La Causa y el Significado del Macropterismo y Braquipterismo en Ciertos Tisanópteros, y Descripción de una Nueva Especie Mexicana

The Cause and Significance of Macropterism and Brachypterism in Certain Thysanoptera, with Description of a New Mexican Species

Por el Dr. *J. Douglas Hood,* Profesor de Biología (Assistant Professor of Biology), Cornell University, Ithaca, New York.

(With two figures)

A study of the following description, or even a brief glance at the table of measurements, supported by similar evidence on other species, discloses the fact that brachypterous (or short-winged) individuals are usually, if not invariably, somewhat larger than macropterous (or long-winged) ones of the same kind. As a mere isolated fact this is of some interest; but a larger biological importance appears when we compare the significance, in the Thysanoptera, of brachypterism and macropterism. Aside from the mere absence or presence of wings, which limits one group to the parental home and endows the other with the means for escape and colonization, such forms often exhibit a marked disparity in color as well as in size, in the presence or absence of ocelli, in the relative size of the eyes, legs, thoracic and antennal segments, and in the size, form, and disposition of the setae. These differences produce a total result which is often very striking, and make the preparation of synoptic tables and descriptions an arduous undertaking in certain genera. Often, too, there may be noted equally striking examples of heterogony: progressive, continous differences discernible in almost any long

series of certain species, usually, though not necessarily, within the same form of the sex, which are translatable into definite mathematical formulae and graphs. (1)

There is no published information on the factors which produce such profound structural differences in the Thysanoptera. My own limited work on the subject may permit a few generalizations. It shows clearly that in the one species studied (*Hoplothrips flavipes* Bagnall) the type of structure to be manifested later by the adult is not genetically determined, for the progeny of one female will under varying conditions mature into individuals which differ in wing-development, with all of the peculiar associated structural and colorational qualities of the particular form, and which, at the same time, may exhibit heterogony in one more of the forms. In fact, within the investigator's experimental capacity – according to his skill in duplicating within the laboratory the slight variations in the natural environment of the species—, the several body-types of the organism can be produced almost at will, much as a cabinet-maker might choose to construct different articles of furniture from the same lot of wood. Clearly, *the development of the individual in any given direction is not predetermined genetically according to the chromosome content of the sperm and egg, but is initiated by some environmental factor, or factors.* (2)

Under unfavorable environmental conditions (which are secured altogether too readily by even the most expert insectary worker who attempts to rear thrips that feed upon fungi or their products), most of the individuals are smaller than normal and long-winged. Even in the natural habitat of the species, when the inevitable progressive changes that take place make it increasingly less suited as a dwelling place, successively larger proportions of the individuals will be macropterous when they reach maturity. *A colony, then, in which nearly every individual is brachypterous is one living under optimum conditions.*

These facts may often be noted in the field. Recently the writer found the rare *Hoplothrips flumenellus* (Hood) in abundance on two young hemlock trees that had been damaged by ice and boring insects, and whose tops had been broken off by wind. This thrips, like others of its genus, is usually (perhaps always) found in association with a particular fungus, and probably feeds upon the extra-cellular products of the digestive activity of the fungus, or upon similar products of bacterial action, rather than upon the sap or tissue of the tree itself. (3) In this case the fungus had apparently infected the tall stumps at the top, and had progressed downward to the roots. Among the older growths of fungi, evidence in the form of

(1) See Hood, Stylops, 4 (9): 193-197, Figs. 1 and 2, 1935; Rev. d. Ent., 5 (2): 185-187, Figs. 5 and 6, 1935; and idem., 7 (4): 498-506, Figs. 3 and 4, 1937.

(2) Precisely how such modifications in structure are brought about is not known. By analogy with other better understood organisms, the natural inference is that it is the result of hormone action. Wigglesworth, for example, has demonstrated that the *corpora allata* function as endocrine glands in the hemipteran *Rhodnius*, and are the source of hormones which control moulting. (See Nature, 133: 725-726, and Quart. Journ. Micr. Sci., 77: 191-221, both published in 1934.)

