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Short Title:

A REVISION OF GRAPHOMYA R.-D. FROM NORTH AMERICA



A Revision of <u>Graphomya</u> Robineau-Desvoidy (Diptera: Muscidae) from North America.

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by

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A thesis submitted to the Faculty of Graduate Studies and Research, McGill University, in partial fulfillment of requirements for the degree of Master of Science.

March 1973

ABSTRACT

A revision is presented of the species of <u>Graphomya</u> Robineau-Desvoidy, found in North America. Nine species are recognized of which two, <u>G. americana</u> R.-D. and <u>G. idessa</u> Walker, are resurrected from synonomy under <u>G. maculata</u> (Scopoli), and the others <u>G. occidentalis</u>, <u>G. columbiana</u>, <u>G. interior</u>, <u>G. minuta</u>, <u>G. ungava</u>, <u>G. alaskensis</u> and <u>G.</u> <u>transitionis</u> are described as new.

A review of the taxonomic position and biology of the genus <u>Graphomya</u> is presented. Keys are provided for both males and females of the species from North America. Each species is described and biology, when known, is presented. Distribution for each species is presented by locality records and a distribution map. A generic diagnosis for <u>Graphomya</u>, from North America, is also given.

RESUME

Une revision des espèces nord américaines du <u>Graphomya</u> R.-D. est présentée. Parmi les neuf espèces reconnues, deux sont détachées de la synonymie <u>G. maculata</u> (Scopoli) et redecriment <u>G. americana</u> et <u>G. idessa</u>; les autres, <u>G. occidentalis</u> <u>G. columbiana, G. interior, G. minuta, G. ungava, G. alaskensis</u> et <u>G. transitionis</u> sont de nouvelles espèces.

Une revue de la taxonomie et de la biologie du genre <u>Graphomya</u> est présentée. Les clefs sont établies pour la classification des mâles et femelles de l'Amérique du Nord. Une description détaillée de chaque espèce est présentée. La distribution de chaque espèce est établie d'après les records locaux et est décrite par une carte de distribution. Une diagnose du genre <u>Graphomya</u> pour l'Amérique du Nord est présentée.

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ACKNOWLEDGEMENTS

I wish to gratefully thank Dr. V. R. Vickery, my advisor, for his help and guidance in completing this study, his critical reading of the manuscript was appreciated too. Thanks go to Dr. J. F. McAlpine, Dr. J. R. Vockeroth and Dr. D. M. Wood for their help, especially at the beginning of the study, and again to Dr. McAlpine for reading the manuscript; many thanks to Mrs. Vickery for her patience and fortitude in typing my thesis; and, finally, a special thanks to friends who have made the rough edges of this graduate student's life a bit smoother.

Acknowledgement is extended to the Canadian taxpayers whose monetary assistance, directed to the National Research Council, made this study possible.

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INTRODUCTION

The genus <u>Graphomya</u> has an almost world wide distribution. The first published record of North American <u>Graphomya</u> was given by Robineau-Desvoidy (1830), when he described <u>G. americana</u>. Walker (1849) subsequently described <u>Graphomya</u> <u>idessa</u> from Ontario. Since then, most authors have placed all North American <u>Graphomya</u> under <u>G. maculata</u> (Scopoli), the common Palearctic species and type species of the genus. However, G. maculata does not occur in North America.

I recognize nine species from North America, including the two previously described species which are resurrected from synonomy. These are <u>G. americana R.-D., G. idessa</u> Walker, and the following new species, described herein: <u>G. minuta, G. occidentalis, G. columbiana, G. interior,</u> <u>G. transitionis, G. alaskensis</u>, and <u>G. ungava</u>.

Members of the genus are very uniform in structure and bristling, especially the females. Until now, identifications have been based on external morphological differences. Since it is necessary to use very few major characters can be recognized, minor characters

Drawings of in most cases to delimit species. A genitalic dissections of both males and females have been included in order to provide as complete identification as possible of

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the species involved. For each, species a holotype is described. For each species, both males and females are described and discussion of specific differences and new biological, where possible, is presented. Paratype localities and distribution maps are provided. Keys to both males and females are given to facilitate identification. No detailed discussion on zoogeography is attempted, but certain specific characters which vary according to latitude and altitude are discussed in a section on diagnostic characters used in determination of the species involved. Finally, a generic is givendiagnosis, based upon North American species.

A review of the literature was undertaken to point out placement of thethe present taxonomic confusion concerning the genus at the subfamily level, and also to bring together previously reported biological information on the genus.

It is hoped this work will clarify the Nearctic species of the genus <u>Graphomya</u>. A revision of the genus on a world basis is now in order.

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MATERIALS AND METHODS

The study was based on approximately 1,100 specimens obtained from the following sources: Dr. R. J. Gagne, United States National Museum, Washington, D.C.; Dr. W. W. Judd, University of Western Ontario, London, Ontario; Dr. J. F. McAlpine, Entomology Research Institute, Central Experimental Farm, Ottawa, Ontario; Dr. D. H. Pengelly, University of Guelph, Guelph, Ontario; Dr. A. G. Robinson, University of Manitoba, Winnipeg, Manitoba; Dr. D. R. Whitehead, University of Alberta, Edmonton, Alberta; Dr. V. R. Vickery, Lyman Entomological Museum and Research Laboratory, Macdonald College, McGill University, Ste. Anne de Bellevue, Quebec.

Locality data, as given on specimen labels, was altered in some cases to make collection data citation consistent. The following abbreviations have been used in the text: Agr. for Agricultural, Bch. for Beach, Biol. for Biological, Co. for County, Col. for Collection, Cor's for Corners, Crk. for Creek, Cy. for City, Dist. for District, Exp. for Expedition, Ft. for Fort, Gt. for Great, Harb. for Harbour, Is. for Island, Ldg. for Landing, Lk. for Lake, Mt. for Mountain, Mts. for Mountains, nr. for near, Pk. for Park, Pkwy. for Parkway, Prov. for Provincial, Pt. for Point, Rd. for Road, Riv. for River, Spgs. for Springs, Sta. for Station, and Twp. for Township.

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List of Collectors

The list of collectors, their names and initials, as used in the text.

Canadian National Collection. Ottawa, Ontario. (C.N.C.)

R.	J.	Acheson	R.J.A.
Ρ.	W.	Arntfield	Ρ.Ψ.Α.
С.	E.	Atwood	C.E.A.
G.	E.	Ball	G.E.B.
J.	I.	Beaulne	J.I.B.
N.	K.	Bigelow	Ν.Κ.Β.
R.	s.	Bigelow	R.S.B.
С.	D.	Bird	C.D.B.
R.	M.	Bohart	R.M.B.
Α.	R.	Brooks	A.R.B.
Α.	and	d J. Brooks	A.andJ.B.
Br	ook	s-Wallis	BW.
W.	J.	Brown	W.J.B.
E.	R.	Buckwell	F.R.B.
F.	E.	Cameron	F.E.C.
E.	F.	Cashman	E.F.C.
J.	G.	Chillcott	J.G.C.
s.	M.	Clark	S.M.C.
R.	Co	yles	R.C.
С.	н.	Curran	C.H.C.
G.	G.	Dilabio	G.G.D.
Μ.	Β.	Dunn	M.B.D.
R.	L.	Fischer	R.L.F.
Н.	s.	Fleming	H.S.F.
Н.	R.	Foxlee	H.R.F.
D.	Fre	eechin	D.F.
Τ.	Ν.	Freeman	T.N.F.
C.	B.	Garrett	C.B.G.
R.	G1 (endenning	R,G,
Η.	R.	Ha11,	H R H
J.	Β.	Hartley	J.B.H.
B.	s.	Heming	B.S.H.
R.	Α.	Hennigar	R.A.H.
s.	D.	Hicks	S.D.H.
G.	Ρ.	Holland	G.P.H.
H.	Hu	cke1	H.H.
R.	Hu	rley	R.H.
F.	Ρ.	Ide	F.P.I.

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J. K. Jacoc..... J.K.J. C. W. Johnston..... C.W.J. E. A. Kurtz.... E.A.K. R. E. Leech.... R.E.L. C. C. Loan..... C.C.L. R. Madge..... R.M. C. H. Mann..... C.H.M. W. R. M. Mason.... W.R.M.M. J. E. H. Martin..... J.E.H.M. J. F. McAlpine..... J.F.McA. J. R. McGillis..... J.R.McG. F. M. McKenzie.... F.M.McK. H. E. Milliron..... H.E.M. W. W. Moss.... W.W.M. 0. Peck..... 0.P. W. W. Perrett.... W.W.P. B. V. Peterson.... B.V.P. R. J. Pilfrey..... R.J.P. B. H. Poole..... B.H.P. W. R. Richards..... W.R.R. G. R. Roberts..... G.R.R. E. W. Rockburn..... E.W.R. K. Sattler.... K.S. J. A. Shemanchuk..... J.A.S. G. E. Shewell..... G.E.S. S. Shinonaga..... S.S. E. E. Sterns..... E.E.S. Swales..... s. Taylor and Wood..... T.andW. H. J. Teskey..... H.J.T. W. R. Thompson.... W.R.T. P. D. Torhill..... P.D.T. J. R. Vockeroth..... J.R.V. G. S. Walley..... G.S.W. J. B. Wallis..... J.B.W. F. V. Waugh..... F.V.W. R. H. Wigmore.... R.H.W. D. M. Wood..... D.M.W. Lyman Entomological Museum and Research Laboratory, Macdonald College. Ste. Anne de Bellevue. Quebec (L.E.M.) United States National Museum. Washington, D.C. (U.S.N.M.)7 34 4

J.	Μ.	Aldrich	1	 	. J.M.A.
Ε.	G.	Anderso	n	 	E.G.A.
N.	Bar	nks		 	N.B.
s.	W.	Bromley	• • • •	 	S.W.B.
Brι	le s		• • • •	 	. В.

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J. S. Buckett.... J.S.B. J. Chamberlain..... J.C. D. H. Clemons..... D.H.C. Cockerell..... С. R. P. Currie..... R.P.C. D. G. Hall.... D.G.H. J. S. Hine..... J.S.H. H. B. Hungerford..... H.B.H. A.J.H. A. J. Hunter.... H. H. Keifer.... H.H.K. T. Kincaid..... Τ.Κ. G. F. Knowlton..... G.F.K. W. L. McAtee..... W.L.McA. A.T.M. A. T. McClay.... A. L. Melander..... A.L.M. S. Miyagawa.... S.M. M. E. Phillips..... M.E.P. C. W. Sabrosky..... C.W.S. R. C. Shannon.... R.C.S. E. B. Southwick.... E.B.S. C. Spannon..... C.S. A. Stone..... A.S. J. B. Tothill..... J.B.T. C. H. T. Townsend..... C.H.T.T. W. R. Walker.... W.R.W. W. I. Wall.... W.I.W. H. V. Weems..... H.V.W. University of Alberta. Edmonton. Alberta. (U. of A.) P. Graham.... P.G. E. H. Strickland..... E.H.S. University of Guelph. Guelph. Ontario. (U. of G.) D. G. Gillespie.... D.G.G. University of Manitoba. Winnipeg. Manitoba. (U. of M.) A. V. Mitchener.... A.V.M. University of Western Ontario. London. Ontario. (U. of W.O.) W. W. Judd..... W.W.J.

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Unpublished notes on <u>Graphomya</u> from the Nearctic region, made by the late Dr. J. G. Chillcott, were loaned to me by Dr. J. F. McAlpine, Entomology Research Institute, Canada Agriculture, Ottawa, Canada. These notes represented the only contemporary literature available on the taxonomy of North American Graphomya.

Specimens were studied and identified by external examination alone. A <u>Wild M5</u> stereo-microscope was used with 10 power oculars and 6, 12, 25, and 50 power objectives with an additional 2 power objective permanently mounted below the main objectives. Light was supplied by a <u>Wild</u> microscope lamp with a 6V, 15 watt bulb and a <u>Hammond Microscope Transformer</u> <u>Model 20-D</u>. In addition, a separate <u>Bausch and Lomb</u> microscope lamp and transformer was used as it was necessary to have an extra source of light for accurate observation.

Measurements were made with a graduated grid (0.1mm. and 0.01mm.). As the grid was too small to fit the <u>Wild</u> eyepiece, it was taped to a cover slip of 25mm. diameter and this was then placed in the eyepiece. Final measurements were determined after calibrating dimensions of the grid with those of a standard slide micrometer.

Those specimens used for genitalic dissection were relaxed for 24 hours. The abdomen of the male was snipped

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off behind the anterior three segments, and that of the female removed wholly, and placed in a small dish containing distilled water and five potassium hydroxide pellets. Genitalia were left one to three hours in this solution. Loose tissue was then teased carefully from the genitalia by using No. 0 insect pins. Cleared genitalia were then dipped in ten per cent acetic acid and placed in microvials, containing glycerine, until needed. It was found that a small amount of cotton batt immersed in glycerine in a deep-well slide made a good base on which to place the genitalia for drawing purposes.

Drawings were done with the aid of a <u>Wild camera lucida</u> attachment to the microscope, on <u>Sheet Cartridge Drawing Paper</u> No. 9512, 9" by 12", using a 4H pencil. Drawings were inked using a <u>Rapidograph</u> 3060 drawing pen with No. 0 and No. 00 nibs.

In the laboratory, photographs were taken using a <u>Wild</u> MK4 automatic camera connected to a <u>Wild</u> M5 microscope by a phototube attached above the main objectives and also connected to a <u>Wild Mel</u> 13 electronic control unit. Light was supplied by two high intensity 6V, 15W. lamps connected to a <u>Wild Mtr</u> 19, 110-250V transformer (C/S 50-60, Va 50, 0-8V, and 6-3 Amax). When the object was too large to view under the microscope, an <u>Asahi Pentax Spotmatic</u> camera, with a Takumar Bellows 11

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and 55mm., f2.5 lens, was used. The camera with bellows attached was mounted vertically on a moveable stand. Light was supplied by two table lamps with 150 watt bulbs. In the field, an <u>Asahi Pentax Spotmatic</u> camera was used with <u>Etco</u>, 64 ASA, 35mm. - 20 exposure daylight colour slide film. Also, colour prints were taken with a <u>Zeiss Ikon Ikonomatic A</u> camera with Kodak daylight colour cartridge film.

During the summers of 1970, 1971, and 1972 trips were made to King Mt., Gatineau Park, Quebec, to collect adults. Adult flies were caught in the field with an insect net of fine nylon mesh, and were killed in potassium cyanide killing tubes. Dead flies were transferred to a small jar containing one or two green leaves to keep them from drying out while in transit. The flies were pinned immediately upon returning to the laboratory and were frozen for two to three weeks.

During mid May, 1971, and late April to mid May, 1972, the Mer Bleue bog east of Ottawa, Ontario, (Figs. 3, 4) was investigated in order to find immature stages of <u>Graphomya</u>. Investigation involved a random search by hand of sphagnum moss above and below the water line in the bog. One pupa was found. During early May, 1972, two trips to the Ste. Scholastique bog, Quebec, (Fig. 5) were made in order to search for immature stages but none were found. The pupa

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collected on May 19, 1971, was returned in moss to the Entomology Research Institute, K. W. Neatby Building, Central Experimental Farm, Ottawa, where it was kept at a constant temperature of 65 degrees F. in a glass tube, partially filled with damp moss and closed by a holed-cork with gauze cover, until adult emergence.

Statistical analysis used in this study was simple as all species were distinguished by morophological characteristics. As most characters available for measurement were a reflection of overall size of the specimens, these were ignored for statistical analysis. The median frontal length from the anterior ocellus to the antennal base (Figs. 1, 2) was found to be of use. In conjunction with this measurement, frontal width, taken at the anterior ocellus (Figs. 1, 2), was an indication of the amount of closing of the front after adult emergence.

It is understood that the names of new species used herein are not to be recognized as valid until published.

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LITERATURE REVIEW AND DISCUSSION

GENUS GRAPHOMYA ROBINEAU-DESVOIDY, 1830

- GraphomyaRobineau-Desvoidy, 1830, Essai Myod.: 403; Walker,
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Graphomia

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The genus was first described by Robineau-Desvoidy (Essai Myod. 1830: 403). He did not designate a type species, but gave descriptions of <u>Graphomya maculata</u>, <u>G. vulpina</u>, <u>G. minor, G. americana</u>, and <u>G. media</u>. Westwood (1840) stated that <u>Musca maculata</u> Fab. was the type species of <u>Graphomya</u> and <u>Curtoneura</u>. Monceaux (1863) credited Linneaus as first describing <u>M. maculata</u> in Syst. Nat. Ed. XII, 2, 900, 70. However, Becker, Bezzi, Kentesz, and Stein (1907), have shown that Scopoli (1763, Ent. Carn. 326: 870) was the author of <u>M. maculata</u>. Therefore the type species of <u>Graphomya</u> is Musca maculata Scopoli.

Agassiz (1848) emended the name <u>Graphomya</u> to <u>Graphomyia</u>. According to the literature, this emendation is unjustified (Stone, <u>et al.</u>, 1965). Many authors, the most recent being Zielke, 1970, have preferred to use <u>Graphomyia</u>. However, the other name has been used with nearly the same frequency with the result that two names representing the same taxon has caused confusion in the literature. Therefore, I recommend that the original spelling of the name be used and that Graphomyia be rejected as an unjustified emendation.

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Taxonomic Position of the Genus Graphomya

Throughout the literature, there has been confusion on the part of various authors as to the taxonomic position of <u>Graphomya</u>.

Karl (1928), Malloch (1934), Huckett (1965), and others have placed it in the subfamily Muscinae on the basis of a large broad lower squama. Eldridge and James (1957) placed it in the subfamily Muscinae because of the truncate squama. bent or upturned medial vein, and a haired hypopleura. They erected the tribe Graphomyini for it on the basis of a haired hypopleura, the egg being of the Phaonia type (see Collin, 1948), and the slits of the posterior spiracular plate of the third stage larva not being strongly sinuate. However, Karl (1928) placed Graphomya in the tribe Muscini. Zimin (1951) placed Graphomya in the tribe Stomoxydini of the subfamily Muscinae and gave it subtribal status as Graphomyina. To place Graphomya in the tribe Stomoxydini seems unreasonable, for Graphomya species have soft probosces not suited for blood-sucking while the species of the other included genera have blood-sucking mouthparts.

According to Collin (1948), <u>Graphomya</u> is an isolated genus with characters showing some affinity with the subfamily

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Phasiinae of the Tachinidae as well as with the Muscidae: he argued that this, coupled with its wide geographical range and semi-aquatic larvae, indicated an ancient genus, and probably represented a distinct subfamily of the Muscidae. To me, this is a weak argument on which to give Graphomya its own subfamily rank. Some muscids do share characters which would align them with representatives of other families of the Calyptratae; for example, the broad lower frons in the male, a large lower squama, and heavy set abdomen. Although the larvae are semi-aquatic, this in no way proves it is an ancient genus. In fact, Hennig considered those muscid genera with saprophagous larvae as being more primitive than those with semi-aquatic larvae (Vockeroth, 1971, per. comm.). A world wide distribution does not necessarily indicate an ancient genus either, although it is certainly possible that these flies have been present a long time and have filled available niches throughout the world (Vockeroth, 1971, per. comm.).

Hennig (1952) discussed the relationship of the <u>Musca-Phaonia</u> group and the <u>Anthomyia</u> group. He considered the subfamilies Phaoniinae and Mydaeinae were too closely related to be separated; and in the larval stages, the subfamilies Coenosiinae, Limnophorinae, and Lispinae, separated by some

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authors, are not separate from the Phaoniinae and Mydaeinae. If the separation of the two major groups is carried out, then decisive distinguishing characters can also be reported for the larvae. On the basis of larval morphology and egg structure, the genus <u>Graphomya</u> could belong to the Phaonia group.

Herting (1957) was of the opinion that the genus was related to a <u>Limnophora</u>-type because of the very large postgenital plate of the abdomen. As the larvae have their posterior ends pointed with the posterior spiracles lying at the tip, <u>Graphomya</u> has been placed in the tribe Limnophorini of the subfamily Phaoniinae (Van Emden, 1965).

Thompson (<u>in</u> Collin, 1948) felt that differentⁱation of groups of Muscidae on the basis of immature characteristics is possible if one looks at two characters in particular; egg structure and posterior larval spiracles. <u>Graphomya</u> eggs belong to the <u>Phaonia</u>-type, characterized by broad, widely separated flanges running strictly parallel to each other throughout their length, not produced into processes anteriorly but equally developed at each end, the surface between the flanges being flat while the other surface is convex and marked with longitudinal corrugations. The posterior

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spiracular slits of the larvae are arranged one above the other as in <u>Phaonia</u>, but are intermediate between the Muscinae and the <u>Phaonia</u> group in that a short length of each slit is recurved.

Hennig (1965) showed that <u>Graphomya</u> has derived characteristics of the group including the Mydaeinae, Limnophorinae, and Coensoiinae. He placed <u>Graphomya</u> in the Mydaeinae because of the presence of setulae on the radial fork, and a pre-alar bristle. This contradicts a close relationship with the Limnophorinae based on larval characteristics. One has to remember that if <u>Graphomya</u> is placed in the Mydaeiane, then it would be the only genus with semiaquatic larvae in that subfamily. Vockeroth (1972, in press), mainly on the basis of Hennig's work, placed <u>Graphomya</u> in the Mydaeinae. However, he now feels that the genus should be placed in the Limnophorinae (Vockeroth, 1971, per. comm.). On the basis of my own studies of the immature stages, I believe it should be placed in the subfamily Limnophorinae.

