tinctiveness is often immediately adaptive. In addition, since larvae of *Pyrota* (and those of other meloids) encounter, on entering the cells of their bee host, a relatively simple and homogeneous environment characterized by readily available food material, general uniformity of physical conditions, and minimal opportunity for interaction with other organisms, it is likely that the ecological adjustments of larval populations involve little differential natural selection compared to those of adult populations. Indeed, it would appear that a near optimal larval phenotype evolved early in each of the major groups of blister beetles and that subsequently there has been little need or opportunity for modification of anatomical or behavioral characters.

ACKNOWLEDGMENTS

This study was supported by a grant (G-18631) from the National Science Foundation.

We are indebted to Messrs. John K. Bouseman and Richard H. Storch for their assistance in the field and to Dr. Dieter Enkerlin for permission to collect at the experimental farm of the Instituto Tecnológico y de Estudios Superiores de Monterrey, where we obtained our adult material of *Pyrota nigrovittata*. The line drawings of intact larvae and the pupa were prepared under our supervision by Mrs. T. A. Prickett; the other drawings were made by one of us (Mathieu). Dr. Leigh E. Chadwick was kind enough to read and criticize our manuscript.

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The Mesophragmatica Species Group of *Drosophila* in Colombia[1]

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ABSTRACT

Collections of *Drosophila* made at altitudes of 200–3300 m at Bogotá and elsewhere in Colombia have yielded *D. mesophragmatica* Duda, *D. viracochi* Brncic and Koref, *D. gasici* Brncic, and a new species, *D. **brncici,*** which seems most nearly allied to *D. gasici*. The other 4 species of the *mesophragmatica* group are known at present only from areas outside Colombia. The results of crosses between isofemale lines of Bogotá *mesophragmatica* and stocks of *D. pavani* Brncic and *D. gaucha* Jaeger and Salzano indicate that the Bogotá strain differs genetically from the *mesophragmatica* of Bolivia and Peru.

In 1959, Marshall R. Wheeler listed approximately 750 species of *Drosophila* belonging to at least 10 subgenera (Stone 1962). In some of the subgenera, the species have been divided into species groups. The *mesophragmatica* group of the subgenus *Drosophila* is a small group limited in distribution to some South American countries. Both the restricted nature of the group and its location in the Andean mountains are of interest in evolutionary studies; it is to be expected that the evolutionary patterns in such a group would be different from those of wide-ranging species. Brncic (1957b) has shown that species in the *mesophrag-*

[1] Accepted for publication April 20, 1964.

matica group have relatively less chromosomal polymorphism than such species as *D. pseudoobscura* or *D. willistoni*, which have wider geographic distribution.

To the present time, 7 species have been included in this group: *D. mesophragmatica* Duda, 1927; *D. gaucha* Jaeger and Salzano, 1953; *D. pavani* Brncic, 1957a; *D. altiplanica* Brncic and Koref, 1957; *D. viracochi* Brncic and Koref, 1957; *D. orkui* Brncic and Koref, 1957; and *D. gasici* Brncic, 1957a. A new species of this group has been found in Colombia and is named in honor of Dr. Brncic. Studies of the degree of interfertility of Bogotá *D. mesophragmatica* with *D. gaucha* and *D. pavani* are herein reported, and so are data on the distribution and frequency of the various species of this group in Colombia. This information is of interest because of its bearing on the evolution of *Drosophila* in the Neotropical region.

Drosophila brncici, new species

EXTERNAL CHARACTERS OF IMAGINES

Male and Female.—Arista with 3–4 branches above, 2 below and the terminal fork. Antennae grayish-black. Third joint with fine soft pile. Front blackish-brown. Ocellar triangle black. Base of the orbitals lighter and somewhat pollinose. Anterior orbital 0.7 of posterior and middle orbital 0.5 of anterior. One prominent oral bristle. Carina high and narrowly sulcate. Face and cheeks brownish-gray. Cheek width ⅕ greatest diameter eye. Eyes dark wine red covered with short pile.

Acrostichal hairs in 6 fairly regular rows. No prescutellars. Anterior scutellars divergent. Mesonotum brownish-black with gray pollinose stripes as follows: a central stripe (between 2 rows of acrostichal hairs) in the posterior part; a pair of paramedial stripes inside the anterior dorsocentrals which are more pronounced anteriorly; a pair of faint light stripes lateral to the dorsocentrals which are divided by the suture. The pattern is similar to that of *D. gasici*. Scutellum brownish-black with gray pollinose stripe on lateral border. Pleurae brownish-black. Sterno index about 0.8. Legs brownish-black except tibia and tarsus which are yellowish-brown. Apical bristles on first and second tibia, preapicals on all 3.

