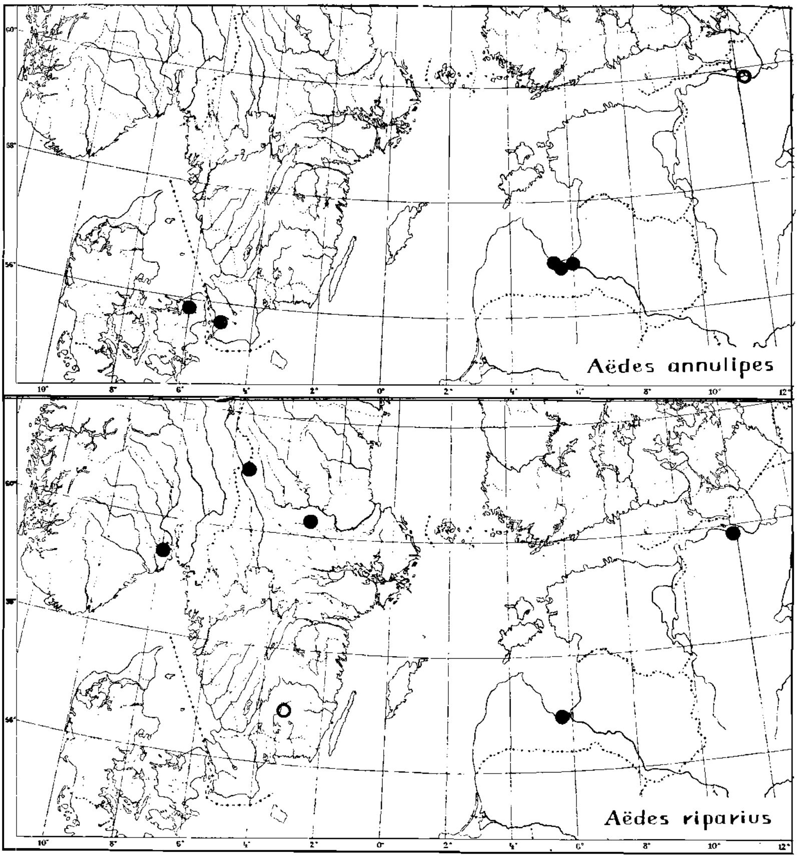

Fig. 138. The distribution of *Aëdes annulipes* Meig. (above) and *Aëdes riparius* D. K. (below). Legend as in fig. 125. (Aut. del.)

Scotland, North Germany (Hamburg-Oberschlesien), lower Austria, USSR (Archangel, Bolschesemelnaja Tundra, median Ural, Moskva distr., Kaukasus). In Siberia it is recorded from the Taimyr peninsula in the north to Minusinsk-Irktusk and eastwards from Jakutsk to Kamtschatka.

Th. bergrothi is, outside Fennoscandia, recorded from Irkutsk in Siberia. *A. diantaeus* occurs in Europe in North-Germany (Hamburg-Ostpreusen) Letland and USSR (Leningrad-Perm), in Siberia it is recorded from Tomsk-Ussurijsk Kraj. *A. intrudens* is recorded

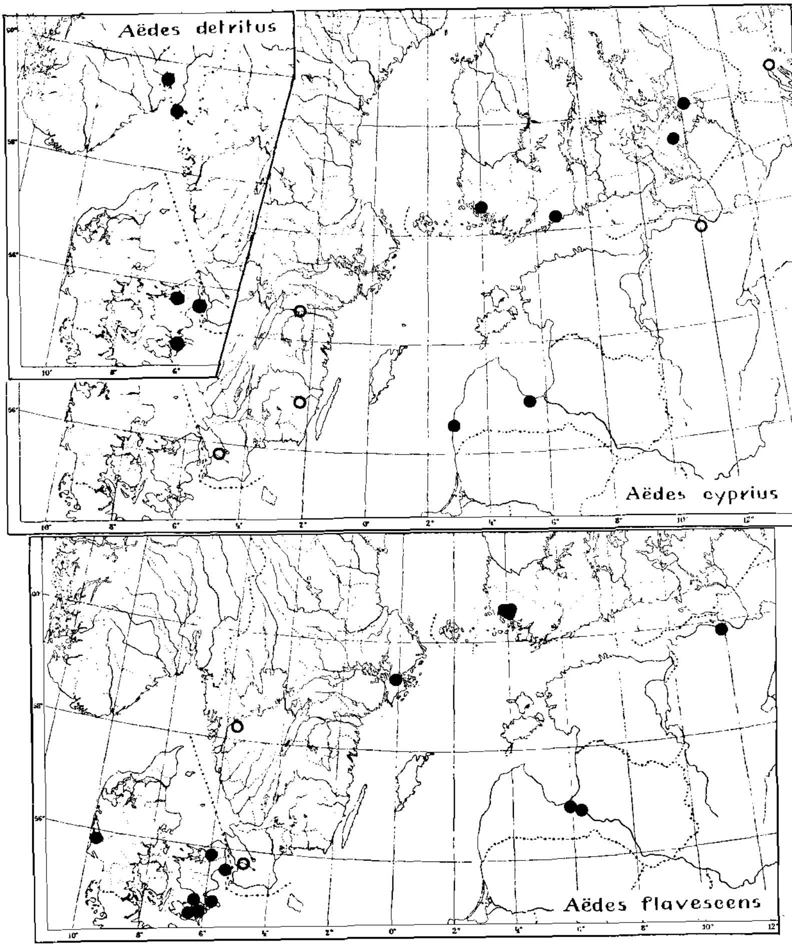

Fig. 139. The distribution of *Aëdes detritus* Hall. (above left) *Aëdes cyprius* Ludl. (above right) and *Aëdes flavescens* Müll. Legend as in fig. 125. (Aut. del.)

from North-Germany (Berlin-Ostpreusen) and Letland. In Europ. U S S R it is found from Leningrad distr. to Ukraine and lower Volga distr.; in S i b e r i a from Tomsk eastwards to Ussurijsk Kraj. According to Martini (1931, pp. 276, 295) *A. diantaeus* as well as *intrudens* are among the rarer species in Germany.

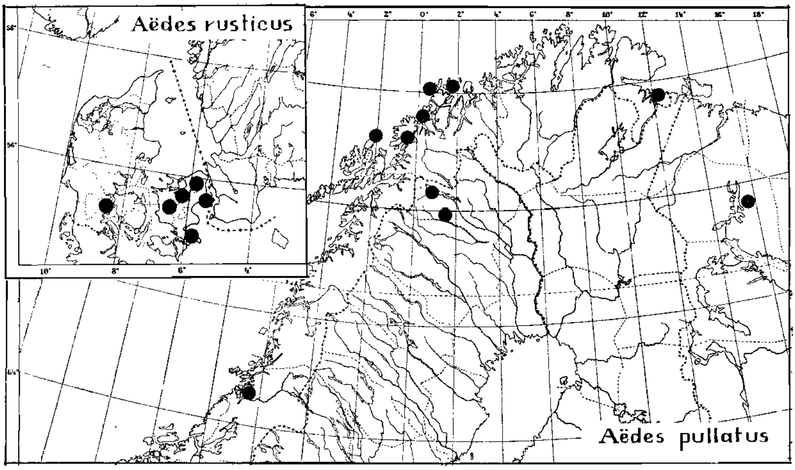

Fig. 140. The distribution of *Aëdes rusticus* Rossi (above) and *Aëdes pullatus* Cocq. (below). Legend as in fig. 125. (Aut. del.)

Th. alascaensis prevails, in Germany, in light woodland in swampy areas. Most finds in Norway indicate a preferance for open localities; however, in the Hvaler islands the species has been found in woodland. Larvae of *Th. bergrothi* are mostly found in shaded places in southern Norway, but from northern Norway the species is recorded from openlying pools. Most Norwegian breeding places of *A. diantaeus* lie in woodland, but in Trysil I have found larvae in an openlying pool. From Germany this species is recorded from woodland of mixed type and, according to Dyar (1928, p. 174) the species, in USA, frequents the darkest woods. *A. intrudens,* which in Germany is recorded from woodland (Hochwald), is in Norway mostly found at the border of pine woodland.

In Norway *A. intrudens* has been found up to about 700 m above sea level, *Th. alascaensis* and *bergrothi* up to about 620 m and *A. dianteus* up to about 270 m above sea level.

5. The Arctic species.

This group includes three species viz. *Aëdes nigripes,* (fig. 145, above), *nearcticus* (fig. 145, below) and *pullatus* (fig. 140, below), which in Fennoscandia occur in the Arctic region, *A. nigripes* and *nearcticus* also in mountainous regions in Central Scandinavia. The two last mentioned

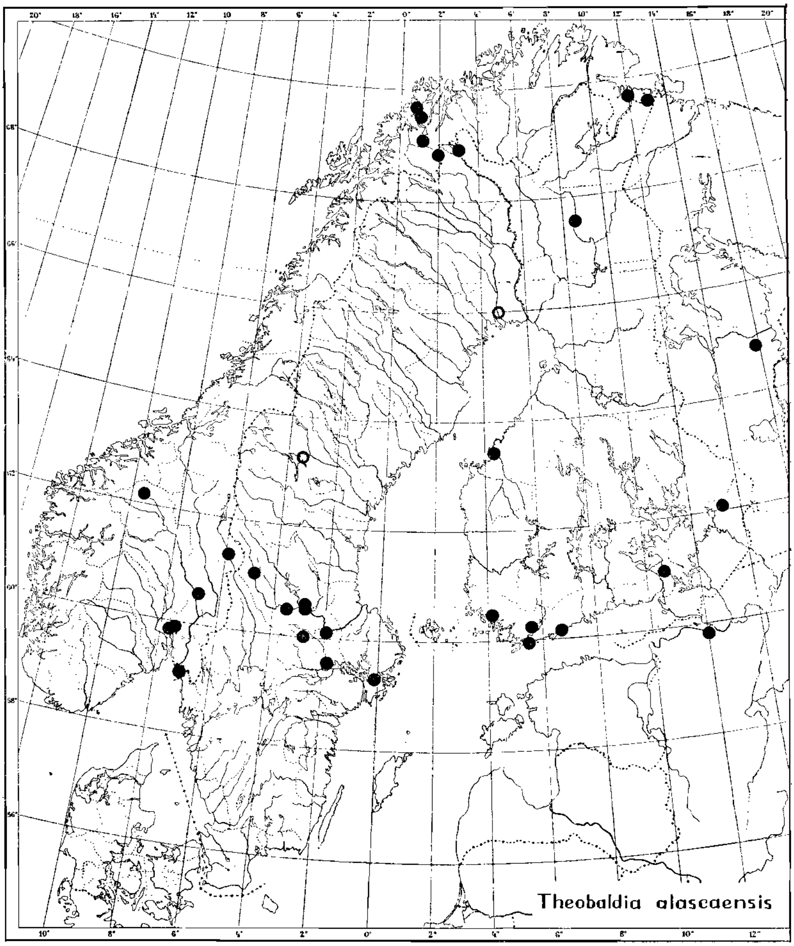

Fig. 141. The distribution of *Theobaldia alascaensis* Ludl. Legend as in fig. 125. (Aut. del.)

species are circumpolar and occur, outside Fennoscandia, in Greenland and the northermost areas of the Eurasiatic and American continents. *A. pullatus* is in Europe a typical boreoalpine species, the distribution of which will be discussed below.

