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THE OCCURRENCE OF *TIPULA (VESTIPLEX) ARCTICA* CURTIS IN GREENLAND

AND ITS DECREASING BODY LENGTH WITH INCREASING LATITUDE

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WITH 4 FIGURES IN THE TEXT AND 2 PLATES

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CONTENTS

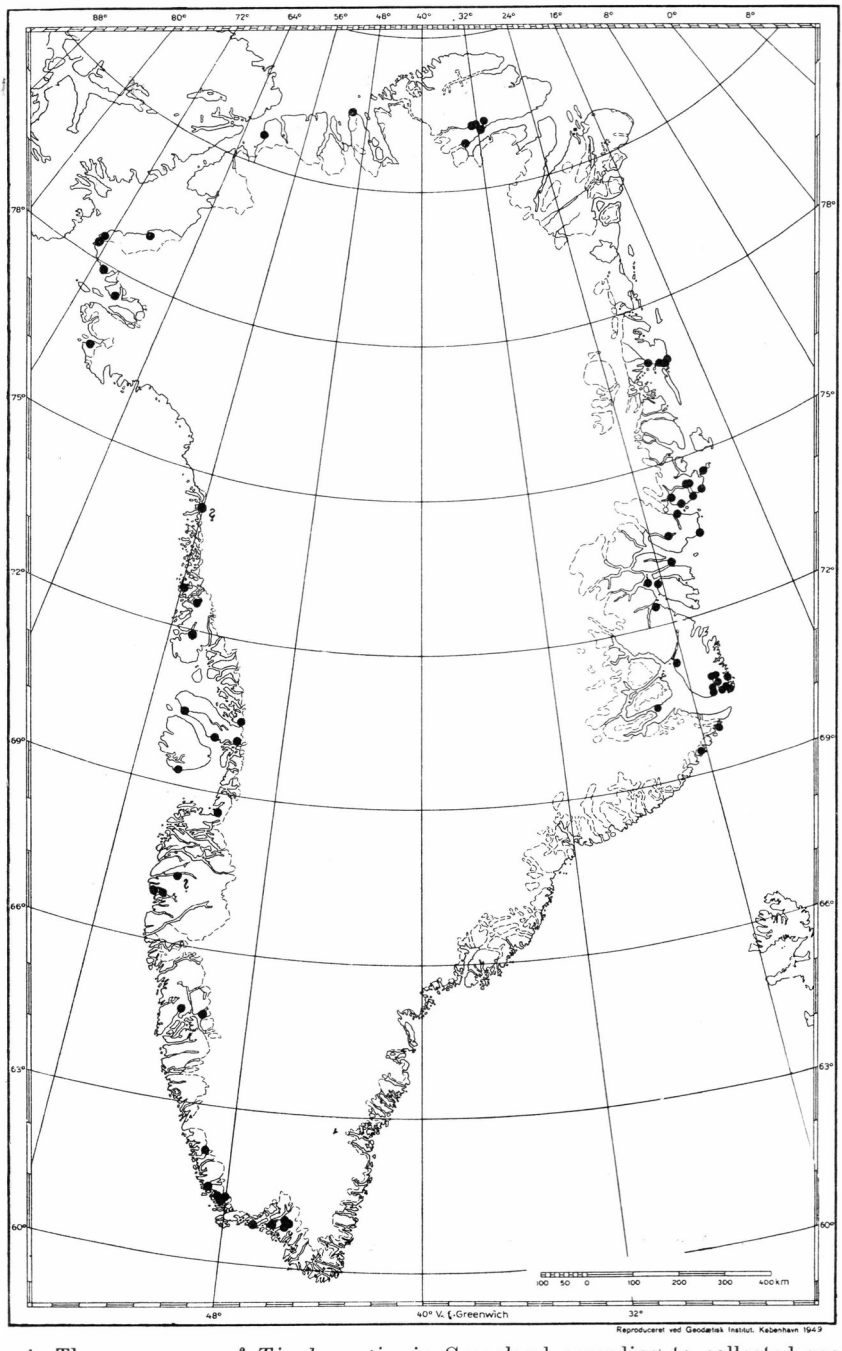

Fig. 1. The occurrence of *Tipula arctica* in Greenland according to collected specimens (including literature records). Each filled circle represents a collecting locality regardless of number of specimens collected. The queried occurrences mean that the exact localities could not be established with certainty.

1. Introduction.

In connection with studies on the oviposition of crane-flies belonging to the subgenus *Vestiplex* Bezzi (HEMMINGSEN, 1952 and 1956) a need has been felt for information on the occurrence in Greenland of the holarctic representative of the subgenus: *Tipula* (*Vestiplex*) *arctica* Curtis. A survey of its occurrence there has therefore been undertaken on the basis of 1) literature, 2) collections available in Copenhagen, and 3) observations made in Greenland in 1954 by the senior author (A.M.H.) and others.

2. Literature on the occurrence of *Tipula (Vestiplex) arctica* in Greenland.

All the literary references quoted by HENRIKSEN and LUNDBECK (1917, pp. 603—604) and HENRIKSEN (1939, pp. 79—80) have been consulted as to dates and localities. They cover the years from 1780 to 1938. A consultation of the Zoological Record (*Insecta*, Faunistic, Arctic, *Diptera:* 1937—1951) revealed no further records. Apart from this, and a few occurrences mentioned by MANNHEIMS (1953, p. 134), the exact locality of one of them being checked by consulting VANHÖFFEN (1897), no other literary sources have been traced.