(3) While it is conceivably possible that the insects themselves may produce a digestive enzyme capable of breaking down cellulose and lignin, and may force this out through their mouth-parts, to be sucked up again later with the products of digestion, this appears unlikely, if for no other reason than that the species is invariably associated with agents of wood decomposition. There is some doubt, too, that insects produce enzymes of the sort, our "wood-feeding" species being apparently dependent upon symbiotic micro-organisms for this task.

egg shells and larval exuviae attested the development at these points of large numbers of the thrips; yet only a few individuals, all adults or pupae and all macropterous, inhabited the once populous galleries. Further down the stumps the environment was clearly more suitable, and the colonies of thrips larger and more frequent; but still all adults were macropterous. Only at the more recently infested roots, moist and supporting a healthy growth of fungi, and probably capable of producing an additional generation or two of thrips, were brachypterous individuals to be found. Here they were abundant, with only an occasional long-winged female— probably a stray, which had flown there for oviposition or, perhaps, had migrated from the upper portion of the stumps.

Though such experiences and observations often enable the collector to secure a full complement of the various forms of a species, the principal thought which occurs to the naturalist from such an observation is, perhaps, that *ecological succession may occur within a species*, the long-winged form succeeding the short-winged one; or he may see the broader vista —that *the inmature organism carries within itself an environmentally-actuated mechanism which assures a means of escape from the parental home should inevitable changes make it no longer suitable to the life of the organism itself or that of its race.*

The Genotype of *Elaphrothrips*

The genus *Elaphrothrips* was erected by Dr. Pietro Buffa, in 1909, (4) to receive the new species *uniformis* and five other large tubuliferous Thysanoptera which had previously been described in *Idolothrips* Haliday. The type of this new genus was not designated by Buffa or, to the best of my knowledge, has it been fixed by any subsequent writer. (5) Of the six originally included species (from which, of course, any selection of genotype must be made), one, *Idolothrips quadrituberculatus* Bagnall, a very discordant element, should no longer be considered eligible because of its transfer in 1916 (6) to the genus *Megathrips* Targioni-Tozzetti; while four, *I. coniferarum* Pergande, *I. assimilis* Bagnall, *I. longiceps* Bagnall, and *I. uniformis* Buffa, are not only rare in collections but are also inadequately described and figured. The one remaining species. *I. flavipes* Hood (7), while not described in the best modern manner, is nevertheless illustrated by a tolerably accurate camera-lucida drawing and has been distributed to most of the principal collections of Thysanoptera. It seems best, then, to make the following designation of type:

Genotype: *Idolothripes flavipes* Hood.

---

(4) Redia, 5: 162.

(5) Moulton, in Rev. d. Ent., 3 (4): 409, 1933, gives "*Thrips schotti* Heeger" as the genotype; but this designation is untenable, for *schotti* was not one of the species included in the genus by Buffa, but was, in fact, specifically assigned by him to a second new genus, *Dicaiothrips*, described on page 169 of the same paper. The fact that *Dicaiothrips* is a synonym of *Elaphrothrips* does not effect the designation of a genotype for the latter.

(6) Bagnall, Ann. & Mag. Nat. Hist., (8) 17: 406, May 1916.

(7) Bul. Illinois State Lab. Nat. Hist., 8 (2): 377, Aug. 22, 1908. (I have noted an inaccuracy in my original description, namely, the use of "tibiae" intead of "tarsi" in the second line of the description of the male.)

Elaphrothrips dampfi, sp. nov.

(Figs. 1 and 2).