Life Stages of Graphomya species

Little is known about the biology of this genus of flies. The adults have no medical or veterinary significance (Eldridge and James, 1957). The larvae are semi-aquatic and predacious.

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Egg:

According to Vockeroth (1972, in press), the egg is long, slender, about one-half as long as preabdomen, four and a half times as long as broad, with a pair of infolded appressed flanges along the length of the egg, each flange half as broad as the egg and rounded at each end; body of egg rounded apically, without median apical process; micropyle at one-twelfth length of egg; the margin of the flange finely and uniformly scalloped; most of the egg surface minutely papillate, the papillae on the anterior third of the dorsal surface of flanges grouped into hexagonal clusters. This description compares closely with that given by Thompson (1937) for the Phaonia-type, as previously discussed.

The number of eggs per female has been reported by Vockeroth (1972, in press) as eleven, and by Eldridge and James (1957) as forty to fifty.

Larva:

Keilin (1917) found <u>G. maculata</u> larvae in small depressions in the remains of a bog. The depressions, bordered with moss and bog flora, were two to three meters in diameter, not very deep, and were filled with rabbit excrement, putrefying humus and plant debris. It was in the

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middle of this mass of decomposing animal and vegetable matter that the larvae were found. According to Karl (1928), the larvae develop in moist places on the ground where plants become rotten. The larvae have been reported by Stackelberg to inhabit dung (Eldridge and James, 1957). The larvae of <u>Graphomya</u>, and many <u>Limnophora</u> and <u>Spilogona</u>, occupy a special niche as they live among wet vegetation submerged in water or sprayed by waterfalls (Van Emden, 1965).

The morphology of <u>G. maculata</u> larvae has been described by Keilin (1917).

The larvae are easy to recognize by the series of hooklike sclerotized appendages situated on the sternum of abdominal segments four to nine (Séguy, 1923), and by their peculiar elongated tapered shape (Séguy, 1937). Discussions of the creeping welts are given by Keilin (1917) and Van Emden (1965). According to Keilin (1917), these protusions enable the larvae to travel about and to hold onto solid debris which is found in the environment in which they live.

The larvae are said to be predaceous (Keilin, 1917; Séguy, 1930; Eldridge and James, 1957), are humicole (Séguy, 1930), and are scavengers (Malloch, 1934). According to Keilin (1917), a third stage <u>G. maculata</u> larva is capable of killing an Eristalis sp. larva up to six times its size.

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Zimin (1951) reported first and second stage larvae to be scavengers. However, according to Eldridge and James (1957), Portchinsky (1910, Trudy Biuro Ent. <u>8</u>: 1-90) thought the second instar larval stage was omitted.

Nothing is known on the duration of the larval stages in Graphomya species.

Pupa:

The pupa of <u>G. maculata</u> has been described by Keilin (1917). Nothing else has been reported concerning this stage of the life history.

Adult:

The literature on biology of the adult flies is as limited as the literature on the immature stages.

Adult flies of <u>Graphomya</u> are usually seen from late May to early October in the Nearctic region. They can be caught with moderate frequency (Eldridge and James, 1957).

Snyder (1965) reported females to be abundant around feces or garbage in shady, swampy environments. According to Robineau-Desvoidy (1830), Séguy (1923), Karl (1928), Malloch (1934), and Eldridge and James (1957), adults have been found on flowers, particularily those of the Umbelliferae. Snyder 7

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(1965) said that males, while often hovering near females could usually be found more abundantly on adjacent blossoms or leaves of legumes and umbelliferous plants. Liebermann (1926) stated that adults visited flowers of yarrow, <u>Achillea</u> <u>mullefolium</u>, and clover. Judd (1970) reported adults having been caught in a trap on a shagnum mat in the Byron bog, near London, Ontario.

Adults have been reported to be attracted to cow dung, especially fresh droppings (Van Emden, 1965). Eldridge and James (1957) reported the females visited dung for the purpose of oviposition. Liebermann (1926) stated that eggs were deposited in horse dung.

According to Séguy (1937), the adults are anthophilic or hygrophilic, and are occasionally coprophagous to saprophagous.

Liebermann (1926) discussed the morphology of the antennae of <u>G. maculata</u>.

Observations which I have made on the biology of the genus from North America will be given in discussion of the species involved.

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EVALUATION OF CHARACTERS

All species of <u>Graphomya</u> are sexually dimorphic; males are always holoptic, females are always dichoptic (Fig. 6).

<u>Males</u>

Head. The length and width of the frontal area, as previously discussed, are good characters (Figs. 1, 2). The colour of the pollinosity of the parafacial region is usually a reliable character. However, the intensity of the yellow colour on the parafacials decreases in the northern part of the range of some species with this character, such as in americana R.-D. In other species, such as idessa and minuta, there is a slight yellow tinge near the antennal base on an otherwise silver-grey pollinose background (Fig. 7). Pollinosity of the parafrontal region is either silver-grey or yellowish (Fig. 7). Width of the parafrontal region and the degree to which it is pinched out by the ocellar triangle is a useful character as in occidentalis (Fig. 7). The number of frontal bristles is fairly constant for each species but should be used in conjunction with other characteristics.

A particularily useful character is the degree to which the eye is haired. In some species, such as <u>columbiana</u> and ungava, eye hairs are very similar in length and in number

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over the whole eye. In other species, the eyes may be haired only on the upper half or the hairs on the lower half are shorter than those above. Usually there is considerable sexual dimorphism with respect to eye hairs, which must be taken into account when associating males and females of the same species. Eyes of the <u>ungava</u>, <u>transitionis</u>, and <u>alaskensis</u> group are produced further back on the head where they meet the postocular bristles (Fig. 7). This character is also found in some high altitude specimens of other species and must be taken into account.

The vibrissal angle and the bristling thereon is of some use in separation of species.

<u>Thorax</u>. The most consistent characters of the thoracic region are the division of the pre- and postsutural median black pattern by grey vittae as in <u>minuta</u>, and the width of the posterior median black stripe in relation to the distance between the prescutellar acrosticals (Fig. 8).

Size of the median black spot in relation to the width of the sub-median grey vitta on the dorsum of the scutellum is also useful.

The position of vein R_{4+5} at the wing margin in relation to the wing tip and the M_1 vein is of limited use as a character as the position of R_{4+5} and M_1 varies within species

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(Fig. 9). Wing infuscation and the colour of the lower squama are sometimes useful characteristics.

Setae, hair and bristle patterns on the legs are fairly constant throughout the genus. However, presence or absence of an anterodorsal bristle on the mid tibia is diagnostic to a certain extent.

The number of bristles on the posterior margin of the mesopleuron is too variable within species to be of much use.

<u>Abdomen</u>. The abdominal pattern and the colour of the integument is of considerable diagnostic value. Extent of the orange to reddish-orange integumental colour on the lateral margins of the dorsum of segments two, three, and four, and the degree to which it is obscured by pollinosity, is particularily useful. Dusting on the dorsum of segment five is a less $\frac{obvious}{4}$ character, as in <u>americana</u>, <u>interior</u>, and <u>occidentalis</u>. On segment three, the length of the median hairs in relation to the anterior to posterior length of the segment is useful, when used with other characters.

<u>Genitalia</u>. The genitalia provides few good characters. Shape and size differences in structures such as the surstylus, cercus, epiphallus, postgonite and paraphallus

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are minor. The fifth sternite is fairly constant in shape and in bristling throughout the genus.

Females

Females are very uniform in colour, bristling and structure.

<u>Head</u>. Frontal length and width, as in the male, are useful characters. Abundance and distribution of eye hairs are the major characters found on the head. Other useful characters are the extent of bristling on the vibrissal angle and colour of pollinosity on the parafrontal and parafacial regions. Minor characters include the extent of the grey triangular vitta on the frontal vitta, as in the northern group of species, and the number of parafrontal bristles.

<u>Thorax</u>. Width and length of the median postsutural black stripe on the dorsum of the mesonotum are major diagnostic characters. Shape and size of the median black spot on the scutellum are also useful. Wing venation, leg bristling and colour vary as in the male.

<u>Abdomen</u>. General pattern and vittation **v**ary little between species. Extent of yellow dust on the dorsum of

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segment five in southern and western species, such as <u>americana</u>, <u>occidentalis</u>, and <u>interior</u>, is useful. Erectness of the short hairs on the dorsum of segments three and four is a minor character.

<u>Genitalia</u>. As in the males, genitalic characters are few. Differences in the shape of the cercus, subanal plate, and ninth tergite are minor.

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GENERIC DIAGNOSIS

MALE

Eye large, densely to weakly haired, posterior Head. margin weakly sinuate; in profile occupying seven-eighths of head height and three-fourths of head length; upper half of eye often slightly wider than lower half; facets on upper half usually enlarged. Front open and distinct in all species, at narrowest varying from two-thirds width of ocellar triangle to twice ocellar triangle; strongly broadened toward antennal base. Parafrontals usually separated by black or brown frontal vitta, and broad to vertex (in one species, occidentalis, pinched out by ocellar triangle). Frontal bristles five to twelve in number, restricted to anterior two-thirds of front; accessory hairs many, on both sides of frontal bristles extending almost to anterior ocellus. Ocellar triangle prominent, fully visible in profile, bearing one pair of anterior bristles and numerous strong hairs. Postocciput flat, densely bristled, with a flat bare postorbital surface between eye and orbital bristles; orbital bristles differentiated only on dorsal region of head; postorbital surface continued to ocellar tringle in many species, but in some (transitionis, ungava, and alaskensis) pinched out dorsally by the enlarged eye. Parafacials broad, flat, about one-third as wide at

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narrowest point as distance between vibrissae. Facial ridge distinctly bristled at least halfway from vibrissal angle to antennal base. Vibrissal angle scarcely to moderately projecting beyond anterior margin of front; one strong vibrissa with one or two bristles above and several below continuous with bristles of oral margin; hairs of vibrissal angle sometimes developed as distinct bristles in several serial rows. Genae densely haired. Antennae with first segment recessed and barely visible; second segment three to four times as long as broad, extending four-fifths of the distance to the vibrissal angle; arista long-plumose above, short to longplumose below. Mouthparts normal, theca weakly pollinose; palpi black to reddish-brown with yellow or grey tips.

<u>Thorax</u>. Dorsum of thorax with black stripes presuturally and postsuturally, remainder of dorsum with grey vittae. Central presutural black stripes usually separated by two narrow grey vittae. Central postsutural stripes either separated by two narrow grey vittae or intact throughout, posteriorly narrower, as wide or wider than distance between prescutellar acrosticals. Submedian postsutural stripe extending to a level between the first two dorsocentral bristles. Sublateral black stripes, situated just outside of dorsocentrals, wider anteriorly and extending to a level with the last

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dorsocentral. An additional pair of stripes present between the suture and the postalar callus extending through the prealar Scutellum with a distinct central black spot separated area. from lateral triangular spots by grey vittae of varying width; tip of scutellum in some species with a reddish tinge. Pleurae usually grey. Prescutellar acrosticals strong, others undifferentiated. Dorsocentrals 2+4. Two anterior sublateral bristles, one posterior intraalar, one prealar and one supraalar bristle present. Two humeral bristles, inner one slightly weaker. Notopleuron with two notopleural bristles. Two lateral scutellar bristles, one submedian bristle and a pair of strong apical scutellar bristles. Dorsal accessory hairs numerous, continuous on disc and extending to a varying degree beyond sublateral and supraalar bristles. Some hairs present around notopleural bristles. Prosternum bare, weakly pubescent posteriorly. Propleural bristle present with a weaker bristle just anterior to it. Stigmatic bristle present with a distinct cluster of hairs around and behind its base. Mesopleuron with a full row of bristles on posterior margin, haired, with multiple rows of hairs behind anterior spiracle. Pteropleuron bare. Sternopleuron haired on posterior half, with two posterior bristles and a row of bristles ventrally. Barette haired, scarcely inclined above the horizontal. Hypopleuron with a single to multiple row of hairs

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in front of and below posterior spiracle and a small group of hairs above hind-coxal articulation. Posterior spiracle large, open, ringed by short weakly plumose hairs. Haltere yellow, knob lighter in colour. Lower squama whitish-yellow to dark brown. Wing clear to moderately infuscated; costal bristles absent, but with two rows short black setulae to apical curve; auxillary vein doubly sinuate; radial fork with several hairs above and below; vein M1 curved posteriorly then anteriorly ending at wing tip or distal to it; M-m crossvein moderately to strongly sinuate. Legs black to reddish-brown (also varies within species). In some species femora grey dusted ventrally and laterally. C_1 strongly bristled anteriorly; F_1 with a full row of dorsals, a weaker row of posterodorsals and a strong row of posteroventrals, hairs on posterior surface often absent near apex below; T1 without distinct bristles. C₂ strongly bristled anteriorly, haired posteriorly; F_2 with a row of strong anterior bristles on apical half, and rows of weaker anteroventral and posteroventral bristles which are well-developed only on basal half; T2 with none or one (rarely two) anterodorsal, one to three posterior bristles and one strong posteroventral bristle medially. C3 bristled anteriorly, bare behind; F3 with rows of strong anterodorsal and anteroventral bristles variously developed from almost

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prostrate setulae to distinct bristles on basal two-thirds. All tarsi usually black.

Abdomen. Dorsal integument almost entirely orange to almost black, with grey and silver-grey vittation. First segment black, largely hidden. Second segment black basally extending to posterior margin laterally and submedially, and with a small black discal spot medially (some species with orange marking posterolaterally). Segment three with a median black discal spot from anterior margin to four-fifths or total length of segment; with a large L-shaped or semitrapezoidal-shaped submedian black marking and a posterolateral black spot (some species with orange or reddish-brown marking laterally). Segment four much the same as segment three, but with central and submedian black markings smaller. Segment five with narrow central black stripe and usually two submedial black spots of varying size. Dorsal bristles suberect laterally, erect medially; median bristles on segments three and four shorter to longer than one-half length of segment; marginal bristles distinctly stronger than medial bristles. Hypopygium relatively simple. Cercal plate weakly fused ventrally, cercus with inner row of bristles and few centrally. Surstylus a broad lobe with an outer hook-like extension, variously bristled on inner and ventral surfaces.

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Adeagus largely membranous, forming a simple tube. Paraphallus usually bent anteriorly. One pair of postgonites. Epiphallus wider posteriorly, with a ventral extension between postgonites. Pregonites largely hidden by saddle-shaped ninth tergite. Ninth tergite without bacilliform process but with narrow lateral extension articulating with dorsal part of surstylus.

FEMALE

<u>Head</u>. Front broad, at vertex one-third of total head width. Frontal vitta black to reddish-brown about half frontal width, and with a central grey stripe. Frontal bristles about ten in number. Numerous hairs on inner twothirds of parafrontals (most near ocellar triangle), and outer half of frontal vitta. One weak reclinate posterior orbital bristle opposite ocellar triangle. One pair of divergent ocellar bristles and a weaker pair of divergent postocellar bristles. Inner and outer vertical bristles strong, subequal. Eye with facets of uniform size, upper portion of eye not enlarged. Postocular areas always distinct and broad to vertex. Eye hairs much shorter, sparser and weaker than in male, sometimes virtually undectable. Other characters as on male.

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<u>Thorax</u>. Much paler than in male, vittation more sharply defined. Presutural central black stripes separated by a single grey vitta. Postsutural central black stripe from scutellum up to suture, narrower, as wide or wider than distance between prescutellar acrosticals posteriorly. Lower squama white to yellowish-white. Wings clear. Legs as for male, bristles generally shorter and stouter, and posteroventral row on F_2 and F_3 usually setulose. Scutellum with median black spot narrow (on some specimens spot almost offset completely from base by grey vitta); some species with reddish tinge at tip. Remainder of characters as for male.

<u>Abdomen</u>. Integument without trace of orange or orangebrown colour. Black markings less extensive than in male and more diffuse. Bristling short and suberect to prostrate except on fifth segment. Eighth and ninth tergites notched dorsally. Ninth sternite divided into two spiculated plates. Eighth sternite partially separated. Seventh sternite Y-shaped, broad. Cercus is lobed - shaped.

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KEYS

Key to Male Graphomya of North America

1.	Eye hairs same length overall 2
	Eye hairs not same length overall or eyes bare below
2.	Eyes extended on back of head meeting postocular bristles, parafacials and parafrontals with silver-grey pollinosity, presutural median black patterns separated by a single grey vitta, postsutural black patterns separated by two narrow grey stripes, median black postsutural pattern narrower than distance between prescutellar acrosticals ungava new species
	Eyes not extended on back of head and do not meet postocular bristles, parafacials with golden-brown pollinosity, parafrontals with yellow to yellowish-grey pollinosity, dorsal presutural median black patterns separated by two grey vittae, postsutural median black pattern on dorsum of thorax complete and as wide as distance between prescutellar acrosticals (predominantly lowland British Columbia, North Western United States in distribution) columbiana new species
3.	Parafacials with predominantly yellow pollinosity 4
	Parafacials with predominantly silver-grey pollinosity
4.	Parafrontals continuous to vertex on each side of ocellar triangle and with yellow pollinosity, postsutural dorsal median black stripes on the thorax separated by two grey vittae, mid tibia without an anterodorsal bristle, lower squama light brown, abdomen with a predominantly orange integument (California, high altitude Mexico) occidentalis new species

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	Parafrontals pinched out by the ocellar triangle and with yellow to yellowish-grey pollinosity, postsutural dorsal median thoracic black stripe not divided or barely so by two very narrow faint grey vittae, abdominal integument predominantly black
5.	Eyes with slightly shorter and less numerous hairs on lower quarter, mid tibia with an anterodorsal bristle, lower squama light brown in colour (high altitude Western Canada and United States) interior new species
	Eyes with hairs usually absent on lower third, mid tibia without an anterodorsal bristle, lower squama dark brown (Eastern, Southern, Central, and Northern United States; Eastern Canada) <u>americana</u> RD.
б.	Eyes extended on back of head meeting postocular bristles, lower squama nearly white, parafacials with completely silver-grey pollinosity
	Eyes not extended on back of head and not meeting postocular bristles, lower squama medium to dark brown, parafacials with silver-grey pollinosity and slight yellow tinge near antennal base 8
7.	Eyes entirely bare on the lower quarter of the eye, dorsal thoracic median postsutural black stripes separated by two grey vittae <u>transitionis</u> new species
	Eyes shortly and sparsely haired on lower quarter of the eye, dorsal thoracic median postsutural black stripe not divided <u>alaskensis</u> new species
8.	Frontal vitta at narrowest point distinctly wider than the distance between the posterior ocelli, thoracic dorsal postsutural median black stripes definitely separated by two grey vittae idessa Walk.

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Frontal vitta at narrowest point distinctly narrower than distance between the posterior ocelli, thoracic postsutural dorsal median black stripe not divided or very faintly so by two very narrow grey vittae..... minuta new species

Key to Female Graphomya of North America

1.	Eyes usually bare; at most with a few hairs on upper third <u>americana</u> RD.
	Eyes haired on more than the upper third 2
2.	Eye hairs same length overall 3
	Eye hairs shorter to absent on lower half 5
3.	Parafacials and parafrontals with silver-grey pollinosity (Subarctic in distribution) ungava new species
	Parafacials and parafrontals with yellow pollinosity 4
4.	Parafacials with yellowish to golden-brown pollinosity, parafrontals with grey to yellowish- grey pollinosity, mean frontal length of the head 1.06mm., fifth abdominal segment with silver-grey to grey vitta (lowland British Columbia in distribution)
	Parafacials and parafrontals with yellow pollinosity, mean frontal length of head .91mm., dorsum of fifth abdominal segment yellow dusted (mostly at high altitude on mountain ranges of Southern British Columbia and Western United States)
	interior new species

5. Parafacials and parafrontals with yellow pollinosity, mid tibia without an anterodorsal bristle, fifth abdominal segment with yellow dust dorsally (mostly lowland Californian and at high altitude occidentalis new species in Mexico).... Parafacials and parafrontals with silver-grey pollinosity, mid tibia with or without an anterciorsal bristle, fifth abdominal segment with grey vittae..... 6 Mid tibia with an anterodorsal bristle..... 7 6. Mid tibia without an anterodorsal bristle..... 8 Dorsal median thoracic postsutural black stripe 7. wider than distance between the prescutellar acrosticals, mean frontal length 1.05mm., frontal bristles six to eight in number (mainly Alaska and North West Territories in distribution) alaskensis new species Dorsal median thoracic postsutural black stripe not wider than distance between prescutellar acrosticals, mean frontal length 1.13mm., frontal bristles eight to twelve in number (trans Canadian and northern in distribution) transitionis new species 8. Eyes sparsely haired on upper half only, lower half bare, mean frontal length 1.01mm., black median spot on scutellum wide..... idessa Walk.

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Graphomya occidentalis new species

Holotype. Male, Riverside, California, 19 May 1935, A. L. Melander. Holotype deposited in the United States National Museum, Washington, D.C., U.S.A.

Description of the Holotype

Frontal length 0.95mm.; frontal width 0.44mm. Head. Frontal vitta light reddish-brown, at narrowest point as wide as distance between posterior ocelli, and with a median narrow grey longitudinal triangular stripe. Frontal bristles eight in number. Parafrontals with light yellow pollinosity, not pinched out by black ocellar triangle. Antennae grey, aristal rays more numerous above. Parafacials with yellow pollinosity but with orange pollinosity along facial ridge. Genae grey, reddish-brown near parafacials, weakly haired above, densely haired below. Face grey, dusted with light yellow. Facial ridge with short hairs half the distance to the antennal base. Vibrissal angle with one row of strong bristles. Palpi light reddish-grey. Eyes densely haired above, hairs shorter and fewer on lower third. Postocular area dusted with yellow.