Abdomen grayish-brown. Posterior border of each segment pollinose, giving the appearance of a narrow, shiny, gray line. Anterior border of each segment also pollinose. This pollinosity widens midlaterally and sometimes also extends centrally forming a gray midline in the first 3 segments. The degree of pollinosity varies with age.

Wings clear, grayish-yellow; veins brown. Two prominent bristles at apex of first costal section. Heavy bristles on ⅓–½ of third costal section. Costal index about 3.6; 4th vein index about 1.6; 4c index about 0.7; 5x index about 1.2.

Length body: 3.0–4.0 mm; wings about 3.0–3.5 mm.

INTERNAL CHARACTERS OF IMAGINES

Anterior malpighian tubes free; posterior tubes continuous. Testes yellow with 4 inner and 5 outer coils. Sperm pump with 2 posterior diverticula. Ventral receptacle with about 35 coils. Spermathecae cone shaped, brown and chitinized. *Eggs.*—4 filaments, posterior pair slightly longer. *Puparia*—yellowish-brown; horn about ⅛ length of puparium; anterior spiracle with about 16 branches.

Chromosomes.—Metaphase plates show 1 pair of V-shaped chromosomes, 3 pairs of rods, and a pair of dots. The salivary gland cells show 1 long arm, 3 medium arms, and 1 short arm.

Relationships.—Belongs to the *mesophragmatica* group and is closely related to *D. gasici*. Differs from *D. gasici* in general coloration, being gray and black in *D. brncici* and yellow and brown in *D. gasici*. No hybrids have been obtained.

Types.—Type material for the present description consists of 6 individuals (3 ♂ and 3 ♀) collected in Bogotá (altitude 2700 m) and are preserved in the Universidad de los Andes. A stock has been sent to the University of Texas for maintenance there.

Distribution.—Bogotá, Paipa, Manizales, and Pasto, Colombia.

D. mesophragmatica OF BOGOTÁ

In order to check the identity of the *D. mesophragmatica*-like flies collected in the vicinity of Bogotá, some mass test crosses were made with stocks of *D. mesophragmatica, D. gaucha,* and *D. pavani* obtained from Dr. Brncic's laboratory. Reports from that laboratory stated that no adult hybrids were obtained in their crosses of *D. mesophragmatica* with *D. gaucha* or with *D. pavani* (Koref et al. 1958). However, we found that in the mass crosses of *D. mesophragmatica* males of Bogotá with female *D. pavani* and with female *D. gaucha* some adult hybrids were obtained. Therefore, a more detailed analysis of the interfertility of Bogotá *D. mesophragmatica* was undertaken.

Wild females of Bogotá *D. mesophragmatica* were isolated, and 38 isofemale lines were established and test-crossed with stocks from Dr. Brncic's laboratory. The crosses were made using virgin females 5–7 days old and were set up in 10 pairs in 1-lb jars containing the usual banana medium seeded with yeast. All stocks and crosses were kept at 20°±2°C. Twenty of the 38 isofemale lines tested did not produce even larvae with *D. gaucha* or with *D. pavani*. However, 18 of the lines did in some crosses give an adult F_1. The results obtained with these 18 lines are shown in Table 1. In all crosses where larvae hatched the larvae grew and pupated and, with the exception of 1 case, the pupae hatched. Whenever an adult F_1 was obtained, it was passed to another jar to see if it was fertile. In some cases, as can be seen in the table, an F_2 resulted. These were not studied further.

Summarizing the results obtained with these 18 lines, Table 1 shows that in the crosses with *D. gaucha*, 6 of the isofemale lines produced adult hybrids when crossed with males, and 11 of the lines produced an F_1 and 5 of them an F_2 when crossed with female *D. gaucha*. Considering the crosses with *D. pavani*, there is less interfertility. Only 3 of the lines produced adult hybrids with *D. pavani* males

Table 1.—Outcome of crosses between species of the *Drosophila mesophragmatica* group. N, no progeny; E, eggs; P, pupae; F_1, adult F_1; F_2, adult F_2.