3. Collections available in Copenhagen.

The collections of the Zoological Museum of Copenhagen University (54 ♀♀ and 81 ♂♂ collected 1884—1934), of the zootopographical Greenland Department (17 ♀♀ and 38 ♂♂ collected 1938—1954), and of the Peary Land Expedition (15 ♀♀ and 18 ♂♂ collected 1947—1949), have kindly been placed at our disposal by Dr. S. L. TUXEN; Mr. CHR. VIBE, M. Sc.; and Mr. PALLE JOHNSEN, M. Sc., respectively. To these may be added 2 ♀♀ and 11 ♂♂ collected at Grønnedal 2/VII 1954 by the senior author (A. M. H.). One male collected by Professor A. ROSENKRANTZ out of myriads flying over the luxuriant vegetation up to 10 km up the Simiútap kûa river valley in the northern part of the Svartenhuk penin-

sula at the Umîarfik fjord and also along part of the fjord coast south west of the river mouth 12–14/VI 1956, and 8 ♀♀ and 8 ♂♂ collected by CHR. VIBE, M.Sc., at Scoresby Sund at sea level 17/VII 1956, were received after conclusion of the main treatment of the data and could be allowed for only in fig. 1 and where else expressly stated. According to Dr. E. SÉGUY (*in litt*), neither the collections of Dr. H. DE LESSE from the Expeditions Polaires Françaises, Mission PAUL-ÉMILE VICTOR, nor the collection of the Museum National d'Histoire Naturelle in Paris, contain this species. No further attempts have been made to trace Greenlandic specimens in collections abroad.

4. Observations made in 1954.

On a visit to the Danish military marine base at Grønnedal (= Green Valley) (61°14′ N, 48°06′ W) in southern Greenland onboard M/S "Disko", on July 2nd, 1954, one of us (A.M.H.) was kindly permitted by the chief of the Greenland Command, Rear Admiral F. KJØLSEN, to make an excursion into the valley to the top of the mountains (about 5—600 m altitude), about 5—6 km inland. During this excursion, lasting from 8 a.m. to 2 p.m., flying specimens of *T. arctica* were frequently seen, 2 ♀♀ and 11 ♂♂ were caught. As is often the case with tipulids, the females were apparently in the minority. The flies were seen all over the arctic heath, including its driest parts, e. g. on the top of the mountains separating Grønnedal from the bottom of the Íka fjord situated to the south east. The males flew in the characteristic tipulid zig-zag flight; the females, as in many other species, more in straight lines.

The studies on the ovipository behaviour carried out with these flies are reported elsewhere (HEMMINGSEN, 1956, pp. 266—267).

The day before, on July 1st, in the rather luxuriant area, Ivigtut Dal (= valley), behind the settlement of Ivigtut, situated at the coast of the Arsuk Fjord 5 km due south west of Grønnedal, not a single specimen had been seen in spite of searching for several hours. Neither was any seen there on 23–24/IX. The Zoological Museum has an undated female specimen marked Ivigtut, Møller.

It was hoped to establish in other localities in West Greenland further details of the ovipository processes of this species, which according to available data occurs there till well into August. But in spite of thorough searching during visits to the following localities between 62° and 69°20′ N (and their surroundings), only 1 specimen was seen (a male, 14/VII at Itivnera):

Frederikshåb (3/VII); Færingehavn (5/VII); Godthåb (6–13/VII & 30/VII–2/VIII); Itivnera (at the head of Pisigsarfik, a tributary fjord to Godthåbsfjord) and the adjacent valley and mountain (800 m) down to Itivdleq, a tributary fjord to the Ameralik fjord (13/VII–28/VII); Kapisigdlit river valley (15/VII); Kapisigdlit (15, 19 & 28/VII) and Akia (16, 19 & 29/VII); the valley at the head of the Amitsuarssuk fjord (21/VII), another tributary

fjord to the large Godthåbsfjord; Qôrnoq (29/VII); two skerry islands near Satsigsúnguit, North of Godthåb (2/VIII); short visits to Atangmik, Tovqussaq and Napassoq (3/VIII); the mountain area behind Sukkertoppen (4/VIII & 19–21/IX); short visits to Agpamiut, Kangâmiut and Itivdleq (5/VIII); the area East of Holsteinsborg to the end of the lake 6 km inland (6/VIII & 13–18/IX); short visits to Aqigsserniaq, Agto, Kangâtsiaq, Manermiut (7 & 8/VIII); Egedesminde (9/VIII & 12/IX); Godhavn on the island of Disko, around the Arctic Scientific Station (10/VIII–10/IX); special excursions to Kangerdluarssuk, Evqitsoq, and Kangikitdleq (= Kangikerdlak) (17–19/VIII & 4–5/IX) in Diskofjord; and Blæsedalen (=Windy Valley) (26/VIII). I (A.M.H.) also searched in vain in various places for larvae and pupae by turning stones and plant cover or by digging with a spade.

A very similar experience as regards the scarcity of *T. arctica* in West Greenland in 1954 at least after the beginning of July, was gained by Mr. Torben Andersen. He collected insects for zootopographic purposes at Kûngnât Bugten near Arsuk (61°15′ N, 48°30′W), 7–20/VII, and at Tigssaluk (61°23′ N, 48°50′ W), 23/VII–9/VIII, including several excursions to altitudes of 2—500 m, but he saw and collected only 3 specimens altogether, a pair in copulation at Kûngnât (200 m altitude on 13/VII) and a male at Tigssaluk (500 m altitude on 1/VIII). On 11/VIII he found none on an excursion, during fair weather some kilometers into the valley at Grønnedal, where as mentioned above I(A.M.H.) had found many on 2/VII.

T. arctica is known by the native Greenlanders by the name tugtûssaq, plur. tugtûssat; (= reindeerlike, from the long legs; by Fabricius, 1780, p. 200, spelled Tuktursak) or tugtûssarssuaq (= the big reindeerlike, presumably alluding to the smaller species of other genera, or applying especially to the larger female [?]). These names were verified in many of the places visited by showing to the Greenlanders the specimens collected at Grønnedal. And it became clear that they usually see the species on the tents when hunting reindeer. As reindeer hunting always takes place in August this is an indication of the occurrence of *T. arctica* adults as late as August.

Mr. Chr. Vibe, M.Sc., informs us that he saw the species, including copulating pairs, on his arrival at Mesters Vig (ca. 72° N, 22°30′ W) in East Greenland, 21/VII 1954; and it was abundant there at least until about the middle of August.

One explanation of the apparent rarity of the species in West Greenland in the greater part of July and in August, 1954, might be unfavourable conditions during the period of development, e. g. too dry during the season of oviposition, or the allegedly particularly long winter of 1953—1954, at the end of which thaw and frost often alternated. Similar effects are known to have affected *T. paludosa* in Europe, e. g. after the cold winters 1939—1942.

For similar reasons, the fact stated by J. C. NIELSEN (1910, p. 58) that the larvae take two years for their development may well result, in certain districts, in the absence of imagines in certain years.