<u>Thorax</u>. Mesonotum black with yellowish-grey vittae. Presutural median dorsal black stripes separated longitudinally by two grey vittae. Postsutural median black stripes separated

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also, with central stripe as wide as distance between prescutellar acrosticals and extending to margin of scutellum and narrowing towards suture. Scutellum with median triangular black spot, the base of which as wide as distance between posterior dorsocentrals, continuing to tip of scutellum. Lateral scutellar black spots separated from median spot by reddish-yellow vittae. Pleurae grey. Mesopleuron bare on anterior lower third, with thirteen bristles on posterior margin. Mid- and hind-femora and tibiae reddish-brown, the mid tibia without an anterodorsal bristle. Wing with vein $\frac{vein}{R_{4+5}}$ ending proximad of MI on the wing margin. MI ending before wing tip. Wing mostly clear. Lower squama light brown.

Abdomen. Integument predominantly orange in colour. Segments two, three, and four each with median black discal spot surrounded by narrow yellowish margin. Segment two predominantly black with reddish-yellow vitta on lateral margin. Segments three and four with submedian brownish-red markings, and lateral reddish-brown spots on posterior margin. Submedian spot on segment four with black on posterior margin. Fifth segment light yellow dusted and with median narrow black stripe. Mid-dorsal hairs on segment three not as long as half the length of the segment.

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Description of Graphomya occidentalis

Males.

Males agree closely with the description of the holotype. Frontal length, range 0.80mm. to 1.00mm., mean 0.94mm., \underline{n} =33; frontal width, range 0.38mm. to 0.47mm., mean 0.43mm., \underline{n} =33. Frontal bristles seven to ten. Parafrontals and parafacials with yellow pollinosity. Frontal vitta as wide as distance between posterior ocelli. Parafrontals wide to ocellar triangle. The median dorsal postsutural black stripe on the thorax as wide or wider than the distance between the prescutellar acrosticals. Vein R₄₊₅ ending before vein M₁ on the wing margin. Abdominal pattern orange and black, the intensity of orange varying somewhat.

<u>Genitalia</u>. In posterior view (Figs. 10, 11), cerci with inner extensions about one-third to one-half length of cercus, weakly joined at ventral margin, an outward knob-like extension on dorsal third which articulates with surstylus, ventral portion below articulation point narrow; dorsally, surstylii meet over epiphallus, outer portion blade-like with a short sharp process ventrally, narrow along whole length, curving inwards below. In lateral view (Fig. 12), ventral portion of cercus narrowed below articulation point with surstylus; surstylus slightly L-shaped ventrally, the dorsal shield-like portion wider in Mexican specimens, the dorsal posterior process longer in Californian specimens, extreme anterior

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ventral margin inverted V-shaped; epiphallus with posterior portion long in relation to point of ventral extension; postgonite with a short rounded hook-like tip; paraphallus as long as epiphallus with anterior end bent dorsally. Fifth sternite (Fig. 13), with posterior, gradual, U-shaped indentation; bristles longer and stouter on lateral posterior third.

Females.

Frontal length, range 0.85mm. to 0.99mm., mean 0.94mm., n=9; frontal width, range 1.00mm. to 1.23mm., mean 1.05mm., n=9 (a female from Barton Store, California, is smaller than others with frontal length 0.64mm. and frontal width 0.85mm.). Frontal bristles six to eight. Frontal vitta reddish-brown to black (some specimens with a yellowish spot before anterior ocellus). Parafrontals and parafacials with yellow pollinosity. Eyes haired on upper half (some specimens with a few weak hairs on lower half). Postocular area yellow dusted. Antennal segments grey. Palpi reddish-brown with yellow-grey tips. Face and facial ridge as on male. Dorsum of thorax black with grey vittae fringed with yellow reddish-brown dust. Central dorsal postsutural black stripe as wide as distance between prescutellar acrosticals, narrowing towards suture and scutellum. Scutellum with narrow, dorsal brownish spot and submedian greyish vittae. Lower squama white. Wing clear, with vein R4+5 ending

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proximad to vein M_1 on wing margin, and M_1 ending before wing tip. Mid tibia without an anterodorsal bristle. Mid- and hind-femora and tibiae reddish-brown to black. Femora sometimes grey dusted laterally and ventrally. Abdominal tergum predominantly black with grey vittae. Third and fourth abdominal segments each with median black discal spot fringed with yellowish-brown dust, and with lateral black transverse spots preceded by grey. Fifth segment predominantly yellow dusted with two black anterior triangular spots. Dorsal hairs short, nearly flat to tergum.

<u>Genitalia</u>. In lateral view (Fig. 14), cercus with anterior end narrowed ventrally, wide to posterior third where curved to posterior end which is flat, ventral margin undulated slightly in middle. In ventral view (figs. 16, 17), subanal plate narrowed at anterior end. Seventh sternite with a deep notch on mid-anterior margin; fifth sternite horseshoe-shaped with pointed ends and with slight median indentation on posterior surface.

Paratypes - 32 males and 9 females

California: one male, Barton Store, 3 September 1950, A.L.M.(U.S.N.M.); one female, 23 August 1952, A.L.M.(U.S.N.M.); three males, Bird's Ldg., 30 July 1936, H.H.K.(C.N.C.); one male, Buena Pk., 19 May 1944, A.L.M.(U.S.N.M.); one female,

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Elkhorn Ferry, Yolo Co., 12 May 1952, W.I.W.(C.N.C.); one male, Fresno Bluffs, 13 May 1925, M.E.P.(U.S.N.M.): one female, Jenks Lk., 20 June 1945, A.L.M.(U.S.N.M.); one male, Los Angeles Co., October 1936, (U.S.N.M.); one male, Mono Lk., 22 July 1911, J.M.A.(U.S.N.M.); one male, Morongo, 28 September 1944, A.L.M. (U.S.N.M.); one male, Morro Bay, 7 October 1946, A.L.M.(U.S.N.M.); one female, Pacific Grove, 10 May 1906, J.M.A.(U.S.N.M.); one female, Palo Alto, 28 April 1906, J.M.A.(U.S.N.M.); one male, Petaluma, Sonoma Co., 26 June 1960, J.S.B.(C.N.C.); one male, San Francisco, July 1918, J.M.A.(U.S.N.M.); one female, Tanbark Flat, Los Angeles Co., 5 July 1952, S.M.(C.N.C.); four males, Topaz, 17 July 1918, Bishop no. 8099, (U.S.N.M.); two males, Yosemite, 16 June 1935, A.L.M.(U.S.N.M.); one male, Woodland, Yolo Co., 14 August 1955, A.T.McC.(C.N.C.).

Hawaii: one male, Waimanalo Oahu, 30 May 1967, S.S.(C.N.C.).

Mexico: one male, Dist. Fedrl., L.C. (U.S.N.M.); six males, E1 Salto, Dur., 9,000', 26 July 1964, J.F.McA.(C.N.C.); two males, two females, Navios, 26 mi. E. El Salto, Dur., 8,000', 27 July 1964, J.F.McA.(C.N.C.); two males, San Cristobal, Chis., 8 Mi. N.E., 6 May 1969, 7,500', H.J.T.(C.N.C.); one male, 10 mi. W. El Salto, Dgo., 10 July 1964, 9,000', J.F.McA. (C.N.C.); one female, 10 mi. W. El Salto, Dgo., 9,000', 26 June 1964, J.E.H.M.(C.N.C.).

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Discussion

Males of <u>Graphomya occidentalis</u> can be separated from those of <u>Graphomya mexicana</u> Gig.-Tos as males of <u>mexicana</u> have silver-grey pollinose parafrontals and parafacials, parafrontals pinched out by the ocellar triangle, front almost closed, frontal bristles more than ten, and dorsal median thoracic presutural black stripes separated by a single grey vitta. Males of <u>occidentalis</u> can be separated from males of <u>Graphomya</u> <u>maculata</u> (Scopoli) as males of <u>maculata</u> have eye hairs shorter on lower quarter, eyes extended posteriorly to postocular bristles on back of head, and the thoracic postsutural black stripe not divided. <u>G. occidentalis</u> males can be separated from males of other North American <u>Graphomya</u> by the key characters.

<u>Graphomya occidentalis</u> females can be separated from those of <u>G. maculata</u> and <u>G. mexicana</u> as females of these species have silver parafacial and parafrontal pollinosity. Eyes of female <u>mexicana</u> are devoid of hairs, those of <u>maculata</u> have few hairs above, fewer and shorter below. <u>G. maculata</u> females also have median thoracic postsutural black stripe very short, not extending to a level with the posterior margin of the sublateral black stripes. Female <u>occidentalis</u> can be separated from females of other North American <u>Graphomya</u> by the key characters.

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<u>Distribution</u>. Distribution of <u>G. occidentalis</u> extends from California south to Mexico. One specimen was taken in Hawaii, a probable recent immigrant from the mainland. Within its range, <u>occidentalis</u> inhabits the coastal areas of California, southern parts of the Coast Range, Sacramento and San Joaquin Valleys, then into high altitude areas of the Sierra Nevada Range. At Mono Lake, California, it is sympatric in distribution with <u>G. interior</u>. In Mexico, <u>occidentalis</u> inhabits high altitude areas of the Sierra Madre (9,000') and is found as far south as San Cristobal at high altitude (7,500') (Map 1).

Graphomya columbiana new species

 Holotype. Male, 32 mi. S.W. Terrace British Columbia, 50'
6 June 1960, R. Pilfrey. Holotype deposited in Canadian National Collection, Ottawa, Canada.

Description of Holotype

Head. Frontal length 1.20mm., frontal width 0.30mm. Frontal vitta black, at narrowest point wider than distance between posterior ocelli. Frontal bristles ten in number. Antennal segments grey, second segment with small brown patch on inner margin; arista reddish-brown with black tip, aristal rays slightly longer above. Parafrontals with yellow pollinosity,

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pinched out by black ocellar triangle. Parafacials with golden-brown pollinosity, a yellow patch near facial ridge, blackish near vibrissal angle, and reddish-brown near base of eye. Genae grey. Face grey, brownish-yellow dusted on upper half, and with a narrow medial black stripe from ocellar triangle to oral margin fringed with yellow dust. Facial ridge grey on outside margin, yellowish-brown on inside to face, with short hairs over half the distance to antennal base. Vibrissal angle greyish, reddish-brown on lower half, with one row of strong bristles. Palpi reddish-brown with grey on distal quarter, yellowish tips. Eyes densely haired on all but lower fifth, hairs nearly as long on lower third as above. Postocular area grey, dusted yellow.

<u>Thorax</u>. Mesonotum black with bluish-grey vittae. Dorsal median presutural black stripes separated by two narrow grey vittae. Median postsutural black stripe divided very faintly by two grey vittae; central portion as wide as distance between prescutellar acrosticals, narrowing towards suture and uniting there with presutural median stripe. Scutellum with large median black triangular spot not as wide at base as distance between posterior dorsocentrals, and with submedian grey vittae and reddish infuscation. Pleurae bluish-grey. Mesopleuron haired except for anterior ventral corner, sixteen posterior

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bristles, blackish on dorsal third. Lower squama light brown, fringed with white hairs. Wing with vein R_{4+5} and vein M_1 equidistant from wing tip at margin; and with infuscation above medial vein, at base, and between subcosta and wing margin. All coxae grey; mid and hind femora dark grey with reddish-brown ventrally and laterally on distal half; mid tibia reddish-brown with an anterodorsal bristle, hind tibia dark reddish-brown; tarsi black.

<u>Abdomen</u>. Tergum black with blue-grey and silver-grey vittae. Second segment above with black pattern posteriorly, anteriorly and medially with grey vittae, laterally grey with black anteriorly. Third segment dorsally with a central black spot extending to hind margin and set off by silver pollinosity, submedian L-shaped black pattern, and a lateral black spot on posterior margin. Fourth segment dorsally with central narrow black stripe, posterior submedian black pattern and lateral black spot, each preceded by grey. Fifth segment with median black line not reaching hind margin, flanked by two black spots fringed with brown dust. Mid-dorsal hairs on segment three longer than one-half length of the segment.

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Allotype. Female, same data as holotype. Allotype deposited in Canadian National Collection, Ottawa, Canada.

Description of Allotype

Allotype differs from holotype by the usual sexual differences and the following characters: frontal length 1.08mm., frontal width 1.16mm.; parafrontals with silver-grey pollinosity tinged with yellow; parafacials with yellow pollinosity and golden-brown pollinosity on inner half along facial ridge; palpi black; eyes evenly haired; dorsocentrals on left side 2+3; mesopleuron with thirteen posterior bristles; vein M_1 ending at wing tip; femora black, grey dusted ventrally; dorsally, pattern on abdomen obscured by grey vittae but nearly as same as on holotype except for lack of lateral reddishorange integumental colour.

Description of Graphomya columbiana

Males.

Frontal length of head, range 1.04mm. to 1.24mm., mean 1.14mm., \underline{n} =31; frontal width, range 0.22mm. to 0.32mm., mean 0.28mm., \underline{n} =31. Parafrontals narrowed towards frontal triangle, with silver-grey pollinosity (some specimens with yellow tinge on parafrontals). Nine to eleven frontal bristles. Frontal vitta at narrowest point as wide or wider than distance between posterior ocelli. Eyes not extending to postocular bristles on back of head. Other head characters consistent with those

of the holotype. Thorax with dorsal postsutural median black stripe usually complete, sometimes divided by two faint grey vittae and posterior part as wide or wider than distance between prescutellar acrosticals. Mid tibia with one or two anterodorsal bristles. Wing sometimes clear or as on holotype, vein R₄₊₅ ending even with or proximad to vein M₁ on the wing margin, vein M₁ ending approximately with wing tip. Lower squama light to medium brown. Abdominal pattern as for holotype (some specimens with reddish-orange patches laterally on segments two, three and four, others laterally on segments three and four with reddish-brown markings sometimes covering part of sublateral vittae). Segment four with median black stripe narrower than black disc on segment three.

<u>Genitalia</u>. From posterior view (Figs. 18,19), cercus with inner extension short, not half length of cercus, ventral portion short, outer margin below articulation point with surstylus curved outward near middle, dorsal portion slanted outward and anteriorly, inner margin nearly straight; surstylus wider at bottom, slightly L-shaped but rounded ventrally. In lateral view (Fig. 20), paraphallus curved in middle; postgonite flat dorsally, and with a slightly hooked portion at the end; epiphallus wider and rounded on posterior end, ventral extension beginning about halfway from posterior end. In ventral view (Fig. 21), fifth sternite with posterior

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indentation, narrowed gradually from anterior third to anterior margin, and with most large bristles on posterolateral third.

Females.

Head with frontal length, range 0.90mm. to 1.18mm., mean 1.06mm., n=32; frontal width, range 1.00mm. to 1.32mm., mean 1.15mm., n=32. Frontal vitta black, with grey median stripe wide at ocellar triangle and changing to brownish-grey near antennal base. Seven or eight frontal bristles. Parafrontals with grey to yellow pollinosity, haired almost two-thirds to eye margin. Parafacials with yellow to golden-brown pollinosity. Face, facial ridge, and vibrissal angle as in male. Genae mostly grey. Second antennal segment without brown patch on inner margin. Palpi black. Eyes evenly haired to fewer on lower half, hairs same length throughout. Thorax with dorsal median postsutural black stripe as wide as distance between prescutellar acrosticals, and fringed with brown dust. Scutellum with dorsal median black spot narrower than on male; grey submedian vitta fading out at level with sublateral bristle (some specimens with reddish infuscation); lateral black triangular spot faintly extended to median spot. Lower squama white. Wing clear; vein M_1 ending at wing tip; vein R_{4+5} ending proximad to vein M1 on wing margin. Femora reddish-brown to black, grey dusted laterally and ventrally; mid tibia reddishbrown to grey-black with one to two anterodorsal bristles;

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hind tibia black with grey dust. Abdominal tergum as for male but obscured by grey vittae; second segment with black pattern not as extensive as on male and with more grey laterally; all segments without lateral reddish-orange pattern.

<u>Genitalia</u>. In lateral view (Fig. 22), subanal plate extended past cercus; cercus slightly hooked on posterior ventral margin, outcurved slightly on ventral margin, dorsally rounded, sloped anteriorly and downward sharply at anterior margin. In dorsal view (Fig. 23), ninth tergite semicircular with a posterior indentation; eighth tergite with U-shaped indentation anteriorly. In ventral view (Figs. 24, 25), subanal plate is widest at posterior end, curved anteriorly on posterior margin and narrowed gradually to rounded tip where joined with dorsal extension of the subanal plate; ninth sternite paired, rounded slightly on outer margin, with one large bristle on posterior end near middle of sternite.

Paratypes - 31 males, 31 females

British Columbia: one female, Agassiz, 15 July 1926, R.G.(C.N.C.); two females, Gagnon Rd., 6 mi. W. Terrace, 20 June 1960, J.G.C.(C.N.C.); one female, 20 June 1960, B.H.(C.N.C.), two males, two females, 24 June 1960, C.H.M. (C.N.C.), one male, 20 June 1960, W.W.M.(C.N.C.), one male,

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20 June, 1960, R.P.(C.N.C.), two females, 24 June 1960, G.E.S. (C.N.C.); one female, Kaslo, July 1907, R.P.C. (U.S.N.M.); one female, Kitimat, 19 July 1960, B.H.(C.N.C.); one male, Kleanza Crk., 14 mi. E. Terrace, 29 June 1960, B.H.(C.N.C.); one female, Lakelse Lk., nr. Terrace, 14 July 1955, G.P.H. (C.N.C.); one male, Lakelse Lake Bog, nr. Terrace, 11 July 1960, J.G.C. (C.N.C.), one female, 14 June 1960, C.H.M. (C.N.C.); one female, 11 July 1960, G.E.S. (C.N.C.); one female, MacGillivary Crk. Game Reserve nr. Chilliwack, 27 July 1953, W.R.M.M.(C.N.C.); one male, Manning Pk., pinewoods, 4,000', 7 August 1953, J.R.McG.(C.N.C.); one male, Shames, 18 mi. S.W. of Terrace, 17 July 1960, B.H. (C.N.C.), one male, 23 June 1960, W.W.M.(C.N.C.), one male, 23 June 1960, R.J.P.(C.N.C.); on male, one female, Terrace 3 mi. S. Lakelse Rd., 19 August 1960, C.H.M. (C.N.C.); one male, Terrace airport, 3 July 1960, B.H.(C.N.C.); one male, Vancouver, 10 September 1916, R.S.S. (U.S.N.M.); one male, 25 mi. N. Terrace, 18 June 1960, B.H. (C.N.C.); 32 mi. S.W. Terrace, one female, 4 June 1960, one female, 6 June 1960, one male, one female, 11 June 1960, J.G.C.(C.N.C.), one female, 4 June 1960, two males, one female, 6 June 1960, one male, one female, 11 June 1960, B.H. (C.N.C.), one male, one female, 6 June 1960, two males, 11 June 1960, W.W.M.(C.N.C.), one male, 4 June 1960, two males, 6 June 1960, one male, one female, 11 June 1960, R.P.

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(C.N.C.), two males, 4 June 1960, four males, one female, 6 June 1960, G.E.S.(.C.N.C.).

Washington: one male Pysht, 19 June 1967, C.W.S.(U.S.N.M.); one female, Sappho, 18 June 1967, C.W.S.(U.S.N.M.).

Discussion

Males of <u>G. columbiana</u> can be separated from males of <u>G. maculata</u> (Scopoli), as those of <u>maculata</u> have eyes extended on back of head where they meet the postocular bristles, parafacials and parafrontals with silver to yellow pollinosity; eye hairs on lower half to lower quarter not as long and numerous as those above; mid tibia without an anterodorsal bristle; abdomen mostly with orange-brown integument with dorsal median black discal spot on each of segments two, three and four. Males of <u>columbiana</u> can be separated from males of other North American Graphomya by the key characters.

Females of <u>G. columbiana</u> can be separated from females of <u>G. maculata</u>, as female <u>maculata</u> have parafrontals and parafacials with silver-grey pollinosity and eye hairs shorter on lower half of eye. Female <u>columbiana</u> can be separated from other North American Graphomya by the key characters.

Biology. Adults have been taken on Heracleum maximum Bartr.

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<u>Distribution</u>. <u>G. columbiana</u> is predominantly coastal in distribution in British Columbia and northern Washington, but is found at high altitude (4,000' plus) in interior British Columbia (Map 2).

Graphomya interior new species

Holotype. Male, Tennessee Pass, Colorado, 24 July 1917, J. M. Aldrich. Holotype deposited in the United States National Museum, Washington, D.C.