Female, forma macroptera.—Lenght about 3.12 mm. (partially distended, 3.79 mm.). Color opaque black, with all femora concolorous with body, trochanters distinctly yellowish and much paler, all tarsi and the distal two-thirds of fore tibiae, distal half of middle tibiae, and distal third of hind tibiae, bright clear yellow, the proximal ends of the tibiae successively darker; fore wings clear, lightly brownish at base, and with two brown longitudinal vittae, the anterior one paler, indistinct, and extending to the last subbasal seta, the posterior one median, blackish, and disappearing at middle of wing; antennae with segments I and II nearly black, I somewhat paler across base, II distinctly brownish at apex, III bright yellow, darkened with blackish in the region of the apical setae, IV and V yellow in basal three-fifths and one-half, respectively, shading to blackish brown in apical third and two-fifths, respectively, V darker throughout, VI-VIII blackish brown, nearly black, VI paler and brownish in about basal fifth; major setae on head and prothorax dark brown, those on abdominal segments IV-VIII nearly colorless, the basal and apical abdominal segments with the setae brownish at base; internal pigmentation bright red.

Head more than 2.6 times as long as width across eyes, broadest at basal third, narrowed behind eyes and again in front of basal collar; front markedly produced in front of eyes, only 1.6 times as wide as long, its total length about 74 μ, its lateral length about 35 μ, and its greatest width only 119 μ, vertex conically produced, sharply pointed, but with the median ocellus situated posterior to its apex and not all overhanging, not attaining frontal costa, and directed more upward than forward, the frontal costa itself shallowly concave; dorsal and lateral surfaces cross-striate in the usual manner, with a few dark brown setae arising from slight eminences, the largest pair of these minor setae (which is the lateral pair behind eyes) about 18 μ long; postocular setae dull at tip, about 73 μ long and 93 μ apart; interocellars (62 μ)somewhat shorter than postoculars and about 67 μ apart; occipital setae approximately 30 μ long, 67 apart, and 140 from posterior margin of head. *Eyes* about one-fourth the length of head, rounded and protruding, slightly flattened posteriorly, longer and somewhat produced dorsally. *Ocelli* normal. *Antennae* normal; segments III and IV short, 161 and 130 μ long, respectively. *Mouth-cone* short, semicircularly rounded at apex, its extent beyond posterior dorsal margin of head about 151 μ

Prothorax with median line of pronotum about 0.35 that of head and contained in the trans-coxal width about 2.1 times, its dorsal surface lightly sculptured anteriorly and laterally, more strongly along posterior margin; anterior margin heavily thickened throughout and united with the heavy median apodeme which extends posteriorly to the line of the postero-marginal setae; major setae all present, with pale rounded tips, the antero-marginals and antero-angulars

24 μ, midlaterals 51, postero-marginals 77, coxals 38. *Pterothorax* normal; anterior angles of mesothorax not produced or pointed. *Fore* wings 1.08 mm. long and 80 μ broad at middle, with 17 accessory setae, the subbasal setae respectively 45-50, 61-63, and 107-108 μ. *Legs* normal, the fore femora without tubercle at apical third of lower surface, the fore tibiae and tarsi unarmed.