D. mesophragmatica, isofemale lines[a]		*D. gaucha*		*D. pavani*	
		Males	Females	Males	Females
1	Males	—	F_1, F_2	—	N, E
	Females	N, F_1	—	N, E	—
2	Males	—	F_1, F_1	—	N, E, E
	Females	E	—	N	—
3	Males	—	F_1, F_2	—	E, F_1
	Females	F_1	—	F_2, N, E	—
4	Males	—	F_2	—	N
	Females	N	—	N	—
5	Males	—	F_1, N	—	N, E
	Females	E, F_1	—	E, F_1, N	—
6	Males	—	F_1	—	N, P
	Females	E, F_1	—	N, N	—
7	Males	—	F_2, N	—	F_1, N, N
	Females	N	—	E, E	—
8	Males	—	F_1	—	N
	Females	N	—	N	—
9	Males	—	N, F_1	—	N, E
	Females	N, N	—	F_2, N, N	—
11	Males	—	F_1	—	E, E
	Females	E, N	—	N, E	—
14	Males	—	F_1	—	N, E, E,
	Females	E, N	—	E, E, E	—
17	Males	—	F_1	—	N, N
	Females	N, E, F_1	—	N	—
18	Males	—	F_1	—	N, N, N
	Females	N, N, N	—	N, N, N	—
22	Males	—	F_2, E, N	—	N, E, F_1
	Females	E, N	—	N, N	—
23	Males	—	N, F_1	—	F_1, E, N
	Females	N	—	N	—
43	Males	—	—	—	—
	Females	F_1	—	N	—
44	Males	—	F_1	—	E, N, N, N
	Females	E	—	E	—
47	Males	—	F_1	—	E
	Females	N	—	N	

[a] Original source: Bogotá, Colombia.

and in 2 of these an F_2 also was obtained. Four of the 18 isofemale lines produced adult hybrids when crossed with *D. pavani* females. We concluded from these results that the *D. mesophragmatica* of the Bogotá region differ from those of Peru and Bolivia in their degree of reproductive isolation, since the latter did not give adult F_1 flies in similar crosses.

GEOGRAPHIC DISTRIBUTION AND FREQUENCY

During the past 3 years, we have collected *Drosophila* in many parts of Colombia. Data will be reported here only on collections at higher altitudes, since species of the *mesophragmatica* group have not been found below 2000 meters. In all collections, the flies are swept with a net over a bait of mixed fruits which have been allowed to "ripen" and attract flies for 2–3 days. At temperatures about 10°–20°C very few flies are attracted to the bait the first few days after it is offered. The sites are selected with trees or bushes for shade and near a stream or moist area whenever possible. The sites are also well away from buildings and towns.

In Table 2, the data from collections in various parts of Colombia are summarized. Manizales is located on the western slope of the central mountain range, while Medellin is centrally located in this same range. Pasto is in the southern part of the mountains where the central and western range converge. San Lorenzo is in the Sierra Nevada of Santa Marta, an isolated group of mountains in northern Colombia. Both Paipa and Bogotá are on the eastern range of mountains.

D. pavani is an abundant species in several parts of Chile, and has been found also in Argentina. It has been reported as far north as Copiapo, Chile (Brncic 1958) but in our collections in Colombia it has not been encountered. Similarly, we have not found *D. gaucha* in Colombia although it has been reported from Brazil, Uruguay, Argentina and Bolivia (Brncic 1958). Although *D. orkui* and *D. altiplanica* have been reported collected in the vicinity of Bogotá (Brncic 1958), our extensive collections in this region do not confirm the observation. *D. altiplanica* is probably limited to Bolivia and *D. orkui* to Peru.

D. mesophragmatica has been found in all the different sites, as seen in Table 2 and Fig. 1. In general, its frequency is higher at the higher altitudes. *D. viracochi* is the second in frequency, and similarly has been found in the different parts of Colombia checked. *D. gasici* and *D. brncici* are not found in large numbers. Their low frequency of around 1% means that the total collection has to be fairly large before one can except to encounter them. In the Sierra Nevada of Santa Marta (San Lorenzo), no *D. brncici* have been found in 2975 flies collected. This species has been collected as far south as Pasto and as far west as Medellin. In Fig. 1 the distribution of the 4 species is seen on the map of Colombia.

Table 2 shows that the *mesophragmatica* group represents most of the *Drosophila* collected in the southern site of Pasto. It is interesting to note that at an altitude not much lower in Paipa, the frequency of flies of this group is not so high as in Pasto. This difference may be related to the difference in temperature. The collecting site in Paipa is in a protected valley region of hot springs and the average temperature is usually higher during collections than that of Pasto. An interesting comparison can be made of the collections at different altitudes in San Lorenzo. The 4 sites are on the same slope of the mountain but at different altitudes, and a direct relationship between the frequency of *D. mesophragmatica* and the altitude can be seen. Comparing the frequencies of *D. mesophragmatica* and *D. viracochi* within each collection, there is a suggestion of competition between these species, and in most sites the former is the more successful.