Description of the Holotype

<u>Head</u>. Frontal length 1.01mm., frontal width 0.33mm. Frontal vitta black with narrow grey stripe along middle. Frontal bristles nine in number. Parafrontals with yellow pollinosity. Antennal segments reddish-brown, third segment grey dusted; aristal rays shorter and much fewer below. Face grey, with median narrow brown dusted stripe from antennal base to oral margin. Facial ridge grey with reddish tinge. Vibrissal angle grey. Hairs on facial ridge as strong and as long as hairs on vibrissal angle. Parafacials reddish-brown to black in places with yellow pollinosity along eye margin from antennal base. Palpi reddish-brown. Eyes haired, hairs slightly shorter and less numerous on lower quarter. Eyes extended almost to postocular bristles on back of head. 1

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Dorsum of mesonotum black with grey and silver-Thorax. grey pollinosity. Central presutural dorsal black stripes separated by a single grey vitta as wide as black stripes. Postsuturally, central black triangular stripe as wide as distance between the prescutellar acrosticals. Submedian black stripes, in line, before and after the thoracic suture. Scutellum reddish with a black spot twice as wide at base as the preceding black stripe; submedian area with yellowishgrey pollinosity, one-half as wide as base of median spot. Wings with infuscation along radial veins and medial veins. Vein R_{4+5} ending proximad to vein M_1 , on wing margin; vein M_1 ending slightly posterior to wing tip. Lower squama white with slight yellow tinge. Legs dark reddish-brown with grey dusting. Tarsi reddish-brown. Mid tibia with an anterodorsal bristle.

Abdomen. Basic pattern on dorsum of abdomen black; segments two and three laterally with reddish integument covered by yellowish-grey and grey vittae. Second segment with posterolateral and median black patterns, separated by yellowish-grey and grey vittae. Third segment with central narrow oblong black disc bordered by greyish vittae, submedian black L-shaped pattern with red on outer margin, and reddish from there to lateral margin and below obscured by silvergrey vittae. Fourth segment with narrow central linear black

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stripe, submedian black spot on posterior half and lateral anterior surface reddish. Fifth segment with central black stripe reduced to three small black dots, two submedial narrow black spots, remainder with grey to yellowish-grey dust.

Allotype. Female, Tennessee Pass, Colorado, 10,240', July 1907, J. W. Aldrich. Allotype deposited in the United States National Museum, Washington, D.C.

Description of the Allotype

The allotype differs from the holotype by the major female characters and by the following: frontal length 0.94mm.; frontal width 1.04mm.; frontal vitta brownish dusted on the upper half; frontal bristles eight in number (three nearest antennal base on left side broken); antennal segment two, grey, lighter near apex, third segment grey, left arista missing; parafrontals with silver-grey pollinosity; parafacials with silver-grey pollinosity and yellow tinge near antennal base; vibrissal angle with inner row of strong bristles and several rows of strong hairs; eyes haired to same extent overall; dorsum of thorax with presutural central grey vitta wider than the bordering black stripes; postsufural posterior black stripe almost as wide as distance between prescutellar acrosticals; central black spot on scutellum narrow, bordering grey vittae as wide as spot; mesopleuron with thirteen posterior

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bristles; dorsum of abdomen as on holotype but without orange integumental colour; sublateral black markings on segments three and four smaller; fifth segment with submedian black spots large, most of segment mottled-grey; lateral black spots on segments three and four very small.

Description of Graphomya interior

Males.

Frontal length of head, range 0.77mm. to 1.14mm.. mean 0.95mm., n=51; frontal width, range 0.21mm. to 0.42mm., mean 0.33mm., n=51. Parafrontals with silver-grey pollinosity and a yellow tinge. Frontal bristles seven to ten in number. Parafacials with yellow tinge near antennal base. Eye hairs shorter on lower half to lower third of eye (some specimens with hairs fewer in number on lower third). Vibrissal angle with two or three strong bristles on inner row with oral vibrissa; outer bristles short and strong. Face reddish (darker face colour associated with shorter hairs on lower part of eye). Other head characters as on holotype. Dorsal presutural central black stripes separated by a single grey vitta (some specimens with stripes separated by two narrow grey vittae, close together). Postsutural dorsal black stripe intact (some specimens with stripe divided by two narrow grey vittae). Posterior portion of black central postsutural stripe

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as wide or wider than distance between prescutellar acrosticals. Vein R_{4+5} ending proximad to vein M_1 on wing margin; vein M_1 ending at, or just distal to, wing tip. Legs reddish-brown or black. Other thoracic characters as on holotype. Orange-brown abdominal integumental colour on segments two, three, and on the anterolateral quarter of segment four. Discal black spots on segments three and four not completely oval (some specimens with discal spots bordered by brown). Submedian spots on segment four small, round and on posterior margin. Other characters of abdomen as on holotype.

<u>Genitalia</u>. In posterior view (Fig. 26), cerci weakly joined ventrally, cercus narrow throughout whole length, inner margin short, one-fifth total length, ventral lobe narrow, outer margin with sharply defined lobe at articulation point with surstylus; outer extension of surstylus narrow, sharply pointed at tip. In lateral view (Fig. 27), cercus with distinct anterodorsal extension, below with anterior margin pointed at articulation point and outcurved in centre; postgonite with narrow apex and reverse S-shaped ventral margin; surstylus with round ventral margin and posterior portion pointed dorsally. In ventral view (Fig. 28), fifth sternite semi-round-shaped, with bristles mainly on anterior two-thirds, largest bristles on posterior lateral portion.

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Females.

Frontal length of head, range 0.68mm. to 1.10mm., mean 0.90mm., n=34; frontal width, range 0.80mm. to 1.30mm., mean 1.08mm., n=34. Frontal bristles five to seven in number. Parafrontals with yellowish-grey pollinosity. Frontal vitta black (some specimens with brown frontal vitta), with median grey stripe. Ocellar triangle black, bordered at front and sides by brown dust. Parafacials with yellow pollinosity, slightly reddish-brown on inner margin. Antennae grey. Face grey over light reddish integument and with a slight yellowish tinge. Facial ridge grey with short hairs more than halfway to antennal base. Vibrissal angle grey. Palpi black (in some specimens palpi reddish-brown). Eyes haired same length overall, hairs slightly more numerous above. Dorsum of thorax with presutural grey central vitta twice as wide as bordering black stripes. Postsutural central black stripe as wide as distance between prescutellar acrosticals (in some specimens black stripe narrower), stripe not as long as distance from suture to scutellum. Scutellum with central black spot wider at base than preceding black stripe (in some specimens black spot nearly isolated brom base by grey vittae), widening to middle then narrowing to tip; submedian grey vittae more than half as wide as central black spot. Legs black, grey dusted; mid tibia with an anterodorsal bristle.

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Lower squama white. Wings clear, vein M_1 ending at wing tip or slightly distal to it, vein R_{4+5} ending proximad to vein M_1 . Abdomen as on male without reddish or orange integumental colour; segment two with less black laterally, segment three with sublateral black spots oblong, preceded by grey vittae, submedial spots fringed with brownish and yellowish dust, segment five with central black stripe nearly absent or distinct depending on amount of yellowish-grey dusting on dorsum of segment.

<u>Genitalia</u>. In lateral view (Fig. 29), cercus largest posteriorly with an anteroventral narrow extension, ventral margin sinuate, curved inwards; subanal plate extending past cercus posteriorly. In dorsal view (Fig. 30), eighth tergite deeply indented centrally on anterior margin; ninth tergite with posterior margin slightly indented. In ventral view (Fig. 31), ninth sternite spiculated and with large bristle on posterolateral corner; seventh sternite compressed longitudinally with deep central notch on posterior margin and two large bristles laterally.

Paratypes - 51 males, 37 females

Canada

British Columbia: two males, Keremeos, 14 July 1923, C.B.G. (C.N.C.); Oliver, one female, 3 June 1923, C.B.G.(C.N.C.),

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one male, 22 July 1923, E.R.B. (C.N.C.); Robson, one male, 21 October 1947, one female, 15 August 1949, H.R.F. (C.N.C.); three males, Vernon, 10 September 1923, D.D.G. (U.of G).

Alberta: Banff, one female, 23 July 1922, one female, 18 August 1922, C.B.D.G.(C.N.C.); Wabamun, one female, 2 July 1939, one female, 3 July 1939, one female, 24 July 1939, E.H.S. (U.of A.).

United States

Washington: one male, Almota, 20 May 1923, A.L.M. (U.S.N.M.); Pullman, one female, 4 July 1901, one female, 4 June 1904, one female, 8 May 1905, two males, 16 August 1907, A.L.M. (U.S.N.M.).

Oregon: one female, Hood Riv., 14 July 1932, J.M.A. (U.S.N.M.).

Idaho: two males, one female, Elk. Riv., 15 July 1910, J.M.A.(U.S.N.M.); seven males, three females, Moscow, August 1920, J.M.A.(U.S.N.M.); two males, Potlatch, 27 July 1912, A.L.M.(U.S.N.M.); one male, Priest Lk., 4mi. Camp, August 1920, A.L.M.(U.S.N.M.); one male, Viola, 26 June 1912, J.M.A. (U.S.N.M.); one female, Yale, Latah Co., 28 July 1927, J.M.A. (U.S.N.M.). 7

Montana: one male, Laurel, 27 July 1914, (U.S.N.M.).

Wyoming: three males, one female, Togwotee Pass, Teton Co., 17 July 1961, J.G.C.(C.N.C.); one female, Up. Gey Basin, 25 July 1956, A.L.M.(U.S.N.M.); Yellowstone Pk., two females, Roosevelt Sta., 3 July 1923, one female, Clematis Crk., 9 July 1923, one male, Beach Spgs., 19 July 1923, A.L.M.(U.S.N.M.).

Colorado: one male, Boulder, C. (U.S.N.M.); one female, Cottonwood Pass, Chaffee Co., 11,900', 29 July 1961, J.G.C. (C.N.C.); one male, Echo Lk., Mt. Evans, 10,600', 22 July 1961, J.G.C. (C.N.C.); one female, Estes Pk., 14 July 1934, A.L.M. (U.S.N.M.); four females, Idaho Spgs., 5 mi. S.W., 8,600', 27 July 1961, C.H.M. (C.N.C.); one male, Loveland Pass, W. slope, 9,850', 28 July 1961, B.H.P. (C.N.C.); one female, Nederland Science Lodge, 9,500', 29 June 1961, B.H.P. (C.N.C.); Tennessee Pass, 10,240', three males, one female, July 1907, three males, July 1912, one male, July 1916, one female, 23 July 1917, two males, 24 July 1917, one male, 17 July 1930, J.M.A. (U.S.N.M.).

Utah: Corinue, three males, 8 August 1953, one male, 16 August 1953, G.F.K.(U.S.N.M.); one female, Daniels Pass, 2 mi. S., Wasatch Co., 8,500', 29 July 1961, J.G.C.(C.N.C.); one female, Newton, 14 September 1954, W.R.W.(C.N.C.); one female, Soldier Summit, 7,454', July 1906, J.M.A.(U.S.N.M.). ٦

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Nevada: one male, Washoe Lk., Washoe Co., 16 June 1952, E.I.S.(C.N.C.).

California: three males, one female, Mono Lk., 22 July 1911, J.M.A.(U.S.N.M.); one female, nr. Hobart Mills, Nevada Co., 8 September 1952, R.M.B(C.N.C.); one female, Portola, 5 September 1917, C.U.Exp.(U.S.N.M.); one male, Weber Lk., 5 mi. E., Sierra Co., 30 July 1955, E.A.K.(C.N.C.).

Other: one male, Trenton, 24 June 1906, (C.N.C.).

Discussion

<u>G. interior</u> males can be separated from <u>G. maculata</u> (Scopoli) males as the latter have eyes extended to postocular bristles on back of head, dorsal black central spot on scutellum extended to lateral black spots at base, without an anterodorsal bristle on mid tibia, abdominal integument predominantly orange in colour, and abdominal segment three dorsally without submedian black markings. Males can be separated from males of other North American <u>Graphomya</u> by the key characters.

<u>G. interior</u> females can be separated from female <u>G. maculata</u>, as female <u>maculata</u> have central posterior postsutural black stripe short and wider than distance between 1

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the prescutellar acrosticals, eyes haired on upper part of eye, and mid tibia without an anterodorsal bristle. <u>G. interior</u> females can be separated from females of other North American species of <u>Graphomya</u> by the key characters.

Biology. Adults have been taken on flowers of Umbelliferae and on celery.

<u>Distribution</u>. Distribution of <u>Graphomya</u> <u>interior</u> is restricted to western North America, at high altitude, 8,500' to 11,900', in the Rocky Mountains; the range extends from British Columbia to Colorado and west to California (Map 3).

Graphomya americana Robineau-Desvoidy, 1830.

G.	americana		Robineau-Desvoidy 1830
G.	americana		Schiner 1868 (homonym)
G.	maculata .		Stein 1917
G.	maculata	, ,	Huckett 1965
G.	maculata	,	Stone, et al. 1965

Robineau-Desvoidy (1830) described <u>Graphomya americana</u> and gave North America as the type locality. No type specimen was designated, and as far as is known, all original material has been lost.

Schiner (1868) described a new species from South America and called it <u>G. americana</u>. Since <u>americana</u> Schiner

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was a homonoym of <u>americana</u> Robineau-Desvoidy, it had to have a new name. According to Pont (1972), Townsend 1892: 32, designated <u>meridionalis</u> as a new name for <u>americana</u> Schiner, giving as the type locality Distr.-Brazil in South America. Therefore, <u>G. americana</u> Schiner is a synonym of <u>meridionalis</u> Townsend, and a primary homonym of <u>americana</u> Robineau-Desvoidy.

As <u>G. americana</u> can be distinguished from <u>G. maculata</u>, <u>americana</u> is resurrected from synonomy under <u>maculata</u> and returned to full species status with a neotype designated below.

Neotype. Male, Capital Hill, Scott Co., Tennessee, 28 June 1965 J. G. Chillcott. Neotype deposited in the Canadian National Collection, Ottawa, Canada.

Description of the Neotype

Head. Frontal length 1.04mm., frontal width 0.70mm. Frontal vitta black. Frontal bristles nine in number. Hairs on frontal ridge almost to black ocellar triangle. Parafrontals with yellow pollinosity which is silver-grey tinged, pinched out by ocellar triangle. Parafacials with yellow pollinosity above and below along eye margin, dark golden-red along facial ridge, and below, between vibrissal angle and ventral margin of eye. Facial ridge reddish on

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outer margin, grey inwards, with hairs almost to antennal base. Vibrissal angle grey, with one row large bristles, two outer rows shorter thinner bristles, and three rows of hairs. Third antennal segment grey, second black; arista brown, black tip, rays longer above than below. Face grey, brown dusted on median ridge between antennae, and slightly below facial angle. Palpi black. Genae grey. Eyes bare on lower third, with hairs of even length above; outer margin bare; eyes produced almost to postocular bristles on back of head; and outer margin of eye slightly indented.

<u>Thorax</u>. Dorsal presutural median black stripes not completely separated by two very faint linear grey vittae. Postsutural median black stripe not divided, posterior section only slightly wider than distance between prescutellar acrosticals. Mesopleuron black on posterior half, haired except for anterior ventral portion and with fourteen posterior bristles. Lower squama dark brown, outer fringe white. Wing slightly infuscated along vein R_1 ; vein R_{4+5} ends proximad to vein M_1 which ends at tip of wing. All coxae grey. All femora dark reddish-black with grey dust ventrally and laterally. All tibiae reddish-brown, mid tibia without an anterodorsal bristle. Tarsi black. Scutellum with base of median black spot one and a half times as wide as width of posterior section of median postsutural black stripe.

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Grey vittae clouded with red spots; lateral black stripe faded-out towards tip; lateral margin below, yellowish-silvergrey with a few black hairs almost to tip of scutellum.

Abdomen. Integument mostly black. Segment two mostly black with sublateral grey vittae and two lateral posterior reddish intrusions which appear grey depending on angle of light. Segment three with median black disc surrounded by silver-grey pollinosity, submedian brown shoe-like patches, silver-grey over orange-brown outside to lateral black spot tinged orange-brown, postlaterally, orange-brown covered by grey pollinosity. Fourth segment similar to segment three with median and submedian spots narrower. Fifth segment dark slate-grey with yellow-grey pollinosity, a thin linear black median stripe and two submedian black spots fringed with brown on posterior margin. Lateroventral portion of abdominal tergum mostly orange-brown in colour.

Description of Graphomya americana R.-D.

Males.

Frontal length of head, range 0.86mm. to 1.18mm., mean 1.02mm., <u>n</u>=96; frontal width, range 0.26mm. to 0.41mm., mean 0.34mm., <u>n</u>=96. Frontal vitta black to reddish-brown. Parafrontal pollinosity yellow to predominantly silver-grey with a slight yellow tinge. All parafacials with deep yellow

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pollinosity and red-brown area below sometimes runs to reddishblack. Frontal bristles nine to eleven in number. Eye hairs as in neotype (some specimens with more hairs below, which always end abruptly). Thorax with presutural median black stripe occasionally divided completely by two narrow grey vittae. Postsutural central black stripe with only a slight trace of two grey vittae. Sublateral grey vittae on scutellum with reddish infuscation varied in intensity. Legs reddishbrown to black; when black, femora grey dusted ventrally and laterally. Mid tibia without an anterodorsal bristle. Vein R_{4+5} proximad to vein M_1 on the wing margin, vein M_1 ending at or before wing tip. Abdomen with reddish-orange pattern on dorsum varied in intensity, usually present on segments two, three, and four. Discal spot on segment three circular to oblong-shaped. Posterior margin of segment five grey to yellow dusted. Description, other than above, same as for neotype.

<u>Genitalia</u>. In posterior view (Figs. 32, 33), cerci joined at ventral margin of inner extensions which are approximately one-fifth to one-quarter length of cercus; cercus, below articulation with surstylus, with rounded bulge on outer surface, dorsal portion rounded slightly anteriorly on top, and slanted outwards; surstylus rounded and slightly L-shaped

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on outer margin, dorsal arms sharp and narrow, meeting rooflike at an angle over epiphallus. In lateral view (Fig. 34), cercus curved inward and narrowed ventrally on posterior margin, slightly hooked anteriorly, and curved on dorsal margin; epiphallus slightly squared on posterior margin and rounded ventrally; postgonite rounded, slightly hooked downwards and rounded anteriorly; paraphallus hooked downwards at end and curved on anterior third. In ventral view (Fig. 35), fifth sternite rounded on outer posterior margin, bristles absent anteriorly, concentrated on lateral posterior section of the sclerite, posterior margin with slight U-shaped indentation and lateral knob-like extensions rounded and slightly hooked towards middle.

Females.

Frontal length of head, range 0.85mm. to 1.12mm., mean 0.98mm., <u>n</u>=43; frontal width, range 0.87mm. to 1.24mm., mean 1.09mm., <u>n</u>=43. Frontal vitta brown to black with median longitudinal grey stripe from antennal base to ocellar triangle with upper portion dusted light brown. Nine frontal bristles. Front outward curved near antennal base, then back inwards to ocellar triangle with frontal bristles following the curve. When not rubbed, parafrontals with light yellow over silver-grey pollinosity, and parafacials with yellow pollinosity above and along eye margin; reddish-

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brown below from vibrissal angle to eye margin and along facial ridge. Facial ridge grey with hairs over halfway to antennal base. Vibrissal angle grey with one row of strong bristles. Genae grey. Face grey, sometimes yellow-brown dusted medially. Antennae mostly grey (some specimens with second segment black); aristal rays longer above. Palpi reddish-brown with grey tips. Eye with a few hairs on extreme upper surface (in some specimens, eyes with hairs extending to a maximum of one-third eye length). Thorax with dorsal presutural black stripes separated by a single grey vitta; grey vitta brown dusted along mid-longitudinal surface. Postsutural median black stripe from suture to scutellum and not as wide posteriorly as distance between prescutellar acrosticals. Scutellum with median spot dark reddish-brown to black with brown dust; tip with reddish tinge; lateral black stripe extended laterally only to submedian bristle. Femora reddishbrown to black; tibiae dark reddish-brown, mid tibia without an anterodorsal bristle; tarsi reddish-black to black. Wings clear; vein M1 ending at, or posterior to, wing tip; vein R_{4+5} and vein M_1 equidistant from wing tip (some specimens with R_{4+5} ending proximad to vein M_1 on wing margin). Pleurae grey with reddish tinge around tergites. Mesopleuron with eleven to sixteen posterior bristles. Abdomen with segment two dark grey to black with silver-grey vittae, black posterosubmedially and a black spot posterolaterally; segment three with central

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black disc oblong surrounded by silver vittae, submedial inverted T-shaped to trapezoidal-shaped spot, and a posterolateral black spot preceded medially by lateral V-shaped grey vitta; segment four similar to three, but with medial black disc narrower and posterosubmedial markings small; segment five with submedial black spots fringed with extensive light brown dust, two anterosublateral crescent-shaped black markings, median black stripe very narrow.

<u>Genitalia</u>. In lateral view (Fig. 36), cercus is fairly flat on dorsal and ventral margins and anteriorly, rounded dorsally and posteriorly, end rounded at edges but nearly squared otherwise. In ventral view (Fig. 37), subanal plate with flat rounded posterior end indented slightly after lateral extremes. In dorsal view (Fig. 38), posterior end of subanal plate slightly flatened; eighth tergite with deep U-shaped indentation on mid-anterior margin, reaching almost to posterior margin; ninth tergite slightly flattened on posterior margin.

New Locality Records for Graphomya americana

Canada

New Brunswick: one male, St. Andrew's, 30 August 1913, R.R.G.(C.N.C.); one female, St. Andrew's, 11 August 1957, G.E.S.(C.N.C.).

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Quebec: one male, Aylmer, 21 October 1924, C.H.C.(C.N.C.); one female, Breckenridge, 19 July 1962, C.H.M.(C.N.C.); La Verendrye Prov. Pk., mi. 61, Rte. 58, one male, 20 August 1965, one male, 21 August 1965, D.M.W.(C.N.C.); Ste. Anne, one female, 7 July 1930, one female, 10 July 1930, (L.E.M.).