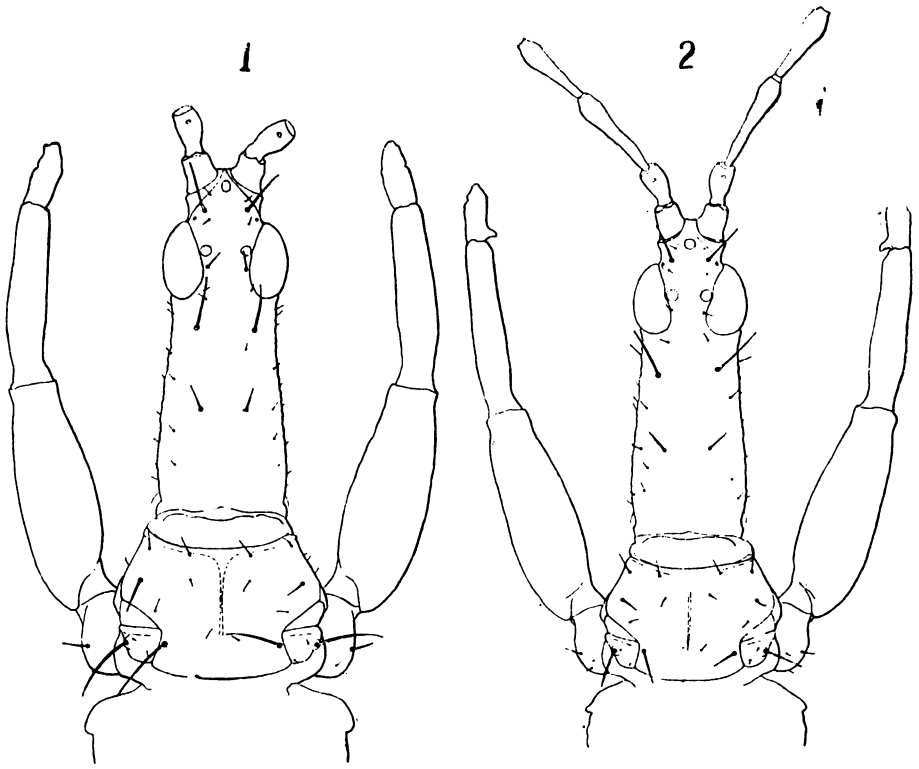

Fig. 1. *Elaphrothrips dampfi, sp. n.*—Cabeza y protórax de una hembra braquiptera (paratipo).
Head and prothorax of brachypterous female (paratype.)

Fig. 2. *Elaphrothrips dampfi sp. n.*—Cabeza y protórax de macho macróptero (paratipo).
Head and prothorax of macropterous male (paratype.)
(Both drawings camera lucida, by the author: all setae omitted from appendages.)

Abdomen about 1.24 times as broad as prothorax across coxae and 1.16 times the width across anterior angles of mesothorax, sculptured as usual in the genus; major setae on segments I-VIII with rounded tips, the others pointed; terminal setae about 256 μ; segment IX with the three major pairs of setae respectively 375, 434, and 266 μ; tube (segment X, only) long and slender, fully 0.91 the length of head, tapering smoothly to near apex and then somewhat more abruptly narrowed, its length about 3.7 times the greatest width near base, this about 2.3 times the apical width.

Female, forma brachyptera.—Size a trifle greater than in the long-winged form, color not different; fore wings about 413 μ long, with a dark vitta on the line of the subbasal setae and a median one extending nearly to tip.

Male, forma macroptera.—Color as in female; structure not markedly different, except in the usual ways; head more slender, nearly or quite 2.8 times as long as width across eyes, the cephalic process 1.56-1.7 times as broad as long; prothorax scarcely enlarged, mesothorax with anterior angles not produced; fore femora only slightly swollen (if at all), without the large, hooked, distal seta found in some species, all setae relatively weak and inconspicuous; fore tibiae unarmed; fore tarsi with a strong tooth near base; fore wings with 18 accessory setae; tube much shorter than in female (as is usual in this genus), the length of segment X alone about 0.7 that of head; setae on abdominal segment IX extending beyond basal two-thirds of tube.

Male, forma brachyptera.—Negligibly different from the macropterous form of this sex, though a trifle larger; fore wings colored as in brachypterous female, their length about 406 μ.

Measurements of *Elaphrothrips dampfi*, sp. nov. (all specimens topotypic).