Concerning the two species *Aëdes sticticus* (fig. 146, above) and *nigrinus* (fig. 146, below), I find a discussion of their geographical distribution, at present, of little value.

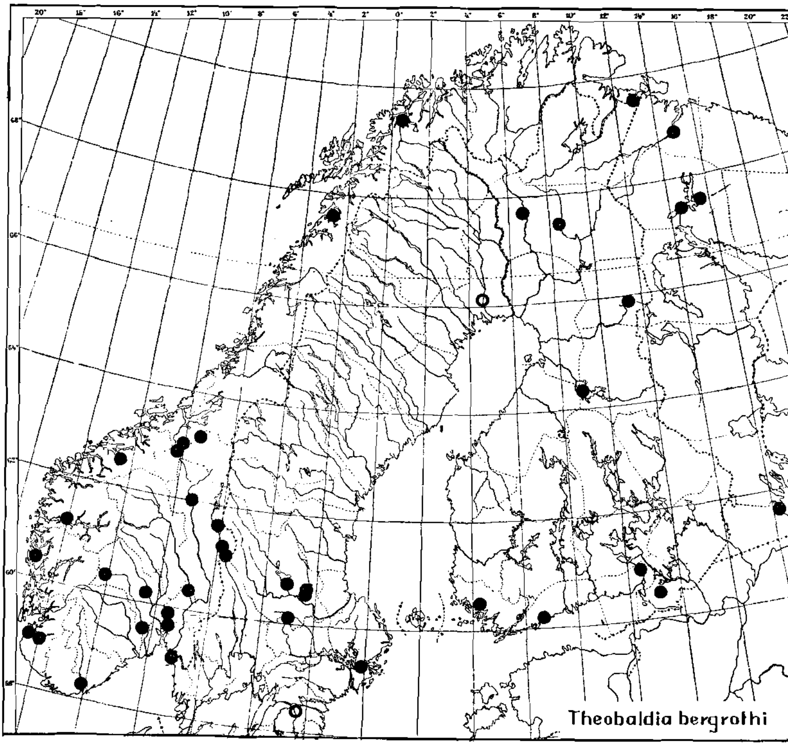

Fig. 142. The distribution of *Theobáldia bergrothi* Edw. Legend as in fig. 125. (Aut. del.)

As indicated in chapter 9 these species have been confused in older literature and probably most records from outside our region have to be controlled before we may have a reliable picture of their real distribution in Europe. The few Fennoscandian finds, however, indicate that *A. nigrinus* is a more northern species than *A. sticticus*.

As will be seen from the maps, only 6 culicine species are hitherto recorded from western Norway, viz. *Theobaldia annulata, bergrothi, morsitans, Aëdes punctor, Neoculex apicalis* and *Culex pipiens*. To be sure, rather few culicidological researches have been carried out in western Norway and possibly further investigation will increase the number of species to a certain extent. However, previous investigation in other groups of insects, i. e. *Lepidoptera* (W. M. Schøyen 1883, pp. 7—10, Sparre Schneider 1901, pp. 10—12) indicates

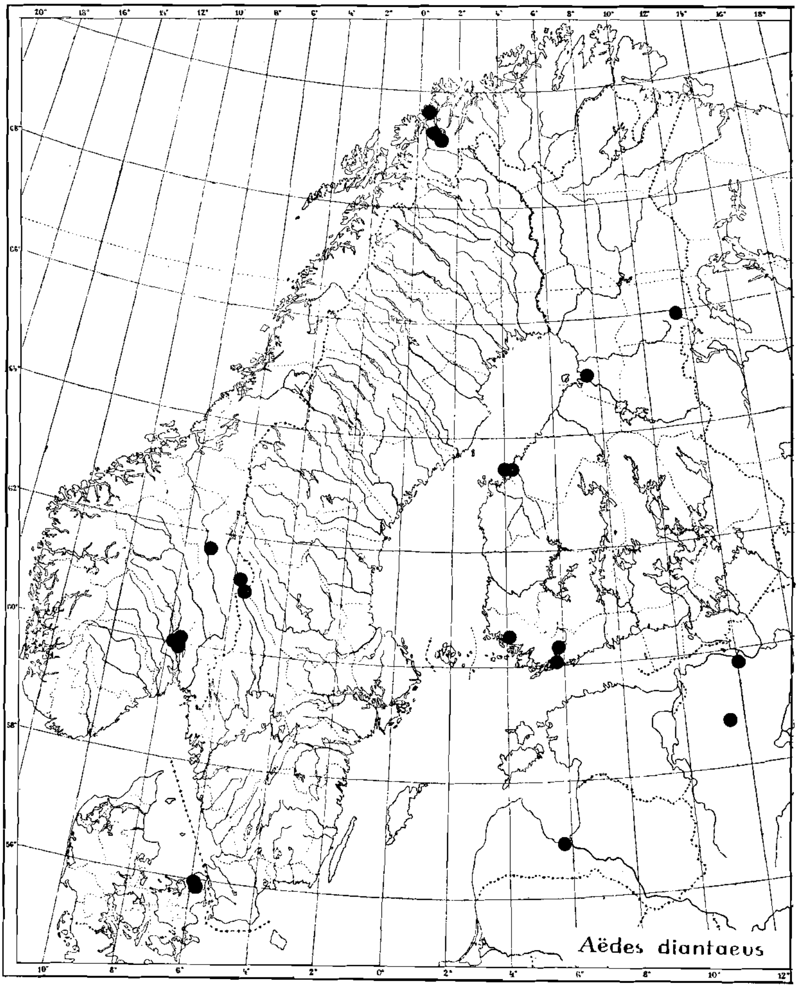

Fig. 143. The distribution of *Aëdes diantaeus* H. D. K. Legend as in fig. 125. (Aut. del.)

the poverty in species of the fauna of western Norway compared with that of the south-eastern part of the land. I consider it probable that similar conditions will be found also concerning the mosquitoes. The scarcity of mosquito species in western Norway may be due either to existence-ecological factors (Ekman 1922, p. 308) or to dispersal-ecological factors.

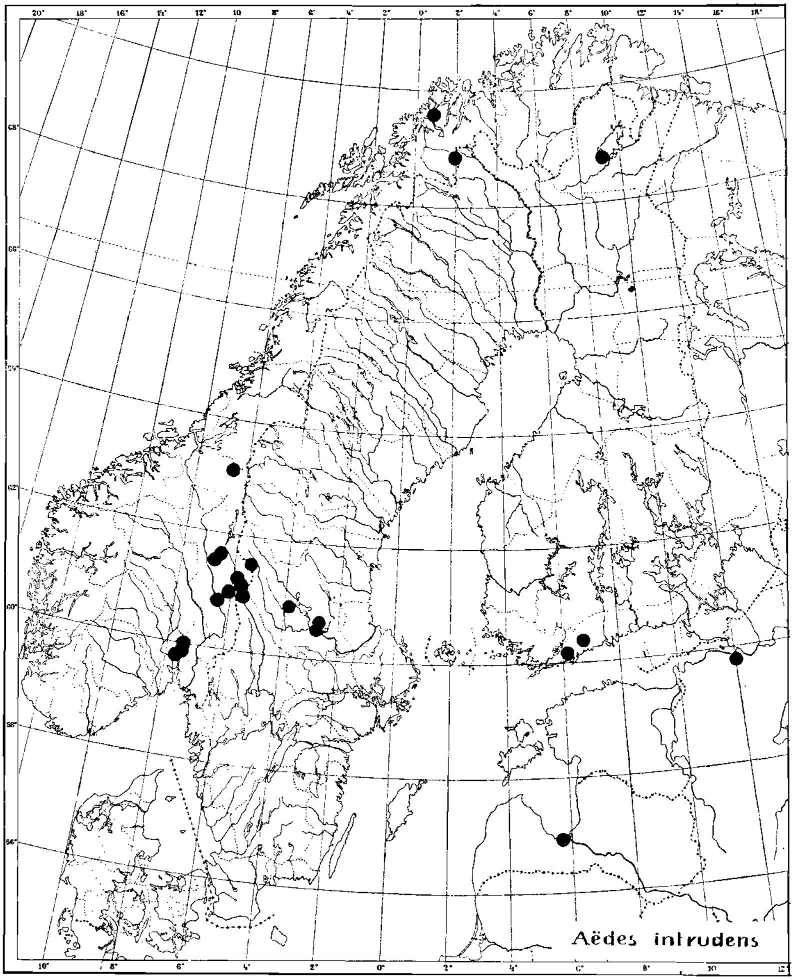

Fig. 144. The distribution of *Aëdes intrudens* Dyar. Legend as in fig. 125. (Aut. del.)

The topographical and climatological conditions in western Norway are particular. Owing to the high mountains falling headlong into deep glens or fjords, extensive barren grounds or moorlands are rarer here than in southeastern Norway. Coniferous woodland is rare and local (fig. 122), the precipitation is extremely great (fig. 123), the mean temperature in summer is relative low whereas the mean tempe-

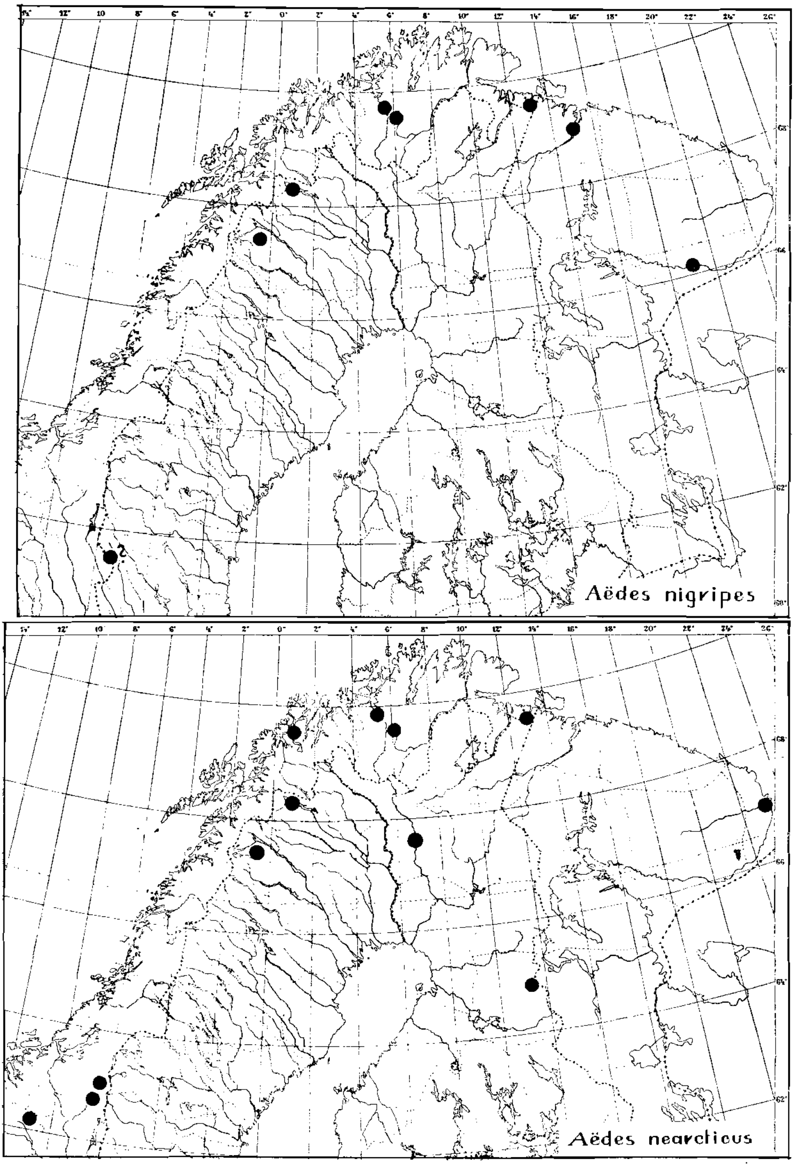

Fig. 145. The distribution of *Aëdes nigripes* Zett. (above) and *Aëdes nearcticus* Dyar (below). Legend as in fig. 125. (Aut. del.)