Ontario: one male, Bell's Cor's., 22 August 1965, K.S. (C.N.C.); one female, Copetown Bog, Wentworth Co., 17 July 1970, T. and W. (C.N.C.); Dryden, two males, 17 July 1963, two females, 20 July 1963, R.J.A. (C.N.C.); Lake Sasajewan, Algonquin Prov. Pk., one male, 21 August 1956, one female, 29 August 1956, one male, 31 August 1956, D.M.W.(C.N.C.); London, one female, 3 June 1953, two females, 4 June 1953, one female, 29 October 1956, one female, 2 November 1956, one female, 3 November 1956, two females, 4 November 1956, two females, 6 November 1956, W.W.J. (U.of W.O.); Low Bush, Lake Abitibi, one female, 3 July 1925, one female, 23 July 1925, one female, 12 August 1925, N.K.B.(C.N.C.); one female, Luther Lk., 15 July 1959, H.J.T.(C.N.C.); N. Burgess Twp., Lanark Co., one male, 27 July 1967, one male, one female, 28 September 1967, D.M.W. (C.N.C.); Orillia, one female, 9 June 1925, one male, 8 September 1925, C.H.C.(C.N.C.); Ottawa, one male, 25 May 1896, (C.N.C.), one male, 10 July 1912, J.I.B. (C.N.C.), one male, 18 August 1912, J.I.B. (C.N.C.), one male, 24 September 1912, J.I.B. (U.S.N.M.),

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one female, 30 August 1945, A.R.B.(C.N.C.); one female, Perth Rd., 18 August 1957, J.R.V.(C.N.C.); one male, Picton, 7 July 1970, J.F.McA.(C.N.C.); four males, one female, Pt. Pelee, 29 June 1931, G.S.W.(C.N.C.); one male, one female, Quibell, 16 July 1963, R.J.A.(C.N.C.); one male, Rondeau Prov. Pk., 24 September 1961, T.and W.(C.N.C.); one female, Sand Bar nr. Mer Bleue Bog, Ottawa, June 1970, D.M.W.(C.N.C.); one female, Sand Lk., 28 July 1926, F.P.I.(C.N.C.); one female, Sheffield, Wentworth Co., 18 June 1960, T.and W. (C.N.C.); one male, Smith's Bay, nr. Picton, 1 July 1970, J.F.McA.(C.N.C.); one female, South Baymouth, Manitoulin Dist., 14 June 1954, D.M.W.(C.N.C.); one male, Vermillion Bay, 5-9 July 1963, R.J.A.(C.N.C.); one female, Whitby, 6 July 1926, C.H.C.(C.N.C.); one female, Windy Pt., 3 August 1960, S.M.C.(C.N.C.).

Manitoba: one male, Angusville, 20 July 1954, B.and W. (C.N.C.); one female, Teulon, 16 July 1923, A.J.H.(U.S.N.M.); one female, Wanless, 4 July 1961, H.E.M.(C.N.C.).

Alberta: one female, Wabamun, 13 June 1936, E.H.S. (U.of Man.).

United States

New Hampshire: two males, Franconia, 6 August 1915, C.H.T.T.(U.S.N.M.).

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Massach_usetts: one female, Wood's Hole, 24 July 1900, A.L.M.(U.S.N.M.).

Connecticutt: Stamford, one female, 5 July 1929, one female, 10 July 1929, one female, 8 August 1929, one female, 8 October 1931, B.T.R. Col., S.W.B.(U.S.N.M.).

New York: one male, Amityville, L.I., 6 September 1925, (U.S.N.M.); one female, Cedarville, 19 June 1921 (U.S.N.M.); one male, Cinnamon Lk., Schuyler Co., 20 June 1965, H.J.T. (C.N.C.); one male, Ithaca, 7 September 1922, C.S.(U.S.N.M.); McLean, one male, 8 July 1916, E.G.A.(U.S.N.M.), one male, 18 July 1921, (U.S.N.M.); one female, Varna, Tomp. Co., 17 July 1946, A.S.(U.S.N.M.); one male, E.B.S.(U.S.N.M.); one male, N.Y. Co., 15 August 1938, A.L.M.(U.S.N.M.).

New Jersey: Clementon, one male, 29 July 1906, one male, 8 September 1908, two females, 11 September 1909, (U.S.N.M.); one male, Riverton, 12 July 1908, (U.S.N.M.).

Maryland: one male, one female, Beltsville, 10 September 1916, W.L.McA.(U.S.N.M.); one male, Bethesda, 23 September 1914, R.C.S.(U.S.N.M.); Chespk. Bch., one male, 4 September 1914, J.M.A.(U.S.N.M.), one male, 17 September 1914, R.C.S. (U.S.N.M.), one female, 18 September 1914, N.B.(U.S.N.M.), one male, one female, 20 September 1914, (U.S.N.M.); one male,

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Hagerstown, 15 July 1938, A.L.M. (U.S.N.M.); two males, Lakeland, 25 September 1909, F.K. (U.S.N.M.); one male, Plummersld, 22 October 1915, R.C.S. (U.S.N.M.).

District Columbia: one female, Eastern Branch, nr. Bennings, 29 August 1915, W.L.McA.(U.S.N.M.); Washington, one female, 28 September 1906, W.L._A(U.S.N.M.), one male, D.H.C.(U.S.N.M.).

Virginia: one male, Glencarlyn, 19 September 1909, F.K. (U.S.N.M.); one male, Glencarlyn to mouth 14-mile Run, 11 June 1916, W.L.McA.(U.S.N.M.); one male, Mountain Lk., Giles Co., 3,800', 28 May 1962, J.G.C.(C.N.C.); one male, nr. Mouth 14-mile Run, 17 September 1916, W.L.McA.(U.S.N.M.); one male, 18 mi. N.E. Roanoke, B.-R. Pkwy., 18 May 1965, J.G.C.(C.N.C.); one male (U.S.N.M.).

North Carolina: one male, Cumberland Knob, mi. 218, B.-R. Pkwy., 13 June 1965, J.G.C.(C.N.C.); Highlands, 3,000' to 5,000', one male, April-May, 1936, R.C.S.(U.S.N.M.), two females, 6 May 1957, W.R.M.M.(C.N.C.), one male, 3,800', 16 May 1957, J.R.V.(C.N.C.), one male, 21 August 1957, W.R.R. (C.N.C.); one male, Linville, mi. 306, 3 June 1965, J.G.C. (C.N.C.).

Georgia: Tifton, one male, 2 October 1896, one male, 5 October 1896, one female, 12 October 1896, A.L.M.(U.S.N.M.), three females, October 1896, J.M.A.(U.S.N.M.).

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Florida: one female, Levy Co., 13 November 1955, H.V.W. (U.S.N.M.); Miami, one male, 14 November, one male, 25 November, C.H.T.T.(U.S.N.M.), White Spgs., two males, 15 October, one male, 16 October, three males, two females, 17 October, one female, 18 October, one male, 19 October, C.H.T.T.(U.S.N.M.).

Pennsylvania: one male, Glenside, 1 September 1908, (U.S.N.M.); one male, North Mt., 5 June 1899, (U.S.N.M.); one male, Tiniqum Is., 24 September 1904, (U.S.N.M.).

Indiana: La Fayette, one male, 17 June 1916, one male, August 1921, two males, 19 October 1924, J.M.A.(U.S.N.M.); one female, Logansport, 30 June 1914, J.M.A.(U.S.N.M.).

Tennessee: one male, Coral Hill, Scott Co., 28 May 1965, J.G.C.(C.N.C.).

Mississippi: one female, Bay St. Louis, Hancock Co., 25 July 1958, D.M.W. (C.N.C.).

Louisiana: two males, Opelousas, March 1897, J.M.A. (U.S.N.M.).

Michigan: one male, Gull Lk. Biol. Sta., Kalamazoo, 10 July 1959, R.L.F.(C.N.C.); one female, Pittsford, Hillsdale Co., 15 June 1959, R.L.F.(C.N.C.).

Illinois: one male, Chicago, 11 June 1899, A.L.M. (U.S.N.M.); one female, Lake Forest, (U.S.N.M.); one male, Maywood, 21 June

1949, A.L.M.(U.S.N.M.); one male, McHenry, September 1903, A.L.M.(U.S.N.M.); one female, Robertson Carlinville, (U.S.N.M.).

Minnesota: two females, Detroit Lakes, 9 August 1935, A.L.M.(U.S.N.M.); one female, Winona, 11 July 1933, A.L.M. (U.S.N.M.).

Iowa: Ames, two males, three females, 25 June 1947, three males, one female, 28 June 1947, one female, 29 June 1947, A.R.B.(C.N.C.).

North Dakota: one male, two females, Burgen, 8 August 1935, A.L.M.(U.S.N.M.); one female, Martin, 8 August 1935, A.L.M.(U.S.N.M.).

South Dakota: one male, Big Stone Cy., J.M.A.(U.S.N.M.); two males, Brookings, J.M.A.(U.S.N.M.).

Kansas: one female, Baldwin, (U.S.N.M.).

Texas: one male, Fredericksburg, 18 April 1959, W.R.M.M. (C.N.C.); Kerrville, one female, 30 March 1959, W.R.M.M. (C.N.C.), one male, 21 April 1959, J.F.McA.(C.N.C.).

Wyoming: Yellowstone Pk., one female, Beach Spgs., 19 July 1923, one female, Roosevelt Sta., 5 July 1923, A.L.M. (U.S.N.M.), one female, Old Faithful, 13 August 1927, J.M.A. (U.S.N.M.).

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Utah: one female, Newton, 14 November 1954, W.R.W. (U.S.N.M.).

Discussion

Males of <u>G. americana</u> can be separated from those of <u>G. maculata</u> (Scopoli) as males of <u>maculata</u> have eyes extended to postocular bristles on back of head, abdominal integument mostly orange to orange-brown in colour, and lower squama light to medium brown. Males of <u>americana</u> can be separated from males of other North American <u>Graphomya</u> by the characters given in the key.

Females of <u>G. americana</u> can be separated from those of <u>G. maculata</u> as female <u>maculata</u> have parafacials and parafrontals with silver-grey pollinosity and eyes haired below upper third. Female <u>americana</u> can be separated from other female North American <u>Graphomya</u> by the key characters.

<u>Distribution</u>. From Florida along the east coast to New Brunswick, northwest to Northern Ontario, west to Central Manitoba and North Dakota, and south to Texas. <u>G. americana</u> is predominantly a lowland species, probably derived from a neotropical intrusive which spread north and west from the southern United States. In the eastern United States <u>americana</u> avoids the Appalachian Mts. (Map 4).

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<u>Biology</u>. Adults have been taken on <u>Aster ericoides</u> L., flowers of <u>Solidago graminifolia</u> (L.) Salisb., flowers of <u>Aruncus sp., Castanea pumila</u> (L.) Miller, <u>Castanea sp., on</u> flowers of <u>Ceanothus americanus</u> L. and on <u>Flaveria linearis</u> Log.

Graphomya idessa Walker, 1849

Graphomya	idessa		Walker	, 18	349	
Graphomya	idessa	,	Stein,	191	.7	
Graphomya	idessa	•	Séguy,	193	57	
Graphomya	maculata	9	Stone,	et	<u>al.</u> ,	1965

As was the case with <u>G. americana</u> R.-D., <u>Graphomya</u> <u>idessa</u> Walk. is resurrected from synonomy under <u>G. maculata</u> (Scopoli) to valid species status since <u>G. idessa</u> can be distinguished from G. maculata.

The holotype, a female, is deposited in the British Museum (Natural History). The type locality is St. Martin's Falls, Albany River, Hudson's Bay. I have not seen the holotype, but Mr. A. Pont of the British Museum (Natural History), in a letter in 1964 to the late Dr. J. G. Chillcott, of the Entomology Research Institute, Ottawa, made a detailed comparison between the holotype of <u>G. idessa</u> and females from Ogoki, Ontario, Great Whale River, Quebec, and Ames, Iowa. Mr. Pont

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came to the conclusion that the holotype most closely resembled the female from Ogoki, Ontario. Since I have many females from Ogoki, I have used these as a basis for comparative purposes with other females.

Description of Graphomya idessa

Males.

Frontal length of head, range 0.90mm. to 1.30mm., mean 1.07mm., n=47; frontal width, range 0.28mm. to 0.42mm., mean 0.36mm., n=47. Frontal vitta black, with median longitudinal grey stripe sometimes brownish tinged, and at narrowest point wider than distance between posterior ocelli. Nine to ten frontal bristles. Parafrontals with silver-grey pollinosity, pinched out by the black ocellar triangle. Second antennal segment grey, reddish tinged; third segment grey, aristal rays longer and more numerous above. Face grey, with or without a black border on oral margin (some specimens with ridge between the antennae brownish dusted). Facial ridge grey (some specimens with reddish tinge on inner side). with weak short hairs almost to antennal base. Parafacials with silver-grey pollinosity (some specimens have a slight yellow tinge near the antennal base), with reddish-brown along facial ridge and with reddish-brown to dark brown between vibrissal angle and eye margin. Vibrissal angle mostly dark grey with

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reddish inclusions below, extending to lateral oral margin, with one row large bristles and three rows shorter weaker bristles. Genae grey with long black hairs. Palpi black with yellowish tips. Eyes haired, hairs shorter on lower third; facets larger on upper inner surface; posterior margin of eye not reaching postocular bristles but extending further posteriorly than hind margin of ocellar triangle. Dorsum of thorax with dark bluish-grey markings, and black areas with brownish tinge. Presutural median black stripes separated by two narrow grey vittae. Median postsutural black stripe not divided or only weakly divided by continuation of presutural grey vittae; posterior portion as wide or wider than distance between prescutellar acrosticals. Scutellum with large wide triangular black spot, and submedian grey vittae with reddish tinge. Lower squama medium to dark brown. Mesopleuron haired on posterior half, with ten to thirteen posterior bristles. Coxae grey to reddish-grey-brown. Femora reddish-black (some specimens with femora grey dusted). Tibiae reddish-brown to reddish-black, mid tibia usually without an anterodorsal bristle. Tarsi black; hind tarsus with short weak brown setae on ventral surface. Wings only slightly infuscated; vein R₄₊₅ ends proximad to vein M_1 on wing margin; vein M_1 ends at wing tip or just distad to it. Abdominal segment two, dorsally, with extensive black submedially and laterally, with reddish posterior

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lateral intrusions, and submedian grey vittae. Segment three, with a median black disc, submedian grey vittae wider anteriorly, submedian black markings L-shaped, and laterally, a reddishorange-brwon patch predominant to a posterolateral black spot; hairs on median disc shorter than one-half length of the segment; some specimens with reddish colour extending to submedian grey vittae on segments three and four. Segment four with a median black longitudinal marking, submedian black splash narrower than on segment three (in some specimens reduced to spots on posterior margin); lateral black spot smaller than on segment three. Fifth segment with median black stripe very narrow, with two submedian very small black spots fringed with brown dust, and with blue-grey to yellowish-blue-grey vittae.

<u>Genitalia</u>. In posterior view (Figs. 39, 40), cerci with inner extensions joined below and not long, ventral portion short, curved on inner surface, outer margin quite rounded at articulation point, dorsally curved backwards and wide at top; surstylus ventrally with lower portion wider in middle, outer margin smoothly rounded to angular, apex truncate, lateral arm wider ventrally, slightly sickle-shaped. In lateral view (Fig. 41), cercus curved dorsally, narrowed gradually below; surstylus fairly large, rounded below with sharp incurved portion leading to dorsal extension, posterior

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lateral portion wider ventrally and rounded on posterior edge; paraphallus bent downwards at anterior end; postgonite with distinct incurvature near end, anterior portion slightly knobbed above; epiphallus almost spoon-shaped posteriorly, with ventral extension halfway from the end and dorsal margin curved downward at anterior end. In ventral view (Fig. 42), fifth sternite with posterior lateral knobs bent slightly inwards; posterior margin with a gradual U-shaped indentation; lateral margins nearly parallel, slightly wider at posterior end; bristles almost to anterior margin.

Females.

Frontal length of head, range 0.88mm. to 1.24mm., mean 1.01mm., \underline{n} =91; frontal width, range 0.86mm. to 1.30mm., mean 1.15mm., \underline{n} =91. Frontal vitta black, sometimes brown dusted, with median longitudinal triangular grey stripe. Frontal bristles seven or eight in number. Parafrontals with silvergrey pollinosity, wide near antennal base with black hairs almost to eye margin above. Second antennal segment greyblack, third segment grey, rays of arista slightly longer above. Face grey. Parafacials with silver-grey pollinosity above to dark reddish-brown below. Vibrissal angle with two rows of strong bristles. Facial ridge grey, hairs extending halfway to antennal base. Palpi grey, reddish-grey or black. Eyes

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haired on upper half, hairs decreasing markedly in length along one-quarter to one-half eye length. Dorsal median postsutural black stripe of thorax extended nearly from the scutellum to the second dosocentral bristle or the suture. wider posteriorly than the distance between the prescutellar Thoracic black stripes sometimes brown dusted. acrosticals. Scutellum with median black spot as wide at base as preceding black stripe. Posterior mesopleural bristles ten to fourteen in number. Femora reddish-black, covered by grey dust; tibiae coloured somewhat like femora, but more brownish and without grey, mid tibia without an anterodorsal bristle; mid tarsus brownish-black, hind tarsus black above, brownish below. Abdomen with third, fourth, and fifth segments as in male, but without orange-brown integumental colour, and with submedian markings confused by grey vittae. Fifth segment with submedial spots brown fringed as are median discs on segments three and four, and with more grey anteriorly. Segment two with lateral and submedian black markings separated by grey vittae.

<u>Genitalia</u>. In dorsal view (Fig. 43), eighth tergite with disc-shaped indentation on posterior margin and anteriorly with inner V-shaped indentation extending laterally, then anteriorly with parallel sides, and then gently curving laterally. Ninth tergite slightly flattened on posterior margin. In lateral view (Fig. 44), cercus seems flat at both

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ends, fairly straight ventrally, and slightly rectangularshaped, the posterior end being widest, and with an anteroventral, narrow, curved portion. In ventral view (Fig. 45), ninth sternite with large outer bristle.

New Locality Records for Graphomya idessa

Canada

British Columbia: one female, Ft. Nelson, 27 August 1948, W.R.M.M.(C.N.C.); Gagnon Rd., 6 mi. W. Terrace, one female, 20 June 1960, one female, 24 June 1960, G.E.S.(C.N.C.); one female, Jesmond, 19 August 1938, J.K.J.(C.N.C.); one male, one female, Kamloops, 22 August 1950, F.E.C.(C.N.C.); one female, Keremeos, 26 June 1923, C.B.G.(C.N.C.); one female, Mt. Allard, 23 mi. N. Terrace, 20 July 1960, C.H.M.(C.N.C.); one female, Summit Lk., mi 392 Alaska Hwy., 4,500', 13 August 1959, R.E.L. (C.N.C.); Vernon, one female, 28 August 1923, one female, 10 September 1923, D.G.G.(U.of G.); one male, 25 mi. N. Terrace, 18 June 1960, B.S.H.(C.N.C.); one male, 32 mi. S.W. Terrace, 100', 4 June 1960, W.W.M.(C.N.C.).

Alberta: one male, George Lk., 53°57'N., 114°06'W., 18-22 August 1966, P.G.(U.of A.); McMurray, one male, 3 July 1953, one female, 6 July 1953, nine females, 14 July 1953, one female, 27 July 1953, G.E.B.(C.N.C.).

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Saskatchewan: one male, Attona Lk., 22 August 1940, A.R.B.(C.N.C.); one female, Torch Riv., 29 August 1954, B.-W.(C.N.C.).

Manitoba: one male, Ft. Churchill, 17 July 1955, D.M.W. (C.N.C.); Gillam, one female, 28 July 1949, J.B.W.(C.N.C.), one male, 12 July 1950, J.F.McA.(C.N.C.); one female, Mafeking, 3 September 1959, A.andJ.B.(C.N.C.); one male, Pikwitonei, 1 August 1949, J.B.W.(C.N.C.); four females, Wabowden, 10 August 1949, J.B.W.(C.N.C.).

Ontario: one male, Algonquin Pk., 26-30 June 1955, C.S.S.(U.S.N.M.); one female, Bergland, 4 August 1960, S.M.C. (C.N.C.); two females, Dryden, 20 July 1963, R.J.A.(C.N.C.); one male, Lake Sasajewan, Algonquin Pk., 3 August 1956, D.M.W. (C.N.C.); Low Bush, Abitibi, one male, 3 July 1925, one female, 12 July 1925, one male, one female, 23 July 1925, N.K.B.(C.N.C.); Michipicoten Is., Thunder Bay Dist., one female, 5 July 1954, two males, 24 July 1954, D.M.W.(C.N.C.); Ogoki, five males, one female, 4 July 1952, two females, 5 July 1952, one male, 2 August 1952, one male, three females, 4 August 1952, one female, 8 August 1952, five males, four females, 12 August 1952, three males, ten females, 18 August 1952, one male, two females, 26 August 1952, one female, 27 August 1952, one female, 28 August 1952, J.B.W.(C.N.C.);

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five females, Quibell, 16 August 1963, R.J.A.(C.N.C.); one male, Sudbury Co., 28 June 1925, M.B.D.(C.N.C.); two males, one female, Vermillion Bay, Cedar Lk., 7 July 1949, J.R.V. (C.N.C.).