There is, however, much to suggest that the flying season in West Greenland, at least in 1954, fell earlier, presumably in the last part of June and the beginning of July. I was told at Arferusâq on the south-facing inner part of Pisigsarfik in Godthåbsfjord, that there the species may occur as early as the end of May; and a male collected on Ella Ø (73° N, 25° W; Ø = island) 19–31/V 1932 by Dr. G. THORSON supports this. Seasonal records of occurrence available from the literature begin about the middle of June (cf. chapter 7).

It is well known that this species may occur in great numbers. FABRICIUS (1780, p. 200 f.) found it common in summer. And J.C. Ross (see CURTIS, 1835) reported that it appeared in as great numbers as the mosquitoes and at about the same time, and that its larvae served as an essential part of the food of certain birds. On the 1st Thule expedition, KNUD RASMUSSEN (1931, p. 136) on 28–29/VI 1912, saw huge numbers of crane-flies in a gulley (ca. 81°50′ N, 35° W) which was therefore named "Stankelbenenes Kløft" (= the gulley of the crane-flies).

5. Zootopography.

The filled circles in the map in fig. 1 represent all the localities in which imagines have been caught, according to the sources mentioned above.

Verbal or *in litt.* records not based on collected specimens have not been included. For, though most such records are likely to be concerned with this species, there are authentic records (collected specimens) of a few other crane-fly species from Greenland, with which confusion in the field is not entirely out of the question. Thus *Tipula* (*Arctotipula*) *besselsi* Osten Sacken has been recorded from Polaris Bugt (82°30′ N), though apparently only once, 7/VII 1872 (OSTEN SACKEN, 1876, p. 42), and also one *Prionocera* species (*P. parrii* Kirb.) and two *Pales* (= *Nephrotoma*) species (*P. lineata* Scop. and *P. lundbecki* Nielsen) have been collected in Greenland, again rather rarely. There are in Greenland some few species of *Limoniinae* and *Trichocera*, but they are too small for any confusion to be feared.

Observations not based on collected specimens and therefore not included in fig. 1, but presumably concerned with this species, include records at "Stankelbenenes Kløft" ("the gulley of the crane-flies"; ca. 81°50′ N, 35° W) on 28–29/VI 1912 (huge numbers: KNUD RASMUSSEN, 1931, p. 136); at the edge of a river bed, east of the narrowing of Olriks Fjord (ca. 77°15′ N,

68° W) 24–30/VII 1950 (some: Shipmaster CHR. PEDERSEN, *in litt.*); at Qugssuk in Godthåbsfjord one year in August, and at Itivnera in Godthåbsfjord in first half of July 1954 (a few: Mr. JENS ROSING, verbally); at Itivnera 14/VII 1954 (1 ♂: A.M.H.); at the northwestern end of the Nûgssuaq (71° N) peninsula July 1954 (many: Professor A. ROSENKRANTZ, *in litt.*); at Mesters Vig (ca. 72° N, 24° W) on 21/VII 1954 (copulating pairs on 21/VII and abundant till at least about mid August: Mr. CHR. VIBE, M.Sc., verbally); Godthåb 31/VIII 1954 (1 in house: Shipmaster MORTENSEN, verbally).

In the previously mentioned collections, there are some larvae and pupae of tipulids. Some of these correspond rather closely with the descriptions and pictures given by J. C. NIELSEN (1910, pp. 57—59, pl. VII, figs. 1—7) from northeast Greenland, or ALEXANDER (1919, pp. 18c—19c; plate IV, fig. 45; plate V, figs. 50—53 and 56—57) from northwestern Canada, although a good deal of variation is evident, especially among the larvae. ALEXANDER states, however, (1919, p. 19c) that "as there are some discrepancies between the descriptions and the figures of the material from northeastern Greenland and that from the Canadian Northwest, it is possible that more than one species is involved under the name of *T. arctica*." Furthermore, as stated by HENNIG (1950, p. 407), it is rather annoying that no criteria are known by which the larvae of the genus *Tipula* can be distinguished from those of *Pales*, a genus which, as mentioned, also occurs in Greenland. Fortunately, with very few exceptions the larvae and pupae appearing to be of *T. arctica* are from localities where imagines of the species have also been collected, so we have decided to base the present zootopographical survey on imagines only.

Among the imagines under study there is also some variation. For instance, in some there are no hairs on the mesepisternite, although in the material studied by MANNHEIMS (1953, p. 118) there were such hairs. Females from some localities (e. g. Grønnedal) have a more or less uniformly coloured, bluish praescutum, whereas most of the flies have the normal stripes. Some other differences will be discussed in chapter 8. Some of the flies have a blackish praescutum, but this no doubt must be because they have been kept for more than 3—4 hours in air saturated with moisture for softening before mounting.

A detailed critical analysis by a trained taxonomist or geneticist may lead to the establishment of differences of taxonomic rank within populations at present grouped under the name *T. arctica*, as already suggested in the above quotation of ALEXANDER. In the collections under study, we have satisfied ourselves that apart from the exceptions mentioned all the flies possess between the praescutal stripes the brown dots with yellowish hairs characteristic of the species; the females, the shovel-shaped ovipositor characteristic of the subgenus *Vestiplex*; and

the male, the specific hypopygial characters, especially the saucer-shaped 9th tergite. The specific identification of the specimens collected by A.M.H. at Grønnedal (ca. 61° N) and of 2 ♀♀ and 6 ♂♂ collected by PALLE JOHNSEN in Peary Land (ca. 82° N) has been confirmed by Dr. B. MANNHEIMS, Museum Koenig, Bonn.