	♀ macr. (holotype)	♀ brachy.	♀ brachy. (NaOH)	♂ macr. (allotype)	♂ macr. (NaOH)	♂ brachy.
Length, corrected	3.12	3.39	3.84	3.42	3.29	3.39
fully distended		4.09	4.54		3.85	3.96
Head:						
total length	518 μ	543 μ	581 μ	552 μ	536 μ	565 μ
width across eyes	196	200	207	196	193	195
least width behind eyes	168	167	169	158	160	163
greatest width	202	209	217	195	195	199
least width near base	185	193	206	179	178	186
width across basal collar	193	202	220	186	186	196
length of head-process	74	77	85	66	73	77
width of head-process	119	120	127	112	114	118
Eyes:						
dorsal length			127		120	
width			67		67	
interval			73		60	
ventral length			112		104	
width			57		61	
interval			92		72	
Ocelli:						
median, diameter			17		17	
posterior, diameter			17		20	
interval			50		39	
distance from median ocellus			92		73	

	♀ macr. (holotype)	♀ brachy	♀ brachy. (NaOH)	♂ macr. (allotype)	♂ macr. (NaOH)	♂ brachy.
Postocular setae:						
length.	73	93	98		84	89
interval.	93	93	92		96	90
distance from eyes	64		50		69	50
Interocellar setae:						
length. . . .	62		84		71	70
interval.	67		69		58	67
Occipital setae:						
length. . . .	30?		47		47	53
interval.	67		71		73	67
distance from base of head..	140		182		152	165
Mouth-cone:						
length beyond dorsum of head	151		165		118	
Prothorax:						
median length of pronotum..	182	210	217	196	186	213
width, inclusive of coxae....	384	423	...	377	...	417
seatae: antero-marginal.	24	...	34		34	26
antero-angular. . .	24	38	36		45	35
midlateral.	51	63	63		37	47
epimeral.	...	111	119		68	66
postero-marginal.	77	96	122	...	58	62
coxal.	38		52	35	31	38
Mesothorax:						
width across anterior angles.	409	423	452	398	374	378
Metathorax:						
greatest width of posterior part.	409	445		402		382
Fore wings:						
length.	1.08 mm.		413	1.16 mm.	...	406
subbasal setae: I. .	45- 50		63	44	47	47
II.	61- 63		80	56	54	56
III.	107-108		108	100	90	87
Abdomen:						
greatest width.	569	629	...	398	381	403
segment X (tube): length...	475	512	542	...	379	382
greatest subbasal width.	130	127	137	98	98	103
least apical width. .	56	57	58	51	49	49
setae on segment IX: I.....	375	...	420	315	332	322
II.	434	396	448	...	311	339
III. .	266	308	301	259		280
terminal setae. . .	256	259		241		224

	♀ macr. (holotype)	♀ brachy.	♀ brachy. (NaOH)	♂ macr. (allotype)	♂ macr. (NaOH)	♂ brachy.
Antennal segments:						
I, length (width)[8]....	51 (56)	56 (60)		46 (53)	53 (54)	51 (57)
II	80 (42)	82 (43)		76 (40)	70 (39)	78 (40)
III	161 (38)	169 (39)		162 (36)	164 (37)	166 (38)
IV	130 (39)	143 (40)		137 (40)	135 (40)	143 (42)
V	117 (36)	123 (35)		120 (35)	119 (34)	123 (35)
VI	97 (31)	107 (31)		99 (27)	104 (29)	94 (30)
VII	70 (27)	71 (26)		70 (26)	67 (25)	68 (26)
VIII	67 (19)	71 (19)		65 (19)	67 (17)	68 (18)
total length of antenna[9].	0.773 mm.	0.822 mm.		0.775 mm.	0.779 mm.	0.791 mm.

México. Tamazunchale (San Luis Potosí), April 30, 1939, J. D. H., 10 ♀♀ and 3 ♂♂ taken from dead fallen leaves in a forest.

From all the other species of *Elaphrothrips* known from Mexico and the United States, with the possible exception of *longiceps*, this graceful and attractive little species differs in having the tibiae conspicuously bicolored, and the cephalic process quite long and not more than 1.7 times as broad as its length. *E. longiceps* (Bagnall), described from a unique male taken in 1857 and labeled "Orizaba", is a much larger insect, with a total length of 4.75 mm. and a mesothoracic breadth of 0.55 mm., and has, according to Bagnall, the fore tibiae "produced to a spine-set tooth at the apex within" and the setae on the ninth abdominal segment "only reaching to the middle of the tube"

Elaphrothrips dampfi is closely allied to the genotype and occupies a similar habitat, dead leaves on the forest floor. Both species occur in the short-winged and long-winged forms, and both have the three pairs of tibiae largely or wholly yellow. These characters are nearly or quite unique in the genus.