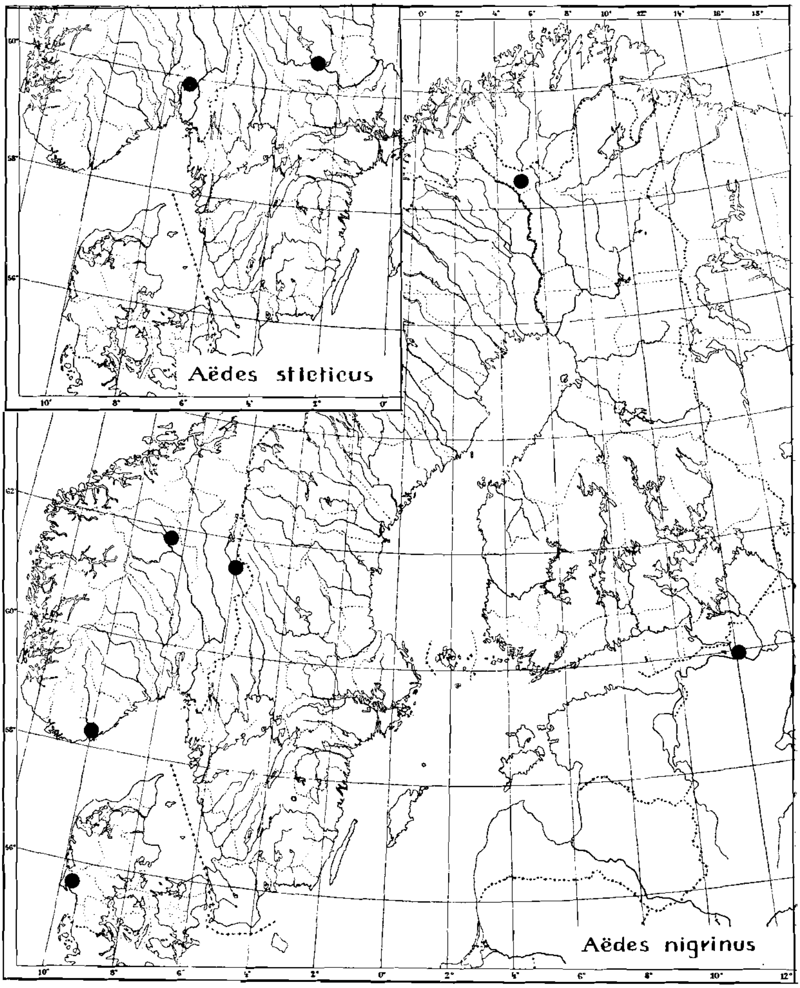

Fig. 146. The distribution of *Aëdes sticticus* Meig. (above) and *Aëdes nigrinus* Eckst. (below). Legend as in fig. 125. (Aut. del.)

rature in winter is rather high. To what extent one or more of these factores may influence the distribution of Norwegian culicines very little can, for the present, be said. In reality our knowledge is rather scanty concerning the ecological claims governing the distribution (i. a. Bettie 1932, Marshall 1938, p. 26).

Discussing the dispersal-ecological factors in southern Norway Ekman (1922, p. 369) points out the importance of extended valleys for the trend of southern immigrants towards the north. Lindroth (Lindroth och Palm 1934, p. 123) emphasises that the extention of insects d o w n w a r d s the river-valleys is similarly important. Most possibly the mosquito adults may extend upwards the valleys whereas immature stages (eggs, larvae) occasionally are flooded downwards to new localities. According to our present knowledge three, more or less widely distributed species, viz. *Theobaldia alascaensis, Aëdes excrucians* and *A. communis* have not crossed the watershed between eastern and western Norway. On the contrary this is obviously the matter with *A. punctor* (fig. 126) and most probably also with *Th. bergrothi* (fig. 142), the last species being recorded from altitudes above 600 m. The other culicine species found in western Norway evidently have a coastal distribution here, *Th. annulata* (fig. 130, above) and *morsitans* (fig. 134, above) being recorded from Stavanger (Ry), *Neoculex apicalis* (fig. 133, above) and *Culex pipiens* (fig. 133 below) occur along the coast north to Romsdalsfjord (MRi).

As far as known most of our culicine species are rather stationary and do not migrate far from their breeding waters. However, Martini (1931, p. 284) indicates migratory habits for *A. caspius* and *A dorsalis* and Clarke (1943) records migrating *Culex pipiens*. The most widely distributed of our species is presumably *A. vexans*. On this mosquito Edwards (1921. p. 323) i. a. remarks: "Apart from the domestic species (*Culex pipiens, C. fatigans* and *Aëdes argenteus*), this is the most widely spread of all mosquitoes, occurring practically throughout the Palaearctic, Oriental and Nearctic regions." According to Buxton (1935, p. 44): "it extends eastwards as far as Samoa; it is even known to occur on some Polynesian atolls" *A. vexans* is repeatedly recorded as a migrating species (Clarke, 1943, Martini 1931, Twinn 1931) and Buxton (1935, pp. 43—4) declares that the wide and erratic distribution of this species points to aerial distribution, in particular by the currents of the upper air. Some recent records (i. a. Glick 1939, p. 82, Pemberton 1944) of *A. vexans* found in aeroplanes or actually caught at altitudes up to 5000 feet strongly support this view.

Before approaching the problems concerning the time and ways of immigration of the Fennoscandian culicine species, I find a brief comment on the geological history of the mosquitoes of interest. In a review on this matter Edwards (1932, 194, pp. 6—7) remarks: "Since we have reason for believing that the order d i p t e r a arose not later than the Triassic period, and since the *Culicidae* are certainly one of the more primitive families of the order, it is highly probable that members of this family existed during the Jurassic period, before the age of mammals; the fact that many *Culex* at the present day attack lizards and frogs suggests that even the blood-sucking habit may have been developed at this early period. Unfortunately the known insect-bearing beds of Jurassic or Cretaceous period are few, and in them no remains of *Culicidae* have yet been found. We have therefore no direct palaeontological evidence as to the time of origin or phylogenetic history of the family."

According to the same author the only Jurassic find, from Purbeck, England, is probably a C h i r o n o m i d. From the Eocene there are two finds of mosquitoes, possibly belonging to the *Culex*-group. Kjell Ander (1942, p. 20) points out that records of *Culicidae* from Baltic amber are rare. According to Edwards (1932) the species represented in amber belong to the generae *Dixa, Chaoborus* and *Mochlonyx.* From the Middle and Upper Oligocene, however, several finds of true *Culicinae* are known, from Isle of Wight, Aix-en-provence and W. Germany, but as pointed out by Edwards, they hardly differ from those of the present time.

Kai Henriksen (1933, p. 314) emphasises the importance of palaeontological finds for a correct judgment of the (geological) time of immigration of a species. An interpretation solely based on the geographical distribution may, according to his opinion, in several cases be misleading.

Unfortunately the actual palaeontological finds of *Culicinae* are few, and, as stated by Stackelberg (1937, p. 249), they are therefore of little use for an interpretation of the recent geographical distribution.

According to Stackelberg (l. c., p. 252) the composition of the Palaearctic Culicide fauna is a result of several immigrations of different origin, which possibly have taken place at different times. Concerning the advance of southern elements towards the north he points out that Ethiopian elements have immigrated into the western Palaearctic region and Oriental elements into the eastern part of the region. However, the culicide fauna of the Boreal and Arctic zone of the Palaearctic, dominated by the multitude of *Ochlerotatus* species, did not take its rise in the tropical fauna of the Old World. On this element Stackelberg further remarks: "Die boreale und arktische Culicidenfauna der Paläarktis hat bestimmte genetische Zusammenhänge mit der Nearktis, wo die für das boreale Gebiet charakteristischen Gruppen besonders üppig entfaltet sind. Deshalb haben wir das Recht, die Genesis unserer borealen und arktischen Culicidenfauna mit der Nearktis in Zusammenhang zu bringen. Die Ausbreitungswege der borealen Culiciden aus dem Nearktischen Zentrum in die Paläarktis sind noch unklar; die Einwanderung fand offenbar sowohl auf westlichen als auch auf östlichem Wege statt. Der frühere (vor der Abtrennung Amerikas von Europe nach Wegener) westliche Weg diente offenbar zum Austausch mancher Formen, welche südlicheren Breiten der westlichen Paläarktis eigentümlich sind, — — — ." As representatives of this group, Stackelberg mentions the Genus *Orthopodomyia* and species of the peculiar *rusticus*-group of the genus *Ochlerotatus*.

Also other authors (i. a. Edwards 1921 b, p. 264; H. Dyar 1922 b, p. 65) point out the close relationship of the boreal and arctic *Culicinae* of Eurasia with those of the Nearctic. It is therefore supposed that an immigration has taken place via Alaska and East-Siberia at a comparatively recent time. Stackelberg (l. c., p. 253) says on this problem: In Bezug auf die geologische Zeit, auf welche die Ausbreitung bestimmter Elemente der Culicidenfauna in der Paläarktis bezogen werden kann, ist es schwierig etwas zu sagen; sicher kann nur das eine konstatiert werden, — daß die Besiedelung des borealen Gebiets der Paläarktis durch die Grundmasse der Culicidenformen in der oberen Tertiärzeit und jedenfalls vor dem Pleistozän stattfand; dafür spricht das Vorhandensein einer ganzen Reihe von Culicidenformen in den Bergketten im Süden des paläarktischen Gebiets (Pyrenäen, Kaukasus), die der Taiga- und Waldzone eigentümlich sind, wie insbesondere *Aëdes (Ochlerotatus) pullatus* Coq. in den Pyrenäen."