The map shows that no records have been found of occurrences between 60° N and about 69° N in East Greenland. Whether this is due to absence of the species on account of the particularly inhospitable, moist climate of this region—poor in animal life in general—or to scarcity of explorations, cannot be definitely decided at present. The Scoresby Sound Committee's 2nd East Greenland Expedition 1932, covering 68°—69°30′ N, and the 6th—7th Thule Expedition 1932—1933, covering 60°—68° N, brought back no records from this region, though especially the latter of these expeditions involved intense insect collecting, viz. by R. BØGVAD (acc. to HENRIKSEN, 1939). It is evident, however, from the above recorded experience of A.M.H. on the west coast in 1954 that the absence in a certain part of its flying period in one year is no proof of absence from the region in other years. However, if the species occurred in the region, one would expect that it would be known to the native Greenlanders at Angmagssalik (65°36′40″ N, 37°33′26″ W). But according to Professor A. ROSENKRANTZ (*in litt.*) the old founder and former head of the colony, Mr. JOHAN PETERSEN, whom he has interviewed (Oct. 1956) in response to our inquiry, does not remember to have seen crane-flies at the colony, though he has lived there for many years; and as far as he knows, the Greenlanders there have no name for these flies. According to Professor ROSENKRANTZ the Greenlanders at Scoresby Sund, who came from Angmagssalik, Disko Bugt and Umanak Fjord, call the species, which is common there, by its West-Greenlandic name, tugtûssaq. As far as this goes, *T. arctica* appears actually not to occur in the region of Angmagssalik.

ALWIN PETERSEN (*in litt.*) states that in the places where he wintered from Scoresby Sund north to Dove Bugt he found the species nowhere so common as at Scoresby Sund.

The species is circumpolar, but no attempt has been made to include possible localities in the Canadian part of the map in fig. 1. The species is not known from Iceland. In Greenland it occurs not only in the high arctic but also in the low arctic and subarctic regions.

For some time, the northernmost world record of a tipulid has been that of *Tipula besselsi* Osten Sacken, 1876, from Polaris Bugt (82°30′ N) in Greenland (ALEXANDER, 1922, p. 14; TJEDER, 1949, p. 517). It will be seen from the map that there are still more northern records of *T. arctica* (specimens collected by PETER FREUCHEN and PALLE JOHNSEN in Wulff Land and Peary Land).

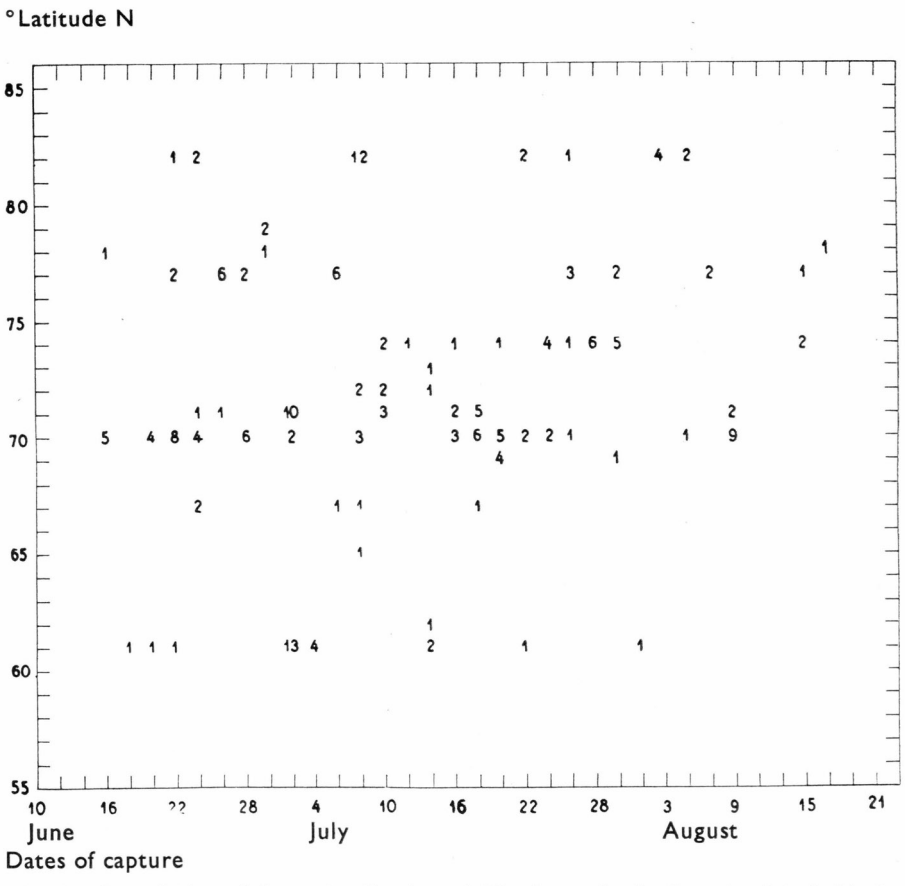

Fig. 2. The relation of date of collection of *Tipula arctica* in Greenland to latitude. Each figure shows the number of flies, regardless of sex, collected at the respective date and latitude. They are plotted to the nearest whole degree of latitude, but only to every second date, so that, for instance, flies from 21 & 22/VI are plotted against 22/VI; flies from 8 & 9/VIII, against 9/VIII, etc. Exact dates were not specified for 1 ♂ 19—31/V, 1 ♂ in June, 4 ♂♂ 19/VI—12/VII, 9 ♀♀ 20/VI—19/VII, 13 ♂♂ + 10 ♀♀ in July and 1 ♂ in August. These are not incorporated in the figure.

It strikes even the casual observer that some plants (e. g. *Cassiope tetragona* (L.) Don.) are found in South Greenland only at rather high altitudes, whereas in North Greenland they occur in the valleys. A similar distribution might be expected *a priori* for some insects such as *T. arctica*. But a treatment undertaken of the material at hand affords no evidence of this: Both in the south (at 61° N and 65° N) and in the north (at 82° N) there are records at rather high altitudes (up to about 6—700 m); and in several localities between 61° N and 79° N, also in the valleys and near the coast below, say, about 50 m or lower.

ALWIN PETERSEN (*in litt.*) noted as his general impression from Liverpool Land and Jameson Land 16/VII 1928, that the species was most numerous in marshy places at low levels and rare on elevated, dry slopes, rocks, and similar localities generally exposed to winds. At Grønnedal, 2/VII 1954, no flies of the species were seen by A.M.H. near the military settlement, which is on the shore of the fjord, but not very far from it, in the valley, the first were seen; and they were common up to at least about 5—600 m.

6. Seasonal occurrence relative to latitude.

Fig. 2 indicates no earlier appearance of the species in the south than in the north. It must be suspected, however, that expeditions prior to mid June have been too rare for a reliable picture of possible earlier occurrences in the south to have been obtained.