DISCUSSION

The observations on the *mesophragmatica* species group in Colombia have added some information rele-

Table 2.—Frequency of *mesophragmatica*-group flies in collections from various regions in Colombia. M, *Drosophila mesophragmatica*; B, *D. brncici*; V, *D. viracochi*; G, *D. gasici*.

Locality	t°C	Alt. (m)	Date	Total flies	Percent of total				
					M	B	V	G	Others
Manizales	17–22	2127	Oct. '62	801	—	—	0.2	—	99.8
Manizales	11–13	2084	Oct. 62	470	—	—	1.1	—	98.9
Manizales	15–19	2127	Jan. 63	1627	3.0	—	3.2	—	93.8
Manizales	15–20	2084	Jan. 63	1864	1.3	0.2	2.7	0.2	95.6
Manizales	16–20	2127	Apr. 63	1106	0.5	—	1.8	—	97.7
Manizales	15–18	2084	Apr. 63	1060	1.5	—	3.8	—	94.7
Medellin	14–19	2330	Dec. 62	1142	8.1	—	15.1	—	76.8
Medellin	17–20	2347	Dec. 62	957	9.2	—	34.6	—	56.2
Pasto	12–17	2600	May 62	2858	82.5	1.1	4.0	0.5	11.9
Pasto	9–18	2600	Dec. 62	1540	81.9	0.1	2.7	0.3	15.0
Pasto	10–22	2600	Apr. 63	701	80.7	—	9.1	0.1	10.1
San Lorenzo	15–23	2630	Feb. 62	71	69.1	—	2.8	2.8	25.3
San Lorenzo	17–24	2580	Apr. 62	1391	40.9	—	24.5	2.4	32.2
San Lorenzo	9–16	2060	Sep. 62	504	—	—	6.0	—	94.0
San Lorenzo	15–21	2240	Sep. 62	1009	2.5	—	51.5	—	46.0
Paipa	16–19	2570	Nov. 61	741	45.7	4.5	2.2	—	47.6
Paipa	18–22	2570	May 62	613	18.1	2.4	2.4	—	77.1
Paipa	14–20	2570	Jan. 62	448	23.2	1.8	9.2	—	65.8
Paipa	18–22	2570	Nov. 62	2725	57.6	1.2	13.7	—	27.5

vant to the study of the evolutionary patterns in this group. The group is endemic to a part of South America, and its species are "wild" rather than associated with man. There are 3 main chains of the Andes in Colombia, which unite to the south and continue to the southern tip of the continent. In addition, there are some more-or-less-isolated mountain ranges. *D. mesophragmatica* and its 3 relatives in Colombia seem to be limited to high altitudes, where they form colonies isolated by the terrain not ecologically suited for their needs. Carson (1959) has suggested that species formation may be promoted by this type of distribution, so the presence of new and incipient species may be expected.

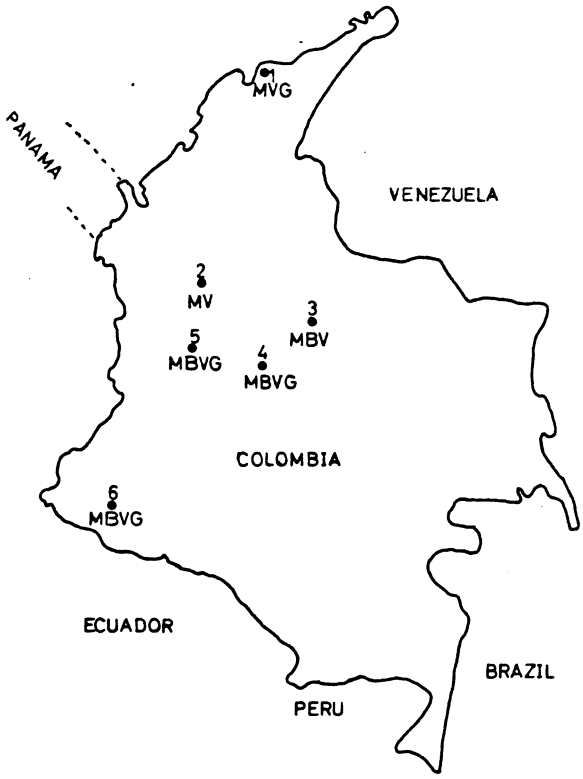

FIG. 1.—Species of the *mesophragmatica* group collected at various localities in Colombia. M, *Drosophila mesophragmatica*; B, *D. brncici*; V, *D. viracochi*; G, *D. gasici*. 1, San Lorenzo; 2, Medellin; 3, Paipa; 4, Bogotá; 5, Manizales; 6, Pasto.