Quebec: one female, Gt. Whale Riv., 1 August 1949, J.R.V. (C.N.C.); one female, Laniel, 4 August 1935, H.S.F.(C.N.C.); one male, Laurentide Pk., 47°40'N., 71°13'W., 7 July 1959, G.E.S.(C.N.C.); La Verendrye Prov. Pk., mi. 61 Rte. 58, one female, 26 June 1965, three males, four females, 16 August 1965, six males, four females, 20 August 1965, five males, one female, 21 August 1965, mi. 87 Rte. 58, one male, 28 June 1965, mi. 139 Rte. 58, one male, 18 August 1965, D.M.W.(C.N.C.); one male, Parke Reserve, Kam. Co., 950', 13 August 1937, W.R.M.M.(C.N.C.); one female, Sept. Isles, 6 July 1924, F.V.W. (C.N.C.).

New Brunswick: one male, Chamcook, 13 July 1965, G.E.S. (C.N.C.); one male, Fredericton, 16 July 1913, P.D.T.(C.N.C.); one male, Red Rapids, 23 July 1913, R.P.G.(C.N.C.).

North West Territories: one female, Eskimo Pt., 16 July 1950, G.G.D.(C.N.C.); one female, Norman Wells, 8 August 1949, W.R.M.M.(C.N.C.); Kee Scarp., 1,200', one female, 28 June 1969, one female, 4 August 1969, three females, 16 August 1969, G.E.S.(C.N.C.); one female, Yellowknife, 5 July 1949, H.R.H. (C.N.C.).

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Yukon: Rampart House, one male, 7 July 1951, one female, J.E.H.M. (C.N.C.).

United States

Alaska: one male, one female, Anchorage, 20 July 1951, R.S.B.(C.N.C.).

Discussion

Males of <u>G. idessa</u> Walk. can be separated from males of <u>G. maculata</u> (Scopoli), as males of <u>maculata</u> have eyes extended to postocular bristles on back of head, median black of scutellum extended to lateral black spots spot on dorsum, and abdominal integument mostly orange to orangebrown in colour. Males of <u>idessa</u> can be separated from males of other North American Graphomya by the key characters.

Females of <u>G. idessa</u> can be separated from females of <u>G. maculata</u>, as female <u>maculata</u> have eyes only slightly haired above with short hairs, median dorsal postsutural black spot short and not wider than distance between the prescutellar acrosticals, and dorsal black spot on scutellum wider at base than preceding thoracic black stripe. Female <u>idessa</u> can be separated from females of other North American <u>Graphomya</u> by the key characters.

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<u>Distribution</u>. Distribution is trans Canadian, from New Brunswick, with probable intrusion into northwestern Maine, to British Columbia, no further south than Algonquin Park, Ontario, to as far north as Rampart House in the Yukon and as far west as Anchorage, Alaska. It is sympatric with <u>G.</u> <u>transitionis</u> in the east, with <u>G. minuta</u> in New Brunswick, Quebec, Ontario, and Manitoba, with <u>G. columbiana</u> at Terrace, British Columbia, and with <u>G. alaskensis</u> at Anchorage, Alaska, and Rampart House, Yukon Territory (Map 5).

Graphomya minuta new species

Holotype. Male, King Mt., Gatineau Park, Quebec, 4 August 1971, P.W. Arntfield. Holotype deposited in the Canadian National Collection, Ottawa, Canada.

Description of the Holotype

<u>Head</u>. Frontal length 0.94mm., frontal width 0.22mm. Parafrontals with silver pollinosity, pinched out by the black ocellar triangle. Frontal vitta black, at its narrowest part narrower than the distance between the posterior ocelli. Frontal bristles ten (most broken). Parafacials with silvergrey pollinosity, a yellow tinge near the antennal base, and black near vibrissal angle on inner margin. Second antennal segment black, third grey, aristal rays longer above than

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below. Face grey with brownish tinge between antennae and with a blackish stripe near middle of the oral margin. Facial ridge grey, with three rows of short hairs more than half the distance to the antennal base from the vibrissal angle. Vibrissal angle with one row of strong bristles and three rows of weaker bristles. Genae grey below eye to oral margin, partially reddish-brown above. Palpi black. Eyes haired on upper three-fifths, gradually with fewer and shorter hairs below.

<u>Thorax</u>. Dorsal median presutural black stripes separated by two very faint grey vittae. Postsutural median black stripe not divided and wider posteriorly than distance between prescutellar acrosticals. Mesonotum with silver vitta before scutellum and behind dorsocentrals. Scutellum with dorsal median black triangular disc as wide at base as distance between posterior dorsocentrals; sublateral grey vittae onehalf as wide as median black spot. Mesopleuron black except for mid-third, haired except for mid-ventral margin, and with sixteen posterior bristles. Lower squama dark brown. All coxae grey. All femora and tibiae black; mid tibia without an anterodorsal bristle (left mid femora, tibia and tarsus missing); tarsi black. Vein R_{4+5} proximad to vein M_1 on wing margin, vein M_1 ending after wing tip; wing infuscated except for distal third and ventral margin.

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<u>Abdomen</u>. Grey and black with silver-blue pollinosity and markings. Second segment with black on posterior half, with silver-grey markings laterally and medially and grey fringed with light brown on anterior half. Third segment with median black circular disc not reaching posterior margin; submedian black markings roughly trapezoidal-shaped, separated from posterolateral black spot by silver-grey vitta over orangebrown integument. Fourth segment with rectangular medial black disc not reaching posterior margin; submedian black marking narrow at anterior margin, wider posteriorly; with a black spot on posterolateral margin. Fifth segment with two submedial black spots, and narrow, central black stripe. Hairs on central disc on segment three almost one-half length of the segment.

Allotype. Female, Duncan Lake, nr. Rupert, Quebec, 30 July 1969, J. F. McAlpine. Allotype deposited in the Canadian National Collection, Ottawa, Canada.

Description of the Allotype

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The allotype differs from the holotype by the major female characters and by the following: frontal length 0.84mm., frontal width 0.92mm., frontal vitta brown dusted except for median grey vitta; frontal bristles six in number; eyes haired on upper third and along outer margin; central postsutural black stripes on dorsum of the thorax separated by two very

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narrow grey vittae, central stripe wider posteriorly than the distance between the prescutellar acrosticals, and extending from the scutellum to its narrowest point at the suture; scutellum with central black spot not as wide at base as distance between the last pair of dorsocentrals, submedian grey vittae about two-thirds as wide as median black spot; lower squama white; wings clear, with vein R_{4+5} and vein M_1 equidistant from the wing tip at the wing margin; left middle leg missing; tibia brown; abdominal pattern similar to that of the holotype but uneven and without reddish-brown integument colour; third abdominal segment with median disc fringed with brown; fifth segment with submedian black spots fringed with brown.

Description of Graphomya minuta

Males.

Frontal length of head, range 0.73mm. to 1.07mm., mean 0.94mm., \underline{n} =50; frontal width, range 0.17mm. to 0.33mm., mean 0.24mm., \underline{n} =50. Parafacials with silver-grey to yellowish-silver-grey pollinosity. Frontal bristles seven to eleven in number. Eye hairs numerous on upper three-quarters of eye surface, fewer in number and shorter below. Frontal vitta black to dark brown, narrower at narrowest point than distance

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between posterior ocelli. One wide thoracic dorsal presutural black stripe not separated or black stripes very faintly separated by one or two noticeable grey vittae. Postsutural dorsal median black stripe intact throughout. Mid tibia usually without an anterodorsal bristle. Wings infuscated, vein R_{4+5} proximad to vein M_1 , on wing margin, vein M_1 ends posterior to wing tip. Lower squama medium to dark brown. Abdomen with red-orange patch laterally to sublateral black vitta on segments two and three; segment five with submedial spots fringed with brown. Other characters as on holotype.

<u>Genitalia</u>. In posterior view (Figs. 46, 47), cercus with a short ventral portion, inner margin short, dorsal portion slanted outward, outer margin outcurved in middle below point of articulation with the surstylus; surstylus widest at angle below articulation point, outer extension very narrow at base and sharply pointed at tip. In lateral view (Fig. 48), paraphallus bent downward in middle; postgonite nearly flat dorsally, posterior portion long and narrow and not hooked at the end; epiphallus narrow on posterior margin, ventral portion beginning just behind posterior margin, and dorsal anterior portion slightly curved ventrally; cercus widest at articulation point with surstylus, dorsally curved anteriorly, outer margin curved posteriorly on dorsal half, ventral half narrowed

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gradually; surstylus gently curved on dorsal anterior margin. In ventral view (Fig. 49), fifth sternite with posterior margin indented, slightly incurved laterally, and bristles weak, most bristles on lateral posterior margin.

Females.

Frontal length of head, range 0.76mm. to 0.94mm., mean 0.85 mm., n=21; frontal width, range 0.78 mm. to 1.02 mm., mean 0.90mm., n=21. Frontal bristles six to nine in number. Frontal vitta dark reddish-brown to black with a median grey triangular vitta dusted light brown. Parafrontals with silver pollinosity. Ocellar triangle black. Eyes haired on upper third to twothirds with hairs on outer margin shorter than those above (some specimens with upper half of eyes haired, lower half with fewer, shorter hairs). Eyes slightly indented by extension of frontal area, halfway along front. Second antennal segment black; third segment grey; aristal rays longer above. Face grey with median narrow black stripe merging into light brown vitta above. Parafacials with silver pollinosity, and reddishbrown or brownish-black below, between vibrissal angle and eye, and along inner margin. Facial ridge grey, with short hairs only halfway to antennal base. Vibrissal angle with one row strong bristles on inner margin, one row shorter bristles, and two rows weak short hairs which merge with those on facial ridge.

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Genae grey. Palpi black. Dorsum of thorax with presutural median black stripes separated by a single grey vitta. Postsutural median black stripe extending from suture to scutellum. bordered by two very narrow grey vittae, and wider than the distance between the prescutellar acrosticals. Scutellum with central black spot not as wide at base as distance between posterior pair of dorsocentrals and extending to tip of scutellum; sublateral grey vittae two-thirds as wide as central black spot; tip of scutellum sometimes reddish. Mesopleuron with ten to twelve posterior bristles, black on dorsal third and central to posteroventral fourth. Lower squama white (some specimens with lower squama yellow tinged at tip). Wings clear, vein R_{4+5} ending proximad or even with vein M_1 on wing margin. All coxae grey; all femora black to brown with grey dust laterally and ventrally; all tibiae very dark brown to black, mid tibia without an anterodorsal bristle; tarsi black. Abdomen, dorsally, dark grey and black with silver-grey vittae (as for male), but more confused and uneven. Central black disc on segment three and submedial black spots on segment five fringed with brown dust.

<u>Genitalia</u>. In lateral view (Fig. 50), subanal plate does not project beyond cercus; cercus rounded on posterior margin with a slight indentation on ventral margin posteriorly and sloping gradually anteriorly. In dorsal view (Fig. 51),

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eighth tergite narrow, only slightly indented anteriorly and posteriorly on dorsal surface; ninth tergite rounded posteriorly. In ventral view (Fig. 52), subanal plate flattened somewhat on posterior margin, and narrowed anteriorly.

Paratypes - 51 males, 31 females

Canada

Newfoundland: one female, Agric. Exp. Sta. St. John's, 26 July 1967, J.F.McA.(C.N.C.); two females, Top, Signal Hill, St. John's, 24 July 1962, J.F.McA.(C.N.C.).

Labrador: one female, Cartwright, 23 July 1955, E.E.S. (C.N.C.).

Nova Scotia: one female, Laurencetown, Halifax Co., 19-20 July 1967, D.M.W.(C.N.C.).

New Brunswick: one male, Barker Pt., 24 June 1914, F.M.McK.(C.N.C.); Birch Cove, nr. Chamcook, two females, 13 July 1957, one female, 14 August 1957, one female, 15 August, G.E.S.(C.N.C.); one female, Snowcap Pk., 1.2 mi. N. Upsalquitch Riv., Hwy. 17, 3 July 1971, B.V.P.(C.N.C.).

Quebec: one female, Duncan Lk., nr. Rupert, 30 July 1969, J.F.McA.(C.N.C.); one female, Gaspe Bay, 17 July 1931, J.M.A.(U.S.N.M.); King Mt., Gatineau Pk., three males 21 July

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1970, one male, 6 August 1970, two males, 9 June 1971, five males, 4 August 1971, P.W.A.(C.N.C.); four females, Laurentide Prov. Pk., 15 August 1971, D.M.W.(C.N.C.); La Verendrye Prov. Pk., mi 61, Rte. 58, one male, 16 August 1965, three males, 20 August 1965, three males, 21 August 1965, D.M.W.(C.N.C.); 01d Chelsea, one male, 14 June 1963, J.R.V.(C.N.C.), five males, 22 July 1968, D.M.W.(C.N.C.); four females, Ramsey Lk., 22 August 1971, D.M.W.(C.N.C.); Summit, King Mt., Old Chelsea, one male, 12 July 1970, one male, 19 August 1970, D.M.W.(C.N.C.).

Ontario: one male, Algonquin Pk., September 1952, W.R.T. (C.N.C.); one female, Hurkett, 12 August 1960, (C.N.C.); one female, London, 31 October 1956, W.W.J.(U.of W.O.); one male, Low Bush, Lake Abitibi, 21 July 1925, N.K.B.(C.N.C.); one female, Marmora, 15 July 1952, J.C.M.(C.N.C.); Mer Bleue Bog, Ottawa, one female, 3 June 1938, H.R.B.(C.N.C.), one male, 19 July 1963, J.R.V.(C.N.C.), one female, 19 May 1971, P.W.A. (C.N.C.); N. Burgess Twp., Lanark Co., two males, 14 July 1968, one male, 1 July 1970, one male, 19 July 1970, D.M.W.(C.N.C.); one male, Temagami, 19 August 1947, G.S.W.(C.N.C.).

Manitoba: two males, four females, Cedar Lk., July 1936, B(U.S.N.M.); one female, Churchill, 19 July 1950, H.J.T. (C.N.C.); one female, Ft. Churchill, 8 July 1952, C.D.B. (C.N.C.); one female, Gillam, 7 July 1950, J.F.McA.(C.N.C.);

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one male, one female, Mafeking, 3 September 1959, A.and J.B. (C.N.C.); two males, one female, 5 mi. S.W. Shilo, 16 June 1958, J.F.McA.(C.N.C.).

Alberta: one female, Banff, 21 August 1922, C.B.D.G. (C.N.C.); Sibald Crk., Morley, one male, 25 June 1968, two males, one female, 26 June 1968, one male, 27 June 1968, H.J.T.(C.N.C.).

British Columbia: one male, 32 mi S.W. Terrace, 6 June 1960, J.G.C.(C.N.C.).

United States

New Hampshire: one female, Base, Mt. Washington, 2,600', 31 August 1914, C.H.T.T.(U.S.N.M.).

Massachusetts: one female, Beverly, 18 July 1969, C.H.R. (U.S.N.M.).

Maryland: one male, Bar Harbor, 3 July 1918, C.W.J.(C.N.C.); one male, bog, nr. togue pond, Baxter St. Pk., 1-6 July 1968, D.M.W.(C.N.C.); one female, Mt. Desert, August 1921, (U.S.N.M.).

Michigan: one female, Cheboygan Co., 13 July 1931, H.B.H. (C.N.C.).)

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Discussion

<u>G. minuta</u> males can be separated from <u>G. maculata</u> males, as males of <u>maculata</u> have eyes extended to postocular bristles on back of head, central black spot on scutellum meeting lateral black spot at base, abdominal integument, dorsally, mostly orange to orange-brown in colour. <u>G. minuta</u> females can be separated from <u>G. maculata</u> females as <u>maculata</u> females have wide submedian grey vittae on dorsum of the thorax behind the suture, and the posterior median black spot as wide as distance between prescutellar acrosticals but very short in length, not extending to a level with posterior margin of the sublateral black stripes. <u>G. minuta</u> males and females can be separated from males and females of other species of Graphomya from North America by the key characters.

Life Stages .

Egg: Twenty eggs were extracted from a female taken by Dr. D. M. Wood in the Laurentide Park, Quebec, on 15 August 1971. The eggs were cream coloured, approximately 1.65mm. long, and approximately 0.40mm. wide. The eggs could be favourably compared descriptively with the description previously given for eggs of <u>Graphomya</u>, except that the flanges represent about forty percent of the width of the egg and have more serrations on the lateral margins near the ends of the flanges.

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Larva: one larva was taken in a swamp at Sibbald Creek, Morley, Alberta, by Dr. H. J. Teskey on 16 June, 1968, and stored in alcohol (Fig. 53). It was white in colour, and about 15mm. long, with creeping welts on segments five to ten (Fig. 54).

Pupa: One pupa was taken at the Mer Bleue Bog, Ottawa, Ontario, on 19 May, 1971, in wet <u>Sphagnum magellanicum</u> Brid., just above the water-line (Fig. 55). The pupa was dark brown in colour, about 6.81mm. long, and was reared to maturity on 31 May, 1971 (Fig. 56). A pupal stage of approximately twelve days in length corresponded with longevity records kept for several pupae found in the same locality as the larva described above by Dr. H. J. Teskey. Length of the pupae varied from 6.81mm. to 8.01mm., and each pupa had a short black spicule on the anterior-third just behind the opening (Figs. 57, 58).

Adult: Adult male <u>minuta</u> have been taken on a small maple bush beside a temporary woodland pool at the end of the trail leading to the survey cairn on top of King Mt., Gatineau Pk., Quebec (Fig. 59). The males were seen to take up stations on the upper leaves of the maple bush, where they seemed to face the sun directly. Dr. D. M. Wood made an important discovery when he caught female G. minuta while

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they were feeding on honey dew of the aphid, <u>Bornerina</u> <u>variabilis</u> Richards, on <u>Alnus crispa</u> (Ait) Pursh, near a boreal bog beside a lake in Laurentide Pk., Quebec, on 15 August 1971. Adults have also been taken on sedges, and on flowers of Heracleum and Solidago.

<u>Distribution</u>. Distribution of <u>Graphomya minuta</u> is very similar to that of <u>G. idessa</u> Walk. with range extensions into Newfoundland and Nova Scotia, southward along the eastern coast to Maryland, and in the north as far as Churchill, Manitoba, and in the west to Terrace, British Columbia (Map 6).

Graphomya ungava new species

Holotype. Male, Great Whale River, Quebec, 31 July 1949, J. R. Vockeroth. Holotype deposited in the Canadian National Collection, Ottawa, Canada.

Description of the Holotype

<u>Head</u>. Frontal length 1.21mm., frontal width 0.30mm. Frontal vitta black, brown dusted. Frontal bristles nine in number (most missing). Parafrontals with silver pollinosity, appearing narrow along whole length due to hairs on outer margin, and pinched out by black ocellar triangle. Second antennal segment grey; third antennal segment dark reddish-brown with grey pollinosity; aristal rays longer and more numerous

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above. Face grey with brown dust centrally. Parafacials with silver pollinosity above and brownish-black colour below. Facial ridge dark grey with hairs over halfway to the antennal base. Vibrissal angle almost continuous with facial ridge and no wider, with one row large bristles, one row weaker shorter bristles and strong hairs continuous with those on facial ridge. Genae grey. Palpi brownishblack with yellow tips. Eyes densely haired, with hairs not much shorter below than those above. Eyes extended to postocular bristles on back of head.

<u>Thorax</u>. Dorsum of mesonotum black with dark bluishgrey vittae. Central presutural black stripes separated by a single wide grey vitta. Postsutural median black stripes separated by two grey vittae, central stripe extending from suture to scutellum, wider below, but enclosed by the prescutellar acrosticals. Scutellum with large central black spot reaching tip of scutellum, sublateral grey vittae narrow and dark reddish-brown tinged, lateral black stripes wide. Lower squama light brownish-yellow, and with fine white hairs along lower margin. Mesopleuron haired on posterior half, and with fifteen posterior bristles. Fore femur dark reddishbrown mostly covered by grey dust; mid femur similar but with less dusting; hind femur darker above than the fore femur. All tibiae reddish-brown, slightly grey dusted; mid tibia with

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an anterodorsal bristle. Tarsi black, with hind tarsus brown below. Wings slightly infuscated near base; vein R_{4+5} and vein M_1 ending on wing margin equidistant from wing tip.

Abdomen. Posterolateral portion of segment two, segment three from lateral margin to bluish-grey vitta surrounding central black spot, and anterolateral half of segment four orange-brown. Segment three with hairs on central black disc as long as half the length of the segment. Segment two predominantly black dorsally, and reddish-grey sublaterally. Segment five with two submedian black spots and a narrow median black stripe from the anterior margin to a level between the spots, and mostly with light bluish-grey to dark grey vittae. Posterior margin of segments three and four with orangebrown colour.

Allotype. Female, same data as holotype, deposited in the Canadian National Collection, Ottawa, Canada.

Description of the Allotype

The allotype differs from the holotype by the major female characters and by the following characteristics: frontal length 1.06mm., frontal width 1.22mm.; frontal vitta with grey vitta extended around ocellar triangle; parafrontals without pollinosity on greyish-black integument above, with abundant black hairs and with silver pollinosity below; 7

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parafacials with silver-grey pollinosity above, below with reddish-brown colour to vibrissal angle; eyes evenly haired with hairs of the same length throughout; postsutural central black stripe on dorsum of thorax about as wide as distance between prescutellar acrosticals and extending from the scutellum almost to the suture; dorsal central black spot on the scutellum as wide at base as the preceding black stripe, narrowing sharply and then widening again at a level with the first lateral scutellar bristle; submedian grey vitta of scutellum almost as wide as the central black spot; mid right leg missing; posterior mesopleural bristles thirteen in number; abdominal pattern as for the holotype but without orange-brown integumental colour.