7. Occurrence relative to season.

Fig. 3 shows that pooling of the observations from all of Greenland suggests an early as well as a total numerical excess of males over females; and for both sexes, a rise in numbers from mid-June to about the beginning of July, followed by a gradual fall until the beginning of August. This is clearly reflected by undated specimens from June, July and August (see legend of fig. 3). To what extent this may on the whole reflect the activity of entomologists rather than that of the crane-fly species is rather difficult to decide.

As already mentioned, a single record of a male from Ella Ø (73° N, 25° W) confirms the assertion by a native Greenlander that flies may appear as early as in May.

According to VANHÖFFEN (1897, p. 147) speaking of *T. arctica*: "Nicht selten zeigte sich diese schon am 25. Juni bei unserem Abstieg vom Inlandseise . . ."; that is: "Not rarely *T. arctica* appeared already on 25/VI when we descended from the inland ice".

At "Danmarks Havn" (76°46′ N, 18°14′ W), where investigations on the insect life undertaken by JOHANSEN (1910, p. 35) extended over the latter half of August (from 17th) 1906, the summer of 1907 and the early summer of 1908 (till July 21st), the pupae of *T. arctica* were found at the end of June; and empty pupa cases, on the 25th of the same month, and the period of flight lasted till the beginning of August (NIELSEN, 1910, p. 57).

Also, ALWIN PETERSEN (*in litt.*) had the opportunity of ascertaining some first appearances of *T. arctica*: 25/VI 1925 (Hurry Inlet); 23/VI

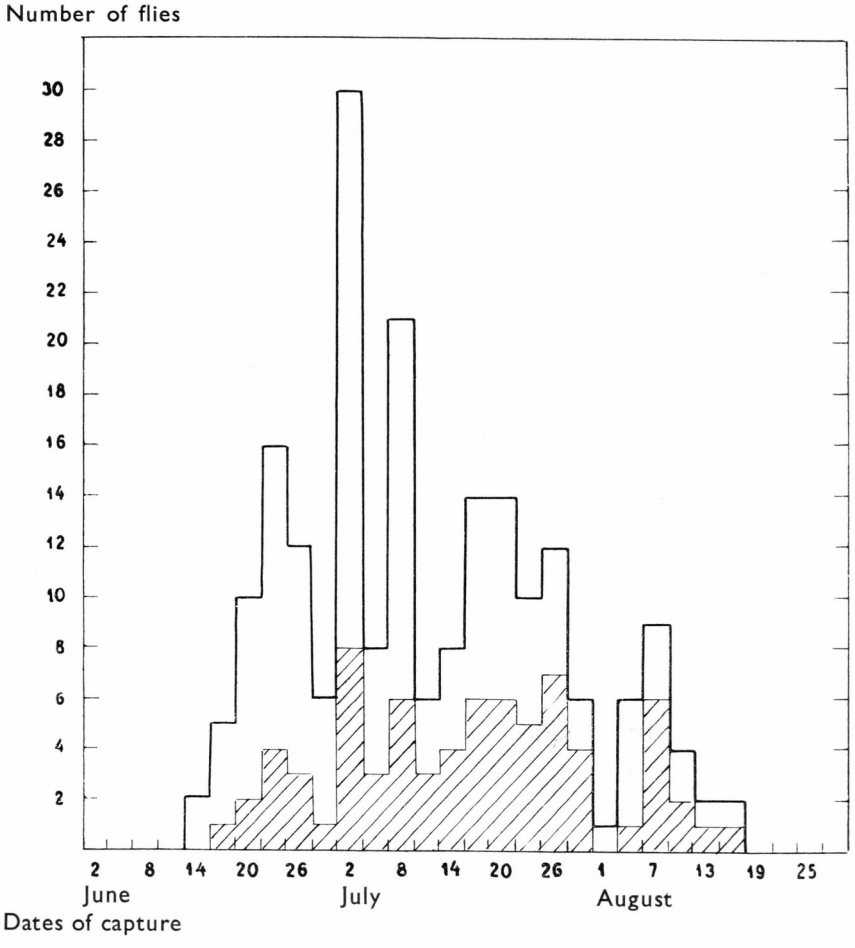

Fig. 3. Specimens of *Tipula arctica* collected in Greenland, arranged according to dates of collection. Each abscissa interval represents three days. Shaded areas represent females; unshaded, males. Exact dates were not specified for 1 ♂ 19–31/V, 1 ♂ in June, 4 ♂♂ 19/VI–12/VII, 9 ♀♀ 20/VI–19/VII, 13 ♂♂ + 10 ♀♀ in July and 1 ♂ in August. These are not incorporated in the diagram.

1928 and 24/VI 1929 (south coast of Liverpool Land). He found many on the fjord ice off the south coast of Liverpool Land, 30/VI 1928, sitting on the ice or having fallen into melted water on the ice.

Thus, most records agree with fig. 3 that *T. arctica* does not appear until the latter half of June. Year-to-year variations in the dates of first appearance are presumably due to differences in the onset of spring.

The maximum abundance of adults about the beginning of July in fig. 3 agrees with the experience of A.M.H. in West Greenland in 1954 (excluding, of course, from fig. 3 the collections of A.M.H.) and with

the above-mentioned observation of great numbers in "Stankelbenenes Kløft" ("the gulley of the crane-flies") at about 81°50′ N, 35° W on 28–29/VI 1912 by KNUD RASMUSSEN (1931, p. 136).

8. Body length relative to latitude.

In fig. 4 the body lengths have been plotted against latitude. For the sake of homogeneity only dried, pinned flies were included. Logarithmic ordinates have been chosen not only because fundamentally the logarithms and not the actual body sizes tend to be normally distributed in frequency curves (HEMMINGSEN, 1934), but here mainly in order to make the percentage decrease in body length with increasing latitude graphically comparable for both sexes. If logarithms are not used, a greater decrease in the females than in males will be indicated graphically because the absolute decrease *is* greater in females.