D. brncici is a new species of the *mesophragmatica* group, morphologically most similar to *D. gasici*. The Karyotype as seen in the metaphase plate is the same as that of *D. gasici*, *D. gaucha*, *D. pavani* and *D. viracochi*. Regarding salivary chromosomes, the number of arms is also the same, but band homologies have not been studied. Considering the morphological and chromosomal evidence and the geographic distribution of these species, it seems probable that *D. brncici* has evolved from *D. gasici*. Further evidence for this hypothesis can be obtained only from studies of gene arrangements in the salivary chromosomes and reproductive isolation between the species.

The results of the crosses between the Bogotá strains of *D. mesophragmatica* and the stocks of *D. pavani* and *D. gaucha* are interpreted as evidence of a lower reproductive isolation between these species than had been found previously with *D. mesophragmatica* from Peru and Bolivia (Brncic 1957, 1958). Particularly, there is greater interfertility between the *D. mesophragmatica* from Bogotá and *D. gaucha*. In Bolivia, *D. gaucha* and *D. mesophragmatica* are sympatric species and the reproductive isolation is complete. A strong reproductive isolation is adaptively more important when species are sympatric than when they are allopatric (see Dobzhansky et al. 1964 for further discussion). In the *D. mesophragmatica* living in Colombia, the development of the reproductive has not progressed so far as it did in the more southern populations. Further data are needed

to decide whether the Colombia population is conspecific with the southern form or is a "species in statu ascendi," as suggested by Dr. Brncic (personal communication).

The extensive collections which have been made in Colombia enable us to establish with more certainty the northern limits of the species of the *mesophragmatica* group. Four species (*D. pavani, D. gaucha, D. altiplanica,* and *D. orkui*) have not been found in Colombia, but we cannot exclude the possibility that they are present in small numbers or in regions not studied. Of the 4 species collected in Colombia, *D. brncici* is new and appears to be limited to the central and southern parts of Colombia; at least it has not as yet been found in the Sierra Nevada of Santa Marta. Possibly it has not yet crossed over from the Cordillera Oriental since this is separated from the Sierra Nevada by the Valle de César, and *D. brncici* does not survive well at higher temperatures of the low altitudes. *D. gasici* and *D. mesophragmatica* have a wider distribution extending from Bolivia north through Colombia while *D. viracochi* is found in Peru and Colombia.

The geographic distribution of species of this group is related to the ecological requirements of the species and the discrete structure of the Andean mountains. The 4 species collected in Colombia have not been found at altitudes lower than 2000 m and so are distributed on the slopes of the mountains and are absent from the valleys between and the lowlands of the borders. Such a distribution raises the question as to what are the limiting factors. Are they altitude per se, temperature, humidity, or competing organisms? Laboratory studies in progress suggest that the temperature may be important but the entire gamut of ecological factors needs to be investigated.

ACKNOWLEDGMENT

Grateful acknowledgment is made to Jesusita Gonzalez for her work on the crosses, to Alberto Cadena for his chromosomal studies, and to the National Science Foundation for financial support.

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Some Relationships Between Grasshoppers and Vegetation[1]

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ABSTRACT

A report is made of detailed studies carried out on 105 native grassland and abandoned field sites. Measurements of vegetational changes over a 10-year period on one area and field experiments on grasshopper movement involving marked individuals are also reported. The results of the investigations are discussed and evaluated in terms of field observations on grasshopper behavior. Both the taxonomic composition and physical structure of the vegetation are found to play an important role in the selection of areas of occupancy by grasshoppers. There is no evidence to suggest that changes in vegetation are directly responsible for initial fluctuations in population density.

Opinions differ concerning the precise role of vegetation as an environmental factor affecting the distribution and abundance of grasshoppers. Some workers have concluded that grasshoppers are largely unselective feeders and, as Morse (1899) stated ". . . are voracious, their food being general in character rather than special, a question of quantity rather than quality." Most workers, however, have recognized foodplant preferences and concluded that grasshoppers in general are highly selective (Criddle 1933; Isely 1938; Anderson and Wright 1952; Brooks 1958; Gangwere

[1] A contribution from Montana State College, Agricultural Experiment Station Project no. MS-1138 and Regional Research Project W-37. Paper no. 590 Journal Series. Accepted for publication April 20, 1964.

[2] This paper is based on a portion of a thesis submitted to the Graduate Faculty at Montana State College in partial fulfillment of the requirements for the degree of Doctor of Philosophy. The generous assistance in many phases of the study by Professors J. H. Pepper and E. B. Hastings of the Department of Zoology and Entomology and of Professors W. E. Booth, J. H. Rumely, and J. C. Wright of the Department of Botany and Bacteriology is gratefully acknowledged.