This opinion we also find verified, as regards the *Coleoptera,* in a treatise by A. Semenov-Tian-Shanskij.[114] (1935, *2,* pp. 397—410). He emphasises that the taiga zone is inhabited by a considerable number of transpalearctic species, part of which inhabit North America, thus connecting the Nearctic with the Palaearctic fauna. The reduced regions of distribution of several species gives evidence for the conception of this zone as a decimated modification of the arctotertiary fauna.

[114] Here translated from S. Stockmann (1941).

In consideration of these facts I find some quotations concerning the Bering Strait area, the "Beringia" of Hultén, and the glaciations in northern Siberia during Pleistocene of importance.

Wegener, in his work: "Die Entstehung der Kontinente und Ozeane" (1929) gives, on p. 19, a map reconstructing the state in Eocene where Alaska was joined to the North-eastern Siberia. The author furthermore remarks (p. 124): "Die früher erwähnte Abstimmungstabelle von Arldt über die Existenz der Landbrücken, die auch die Brücke über die Beringstraße berücksichtigt, zeigt, daß hier Landverbindung vermutlich schon im Perm und Jura, mit Sicherheit aber vom Eozän bis ins Quartär hinein bestanden hat. Die heutige Trennung durch den flachen Schelf des Beringmeeres ist also sehr jungen Alters."

On this land-bridge Flint (1947, p. 529) says: "Hardly more than 50 miles wide and very shallow, this strait could have become dry land as a result of a 150-foot upwarping of this part of the Earth's crust or an equally moderate sinking of sealevel. The result would have been not a mere narrow bridge but a broad plain continuing as a fringe along the coasts of both Alaska and Siberia. Warmed by the Japan Current this plain would have had at least as mild a climate as that of the Aleutian Chain today. It is likely to have been covered with long thick grass like that now growing on the Alaska Peninsula — ideal fodder for the woolly mammoth and other herbivores. Even the dead grass beneath the winter blanket of snow should have provided nourishing forage." Hultén (1937, p. 34) indicates even a broader connection between the continents "A water-level 100 m lower than at present would result in the entire northern half of the Bering Sea becoming dry, the present islands low mountains. The two continents would be connected by a land-bridge about 1200 km wide. — — — In fact the distribution of the plants indicate that a connection of about that extension actually did exist during Quarternary time." Malaise (1945, pp. 40—41) puts forth some considerations on the climatical conditions in the supposed land-bridge. "We may assume that the climatical conditions of the probably very broad Bering land-bridge were very different on the Arctic and on the Pacific side even during Tertiary, and especially before the rift of the Bering Sea. This will help to explain how warmth-lowing and hardier northern forms may then have passed it at the same time. The southern coast of this land-bridge, washed by a warm maritime current must have enjoined a considerable warmer climate than its geographical situation would presuppose."

According to several recent publications (Bolschoi Sovjetskii Atlas Mira 1937, 1, pl. 90; Flint 1947, pp. 351—61 and pl. 3; Gerasimow and Markow 1939, pp. 445—50 and fig. 1; Hultén 1937, pp. 31—4, fig. 3 and pl. 43) the glaciation during Pleistocene has not been so extensive in northern Siberia as in Europe. "Intensity of glaciation of plains and mountains diminished eastwards, from regions with a marine climate to regions with a more continental climate" (Gerasimov and Markow 1939, p. 461). When glaciation was most extensive the principal Siberian Ice Sheet merged with the Scandinavian Ice Sheet in the west and extended eastwards to Severneya Zemlya. Another ice sheet reached from Lena River in southwest to the Bering Strait in northeast, in addition to (smaller) independent areas of glaciation.

During the last Glacial epoch the continuous Siberian Ice Sheet was broken up into insular glacial sheet, and the ice reached southwards only to latitude 64. In the character of the non-glaciated areas in this epoch Gerasimow and Markow (*l. c.,* p. 460) remarks: "In Europe — —. At the limit of the glacier — shrub — tundra alternating with birch — fir forest tundra. Southward-cold forest steppe gradually passing into a warmer forest steppe. On the elevated tracts amidst the forest steppe regions islets of broad-leaved forest. Analogous conditions in the north of Western Sibera. In the inter-mountain depressions not covered with ice, in Eastern Siberia, forest and tundra flora and fauna are developing as a succession from the Tertiary age bearing the stamp of a cold climate and a certain xeropitisation." As will be seen the conditions for mosquito-breeding of different type should be rather favourable.

An indication of the possible cause of the migration of the arctic and boreal mosquitoes, we may, in my opinion, find in the extensive migrations of land mammals in Tertiary time. Thus O. Abel ("Die vorzeitigen Säugetiere", 1914) publishes a chronological table of the Tertiary land mammals, where details are given concerning the repeated migrations between North-America and Siberia in Eocene and Oligocene, and further movements from Asia westwards in Miocene and Pliocene. Among the species mentioned several, most probably, lived in great herds. Concerning the intimate relations in recent time between reindeer and mosquito (see chapter 4). I think it would hardly be too audacious to suppose similar relations between the movements of great mam-

Table 41.

Culicine species common to Denmark-Fennoscandia and the northern part of America.

Species			Fennosc. Denmark	Siberia	N. America
Theobaldia	*(Theobaldia)*	*alascaensis*	×	×	×
—	—	*annulata*	×	-	-
—	—	*subochrea*	×	-	-
—	—	*bergrothi*	×	×	-
—	*(Culicella)*	*morsitans*	×	×	-
—	—	*fumipennis*	×	-	-
Taeniorhynchus		*richiardii*	×	×	-
Aëdes	*(Ochlerotatus)*	*dorsalis*	×	×	×
—	—	*caspius*	×	×	-
—	—	*cantans*	×	×	-
—	—	*annulipes*	×	×	-
—	—	*riparius*	×	-	×
—	—	*excrucians*	×	×	×
—	—	*cyprius*	×	×	-
—	—	*flavescens*	×	×	×
—	—	*detritus*	×	×	-
—	—	*cataphylla*	×	×	×
—	—	*leucomelas*	×	-	-
—	—	*nigripes*	×	×	×
—	—	*nearcticus*	×	×	×
—	—	*communis*	×	×	×
—	—	*punctor*	×	×	×
—	—	*sticticus*	×	× (?)	×
—	—	*nigrinus*	×	-	-
—	—	*diantaeus*	×	×	×
—	—	*intrudens*	×	×	×
—	—	*pullatus*	×	×	×
—	—	*rustricus*	×	-	-
—	*(Finlaya)*	*geniculatus*	×	-	-
—	*(Aëdimorphus)*	*vexans*	×	×	×
—	*(Aëdes)*	*cinereus*	×	×	×
Culex	*(Neoculex)*	*apicalis*	×	-	×
—	*(Culex)*	*pipiens pipiens*	×	×	×
—	—	*pipiens molestus*	×	-	× (?)
—	—	*torrentium*	×	×	-
			35	24(25?)	18(19?)

mals and the migration of the mosquitoes in that remote period. This does not mainly concern the seasonal migration but more the slow expansion of range from year to year.

By way of contradistinction to Stackelbergs view of a western and an eastern way of immigration the Swedish botanist Hultén (1937, pp. 140—1) points out that most arctic and numerous boreal plants radiate from the Bering Sea area. He considers the present areas of arctic and boreal biota on the whole a reduction from the areas which had developed during the great interglacial period, preceding the maximum glaciation. "During the warm interglacials these plants have had good possibilities for spreading, especially northwards, while at the same time reductions from drought took place in the south. During the glacials the northern part of their area was in its turn reduced by the ice. Fragments bearing evidence of the former area were left on several larger or smaller refugia. By the interchange of these agencies the present areas were built up, the plants after the glacials spreading again from these refugia and trying once more or occupy large areas, similar to those they once possessed during the great interglacial."

In order to prove the applicability of Hultén's point of view on the Fennoscandian culicine mosquitoes I have tabulated the species according to their occurrence in the three chief areas: Europe, Siberia and the Nearctic region.

As will be seen from the table above 24 (25?) species are common to Europe and Siberia and 18 species are common to Eurasia and the Nearctic region. To be sure, there are great lacunae in our knowledge as to the culicide fauna of Siberia, not the least concerning the northeastern part of that region. However, as a base for some tentative considerations on the problem, I have mapped the few records at hand. These provisional maps indicate that future investigation of the Arctic and boreal mosquitoes in Siberia according to the lines pointed out by Hultén most probably will bring results of importance.

Arranged according to the northernmost finds, 5 of the 18 species, common to Eurasia and the Nearctic, are recorded from the arctic coast of Siberia These are *Th. alascaensis, A. nigripes, nearcticus, communis* and *punctor*. The two circumpolar species *A. nigripes* and *nearcticus* have a distribution indicating their survival during the maximum glaciation i. a. somewhere at the arctic coast (or at the now submerged shelf?) of Asia. The three other species of this group, viz. *Th. alascaensis, A. communis* and *punctor* have a wider range of distribution and probably they survived both north and south of the maximum glaciation. A record of *A. excrucians* from Verkojansk may indicate a similar type of distribution.

The distribution of the 12 other species, common to Eurasia and the Nearctic, indicate their survival south of the maximum glaciation in Siberia.

Arranged according to their distribution in Siberia, from east to west, 6 species, viz. *Th. alascaensis, A. excrucians(?), flavescens, communis, punctor* and *pullatus,* are recorded from the Ussuri prov. and *A. cinereus* from Blagoweschensk at Amur. *A. nigripes* is recorded east to the outlet of Lena and *A. nearcticus* east to the Taimyr Peninsula. The three species *A. cataphylla, sticticus* and *Neoculex apicalis* are recorded from the western part of Siberia, and *A. riparius* and *intrudens* are, as far as known, hitherto not recorded from Siberia.

In spite of the scattered records the mapping indicates that at least 8 species, viz. *Th. alascaensis, A. dorsalis, excrucians, flavescens, communis, punctor diantaeus* and *A. cinereus* have a continuous distribution throughout the Euasiatic continent from the Atlantic in the west to the Pacific in the east. As to *A. pullatus* there is a gap between the easternmost European find (Saratov) and the find in Kamtschatka, but probably future investigation will modify the picture more or less as to this species as well as concerning other of the 18 species discussed.

The considerations above are directed only towards the A s i a t i c b r a n c h of the distributional area. However, it may briefly be mentioned that, according to Dyar (1928, p. 148), the bulk of these species have their principal N e a r c t i c distribution in the western part of that continent.