Assuming the relation between body length and latitude to be at least roughly linear, the constants of the corresponding straight lines were calculated by the method of the least sum of squares for females and males separately. The lines are drawn in fig. 4. As will be seen they are at least very nearly parallel. They correspond to a decrease in body length of about 4.5 per cent per 10 degrees increase in latitude, or practically 10 per cent for the whole range of latitudes covered (61° N—82° N). The inclination angles are in both cases significantly different from zero. The statistical significance corresponds for the males to a probability greater than 99.95 per cent and for the females between 97.5 and 99 per cent that the observed decrease in body length with rising latitude is not due to chance. Actually the statistical significance is still greater as the data from females and males support one another. But the significantly different variances for the two sexes prevent calculation of the exact value of this greater statistical significance.

The linear equations calculated are for females: log. body length in mm =

$$1.3331 - 0.001921\ (\pm\ 0.00038) \times \text{latitude}$$

for males: log. body length in mm =

$$1.4953 - 0.001807\ (\pm\ 0.00079) \times \text{latitude}$$

Assuming the two lines to be parallel, their common regression coefficient (= change in log. body length per degree of latitude) is found to be:

$$0.00188 \pm 0.00054.$$

Now, theoretically, a variation in body length need not necessarily mean a variation in body weight or volume going in the same direction. With a decrease in body length, body thickness might increase and partially or wholly compensate for the decrease in length.

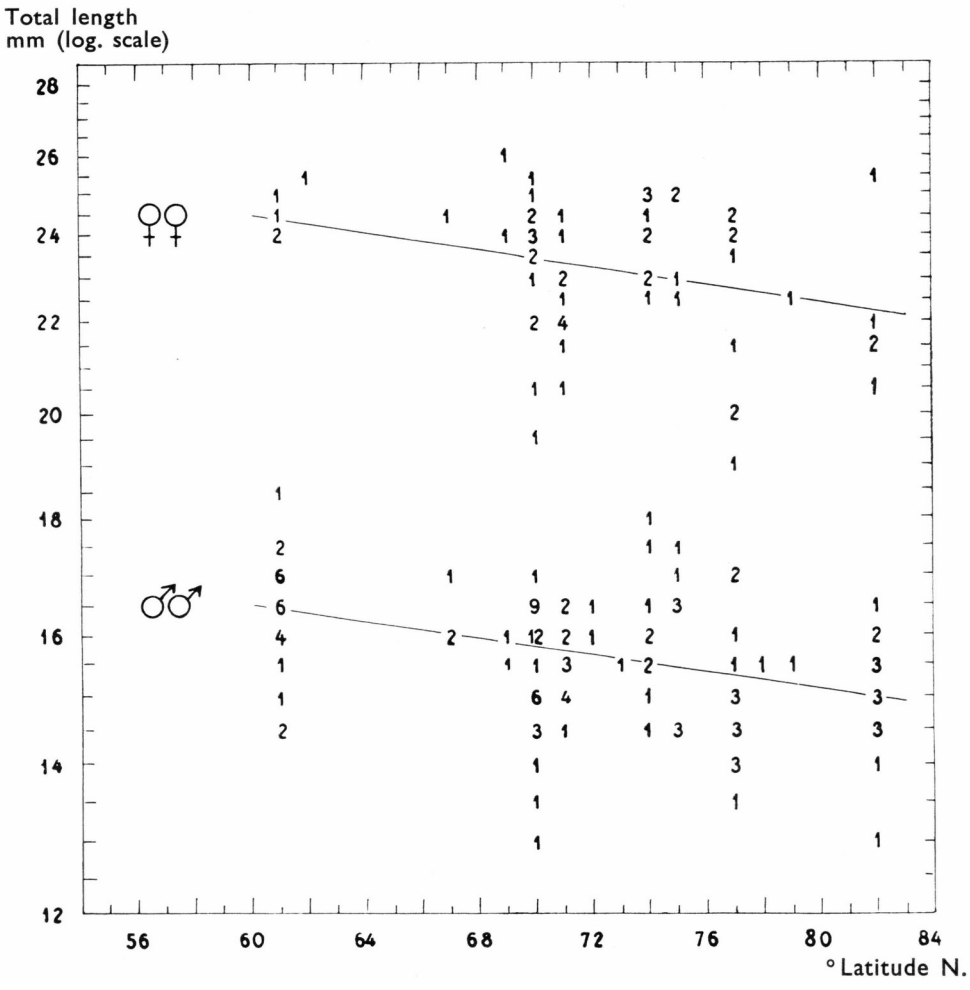

Fig. 4. The relation between total length of body in *Tipula arctica* and latitude. The ordinate scale is logarithmic. The figures represent numbers of flies collected of the respective length at the respective latitude. They are plotted to the nearest whole degree of latitude.

Weighing of dried flies was out of the question, for they had to be left on the pins, and these varied irregularly in size. However, a glance at the photographs shown in plates I and II of the flies from 61°—62° N and 82° N leaves no doubt that there is no inverse correlation of body thickness with body length, so that not only the body length but also the body bulk is smaller in the northern flies than in the southern ones. In this comparison the flies pinned from the side should perhaps be disregarded, as it is difficult to compare them directly with the others.

Not only are the flies from 61°—62° N larger in bulk, but the abdomen of the males are also more brownish and the wings more distinctly marmorate than in the smaller flies from 82° N. Still, no doubt they belong to the same species, for the male hypopygia show no appreciable differences. As mentioned above specimens of both groups were sent to Dr. B. MANNHEIMS, Museum Koenig, Bonn, Germany. He declared (*in litt.*) that they were all *Tipula* (*Vestiplex*) *arctica* Curtis in spite of the size and colour differences. He finds that *T. arctica* appears to be as variable as the closely related boreo-alpine (*Tipula* (*Vestiplex*) *excisa* Schummel of which, for instance, the alpine *Tipula cinerea* Strobl is merely a colour variant (MANNHEIMS, 1951—1953).

Only from 69°—72° N (cf. fig. 1) were flies available both from West Greenland (11 ♀♀ and 28 ♂♂) and from East Greenland (16 ♀♀ and 28 ♂♂; further 8 ♀♀ and 8 ♂♂ collected at Scoresby Sund in 1956 by CHR. VIBE have later become available). Within this range of latitudes the western flies were on the average slightly larger than the eastern though the difference was not statistically significant; and the male abdominal colour was browner in West Greenland individuals; but distinctly marmorate wings occur in both groups. A comparison of figs. 1 and 4 will show that the size differences cannot be a question of an east—west difference, but are decidedly a question of a north and south cline. But the abdominal colour differences might perhaps be east—west geographical differences. It is of course impossible at present to decide to what extent any of the differences in question are truly racial, hereditary differences or merely modifications due to environmental factors.