Description of Graphomya ungava

Males.

Frontal length of head, range 1.20mm. to 1.34mm., mean 1.25mm., \underline{n} =14; frontal width, range 0.25mm. to 0.30mm., mean 0.26mm., \underline{n} =14. Parafacials on some specimens rubbed below with silver-grey pollinosity absent. Reddish-brown between eye and vibrissal angle varied in intensity. Vibrissal angle on some specimens wider than facial ridge. Some specimens with eye hairs less numerous below than on upper half to twothirds. Other head characters same as holotype. Thorax as for

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holotype with the following variations: some specimens with thoracic black stripes brownish tinged and grey vittae darker; postsutural central stripe extended anteriorly; posterior mesopleural bristles twelve to fourteen in number; grey vittae of scutellum reddish tinged; mid tibia with an anterodorsal bristle; grey dust on legs varied in amount. Abdomen as for holotype, with minor variations in the extent and intensity of grey vittae.

Genitalia. In posterior view (Figs. 60, 61), innermost margin of cerci apparently joined below and extended dorsally at an angle forming a V-shape before margins curve outward to top, ventral portion of cercus about a sixth of the widest portion of the cercus; outer posterior portion of surstylus about half as long as cercus, and with dorsal part narrow and hooked slightly inwards, ventral portion widest below articulation point with cercus and angled inwards. In lateral view (Fig. 62), cercus with outer margin curved slightly anteriorly on dorsal half, curved slightly posteriorly at mid margin and straight ventrally with slight posterior curve at bottom, dorsal margin slanted downwards from posterior side to form a thin knob with the anterior margin being outcurved centrally leading to a narrow ventral portion. Extension of the surstylus widest at base and tapering to blunt point dorsally, paraphallus slightly S-shaped anteriorly;

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postgonite with posterior end slightly bent ventrally, ventral margin flat after bend, dorsal margin slightly curved ventrally near posterior end; epiphallus, dorsally, with a knob-like extension at one-quarter the distance from the anterior end. In ventral view (Fig. 63), fifth sternite widest posteriorly with lateral margins curving inwards at the central point and then straight to flat anterior margin; with more bristles on anterolateral quarter and largest bristles on posterolateral quarter.

Females.

Frontal length of head, range 0.82mm. to 1.18mm., mean 1.02mm., <u>n</u>=35; frontal width, range 1.00mm. to 1.32mm., mean 1.17mm., <u>n</u>=35. Parafacials with silver-grey pollinosity above and reddish-brown along facial ridge and near vibrissal angle (some specimens with grey below). Parafrontals with silver-grey pollinosity and many long black hairs concentrated somewhat on upper half. Frontal bristles seven to eight in number. Frontal vitta black with brownish dust and with grey triangular vitta enclosing ocellar triangle. Second antennal segment black, third segment grey, arista brown to black with rays longer and more numerous above. Face grey with a median black stripe from facial angle to oral margin or completely grey. Facial ridge grey with a single row of short hairs halfway to antennal base. Vibrissal angle grey, with

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inner row of bristles strong, second row shorter and weaker; oral vibrissa and bristle immediately ventrad to it about same size. Eyes haired to same extent overall, hairs same length or slightly longer above. Ocellar triangle black. Palpi black. Postocular area grey. Central dorsal presutural grey vitta of thorax wider before suture. Postsutural central black stripe triangular-shaped, from narrowest point at or behind suture to widest point which is no wider than distance between prescutellar acrosticals. Pleurae as in males, mesopleuron with fourteen to fifteen posterior bristles. Lower squama yellowish-white. Scutellum with central dorsal brownish-black spot at narrowest point as wide as preceding black stripe; grey vittae almost as wide as central black spot. Legs and wings as on male. Second segment of abdomen mostly black dorsally with posterolateral and median grey vittae (some specimens with more grey medially and submedially). Segment three mostly grey, with central black disc bordered by silver-grey vitta and submedially with large trapezoidalshaped black markings (some specimens with submedial markings narrowed anteriorly, obscured there somewhat by grey vitta), laterally with posterior black spots preceded by grey vitta. Segment four of abdomen dorsally with median black spot narrower than on segment three, submedial markings reduced to posterior black spots preceded by grey vittae, lateral

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markings same as for segment three. Segment five of abdomen same as for male but narrowed at apex.

<u>Genitalia</u>. In lateral view (Fig. 64), cercus almost rectangular-shaped, dorsally with central point, at posterior end ventral three-quarters of margin nearly flat, ventral margin with central out-curved portion, anteroventral margin narrowed forming a knob-like extension leading to curved anterior margin; subanal plate ending just past cercus; seventh tergite wider dorsally, anterolateral margin with two V-shaped indentations. In dorsal view (Fig. 65), ninth tergite with rounded indentation on posterior margin, and sub-bell-shaped overall. In ventral view (Figs. 66, 67), subanal plate widest at posterior third, narrowed slightly to anterior third, and curved inwardly to an anterior point; first sternite as for <u>G. occidentalis</u> but with mid-posterior indentation narrower and deeper.

Paratypes - 14 males, 36 females

Canada

Newfoundland: one female, Bell Is., 4-7 August 1967, J.F.McA.(C.N.C.).

Labrador: Cartwright, one female, 23 July 1955, E.F.C. (C.N.C.), one female, 24 July 1955, one male, 26 July 1955,

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E.E.S.(C.N.C.), two males, two females, 28 July 1955, one female, 29 July 1955, E.F.C.(C.N.C.); Hebron, one female, 10 July 1954, J.F.McA.(C.N.C.), one female, 16 July 1954, E.E.S.(C.N.C.), one female, 17 July 1954, J.F.McA.(C.N.C), one male, 9 August 1954, E.E.S.(C.N.C.); one male, Hopedale, 19 July 1927, W.W.P.(C.N.C.); one female, Menihek, 25 July 1954, T.N.F.(C.N.C.).

Quebec: Ft. Chimo, one male, 6 July 1954, H.H.(C.N.C.), three females, 6 July 1954, J.F.McA.(C.N.C.); Gt. Whale Rv., one male, 12 July 1949, one male, 25 July 1949, one male, one female, 31 July 1949, one female, 1 August 1949, nine females, 2 August 1949, one male, 13 August 1949, J.R.V. (C.N.C.); Indian House Lk., two females, 8 July 1954, R.C. (C.N.C.), one female, 8 July 1954, W.R.R.(C.N.C.), one female, 17 July 1954, W.R.R.(C.N.C.), one female, 18 July 1954, W.R.R.(C.N.C.), one female, 22 July 1954, R.C.(C.N.C.), one female, 24 July 1954, W.R.R.(C.N.C.).

British Columbia: one female, Moosehorn Lk., 58°10'N., 132°07'W., 4,500', 30 July 1960, W.W.M.(C.N.C.).

Yukon Territory: one female, La Force Lk., 132^o20'W., 62^o41'N., 3,000'. 11 July 1960, E.W.R.(C.N.C.), Otter Lk., one female, 130^o25'W., 62^o30'N., 4,000', 16 July 1960, J.E.H.M.

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(C.N.C.), one male, 28 July 1960, E.W.R.(C.N.C.); two males, Sheldon Lk., 131⁰06'W., 62⁰40'N., 3,000', 21 July 1960, J.E.H.M.(C.N.C.).

United States

Alaska: one male Anchorage, 15 June 1921, J.M.A. (U.S.N.M.).

Discussion.

Males of <u>G. ungava</u> can be separated from males of <u>G. maculata</u> as <u>maculata</u> males have eye hairs shorter on lower third, central dorsal black spot on scutellum reaching the lateral black spots, a dorsal postsutural central black stripe on the thorax not separated by grey vittae, and abdominal integument mostly orange to orange-brown in colour. Female <u>G. ungava</u> can be separated from females of <u>G. maculata</u> as female <u>maculata</u> have eyes with few hairs above and those on lower part (if any) much shorter and fewer in number, and the median postsutural black stripe short not reaching the level of the posterior margin of the sublateral black stripes. Male and female <u>ungava</u> can be separated from other species of North American Graphomya by the key characters.

<u>Distribution</u>. Mostly subarctic in distribution, <u>G. ungava</u> is found along the eastern coast of Labrador, inland Labrador,

along the coast of Hudson's Bay, northern Newfoundland, northern British Columbia, in the Yukon Territory and on the south-west coast of Alaska (Map 7).

Graphomya alaskensis new species

Holotype. Male, Umiat, Alaska, 18 July 1959, J.E.H. Martin. Holotype deposited in the Canadian National Collection, Ottawa, Canada.

Description of the Holotype

Head. Frontal length 1.14mm., frontal width 0.25mm. Frontal vitta black with light brown dust, front slightly folded lengthwise in middle. Parafrontals with silver-grey pollinosity, narrowed towards black ocellar triangle. Nine weak frontal bristles: hairs above bristles extend almost to ocellar triangle. Second antennal segment light black, third segment grey, aristal hairs longer and more numerous above. Face grey. Facial ridge greyish-black, raised somewhat above parafacials, with hairs almost to antennal base. Parafacials with silver-grey pollinosity above and reddish-brown below near the vibrissal angle. Vibrissal angle greyish-black with one row of strong bristles and strong hairs merging with those on facial ridge. Genae grey. Palpi dark reddish-brown. Eyes haired, shorter and fewer on lower quarter than above and longest in middle; eyes extending to postocular bristles on back of head.

Thorax. Dorsum of thorax black with grey vittae. Presutural and postsutural central black stripes intact. Posterior portion of postsutural stripe wider than distance between prescutellar acrosticals. Scutellum with large central triangular black spot wider at base than width of postsutural black stripe; submedian vittae greyish-orange-brown, particularily towards end of the scutellum. Mesopleuron mostly black, grey dusted anteriorly, with fourteen posterior bristles. Squama white, yellowish around margin, with white hairs. Wings clear, vein R_{4+5} ending just proximad to wing tip, wings slightly tattered around ventral margin. A11 coxae grey. All femora reddish-black, dusted grey. Tibiae reddish-brown-black; mid tibia with an anterodorsal bristle. Tarsi black.

Abdomen. Integument, black dorsally with orange posterolaterally on segment two and anterolaterally on segment three; other markings silver to dark grey. Segment two with black laterally and sublaterally, anteriorly with median and submedian grey vittae to a central oval black spot. Segment three with central black spot, submedian black inverted Tshaped spots almost touching central spot posteriorly, and with posterolateral black spots. Segment four with submedian and lateral black spots reduced. Segment five with central black marking ending at a level with the ends of the two

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submedian black spots; remainder of segment five grey dusted. Hairs on central black spot of segment three about one-half as long as segment, lateral hairs short and nearly flattened to the integument.

Allotype. Female, Umiat, Alaska, 7 July 1959, R. Madge. Allotype deposited in the Canadian National Collection, Ottawa, Canada.

Description of the Allotype

The allotype differs from the holotype by the major female characteristics and by the following: frontal length of the head 1.20mm., frontal width 1.32mm.; parafacials with silver-grey pollinosity overall; facial ridge with only a very few short hairs near vibrissal angle; palpi black; outer margin of eyes devoid of hairs; postsutural central black stripe very narrow at suture but widening below to greater than distance between prescutellar acrosticals; vein R_{A+5} and vein M_1 equidistant from wing tip; dorsal central black spot on scutellum wider at base than preceding black stripe, widening at a level with the first lateral scutellar bristle then narrowing to tip; apex of black spot slightly brownish in colour; tibiae dark reddish-brown; hind tarsus with brown ventrally; abdominal integument without orange colour; sublateral black marking on segment three only on posterior half of segment, preceded by grey vitta; central black disc

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on segment three not reaching posterior margin; sublateral black marking on segment four only half the size of the one on segment three; central black disc on segment four nearly same size as one on segment three; lateral black spot on segment four reduced to a very small spot on posterior margin; segment five with central black stripe narrow and about half the length of the segment.

Description of Graphomya alaskensis

Males.

Frontal length of the head, range 1.04mm. to 1.42mm., mean 1.19mm., \underline{n} =17; frontal width, range 0.21mm. to 0.37mm., mean 0.28mm., \underline{n} =17. Frontal vitta dark brown to black. Frontal bristles ten to fourteen in number. Parafrontals with long black hairs extending onto frontal vitta. Parafacials and parafrontals with silver-grey pollinosity. Vibrissal angle with one row strong bristles and two to three rows of strong hairs. Face grey with central brownish dusted stripe of varying intensity. Other head characters as for holotype. Presutural, central black stripes of thorax separated by two narrow grey vittae (in some specimens stripes not divided). Postsutural central thoracic stripe wider posteriorly than the distance between the prescutellar acrosticals. Scutellum 7

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with reddish tinge on tip. Posterior mesopleural bristles fourteen to seventeen in number. Mid tibia with an anterodorsal bristle. Squama white to light yellowish-brown. Remainder of thorax as on holotype. Dorsum of abdomen of some specimens with orange integumental colour on segments two, three, and four absent and black markings on abdomen large.

Genitalia. In posterior view (Fig. 68), ventral inner margin of cercus short, weakly joined ventrally to other cercus, wider apart dorsally, ventral extension of cercus short almost as wide as the remainder; ventral outer margin with outcurved portion before ventral extension, dorsal outcurved projection weak; surstylus below, elongate ovalshaped, anterior dorsal section widest behind cercus, outer projection short, not as long as ventral half. In lateral view (Fig. 69), apex of postgonite hooked ventrally, about half as wide posteriorly as anteriorly; paraphallus with anterior end hooked ventrally, dorsally with incurved notch before hook; epiphallus flat dorsally, slightly wider at posterior end; surstylus with central anteroventral projection, wider dorsally, and outer projection wider in mid line; cercus nearly as wide below as above, only slightly outcurved posterocentrally. In ventral view (Fig. 70), fifth sternite oval-shaped, most bristles confined to posterior half, strongest ones laterally.

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Females.

Frontal length of head, range 0.76mm. to 1.20mm., mean 1.05mm., n=74; frontal width, range 1.00mm. to 1.42mm., mean 1.22mm., n=74. Parafrontals with silver-grey pollinosity. Frontal bristles six to eight in number. Frontal vitta black (some specimens with reddish-brown), with brownish dust and a median triangular grey vitta extending from anterior ocellus to the antennal base, and with black hairs inside frontal bristles to grey vitta. Antennal segments dark grey, aristal rays longer above (some specimens with rays below almost as long as those above). Parafacials with grey pollinosity except for reddish-brown on lower part (some specimens with overall grey pollinosity). Facial ridge grey with three rows of short hairs less than halfway to the antennal base (in some specimens hairs halfway to antennal base or closer). Most of vibrissal angle grey with reddish-brown on ventral portion. Outer lower margin of eye weakly sinuate. eyes haired evenly or with more above or with hairs absent on lower third. Ocellar triangle black, surrounded by brownish dust to back of triangle. Palpi black (some specimens with reddish-brown palpi). Dorsum of thorax with presutural central black stripes separated by one grey vitta being wider at suture than either black stripe. Central postsutural black stripe extending from a narrow point at suture to a width

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behind wider than distance between prescutellar acrosticals. Scutellum with central black spot as wide or wider at base than width of preceding black stripe; submedian grey vitta almost as wide as central spot; tip with slight reddish tinge. Wings clear, vein R_{4+5} and vein M_1 equidistant from wing tip. Lower squama white. Legs mostly black (some specimens with dark reddish-brown femora and tibiae), with or without grey dusting on ventral and lateral surfaces; mid tibia usually with an anterodorsal bristle. Abdomen black with grey and silver vittae, pattern much the same as for males but without orange markings, median black stripe on segment five larger and central hairs on segment three suberect.

<u>Genitalia</u>. In lateral view (Fig. 71), cercus on dorsal surface flat anteriorly, angled obliquely dorsally to curvature, then flat to semi-truncate posterior margin, ventral margin outward curved centrally to narrow anteroventral projection leading to curved anterior margin; eighth tergite nearly rectangular except for dorsal margin which is downward curved anteriorly; seventh tergite saddle-shaped with an anterodorsal projection, with anteroventral hooked projection, and at narrowest point ventrally about one-third as wide as dorsal length. In dorsal view (Fig. 72), posterior margin of eighth tergite with slight median notch, anterior margin with

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deep U-shaped or V-shaped notch. In ventral view (Figs. 73, 74), subanal plate with slight posterior indentation; ninth sternite with large bristle on posterolateral corner.

Paratypes - 17 males, 73 females

Canada

Yukon Territory: La Force Lk., $132^{\circ}20$ 'W., $62^{\circ}41$ 'N., one female, 5 July 1960, J.E.H.M.(C.N.C.), one female, 11 July 1960, E.W.R.(C.N.C.); North Fork Crossing, mi. 43, Peel P1t. Rd., 3,500', one male, 25 June 1962, one female, 4 July 1962, R.E.L.(C.N.C.); Rampart House, two females, 7 July 1951, one female, 12 July 1951, two females, 13 July 1951, one female, 19 July 1951, two females, 22 July 1951,J.E.H.M.(C.N.C.), one female, 13 July 1951, one female, 18 July 1951, C.C.L.(C.N.C.); one male, Sheldon Lk., 131⁰06'W., 62⁰40'N., 3,000', 21 July 1960, J.E.H.M.(C.N.C.).

North West Territories: one female, Aklavik, 18 July 1932, Bryant, Lot 305 (U.S.N.M.); Ft. McPherson, one female, 20 July 1957, S.D.H.(C.N.C.), four females, 25 July 1957, R.H.(C.N.C.); Reindeer Depot, Mackenzie Delta, one male, 7 July 1948, J.R.V.(C.N.C.), one male, 2 August 1948, W.J.B. (C.N.C.), one female, 10 August 1948, W.J.B.(C.N.C.), one female, 10 August 1948, J.R.V.(C.N.C.); one female, Inuvik, 26 July 1965, S.(C.N.C.).

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United States

Alaska: three males, one female, Healy, 6 July 1921, J.M.A. (U.S.N.M.); King Salmon, Naknek Riv., one female, 4 July 1952. W.R.M.M.(C.N.C.), one female, 5 July 1952, J.B.H.(C.N.C.), one female, 13 July 1952, J.B.H.(C.N.C.), five females, 19 July 1952, W.R.M.M. (C.N.C.); one male, four females, Matanuska, 44-27645 trap, June 1944, J.C. (U.S.N.M.); On Tundra, Naknek, five females, 18 July 1952, one female, 19 July 1952, three females, 21 July 1952, J.B.H. (C.N.C.); one female, Popoff Is., 10 July 1899, Harriman Exp., T.K. (U.S.N.M.); two males, Savonoski, Naknek Lk., June 1919, J.S.H. (U.S.N.M.); Umiat, one male, 4 July 1959, J.E.H.M. (C.N.C.), eleven females, 7 July 1959, R.M. (C.N.C.), one female, 7 July 1959, J.E.H.M. (C.N.C.), four females, 11 July 1959, R.M. (C.N.C.), one male, 12 July 1959, R.M. (C.N.C.), one male, one female, 19 July 1959, J.E.H.M. (C.N.C.), three males, one female, 21 July 1959, J.E.H.M. (C.N.C.), one female, 23 July 1959, J.E.H.M.(C.N.C.), one female, 24 July 1959, R.M. (C.N.C.); Unalakleet, one female, 8 August 1961, one female, 9 August 1961, one male, 10 August 1961, one female, 14 August 1961, one female, 15 August 1961, B.S.H. (C.N.C.).

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Discussion.

Males of <u>G. alaskensis</u> have eyes extending to postocular bristles on back of head, as do males of <u>G. maculata</u>. However, males of <u>maculata</u> have predominantly orange abdominal integument, central black spot on scutellum reaching lateral black spots, lower squama brown, third abdominal segment without submedian black markings, and mid tibia without an anterodorsal bristle. Females of these two species can be separated as female <u>maculata</u> have eyes nearly devoid of hairs on lower half and central dorsal postsutural black posterior stripe on thorax not reaching the suture. Male and female <u>alaskensis</u> can be separated from the other northern species, <u>idessa</u>, <u>ungava</u> and <u>transitionis</u> by the characters given in the key.

<u>Distribution</u>. Subarctic and Arctic along the coast of Alaska and North West Territories and inland following river systems in Alaska and Yukon Territory (Map 8).

Graphomya transitionis new species

 Holotype. Male, Agric. Exp. Sta. St. John's, Newfoundland,
9 August 1967, J. F. McAlpine. Holotype deposited in the Canadian National Collection, Ottawa, Canada. -120-

Description of the Holotype

Head. Frontal length 1.36mm., frontal width 0.35mm. Parafrontals with silver-grey pollinosity. Frontal vitta black in dorsal view, brownish in frontal view. Frontal bristles ten in number. Front with many black hairs on vitta and ridge. Ocellar triangle black. Frontal vitta at narrowest point not as wide as distance between posterior ocelli. Parafacials with silver-grey pollinosity from antennal base triangularly along eye margin, more brownish along facial ridge and below. Antennal segments brownishgrey, aristal rays very short below except for apical few. Face mostly grey with median band brown dusted above to blackish-grey below. Vibrissal angle grey, oral vibrissa longest, immediate ventral bristle almost as long; second row of weak bristles less than one-half as long as first row. Facial ridge grey with three rows of short hairs almost reaching antennal base. Genae blackish-grey. Eyes haired on dorsal three-quarters to same extent, hairs absent on lower quarter and along outer margin of eye; eyes extending to postocular bristles on back of head. Palpi black.