Regarding the origin of the 17 Danish and Fennoscandian culicine species, hitherto not recorded common to Eurasia and the Nearctic, comparatively little can, at present, be said. Possibly detailed comparative investigation of the European and Nearctic boreal culicines will uncover further relations. Thus Dyar (1928, p. 260) and Matheson (1929, p. 198) consider the Nearctic species *Mansonia (Coquilletidia) perturbans* Walk. identic with the European *Taeniorhynchus (Coquilletidia) richiardii* Fic. However, Edwards (1932, p. 119) and Martini (1931, p. 223) indicate that they are different but closely related species. Stackelberg's indication of *A. (O) rusticus* as a western immigrant has been quoted above. He further considers (1937, p. 253) *Culex pipiens* a relict from older immigrations which took place before the immigration of the boreal fauna. According to the genetical relations he esteems *Culex pipiens* a true Ethiopian element.

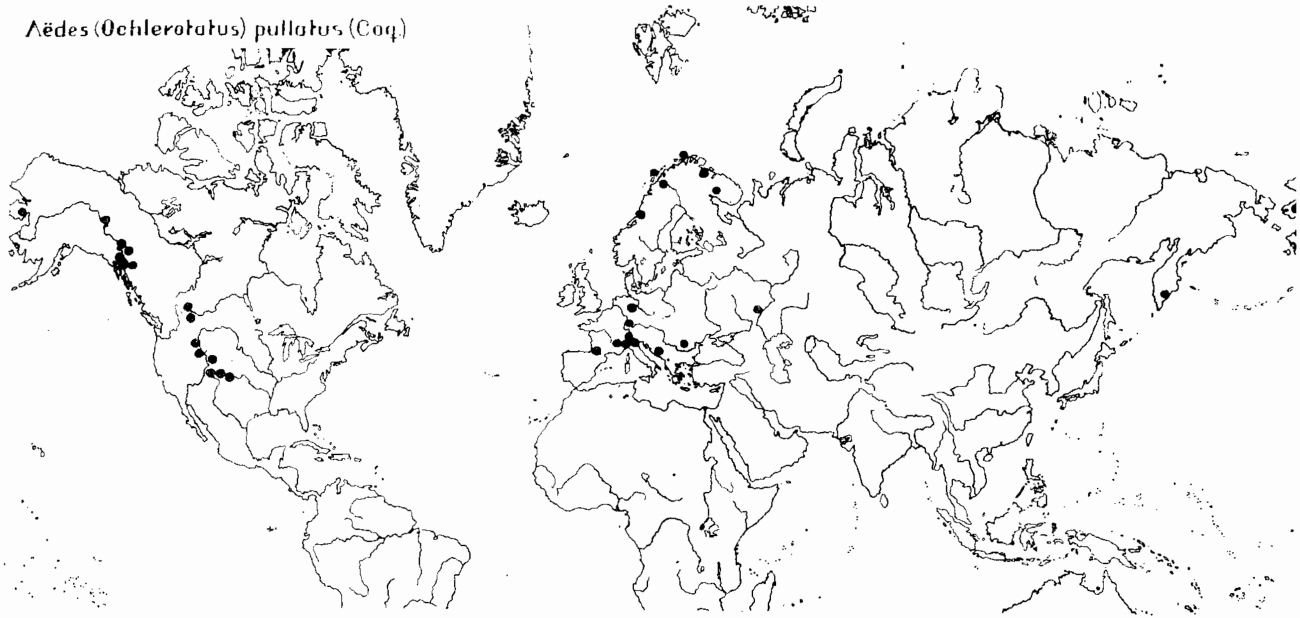

Fig. 147. Distribution of *A. pullatus* Coq. When many localities are close together this small map shows only some of them. (Aut. del.)

Having touched the questions concerning the origin and total distribution of the Danish and Fennoscandian culicine mosquitoes, we will now direct our attention to the problems connected with the (geological) age and ways of immigration of these mosquitoes into Fennoscandia.

By far the most interesting of our species is *A. pullatus* Coq., being the only one giving evidence of its existence in Fennoscandia in very remote time. As will be seen from the adjoining map (fig. 147) *A. pullatus* is found in the Arctic parts of Scandinavia and in the Kola Peninsula in the north, and its southern distribution in Europe is restricted to the alpine regions. It is thus found in Harz, Schwarzwald, in the Alps of Switzerland, eastern France, the Pyrenées, northern Italy, Jugoslavia and the Transylvanian Alps, and mostly in high altitudes. A find somewhat outside this scheme is that in Saratow. As to the closer circumstances of this find, Martini (1928 c, p. 44) remarks: "Die Larven dieser Species wurden in einem kleinen Wasserloch, das mit einem kleinen Bach in Zusammenhang stand, gefunden auf der Nordseite des Höhenrückens von Saratow, in einem stark mit Busch verwachsenen Tal. — — Sie lebten hier zusammen mit *cantans* und *rostochiensis*." More recently *pullatus* has been found in Kamtschatka. The species is a typical exponent of the interesting group known as the Boreo-Alpine animals. This type of geographical distribution is defined by Holdhous and Lindroth (1939, p. 124) thus: "Als borealpin sind solche Tierformen zu bezeichnen welche in diskontinuierlicher Verbreitung im Norden der paläarktischen Region und in der höheren Lagen der Gebirge Mitteleuropas (und teilweise auch noch Südeuropas und Zentralasiens) vorkommen, im Zwischengebiet aber vollständig fehlen."

As to the time of origin of the Boreo-Alpine type of distribution most investigators consider it as a consequence of the glaciation in "the Ice Age". To be sure some investigators as Scharff (1907) and Sainte-Claire Deville (1926) have advanced the theory [115] that the Boreo-Alpine type of distribution originates from a far more remote time than "the Ice Age", possibly even in Miocene. According to Scharff the immigration should have taken place from Central Asia in two directions, i. e. partly along the arctic coast, and partly following the alpine massives in the northeastern part of the Mediteranean region. However, Holdhaus (1939, p. 211) and Holdhaus and Lindroth (1939, p. 277

[115] Quoted from Holdhaus and Lindroth (1939, pp. 276—7).

—278) expressely keep aloof from this theory on account of geological as well as zoogeographical data. They i. a. point out that the number of Boreo-Alpine species of *Coleoptera* found in the mountain regions of Central-Europe decreases from west to east, a fact that does not harmonize well with a supposed immigration from the east. As another important fact they emphasise that the Boreo-Alpine *Coleoptera* in the mountains of Central Europe correspond exactly with the specimens of the same species from North Europe and Siberia, only a few species showing slight variations. This the authors take as token of the relatively young age of this type of animals. An attempt towards a closer determination of the age of the Boreo-Alpine type we find in a paper by Lindroth on the Boreo-British *Coleoptera* (1935, p. 627) where the author remarks: "The birth of the borealpine type must be removed to the time of Riss-glaciation, when the distance between the Scandinavian and the Alpine ice-sheet was shorter (already considered by Brundin 1934, p. 174). This would be a satisfactory explanation of the difference between these two types of distribution, the borealpine and the boreobritish: The former was shaped during Riss, the latter during Würm."

Interesting details as to the immigration into Britain are found in a recent paper by Beirne (1947) on "The origin and history of the British Macro-Lepidoptera." The author here remarks (l. c. p. 285): "Thus with a few possible exceptions, we cannot at present reconstruct the history of any species of *Lepidoptera* as an inhabitant of the British Isles farther back than the beginning of the last of the four main glaciations of the Pleistocene." The last glaciation epoch, the author divides into three phases and the immigrants of each of these phases are dealt with in detail. As to the nomenclature of the "First Glacial phase of the Upper Pleistocene" the author, in a footnote remarks: "Also known as the Old drift (in part)." However, according to a recent publication of Flint (1947, table 12, p. 343) the Warthe glaciation, synonymised by Beirne with his first phase, has to be included in the "Newer drift." To be sure, different authors are of diverging opinions as to the synonymy of these glacial phases (see i. a. Nordhagen 1933, p. 4) and I do not feel competent to enter further into the matter. In the adjoining map (Beirne, l. c. p. 287), reconstructing the probable maximum extent of the Upper Pleistocene ice-sheet in northern and Central Europe, the glaciation of the first phase is indicated covering Denmark completely. However, as stated by S. A. Andersen (1933, fig. 125, p. 143), Madsen (1928, pp. 115—7) and Nordhagen (1933, pp. 7—8, 122—4) the greater part of the western Jylland has not been covered by the ice-sheet during the last Pleistocene glaciation epoch. Interesting is the statement of Beirne (l. c. p. 321): "It may be concluded that all or most of the Alpine and northern European species of *Lepidoptera* probably arrived in the British Isles not later than the second glacial phase. The reason for this is that during that glacial phase the British ice-sheets were in contact with the northern European (The Weichsel (Brandenburg)), so that a belt of land on which ecological conditions were favourable to those species must have extended from north-central Europe into the British Isles, south of the British and northern European and north of the Alpine ice-sheets. — — — During the third glacial phase, however, the British ice-sheets were not in contact with those of the Continent but were separated by regions where conditions were ecologically unfavourable to the northern European and Alpine species and which may have formed an effective barrier to their migration into the British Isles."

Consulting the literature on the Quarternary time in Norway I have found several facts of the utmost interest for the problem under discussion in the admirable papers of the Norwegian botanist Nordhagen (1933, 1935, 1936). Based on investigations of Norwegian geologists and archaeologists, combined with his own extensive botanical researches, Nordhagen here advocates in a convincing manner the existence of refuges in western and northern Norway during the last glaciation (Würm). Concerning the refuges in Finmark Nordhagen (1935, p. 106) remarks: "According to my opinion there are therefore very strong botanical and archaeological pleas for the hypothesis that the principal refuges of late quarternary time have been located in the regions of Sørøya—Seiland—Stjernøya—the Oksfjord peninsula".[116] Further on p. 122, he again emphasises that the principal refuges in Finmark are those mentioned above, but smaller refuges are indicated in the regions of Magerøya — Outer Porsanger and the Varanger peninsula. As to Nordland county (fylke) Nordhagen (p. 136) indicates the strong possibility of coastal refuges in several places, but he supposes that the plant relics have, in postglacial time, evacuated in the inner districts near the frontier between

[116] Translated from the Norwegian original.