According to ALLEE, EMERSON, *et al.* (1949, p. 120) terrestrial poikilothermal animals such as lizards, snakes and many insects tend to have their larger species, or individuals within a species, in the warmer part of their range. Evidence of this trend in insects has been adduced by STANDFUSS (1896, pp. 152—153 and 216) for some palaearctic *Lepidoptera*, by HANDLIRSCH (1910) for insects in general, recent and extinct (cf. HEMMINGSEN, 1934, p. 155), by ALPATOV (1925, 1929) for the honeybee, by HEMMINGSEN (1934, p. 155) for Danish and French *Sphecidae*, by BJÖRN PETERSEN for some fenno-scandian (1947) and some European (1949) *Lepidoptera*, and by PARK (1949) for the carabid beetle *Dicaelus purpuratus*.

The opposite trend, that is, an increase in body size towards the north, as postulated for homoiothermal animals by BERGMANN's law was stated by BACHMETJEV (1909) and TITSCHAK (1925) for butterflies, and as quoted by ALLEE, EMERSON, *et al.* (1949, p. 120) for bumblebees, which become fuzzier and larger in the northern part of their range, adjustments that conserve the body heat generated by the action of large wing muscles.

RENSCH (1943, p. 155) states that by far the majority of "*Rassenkreise*" of poikilothermal animals have larger forms in warmer than in colder countries, but that in a number of "*Rassenkreise*" the trend is the opposite. From his own experience with European terrestrial snakes and his own and S. GISLE LARSSON's studies (1939) on carabid beetles, RENSCH concludes that thermophobous, humidophilous forms (carabids hibernating as larvae) decrease in size towards the south; whereas thermophilous, humidophobous forms (carabids hibernating as imagines) increase in size. The body size attained in the carabids is thought to vary directly with the length of the larval period. According to NIELSEN (1910), the larval period of *T. arctica* is two years. Inasmuch as the summer is shorter in the north than in the south this may, then, perhaps explain the relation found between body length and latitude in Greenland.

Investigations by DEGERBØL and KROG (1951, pp. 103—104) of sub-fossil Danish pond tortoises (*Emys orbicularis* L.) testify to a decrease in size with a rise in temperature. This is a thermophilous, poikilothermal animal so the above-mentioned explanation by RENSCH seems not to apply in this case.

According to MANNHEIMS (1953, p. 134) Greenlandic specimens of *T. arctica* are larger than some from Polar Ural and Novaja Zemlya. Only comparisons of clines like that described in the present paper could show whether such a difference is of a consistent nature.

From the relation found between body length and latitude in *T. arctica* it might be suspected that a similar relation would exist between body length and altitude. And if so, the slopes of the lines in fig. 4 might be misleading in case measurements were not obtained from flies from both low and high altitudes, equally distributed over the latitudes. As already stated, the flies under consideration were collected at low and high altitudes, at both the northern and more southern latitudes. And a check diagram, in which the altitudes were plotted against the deviations of the corresponding ordinates in fig. 4 from the respective two straight lines, showed an equal distribution of positive and negative deviations from low altitudes (below 100 m). A slight tendency for flies of both sexes from higher altitudes (200—600 m) to be represented by negative deviations was far from convincing.

We have been kindly informed by Dr. F. SØGAARD-ANDERSEN that near the outer coast of East Greenland, notably in years with little ice, the onset of spring occurs earlier at 200—500 m altitude than at sea level, because the fog excludes the sun. In years with much ice extending far from the coast, the fog has little influence, and spring arrives first at sea level. The same applies to the head of the fjords to which the fog hardly ever penetrates. Such conditions may of course tend to obscure the influences of altitude on biological phenomena.

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10. Summary.

The localities in Greenland from which imagines of *Tipula* (*Vestiplex*) *arctica* Curtis have been recorded, are shown in a map.

No records have been found from East Greenland between 60° and 69° N.

The species may be on the wing in May, but mostly not until the latter half of June, including northern localities. The flight period continues until August, with a maximum of abundance of individuals apparently about the beginning of July. As with most other tipulids, there is a preponderance of males in the collections, especially among specimens taken early in the season.

The body length of the species in Greenland decreases towards the north in both sexes.

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Plate I.