<u>Thorax</u>. Presutural central dorsal black stripes separated by two grey vittae. Postsuturally, black stripes separated by continuation of presutural grey vittae. Central posterior

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postsutural black stripe wider than distance between prescutellar acrosticals. Mesopleuron mostly black, anterior grey, haired black on posterior two-thirds and with seventeen posterior bristles. Lower squama nearly white. Scutellum with base of central dorsal black spot about one-third larger than width of preceding black stripe, submedian grey vittae reddish along edge of scutellum and dorsally. Legs mostly black; femora reddish-brown ventrally and apically; tarsi black above, brownish below; mid tibia with an anterodorsal bristle. Wings clear, vein R_{4+5} and vein M_1 equidistant from wing tip and vein R_{4+5} slightly proximad to vein M_1 on wing margin.

Abdomen. Dorsum of segment two black laterally and submedially except for posterolateral orange integumental colour, and with central black disc bordered by grey vittae. Segment three with central black subtriangular disc, bordered laterally by cup-shaped grey vittae covered by silver pollinosity; lateral and submedial orange integument obscured by silver-grey pollinosity except on area of submedian black angle-shaped pattern and on posterolateral black spot. Segment four with central black narrow spot fringed with grey mottled by silver-grey pollinosity; submedian black pattern reduced to a spot; lateral spot black; anterior margin

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with orange laterally. Segment five with anterior central black line flanked by two black spots; remainder of segment grey with silver-grey pollinosity.

Allotype. Female, St. Mary's, Newfoundland, 10 August 1967, J. F. McAlpine. Allotype deposited in the Canadian National Collection, Ottawa, Ontario.

Description of the Allotype

The allotype differs from the holotype by the major female characters and by the following: Frontal length 1.24mm., frontal width 1.36mm.; a large grey central stripe on frontal vitta; frontal vitta with two to three rows of black hairs on outer margins; second antennal segment grey; hairs on facial ridge few and not reaching halfway to the antennal base; vibrissal angle with two rows of short bristles; eyes haired overall, those hairs on upper half of eye slightly longer; central dorsal postsutural thoracic black stripe as wide as distance between prescutellar acrosticals, and almost reaching suture anteriorly; central dorsal black spot on scutellum narrow anteriorly, wider at anterior third and narrowing slightly to a reddish-brown tip; submedian grey vitta on scutellum almost as wide as central black spot; femora grey dusted ventrally and laterally; dorsum of abdomen without orange integument, as in male; segment two with definite posterior submedian black marking; segment three with submedian

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black marking reduced to posterior half of the segment; fifth segment with very short black central stripe, submedian black spots small, and remainder with grey dust.

Description of Graphomya transitionis

Males.

Frontal length of head, range 1.14mm. to 1.42mm., mean 1.34mm., <u>n</u>=15; frontal width, range 0.19mm. to 0.35mm., mean 0.28mm., <u>n</u>=15. Frontal bristles ten to twelve in number. Some specimens with very light yellow tinge on parafacials near antennal base. Some specimens with eye hairs on lower quarter as long as those above. Some specimens with palpi grey-reddish-black. Other head characters as on holotype. Some specimens with thoracic dorsal median black postsutural stripe as wide as distance between prescutellar acrosticals. Posterior bristles on mesopleuron seventeen to twenty-one in number. Some specimens with legs reddish-brown to reddishblack with tarsi black below. Other thoracic characters as on holotype. Fifth abdominal segment on some specimens with central black stripe very short, with more grey vittae and silver pollinosity, and submedian black spots much larger.

<u>Genitalia</u>. In posterior view (Figs. 75, 76), cerci weakly joined ventrally, inner section of cercus short, slightly bent posteriorly, ventral section short, outer margin below articulation point with surstylus slightly sinuate, dorsal section on outer margin with large outer lobe; ventral portion of surstylus very rounded, almost oval-shaped, lateral extension narrow along length. In lateral view (Fig. 77), paraphallus bent downward from centre, anterior third with dorsal indentation; postgonite wide at posterior end, with a strong notch ventrally; epiphallus wider at posterior end, rounded at end and with curved posteroventral margin; cercus wider dorsally; surstylus round below, posterior section wide at mid line, and with tip slightly hook-shaped. In ventral view (Fig. 78), fifth sternite with sides nearly parallel, bristles strong on anterolateral third.

Females.

Frontal length of head, range 0.90mm. to 1.28mm., mean 1.13mm., \underline{n} =25; frontal width, range 1.02mm. to 1.40mm., mean 1.19mm., \underline{n} =25. Parafrontals with silver-grey pollinosity. Frontal bristles eight to twelve in number. Three to four rows of black hairs outcurved on parafrontals along whole length to the anterior bristle. Frontal vitta black (brown in some specimens), brownish dusted, with median grey clubshaped vitta, and with black hairs to grey vitta. Face mostly grey, with narrow central black stripe from facial

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angle to oral margin, slightly brownish between antennae. Antennae with second segment dark grey, third segment light Facial ridge grey, haired over halfway to antennal grey. base. Vibrissal angle mostly grey. Parafacials with grey pollinosity and reddish-brown along facial ridge (in some specimens parafacials totally grey pollinose). Palpi black (in some specimens reddish-brown). Eyes haired above, very few short hairs on lower half (in some specimens eyes bare Thoracic, presutural, median wide grey vitta separating below). two narrow black stripes. Postsuturally, median black stripe widening from suture to scutellum and no wider than distance between prescutellar acrosticals. Lower squama white. Wing with vein R_{4+5} and vein M_1 equidistant from wing tip. Scutellum with submedian grey vittae wide; median black spot arrowheadshaped, small, and slightly reddish at tip. Legs dark reddishbrown (black in some specimens), most femora grey dusted laterally and ventrally (to a lesser extent on those specimens with reddish-brown femora); mid tibia with an anterodorsal bristle. Abdomen with dark grey and silver-grey markings. Segment three with central black disc narrow to oblong-shaped; central black disc on segment four the same size as that on segment three. Submedian black markings on segments three and four restricted to posterior third of segment. preceded by grey. Fifth segment with narrow black stripe centrally and two large submedian spots.

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<u>Genitalia</u>. In lateral view (Fig. 79), cercus narrowed anteriorly, dorsal margin slightly dome-shaped, posterior margin flat dorsally, ventral margin slightly sinuate. In dorsal view (Fig. 80), eighth tergite with straight posterior margin and deep central anterior semi-tent-shaped notch. In ventral view (Fig. 81), subanal plate with narrow lobes at widest point.

Paratypes - 30 males, 28 females

Canada

Newfoundland: Agr. Exp. Sta., St. John's, four males, 3 August 1967, one male, 4 August 1967, four males, 9 August 1967, J.F.McA.(C.N.C.); one female, Gander, 5 July 1949, R.A.H.(C.N.C.).

Prince Edward Island: one male, Charlottetown, 7 June 1947, R.H.W.(C.N.C.).

Nova Scotia: one male, Kings Co., 18 August 1932, C.E.A. (C.N.C.).

New Brunswick: one male, Chamcook, 7 August 1957, G.E.S. (C.N.C.); one female, Nerepis, 11 July 1915, F.M.McK.(C.N.C.).

Labrador: Cartwright, one female, 23 July 1955, one male, 28 July 1955, E.F.C.(.C.N.C.).

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Quebec: one male, Abbotsford, 29 July 1937, G.E.S.(C.N.C); one male, Aylmer, 21 September 1924, C.H.C.(C.N.C.); one female, Cap Chat, 18 August 1954, W.J.B.(C.N.C.); one male, Cap Rouge, 4 August 1955, O.P.(C.N.C.); one female, Harrington Harb., 4 July 1929, W.J.B.(C.N.C.); one male, La Verendrye Prov. Pk., mi. 61, Rte. 58, 21 August 1965, D.M.W.(C.N.C.); one female, Lac Crescence, Kam. Co., 10 August 1957, W.R.M.M. (C.N.C.); one male, Mont. Joli, 1 August 1954, J.R.McG.(C.N.C.).

Manitoba: one male, Angusville, 20 July 1954, B.-W.(C.N.C.); one female, Bald Head Hills, 13 mi. N. Glenboro, sand dunes, ecol. data F.C., 21 June 1958, J.F.McA.(C.N.C.); two females, Churchill, 21 July 1949, J.A.S.(C.N.C.); one female, Warkworth Crk., near Churchill, 7 July 1952, J.G.C.(C.N.C.); one male, Winnipeg, 29 May 1925, A.V.M.(U.of M.).

Saskatchewan: one female, Attons Lk., 22 August 1940, A.R.B. (C.N.C.); one female, Esterhazy, 14 August 1954, B.-W. (C.N.C.); one female, Hudson Bay, 6 September 1959, A.and J.B. (C.N.C.); one female, Indian Head, 10 August 1954, B.-W. (C.N.C.); two males, Kenosee, 15 June 1958, A.R.B. (C.N.C.); two males, Wapella, 4 June 1958, D.M.W. (C.N.C.).

Alberta: two males, Edmonton, 24 June 1941, E.H.S.(U.of A.); one male, Webamun, 14 June 1931, E.H.S.(U.of A.). -

British Columbia: one female, Robson, 16 August 1948, H.R.F.(C.N.C.).

Yukon Territory: one female, Herschel Is., 24-28 July 1971, D.M.W.(C.N.C.); two females, Whitehorse, 28 August 1959, R.M.(C.N.C.).

Northwest Territories: one male, Eskimo Pt., 10 August 1950, G.R.B.(C.N.C.); Reindeer Depot, Mackenzie Delta, one female, 12 July 1948, J.R.V.(C.N.C.), one female, 5 August 1948, W.J.B.(C.N.C.).

United States

Alaska: two females, Matanuska, 44-27645 trap, June 1944, J.C.(U.S.N.M.).

North Dakota: one female, Lake Metigoshe, Turtle Mts., 20 June 1918, J.M.A.(U.S.N.M.).

Colorado: one female, Doolittle Ranch, Mt. Evans, 9,800', 10 August 1961, B.H.P.(C.N.C.); one female, Echo Lk., Mt. Evans, 10,600', 11 August 1961, C.H.M.(C.N.C.); Loveland Pass, W. slope, 9,850', one male, 3 July 1955, E.E.S.(C.N.C.), one male, 28 July 1961, B.H.P.(C.N.C.); one female, Marshall Pass, 10,856', 28 July 1908, J.M.A.(U.S.N.M.).

Michigan: one female, Brule Riv. Camp, Riordan Limits, 31 July 1918, (C.N.C.).

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Other: one female, 26-12, (U.S.N.M.).

Discussion.

G. transitionis males can be separated from males of G. macualta (Scopoli), as males of maculata have abdominal integument predominantly orange to orange-brown, with no sublateral black markings on segment three, no anterodorsal bristle on mid tibia and dorsal postsutural black stripe on thorax not divided. Females of G. transitionis can be separated from females of G. maculata, as females of maculata have postsutural central posterior black stripe short and wider than distance between prescutellar acrosticals; central dorsal black spot on scutellum wide at base, wider than preceding black stripe, fifth abdominal segment with two large spots flanking the central black stripe, and sublateral black markings on second abdominal segment joined to lateral black markings, posteriorly. G. transitionis males and females can be separated from North American species of Graphomya by the key characters.

<u>Life Stage</u>. Two pupal skins (with adults), from Churchill, Manitoba, are similar in structure to the pupal skins described for <u>G. minuta</u>, but are 10mm. and 10.5mm. long and the lateral anterior spicule is longer. Nothing else is known on the biology of this species.

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<u>Distribution</u>. Subarctic distribution in southern Alaska; central to northern trans-Canadian; and with southern intrusives into high altitude (9,880' to 10,850') areas of Colorado (Map 9).

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SUMMARY

The northern group of North American <u>Graphomya</u>, composed of the species, <u>G. alaskensis</u>, <u>G. ungava</u>, and <u>G. transitionis</u>, were the most difficult to separate conslusively, particularly the females. These species most closely resemble <u>Graphomya</u> <u>maculata</u> (Scopoli), and are the only species to share consistently the characteristic of having the eyes enlarged, extending to the postocular bristles on the back of the head. It may be found that these species will be relegated to subspecific status when more specimens are available.

The species <u>G. idessa</u> Walk. and <u>G. minuta</u> share morphological characteristics and generally the same range throughout North America and it is supposed that these species are closely allied systematically.

In California <u>G. occidentalis</u> seems to be a northern intrusive from Mexico and could be related to <u>Graphomya</u> <u>mexiciana</u> Gig. Tos. However, these species are easily separated by morphological characteristics.

<u>G. columbiana</u> seems to have evolved as an offshoot of one of the other species, probably <u>G. idessa</u>, and reached specific status along the western coasts of Canada and the northern United States, and is limited in distribution by the Rocky Mountsins.

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<u>G. americana</u> R.-D. probably evolved from a Neotropical intrusive from South and Central America and expanded its range northwards.

<u>G. interior</u> seems to be the only species from North America with a predominantly high altitude distribution, mainly in the Rocky Mountains of the United States. This species shows some morphological affinities with <u>G. occidentalis</u> in the west, with <u>G. columbiana</u> in the north, and with <u>G. americana</u> in the eastern part of its range.

The biology of North American <u>Graphomya</u> is not well enough known in order to give a complete ana/ysis of the nine species involved. New biological information is needed in order to clarify discrepancies at the generic level and also to enable taxonomists to clarify relationships at the specific level.

It is hoped that this revision will be of benefit to all those in muscid taxonomy and that it will encourage revision of the genus Graphomya on a world-wide basis.

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Zimin, L. S. 1951. Muscidae, pp. 240-248. In Fauna U.S.S.R. Ins. Dipt. 18(4). 286pp. Figure 1: Schematic diagram of head region of a male <u>Graphomya</u>, anterodorsal view.

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A. frontal width at anterior ocellus

B. frontal length from anterior ocellus to antennal base

Figure	2:	Schemat	cic	diagram	of	head	regio	n	of	a
		female	<u>Graphomya</u> ,		anterodorsal			vi	.ew.	

- C. frontal width at anterior ocellus
- D. frontal length from anterior ocellus to antennal base.



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Figure 3: Mer Bleue bog, east of Ottawa, Ontario.

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Figure 4: Mer Bleue bog, east of Ottawa, Ontario.

Figure 5: Ste. Scholastique bog, Quebec.



Figure 6: Left, male <u>Graphomya</u> <u>americana</u> with holoptic eyes; right, female <u>Graphomya</u> <u>americana</u> with dicoptic eyes.

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Figure 7: Schematic diagram of head region of a

male Graphomya, frontolateral view.

- A: front
- B: parafrontal region
- C: frontal bristles
- D: facial region
- E: parafacial region
- F: face
- G: vibrissal angle
- H: gena
- I: postocular bristles
- J: eye
- K: second antennal segment
- L: third antennal segment
- M: arista without rays
- N: ocellar triangle



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Figure 8: Schematic diagram of the thorax of male Graphomya, dorsal view.

A: presutural dorsocentral bristle

- B: presutural median black stripe divided by two grey vittae.
- C: suture
- D: postsutural dorsocentral bristle
- E: central postsutural black stripe
- F: prescutellar acrostical bristles
- G: dorsal median black spot on scutellum
- H: sublateral grey vitta on scutellum



Figure 9: Schematic diagram of wing of a male <u>Graphomya</u>.

- A: radial fork
- B: vein R_{4+5}
- C: vein M_1
- D: M-m crossvein



Figure 10: Posteroventral view, male genitalia, <u>G. occidentalis</u>.

Figure 11: Posterior view, male genitalia, <u>G. occidentalis</u>.

Figure 12: Lateral view, male genitalia, <u>G. occidentalis</u>.

Figure 13: Ventral view, fifth sternite, male, <u>G. occidentalis</u>.



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Figure 14: Lateral view, female genitalia, <u>G. occidentalis</u>.

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- Figure 15: Ventral view, subanal plate, female <u>G. occidentalis</u>.
- Figure 16: Ventral view, seventh sternite, female, <u>G. occidentalis</u>.
- Figure 17: Ventral view, fifth sternite, female, <u>G. occidentalis</u>.



Figure 18: Posterior view, male genitalia, <u>G. columbiana</u>.

- Figure 19: Posterior view, male genitalia, <u>G. columbiana</u>.
- Figure 20: Lateral view, male genitalia, <u>G. columbiana</u>.
- Figure 21: Ventral view, fifth sternite, male, <u>G. columbiana</u>.



Figure 22: Lateral view, female genitalia, <u>G. columbiana</u>.

Figure 23: Dorsal view, female genitalia, <u>G. columbiana</u>.

Figure 24: Ventral view, subanal plate, female, <u>G. columbiana</u>.

Figure 25: Ventral view, sternites seven to nine, and subanal plate, female, <u>G. columbiana</u>.



Figure 26: Posterior view, male ganitalia,

G. interior.

Figure 27: Lateral view, male genitalia, <u>G. interior</u>.

Figure 28: Ventral view, fifth sternite, showing bristle scars, male, <u>G. interior</u>.



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Figure 29: Lateral view, female genitalia, <u>G. interior</u>. -----

Figure 30: Dorsal view, female genitalia, <u>G. interior</u>.

Figure 31: Ventral view, seventh to ninth sternite and subanal plate, female, <u>G. interior</u>.



Figure 32: Posterior view, male genitalia, <u>G. americana</u>.

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Figure 33: Posterior view, male genitalia, <u>G. americana</u>.

Figure 34: Lateral view, male genitalia, <u>G. americana</u>.

Figure 35: Ventral view, fifth sternite, male, <u>G. americana</u>.









Figure 36: Lateral view, female genitalia, <u>G. americana</u>.

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- Figure 37: Ventral view, subanal plate, female, <u>G. americana</u>.
- Figure 38: Dorsal view, ninth tergite, female, <u>G. americana</u>.



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- Figure 39: Posterior view, male genitalia, <u>G. idessa</u> Walk.
- Figure 40: Posterior view, male genitalia, <u>G. idessa</u>.
- Figure 41: Lateral view, male genitalia, <u>G. idessa</u>.
- Figure 42: Ventral view, fifth sternite showing bristle scars, male, <u>G. idessa</u>.









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Figure 43: Dorsal view, ninth tergite, female, <u>G. idessa</u>.

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Figure 44: Lateral view, female genitalia, <u>G. idessa</u>.

Figure 45: Ventral view, ninth sternite, subanal plate, female, <u>G. idessa</u>.


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Figure 46: Posterior view, male genitalia, <u>G. minuta</u>.

Figure 47: Lateral view, male genitalia, <u>G. minuta</u>.

Figure 48: Lateral view, male genitalia, <u>G. minuta</u>.

Figure 49: Ventral view, fifth sternite, male, <u>G. minuta</u>. .





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Figure 50: Lateral view, female genitalia, <u>G. minuta</u>.

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- Figure 51: Dorsal view, female genitalia, <u>G. minuta</u>.
- Figure 52: Ventral view, subanal plate, female, <u>G. minuta</u>.









Figure 53: Ventral view, larva, <u>G. minuta</u>.

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Figure 57: Lateral view, pupa, <u>G. minuta</u>.

Figure 58: Lateral view, pupa, <u>G. minuta</u>.







Figure 54: Photograph of larva of <u>Graphomya minuta</u>, ventral view of a creeping welt.

Figure 55: Photograph of area in which pupa of <u>G. minuta</u> was found in Mer Bleue bog, east of Ottawa, Ontario.



Figure 56: Photograph of pupal skin of <u>Graphomya</u> <u>minuta</u>, found in Mer Bleue bog.

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Figure 59: Photograph of temporary woodland pool, summit, King Mt., Gatineau Pk., Quebec, around which <u>G. minuta</u> males have been collected on small maple shrubs.



Figure 60: Posterior view, male genitalia,

G. ungava.

Figure 61: Posterior view, male genitalia, <u>G. ungava</u>.

Figure 62: Lateral view, male genitalia, <u>G. ungava</u>.

Figure 63: Ventral view, showing bristle scars, fifth sternite, male, <u>G. ungava</u>.

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Figure 64: Lateral view, female genitalia, <u>G. ungava</u>.

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Figure 65: Dorsal view, female genitalia, <u>G. ungava</u>.

Figure 66: Ventral view, subanal plate, female genitalia, <u>G. ungava</u>.

Figure 67: Ventral view, fifth sternite, female, <u>G. ungava</u>.



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Figure 68: Posterior view, male genitalia, <u>G. alaskensis</u>.

Figure 69: Lateral view, male genitalia, <u>G. alaskensis</u>.

Figure 70: Ventral view, fifth sternite showing bristle scars, male, <u>G. alaskensis</u>.



Figure 71: Lateral view, female genitalia, <u>G. alaskensis</u>.

Figure 72: Dorsal view, ninth tergite, female genitalia, <u>G. alaskensis</u>.

Figure 73: Ventral view, subanal plate, female genitalia, <u>G. alaskensis</u>.

Figure 74: Ventral view, ninth, eighth, and seventh sternites, female, <u>G. alaskensis</u>.



Figure 75: Posterior view, male genitalia, <u>G. transitionis</u>.

Figure 76: Posterior view, male genitalia, <u>G. transitionis</u>.

Figure 77: Lateral view, male genitalia, <u>G. transitionis</u>.

Figure 78: Ventral view, showing bristle scars, fifth sternite, male, <u>G. transitionis</u>.



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Figure 79: Lateral view, female genitalia, <u>G. transitionis</u>. ____

- Figure 80: Dorsal view, female genitalia, <u>G. transitionis</u>.
- Figure 81: Ventral view, subanal plate, female genitalia, <u>G. transitionis</u>.





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