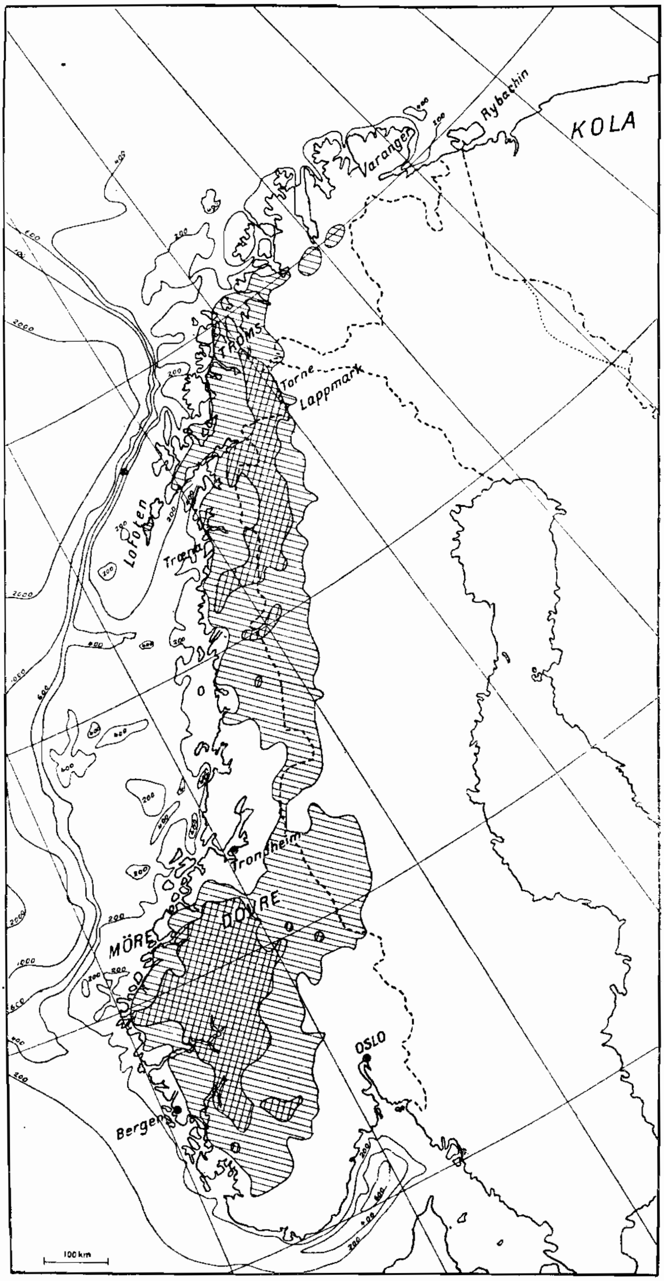

Fig. 148. Map of some features of the submarine and mountain relief of Scandinavia. Shaded: areas with summits more than 1000 h high. Cross-hatched: areas with summits higher than 1500 m. (After Eilif Dahl 1946.)

Norway and Sweden. Concerning possible refuges in the Kola peninsula, opinions diverge, but Nordhagen (1936, pp. 131—32) emphasises the concentration of rare alpine plants in Imandra (i. a. Chibinä), in his opinion indicating their survival during Würm, possibly somewhere in the costal area.

It has to be mentioned that not all geologists agree in detail with Nordhagen in his interpretation of the geological facts and the conclusions drawn thereform. Among other problems the identification of the coastline in different phases of the last Pleistocene glaciation and the possible existence of, now submerged, "Forelands" along the Norwegian coast are matters of diverging opinion (Nordhagen 1933, pp. 86—102).

A very interesting treatise on the localisation and nature of the refuges in the Pleistocene epoch is recently published by the Norwegian botanist Eilif Dahl (1946). Discussing the Norwegian refuges supposed by Nordhagen, Eilif Dahl advances the question: "Why only in these regions?" Considering the topography of the Scandinavian Peninsula he arrives at the conclusion: "If high mountains are situated near the border of deep oceans, the ice-shield will not have sufficient distance in which to grow thick enough to cover the high mountains." In Norway these conditions are to be found just in the Møre and the Troms area (fig. 148). An unglacial area of this type Eilif Dahl denominates the coastal mountain type. He further gives a review of unglaciated refuges and the floras in the Arctic as well as in the Antarctic regions (l. c. p. 238).

"The following typology of the refuges is therefore proposed:

I. The Scandinavian type. The firn line (The firn line is defined as the border between the accumulation area and the ablation area) never descends to sea-level. Atlantic climate. Flora: Rich vegetation of vascular plants, mosses and lichens characterized by coastal mountain refuges.

II. The Antarctic type. The firn line descends to the level of the sea in the severest period. Antarctic cimate. Flora: Few or no vascular plants. Few mosses. Rich vegetation of lichens especially microlichens.

III. The Tundra type. Caused by small precipitation in winter. Firn line never descends to sea-level. Continental climate. Flora: Numerous species of vascular plants, mosses and lichens characterized by tundra refuges."

Concerning the distribution of these different types of refuges he sums up (l. c., p. 234): Refuges of the coastal mountain type are found in western and north-western Scandinavia, probably in Scotland, Iceland, the southern half of Greenland (where the relief conditions to a high degree favour refuges of this type), and possibly in Labrador. Refuges of the tundra type are found in Siberia, possibly in the Kola Peninsula and Rybachin Peninsula, in northern Norway, Bjørnøya, Spitsbergen, in the northern half of Greenland and in Arctic Canada. I think it safe to include Novaja Zemlya in this category. In refuges of the tundra type the climate will be continental. In refuges of the coastal mountain type the climate may be atlantic or oceanic." On the physical and ecological conditions in glaciated areas Lindroth (1939, p. 264) gives some interesting details from Iceland in recent time.

"Von Meer aus sieht die Küste wenig gastfreundlich aus — — —. Der gewaltige Vatnajökull — der größte Gletscher Europas — ragt bis zu mehr als 2000 m fast gerade aus dem Meer hinauf, nur einen schmalen, grauen Saum von Fels und Sand dazwischen lassend. Aber drinnen in den Tälern, im Schutz des Eises, liegen grüne Wiesen und wächst der Birkenwald. Eine solche Oase ist Skaftafell, nach zwei Seiten hin vom Gletscher umgeben, nach den beiden übrigen von den völlig sterilen Kiesfeldern der Gletscherflüsse, die bis zum Meer reichen." The photo published (l. c. fig. 28) gives the impression of a luxuriant flora and the author emphasises that the fauna of insects is very rich on the spot.

Besides the botanists mentioned above also other botanists (see Nordhagen 1933, pp. 8—14) and an increasing number of entomologists have published researches which strongly support the theory of glacial refuges in Norway (i. a. Holdhaus und Lindroth 1939, pp. 251—282; Lindroth 1933, p. 349; 1935, pp. 623—8; 1939; pp. 240—67; Palm och Lindroth 1936, p 34; B. Petersen 1947, pp. 441—52; A. Strand 1930, pp. 258—9; E. Wahlgren 1919, pp. 22—32). However, the first Norwegian entomologist advancing the theory of glacial survivors was the old curator at Tromsø museum, J. Sparre Schneider, who already in 1899 touched the problem and since then took it up again in subsequent publications (i. a. 1906, 1910). As to the mammals Ekman (1920, *2*, pp. 3—12) points out that the Scandinavian lemming must be considered a survivor of the last glaciation.

If we compare the finds of *A. pullatus* in the North with the above mentioned facts, there is a striking coincidence of the distribution of this mosquito and the refuges as stated by Nordhagen. The localities where *pullatus* has hitherto been found lie just within or near his glacial refuges. However, the possibility can not be excluded that *A. pullatus* may be found in Scandinavian mountainous regions hitherto unexplored, but this will not influence the principal fact that this species is a characteristic exponent of the boreoalpine type of distribution As the ecological facts known indicate that *A. pullatus* is a hardy species, living in high altitudes in the central European mountains and preferring waters of low temperature in the north, we may suppose that it would survive rather "arctic" conditions.

What has been advanced above indicates, in my opinion, that *A. pullatus* existed in Norway at least in the last interglacial. Certainly Lindroth (1935, p. 627) removes the birth of the boreoalpine element to the time of Riss-glaciation, but as to *A. pullatus* in Scandinavia I can not find that the facts at hand do admit of constructions for mere remote time than Würm. However, as to the existence of this mosquito in Europe the find near Saratow, east of the Don-lobe of the maximal glaciation, strongly indicates the great age of *A. pullatus* in this region. This locality lies quite outside the typical areas where the mosquito lives in recent time.

A problem of more hypothetical character is whether *A. pullatús* is the only Würm survivor in Fennoscandia. Considering the general distribution and ecology of the two circumpolar species *A. nigripes* and *A. nearcticus,* there is a probability that these species have to be included in the group of survivors. If further investigation confirms their bicentric distribution in Scandinavia, as indicated by the records at hand (fig. 145) this would strongly support the interpretation above.

Even a fourth species has to be discussed here, viz. *Th. alascaensis*. The total distribution of this mosquito, in particular its occurrence in Scotland, indicates its great age in Europe. To be sure, the present distribution of *Th. alascaensis* in Fennoscandia does not permit any conclusion as to its previous occurrence within this area. Beyond the faint probability of glacial survivors, most likely a postglacial immigration from northeast has taken place.

Apart from the species discussed I am inclined to regard the rest of the Fennoscandian Culicines as post-glacial immigrants. Concerning the ways of immigration they may conveniently by dealt with in different groups. However, some general remarks may be justified. As previously emphasised the regions in Scandinavia, ranging from about the 64 to the 68 degree of northern latitude, are poorly investigated concerning mosquitoes, and the interpretation of the adjoining maps therefore call for caution in several cases. Even a glance at the distributional maps of such a ubiquitous species as *A. (O) communis* (fig. 125), clearly demonstrates the few records from the regions mentioned. In the case of rarer species, where no finds are recorded from this area, the distributional maps may indicate a disjunction between a northern and a southern occurrence of the species within the Scandinavian Peninsula. The interpretation of this seeming disjunction must be a matter of appreciation in each case. In some cases a comparison with the general distribution of the species may prove helpful, in other cases the records at hand do not permit any conclusion.

The principal Fennoscandian group is that of the southern immigrants which embraces the bulk of our culicine mosquitoes, viz. *Th. annulata, subochrea, morsitans, fumipennis, Taeniorh. richiardii, A. dorsalis, caspius, cantans, annulipes riparius, cyprius, flavescens, detritus, cataphylla, leucomelas, rusticus, geniculatus, vexans, Culex apicalis, pipiens pipiens, C. p. molestus.*

A regular establishment by overseas migration in the Scandinavian Peninsula is not very probable and I would consider an overland migration the most likely interpretation. According to the literature (i. a. Kaj Henriksen 1933, p. 87; Flint 1947, fig. 76, p. 412) the immigration of the southern element in Scandinavia probably has taken place in the time of the *Ancylus* Lake, what is also known as the Mainland time. As to this type, which would agree with the South-Scandinavian-Karelian element, as treated by Palmén and Platonoff (1943, p. 187), a double route of immigration must be presumed: one branch immigrating from south into Denmark and southern Sweden and another branch from south-east into Finland.

A group of minor zoogeographical interest is that represented by the ubiquitous species, principally the three species *A. excrucians, communis* and *punctor.* To be sure Økland (1925, p. 3) denominates the species, which extends in all parts of the area considered, from south to north and from west to east, "Total forms". According to this interpretation solely *A. punctor* had to be considered, the two other species hitherto not being recorded from southwestern Norway. However, the distribution of principal interest for our purpose is the extension north-south, and, according to that principle I include the three species in this group. Most probably a double immigration, both from south and from north-east, must be considered, and in this connection I will draw the attention to the papers of Lindroth and Palm (1934, p. 127) and Palm and Lindroth (1936, p. 35) concerning the *Coleoptera*. Most probably also further investigation on a greater material of the previously described colour variants of *A. excrucians* would bring results of interest.