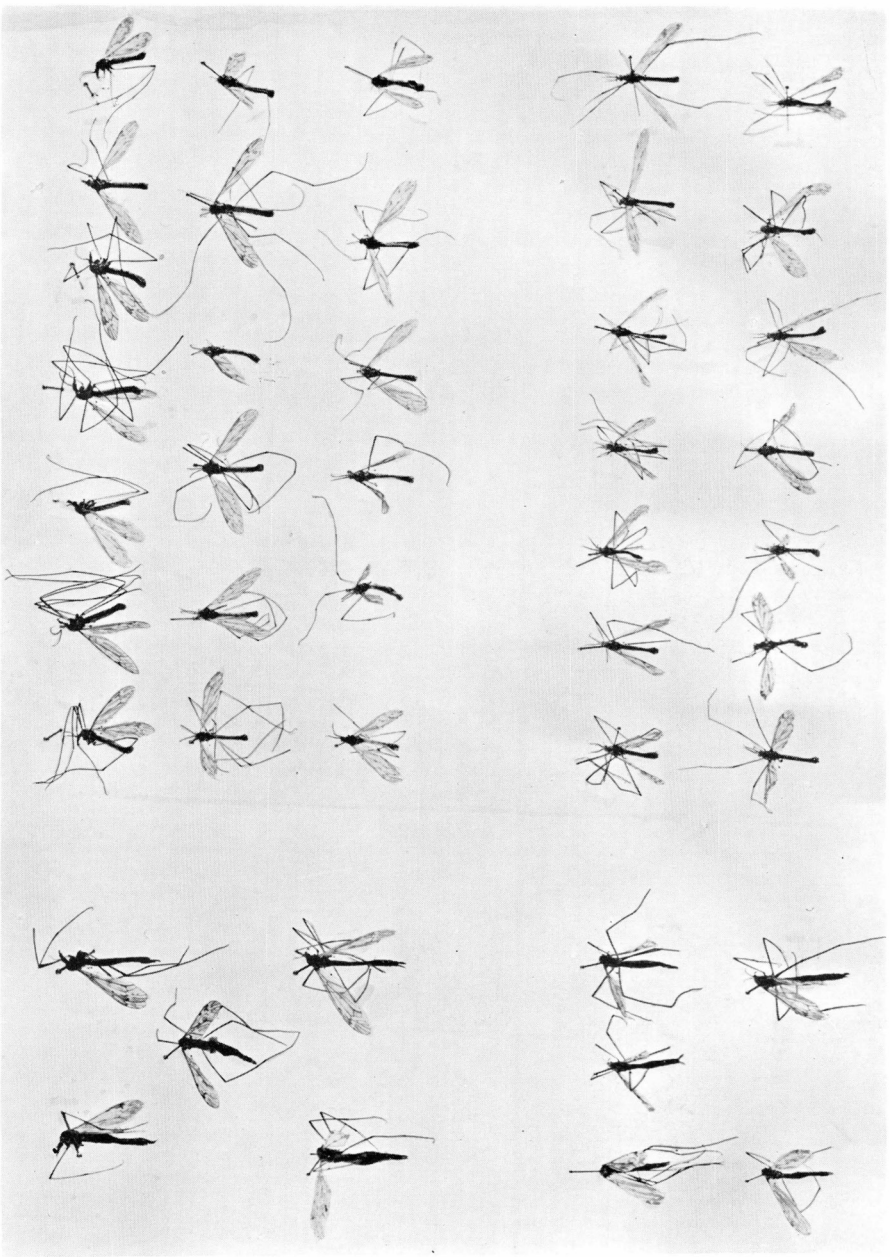
The specimens of *Tipula arctica* represented in fig. 4 from 61°—62° N (5 females to the left and 19 males to the right in the three upper horizontal rows) and from 82° N (5 females to the left and 14 males to the right in the two lower horizontal rows).

Some of the specimens from 61°—62° N derive from the Greenland Zootopographic Department (CHR. VIBE); all the specimens from 82° N from the Danish Peary Land Expedition (PALLE JOHNSEN). All the flies in the first row (pinned from the side, except one) were collected by the senior author (A. M. H.) at Grønnedal. 4 males represented in fig. 4 at 61° N were given away and are therefore missing here.

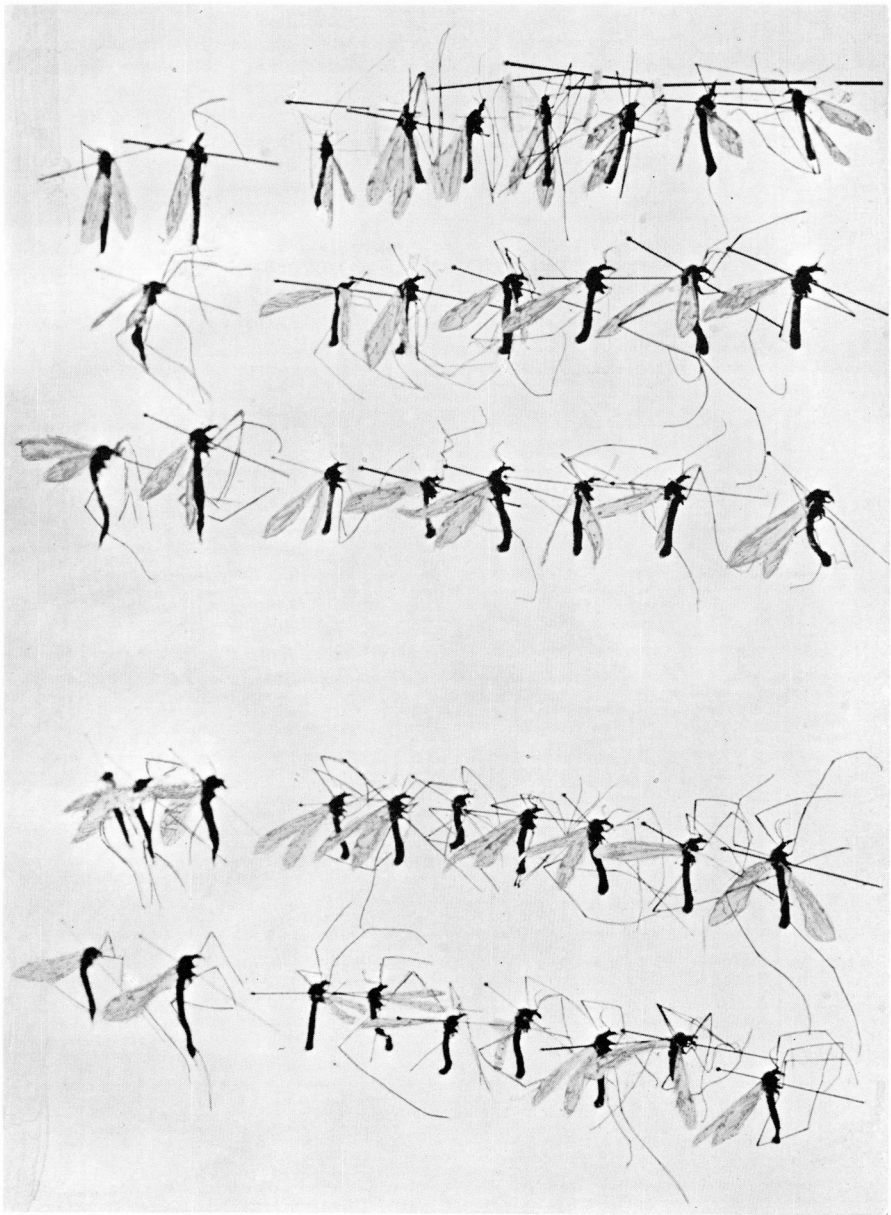
Plate II.

Same arrangement as in pl. I but seen from the right side.

(Plates overleaf).



H. V. CHRISTENSEN



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