I take especial pleasure in naming this species for Professor Alfonso Dampf, as an expresion of high personal esteem.

RESUMEN

El autor llama la atención a la existencia del bimorfismo de los tisanópteros, íntimamente relacionado con el braquipterismo y macropterismo y analiza la significación biológica de este fenómeno. No existen estudios experimentales sobre los factores que producen la mencionada diferencia, pero los datos disponibles hacen suponer que el macropterismo o braquipterismo no son caracteres genéticamente determinados, sino originados por factores exteriores, en primer lugar por la abundancia o escasez de alimento. Si esto último resulta insuficiente, las larvas de tisanópteros se convierten en formas macrópteras que emprenden el vuelo en

(8) Heavy sclerotization of the head makes impossible accurate measurement of the length of the basal antennal segment, except in caustic-treated specimens. For the sake of uniformity in this group of measurements, the length given in each case is that of the exposed dorsal portion. In the paratype of the macropterous male (column 5), the total length of this segment is 60 μ.

(9) Minus, of course, the length of the hidden portion of segment I, which is in the neighborhood of 7-8 μ.

busca de mejores condiciones de vida. Una colonia de estos insectos, en donde cada individuo es braquíptero, vive bajo condiciones óptimas. Se puede hablar de una sucesión ecológica en la vida de un tisanóptero dimorfo.

A la parte teórica agrega el autor la descripción de una nueva especie del género Elaphrothrips (dampfi), *encontrada en Tamazunchale (San Luis Potosí), entre hojas secas sobre el suelo de un bosque. Como genotipo del género Elaphrothrips queda designada la especie* Idolothrips flavipes *Hood.*

SUMMARY

The well known biological phenomena of brachypterism and macropterism in Thysanoptera have not been experimentally investigated anl the factors which produce such profound structural differences are not known. There is every reason to suppose that the changes are not genetically determined and that the several body types in a species can be produced almost at will by varying the life conditions. Under unfavorable conditions the species becomes smaller and long-winged, under optimal conditions the members of a colony will be short-winged. The conclusion is unavoidable that the immature Thysanopteran carries within itself an environmentally-actuated mechanism which assures a means of escape from the parental home, should inevitable changes make it no longer suitable to the life of the organism itself or that of its race.

The author describes a new species of the genus Elaphrothrips, *from Tamazunchale, State of San Luis Potosí, México, with a pronounced dimorphism and designates as genotype,* Idolothrips flavipes *Hood.*

ZUSAMMENFASSUNG

Die Erscheinung der Kurz-und Langflügeligkeit in Thysanopteren ist bisher noch nicht experimentell untersucht worden. Die vorliegenden Tatsachen lassen darauf schliessen, dass es sich hier nicht um genetisch vorbestimmte Charaktere handelt, sondern um Umweltseinflüsse und dass bei ungünstigen Lebensbedingungen die Art in kleinen und langflügeligen Formen auftritt, während bei optimalen die ganze Kolonie durch kurzflügelige Individuen vertreten ist. Wir müsen annehmen, dass jede Larve mit sich einen Mechanismus führt, der es ihr erlaubt, ihre Geburtsstätte zu verlassen, sollten die äusseren Bedingungen ihr Leben und das ihrer Art ungünstig beeinflussen.

Verfasser beschreibt ausfuehrlich eine neue Art der Gattung Elaphrothrips *aus dem mexikanischen Staate San Luis Potosí und bezeichnet als Genotypus der Gattung die Art* Idolothrips flavipes *Hood.*