A to *A. cinereus* I am somewhat in doubt. To be sure the records at hand (fig. 128) indicate a gap between the occurrence of the species in Finland and the northermost Scandinavian finds, and, as far known, northern finds from Siberia are not recorded. However, this small species has repeatedly been overlooked and I would not consider it unlikely that the species in future could be recorded also from the northern parts of Finland. As it is, further investigation must decide whether *A. (A) cinereus* has to be placed in this group or in the first group (the southern immigrants).

The third group is that of the n o r t h e r n i m m i g r a n t s. I consider *Theob. alascaensis* and *bergrothi* typical exponents of this group, possibly also *A. diantaeus* and *intrudens* have to be included here. The three species *Th. alascaensis, A. diantaeus* and *intrudens* also extend into the northern part of Central Europe, *A. diantaeus* in Denmark as well. However, none of them are hitherto recorded from the southern part of Sweden, and future investigation is needed to settle the problem of their origin. *A. diantaeus* and *intrudens* are among the rarer species and comparatively little is known as to their distribution in Europe and not least in Siberia.

As to the two species *A. sticticus* and *nigrinus* I have, on accounts previously discussed, abstained from any zoogeographical discussion.

This treatise clearly demonstrates the many lacunae in our knowledge of the Fennoscandian culicine mosquitoes and the discussion of several problems therefore merely are of tentative character. I hope, however, that the f a c t s compiled may serve as a useful basis for future investigation in this group which hitherto has been rather neglected in our region.

Summary.

The present treatise is the result of field investigations in southern Norway, covering 18 seasons, as well as of a revision of museum and private mosquito-collections in Denmark, Finland, Norway and Sweden.

1. The preface gives a general view of the geographical divisions applied, the abbreviations of the geographical and personal names and the magnifications used in illustrations. Further the technique applied in investigation of the hydrogen-ion-concentration, the iron contents and hardness of the breeding-waters, the mounting of slide preparations and measurements of the wing and the siphonal index are described. Finally the material and collections investigated are reviewed.

2. As a base for the systematical and zoogeographical investigation the external anatomy of the mosquito is described in detail in chapter 1. The denomination tempora is applied to the narrow stripe behind the eye, hitherto mostly designated as the cheek. Discussing different opinions as to the palps, the author interprets the palps in male *Culex* as consisting of five segments, in female of four segments, in other northern genera both male and female palps consist of five segments. The terminology of the parts of the thorax and the pleural bristles follows Edwards (1932). The R-C-N nomenclature is applied to the wing. The term terminalia is applied to the hinder modified abdominal segments. The female terminalia are briefly described, the male terminalia detailed. The terminology applied to the male terminalia is in coincidence with Freeborn (1922). However, the author uses the term claw for the appendage of the dististyle, the term claspette is applied in the strict sense of Dyar (1918), and the denomination claspettoid is proposed for the homologous structures in *Aëdes* and *Aëdimorphus*. The sclerites of the

phallosome in *A. cinereus* Meig. and *A. vexans* Meig. are discussed. A detailed synopsis of the denominations applied to the different parts of the male terminalia concludes the first section.

3. Next to a brief description of the types of mosquitoes eggs, the external anatomy of the larva is detailed. In the short description of the pupa the few Scandinavian papers on this matter are quoted. The internal anatomy of the female mosquito is briefly reviewed.

4. Chapter 3: The Danish and Fennoscandian Culicines are divided into four biological groups: domestic species, rural species, halophilous species and arboreal species. They are further arranged into three groups according to the vertical distribution. The degree of pH in 91 Norwegian breeding-waters examined are tabulated, also some tests of the percentage of salt in the breeding waters. Another table demonstrates the association with each other of the larvae of 22 Norwegian Culicine species. Wesenberg-Lund's life-history calendar of Danish Culicines is quoted, also his observations of mosquitoes as flower visitors. Different kinds of animals, including bird nestlings, attacked by Fennoscandian Culicines, are reviewed. Some records concerning the swarming, mating and hibernation of northern Culicines are quoted. The few observations of Danish and Fennoscandian Culicines as transmitters of diseases and parasites are detailed. Records on these matters from outside Fennoscandia, but concerning species found in our region, conclude chapter 3.

5. As no general view on the mosquito pest in the Far North has hitherto been published the author, in chapter 4, gives excerpts from the principal books and papers on this phenomenon. These quotations start with Olaus Magnus (1567) and are continued up to modern publications. The author emphasises the importance of Thienemann's investigation (1938) on the problem and agrees with Thienemann as to the significance of the frozen ground for the wholesale development of mosquitoes but does not share Thienemann's interpretation of the small rodents as the main blood source of the mosquitoes. Based on personal investigation in northern Norway the author considers the reindeer the chief source of blood for the arctic mosquitoes and this opinion is supported by quotations from the literature concerning conditions in arctic Europe, Asia and America.

6. In chapter 5 the principal systematical characters of the adults and larvae are summed up. The signification of the genitalia for taxonomic purpose, the variability and possible dimorphism in these organs are discussed, as well as the geographical variations in mosquitoes. The author considers *Theobaldia annulata* and *subochrea* as well as *Aëdes dorsalis* and *caspius* as sibling species, but *Culex pipiens* and *molestus* are treated as races. Abnormities in northern Culicines are mentioned and depicted. The classification applied is, in its main features, in coincidence with Edwards (1932). The synonymy is discussed and some innovations detailed. A synopsis of the nomenclature used in recent handbooks concludes this section.

7. Chapter 6 and 7: Previous research on mosquitoes by other investigators in Denmark, Finland, Norway and Sweden is detailed for each of the four northern countries. Field investigation by the author in southern Norway in the years 1929—39 has been carried out by the aid of a motorcar, provisionally fitted up as a field-laboratory. The hydrogen-ion-concertration of 227 breeding-waters were examined, also the iron contents in 72 places as well as the hardness of 75 waters. The occurrence of mosquitoes in dwellings, horse-stables, cow-houses and pig-pens were investigated in 220 places. The number of maxillary teeth and the wing length were examined in 937 specimens of *Anopheles*. 392 specimens of *Anopheles* were isolated for oviposition and the various types of eggs studied and drawn. The blood meal of 157 *Anopheles* were submitted to the precipitin test. Details of the *Anopheles*-investigation appear in the second part of this treatise. The principal results of the author's previous research on Norwegian mosquitoes are briefly summed up.

8. Chapter 8 and 9: The principal part of this paper is devoted to a detailed review of each of the 35 *Culicine* species found within the Danish and Fennoscandian areas, with keys for genera and species (adults of each sex) as well as for male terminalia and larvae. The description of the species starts with a discussion of the synonymy. With a few exceptions the descriptions are founded on Fennoscandian material and for most larvae the chaetotaxy is tabulated. A detailed list of localities is applied for each of the four countries, with the finding dates added, also with the stage actually found at the place. A compilation from the literature of the total distribution of the species is quoted. Biological observations from our area, with quotations from abroad for comparison, concludes the consideration of each species. Illustrations, delineated by the author, of male

terminalia, female palps and details of the larvae are added for each species. The hitherto unknown first instar larva of *Theobaldia bergrothi* Edw. and *Neoculex apicalis* Adams is described and delineated. The incised claw of the disti-style in *Theobaldia annulata* and *Th. subochrea* is described and depicted as well as new differential characters in the male terminalia of *A. cataphylla* and *A. leucomelas*. Further differential characters in the pleural scaling of the female *A. nigripes* and *A. nearcticus* are described. Of the species considered in this paper 2 species, viz. *Th. fumipennis* and *Culex molestus* are "new" to Denmark; 16 species viz. *Th. morsitans, fumipennis, A. riparius, excrucians, leucomelas, sticticus, nigrinus, diantaeus, intrudens, pullatus, geniculatus, vexans, cinereus. C. apicalis, molestus* and *torrentium* are "new" to Norway; 5 species, viz. *A. leucomelas, sticticus, intrudens, C. molestus* and *torrentium* are "new" to Sweden, and 3 species, viz. *Th. subochrea, A. leucomelas* and *C. torrentium* are "new" to Finland.

9. Chapter 10: Some geological, physical and biological features of the Danish and Fennoscandian areas are briefly described. The Culicine species found within this region are tabulated for each country. The possibility of future finds of new species in our area is discussed and the species found in our region compared with those from the adjacent areas. Ekman's zoogeographical divisions are applied in this treatise. The Culicine species are arranged into five groups: 1. Species ranging from Skåne to Finmark; 2. The northerly advanced southern species; 3. The true South-Scandinavian species; 4. The Archiboreal species; 5. The Arctic species. The distribution of each species is demonstrated by adjoining maps. The poverty in species in western Norway is briefly discussed. As a point of departure for a closer consideration of the time and ways of immigrations of the Fennoscandian Culicine mosquitoes, the geological history of these insects is briefly quoted, also some papers on the Bering Strait area and the glaciations in northern Siberia during Pleistocene age. The theory advanced by the Swedish botanist Hultén, that most arctic and numerous boreal plants radiate from the Bering Sea area, is briefly quoted and the Culicine mosquitoes common to Fennoscandia, Siberia and N. America tabulated and discussed according to Hultén's point of view. The concluding pages are devoted to the problems concerning the age and ways of immigration of the Culicine mosquitoes into Fennoscandia. Special attention is paid to the boreo-alpine species,

Aëdes pullatus. A comparison with papers of the Norwegian botanists Nordhagen and Eilif Dahl strongly indicates that *A. pullatus* has survived the Würm glaciation in places in northern Norway. Probably also *A. nigripes* and *nearcticus* are Würm survivors in Norway. The rest of the Fennoscandian Culicine mosquitoes are considered post-glacial immigrants. The bulk of our species are southern immigrants, 3 species probably have immigrated both from south and north and 4 species are considered northern immigrants.

Addenda.

Ad 93 b, p. 313:

In August 1947 I inspected the collection of mosquitoes in the Zoological Museum at Helsingfors. The single male *parvulus* in the Finnish collection had the terminalia cut off. In its general appearance, however, the specimen agrees with *A. nearcticus* Dyar.

Corrigenda.

Page	151,	line	22, for "Romania" read "Roumania".
»	202,	»	25, for "Letterstedt" read "Zetterstedt".
»	216,	»	31, for "Bedia Sali" read "Bedia Bali".
»	235,	»	31, for "*A. canans*" read "*A. cantans*".
»	272,	»	1 from bottom, for "Michályi" read "Mihályi".
»	286,	»	30, for "Seria" read "Serbia".

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B. Species.

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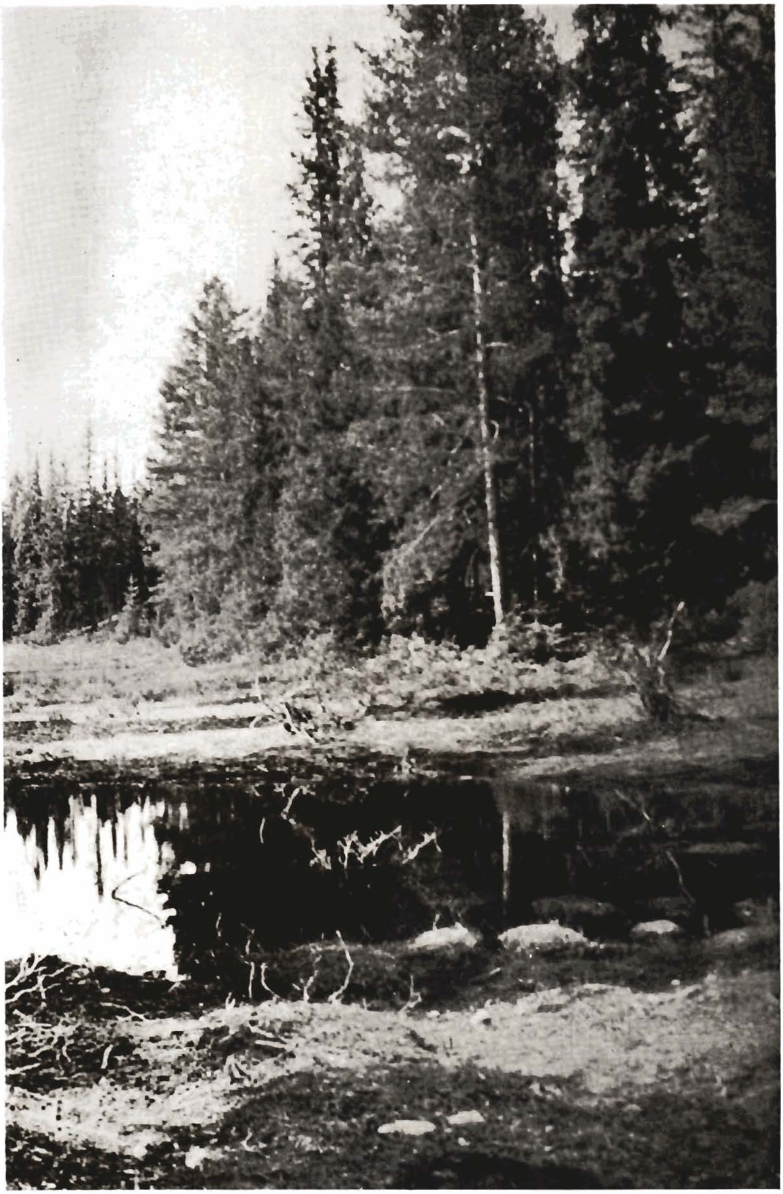


Snow-pool at Indbygda, Trysil (HEn 20), 20. v. 1934. Partly shaded. Larvae and pupae of *A. (O) communis.* (Natvig phot.)

L. R. Natvig.

The same place as shown on Pl. I, but photographed 5. vii. Where the pool was in May there is now a green meadow. Note the shade. (Natvig phot.)

L. R. Natvig.

Shallow pcol with grassy bottom, at the Fokstu swamp (Os 37). In the rear the Snehetta high mountain, 23. v. 1937. Larvae of *A. (O) communis, punctor;* pupae of of *A. (O) nearcticus.* (Natvig phot.)

L. R. Natvig.

Snow-pool near the railroad, Fokstua 23. v. 1937. Stony bottom covered with lichens and mosses. The pool is faintly shaded by dwarf-birches. Larvae of *A. (O) communis* and *punctor*. (Natvig phot.)

From the barren mountains south of the high mountain massif Sølen, Ytre Rendal (HEn 23), 9. vii. 1944. The dark triangle in front of the water net and the saucer is a diminutive pool teeming with larvae of *A. (O) punctor*. Compare the match-box placed near the saucer.
(Natvig phot.)

L. R. Natvig.

Pl. VI.

Swamp-pool on the ridge south of the Sølen massif, Ytre Rendal (HEn 23), surrounded by open woodland (pines and birches). Characteristic are the tussocks of *Carex juncella* in the *Sphagnum*-moor. At the shallow border of the pool larvae of *A. (O) punctor,* in the deeper parts of the pool larvae of *A. (O) excrucians.* (Natvig phot.)

L. R. Natvig.

Partly shaded snow-pool near the lake Sognsvannet (AK 13), 15. v. 1937. Larvae of *A. (O) excrucians, communis* and *C. pipiens.* (Natvig phot.)

L. R. Natvig.

Pl. VIII.

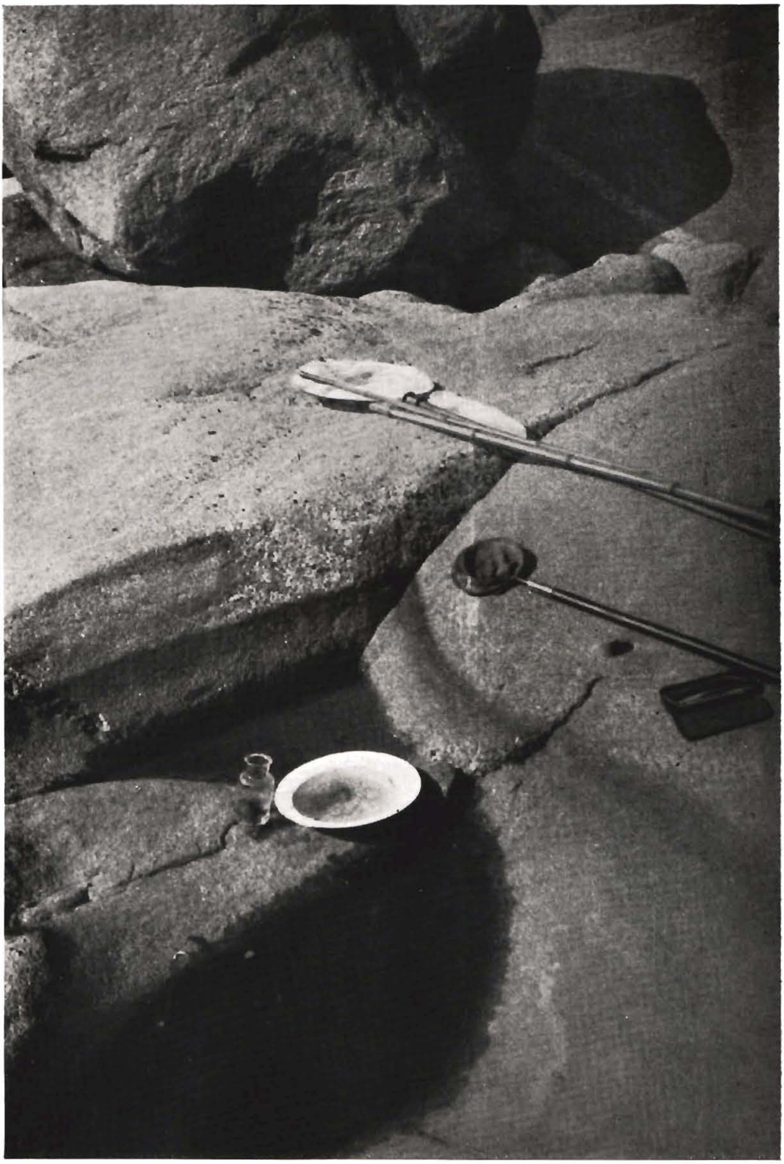
Small pools of brackish water near the sea-shore, Prestesand, Kirkeøya, Hvaler islands, 13. iv. 1938. Several larvae of *A. (O) dorsalis, detritus, leucomelas* and a single larva of *A. (O) communis.* (Natvig phot.)

L. R. Natvig.

Shoal water ("Verlandungszone") at the border of the lake Fiskumvannet (Bø)31, 3. vii. 1928. Pupae of *A. (O) excrucians* at the border of the lake, male and female adults in multitudes in the grass. (Natvig phot.)

L. R. Natvig.

Pl. X.

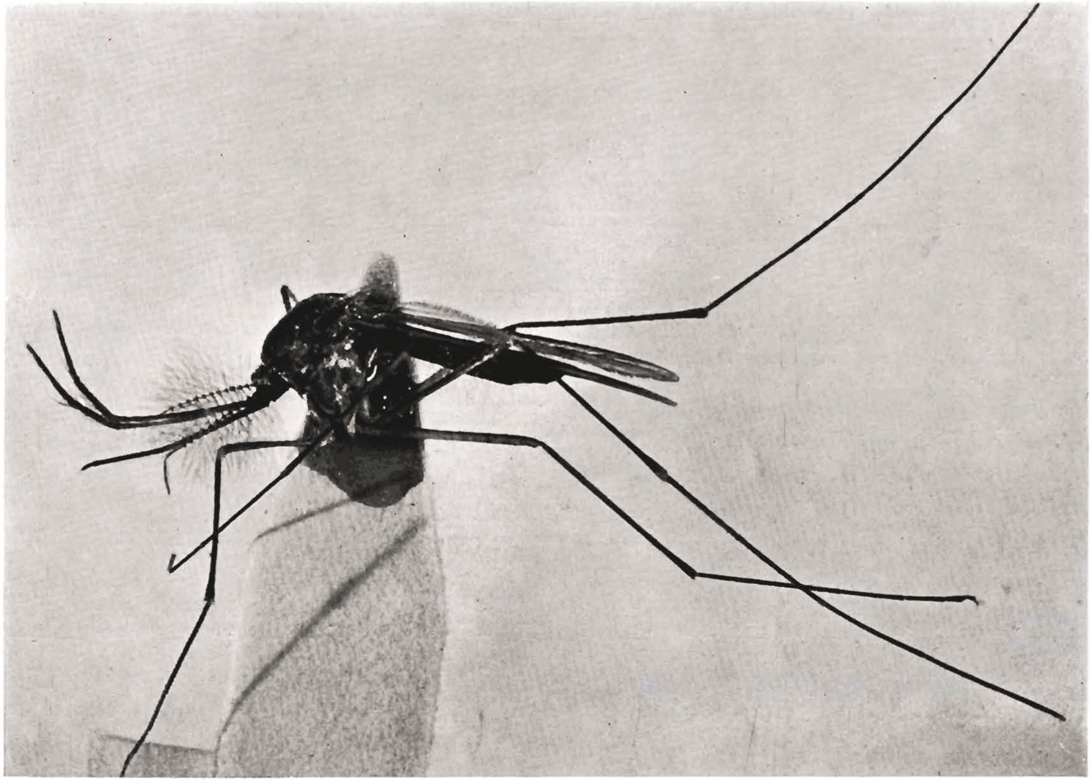


Rock-pool near the sea-shore, Kirkeøya, Hvaler, 28. v. 1928.
Larvae of *Neoculex apicalis*. (Natvig phot.)

L. R. Natvig.

Mosquito swarm on a resting man. Finmark 1901.
(Phot. Dr. Urbye.)

Pl. XII.



Culex torrentium Martini.

Side-view of male. Note the characteristic pointed and upturned palpi. (Orig.)

L. R. Natvig.

The geographical division of Denmark, Finland, Norway and Sweden. Legend see Preface pp. VIII—X. (After A. Strand 1946, with the division of Västerbotten and Lappland added by the author).

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